REPORT

CLIMATE CHANGE, WATER CONFLICTS AND HUMAN SECURITY:

REGIONAL ASSESSMENT AND POLICY GUIDELINES FOR THE MEDITERRANEAN, MIDDLE EAST AND SAHEL

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CLIMATE CHANGE, HYDRO CONFLICTS AND HUMAN SECURITY (CLICO)

Project partners:

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Ecologic Institute, Germany

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Centre de Recerca Ecològica i Aplicacions Forestals (CREAF), Spain

Israeli-Palestinian Science Organization (IPSO), Belgium, Palestinian administered Areas and Israel

Addis Ababa University (AAU), Ethiopia

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Cover photo: Youssouf Wadine, a retired government officer originally from Tchintabaraden, Niger, served as the key research assistant in the Niger case study. Location: Seasonal lake near Ango Lelli, Konni, Niger.

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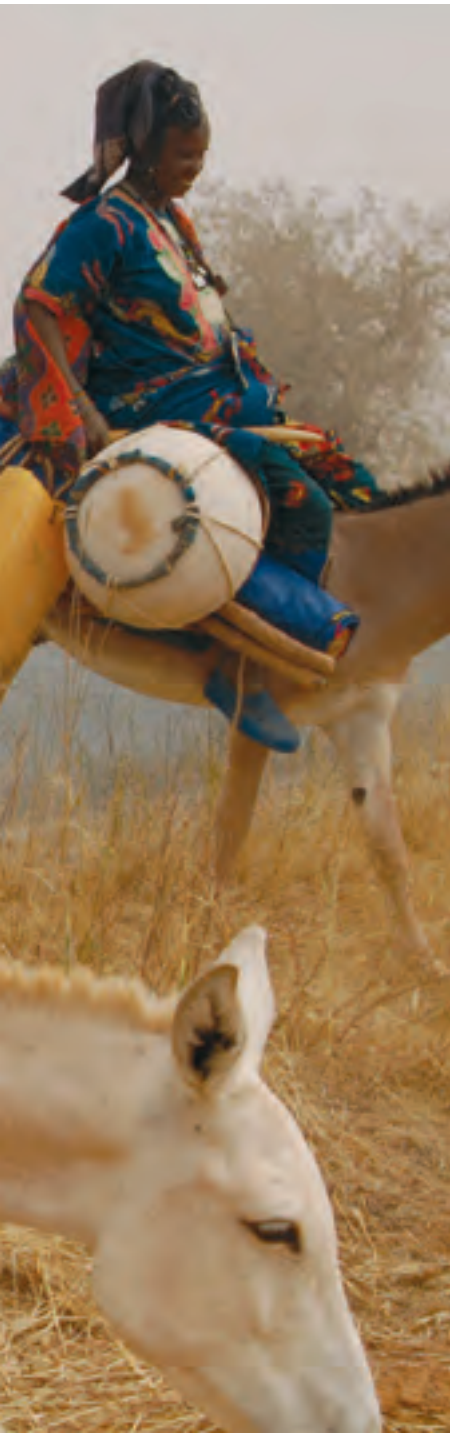

Climate Change, Water Conflicts and Human Security:

Regional Assessment and Policy Guidelines for the Mediterranean, Middle East And Sahel

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"Through its final synthesis report, the CLICO team offers the opportunity to better understand the water/conflict/security nexus and to contribute to build bridges between two neighbouring regions, the European Union and the MMES"

Perla Srour-Gandon
Research Programme Officer
European Commission
DG Research & Innovation

"This work brings new detail and nuance to our understanding of transboundary water conflict and cooperation, and significantly raises the level of discussion on this critical topic."

Aaron Wolf
Professor of Geography
Oregon State University

"Based on a systematic, integrated analysis of the socio-hydrological impacts of climate change, CLICO has provided an authoritative account of human security under environmental stress. The project's findings will be a necessary reference point for all scientists investigating climate and water-related risks to human development, and should make policy-makers wary of simplistic statements on climate change and security."

Dr. Michael Mason
Senior Lecturer in Environmental Geography
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Summary

Climate change has and will continue to have far-reaching impacts on environmental, social and economic conditions, which people and governments will be forced to adapt to. Increasingly, climate change and the associated increase in the frequency of extreme weather events such as floods, droughts and rising sea level is recognized as not only having humanitarian impacts, but also creating political and security risks that can affect national/regional stability and the welfare of people.

This has led to increased political interest in the influence of climate change on water availability and human security. Specifically, whether climatic and hydrological changes and increasing variabilities trigger and multiply conflict at various scales or induce cooperation between and within countries and how this affects human security remains contested.

There is a growing consensus in the climate change and conflict literature that climate change can be considered a threat multiplier for existing tensions. Besides climatic factors there are underlying causes such as poverty, weak institutions, mistrust, inequalities and lack of information and basic infrastructure that may also contribute to these tensions. In comparison, functional and well-adapted institutions can facilitate cooperation and conflict resolution and are therefore considered as threat minimizers that help to maintain human security.

Climate change may impact directly or indirectly on any of the dimensions of human security. People and governments can adapt to these impacts, but their capacity to do so varies; it is dependent on a multitude of factors such as access to assets, knowledge, institutions, power relations, etc. Due to the complexities within the natural system and its interlinkages to the social, economic and political spheres, a highly complex nexus has evolved that connects *climate change, water conflicts and human security.* However, this complexity has made it difficult for researchers to measure the effect of climate change on conflict and human security.

This report presents a comprehensive regional assessment of these questions in the CLICO study area – the Mediterranean, Middle East, and Sahel – in terms of climate change impacts, vulnerabilities, conflict/cooperation and human security at various scales and in a variety of contexts. The Mediterranean, Middle East and Sahel were selected because they are regions that are prone to extreme weather events, such as frequent droughts or floods, which are likely to be triggered by climate change and existing conflicts or tensions taking place at various intensities and scales. An improved understanding of the *climate-water-security-nexus* is therefore key to describing and assessing the vulnerabilities and adaptive capacity to climate change related hazards.

The CLICO project builds on interdisciplinary and cross-comparative research covering a variety of geographical scales and historical contexts to unravel social, political, environmental/ecological and economic conditions in relation to the environment.

Results of the various approaches (in-depth case studies, large N statistical analyses, assessments of transboundary adaptive capacities and transactions costs and policy analysis related to climate change adaptation) confirm observations that *climate and hydrological factors, socio-economic, institutional and political conditions are all important drivers of human (in) security*, but their relative importance depends on the specific context in which they interact. Adaptation plays a key role in determining whether climate change is likely to undermine

human security. Adaptive capacity of individuals, groups or nations varies depending, for instance, on existing institutions and their functionality, knowledge and access to assets. Adaptation processes – either undertaken by individuals/groups or governed and led by the State – can both reduce and increase insecurities. In this context, concepts such as "divergent adaptation" have been developed by CLICO researchers to analyse changes in the adaptive capacities of different actors or entities and evidence for maladaptation has been found. State-led adaptation remains an important issue for providing human security in many of the case studies. States can facilitate adaptation, particularly if people are unable to adapt on their own (e.g., in Alexandria). However, there may also be unintended and potentially negative consequences, particularly if adaptation policies or laws are insufficiently implemented. *State-led adaptation* can initiate far-reaching transformations of existing traditional adaptations while values or preferences between different states (e.g. involved in managing shared water) may vary as might the needs and preferences of people living in the area who are affected by the adaptation policies in place. A strong state can also influence or even suppress individual adaptive capacity. Adaptation can reinforce or widen inequalities of different social groups. Who bears the negative and positive consequences of adaptation and which dimensions of human security are prioritized seems to depend on power relations, existing marginalization of certain groups, as well as governance and institutional structures.

With regard to water-related conflict and cooperation slightly more cooperative than conflictive events have been found in the CLICO area. Diverse sets of "conflict-contexts" exist – ranging from still non existant but foreseeable conflict related to sea level rise and silent or masked conflicts, to frequent and sometimes violent conflicts.

CLICO research points toward stronger links between political, economic and social factors and water-related conflict than between climate-related variables and water conflict. However, in the future these relationships might change.

Uncertainty arising from environmental and climate factors, in combination with uncertain socio-economic development, (e.g. political instability, transformation and ongoing conflict) present difficulties in predicting future changes; resulting in sometimes contradictory predictions and challenging governance and adaptation planning.

CLICO investigates the specific governance challenges of transboundary water basins resulting from uncertainties. In transboundary water basins, international agreements are the strongest tools to manage shared water, but mechanisms and tools in such treaties to address growing uncertainty were found to be underrepresented. Since transboundary agreements require negotiations between different states high transaction costs arising for instance from negotiation processes are an important factor influencing the inclusion and the design of measures to address uncertainty.

Furthermore, a review on national and international policies and institutional frameworks revealed that many policies on climate change adaptation and water resources management exist, addressing risks for human security linked to water and climate change in a more indirect way. Policies that are more explicitly aimed at conflict reduction in this context are missing.

Several recommendations were made to guide policymakers at various levels and in a variety of policy areas in improving adaptive capacities, reducing vulnerabilities and, hence, increasing human security in the face of climate change. They relate to the following main points:

(1) Increase knowledge and facilitate knowledge sharing by strengthening research capacity and information transfer at all scales. This includes assessing root causes of vulnerability, conflict and human (in)security, impacts of adaptation, knowledge management, sharing and transfer, as well as raising awareness of the research results;

(2) Promote and strengthen the accountability and functioning of institutions. This refers to existing institutions by improving, sometimes even reinventing the modalities of their functioning but also the development of new institutions, if necessary. An important characteristic of good governance is the empowerment of marginalized groups and effective participation of all affected groups in policy design and implementation;

(3) Improve capacity to implement policies. CLICO found evidence that in many cases appropriate policies exist, but are insufficiently implemented leading to adverse effects. On the other hand there are instances where policies are missing and need to be formulated;

(4) Improve communication, coordination and cooperation between actors and develop conflict resolution mechanisms as important steps to successful adaptation;

(5) Mainstream climate change adaptation and disaster risk reduction so that they may be integrated with existing policies, leading to synergy and facilitating harmonized approaches;

(6) Strengthen social security systems and civil protection to reduce vulnerabilities and help maintain or improve human security;

(7) Keep planning flexible in policy cycles, with *early planning and ex-ante measures to address systemic issues.* In this context early warning systems can be powerful tools for supporting flexible planning and providing decision support for adaptation of policy design and monitoring of impacts.

Besides these general recommendations for policymakers at all levels, more specific recommendations related to certain sectors (e.g., agriculture, water management) or topics (e.g., migration, infrastructure) were developed.

As an umbrella for all local, national and international actors and actions, the elaboration of a normative adaptation framework is recommended that safeguards which dimensions of human security are traded off against others to ensure equity-based and sustainable adaptation policies. Such a framework can help balance unequal impacts of climate change and related adaptation actions or policies, facilitate social dialogue and guide policy development and implementation.

Foreword

The pace of changes in the planet's climate has no precedent in the history of civilization. The UN has recognized that climate change is a threat to human security. Potential links between natural hazards or scarcities and conflict have been publicly acknowledged by political officials and made their way into international forums such as the Rio Declaration on Environment and Development, the European Security Strategy, and the UN High Level Panel on Threats, Challenges, and Change. The Mediterranean, Middle East and the Sahel are among the regions in the world most exposed and vulnerable to floods and droughts. Does climate change undermine human security in the region by intensifying water hazards?

This is the complex question our research project, CLICO, set to answer. We know from past research that climate extremes do not automatically cause disasters, conflicts or migration. Social factors often matter more than environmental. Our desire was to understand better the links between climate, water, violence, conflict and human security. Funded by the European Commission's (EC) Framework Programme 7 (FP7) theme on Socio-environmental Sciences & Humanities (SSH), the CLICO project mobilized 14 research teams and brought together for the first time some of the world's leading researchers in water resource, vulnerability, and peace and security studies. Eleven cases of areas where droughts or floods pose threats to human security were studied ranging from Niger, Sudan, the Jordan and Nile basins to Cyprus, Italy, Spain and the Sinai desert. A large dataset – the first of its kind – of domestic hydro-conflicts in the Mediterranean, Middle East and Sahel were regressed against climatic, hydrological and socio-economic variables. The resilience of international treaties in the region to deal with climatic variability was explored and national and international policies evaluated, the aim being the development of suitable institutional frameworks for dealing with human security implications of hydro-climatic hazards.

After three years of intense research, we are proud to share with you the fruits of our labour with this comprehensive project Synthesis Report. In brief, we did not find evidence that climate variation is an important source of violence and insecurity, neither at the transboundary nor at the domestic level. Democracy and good institutions emerged as the most important variables for human security. Whereas violent conflict is not the result of climatic hazards, we did find that violence does make affected populations more vulnerable to climatic hazards. We also found that large-scale State-led development projects, often pursued in the name of adaptation to climate change, end up reducing the security of some groups, often those who are most marginalized economically and politically. Strong and well-functioning social security systems appear to be an important instrument for human security in the face of climate risks.

This report elaborates into more detail on these and many other findings and insights. We hope that you will enjoy the reading and that you will find this research and its results as exciting as we did.

Giorgos Kallis
(Project Coordinator)

Christos Zografos
(Scientific Coordinator)

Foreword

Climate change is likely to influence weather-related hazards, increasing the risk of extreme events. At the same time, changes in the variability of rainfall and temperature, availability and flows of surface water and creeping changes such as sea-level rise are very likely to seriously affect livelihoods in many regions. Increasingly, climate change is recognized as a risk multiplier for human security and is put high on the political agenda.

Despite the importance of this general acknowledgement, however, it is essential to improve the understanding of the Climate-Water-Security-Nexus by conducting in-depth research on the exact influences that climate change will induce on human security and peoples' livelihoods among other factors. Will these changes fuel existing tensions and conflicts, trigger new conflicts and/or threaten human security or will they provide new opportunities for cooperation and peace? In the future, who will be particularly vulnerable to climate-induced changes and, potentially more prone to conflicts?

So far, research has shown that climate can play a role in conflicts, but that conflicts are the result of a complex web of interactions in which socio-economic and governance factors often tend to be more important than environmental factors – a finding that the CLICO research confirms.

Adapting to climate change is now recognised as a major challenge for affected communities, and is already underway. Adaptation may allow some groups to deal well with climate change and reduce their vulnerabilities, while for other groups it may increase vulnerabilities and insecurities. Already marginalized groups may lack adaptation strategies and may be left behind by adaptation policies.

CLICO research was built on inter-disciplinary, cross-comparative research covering a variety of geographical scales and historical, socio-economic and political contexts in order to assess the role of climate change on human security and also on the effects of adaptation. This CLICO synthesis report provides a comprehensive assessment of the Mediterranean, Middle East and Sahel regions, highlighting the numerous ways in which people and ecosystems can be affected by, react and adapt to changing environments. The report draws on and provides a synthesis of the research findings generated by all CLICO researchers over the 3-year duration of the project.

One important part of the research highlights which factors lead to "winners" and "losers" of adaptation. Some groups within a society may have higher adaptive capacities because they are well supported by institutions and state-led adaptation strategies. Their adaptive capacities may arise at the expense of other groups within a society ("divergent adaptation") or even manifest existing marginalisation. One of the key recommendations from CLICO is the elaboration of a normative adaptation framework for all actors and the drafting of actions that assesses which aspects of human security are and should be traded for others. These efforts could then promote equity-based and sustainable adaptation policies that improve adaptive capacities of all affected groups and reduce vulnerabilities of those already marginalized.

We are confident that with this report we contribute to the exchange of interdisciplinary knowledge between researchers and also bridge some of the gaps between science and policy.

Prof. Dr. Jakob Rhyner
Director, UNU-EHS

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We would also like to express our sincere gratitude to Dr. Christos Zografos, scientific coordinator of CLICO, and Prof. Dr. Giorgos Kallis, project coordinator of CLICO for their engaged coordination, their intense support and assistance in all scientific questions during the preparation, writing and publishing phase of the report. It was a great pleasure for us to work with the entire CLICO team.

We are also grateful to our supporting team Mr. Daniel Brink, Mr. Hannes Etter and Mr. Philip Schäfer (all UNU-EHS) for reviewing and editing the report, preparing many of the maps for this report and summarizing research material for us. Moreover, we extent our thanks to Dr. Sandrina Rodrigues for proof-reading and editing the key sections of this report.

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Abbreviations

BCM	*Billion Cubic Meter*
ADLI	*Agricultural Development Led Industrialization*
AQUASTAT (FAO)	*Information System on Water and Agriculture of the Food and Agriculture Organization*
BBC	*British Broadcasting Corporation*
CC	*Climate Change*
CHE	*Confederación Hidrográfica Del Ebro*
CIPE	*Inter-Ministerial Committee for Economic Planning*
CLICO	*Climate Change, Hydro-Conflicts and Human Security Project*
COFO	Niger Land Commission
CPA	*Comprehensive Peace Agreement*
CRMS	*Mechanisms for Conflict Resolution*
CRS	*Associate Committee for Sarno*
CYI	*The Cyprus Institute*
DG	*Directorate General*
EC	*European Commission*
ECS	*Emergency Commission Structure*
ENP	*European Neighbourhood Policy*
ENSO	*El Niño–Southern Oscillation*
ENVSEC	*Environment and Security Initiative*
ESS	*European Security Strategy*
EU	*European Union*
FAO	*Food and Agriculture Organization of the United Nations*
GCMS	*Global Circulation Models*
GEF	*Global Environment Facility*
GELSO	*Italian Common Database on Local Management for Sustainability*
GIS	*Geographic Information System*
HDI	*Human Development Index*
IBRM	*Intercontinental Biosphere Reserve of the Mediterranean*
IDPS	*Internally Displaced Persons*
IPCC	*Intergovernmental Panel on Climate Change*
ITCZ	*Inter-Tropical Convergence Zone*

IWRM	*Integrated Water Resources Management*
MMES	*Mediterranean, Middle East and Sahel*
NATO	*North Atlantic Treaty Organization*
NGOS	*Non-Governmental Organizations*
OECD	*Organization for Economic Co-operation and Development*
OPT	*Occupied Palestinian Territories*
OSCE	*Organization for Security and Cooperation in Europe*
PHG	*Palestinian Hydrology Group*
PLO	*Palestinian Liberalization Organization*
RBO	*River Basin Organization*
RSDSC	*Red Sea Dead Sea Water Conveyance*
RSS	*Republic of South Sudan*
SAF	*Sudanese Armed Forces*
SES	*Socio-Ecological System*
SLR	*Sea Level Rise*
SPLA	*Sudan People's Liberation Army*
SRES	*Special Report on Emission Scenarios*
SWAT	*Soil and Water Assessment Tool*
TARSIM	*Agricultural Insurance Pool Enterprise*
TFDD	*Transboundary Freshwater Dispute Database*
UN	*United Nations*
UNDP	*United Nations Development Programme*
UNEP	*United Nations Environment Programme*
UNISFA	*United Nations Interim Security Force for Abyei*
USAID	*United States Agency for International Development*
WARICC	*Water Related Intrastate Conflict and Cooperation*
WES	*Water Events Scale*
WP	*Work Package*
WUAS	*Water User Associations*

1. Introduction

1.1 Problem definition and research framing

Climate change has and will continue to have far-reaching consequences on the timing, flows and quality of water resources around the globe (Bates et al., 2008; Gerstetter and Vidaurre, 2012). There is considerable uncertainty regarding the magnitude of projected changes, but the frequency and intensity of extreme precipitation is expected to increase *flood risks*. Shifts in the seasonal timing of water availability will also increase the *risk of droughts* for the Mediterranean and Southern Africa – among other regions (IPCC, 2007; IPCC-SREX 2012). People and institutions seek to lower the risks posed by the consequences of climatic changes by adapting to the new conditions. Consequently the direct impact of climate change on the natural environment will also lead to shifts in social, political and economic environments.

Whether these changes trigger and multiply *conflict* or induce *cooperation* between and within countries is highly debated and often based on sensationalist messages and conventional wisdom rather than in-depth empirical research on the exact linkages between climate change, resource variability and conflict (Vidaurre et al., 2010).

The United Nations Secretary-General, Ban Ki-moon, the High Representative Javier Solana and the European Commission in a joint report to the European Council, and the National Intelligence Council report to the President of the United States of America all link the potential consequences of climate change to wider security concerns (Ban, 2007; EC, 2008; NIC, 2008; all as cited in Ludwig et al., 2011). These concerns have been taken up by the media which, among others, emphasized the possibility of 'Water Wars' and water conflicts in the near future. Although climate change certainly will have an impact on human security, there is a lack of understanding of how the hydro-climatic system and the socio-economic system interact and when, where and under what conditions climate change may be associated with conflicts:

"Understanding the complexity of interactions between climate stress factors, their human and societal impacts and responses is crucial to assess the implications for security and conflict" (Scheffran and Battaglini, 2011: 28).

Some researchers highlighted connections between factors associated with global climate and climate change, such as higher temperatures or scarcity of water resources and conflict (most recently Burke et al., 2009; Hsiang et al., 2011; UNEP, 2011). However, many of these findings were contested, as an explicit direct causal relationship between climatic or environmental drivers, security and (violent) conflict seems rather unlikely (e.g. Wolf et al., 2005; Barnett and Adger, 2007; Nordas and Gleditsch, 2007, Buhaug, 2010). For example, cooperation has been found to be much more common in conditions of scarcity than conflict within the context of shared water resources in transboundary basins (Wolf, 1999).

Furthermore, the issue of conflict is scale-specific. The evidence of inter-state violent conflicts is very limited. This is not the case when one looks at intra-state[1] or localized contexts where low intensity and violent clashes around scarce water resources (e.g. "water riots"[2]) are far more frequent (e.g. in India or Lebanon) (Gleditsch et al., 2004; Ohlsson, 1995, 1999a and 1999b; Ohlsson and Turton, 1999; Ravenborg, 2004; Swedish Water House, 2005; Carius et al., 2004; Thomasson, 2006; Turton, 2004; Swatuk and Wirkus, 2009).

Extreme hydrological events such as droughts or floods may trigger disasters (drought-related famines, flash-floods and landslides or river floods) but these may not systematically translate into conflicts. Social factors and economic development are often more important than environmental factors in explaining conflicts that do materialize (Collier, 2000). Conflict is less likely in areas with robust and well-functioning institutions at all administrative or local-traditional levels. For example, even in co-riparian countries that have a long history of political conflict (e.g. Jordan basin), stable and resilient water agreements with strong institutions could be negotiated.

The scale and intensity of conflicts and cooperation can vary greatly and conflict and cooperation can often coexist (Zeitoun and Mirumachi, 2008). Conflict can be beneficial and prompt institutions to address problems and reduce vulnerabilities, while cooperation can mask oppression and serve to maintain vulnerabilities and suffering (Kallis and Zografos, 2012).

As recent reviews by Renaud and Wirkus (2012) and Kallis and Zografos (2012) point out, there is consensus that climate change can be considered as a threat multiplier for existing tensions. However, there are underlying causes such as poverty, weak institutions, mistrust, inequalities and lack of information and basic infrastructure that may also explain these tensions. Functional institutions can be considered as threat minimizers (Renaud and Wirkus, 2012) in this context.

The aim of the CLICO project is to unravel the *Climate Change, Water Conflict and Human Security ("Climate – Water – Security") Nexus* by understanding how hydro-climatic hazards, vulnerability and human security and conflict are connected. CLICO identifies influencing factors and causal relations, looks at institutional, political and socio-economic drivers and interprets the state of knowledge with regard to adaptation and security policies.

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1 This includes conflicts between the government/administration of a state and internal groups or between two or more groups, neither of which is the government.

2 Violent interactions, where the violence is not carried out by an organized group and where the target is mostly the government, though it can also be directed against private actors (Gleditsch, 2011).

Understanding the social, political, environmental/ecological and economic conditions and their relation to the environment is key to describing and assessing the vulnerabilities and adaptive capacity of social-ecological systems. The research carried out by the CLICO project aimed at disentangling human (in-) securities at multiple scales – from the local to the global level.

In doing so, CLICO aimed at answering the following seven research questions:

1. How is human security affected by risks associated with water and climate-related stressors, societal vulnerability and socio-political factors?

2. How do political, economic, environmental and climatic factors exacerbate or mitigate water-related conflict?

3. How does human security or the lack of it affect the demand for cooperation?

4. Under what conditions may conflict reduce rather than exacerbate vulnerabilities?

5. What constitutes the capacity of states and their institutions and other organizations to implement change or even radical change necessary under times of stress?

6. What interventions might be suitable for reducing risks and improving human security (either by reducing vulnerabilities of the system, increasing its adaptive capacity or modifying the hazards)?

7. Under what conditions might policies of adaptation to perceived or experienced climate change impacts increase the vulnerability of some groups and/or exacerbate social conflicts?

1.2 Scope of CLICO

CLICO's research builds on interdisciplinary cross-comparative research covering a variety of geographical scales and historical contexts to understand complex and context-specific relationships between environmental, social and political-economic factors. The CLICO project addressed the *water-conflict-security nexus* at various scales and combined localized research within river basins or sub-national boundaries, with research at national, regional and even global scales (see Figure 1). Geographically, the focus of CLICO research has been the Mediterranean, Middle East and Sahel regions. The CLICO project brings together 14 research teams with researchers in water resource, vulnerability and peace and security studies (see Box 1).

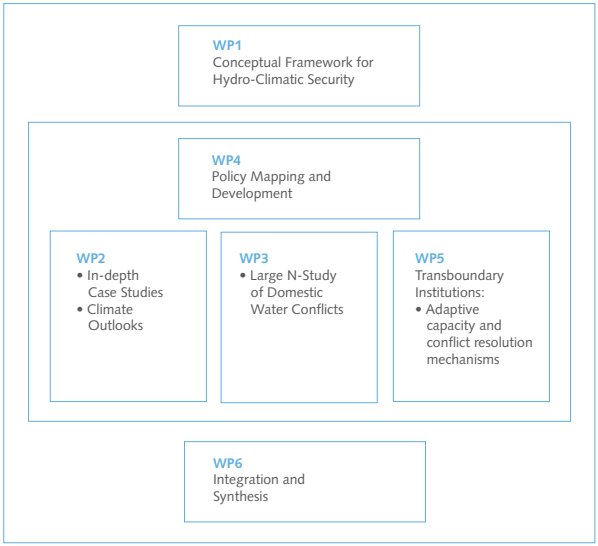

Figure 1: CLICO project structure

Box 1: CLICO partners

- Institute of Environmental Science & Technology (ICTA), Universitat Autònoma de Barcelona (UAB), Spain
- Tyndall Centre for Climate Change Research, University of East Anglia (UEA), UK
- Ecologic Institute, Germany
- Centre for the Study of Civil War (CSCW) and International Peace Research Institute, Oslo (PRIO), Norway
- Department of Geography, The Hebrew University of Jerusalem (HUJ), Israel
- Suez Canal University (SCU), Egypt
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- Addis Ababa University (AAU), Ethiopia

Eleven case studies were chosen in sites where droughts, floods, sea level rise or landslides pose threats to human security. The sample of cases is highly diverse in terms of geography/ location, type of hazards, impacts, levels of development and type of conflict; all of them raising important security concerns:

- *The Jordan basin* – an international river basin with Lebanon, Syria, Israel, Jordan and Palestine as co-riparian countries, located in one of the most densely populated, water-scarce, unstable and conflict-driven parts of the world;

- The Baro-Akobo Sub-Basin of the Eastern Nile, *Gambella* National Regional State, Ethiopia – one of the least populated regions in the country and one of the poorest regions of Ethiopia, although rich in water and other natural resources;

- *Cyprus* – among the top 20 water scarce countries of the world. Significant inter-annual variability in rainfall with frequent droughts and water shortages strongly affect livelihoods and economic sectors;

- *Intercontinental Biosphere Reserve of the Mediterranean (IBRM)* – a joint effort of two countries (Spain and Morocco) with different political and institutional contexts to preserve the natural and cultural diversity of the region;

- *North and South Sudan* – frequently referred to as an example of violence and insecurity originating from climatic conditions;

- *Tahoua Region of Niger* – highly vulnerable to changing environmental conditions with a growing number of conflicts between pastoralists and agro-pastoralists;

- *The Ebro Delta* in Spain – water use and management has historically been a crucial issue in the Delta;
- *Seyhan, Turkey* – highly vulnerable to climate variability and home to a particularly vulnerable group: migrant seasonal agricultural workers;
- *Ras Sudr* in South Sinai – one of Egypt's vulnerable areas with respect to the impact of climate change, particularly threatening the unique traditions and livelihood systems of Bedouins;
- *Sarno in Italy* – the Sarno Valley in the Campania regionsuffered a tragic landslide on 5 May 1998 with 155 fatalities, severe economic damages and long-term impacts on Sarno;
- *Alexandria in Egypt* – a city housing many vulnerable population groups, which might become trapped in places highly exposed to sea level rise.

For each of the case studies, climate outlooks identifying main hydro-climatic hazards were prepared side-by-side with the more detailed case studies (WP2[3]). The objective of the case study-approach was to derive an in-depth context-specific understanding of hydro-(in-) security. Other approaches such as the large N study include data on 35 Mediterranean and Sahel region countries. The principal focus of WP3 was to advance knowledge on climate change related conflict by identifying driving forces that are generic to many countries. Therefore, a large unique dataset of domestic hydro-conflicts was created and then regressed against climatic, hydrological and socio-economic variables (WP3).

The research also focused on *transboundary river basins* and took a closer look at all 42 shared, international river basins within the CLICO study area to assess their adaptive capacity to climate change. Furthermore, the research examined existing transboundary treaties worldwide to understand suitable mechanisms to address uncertainties. Transboundary cooperation regarding shared water resources is common, but not all institutions are performing equally. It is important to know which institutions are more successful, particularly under conditions of uncertainty. At the transboundary level, the capacity of international treaties in the region to deal with climatic variability was addressed by the project (WP5). To advance the current understanding of policies relevant to the climate-water-security context and to envisage links between different policies, existing policies were mapped and evaluated (WP4). The aim has been to develop suggestions for suitable international (UN/EU) and national institutional frameworks for dealing with the human security implications of hydro-climatic hazards. The results of all work packages are synthesized in this report to illustrate the structure of the project.

The project looked at *different time frames* – the large N study used data from 1997–2009, while the earliest transboundary agreement considered in the analysis dates back to 1857. However, the past may not necessarily be an accurate predictor of future changes to the system. Accordingly, the research conducted in all 11 case studies included a scenario-based expert workshop to discuss and reflect on future impacts of climate change and potential adaptation.

Methodologically, a wide variety of tools and approaches was used to unravel the factors that influence vulnerabilities and conflicts (see Appendix Chapter 2). The methods applied during

3 WP stands for 'work package' and represents different blocks of research in the project.

in-depth assessment in the 11 case studies included: direct and participant observations, focus group discussions, workshops, expert/household interviews and scenario-based expert workshops, (small and large-scale) household surveys, discourse analysis and complex hydrological modeling. Other WP results are based on the generation of a data set and regression analysis for the large N study, an indicator based approach and a transaction cost study in the context of transboundary basins. For the policy analysis, several methods were applied ranging from screening of policies, a case study approach on their usefulness and a perception-based assessment with expert interviews.

1.3 Report structure

Following this introduction, Chapter 2 explains the theoretical background on climate change, water conflicts and human security and presents the integrated and adapted CLICO theoretical framework. The framework defines the system under study, the human-security elements, linkages between adaptive capacity, conflict and cooperation as well as its boundaries, scales and relationships. A description of the current climate and climate trends, including outlooks on water-related hazards in CLICO's study region – differentiating between the Mediterranean and the Sahel region with bordering countries – is presented in Chapter 3. Chapter 4 presents a cursory examination of existing policies and evaluates their role and effectiveness in dealing with the climate-water-security nexus. Chapter 5 includes an analysis of institutions at the transboundary level and discusses the factors influencing the adaptive capacity of transboundary institutions and mechanisms to address uncertainty in transboundary agreements. Chapter 6 brings together the findings of the in-depth analysis and assessment of the climate-water-security nexus based on the 11 case studies and the large N regression study. Both approaches concentrate on intra-state conflicts around water and examine context-specific and generic factors respectively. Chapter 7 draws a synthesis of the empirical approaches presented and answers the main research questions adding to the understanding of the climate-water-security nexus. The final chapter presents the conclusions of this report and recommendations related to policies and institutions needed to facilitate adaptation and enhance human security across the region.

2. Conceptual framework

Chapter 2 provides the theoretical background for the project, defines the system under study and the human security elements and discusses linkages between adaptive capacity, conflict and cooperation as well as its boundaries, scales and linkages. The state of knowledge on existing links between climate change and human security is reviewed while introducing the main concepts and definitions of key terms that are relevant to the CLICO project, particularly with respect to the climate-water-security-nexus. The chapter concludes with a presentation of the CLICO conceptual framework, which guides the analysis of the complex manner in which hydro-climatic change, conflict or cooperation and human security interact and provides an explanation of the seven research questions that CLICO addresses.

2.1 The climate change, water conflict and human security nexus

There are many ways in which hydro-climatic change, conflict or cooperation and human security are interlinked. This section aims to introduce the main concepts and key terms used in the CLICO research presented in this report and summarizes the current state of knowledge on the links between these concepts.

2.1.1 Hazards, vulnerability and adaptive capacity

The overall global context within which the CLICO research is undertaken is that of climate change. Following the IPCC (2001) definition:

"Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability

persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use" (IPCC, 2001: 368).

Policymakers, think-tanks as well as the media have considered climate change a security risk (Kallis and Zografos, 2012). Mostly, they assume a simplistic causal structure: hydro-climatic changes cause water scarcity and this triggers conflict and hence impacts negatively on national and human security. Insecurity may also be a direct result of the impact of hazards such as floods or droughts (Kallis and Zografos, 2012). The reality is much more complex. The nature of the *hazards*[4], for instance, influences the type of impacts and insecurity produced. There are important differences between the impacts of changes in average conditions and changes in variabilities of rainfall. Water scarcity but also extreme surpluses such as floods or flash floods and the timing of hazards matter (e.g. meteorological vs. agricultural droughts). Combinations of hazards such as droughts followed by extreme precipitation resulting in flooding can have particularly far reaching and long-term impacts. Whether a hazard leads to a disaster depends on the combination of hydro-climatic/environmental and socio-economic conditions. For instance, changes in land use, consequences of economic growth, globalization and trade as well as cultural developments can make people and places more vulnerable to the impacts of climate change. These changes can happen at broader scales but may trickle down through various interactions and increase vulnerabilities of certain groups of people and make it more difficult for them to adapt to the consequences of climate change.

To examine the impacts of hazards on vulnerabilities and adaptive capacities, relationships between the social, political, environmental/ecological and economic sphere matter. It is essential to look at *socio-ecological systems* (SES) to explore the interaction between human security, conflict and cooperation and how these are influenced by different levels of vulnerability and adaptive capacity. It is also important to understand how these dynamics feed back to the different levels of political and economic dimensions.

An SES is based on a bio-geo-physical unit and its associated social actors and institutions. SESs are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context (see e.g. Glaser et al., 2008).

The concept of *'vulnerability'* helps to determine the extent to which an SES is able to face and withstand hazards, such as those associated with climate change. Vulnerability can have different dimensions: physical, social, environmental, economic and institutional and is usually considered as a function of the exposure[5] of a system to climate change, its sensitivity and adaptive capacity (Adger, 2006; Birkmann, 2006; Füssel, 2007).

"Vulnerability means the characterizations of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard" (Wisner et al., 2004: 11).

"The propensity or predisposition to be adversely affected." (IPCC-SREX, 2012: 3).

Adaptive capacity is *"the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences"* (IPCC, 2001:6).

4 "Hazards are threats to a system, consisting of perturbations and stress (and stressors), and the consequences they produce". (Turner et al., 2003: 8074)

5 The presence of people, livelihoods, environmental services and resources, infrastructure and economic, social, or cultural assets in places that could be adversely affected.(IPCC-SREX, 2012)

The physical sphere is captured in the notion of exposure while sensitivity and adaptive capacity explicitly focus on the social context (IPCC, 2007; IPCC-SREX, 2012). Exposure and vulnerability are dynamic and vary across temporal and spatial scales and population groups. Settlement patterns, urbanization and changes in socio-economic conditions proved to influence exposure and vulnerability to climate extremes (IPCC-SREX, 2012) and impact on the actual *adaptation* to climate change; adaptation being defined as *"a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity"* (Smit and Wandel, 2006: 282).

2.1.2 Conflict and cooperation

Conflict and cooperation can exist at various scales, from national and sub-national to local and inter-communal; at various intensities, from armed and violent to silent conflicts; and take various forms, from social and political to military (Kallis and Zografos, 2012).

Within CLICO, the term *conflict* refers to, *"A range [of] negative interactions that encompass mild verbally-expressed discord and cold interstate relationships, as well as hostile acts or declarations of war."* (Goulden et al., 2009: 806) *while cooperation encompasses, "A range of positive interactions that can take many forms and occur between different actors at different scales."* (Goulden et al., 2009: 806).

Conflicts are rarely monocausal making it hard to disentangle the actual sources of the conflict. Additionally conflictive and cooperative actions often coexist (Zeitoun and Mirumachi, 2008) and conflict can induce social changes that may in the longer term have positive impacts on reducing vulnerabilities and improving the adaptive capacities of social groups to climate change. Conflict may hence be considered as an opportunity rather than a threat, while cooperation may also generate negative impacts when it masks underlying conflicts and avoids necessary societal processes.

2.1.3 Relationship between climate, water conflict and cooperation

Many existing studies have looked at the relationships between climate, water and conflict or cooperation. Kallis and Zografos (2012) differentiate between four lines of research:

1. Transboundary/international water relations
2. Climate, water and armed conflict studies
3. Political ecology of water
4. Vulnerability and adaptation studies

Transboundary studies and international relations

The first of these is the focus of WP 5 of CLICO. In transboundary basins water can provide "pathways to peace" (Wolf et al., 2006). A study by Wolf (2007) revealed that cooperative events are much more common in transboundary basins and conflictive events are in most cases only verbal. Droughts and floods can contribute to interstate instabilities (Michel, 2009) but Gleditsch et al. (2009) suggest that it is rather the abundance of water and related economic benefits that tend to drive conflict. Many studies highlight the key role of institutional arrangements in mitigating the risks of conflict (e.g. Tir and Stinnet, 2012; Bernauer and Kalbhenn, 2010).

Climate, water and armed conflict studies

The second line of research within CLICO focuses on conflict (both violent/armed and non-violent) by compiling a large N data set of domestic water-related events to examine correlations between conflict and hydro-climatic factors while controlling for socio-economic and political factors. This goes beyond existing research that looks at armed conflict at national/international

scales by using evidence from national and sub-national scales. Some researchers found connections between factors associated with global climate and climate change such as higher temperatures or less rainfall and conflict (Miguel et al. 2004; most recently Burke et al., 2009; Hsiang et al., 2011; UNEP, 2011; Raleigh and Kniveton, 2012), but the majority of studies cannot confirm an explicit causal relationship between climatic drivers and violent conflict (e.g. Wolf et al., 2005; Barnett and Adger; 2007; Nordas and Gleditsch; 2007; Buhaug, 2010, Ciccone, 2011; Theisen et al., 2011). Factors such as the political system (Koubi et al 2012) or economic factors (Buhaug, 2010; Buhaug et al., 2010; Buhaug et al., 2008) seem to be more important factors that can influence conflicts. Less evidence is available for low-intensity domestic conflict or violent clashes of intra-state conflict around scarce water resources (for example, "water riots"), mainly due to limits in data availability. This type of conflict around water is far more frequent and may also be prompted by extreme hydrological events such as droughts or floods (Gleditsch et al., 2004; Ohlsson, 1995, 1999a and 1999b; Ohlsson and Turton, 1999; Ravenborg, 2004; Swedish Water House, 2005; Carius et al., 2004; Thomasson, 2006; Turton, 2004; Swatuk and Wirkus, 2009).

Political ecology of water, vulnerability and adaptive capacity

The 'political ecology of water' focuses on access and regulation of water by looking at power over access and use of resources. The identification of winners and losers and the distribution of costs and benefits at multiple scales arising from societal change that is affecting power relations are at the center of this research field. Uneven power relations and injustice are seen as fundamental drivers of vulnerability and insecurity (e.g. Kallis, 2009). Studies from this line of research argue that socio-economic and political inequalities that result in the exclusion of certain groups from accessing water or maintaining water-dependent livelihoods can increase conflict (Castro, 2004). More equitable power relations and democratic structures can facilitate adaptation to climate change and reduce the likelihood of conflicts. As political ecology examines how power relations influence vulnerability and outcomes, the particular role that hydro-climatic conditions may play in triggering conflict is not a major research focus.

Vulnerability studies aim to explain and measure quantitatively or qualitatively the determinants of vulnerability (often focusing on certain dimensions of vulnerability) while recognizing the complex relationships among diverse social, temporal and spatial contexts. The multidimensional and complex concept of vulnerability necessitates the application of various methods that need to be adapted to the specific context and scales considered. A major line of research has used indicators to assess vulnerability and adaptive capacity, related to droughts (e.g. Alcamo et al., 2008), floods (e.g. Lehner et al., 2006; Damm, 2010) or other extreme natural events (WorldRiskReport, 2011, 2012). Another line of research looks at processes and conditions that cause unequal vulnerabilities, building on entitlements theory or livelihood frameworks (Ribot, 2009). Other approaches place a particular emphasis on scale interactions such as impacts of global changes on local vulnerabilities (Leichenko and O'Brien, 2008) or by extending the time-frame to examine vulnerability far beyond the actual disaster to include longer term impacts and recovery management (Whittle et al., 2010).

More recently, value-based approaches to climate change vulnerability emerged that acknowledge climate change may be perceived and valued differently by individuals, groups, societies or governments, which in turn affects vulnerability and adaptive capacity (O'Brien and Wolf, 2010). These approaches also address questions regarding equity through their research focus on vulnerabilities which are prioritized or neglected in policies that aim to foster adaptation to climate change. CLICO WP 2 "In depth Case studies" draws from these two lines of research.

2.1.4 Human security

The concept of human security is at the core of the research carried out within CLICO (see the CLICO conceptual framework in Chapter 2.2) and was the focus of all of the project's case studies. As for the other key terminology used here, there are many definitions of human security (see also Goulden and Porter, 2010). We used the UNDP definition:

"Human security can be said to have two main aspects. It means, first, safety from such chronic threats as hunger, disease and repressions. And second, it means protection from sudden and hurtful disruptions in the patterns of daily life – whether in homes, in jobs or in communities. Such threats can exist at all levels of national income and development" (UNDP, 1994: 23).

People-centred human security concepts are linked to development issues (such as poverty eradication), freedom (e.g. human rights) and equity and justice (Brauch, 2006). In the context of environmental hazards, human security is closely related to the concept of vulnerability (Brauch, 2006), depending on how the latter is defined. Many of these dimensions are included in the CLICO conceptual framework (Goulden and Porter, 2010; Goulden and Grainger, 2012).

In a review of security concepts, in particular on the links between the environment and human security, Brauch (2005) identified that human security was linked to one's survival or quality of life which could be threatened by state actors, globalization, global environmental change, terrorism etc. Climate change, by acting as an amplifier of hydro-climatic hazards but also by affecting environmental resources such as water, has the potential to significantly increase human insecurity depending on the extent to which people and communities rely directly on ecosystem services, how these services are affected by climate change and how communities can adapt to these changes (Barnett and Adger, 2007). Typically however, human insecurity is induced by multiple factors such as poverty, demographic changes, existing conflicts, policies and resource management decisions and very rarely by single, monocausal factors. Human insecurity can be a driver of conflicts (see e.g. Gerstetter et al. (2012) for a summary of the literature). Barnett and Adger (2007) identified the following factors which might affect violent conflict and which could be aggravated by the consequences of climate change: *vulnerable livelihoods, poverty* (and in particular reductions in livelihoods induced by environmental change), *weak state and migration*. Therefore, multiple factors need to be considered in assessing the links between climate change, water resources, human security and conflict/cooperation. This complexity was at the core of what the CLICO conceptual framework attemped to capture.

2.2 Conceptual framework

The research within the CLICO project was based on a common conceptual framework which guided the research. The framework tries to capture all the relations between hydro-climatic and water-related stressors and human security as well as the determinants of human insecurity such as the economic, political and environmental conditions, to the key concepts of vulnerability and adaptive capacity as well as conflict/cooperation at multiple temporal and spatial scales (Goulden and Porter, 2010).

It was designed to be comprehensive and still generic enough to allow its application in all case studies and to provide enough room for a variety of research methods and concepts. Based on the framework, the seven main CLICO research questions were derived to shed light on important aspects and relationships, to better understand the water-conflict-security nexus (Goulden and Porter, 2010).

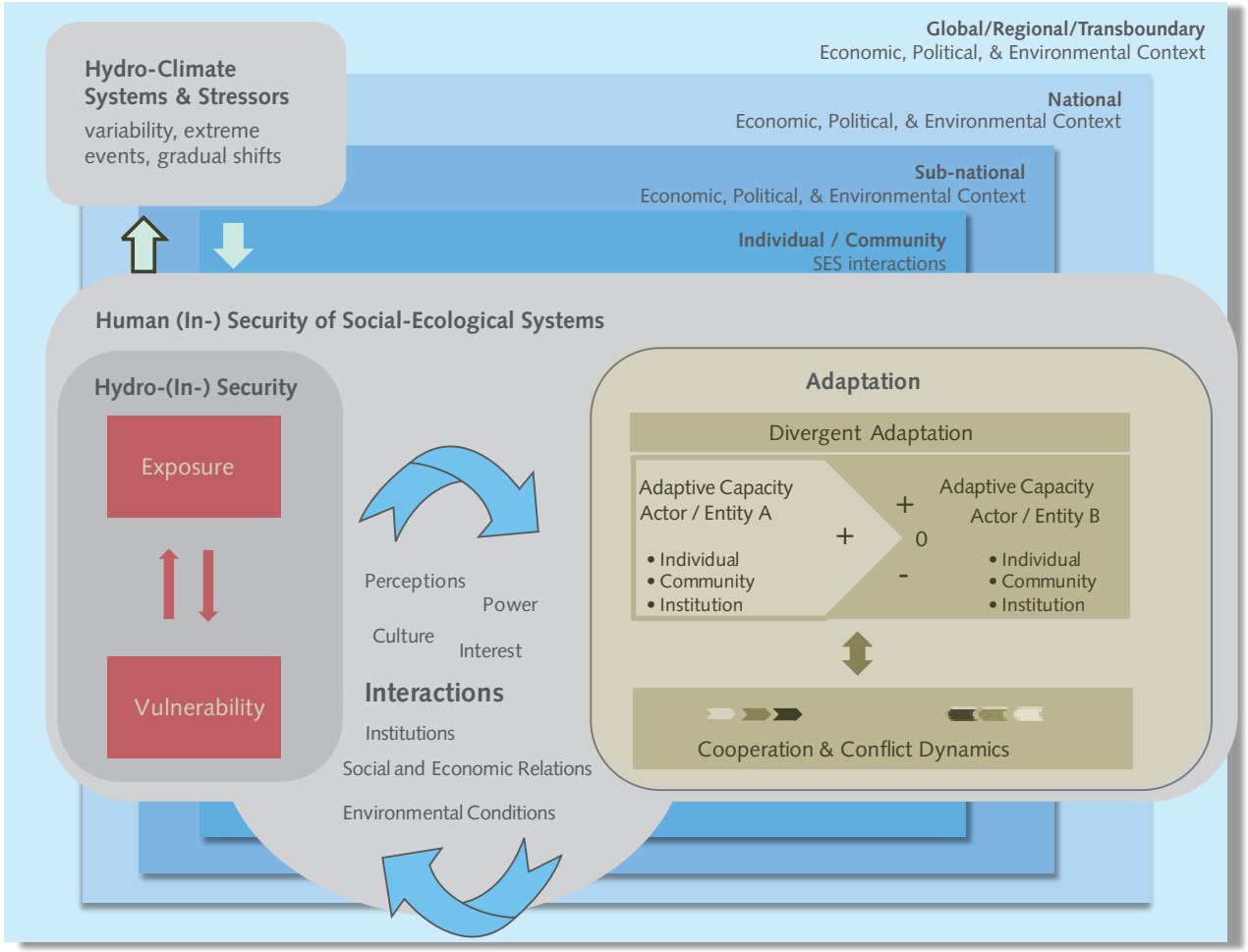


Figure 2: Revised conceptual framework (Goulden and Porter, 2012)

Placing the focus on certain elements of this nexus, the different WPs and case studies complemented each other in identifying the respective relationships and most important factors (see Appendix for an overview of the areas and elements of the framework as well as the particular research questions that were addressed within each WP). As a primary output of the CLICO project, building on the research findings of all Ws, the existing concepts and relationships suggested in the initial framework were revisited, updated and sharpened to contribute to an improved understanding of hydro-climatic security ("how climate and water-related hazards influence human security").

In the revised conceptual framework, shown in Figure 2, the concept of "human security of socio-ecological systems" is the all-encompassing frame embedding hydro insecurity (exposure and vulnerability) and adaptation/adaptive capacity. Conflict and cooperation are considered as their main mediators. Exposure and vulnerability as well as adaptation and adaptive capacity are measurable and have been measured in many different ways in the CLICO case studies – depending on the context and local circumstances as well as the aspects of human security to be covered. As human security evolves at all spatial and temporal scales, the framework embeds the term in several layers representing all scales from global/regional/transboundary to individual/community level (Goulden and Graininger, 2012). The research within CLICO is centred around the human security of elements within SESs and places particular emphasis on the analysis of linkages between society and the environment (Gunderson and Holling, 2002).

The boundaries of the SESs under consideration as well as the temporal and spatial scales considered, differed between the multiple research approaches within CLICO. The framework suggests that hydro-climatic stressors such as increasing climatic variability, extreme events and gradual shifts in interaction with socio-ecological dynamics on various scales are likely to influence exposure and vulnerability to water-related stressors. Adaptation is a dynamic process and may arise out of changes in hydro-security, but is embedded in processes of socio-ecological interactions between factors such as environmental conditions, social and economic relations, institutions, perceptions, culture, power and/or interest. The outcomes of adaptation depend on the formation of adaptive capacities of various actors or entities in place (here exemplified by A and B). Therefore, adaptive capacities and respective adaptation outcomes of one actor/entity are often not independent of the adaptive capacities and respective adaptation outcomes of another actor/entity, resulting in a diverse set of multiple mutual impacts, termed "divergent adaptation". Snorek et al. (2012b) introduced the term *"divergent adaptation"* to describe the situation in Tahoua, Niger, where the adaptation of one group lowers the adaptive capacity of another. This concept of *"divergent adaptation"* is taken up to capture the various possible outcomes of adaptive capacities resulting from these mutual impacts. Originating in evolutionary biology, the term *divergent adaptation* is used to describe an increase in both adaptive capacities ("win-win situation", +/+), a decrease in another individual's or group's adaptive capacity (win-lose situation", +/-)[6] or a neutral change ("win-no change situation"; +/0). During these dynamic shifts of adaptive capacities, conflict or cooperation can arise between the actors (particularly if one group is negatively affected) or ongoing conflict or cooperation can be amplified or reduced. An important outcome of the CLICO research is the confirmation that conflict and cooperation can co-exist and that there can be various intensities and linkages. Conflict and cooperation are seen as potential amplifiers or detractors of adaptive capacity and through feedback loops to vulnerability and exposure, influence the status of human security. Hydro-climatic (and environmental) stressors

6 An example of divergent adaptation resulting in a win-lose situation is illustrated in the Niger case study by Snorek et al. (2012b).

are conceptualized as stressors that trigger certain coping and – in the longer run – adaptive actions of SES that can result in more conflictive or cooperative events. However, there are multiple social, economic and political factors that interfere in this direct relation and simultaneously impact conflict or cooperation, as represented by the curved arrows in Figure 2.

The concept of *divergent adaptation* describes one type of "mal-adaptation" (Barnett and O'Neill, 2010), where adaptation processes undertaken by one group increase the vulnerability of other groups or systems by reducing their adaptive capacity.[7] The state has some potential to amplify or reduce the adaptive capacities of certain groups or systems through how its policies and institutions are designed and function.[8]

In general, the CLICO project adopts a political ecology approach in the theoretical analysis of many of the research pieces in the WPs. According to Kallis and Zografos (2012) political ecology places a certain emphasis on winners and losers and the distribution of costs and benefits within SESs and society as a whole. That includes the analysis of issues related to equity, interests and power relations.

Seven research questions were derived from the CLICO framework and are addressed by the CLICO research. These are briefly described below (for more details see Goulden and Porter, 2010):

1. How is human security affected by risks associated with water and climate-related stressors, societal vulnerability and socio-political factors?

This question can be expanded in two more specific questions:

a. What is the relative importance of environmental risks compared to social and political factors?
b. How do these factors/mechanisms amplify each other at various scales?

The questions reflect the multi-faceted nature of human security. Threats to human security are usually unequally borne between different groups which are embedded in historical and cultural context and the kinds of environmental changes they experience. It is therefore important to distinguish between environmental risks and other factors and analyse feedbacks and causal links among them at various scales. As this may change over time, the questions also address a historical and forward looking approach. Accordingly, CLICO research gives special attention to the ways climate and water-related stressors impact on vulnerabilities and which mechanisms/factors amplify their impact on human security at various scales.

2. How do political, economic, environmental and climatic factors exacerbate or mitigate water-related conflict?

The political context, environmental and economic factors and adaptive capacity can be expected to influence the likelihood of conflict or cooperation. Management and regulations related to water use and associated environmental risks can influence conflict. CLICO places a certain emphasis on the analysis of water-related conflict but also considers other forms of conflict relevant to the specific context.

7 An example of maladaptation is given in the Seyhan case study by Turhan (2012), in which governmental actions reduce the adaptive capacity of migrant agricultural workers.

8 As an example of state-led adaptation see Milman and Arsano (2012) and Gebert et al. (2012).

3. How does human security or the lack of it affect the demand for cooperation?

Increasing water insecurity may pose threats to human security and hence increase the demand for cooperation. But cooperation may come at a certain cost as taking up negotiations requires communication, coordination and efforts to reach consensus. States or individuals who do not have the appropriate institutions in place and whose access to livelihoods are insecure may not have the means to invest in cooperation. Decreasing water resources may also increase the benefits associated with cooperative water management and provide windows of opportunity for cooperation where little incentives existed before.

4. Under what conditions may conflict reduce rather than exacerbate vulnerabilities?

Conflict may also have positive impacts by triggering changes and policy responses to conflicts that may have the potential to decrease existing vulnerabilities. CLICO therefore looks at instances of conflict that facilitate adaptation as well as those that hinder it.

5. What constitutes the capacity of states and their institutions and other organizations to implement change or even radical change necessary under times of stress?

Studies analysing the adaptive capacity of states and institutions frequently focus on organizational elements that tend to perpetuate the current functions rather than facilitating change. The CLICO research aims to contribute to the existing literature by illustrating options and measures that help all kinds of actors – not only the state and its institutions but also communities and individuals-implement change themselves or through cooperation.

6. What interventions might be suitable for reducing risks and improving human security (either by reducing vulnerabilities of the system, increasing its adaptive capacity or modifying the hazards)?

As adaptation often causes winners and losers, interventions can apply different strategies, such as bear the losses, share losses equally or modify threats and prevent effects or changes (Burton et al. 1993; Rayner and Malone, 1998). These interventions may occur either as bottom-up adaptation approaches to respond to change and hazards and/or reduce social vulnerability and improve adaptive capacity or top-down adaptation approaches that rely on models to identify suitable interventions (Dessai and Hulme, 2004). Building upon both approaches, CLICO aims to identify impacts and suggest suitable measures at all scales.

7. Under what conditions might policies of adaptation in response to perceived or experienced climate change impacts, increase the vulnerability of some groups and/or exacerbate social conflicts?

Barnett and O-Neill (2010) have looked at a range of adaptation measures that rather than foster positive outcomes, increased vulnerabilities of some groups and even exacerbated existing social tension. Therefore, it is important to look at the outcomes of adaptation policies to identify potential adverse effects and limit maladaptation.

2.3 Summary

Though often simplified by media and some policy makers, there are complex ways in which hydro-climatic change, conflict or cooperation and human security interact. Environmental and physical factors as well as political, social, economic and institutional factors in conjunction with climate change, can trigger new

conflicts or exacerbate existing ones, but they can also induce co-operation and impact on human security in a multitude of ways. Though some studies found direct links between environmental or climate factors and conflict, many studies emphasize the role political, economic or social factors play as compared to environmental factors. Kallis and Zografos (2012) differentiate between four broad lines of research on the relationships between climate, water and conflict or cooperation from which CLICO draws:

- Transboundary/international water relations;
- Climate, water and armed conflict studies;
- Political ecology of water;
- Vulnerability and adaptation studies.

A conceptual framework was developed that provided guidance to the research conducted in all CLICO work packages. The concept is based on the relevant CLICO key terms: hydro-hazards, vulnerability, adaptive capacity and human security and links them to SES (human-environment interactions).

- Hydro-hazards are threats (perturbations and stresses) arising from the water system such as floods, droughts, land slides and their consequences;

- Vulnerability determines the extent to which an SES is able to face and withstand hazards and depends on the characterizations of a person, group or an SES and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard;

- Adaptive capacity means the ability of an SES to adjust to climate change and to moderate potential damages;

- Human security is multi-faceted, people-centered and includes freedom from hunger, violence and war, political repression, crime, disease and environmental hazards.

Key messages

The Water-Climate-Security-Nexus

There are complex interactions between environmental and physical factors and political, social, economic and institutional factors that in conjunction with climate change affect human security, conflict and cooperation in multiple ways and at various scales.

There seems to be more empirical evidence for a strong role of political, economic and social factors in triggering conflict or cooperation than for climatic/environmental factors.

The CLICO conceptual framework

To analyse the relationships between climate, water and conflict or cooperation, CLICO research draws from all four broad research lines relevant in this field:

1. Transboundary/international water relations;
2. Climate water and armed conflict studies;
3. Political ecology of water;
4. Vulnerability studies.

Human security of SESs is the all-encompassing frame embedding exposure and vulnerability, as well as adaptation and adaptive capacity operating at all scales. Conflict and cooperation are considered as mediators.

The concept of "divergent adaptation" is one of the theoretical contributions of the CLICO research.

The concept of "human security of socio-ecological systems" is the all-encompassing frame embedding hydro insecurity (exposure and vulnerability) and adaptation/adaptive capacity. Conflict and cooperation are considered as their main mediators. Exposure, vulnerability and adaptive capacity are measurable and have been measured in many different ways in the CLICO research. How they are operationalized depends on the context, the aspects of human security to be covered and the spatial and temporal scales to be considered. The framework embeds the term in several layers representing all scales from global/regional/transboundary to individual/community level and allows for a dynamic as well as static application. The CLICO research resulted in the development of the concept of *divergent adaptation* which is used to describe the mutual impacts on adaptive capacities due to the adaptation action of two actors. Divergent adaptation refers to: An increase in both adaptive capacities ("win-win situation", +/+), a decrease in another individual's or group's adaptive capacity (win-lose situation", +/-) or a neutral change ("win-no change situation"; +/0). The seven research questions that CLICO answered were derived from the framework and all linked to the factors influencing vulnerability, human security and conflict or cooperation (questions 1–4) and the specific role of states, institutions and policies to reduce vulnerabilities, facilitate adaptation and ensure human security (question 5–7).

3. Climate conditions and climate change outlook

This chapter presents the current and future climatic conditions in the Mediterranean Region (including the Middle East case studies) and the Sahel following Bruggeman et al. (2012a). For the 11 CLICO case studies that take place in these regions, this chapter also provides an overview of the current climate framework conditions, current trends in hazard characteristics and climate variability as well as predictions of climate change. To provide a wide-ranging, comparable analysis of existing climate change projections for the 11 case studies, *Climate Outlooks* have been developed by the Cyprus Institute (Cyl) and are centred on *average annual temperature and precipitation* [9] (Bruggeman et al., 2012a). Two climate web tools which offered straightforward access to ensemble means and medians were used: the Climate Change Data Portal and the Climate Wizard. The outlooks compile the existing information into one outlook for each case study: Taking into account the uncertainties linked to climate modelling, a set of climate models (16–20 Global Circulation Models, GCMs) were used to construct the Climate Outlooks for two future time periods. The derived projections are based on the scenarios of the Special Report on Emission Scenarios (SRES). Projections of average annual precipitation for 2040–2069, relative to 1961–1990, from 16 GCMs under the B1, A1B and A2 scenarios and from 20 GCMs for the period

9 Climate change projections suffer from various uncertainties that arise from (i) our unknown socio-economic and technological development, (ii) limited or inaccurate observations, (iii) deficits in our understanding of processes within and between different components of the earth system and (iv) the chaotic nature of the climate system (Le Treut et al., 2007; Bruggeman et al, 2012a).

2031–2050, relative to 1980–1999 under the A1B scenario are presented. In addition, information on sea level rise and the impact of climate change on water resources at the case study sites were summarized from the literature.

The first region of intervention for the project was the Mediterranean region which covers a vast area which can be further divided in two parts: the Western Mediterranean and the Eastern Mediterranean. The Western Mediterranean includes the case studies of the Ebro Delta (Northern Spain), the IBRM (Spain – Morocco) and Sarno (Italy). The Eastern Mediterranean comprises the case studies of the Seyhan Basin (Turkey), Cyprus, the Jordan Basin, Alexandria (Egypt) and Ras Sudr, South Sinai (Egypt).

3.1 The Mediterranean region

3.1.1 Climate conditions

The Mediterranean region is characterized by the mid-latitude Mediterranean climate as classified by Köppen (1936). The main features of this climate are mild to cool wet winters and warm to hot, dry summers (IPCC, 2007; Lionello et al., 2006; Köppen, 1936). However, the specificity of the Mediterranean climate lies in the presence of the partially enclosed Mediterranean basin which serves as a "large source of moisture and a heat reservoir" (Lionello et al., 2012: p.xxxvi). Additionally, its complex morphological situation as well as its geographical location, situated between a temperate zone in the north and a subtropical zone in the south, results in a variation within the Mediterranean climate (Lionello et al., 2012).

The distribution of precipitation in the Mediterranean is highly variable with contrasts between the arid to semi-arid climate in the southeast portion of the region and the wet zones situated in the northwest (Lionello et al., 2012). For instance, Cyprus, with a mean annual precipitation of 460 mm (October 1970 – September 2011) is representative of the dry Mediterranean climate. The country is also characterized by high variability of annual precipitation with extreme lows of 213 mm reached in 1972/73 and 272 mm reached in 2007/08 and extreme highs of 739 mm reached in 1929/30 and 800 mm reached in 1968/69 (Bruggeman et al., 2012; CMS, 2012). On the other hand, the IBRM which is situated in the semi-arid part of the Mediterranean is characterized by a high annual mean variability in precipitation (500–800 mm/year). Besides, the influence of the Western Mediterranean Sea and Atlantic wet fronts results in a high amount of annual precipitation (around 2000 mm/year) in some parts of the reserve (Abdul Malak et al., 2012). In Ras Sudr, which has an extremely arid climate, the average annual precipitation is 40 mm (Suez Canal University Team, 2012). In addition, the distribution of average annual precipitation can vary widely according to the topographic conditions as the case study of the Jordan basin reveals. It is equivalent to 300–500 mm in the mountainous area, 200–300 mm in the foothill area and 200 mm in the flat area (Tamimi and Abu Jamous, 2012).

3.1.2 Water resources

Many water basins in the Mediterranean are already under pressure (Ludwig et al., 2011; Bates et al., 2008). In Egypt, the Nile is the the most important source of water as it provides for an annual allocated flow of 55.5 km³/year. In this highly water scarce country, internal renewable surface water resources provide 0.5 km³/year and internal renewable groundwater resources provide 1.3 km³/year. Thus, the total actual renewable surface water resources are estimated at 57.3 km³/year (Aquastat, 2012). The amount of renewable water per capita is expected to shrink from 866 m³/per capita/year (2000) to 576 m³/per capita/year (2025), assuming medium variant population growth (MED WS and DWG, 2007). However, this decrease does not include the potential effects of climate change. A country is considered water stressed if total renewable water resources is less than 1000 m³/per capita/year (Falkenmark et al., 1989).

At present, Morocco's total available renewable resources are 29 km³/year, consisting of 69 per cent surface water and 31 per cent groundwater (Aquastat, 2012). The annual renewable water resources per capita are 899 m³/per capita/year.

In Turkey, the amount of internal renewable water resources is 212 km³/year, consisting approximately of 72 per cent surface water and 28 per cent groundwater (Aquastat, 2012). The country is not considered water scarce, but variations within the country are not taken into account. The amount of water available per capita in Turkey is expected to shrink from 3396m³ per capita/year (2000) to 2558m³ per capita/year (2025) (MED WSand DWG, 2007).

In the case of Palestine, the complex political situation has contributed to severe or chronic water stress. The amount of water available to the Palestinians, including the quanitites that they are allowed to abstract from their wells and springs as well as the quantities purchased from Israel, totals nearly 200 m³/year. This means that annual water resources per capita are 50 m³/year, which is almost one tenth of the water stress level defined by Falkenmark (1992).

3.1.3 Water-related hazards and climate variability

Droughts and heat waves are common features of the Mediterranean climate (Lionello, 2012). Droughts, which are characterized by abnormal spells of dry weather causing serious hydrological imbalances (IPCC 2012), are primarily brought on by a lack of precipitation, while other climatic processes and pre-existing conditions also play a part (Bruggeman et al., 2012a). Cyprus, the IBRM and the Ebro Delta are prone to severe recurrent droughts. In the case of Cyprus, three severe drought years have taken place over the last 40 years: (1972/73, 1990/91, 2007/08) as well as two 2-year droughts 1990/91–1991/92 and 2004/05–2005/06), a three-year drought (1971/72–1973/74); and a three-year mild drought (1995/96–1997/98) (Bruggeman et al., 2012a). Drought frequency in the Catalonia region, where the Ebro Delta is situated, is variable but recurrent. A high number of droughts were reported in the area during the 20th century (ACA, 2005, 2007; ISAEBRO, 2007; PES, 2007) (Calvo Boyero and Zografos, 2012). The IBRM has also suffered frequent drought events. For example, in the mid-1990s severe droughts took place in Spain, Morocco and Tunisia forcing a high number of irrigation dependent agricultural systems to put production on hold (Abdul Malak et al., 2012). The Jordan River Basin, Palestine, Jordan and Israel have also suffered from severe consecutive drought events. The most severe was the drought of 1998/99 (Rabi et al., 2003).

A number of areas in the CLICO Mediterranean case studies are affected by flood hazards. The state of Ras Sudr is particularly vulnerable to flash floods[10] which can be triggered by torrential rainfall. Flooding episodes due to storm events are a regular manifestation in Cyprus. In 2006, flooding caused two casualties and in January and December 2010 floods caused widespread damage in various communities. An increase in flood damages has been observed over the last 10 years (I.A.CO Ltd., 2011). In the Ebro Delta, flooding is a historical occurrence which happens, approximately every five years, causing the breakdown of irrigation canals. In 1866 and in the 1960s flooding had serious repercussions on economic livelihoods in the Delta (MMA, 2005).

Additionally, the Ebro Delta is subject to coastal regression (the average of coastline retreat has been estimated at 0.15 m/pa for the 2050 IPPC scenario). Coastal regression, along with reduced water availability results in groundwater salinization (Boyero and Zagrafos, 2012). Decreased stream flow, lower groundwater recharge rates and increased groundwater abstraction foster the intrusion of saline water in Seyhan in Turkey. Sea level rise affects

10 Flash floods are "the result of heavy or excessive amounts of rainfall within a short period of time, (usually less than 6 hours), causing water to rise and fall quite rapidly.

some case study areas in particular: A study found that, between 1993 and 2005, the Ebro Delta in Spain experienced a sea level rise of 10 mm per year as well as an increase in the intensity of sea storms (PACC-DE, 2008).The geographical situation of the Nile Delta in Egypt, with 35 per cent (700 km²) of the land area being below sea level, means that it is highly vulnerable to flooding and erosion. Global scenarios forecasting sea level rise in the Mediterranean show high uncertainties , with a range of 50-140 cm until 2100 (Pirazzoli in Umgiesser et al., 2011). Empirical data from tidal gauges on relative changes of sea level show a 1.8 mm/year increase in Alexandria (1944-2006) and 3.4 mm/year for Abu Qir (1992-2005) at the northern end of the Alexandria metropolitan area (Frihy et al., 2010). But how these figures will change over time as climate change progresses cannot be predicted.

3.1.4 Climate outlooks

It is predicted that the Mediterranean, which is already characterized by hot and dry weather in the summer and mild temperatures in the winter, will become even warmer and drier (IPCC, 2007). The increase in temperature will intensify the hydrological cycle. This will result in a rise in the occurrence and intensity of extreme precipitation events such as droughts and floods (IPCC, 2012; Ludwig et al., 2011). The Mediterranean region will experience more severe droughts and dry summers are anticipated to begin earlier and last longer (IPCC, 2012). Additionally, increased variability during the dry and warm season is projected (Giorgi, 2006).

Climate change models suggest that there will be a significant drying and decrease in precipitation in the Mediterranean region (Giorgio and Lionello, 2008; Evans, 2009; Krichak et al., 2010). For the 2031–2050 and 2040–2069 periods, projections of decreasing precipitation under the A1B and A2 scenarios were nearly consistent for all 16 GCMs for Morocco-Andalusia, the upper-Ebro, Cyprus, the Seyhan River Basin, the Jordan River Basin and Alexandria, Egypt. A 24–25 per cent decrease is foreseen for the 2040-2069 period relative to 1961–1990 under scenario A1B for the Morocco-Andalusia biosphere reserve, signalling the highest changes in annual precipitation in the case studies. For Cyprus, Jordan and Alexandria, the models indicate a median decrease of 13 per cent, 11 per cent and 9 per cent respectively. In the Seyhan case study, the reduction in precipitation will be more severe in the upstream area of the basin (-17 per cent) compared to downstream (-13 per cent), for the same reference period as above. Climate change is also expected to result in higher precipitation intensities concentrated in short time periods (ISAEBRO, 2007); the Ebro case study for example will be characterized by an intensification of precipitation that is concentrated in shorter periods (Boyero and Zografos, 2012). In Sarno, average precipitation is projected to decrease by 9 per cent but there is a smaller reduction of approximately 5 per cent for the landslide-prone spring period (Bruggeman et al., 2012a).

Sea level rise in the Mediterranean has been recognized as one of the first consequences of global warming and is forecasted to continue (Tsimplis et al., 2008). Atmospheric pressure, variations in temperature and salinity of the water as well as changes in mass all contribute to altering sea levels (Bruggeman et al., 2012a). The combination of sea level rise, coastal erosion and flooding create a significant hazard to water resources and poses a security threat especially in the vicinity of coastal aquifers, many of which have already been compromised through salt water intrusion resulting from excessive groundwater abstraction (Ludwig et al., 2011)[11].

11 Another impact stemming from higher water temperatures and extreme weather events is the deterioration of water quality, which has widespread negative consequences on human lives such as health, food security and the operating of water infrastructure such as irrigation (Ludwig et al., 2011).

The sea level rise projections in the Mediterranean basin involved a high amount of uncertainty, the main reason being the insufficient detailed modelling of the connection between the Atlantic Ocean and the Mediterranean Sea at the Gibraltar Strait. Research by Marcos and Tsimplis (2008) found that during the 21st century the average sea level rise in the basin could range between -2 to 51cm, under the A1B and A2 scenarios, with a higher range in the western part of the region rather than the eastern part. For instance, in the case of Alexandria, the currently observed rate is 1.8–3.4 mm/year (Frihy et al., 2010).

3.2 Sahel and bordering countries: Niger, Sudan, Ethiopia

The Sahel climate zone covers part of the territory of these African countries. It must be clarified that the climate of the Gambella Region in the Ethiopia case study is not a Sahelian one.

3.2.1 Climate conditions

The Sahel, which is defined as a semi-arid region, is an intermediate area situated between the northern arid Sahara desert and the southern humid savannas (Encyclopedia Britannica; Buontempo, 2010). The characteristics of this climate are rooted in strong climate variability, e.g. rainfall in the Sahel is seasonal, based on the position of the Inter-Tropical Convergence Zone (ITCZ) and ranges annually between 200 mm and 600 mm (Kandji et al., 2006; Fox and Röckstrom, 2003). Extreme years are very frequent and a series of dry years and wet years are representative of the climate in that part of the world (Kandji et al., 2006). The climate of the case study Tahoua region in Niger is characterized by a long dry season with interspersed cool and hot periods, followed by a short three-month humid season (Snorek et al, 2012a). The country of Sudan which has an arid to semi-arid climate, experiences different precipitation rates which vary according to regions and range from almost zero rainfall in the arid north to an annual average of almost 900 mm in the regions bordering South Sudan (Hoffman and Selby, 2012). In South Sudan the areas of the Upper Nile, Eastern Equatoria and Jonglei, precipitation rates are found to be around 800 mm in contrast to the other states which have long term annual averages above 1000 mm. In particular, the Western Equatoria zone has a precipitation rate just short of 1400 mm per year (WFP and FAO 2012:48; Hoffman and Selby, 2012).
Although not explicitly part of the Sahel, rainfall in Ethiopia occurs during a short rainy season from March to May and a longer rainy season from May to late September. The climate in Gambella is also characterized by high variability in timing and intensities of rainfall, causing frequent droughts, but the average rainfall – depending on elevation – is higher than in the other two case studies ranging from 720–1350 mm (Milman et al., 2012a).

3.2.2 Hydrological resources

The Sahel's water resources have continuously been at risk due to the combined effects of human interventions and the highly variable climate (Kandji et al., 2006). Ethiopia, which has relatively sufficient water resources (Maplecroft, 2011), benefits from the availability of a total of 122 km^3 of renewable water per year (Aquastat, 2012).

The total natural renewable water resources in Sudan and South Sudan are estimated at 149 km^3/year, while the total actual renewable water resources are 64.5 km^3/year. Between both countries, 90 per cent of these water resources are surface water (Aquastat, 2012). At 30 km^3/year, the total internal renewable water resources of Sudan and South Sudan are relatively low and ilustrate the strong dependence on the inflow brought by the Nile.

The country of Niger, which is extremely water scarce, is 90 per cent dependent on outside water resources to meet its internal demand. Its total renewable resources are projected to be 33.65 km3/year, with 2.5 km^3 of groundwater and 31.15 km^3 of surface water per year and 29 km^3/year of surface water coming

from the River Niger (Aquastat, 2012). Average annual renewable water resources per capita are 2094 m^3, but highly variable in terms of timing and space. They are also only partly exploitable due to technical, environmental and geopolitical reasons (Aquastat, 2012).

3.2.3 Water-related hazards and climate variability

It has been observed that precipitation in the Sahel and the Mediterranean declined between 1900 and 2005 (IPCC, 2007). Environmental changes have occurred in the Sahel over the past decade that are linked to ocean and atmospheric dynamics such as the El Niño southern oscillation (ENSO) cycles (Nicholson, 2001), sea-surface temperatures caused by non-ENSO-related variations (Giannini et al., 2003; Brooks, 2004; Hermann et al., 2005), large-scale land degradation, land-atmosphere interactions (Charney et al., 1975; Hulme and Kelly 1993; Nicholson, 2000; Hulme et al., 2001) and anthropogenic climate change (Giannini et al., 2003). Since the 1970s, temperatures have gradually intensified in the Sahel with particularly high temperatures for the period of 1990–2007 relative to the 1951–1979 period (Agrhymet, 2007). Despite more humid conditions in the mid-1990s, the region has not returned to the climatic period observed in the 1950s and 1960s. For example, Sudan's average annual rainfall declined from 425mm (1941–1970) to 360mm (1970–2000) (Hoffmann and Selby, 2012). Rainfall conditions in Ethiopia show a 20-year cyclical pattern (wet in the mid-1970s and mid-1990s, yet dry in the mid-1980s and mid-2000s) (Milman et al., 2012a). Droughts are a common trait of the climate in Sahelian countries with severe periods of drought occurring in 1910–1916, 1941–1945, 1968, 1971–1974, 1984, 1987, 1989, 2004, 2009, 2011 (Snorek et al., 2012a; Kandji et al., 2006). Floods are also common during the rainy season. Extreme flooding events took place in Gambella in 1993, 1995, 1996, 2007, and 2008; affecting 68,840 persons in 2008.

3.2.4 Climate outlooks

Climate projections for the Sahel indicate that warmer and drier trends are set to continue with increased incidences of droughts and flooding (IPCC, 2007). However, there is no consistency between the results of different GCM, leaving us with an unclear picture of the future for this region. Small precipitation increases from the median of the GCM models are found for the upstream and midstream area of the Gambella Region in Ethiopia, in South Sudan and in Tahoua, Niger. For Dongola and Nyare, both located in North Sudan, precipitation is predicted to increase slightly, by +3 per cent (A1B/ 2031–2050 vs 1980–1999). However, as Dongola only receives an average precipitation of 17mm per year, the increase transfers into very little change in absolute terms. For Gambella, precipitation is expected to increase by 4 per cent for the same period, translating into a much higher absolute increase given the average rainfall of 1792 mm (in Atbara, Gambella Region). The expected temperature increases range from + 2.2 °C in Juba (South Sudan) to +2.5 °C in North Sudan and +2.6 °C in Agadez in Niger for the A1B scenario (2040–2069 vs. 1961–1990). However, it has been suggested that there is no consistency among the different models. Analysis of observations, climate re-analysis data and simulations indicate that for East Africa a decrease in rainfall trends is likely (Williams and Funk, 2011).

3.3 Summary

This chapter presented characteristics of the Mediterranean and Sahelian climate, such as climate zones, climatic and hydrological conditions specific to the CLICO case studies. Following this, it provided climate change projections (i.e. expected changes in temperature and precipitation for the project case studies, based on the results of GCMs) as well as highlighted possible future climate extremes and hazards. Results from most case studies point to a decrease in precipitation. The most important decrease was found to be in the IBRM, with a 24–25 per cent decrease

Key messages

Notwithstanding the many uncertainties inherent in the modeling of future climate trends, the projections of most GCMs agree on a general trend of drying for most of the Mediterranean region, while the projections for the Sahel and Ethiopia are inconsistent.

Floods and droughts

Floods and droughts are important hazards in the majority of the case studies. Floods (Sudan, Sarno, Ethiopia, Cyprus, Alexandria), flash floods (Ras Sudr, Sarno, Niger) droughts (Sudan, Seyhan, Ras Sudr, IBRM, Ethiopia, Ebro Delta, Cyprus, Niger, Jordan basin), landslides (Sarno), sea level rise (Alexandria, Ebro delta).

Temperature

Projected average annual temperature is 1.5–2.0°C for the SRES B1 scenario, 2.0–2.7°C for A1B and 1.9–2.6°C for A2.

The lowest increases in temperature are projected in Alexandria for the scenarios (B1 and A1B) and Cyprus (A2).The highest temperature increases are projected for Tahoua, Niger (B1, A2) the Seyhan Basin, Turkey (A1B) and Khartoum, Sudan (A2).

Precipitation

Results from most case studies in the Mediterranean point to a decrease in precipitation. The most important decrease in precipitation was found to be in the IBRM with a 24–25 per cent decrease (A1B). Slight increases in precipitation are found for Ethiopia, South Sudan and Niger.

Sea level rise

The sea level rise projections in the Mediterranean basin involved a high amount of uncertainty, due to the insufficient detailed modeling of the connection between the Atlantic Ocean and the Mediterranean Sea at the Gibraltar Strait.

for 2040–2069 compared to 1961–1990. On the other hand, only slight increases in precipitation were anticipated for Ethiopia, South Sudan and Niger. However, these findings are very uncertain due to the lack of consistency between the models. With regards to average annual temperature in the CLICO case study sites for the period ranging from 2040–2069 relative to the 1961–1990 reference period, projected increases ranged between 1.5–2.0°C for the SRES B1 scenario, 2.0–2.7°C for A1B and 1.9–2.6°C for A2 (Bruggeman et al., 2012a). Depending on the underlying SRES-Scenario, the lowest temperature increases were anticipated in the case of Alexandria (B1 and A1B) and Cyprus (A2). On the other hand, the highest temperature increases are to be found for the case studies of Tahoua Niger (B1, A2), the Seyhan Basin in Turkey (A1B) and Khartoum, Sudan (A2).

Overview of current and future climate conditions, addressed hazards and location of the case study areas

Climate zones classification

Main	Precipitation	Temperature
A: *equatorial*	s: *summer dry*	a: *hot summer*
B: *arid*	W: *winter dry*	h: *hot arid*
C: *warm, temperate*		

Case study	IBRM (Morocco)	IBRM (Spain)	Ebro Delta (Spain)	Sarno (Italy)	Republic of Cyprus	Seyhan River Basin (Turkey)	Jordan River Basin
Climate zone[12]	Csa	Csa	Csa	Csa	Csa	Csa	Csa
Rainfall							
• Current (mm)[13]	622	622	2622	1170	432	810	311
• Projected (mm)[14]	693	558	556	1108	472	502	665
• Change (%) 2040–2069	- 25	- 24	- 10	- 7	- 10	- 13	- 19
• Uncertainty range (%)	-30 to -1	-32 to -3	-25 to 11	-15 to 7	-23 to 0	-23 to 0	-35 to 0
Temperature							
• Current (°C)	17.5	17.5	25.8	12.2	19.5	19.3	18.9
• Change (°C) 2040–2069	2.4	2.5	2.3	2.2	2.1	2.7	2.4
• Uncertainty range (°C)	0.4 to 2.5	0.5 to 2.5	0.6 to 2.3	0.9 to 2.6	0.8 to 2.4	1.1 to 2.8	1.0 to 2.4
Hazards	Droughts	Droughts	SLR	Floods Landslides	Droughts	Droughts	Droughts

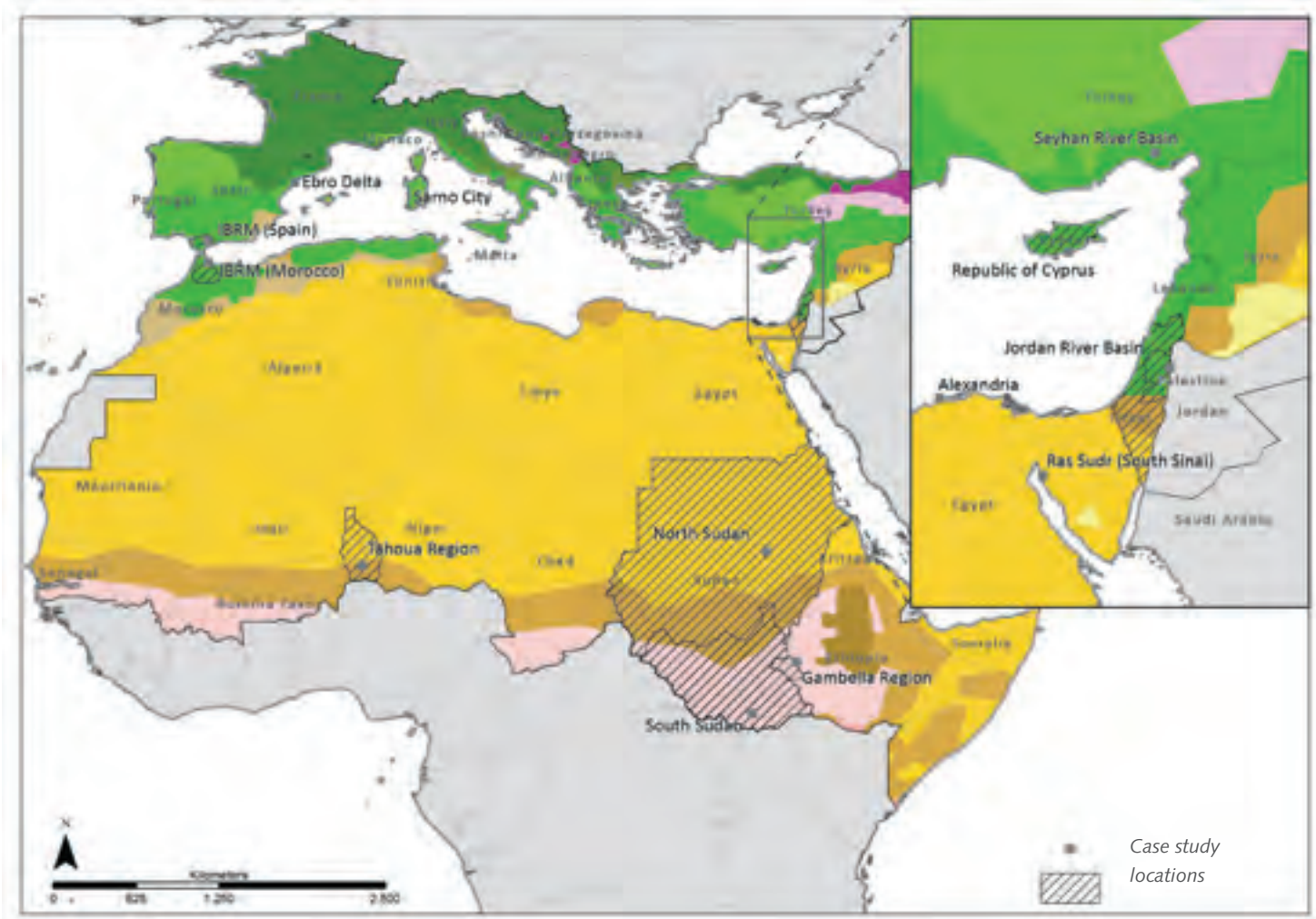
12 Kottek et al., 2006: World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263.

13 Data on current condition based on 1960–1990. Source: http://sdwebx.worldbank.org/climateportal/.

14 Projection for the time span 2040–2069.

Ras Sudr (Egypt)	Alexandria	Gambella Region (Ethiopia)	North Sudan	South Sudan	Tahoua Region (Niger)
BWh	BWh	As	BWh	As	Bsk
58	183	1317	122	929	322
29	164	1169	17	1011	563
- 18	- 19	0	- 17	2	4
-38 to 23	-34 to 4	-10 to 14	-43 to 54	-4 to 15	-15 to 21
19.7	20.5	24.7	29.2	27.8	29.4
2.2	2	2.3	2.5	2.2	2.5
1.0 to 2.4	0.8 to 2.3	0.9 to 2.0	0.7 to 2.4	0.8 to 2.1	1.1 to 2.3
Droughts Flash floods	SLR	Droughts Floods	Droughts	Droughts	Droughts

Table 1: Climate parameters and their projected change for 2040–2069, relative to 1961–1990, under scenario A1B, for case study countries and sites. Source: http://www.climatewizard.org/.



Map 1: Climate zones and case study areas.
Source: Kottek et al., 2006, GADM, Ver. 2.0 .

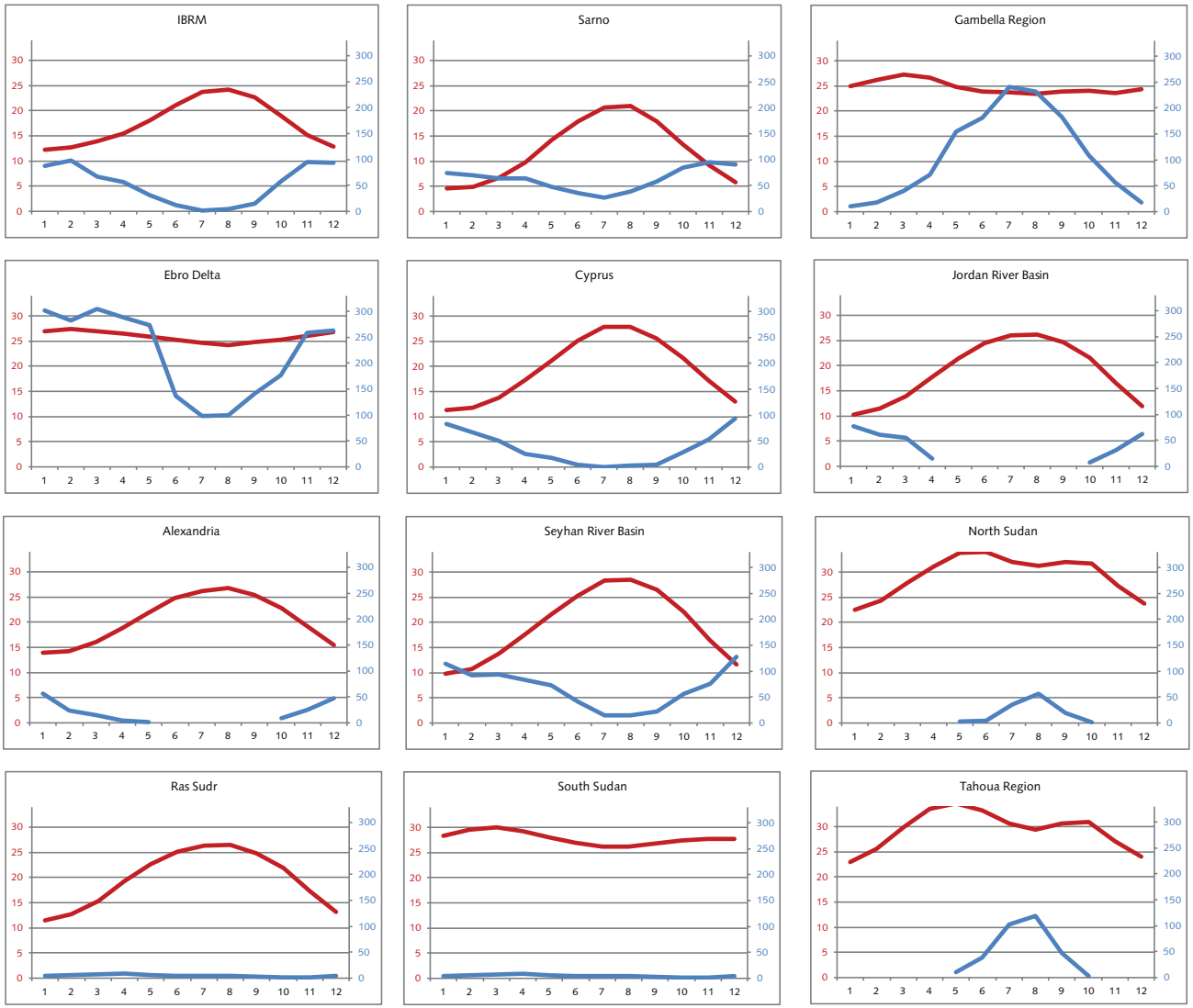


Table 2: Climate diagrams.
Source: http://sdwebx.worldbank.org/climateportal/.

4. Policies at the national and international level

Overall adaptive capacity of societies depends, inter alia, on institutions that can manage risks associated with climate change and on policies to enhance the resilience of vulnerable groups within societies (see Box 2 for a definition of policies). A lack of such policies may impede adaptation or increase the vulnerability of certain groups. Providing public goods and services is a primary function of government which becomes especially important for adaptation. It is, above all, a government's responsibility to manage risk on behalf of all population groups, especially those perceived to be the poorest and most vulnerable. Thus, state-driven policies are an essential part of adaptation efforts. However, there are a number of questions regarding what appropriate climate change adaptation policies should look like, specifically those that address links with human security or conflict.

This chapter discusses the adaptive capacity of some political systems in the countries of focus in CLICO with respect to the systems' capacity to generate and implement policies that mitigate or curtail certain climate induced negative impacts on local populations. Thereby, the focus is on the role of policies that on the one hand, address water-related risks in the context of human security and on the other hand, the risk of increased water-related conflicts potentially resulting from climate change.

The following key issues are addressed:

- What types of policies exist and emerge that explicitly address climate change impacts on human security and conflict/cooperation?

- → What are the types of institutions and adaptation policies that enhance human security and mitigate conflict risks?

- → What is the perceived role and degree of effectiveness of exsiting adaptation policies in addressing human security issues in the context of climate change?

This section explores policy frameworks that currently exist in the MMES and addresses the links between climate change and human security in the context of water-related threats. The main objective of this analysis is to gain an understanding of the current policy landscape on climate change adaptation and water resource management and, especially, the extent to which it already addresses impacts of hydro-climatic hazards on human security and water-related conflicts. The characteristics of current policies and institutional settings are being examined in this light, emphasizing the *advantageous and less advantageous* aspects of different policy examples.

Box 2: Definition of policies

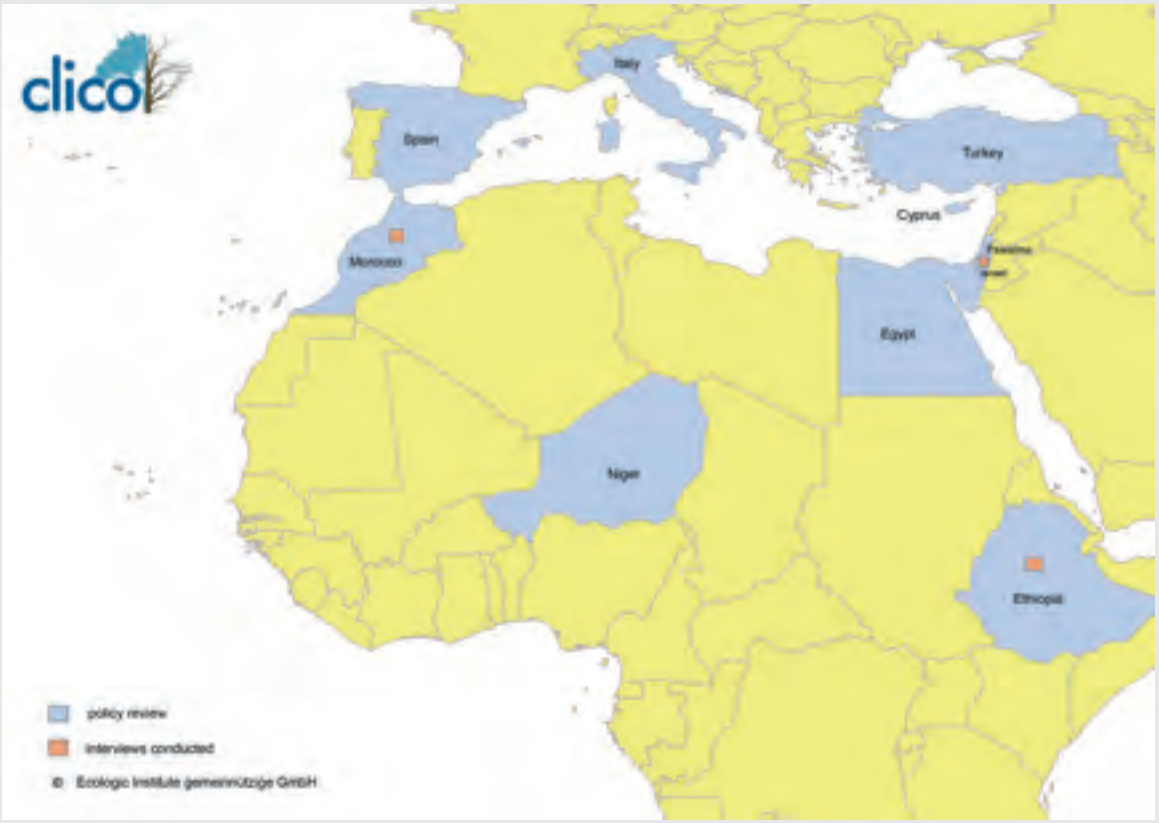
Policy can be defined as *"any decision by a public entity oriented towards a long-term purpose or to a particular problem"*. Thus, the term "policy" is more specific than terms such as "governance", "political factors" or "political system", as this chapter analyses a number of specific interventions undertaken by political institutions of concern.

Policies covered in the review include *regulations, strategies, action plans and advisory bodies.*

A broad array of policies were examined, including: insurance policies (Turkey); civil protection against natural disasters (Italy); desertification, pastoral and water legislation (Niger); sewage water system management (Cyprus); national agricultural and water strategies (Morocco); water policies and plans (Israel/Palestine/Jordan); drought management plans (Spain); early warning systems for flash floods (Egypt); the European Security Strategy (EU); peace building (UN); and adaptation funding mechanisms (UN). An overview of these policies is provided in the Chapter 2 Annexes.

4.1 Policies explicitly addressing the climate-water-security-nexus

The analysis of policies from nine countries as well as at the UN and EU level has led to the conclusion that while links between climate change, conflict and human security are addressed in high-level political resolutions and calls, there are hardly any policies that explicitly refer to and target the link between climate change, water conflicts and human security. However, the analysis also indicated that the lack of explicit mention does not mean that these issues are not addressed in substance. Indeed, a range of policies address these underlying issues. These include, for example, general policies on water and agriculture, but also more specific adaptation policies. Of the few policies that explicitly address the links, most are located at the international level. These include the Environment and Security Initiative (ENVSEC), the European Security Strategy (ESS) and the Strategy for Water in the Mediterranean of the Global Environment Facility (GEF) – Focal Area on International Waters (see Box 4). But even these UN and EU-related policies do not seem to have gone a long way towards integrating climate change specifically.



Box 3: Methods and regions of policy research

Selected national policies have been reviewed which are relevant to adaptation and enhancement of human security in the face of hydro-climatic hazards in *Spain, Italy, Cyprus, Egypt, Morocco, Turkey, Israel and Palestine and Niger as well as at UN and EU level.* On the basis of a set of 41 potentially interesting policies a final selection of 25 policies was made, with two to three policies selected per country and at UN and EU level. Policies were evaluated using the key criteria proposed by the OECD for the evaluation of development cooperation projects: relevance, effectiveness, efficiency, impact. Moreover, 70 interviews with policymakers and experts were conducted in the countries as well as at the EU and UN level (Gerstetter et al., 2011).

Box 4: Examples of international strategies

The Environment and Security Initiative (ENVSEC) is a partnership between OSCE, UNDP and the NATO. Its main objective is to contribute to environmental and security risk reduction. ENVSEC supports vulnerability assessments, early warning and monitoring, improving awareness and providing technical expertise and mobilizing financial support for clean-up and remediation activities.

The European Security Strategy (ESS) conceptualizes security in broad terms, mentioning both national as well as human security. The ESS itself does not refer to climate change. However climate change is acknowledged as a threat multiplier exacerbating existing trends, tensions and instability; thus overburdening states and regions that are already fragile and conflict prone.

At the *national level* the *Spanish National Climate Change Adaptation Strategy* is the only policy document that *explicitly* refers to human security by stating that the evaluation of climate change impacts and vulnerability of different sectors and systems must also consider impacts of climate change on human security, including food security and related topics such as poverty or social inequality.

4.2 Adaptation policies and institutions enhancing human security and mitigating conflict risk

There is a wide range of policies that support adaptation efforts (see chapter 4 Annexes), and are thus likely to improve human security and prevent or reduce conflicts in light of climate change. However, not all of them come under the title of adaptation or human security. And most of the national policies concerned with climate change adaptation rather implicitly address human security by seeking to mainstream climate change adaptation into overall development (e.g. Ethiopia) or promoting the improvement of overall water availability and disaster risk reduction by means of e.g. agricultural insurance schemes, disaster relief, forecasting and early warning, awareness and education. The same applies for conflict prevention and resolution.

Based on insights gained in the policy research carried out in the respective countries, the following contextual conditions that can influence the adaptive capacity of institutions addressing the development–climate change–conflict nexus in pursuit of human security are presented. Broadly speaking, the following types of policies are can be distinguished.

4.2.1 Policies targeted at enhancing the overall adaptive capacity of the population

One way in which policies can contribute to successful adaptation is by enhancing the overall capacity of people to adapt to climatic changes. Measures that improve the socio-economic conditions of poorer people also improve the baseline capacity for people to autonomously cope and adapt to changes in their environment. Such measures can also reduce or mitigate conflicts by making resources available for conservation or substitution (imported or artificially generated, e.g. desalinated water) of scarce resources. Measures which increase the adaptive capacity of rural households include income generation schemes, insurance schemes for climatic risks such as drought or floods, or broader social security schemes and social networks (see examples in Box 5).

Box 5: Measure for enhancing overall adaptive capacity

Insurance schemes:
In Turkey, the state has supported by law agricultural insurance schemes since 2005. The non-profit Agricultural Insurance Pool Enterprise (TARSIM) offers five types of insurance policies (crop, greenhouse, livestock, water products and poultry insurance) covering hail, storm, fire, cyclone, landslide, floods and flash floods.

Social networks:
Water User Associations in Egypt (WUAs) are one example of social networks. WUAs manage water as common or common-pool resources where water allocation and infrastructure maintenance are of mutual interest and benefit. Conflict resolution mechanisms can be included in a WUA to ensure equitable access to water in times of scarcity.

4.2.2 Policies improving institutions and governance

Measures aimed at broadly improving institutions and governance processes in a given country, region or community will frequently also be beneficial for climate change adaptation and in turn human security. Such measures range from eradicating corruption to enhancing participation of those for whom adaptation policies are meant to be beneficial. The following are crucial institutional approaches, factors and characteristiscs for successful adaptation to climate change.

→ *Institutional coordination:* Human security issues such as poverty, unemployment and health and their relation to environmental factors are still often addressed independently from each other. Examples of factors increasing institutional coordination include the designation of issue-specific but cross-cutting interagency authorities that ensure harmonizing policies across sectors of concern (e.g. river basin authorities in Morocco or the UN Peace Building Commission). Moreover, institutionalized mechanisms for knowledge sharing (e.g. the Italian common database on local management for sustainability, GELSO) were found to increase institutional coordination through an increase in transparency and cross-institutional accountability. But often institutional coordination is hampered by the following factors:

- *Competition for influence between actors and institutions within relevant policy areas.* For instance different DGs of the EU claim competence over issues such as water scarcity. Specifically, the Common Foreign and Security Policy, as well as the climate change policy compete over issues related to the climate change–security nexus using different approaches and narratives;

- *Lack of common policy visioning and systematic evaluation of policies.* Prominent examples are food security projects where transitions from relief to long-term food security are not being initiated (e.g. food security projects in Niger);

- *Lack of mediators addressing transboundary water challenges.* Coordination going beyond national boundaries is especially important for water-related security concerns requiring transboundary solutions. Here, capacities of institutions relate to their role as brokers in transboundary settings, in particular in cases of existing conflicts.

→ *Power structures:* Power structures (legal, political and economic) affecting interests and motivation of individual policy actors or groups cannot be overlooked as limiting or enhancing capacity to deal with water and conflict challenges. Although having legal and political power is crucial for state actors in formulating and ensuring the implementation of policy, the case studies also show that in some instances the way power is exercised may lead to criticism or obstruct processes.

→ *Participation and decentralization:* Some of the research results indicate benefits of the state empowering end users and promoting direct societal and stakeholder participation in the management of limited water resources (WUAs in Egypt, civil protection in Italy). Opportunities for participation are often embedded in processes of decentralization: Closely linked with participation, decentralization can lead to significantly improved policies through greater understanding of local needs and issues. This type of governance architecture promotes ownership of the adaptation process by local actors and the development of successful community based solutions. Local governments are often better equipped to understand the requirements of their constituencies than the national government. For example as a result of the decentralization process of the new codes in the rural environment in Niger, the so-called Land Commissions (COFOs) have been empowered by certain ordinances in their role to resolve conflict respecting the intricate cultural needs of pastoral groups.

→ Although local and non-governmental solutions can reduce adaptation costs for governments, depending on the type of adaptation challenge, insecure funding can overburden communities. Finally, a balance between top-down and bottom-up approaches is a requirement for improving adaptive capacity. If conflicts need to be managed at a larger scale (e.g. Ebro Delta), respective laws are required to be designed in a way not to overrule effective local level policies (as happened in Niger).

→ *Knowledge and dissemination* of climate and conflict risks and vulnerability is key for enhancing the formulation and the effective and efficient implementation of respective policy responses. For example, mechanisms for monitoring conflicts related to environmental change and the resulting impacts on human security are often lacking, due to inadequate financial resources and investment in research, education and outreach. In addition, the ineffective dissemination of information poses an obstacle for the most vulnerable to learn about the laws that govern their livelihoods and technical solutions available. National strategies, often evolving from global environmental treaties show how reliable knowledge generation and dissemination can improve a state's adaptive capacity, for instance by conducting research and disseminating information about risks and technical solutions. A good example is the Niger National Action Program for Combating Desertification and for Natural Resources Management (PAN-LCD/GRN) that incorporates building and disseminating knowledge about causes of desertification and respective prevention options, such as natural regeneration, trenches, biological erosion barriers and rock walls. The Spanish National Climate Change Adaptation Plan is also an example of national endeavours that aim to collect and disseminate reliable knowledge for relevant actors. One of the aims of the plan is to continuously provide assistance to all interested administrations and organizations, in evaluating the impacts of climate change in their respective sector, facilitating evaluation knowledge and producing tools and methods on adaptation activities in all sectors.

4.2.3 Adaptation specific policies and measures

Climate change is a cross-cutting issue and policies that have the potential to improve human security and reduce conflict are designed and implemented within a range of policy areas. In this section policy approaches are presented that specifically target climate change adaptation in sectors which are likely to witness serious water-related impacts of climate change as well as approaches that ensure mainstreaming of climate change adaptation in different sectors.

Sector specific measures

Policy areas of particular relevance to water-related climate change impacts include those listed in the overview below (see Table 3). Two different types of adaptation can be distinguished: Measures aiming at preventing long-term impacts in the different sectors (e.g. water, health, agriculture) and measures aiming at enhancing disaster management (e.g. early warning, recovery). Examples of possible adaptation measures and policies are shown as a broad overview, to illustrate the range of possible approaches and relevant policies.

Policy area/sector	Human security and conflict risk	Possible measures and policies
Water management	Climate change is expected to significantly change the availability, distribution and quality of water resources, altering precipitation patterns and carrying implications for water supply, flooding, rain-fed agriculture and domestic and industrial water uses. Increased temperatures will also raise water evaporation rates. Decreased water availability for essential needs such as drinking, sanitation, agriculture and economic production, reduces human security. It also increases competition for scarce resources, which can lead to conflict between water users.	• Water storage and conservation techniques • Water recycling and re-use • Water-use and irrigation efficiency • Desalination • Rainwater harvesting • Integrated water resources management • River basin planning • Market-based water allocations • Drought and water conservation plans • Inter-basin transfers • Water education and awareness
Health	From a water perspective, climate change will affect human health by increasing transmission and incidence of water-borne and vector-borne diseases as well as by increasing occurrence of extreme weather events such as floods and droughts and reducing water quality. Climate change may alter precipitation patterns and water flows, resulting in decreases in both water quantity and quality. As a result, less water or water of degraded quality may be available for sanitation and hygiene purposes. The physical well-being of individuals, which is a component of human security, may deteriorate as a result.	• Water quality regulation • Improved water treatment and sanitation • Watershed protection • Boil water alerts • Improved hygiene and sanitation practices • Vaccination programmes • Behavioural and awareness campaigns • Improved health management • Health infrastructure development
Agriculture	Agriculture is one of the most sensitive sectors to climate change and associated temperature and precipitation variability. More than 80% of agriculture is rain-fed and is highly vulnerable to changes in precipitation, while irrigated agriculture is dependent on available irrigation water supplies. Climate change is projected to impact crop yields, livestock management and agricultural practices and production, having major implications for global food security. Food security is an essential element of human security and a decrease in access and availability of food supplies will reduce human security. Competition for food as a scarce resource may increase, which can lead to conflicts between individuals and communities.	• Alter crop varieties • Crop relocation • Change planting dates • Improve land management • Soil protection, conservation and erosion control • Increase irrigation efficiency • Drip irrigation • Change practices to conserve soil moisture and nutrients and reduce run-off • Seed banking • Agricultural insurance • Compensation for impacts

Policy area/sector	Human security and conflict risk	Possible measures and policies
Disaster Management (DM)	Climate change is predicted to increase climatic and precipitation variability in many areas, resulting in a corresponding increase in climate-related disasters such as floods, droughts and landslides. Disasters significantly affect human security (reducing employment, basic income and economic security) and may also lead to a situation of general instability and absence of effective governance, which may propel conflict. Effective DM (early warning, relief and recovery) increases the resilience of affected countries and populations.	• Early warning systems (flood and drought monitoring and response systems) • Risk communication • Insurance schemes • Social security programmes
Coastal protection	In coastal zones, climate-induced sea level rise could have adverse impacts including greater flooding, coastal erosion and saltwater intrusion into groundwater supplies. Negative impacts to human security could result from hazards to human health and safety, infrastructure damage, forced migration, decreased water quality and available supplies, harm to agriculture and food security.	• Incorporate risks in development planning • Climate proofing flood-prone areas • Building codes and zoning • Rolling easements • Set-backs and buffer zones • Construction or alteration of dykes and dams/sea walls • Dune or wetland restoration, creation and preservation • Beach nourishment • Relocation
Infrastructure	Infrastructure such as roads, rail systems, power generation facilities, water supply systems, sewage, buildings and dykes or dams may be affected by climate-induced flooding. Thus, impairing basic living conditions by reducing services and limiting transportation needed for satisfying a population's economic, food and health needs and thus threatening its human security.	• Building codes • Improved drainage • Water sensitive urban design • Adapt management and maintenance practices • Integrate adaptation in investment decisions • Physical barriers to protect installations
Hydropower (energy)	Climatic changes to river runoff from rainfall and temperature variability will impact hydroelectric power generation, possibly reducing the ability of systems to meet energy demand to support households, services and economic production, for human security needs.	• Increase management flexibility • Design alteration • Increase reservoir storage • Alternative energy supplies

Table 3: Sector specific human security risks and options for adaptation (Ecologic, D.4.3). Source: Gerstetter et al. (2012 b).

Cross-sector adaptation approaches: Mainstreaming

Like other environmental problems, climate change is a cross-cutting issue that does not fit into "ministerial boxes", which suggests the need for broader integration. Calls for mainstreaming climate adaptation (see Box 6) into other activities and planning efforts, ranging from national and sectoral programmes and policies to individual projects such as road-building, are often heard.

The mainstreaming of climate adaptation is relevant to human security in that through mainstreaming, existing policies and projects can be harnessed to improve human security in certain respects, such as water and food security. More generally, it helps avoid setbacks in national priorities related to human security (such as economic development), and its sub-aspects such as water and food security, by helping to avoid water-related climatic impacts.

Box 6: Mainstreaming adaptation

Adaptation mainstreaming is defined as an "iterative process of integrating adaptation considerations into policy-making, budgeting and implementation processes at national, sector and sub-national levels. It is a multi-year, multi-stakeholder effort that entails working with government actors, non-governmental actors and development actors." UNDP (2011)

Including climate considerations (e.g. expected impacts and vulnerabilities) into planning processes has benefits such as helping to decrease population vulnerabilities and the vulnerability of the programmes themselves (e.g. infrastructure development) and to avoid maladaptation. As other environmental problems, climate change is a cross-cutting issue that does not fit into "ministerial boxes", which suggests the need for broader integration.

There is broad consensus on the benefits of mainstreaming climate adaptation into different policy sectors such as agriculture and development. Policy areas such as these take up significant shares of national budgets and some of them present significant synergy potentials with adaptation. Ensuring that these sectoral activities unleash their potential to increase population resilience can have more positive impacts than stand-alone adaptation measures. In this way, adaptation to climate change can "piggy-back" on implementation of policies in specific areas and their existing funding flows and activities. Adaptation can also be incorporated into a country's strategic, long-term initiatives, such as development and poverty reduction strategies, making use of these significant efforts and resources to help decrease vulnerability to climate impacts.

In particular, development activities are often highlighted as presenting strong synergies with adaptation. "Business-as-usual" development is seen as often automatically helping improve adaptive capacity. However, some types of development projects can increase the vulnerability of societies to the impacts of climate change ("maladaptation"). Additionally, climate change can have negative effects on public goods such as infrastructure as well as having the potential to quickly wipe out decades of progress in development and poverty reduction. This highlights the importance of integrating climate adaptation into development activities and strategies.

OECD (2009) and UNDP-UNEP (2011) are good practical guidance documents on mainstreaming climate adaptation, with a focus on development planning. The following summarizes some key points:

- To be high on the national agenda, climate change should be included in relevant national and sectorals laws, regulatory frameworks and strategies within which lower governance levels operate;
- Applying a "climate lens" is often recommended. This is an analytical process to examine a policy, plan or programme (formulation, exploration of risk of plans for mal-adaptation, climate proofing);
- Tools already used in existing policy frameworks can, in some cases, also be used in the context of climate change adaptation. An example is strategic environmental assessment. However, tools have to be evaluated carefully and possibly tailored to make sure they cover all aspects of climate change adaptation.
- Finally, it should be noted that "mainstreaming" is a concept that is not only used with regard to climate change adaptation. In the present context, other topics that could be mainstreamed include human security (Box 7) and conflict resolution (Box 8).

Box 7: Policy Example: UN experiences with mainstreaming human security

The United Nations Human Security Unit (HSU) in the Office for the Coordination of Humanitarian Affairs has taken on the challenge of finding practical methods for operationalizing the concept of human security. Established in 2004, the HSUs approach is two-fold: firstly it raises awareness on the benefits and added value of a human security approach within the UN system and secondly manages the United Nations Trust Fund for Human Security (UNTFHS) to finance activities to translate the concept into practical activities on the ground. Since its founding in 1999, the UNTFHS has committed over USD 350 million to projects in over 80 countries. The HSU tries to ensure that activities funded by the UNTFHS contribute to ensuring human security in a direct and tangible way. Projects must be informed by the tools set out in the HSUs Human Security Handbook and must operationalize a human security approach through 'collaborative, responsive and sustainable measures' that are: i) people-centred ii) multisectoral iii) comprehensive iv) context-specific and v) prevention-oriented. Projects to receive financing must also meet a series of evaluation criteria. These criteria include the promotion of inter-agency cooperation to increase the impact of projects and avoiding the fragmentation and duplication of activities – an area in which the UN is currently striving to improve (United Nations 2006). Projects must furthermore be of a pilot and innovative nature so as to be replicated in other regions or countries and sharing of lessons learned is encouraged. UNTFHS projects must include the implementation of a Human Security Impact Assessment (HSIA) for which the HSU provides detailed guidelines. The HSIA is carried out to ensure that the project action alleviates human insecurity and avoids negative outcomes as well as assesses the external environment and any changes to human security risks at the end of the project.

Box 8: Examples for mainstreaming conflict sensitive approaches in Ethiopia

In all interventions in Ethiopia, USAID implements a "do-no-harm approach". Interventions are preceded by a conflict analysis which includes user groups of natural resources, people with user rights', property rights, etc. The analysis aims to ensure that interventions will not cause or aggravate conflicts. In addition, all implementing NGOs' staff members are trained in conflict sensitivity. USAID also works to clarify discordance over existing natural resources rights. With traditional rights' systems at odds with the current government systems, resulting in lack of ownership and entitlement among possible stakeholders, USAID interventions are focusing on providing land-use and resource-use clarity to different stakeholder groups. In this way, interventions are helping reduce conflict potential in these areas, through the establishment of clear, negotiated and consensual agreement on land-use zoning.

4.2.4 Examples of adaptation measures and policies facilitating cooperation and conflict

Where institutions or mechanisms are in place to solve differences of interest, conflicts are less likely to arise or intensify than where they do not exist. Some examples of such mechanisms or institutions dealing with water-related conflicts are the following:

→ *The Water Court of the Valley of Valencia, Spain:*
For 1000 years, judges locally elected by farmers gather in a circle at one of the city's central squares to settle disputes brought before them by farmers along the Turia River and the Orchard of Valencia. The court is known for making efficient and swift decisions, in rare cases witnesses are called to testify and land can be inspected by the judges. Unique features of the court are: no minutes of court proceedings are taken, judges are democratically elected local townsmen, the Court decisions are legally binding and formally recognized by Spanish law.

→ *Sewerage system in the divided city of Nicosia/Cyprus:*
This system was created despite a political conflict (the division of Cyprus as a result of the Turkish military occupation), because it was desperately needed. However, it was only achieved with the (financial) help of UNDP and the World Bank, opening the way for cooperation between both sides of the city. When the project became a UNHCR project and was recognized as a bi-communal peace building strategy, more bi-communal development projects developed, leading to even greater cooperation. However, the successful operation of sewage treatment could not have been achieved without international support.

→ *Red Sea Dead Sea Water Conveyance (RSDSC):*
This (not yet realized but envisioned) multilateral project (between Israel, Jordan, oPT) seeks to connect a 180 km long pipeline from the Red Sea to the Dead Sea to transport 1.8 billion cubic meters of water from the former to the latter to create a new source of freshwater. Cooperation was initiated, because it seemed the most economically sensible way forward. In light of the financial restraints of partner countries involved, the World Bank became one of the main actors in facilitating the joint project. If realized, this would be the first project that Israel, the Palestinian Authority and Jordan undertake jointly. Thereby, each side would become more dependent on the project potentially leading to greater interdependence and cooperation between these states. This case shows that peace is more likely to develop as a result of cooperation on individual, tangible projects than in abstract terms. In fact, this project is often referred to as the "Peace Conduit" that will lead to amicable relations between the three states.

4.3 Effectiveness of current adaptation policies at the national level

Countries and institutions, to varying degrees, have the capacity and policies to effectively address water-related human security issues and the particular threats they are facing. This section presents insights on the effectiveness (Box 9) of current policy frameworks to mitigate the impacts of climate change on water-related human security and conflict. Since climate change adaptation policy is a new field, the effectiveness of policies addressing hydro-security often depends on the pre-existing policy frameworks (e.g. policies on water resource management), in addition to other factors such as the level of development in a country.

In order to assess if and how policy frameworks are effective and where gaps and deficiencies exist, the policy-cycle approach has been used. The dominant paradigm of policy-cycles is the "stages heuristic" approach that divides the policy process into four stages (Box 9). The approach is practical as it divides the policy process into manageable components. Thus, it clearly presents the gaps and problems and the effectiveness of the current policy frameworks in addressing climate-related risks for human security. For example, if the policies that exist on paper are found to be ineffective, where shortcomings already exist at the stage of policy making, then additional measures will be needed, in contrast to if the problems exist primarily at the stage of implementation. Also, the policy-cycle approach is useful, because it allows the roles of different actors to be distinguished at different stages of the policy-cycle. Except for the "impact & evaluation" stage of the policy cycle, the policy effectiveness for all other stages is explored below (Gerstetter et al., 2012).

Box 9: Definition of effectiveness

"Effectiveness" can be defined as a "measure of the extent to which an [aid] activity attains its objectives". In this context the effectiveness of policies was evaluated against pre-defined objectives (not those stated in examined policies), i.e. mitigating water-related risks to human security and preventing new water conflicts or the exacerbation of existing ones as a consequence of climate change.

4.3.1 Generalized effectiveness of climate change adaptation policies

This chapter briefly describes how key state actors in Niger, Israel, oPT, Morocco, Spain, Turkey, Ethiopia, Egypt and Italy perceive and evaluate their efforts in climate change adaptation.

The following conclusions can be drawn: The impacts of climate change that were considered to be most significant were related to an intensification of already existing phenomena. Therefore, most climate change related risks were perceived to have already been sufficiently addressed in policies (e.g. drought policy, disaster preparedness and reduction policy). Surprisingly, and independent of the degree of concern associated with climate change impacts and the efforts invested in addressing them in policy (ranging from very high in Ethiopia to quite low in Israel, due to the different dependency on natural water resources), interviewees expressed a general satisfaction with the effectiveness of national policy frameworks in place. In regions where climate change was considered to be of less urgency, the rationale seemed to be that the phenomena (e.g. drought or issues with water availability) were already known and were being mastered

quite competently, with only secondary issues requiring attention. In regions where climate change was seen as posing significant threats to human security, the satisfaction seemed to be related to the recent history of serious efforts and strong improvements in addressing the currently occurring (potentially) climate change related disaster risks. However, many challenges and areas of required support were identified mostly relating to policy implementation (particularly funding, human resources and institutional capacity), but also to policy formulation (e.g. capacity for research based input into policy).

Box 10: Policy cycle approach

(1) *Agenda setting/problem definition*: Action requirements are identified and framed by different actors.

(2) *Policy formulation/decision-making:* Responsible and competent bodies decide on a specific policy among several alternatives and spell out its details.

(3) *Implementation:* In this stage the policy gets implemented by the competent bodies, most frequently public authorities.

(4) *Impact and evaluation:* In this stage, the policy achieves a certain impact in the real world, gets evaluated – and the cycle starts all over again.

As for the international level, the EU and UN were considered particularly valuable in placing issues on the agenda in developing countries, in the provision of capacity and guidance and for the funding of initiatives. However, their possible role in policy formulation was viewed more critically.

4.3.2 Effectiveness of policies according to the policy cycle

In this section, we summarize insights on the effectiveness of current policy frameworks by stages of the policy cycle.

Agenda Setting/Problem definition

The uptake of climate change on the national agendas and the extent and speed with which relevant policies have been or are being formulated seem to correlate with how much a country or region "has to lose" (both economically and in terms of livelihoods and lives) from climate change impacts in the short to medium term as well as how climate change interacts with existing agendas and priorities. Efforts have been more sluggish in regions where climate change impacts are only considered to be significant in a longer-term perspective (e.g. Morocco, EU). Moreover, uptake appears to be fostered either by climate change adaptation having strong positive overlaps or synergies with existing agendas, or by climate change impacts being perceived as a threat to achieving existing agendas (for example, increasing agricultural production in Ethiopia). Conversely, if climate change adaptation goes against existing agendas (e.g. of achieving an equitable share of water resources for the oPT), the chances of uptake are restricted in favour of current development needs or the pursuit of existing policy objectives. But compared to the other stages in the policy cycle, the adoption of policies to address climate risks in the agenda-setting/problem-definition stage did not seem to pose a major problem.

Policy formulation/decision-making

The emergence of national climate change adaptation plans and programmes is often a response to international policies and frameworks, initiated for example by the national focal points of the agreements. But the effectiveness of the adaptation policies currently in place is often limited by the lack of knowledge and scientific evidence on climate risks and especially their sector specific economic implications in the national context. The lack of institutional capacity to fully understand the climate change complexity and develop adequate policy responses adds to the problem. Specifically, mainstreaming water and adaptation policy into sector policies by aligning respective policy objectives poses a major governance challenge. Unclear competences (EU) and conflicting interests (Israel –oPT) were found to contribute to these challenges.

Policy implementation

There is a perceived gap between policies on paper and their on-the-ground implementation. Problems and blockages in the decision-making process are often rooted in a lack of political will, insufficient human resources capacity of government institutions (particularly medium level officials and regional government), inadequate technical and institutional capacity (e.g. documentation practices, knowledge management and coordination practices) and a lack of the financial means required to implement changes on the ground. In addition, the unwillingness of government authorities to enforce policies that negatively affect foreign and local investments in specific economic sectors was also found to be of major concern. A good example is the case of Morocco, where the government was unwilling to enforce environmental regulations that would have made investments in the agricultural sector less attractive. A challenge to Ethiopia, but probably valid for many developing countries, was the coordination of international actors such as donors and international agencies.

4.4 Summary

Human security is a useful concept for raising awareness on diverse climate-related and other risks that different population groups are exposed to. From the perspective of the foreign policy of industrialized countries and at the EU/UN level, there is considerable interest in the concept. By contrast, human security is hardly used as a concept in national policymaking in the developing countries investigated. It appears too broad in scope for practical policymaking and it also has negative connotations with respect to national sovereignty.

However, using the concept of human security is not a prerequisite for ensuring human security and effective climate change adaptation. Many specific policies, although not labeled as either climate change adaptation or human security policies, already facilitate climate change adaptation implicitly. Often, they are in place because they either benefit overall development priorities or they aim at managing existing disaster risks. However, a more holistic and targeted approach to adaptation in the form of "mainstreaming adaptation" is often missing. Mainstreaming adaptation requires a harmonization of scattered approaches towards adaptation by different policy actors and should be based on a common (normative) framework that guides the integration of climate change adaptation into the overall national and international policy landscape. Today, adaptation is often not yet effectively mainstreamed due to a general lack of coordination, intersectoral thinking, awareness and knowledge sharing and the organization of administrations along sectoral lines.

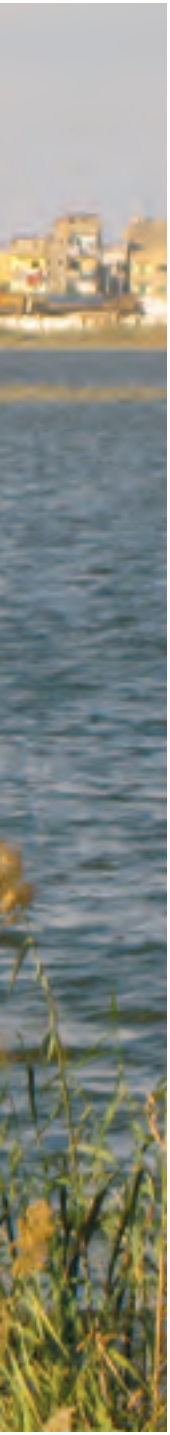
In the countries investigated and at the EU/UN level, many of the interviewees nonetheless considered the policy frameworks in place to be effective for preventing risks to human security resulting from climate change. This may be related to the fact that the climatic impacts considered to be most significant were an intensification of already existing phenomena. Therefore, most of the climate change related risks were perceived to have already been sufficiently addressed in existing policies (e.g. drought policy, disaster preparedness and reduction policy).

Key messages

The formulation and effectiveness of climate adaptation policies depends on a number of factors. Particularly relevant in this respect are: the perception of urgency and risk; the compatibility of such policies with existing national agendas; the level of institutional capacity and scientific knowledge; and the financial and practical support available.

Interpretation and use of the human security concept varies greatly. At the EU/UN level there is interest in the use of human security as a foreign policy tool and for mobilizing international action in a variety of fields, including on climate change. However, human security is a broad concept that can be difficult to operationalize, and at the national level, domestic policies for adaptation seldom explicitly consider human security.

Despite a lack of explicit focus on human security, national policies can facilitate climate adaptation and ensure human security implicitly by increasing overall levels of development or resilience to climatic risks. At the same time, policies labeled as 'adaptation' do not automatically produce positive outcomes for all: policies may also occasionally compromise the adaptive capacity or human security of some groups.



5. Transboundary institutions under conditions of uncertainty

The management of water in a transboundary river basin is complicated by the political boundary that transects the basin. Not only do institutions differ across the boundary, perspectives and values may also differ, leading to disagreement over how to best manage shared water resources. These divergent perspectives may lead to tensions or disputes between countries. Climate change induced uncertainty in water availability, water flows, timing and quality challenges institutions at multiple scales and presents an additional challenge for transboundary water management, including international water treaties and negotiations (Gerstetter and Vidaurre, 2012, see Box 11). Climate change poses a challenge for countries in transboundary river basins because they may need to address not only the impacts of climate change within their national boundaries, but also the potential spill-over effects or externalities resulting from both climate change and responses to it by their co-riparian nations.

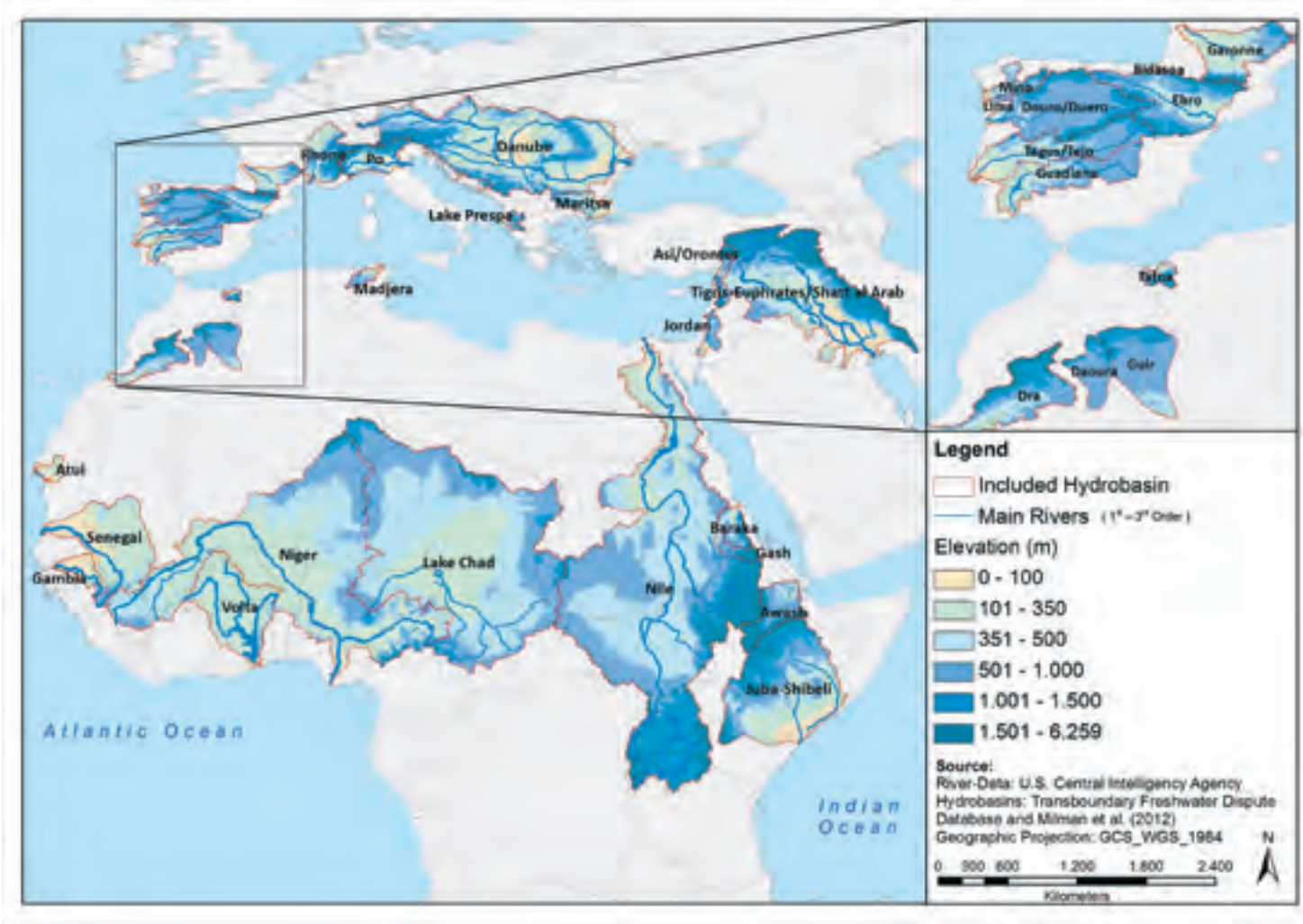
Over 400 transboundary agreements have been established in the last 200 years (TFDD, 2011). Although these treaties address historical and present day transboundary water management issues, they may prove inadequate in the future. Existing treaties that are based on past rainfall patterns may fail to serve the needs of their signatory countries, if due to climate change those historic patterns are no longer representative of current or future conditions. How well countries can cope with and adapt to these changes and uncertainties associated with them is a function of their adaptive capacity. A lack of adaptive capacity together with increased risks of water-related hazards may lead to international tensions and thus potentially decrease human security. Mechanisms for

Box 11: Transboundary river basins and uncertainty

A transboundary river basin is a basin in which "any perennial tributary crosses the political boundaries of two or more nations" (Wolf, 2007:245).

Uncertainty describes a situation in which no unique and comprehensive understanding of the system to be managed exists (Brugnach et al., 2008). In transboundary basins, uncertainty may exist regarding physical availability of water, demands for water, social dimensions (including political aspects), economic development and technological progress. As a result of climate change, it is expected that precipitation will become more variable across the CLICO region. Greater variability in precipitation will increase variability and uncertainties related to timing and location of available water.

Mitigation and adaptation responses designed to address these changes need to include feedback loops between environmental, social and institutional processes.



Map 2: River basins in the study area of CLICO .
Source: River-data: U.S. Central Intelligence Agency.
Hydro-basins: Transboundary Freshwater Dispute Database and Milman et al. (2012). Geographic Projection: GCS_WGS_1984.

governing uncertainty are an essential feature of the adaptive capacity of transboundary basins, including most prominently mechansims for conflict resolution. The following two sections assess adaptive capacity of transboundary institutions and identify measures in international treaties that address uncertainties. The first section presents a comparative assessment across river basins in the Mediterranean, Middle East and Sahel region based on Milman's six adaptive capacity dimensions (Milman et al., 2012b). The second section investigates conditions for and adoption of mechanisms to address uncertainty and conflict resolution in transboundary treaties worldwide (Fischhendler and de Bruyne, 2011; Fischhendler and de Bruyne, 2012).

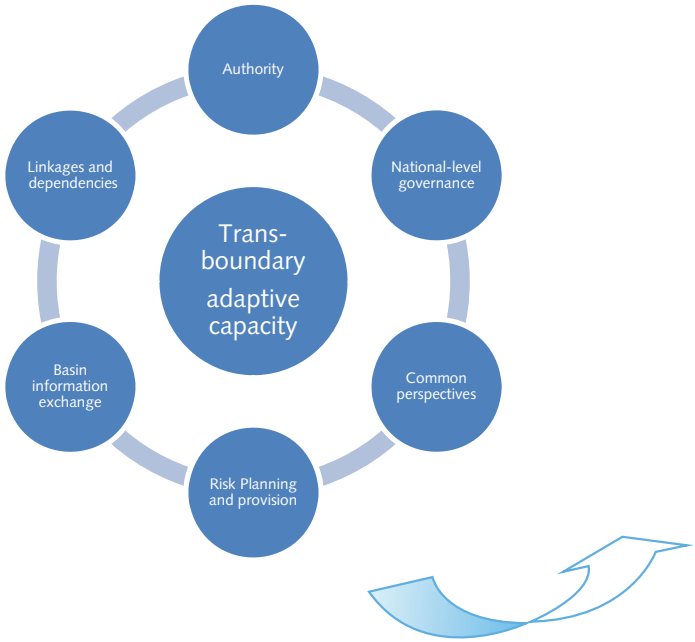
5.1 Measuring adaptive capacity of transboundary institutions

This section focuses on the adaptive capacity of transboundary river basins to climate change following Milman et al. (2012b). The comparative analysis identifies hot spots of potential hydro-insecurity and conflict that might require special targeted interventions by policy makers. Forty-two transboundary basins have been subject of analysis (see Map 2). Many of them are shared by only two or three nations, but several are shared by up to 10 nations; in the case of the Danube 18 nations are involved.

5.1.1 Indicator development

The adaptive capacity of a transboundary river basin depends to the ability of co-riparian nations to communicate, coordinate and cooperate across their political boundaries and thereby to take advantage of any benefits that may arise from coordinated action (Milman et al., 2012b). This capacity is mediated by the institutional regime in place meaning the rules, norms and procedures that influence the way the states act (e.g., share and exchange of information and data), power relations and the distribution of risks and vulnerabilities (UNECE, 2009; Miller, 2008). In addition, adaptation to climate change requires the institutions to have the capacity to respond to uncertainties in future hydro-climatic conditions. To construct a system of indicators that appropriately reflect these aspects, Milman et al. (2012b) differentiated six dimensions of transboundary adaptive capacity and then selected 12 indicators (two each) to represent these dimensions (see Table 4)[15]. *This system of indicators can be used to identify basins of concern, including basins for which projected climate risks are high and adaptive capacity appears low.*

15 Though the use of indicators is very useful for comparisons and can identify general trends or shortcomings of basins relative to others, in quantifying characteristics into measurable units, indicators often fail to capture specific basin level factors or dynamic processes. Additionally, in order to develop indicators that can be compared across the globe, the choice of metrics is constrained by the availability of global data sets.



Dimension	Explanation	Indicators	Data source
Authority	The authority by which the trans-boundary aspects of water in the basin are managed such as existing river basin organizations, treaties or memorandums of understanding	• Percentage of riparians that are signatory to any agreement. • Percentage of riparians that are members of any river basin organization.	TFDD, World Bank database
National-level governance	The ability of co-riparians to devise, enact, implement and comply with transboundary policies at the national levels and sub-national levels	• Political stability index. • Government Effectiveness index.	World Bank
Common perspectives	The "ethos" of water that influences the approach co-riparians take towards transboundary water management. The networks of shared knowledge that influence decision makers, encouraging the formation of convergent policies among riparian countries	• Percentage of riparians that are signatory to the UN convention on non-navigational use of water. • Number of inter-governmental organizations in which all riparians participate.	UN Treaty Collection; Pevehouse et al., 2004
Risk planning and provisions	The provisions in transboundary institutional arrangements that allow co-riparian countries to address variability and uncertainty. The awareness of potential threats which then influence countries' response to climate change	• Specific elements of existing treaties regarding uncertainty management.[16] • Percentage of riparians that have signed the Hyogo Framework for Action Progress Reports.	Drieschova et al., 2011; de Stefano et al., 2010

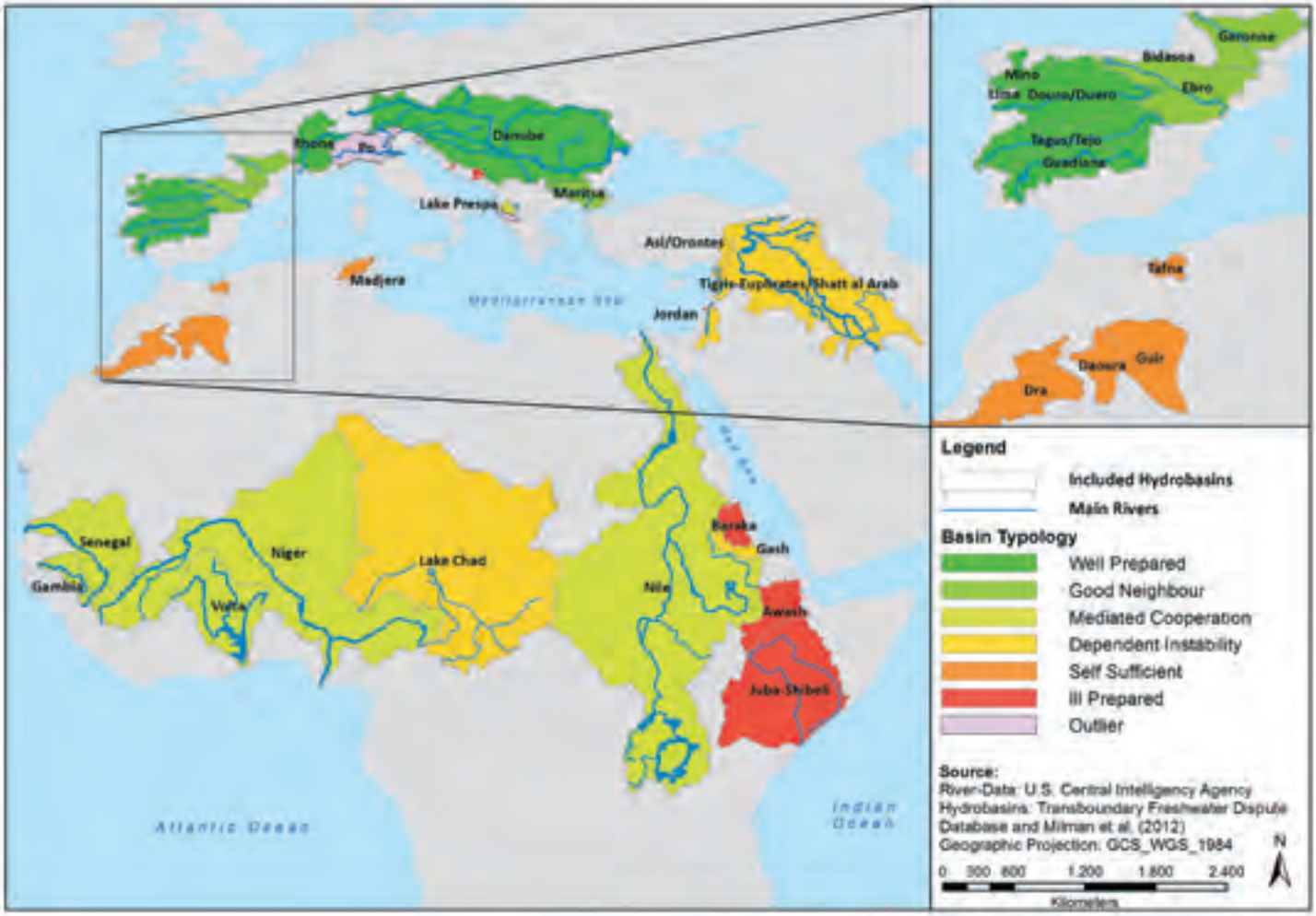
16 Such as inclusion of provisions to address flow variability, provisions that allow for variability in management, provisions that address variability in hydropower needs, provisions for at least one situation in which a different development can occur and alternative modes of action exist.

Dimension	Explanation	Indicators	Data source
Basin information interchange	The mechanisms for communication between co-riparian countries that reduce uncertainties and improve planning	• Specific elements of treaties regarding data sharing. • Percentage of diplomatic exchanges between riparians compared to maximum possible relations.	TFDD; Bayer et al., 2006
Linkages	The economic and water co-dependencies of co-riparians that contribute to the formation of convergent policies among riparian countries	• Ratio of regional trade: among riparians and with the rest of the world. • Ratio of external renewable water resources to total renewable water resources.	FAO Aquastat

Table 4: Measuring different dimensions of transboundary adaptive capacity. Source: Milman et al., 2012b.

Uncertainty is captured by two indicators. The first one captures specific elements of existing treaties and agreements regarding uncertainties (which mechanisms exist to govern uncertainties and why they are chosen is discussed in Section 5.2). The second is supposed to capture risk preparedness and uses the share of riparians having completed the Hyogo Framework for Action progress report (see also Appendix Chapter 5).

After calculating the indicators, a cluster analysis was conducted that highlights characteristics that several basins have in common and hence identifies similar types of transboundary basins in terms of their adaptive capacity. Furthermore, intra-basin characteristics were analysed to determine if national adaptive capacities matter for transboundary adaptive capacity (Milman et al., 2012b).



Map 3: Adaptive capacity categories of transboundary basins. Source: Milman et al. (2012b).

5.1.2 Results

Revealed categories of transboundary basins

The analysis identified six categories of basins that are spread across the Mediterranean, Middle East and Sahel region. An overview of the categories attributed to the different basins is given in Map 3.

- Well prepared basins have high scores on all 12 indicators. That implies that they have the highest transboundary adaptive capacity to climate change. Geographically, they are primarily European based (Douro/Duero, Guadiana, Lima, Miño, Tagus/Tajo, Rhone, Danube).

- Good neighbour: These basins score highly on eight of the 12 indicators; they have low water dependence, lack joint management organizations (though all riparian countries signed at least one formal agreement) and are characterized by lower levels of formal uncertainty management and data sharing. Geographically these basins fall in the Southern Europe Mediterranean region (Roia, Ebro, Garonne, Bidasoa, Maritsa, Rezvaja).

- Mediated cooperation: These basins have high levels of "Authority and Basin Information Interchange", despite lower scores on other indicators. Geographically these basins include the largest of the African river basins included in the study (Volta, Niger, Gambia, Nile, Senegal) and Lake Prespa.

- Dependent instability: Most basins of this category achieved medium scores on most indicators. Basins characterized as "Dependent instability" have high water linkages but countries within each basin tend to be unstable. Geographically, these basins are located in the Middle East and the Sahel (Nahr El Kebir, Asi/Orontes, An Nahr Al Kabir, Jordan, Tigris/Euphrates/Shatt al Arab, Lake Chad, Gash).

- Self-sufficient: Riparian countries are prepared at the national level, but there are no formal agreements or RBOs at the basin-level. Geographically, most of these basins are located in Algeria, although one crosses Bulgaria and Turkey (Daoura, Dra, Guir, Oued Bon Naima, Tafna, Velaka, Medjerda).

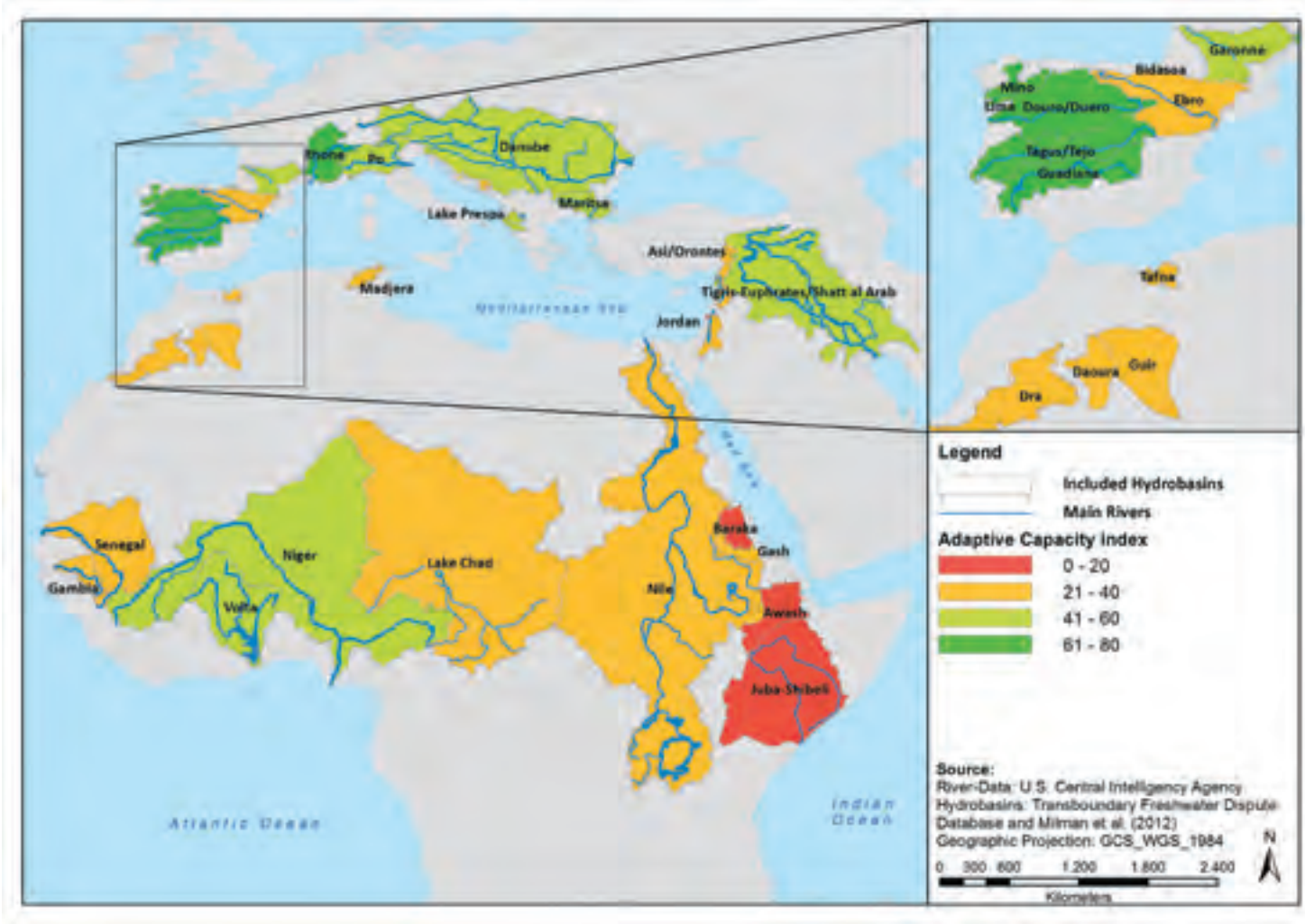
- Ill prepared: These basins score poorly on most indicators and thus lack adaptive capacity to address the risks imposed by climate change. There are no formal agreements or river basin organization, no formal mechanisms for managing uncertainty exists and participation in Hyogo Framework for Action disaster risk reporting is limited. There are no provisions for data sharing and governance effectiveness and political stability are medium to low. In terms of geography, these basins are spread across the Mediterranean (Bosnia-Croatia), the Middle East (Israel-Lebanon) and the Horn of Africa (Krka, Neretva, Wadi Al Izziyah, Baraka, Awash, Juba-Shibeli).

Degree of adaptive capacity

The 12 indicators were also aggregated into a single adaptive capacity index (0–100) in order to identify basins with low to high adaptive capacities (see Map 4). The degree of variance and the spatial distribution of adaptive capacities are visualized and described in the following.

1. Lower transboundary adaptive capacity outside of Europe

The transboundary adaptive capacity of basins varies to quite some extent between regions: While European basins are on average better prepared, less developed countries in the Middle East and North and Subsaharan Africa have lower adaptive capacities. Countries belonging to basins outside of Europe show lower levels of political stability and government effectiveness, which challenges transboundary cooperation and the capacity to implement transboundary adaptation at the national level.



Map 4: Degree of adaptive capacity of selected river basins. Source: Milman et al. (2012b).

2. Lack of mechanisms to address uncertainties

The region as a whole suffers from a systematic lack of mechanisms to address uncertainties. Strategies to deal with uncertainties are limited even in higher scoring basins. Uncertainty mechanisms are lacking completely in basins categorized as self-sufficient and ill-prepared. The next section will take a closer look at the reasons behind this finding.

3. A high transboundary adaptive capacity must be rooted in high adaptive capacities across the entire basin

Lower adaptive capacities of a transboundary basin can rarely be attributed to one specific riparian country (see Milman et al., 2012b for more details). This suggests that low adaptive capacities are systemic to the basin.

4. Transboundary adaptive capacity is more than the sum of its parts

A comparison of national level adaptive capacities with transboundary level adaptive capacities demonstrated the former is not sufficient to capture the latter. This confirms the importance of looking at adaptive capacity at the transboundary level (Milman et al., 2012b).

As the analysis of transboundary adaptive capacity has revealed a substantial lack in the adoption of mechanisms to deal with uncertainty, the next section explains some of the reasoning behind this finding. First, the existing mechanisms to address uncertainty in transboundary agreements are reviewed, followed by identification of conditions under which relevant mechanisms, as well as conflict resolution mechanisms are adopted.

5.2 Governing uncertainty in transboundary agreements

This section investigates the mechanisms that can help to mitigate uncertainties and hence improve adaptive capacities of transboundary agreements in light of climatic changes according to Fischhendler and De Bruyne (2011) and Fischhendler and De Bruyne (2012). In transboundary treaties there exist many different ways of addressing uncertainties, for instance agreements on water storage and minimum allocations, which reduce the impact of uncertain rainfall patterns. Generally speaking, all kinds of mechanisms such as conflict resolution procedures, benefit-sharing, side payments or the establishment of institutions for data collection and monitoring can reduce uncertainties. All these mechanisms can be essential in mitigating disputes and avoiding conflicts over water allocation (Gerstetter and Kampa, 2011). An analysis of the 303 agreements in the TFDD-database allows us to group the existing mechanisms and reveal four underlying strategies: Ignoring uncertainty (no explicit means to tackle uncertainty), complete contracts ("bulletproof" agreement that defines obligations under all possible scenarios), reducing uncertainty (mechanisms to reduce implications or core causes of uncertainty) and open-ended approach (flexible and adaptable agreements that allow for changes by defining procedures instead of outcomes) (see Figure 3)[17].

17 This analysis is not limited to the CLICO area, but includes treaties worldwide.

Ignoring uncertainty	Complete contracts	Reducing uncertainty	Open-ended approach
Fixed allocation	• Variable allocation • Variable water needs • Local needs considered • Right to construct • Compensation • Alternative scenarios used • Agreement finance • Prior consent • Legal means of dispute solution • Monitoring	• Variability management • Ban on particular constructions • Model building for prediction • Technical or financial cooperation • Infromation exchange • National support programmess	• Stakeholder participation • Joint commission • Vague allocation mechanisms • Amendment mechanisms • Diplomatic means of conflict resolution

Figure 3: Strategies and respective mechanisms to address uncertainty in transboundary treaties. Source: Based on Drieschova and Fischhendler (2011).

According to Drieschova and Fischhendler (2011) the majority of treaties contain multiple mechanisms and sometimes follow multiple strategies. Ignoring uncertainty by using fixed allocation is only done in 5 per cent of the treaties; mechanisms such as legal means of solving disputes and monitoring are only present in about every third contract; technical and financial cooperation (47 per cent) as well as information exchange (39 per cent) are further tools to reduce uncertainties. Historically, the use of open-ended approaches, in addition to other strategies, has been increasing and a joint commission can be found in almost 60 per cent of the treaties in TFDD. Diplomatic means of conflict resolution are included in 40 per cent of all treaties. It is useful to combine different mechanisms and strategies to be able to spread the risk in case of failure of a certain mechanism. How to combine different mechanisms and strategies in treaties depends on the unique political, institutional and ecological context. Typically, treaties are constructed gradually and new mechanisms and strategies are adopted over time.

5.2.1 What affects the choice of a mechanism?

Why is there such a variety of mechanisms and how come not all treaties have mechanisms for resolving conflicts? These mechanisms could be very beneficial in ensuring the stability of treaties. One useful explanation for this is that the adoption of such mechanisms within treaties comes at a cost, usually referred to as *transaction costs*. They include all costs related to obtaining information, establishing one's bargaining position, bargaining and arriving at a group decision and enforcing the decision made (Randall, 1972). In the context of transboundary basins, the transaction is an agreement or treaty and *transaction costs relate to the cost of decision-making for institutional change, implementing institutional reforms and policy changes and the set-up of new institutions* (Gilligan, 2003; Keohane, 1989; Moravcsik, 1999; Challen, 2000). As described in the previous section, the ways in which riparian countries communicate, coordinate and finally cooperate depends on the institutions in place. Once they are functional, institutions can also reduce transaction costs (North, 1991). Figure 4 presents a differentiation into static and dynamic transaction costs.

Static	Dynamic
→ Bargain costs → Uncertainty costs	→ Monitoring and enforcement-related

Figure 4: Types of transaction costs.
Source: Fischhendler and de Bruyne (2012).

In the context of international treaties, transaction costs may play a particular role, as negotiations between nations and their respective administrative bodies take place and specific issues of sovereignty, political power and interests matter. Riparian countries therefore face significant trade-offs when aiming to adopt and implement mechanisms to reduce uncertainties and avoid potential conflicts. So far, there has been limited empirical research on the factors that affect institutional design of transboundary treaties (Fischhendler and De Bruyne, 2012).

In the context of the CLICO project addressing the climate–water–conflict nexus, conflict resolution mechanisms are of particular relevance among all mechanisms that govern uncertainties. For a long time, tools and mechanisms for resolving conflict were recognized as being of utmost importance in addressing increasing uncertainties by enhancing flexibility of contracts and mitigating disputes and conflicts. They can serve to prevent disputes over water allocations between co-riparians from turning into more severe and violent conflicts and have the capacity to keep contracts stable over long periods of time.

Mechanisms for conflict resolution

Conflict resolution mechanisms (CRMs) can exhibit various forms within agreements (see Figure 5).

CRMs can be classified into four main types with an increasing level of formality and transaction costs:

In 51 per cent of the agreements included in the TFDD data base, CRMs were found. Among them, negotiation-based CRM mechanisms are the most frequently used, followed by arbitration and mediation. Adjucation-based mechanisms can only be found in 8 per cent of agreements with CRMs.

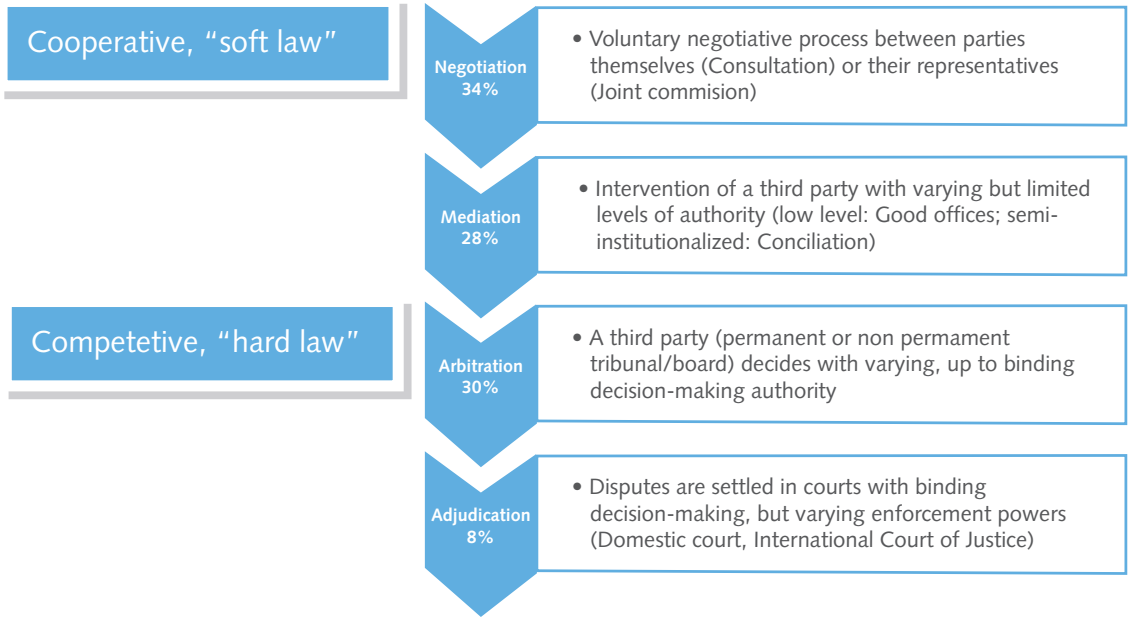


Figure 5: Categories, characteristics and frequencies of CRM-types in transboundary treaties. Source: based on TFDD, 2011; Fischhendler and De Bruyne, (2012).

After adopting CRMs, the modalities of the use of individual CRMs and how to prioritize them in case several ones are adopted, needs to be clarified by the riparian countries involved in the agreement. CRMs can be institutionalized by establishing a joint body such as a basin commission. The more institutionalized a CRM is (including prescriptions on use and cost sharing and accepting unilateral decision) the more "mature" it is considered to be. According to the TFDD database, 33 per cent of the CRMs in treaties are considered to be mature. Despite repeated demands for more developed CRMs in treaties (Haton and Utton, 1989; UNEP, 2002), there is still a gap between the demand for CRMs and their actual adoption and appearance in treaties (Fischhendler and De Bruyne, 2012).

5.2.2 Results

The adoption of CRMs depends on transaction costs, which may also influence the way CRMs are modified and implemented. When assuming that the choice of CRMs and the way they are institutionalized can be explained by using the concept of transaction cost, the following question arises: Which factors drive transaction costs and hence have an impact on CRMs? Tir and Stinnett (2011), Zentner (2010) and Fischhendler (2008) suggest that factors such as the complexity of the treaty's subject and the need to deal with considerable variability and power relations between states, exert influence. States may not get involved in negotiating comprehensive CRMs as they fear losing political autonomy and sovereignty (Hamner and Wolf, 1998; Fischhendler, 2004). Assuming a rational state, a state would try to achieve an institutional structure for the shared waters, in which it is foreseen that the benefits of participating in negotiations and giving up its political autonomy to some degree, at least outweigh the costs of participation. When a treaty is negotiated, every single tool or mechanisms to reach conflict resolution comes at an extra cost. The level of transaction costs depends on the circumstances under which an agreement is negotiated – the characteristics of riparian states and their relationships with each other play a role, as well as factors such as resource attributes and treaty properties (Fischhendler and De Bruyne, 2012). The following factors are considered as relevant and were used for the analysis:

Treaty attributes:

- *Number of signatories:* A high number of signatories increases complexity of negotiations and brings more uncertainties.

Resource attributes:

- *Hydrological variability:* The more variable hydrological resources are, the more difficult and complex negotiations become, due to increased uncertainty. This may even lead to potential conflicts threatening treaty stability (DeStefano et al. 2010; Tir and Stinnett, 2011);

- *Water stress:* Water scarcity as well as institutions which are unable to manage the water properly, may constitute factors that drive bargaining costs upwards and increases the likelihood of water-related conflicts;

- *External resource dependency:* Disputes for water may become more frequent when a country depends largely upon external water resources (Homer-Dixon, 1999) and hence may drive bargaining costs over those of more mature CRMs. Because many treaties are signed between co-riparians with asymmetric resource dependencies, at least countries with a higher resource dependency may be interested in CRMs which may decrease bargaining costs and hence may make adoption of soft law mechanisms more likely.

Riparian attributes:

- *Level of trust:* Political relations between co-riparians that are characterized by low levels of trust may increase bargaining costs, and countries may be less likely to accept binding mechanisms of "hard laws" focusing more on consensus requirements for activating certain mechanisms (Benvenisti, 1996). They may also favour more extensive monitoring and enforcement which drives negotiation costs upwards;

- *Level of political freedom and asymmetry:* States with high levels of political freedom tend to have more lengthy and participatory domestic processes when engaging in negotiations with other countries, but are also more likely to do so. This may increase bargaining costs (Garriga, 2009);

→ *Level of adaptive capacity:* Adaptive capacity refers to the degree to which potential damages or variability associated with climate change can be mitigated or even off-set by appropriate structure and processes. The level to which countries are able to respond to climate change may also influence their position in negotiations;

→ *Colonial power:* Colonial treaties are very often bilateral treaties between the colonial power and only one riparian – excluding all other co-riparians (e.g. UK and Egypt). This may render those treaties more vulnerable to disputes with non-signatories. Negotiations between the colonial power and a colony may be less burdensome, hence decreasing bargaining costs and increasing the likelihood of adopting CRMs and more mature CRMs.

A correlation analysis was conducted (see Table 5)[18] to reveal whether there is a relationship between these characteristics and the presence of CRMs, the degree of formality of a CRM, institutionalization and activation procedures, and the number and maturity of CRMs.

The analysis confirms the hypothesis that despite their obvious usefulness CRMs are not adopted in all treaties or at random but that transaction costs and the factors driving these costs influence their adoption. Not all of the hypothesized factors were indeed confirmed by the statistical analysis.

18 Spearman correlation coefficients were calculated with significance levels at $p \leq 0.05$ (strong correlation) and $p \leq 0.1$ (medium). Due to the global analysis data availability was limited. Sometimes, data was not available for the whole period of analysis, needed to be aggregated or the data used did not reflect the full spectrum of the factor. This is particularly the case for the factors "hydrological variability" and "adaptive capacity" and may limit the usefulness of the correlation analysis.

5.2.3 Findings

Mechanisms to govern uncertainties:

Four broad categories of strategies, used to address uncertainties, are prevalent in existing water treaties: ignoring uncertainties, completing contracts, reducing uncertainties and open-ended approaches. There is a historical trend to increasingly follow the open-ended approach strategy. Treaties adopt several strategies introducing diverse mechanisms, thereby spreading the risk of failures. Employment of certain mechanisms to govern uncertainty comes at a cost. Accordingly, there is a gap between demand and adoption of mechanisms which govern uncertainty.

Adoption of conflict resolution mechanisms

CRMs are adopted only in half of the treaties analysed. Riparian countries with existing and trustful relations face lower transactions costs than states with ambiguous relations. Countries with an equally high level of political freedom or with an asymmetric level face high bargaining costs which decrease the chance of adopting comprehensive CRMs in treaties. If a colonial power is a signatory to the treaty, the chance of CRM adoption decreases considerably and this is of particular relevance for African river basins where many agreements derived in colonial times are still in place today. Water stress and a high dependency on external water sources reduce bargaining costs and allow for adoption of CRMs, however, this does not result in more mature and comprehensive mechanisms.

Some climate-related variables influence CRM-adoption but not in the same way riparian characteristics do. Hydrological variability was not significant, suggesting that it is mainly ignored in treaty negotiations, leaving basins unprepared.

Factor	Data source	Expectation	Result
Number of signatories		A higher number of signatories increases the bargaining costs and hinders the adoption of CRM	Insignificant
		A higher number of signatories increases uncertainty and induces the adoption of institutionalized forms of CRM	Insignificant
Hydrological variability	TFDD	A high level of hydrological variability increases uncertainty and induces the adoption of CRM	Insignificant
		A high level of hydrological variability increases the bargaining costs and induces the adoption of CRMs based upon consensus or majority rule	Insignificant
Water stress	FAO/Aquastat	A high level of water stress increases the bargaining costs and hinders the adoption of CRM	Rejected
External resource dependency	FAO/Aquastat	High external resource dependency increases the bargaining costs and hinders the adoption of *mature* CRM	✓
		High external resource dependency increases the bargaining costs and induces the adoption of *soft* law CRM	✓
Asymmetry of external resource dependency	FAO/Aquastat	Asymmetry in external resource dependency lowers the bargaining costs enough for parties to adopt CRM, but not enough for adopting mature CRM	✓
Level of trust	TFDD	A low level of trust between the parties increases the bargaining costs and hinders the adoption of hard law CRM	Insignificant
		A low level of trust between the parties increases the monitoring and enforcement costs and hinders the adoption of a high number of CRMs	Insignificant
		A high level of trust between the parties lowers the bargaining costs and induces the adoption of CRMs based on unilateral activation and mature CRM	✓

Factor	Data source	Expectation	Result
Level of political freedom	Earth trends	A high level of political freedom increases the bargaining costs and hinders the adoption of CRM	✓
Asymmetry of political freedom	Earth trends	Asymmetry in political freedom increases the bargaining costs and hinders the adoption of CRM	✓
Level of adaptive capacity	UNDP/HDI	High adaptive capacity of states lowers the bargaining costs and induces the adoption of a high number of CRM and mature CRM	Insignificant
Colonial power	TFDD	Colonial powers as signatories lower the bargaining costs and induce the adoption of CRM and a high number of CRMs	Rejected

Table 5: Results of correlation analysis of factors likely to influence CRM adoption. Source: Fischhendler and De Bruyne, (2012).

Given the likelihood that climate change will increase hydrological and climate variability (IPCC, 2007) it may increase the risks of political tensions, even in regions where institutional capacity already exists (Dinar et al., 2011). This implies that there might be a gap between the availability of scientific knowledge and the tendency of policymakers to make use of it by adopting a CRM that is best suited to address variability. Alternatively, it may signal that environmental treaties, as the main available instruments for tackling problems of collective action, are still primarily negotiated from a perspective where state sovereignty is central, potentially discounting other considerations such as the climate (Fischhendler and De Bruyne, 2012).

5.3 Summary

This chapter has analysed the adaptive capacity of transboundary basins in the CLICO region. Factors linked to resource attributes, riparian and treaty characteristics have been useful in identifying suitable indicators that allow measuring adaptive capacity at the transboundary level. Mechanisms to address uncertainties which arise from climatic-environmental but also from social and political factors, are of particular relevance in the transboundary context and therefore were included as an indicator in the analysis of adaptive capacity. Six categories of transboundary basins were revealed by a cluster analysis: Well Prepared, Mediated Cooperation, Good Neighbour, Dependent Instability,

Self-Sufficient, and Ill Prepared. The Douro/Duero, Guadiana, Lima, Miño, Tagus/Tajo, Rhone, and Danube river basins are well prepared and have a high adaptive capacity whereas the Krka, Neretva, Wadi Al Izziyah, Baraka, Awash and Juba-Shibeli river basins are ill prepared. Other basins were categorized based on the presence or absence of treaties and river basin organizations, the degree of trade linkages and the degree of water dependency. Adaptive capacity has been found to be endemic to a basin rather than caused by a single riparian and the transboundary level of analysis provided additional insights as compared to a nation-level analysis of adaptive capacity.

Mechanisms to reduce uncertainties – as an important contributor to a higher adaptive capacity – were underrepresented in the CLICO region. Therefore, an analysis of which mechanisms exist in transboundary agreements and which factors influence their adoption and modification was conducted. This approach was based on all transboundary treaties captured in the TFDD database and categorized all existing mechanisms into four broad categories: *Ignoring uncertainties, complete contracts, reducing uncertainties and an open-ended approach.* Treaties adopt a variety of mechanisms and follow multiple strategies; however, the adoption comes at a certain cost, which can be measured by using the concept of transaction costs. The application of conflict resolution mechanisms, riparian characteristics such as trustful relations, level and asymmetry of political freedom and being a colonial power influenced the choice of CRM adoption and maturity. Climatic variables such as water scarcity and resource dependency mattered as well, but the assumption that hydrological variability mattered was not confirmed. Political factors such as stability, level of political freedom but also water dependency and scarcity influence the degree of transboundary adaptive capacity as well as the conditions for the adoption of CRMs as one aspect of adaptive capacity.

Key messages

Adaptive capacity of transboundary basins varies.
Six categories of transboundary basins were identified: Well Prepared, Mediated Cooperation, Good Neighbour, Dependent Instability, Self-Sufficient, and Ill Prepared. The Douro/Duero, Guadiana, Lima, Miño, Tagus/Tajo, Rhone, and Danube river basins are well prepared and have a high adaptive capacity whereas the Krka, Neretva, Wadi Al Izziyah, Baraka, Awash, and Juba-Shibeli river basins are ill prepared.

Adaptive capacity has been found to be endemic to a basin rather than caused by a single riparian and the transboundary level of analysis provided additional insights as compared to a nation-level analysis of adaptive capacity.

Mechanisms to reduce uncertainties as an important contributor to a higher adaptive capacity *were underrepresented in the CLICO region.*

Four broad categories of mechanisms to reduce uncertainty were identified: Ignoring uncertainties, complete contracts, reducing uncertainties and an open-ended approach. Treaties adopt a variety of mechanisms and follow multiple strategies.

The concept of *'transaction costs'* helps to explain the adoption of a mechanism in a transboundary treaty. Taking conflict resolution mechanisms as one important group of mechanisms to reduce uncertainties, riparian characteristics such as trustful relations, level and asymmetry of political freedom, or being a colonial power influenced the choice of their adoption and maturity in a treaty. Climatic variables such as water scarcity and resource dependency mattered as well, but the assumption that hydrological variability mattered was not confirmed.

Based on these findings, several areas for *policy attention* can be suggested:

1. Improving the adaptive capacity of transboundary basins particularly in basins outside of Europe by targeted interventions:

   → Particularly basins classified as good neighbours, dependent instability and ill prepared can benefit from policies aimed at improving data sharing.

   → Basins classified as mediated cooperation – co-riparians within those basins often do not hold shared water norms though there are formal agreements in place (e.g. the Nile-basin). As a result, policies aimed at sharing data or joint management may be less useful if underlying shared water norms are not addressed first and there is no shared vision on how to deal with issues depicted by the data (Milman et al., 2012b).

2. A focus on only the weak riparians would neglect to address policies directed to the transboundary level. In order to assess the adaptive capacity of a transboundary river basin in the context of climate change and potential cross-border effects, the transboundary scale is more appropriate than the national-level one.

3. One way to improve the adaptive capacity in general is to facilitate the adoption of mechanisms to address uncertainty, such as CRMs, as there is a systematic lack of them. As transaction costs may hinder the adoption of mechanisms, all kinds of policies that reduce transactions costs and build institutions that make negotiations between countries less burdensome are useful in that regard.

   → Particularly in "self-sufficient" and "ill-prepared" basins no formal mechanisms are incorporated to address uncertainty, so policy attention needs to be directed to these basins.

However, the following issues need to be considered when doing so:

   → Mechanisms to address uncertainty have to fit to the unique political, institutional and ecological context at hand. There is no "unique" way of designing transboundary treaties;

   → Particular attention should be given to African basins, because they often have low numbers of CRMs adopted as a result of colonial powers involved during the treaty design. Here, agreements need to be updated, involving all co-riparians and including CRMs;

   → Path dependency suggests that once CRMs are adopted, the likelihood of further institutionalizations and maturity increases. It is therefore advisable to start negotiations with simple CRMs that can be further developed once the first hurdles are overcome (Fischhendler and De Bruyne, 2012b).

4. Measures that reduce transaction costs, such as data sharing and shared norms, make the adoption of CRMs more likely and are useful measures for increasing all dimensions of adaptive capacity in the whole basin.

6. Assessments of hydro-security

6.1 Large scale statistical analysis of factors contributing to water-related conflict or cooperation

This section focuses on the domestic-level, i.e. inter-state water conflicts and cooperation within the CLICO regions of the Mediterranean, Middle East and Sahel countries and aims to identify statistically significant generic drivers of conflict or cooperation over water resources. In this context, intra-state conflict and cooperation refers to all kinds of conflictive or co-operative events occurring between individual water users, firms and economic sectors, non-governmental organizations, state authorities or any possible combination of these actors. Existing research has been inconclusive in determining if and under which circumstances climate change and particularly water scarcity, induces cooperation or increases the likelihood of conflict within countries. There is little evidence of a direct link between climate change and conflict (Gleditsch, 2012)[19].

Studies that aim to analyse domestic water conflicts from a global perspective generally suffer from data shortcomings, making it difficult to conduct statistically sound analysis for a wide range of cooperative and conflictive events from different countries

19 There is a lot of uncertainty in the literature regarding the direction of the relationship, if it indeed exists (Buhaug, 2010, Burke et al., 2009, Ciccone, 2011, Gizelis and Wooden, 2010; Hendrix and Salehyan, 2012; Koubi et al., 2012; Raleigh and Kniveton, 2012; Theisen, 2008 as cited in Böhmelt et al., 2012). At the domestic, sub-national and particularly at the local level there is more evidence that water is and will increasingly become a source of violent conflict (see Gleditsch et al., 2004; Ohlsson, 1995, 1999a and 1999b; Ohlsson and Turton, 1999; Ravenborg, 2004; Swedish Water House, 2005; Carius et al., 2004; Thomasson, 2006; Turton, 2004 as cited in Renaud and Wirkus 2012), potentially leading to 'water riots' (Swatuk and Wirkus, 2009, p.18).

(Theissen, 2006; Binningsbo et al., 2007). For intra-state conflicts, existing studies are based on datasets that capture only relatively extreme forms of conflict and neglect cooperation completely. The only existing datasets that conceptualize conflictive and cooperative events as a continuum are for international water conflicts (Wolf, 2011; Kalbhenn and Bernauer, 2012). However, such a dataset at the domestic level would allow researchers to assess how frequent and intense conflict events are relative to cooperative events within countries, as intra-state forms of conflict are the most common form of conflict by a considerable margin (Gleditsch et al., 2002). The challenge in generating such a database is the requirement to record only those domestic conflicts that are water-related and to separate it from events where disputes are rooted in other issues such as land rights or political power (Bernauer et al., 2012).

6.1.1 A database for domestic, intra-state conflict and cooperation

To be able to investigate whether water scarcity is a significant and recurring cause of conflict and to shed light on the likelihood of more frequent or more intense climate change induced water conflicts in the future, *a new solid and systematically compiled database* for a large number of countries, covering a long period of time had to be constructed for CLICO (see Bernauer et al., 2012). Using BBC Monitoring, almost 80,000 media items from 35 MMES countries for the years 1997–2009 were identified as being potential water-related events. These were then screened and coded and ultimately 10,352 cases were recorded to form the basis of the WARICC database (Water Related Intrastate Conflict and Cooperation). At the core of coding the cooperative and conflictive events was the construction of the Water Events Scale, which captures the intensity of the reported events (Bernauer et al., 2012).

Each category represents a certain intensity level or impact and action related to an event (see Table 6). Positive values are used for more cooperative events and negative values for more conflictive situations.

Looking at the frequency of events according to category (Figure 6), most events fall under the "neutral" category, and do not have an explicit positive or negative effect on water quantity or quality. An important finding is that the CLICO countries experienced more cooperative than conflictive water-related events in the past (1997–2009).

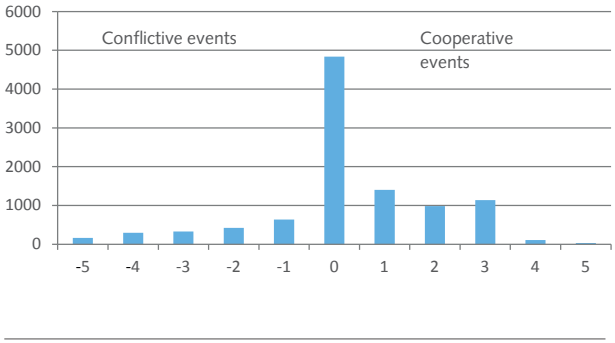


Figure 6: Frequencies of conflictive and cooperative events in the WES-categories. Source: Bernauer et al., (2012).

Looking at the yearly average of conflictive and cooperative events in each country, democracies (Italy, Portugal, or Spain) turn out to have more conflictive events on average, whereas the countries with the highest share of cooperative events are mainly non-democratic. More systematic statistical analysis is needed to identify the factors that contribute to variation in cooperation/conflict levels across countries.

WES Value	Description
5	Events that are likely to or do result in substantial improvement with respect to water quality/quantity in the country as a whole.
4	Events that are likely to or do result in substantial improvement with respect to water quality/quantity at the regional level within the respective country.
3	Events of moderate intensity that may result in an improvement with respect to water quality/quantity at the regional or national level within the respective country.
2	Agreements signed or other measures formally adopted that signal commitment to improvement with respect to water quality/quantity at the regional or national level.
1	Events that are likely to or do result in a very small improvement with respect to water quality/quantity at the local level.
0	Routine and purposive actions on water issues that have no identifiable positive or negative impact on water quality/quantity.
–1	Events that are likely to or do result in a very small negative impact on water quality/quantity at the local level.
–2	Tensions within government (intra-state) or between countries (inter-state) that may affect water quality/quantity at the domestic level.
–3	Large-scale and general opposition of the public towards policies and actions that have negative implications for water quality/quantity at the regional to national level.
–4	Events that are likely to or do result in a deterioration with respect to water quality/quantity at the regional level within the respective country.
–5	Events that are likely to or do result in a deterioration with respect to water quality/quantity at the national level; physical violence associated with water problems.

Table 6: The Water Events Scale (WES).
Source: Bernauer et al. 2012

Besides the variables depicted in the WES, much more useful information has been captured in the WARICC data set. For example, along with the temporal dimension (see Figure 7) the WARICC database also captures the spatial dimension of water related conflict and cooperation.

Albania ALB, Algeria ALG, Bosnia-Herzegovina BOS, Burkina Faso BFO, Chad CHA, Croatia CRO, Cyprus CYP, Egypt EGY, Eritrea ERI, Ethiopia ETH, France FRN, Greece GRC, Israel ISR, Italy ITA, Jordan JOR, Lebanon LEB, Libya LIB, Mali MLI, Malta MLT, Mauritania MAA, Monaco MNC, Montenegro MNG, Morocco MOR, Niger NIR, Nigeria NIG, Portugal POR, Senegal SEN, Slovenia SLV, Somalia SOM, Spain SPN, Sudan SUD, Syria SYR, Tunisia TUN, Turkey TUR, West Bank/Gaza WBG

Figure 7: Median band with three most cooperative and conflictive countries, 1997–2009. Source: Bernauer et al. (2012).

The geographic coordinates are also provided for each event, which can then be linked to a Geographic Information System (GIS). This allows for the analysis of the spatial patterns and dynamics of conflicts and cooperation at sub-national settlement patterns, local weather patterns, waterways, irrigation, topography, land class and other spatial features that may affect the location of such events (see Figure 8 and 9 for an example)[20]. It also allows for the tracing of specific events and either validating them on the ground or serving as a starting point for in-depth qualitative research (Bernauer et al., 2012).

As WARICC is based on events that have been reported in the media, there are several factors that may impinge on the reliability of the derived WES. Often, there is an imbalance between reporting from rural and urban areas, affecting the quality of media coverage. As a result relevant events in rural areas might be underrepresented compared to events in urban areas. Furthermore, restrictions on press freedom in less democratic countries may result in more positive events being reported, potentially introducing a bias towards cooperative events in the data set. Media in democratic countries, however, may find cooperative events less newsworthy than conflict events, which might lead to a bias towards conflictive events (Bernauer et al., 2012). Another potential source for errors in the data set consists of misleading representations or wrong interpretations of events by journalists. To assess whether these factors had resulted in coding related errors, qualitative case studies have also been conducted. Using "outlier" countries, which are characterized by particularly cooperative or conflictive events, allowed for some insights into the processes and reasons that might be affecting the general cooperative or conflictive behaviour related to water (see Box 12).

20 Buhaug and Lujala (2005), Cederman and Gleditsch (2009) and Tollefsen, Strand, and Buhaug (2012) for examples of spatially disaggregated studies of armed conflict.

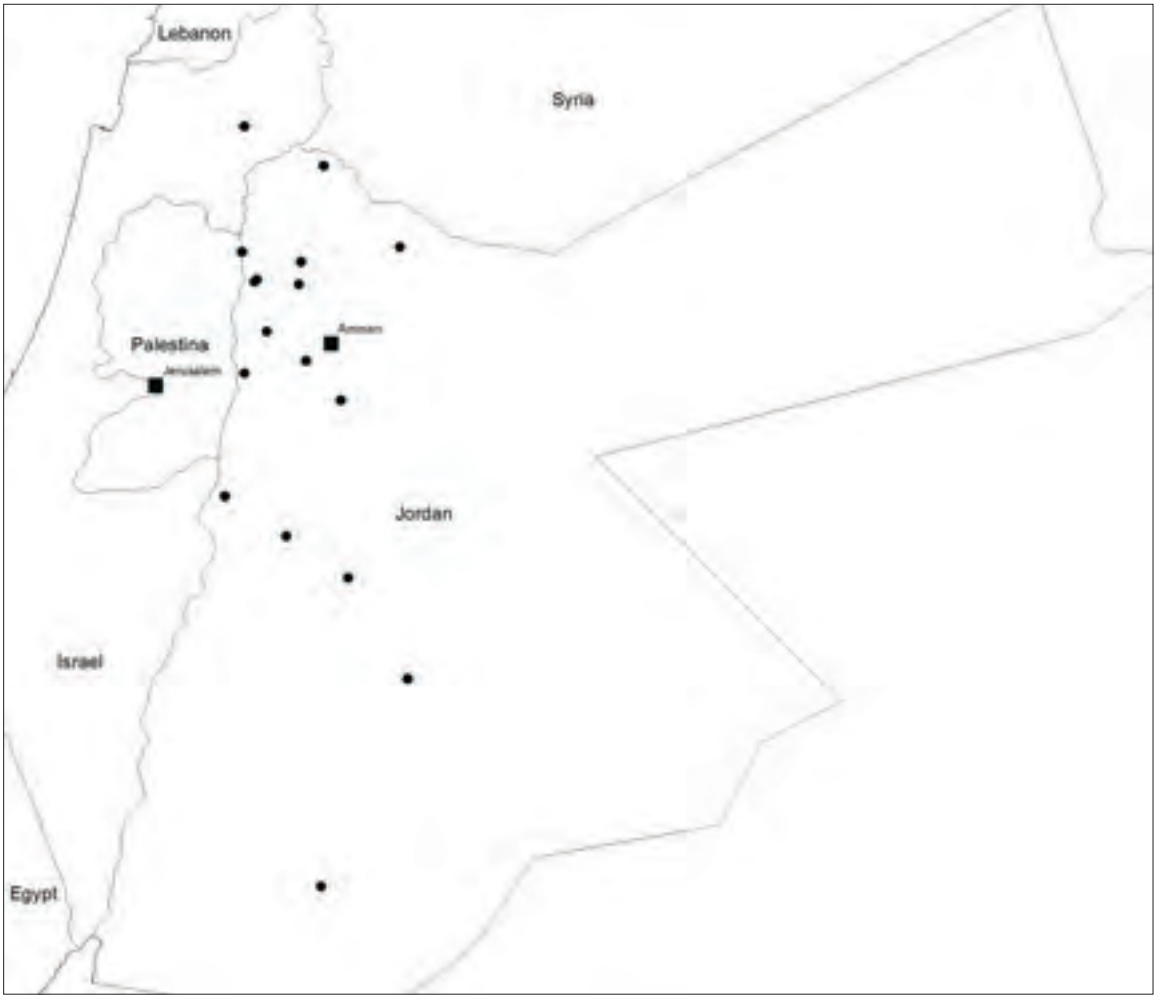


Figure 8: Spatial distribution of conflictive events in Jordan, 1997–2009. Source: Bernauer et al. (2012).

Box 12: Validating WARICC – case study Morocco

Morocco has been selected as an example of very cooperative behaviour as it is one of the countries with the highest degree of water-related cooperation in the WARICC data set. Although Morocco did not score highest in every year, it exhibits persistently positive mean values on the WES-scale during the period considered (Tribaldos, 2012).

In order to validate Morocco's positive results and unravel some factors that have increased cooperation with regards to water, 19 interviews within the national water department, nine river basin agencies and agencies related to development cooperation have been conducted. The case study validated the cooperative character of the integrated and decentralized water management system in Morocco (Tribaldos, 2012). The Moroccan water sector has undergone a substantial reform process initiated in 1995.

The new water law transferred the water management and allocation structure from the national-administrative to the river basin level. For each of the nine river basins, river basin agencies were established which are responsible for the management of the water resources in the river basin area and their planning up to 2030.

At the local level Water User Associations (WUAs) deal with water-related issues and allow participation of all important stakeholders and a decentralized decision-making process. Conflicts, in the form of tensions or small-scale disagreements, occur regularly – mainly between agricultural and other users such as tourism or domestic users – but the authorities in place are able to handle them in an efficient and cooperative manner. All water users that share the same resource are subsumed in the system and can be involved in planning and allocation decisions. Due to the decentralized decision making process, independent from national authorities, they have a greater stake in the cooperative outcomes. Although Morocco seems to be well positioned in terms of water management and institutional structures the qualitative research conducted also detected ongoing and future challenges for water management. River basin agencies are not yet financially sustainable and are still supported by the state, as the use of water without payment remains an unsolved issue. Furthermore, the social changes in the agricultural sector that accompany a system change, towards a more export oriented business model, will be difficult to handle (Tribaldos, 2012).

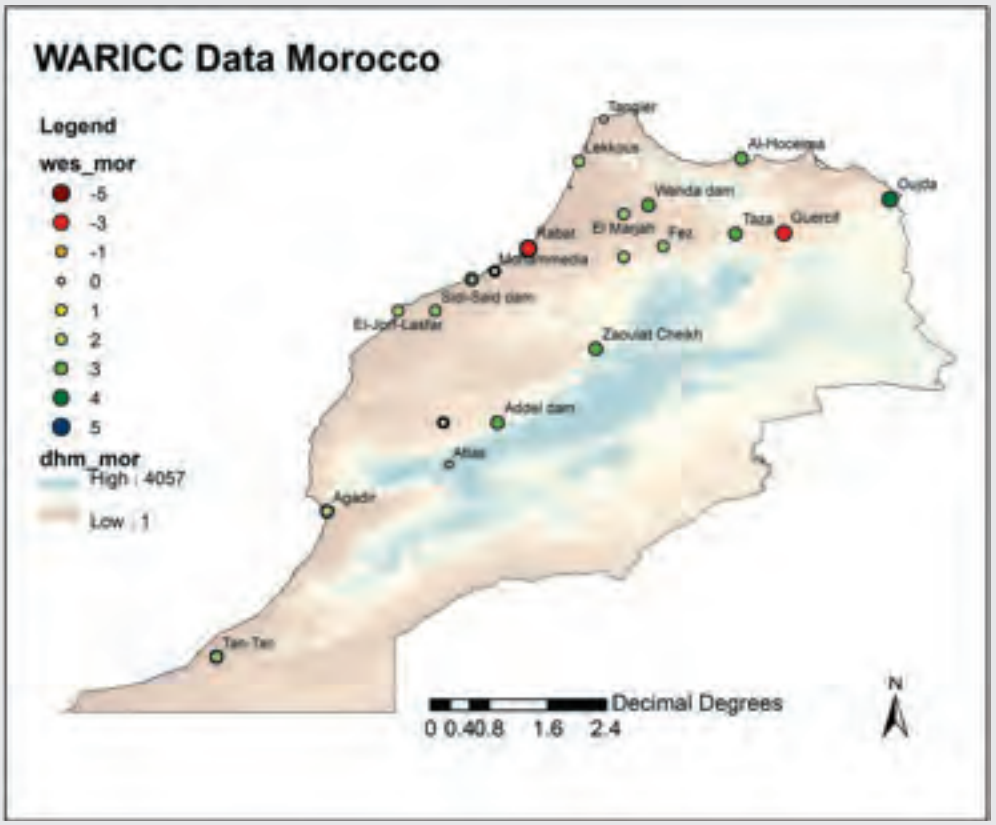


Figure 9: WARICC data for Morocco.
Source: Tribaldos (2012).

6.1.2 Determinants of domestic conflict and cooperation

Findings from a large-scale regression analysis

Building upon the WARICC data set, a systematic quantitative analysis is a useful method to identify statistically significant determinants of conflict and cooperation. Furthermore, it is possible to detect their relative importance and compare the strength of climate stressors versus economic, demographic or other[21] drivers of conflict or cooperation.

The regression analysis presented in Böhmelt et al. (2012) is conducted at the country level, so that the determinants of the average level of domestic conflict within a country for each year (*"yearly mean value of the WES for each country"*; dependent variable in the regression) can be identified. This aggregation of WES data to the country level was necessary due to the fact that the presumed determinants (explanatory variables in the regression) that are tested for their impact on the conflict/cooperative events are not disaggregated further and are only available at the country level for all countries in the MMES region. To be able to capture the temporal dimension of conflict/cooperation, time-series cross-sectional data were required.

Embedded in the CLICO framework, the choice of the presumed determinants of conflict and cooperation is related to demand and supply of water resources. There can be demand-side and supply-side drivers that through increasing scarcities foster conflict or cooperation.

Climatic variables are included in the regression analysis because they may act as stressors or hazards to the climate and water system and change water supply/availability, which might explain the presence of more conflictive or more cooperative events in a country. Data on precipitation and temperature were used to estimate the impacts of climatic anomalies[22] on water-related conflict/cooperation. The two climate variables are defined as the *"deviation of the current level of precipitation from their past, long-run level; and deviation of the current level of temperature from their past, long-run level"* (30 years moving average) (see Koubi et al., 2012:199).

Demand driving variables include *Population density*, which will reflect population pressure on natural resources such as water. A higher density of people will, if everything else is kept constant (so irrespective of institutional or technological changes), increase usage of and demand for water. As water may become scarcer this could lead to conflict or induce cooperation. *Agricultural productivity* refers to the ratio of crop production to percentage of agricultural land and captures how productive a country is relative to land used. According to Gizelis and Wooden (2010), higher agricultural productivity might increase the consumption and hence put pressure on water resources. Inherent in this is the assumption that water availability may be a critical factor for agricultural production in most of the MMES countries. Demand for freshwater in low and middle income countries is likely to increase with economic development and related processes such as industrialization, energy production, health and sanitation infrastructure, food habits and increased irrigation demand (Gleick, 2011). Therefore, the variable *Gross Domestic Product (GDP)* per person is used to capture the total economic activity of a country.

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21 For the regression models, all explanatory variables are lagged by one year. A Prais-Winston regression model with panel-corrected standard errors and an AR1 autocorrelation structure was used (Beck and Katz, 1995, 1996). Additionally, assessments of the ability to actually correctly predict countries' level of water-related cooperation or conflict using in-sample and out-of sample techniques were done. The model results are presented in the appendix as well as the additional tests. The tests revealed a reasonable predictive power of the model. That means that the findings on determinants of conflict and cooperation as presented in box 12 are robust across a wide range of specifications.

22 IPCC (2007) defines climate as "average weather" usually over a time period of 30 years. Accordingly, the term "climate anomalies", due to the relatively short time period under consideration is used instead of using the term "climate change".

All these variables linked to "demand-side" and "needs" for water help to understand whether more demand-side oriented variables affected cooperation and conflict or supply-side/climatic variables. Increasing demand or dwindling supply of water may not necessarily translate into a higher vulnerability to conflicts or reduce the adaptive capacity of countries, since the political, social and institutional context within a country also plays a role.

To address the social, political and institutional context in the countries, two variables ("restraint factors") were included in the regression analysis, namely *levels of democracy and political stability.* The two variables capture a host of factors that altogether determine how well a country's institutional and political set-up increases its ability to restrain escalating water conflicts. Democracies are often found to be characterized by more cooperative solutions to all kinds of environmental and social problems (Blättig and Bernauer, 2009; Lake and Baum, 2001; Neumayer, 2002; Payne, 1995; Gizelis and Wooden, 2010). On the other hand, democracies offer room for opposition and could allow for more low-level conflictive interactions among water users and between water users and authorities, but less higher-level or violent conflicts. The variable "democracy" captures different levels of democratization ranging from -10 (full autocracy) to +10 (full democracy). The political stability variable counts the number of years that a country did not undergo a change larger than three levels on the democracy scale. The results show that there is no statistically significant impact of climate anomalies, as measured by precipitation and temperature, on domestic water conflicts or cooperation (see Box 13). The results confirm earlier studies which concluded that supply-side variables have a very low impact on conflict (Koubi et al., 2012; Gleditsch, 2012).

This is an important finding supporting the viewpoint that climate anomalies, as an indication of climate change, do not directly influence water-related conflict or cooperation at the domestic level, but that economic, social institutional and political factors are much more important determinants.

Box 13: Hypotheses on determinants of conflict/ cooperation and actual findings:

1. Stronger climate anomalies increase the risk of domestic water conflict	X
2. Higher population densities increase the risk of domestic water conflict	X
3. Higher agricultural productivity increases the risk of domestic water conflict	✓
4. Higher economic development increases the risk of domestic conflict	✓
5. Higher levels of democracy increase the risk of domestic water conflict	✓
6. Higher political stability increases the probability of domestic water cooperation	✓

More demand-oriented variables such as population growth, agricultural productivity and economic development are likely to have a stronger impact on domestic water conflict. Particularly, economic development (GDP/capita) has a robust and positive impact on conflict. While high economic development may decrease the risk of high-intensity civil conflicts, it may increase the probability that a country will experience more low-intensity disputes over water resources. The level of democracy has a significant negative impact, which suggests that authoritarian regimes can solve water allocation problems more effectively than democracies as they can impose solutions and suppress opposition more readily. Somewhat in line with that interpretation, political stability has a conflict reducing effect.

This analysis offers new insights, as it is the first study to draw from a large data set covering a broad spectrum of water-related conflicts and cooperation at various intensities. The data set prepares the ground for many more nuanced analyses and research. This approach has been based on aggregated country-level data, but additional approaches may actually use further disaggregated data as WARICC provides and brings more detailed insights.

6.1.3 Summary

The newly constructed data set on domestic water conflicts and cooperation (WARICC) has proven to be a valid source of information. It allows for many possibilities for future research in order to understand the full spectrum of interactions and the resulting drivers of conflict or cooperation at different intensities. The regression analysis conducted within the CLICO research provided useful insights into the determinants of conflict and cooperation on the aggregated country-level data, opening the door for more in-depth and higher resolution assessments that can uncover additional dynamics among supply, demand and restraint factors.

While climatic factors were not found to be significant drivers of conflict or cooperation, it seems that institutiona-related factors, such as democracy and political stability, and demand driving factors, such as economic development are on average more important for conflictive or cooperative outcomes related to water. While democratic and more economically developed countries make room for a higher frequency of conflicts, they also posses the (institutional) means to keep the level of conflict at low intensities. Based on these findings it seems that in the future primarily climate-induced conflicts over water resources in the Mediterranean, Middle East and Sahel region are rather unlikely, at least in the short to medium-term (Gerstetter and Vidaurre, 2012).

Key messages

Data

Construction of a *new data set on domestic water conflicts* for the CLICO research area that covers a wide range of intensities of conflict or cooperation, their location, date and all actors involved in it. Ground-truthing proved the validity and reliability of the data set.

Analysis

More cooperative than conflictive water related events have taken place in the Mediterranean, Middle East and Sahel region.

The analysis cannot confirm that climate anomalies influence water-related domestic conflict or cooperation.

Democracies and more economically developed countries are less likely to experience high-intensity conflicts but they are more likely to see non-violent, low intensity types of conflict.

Political stability has low, but conflict-reducing effect.

6.2 Hydro-security in the case studies

Following a similar format for purposes of comparison between the 11 case studies, this section provides a summary of each case study based on the research conducted. The summary comprises an analysis of the climate change impacts and water hazards (see also Chapter 3) and relates these to the socio-political and institutional context of the case study region. The most vulnerable groups of the population are identified, based on information on the links between the climatic, socio-economic and institutional contexts, the ways in which the vulnerabilities impact conflict and cooperation and contribute or reduce human security are also described. Furthermore, each case study summary provides a scenario case of future hydro-security (see below). Besides the more generic findings on the drivers of human security and existing vulnerabilities, which have been summarized in *"Hydro security profiles"*[23] for each case study, the CLICO research also looked at particular issues that were relevant in the case studies, which are described in the summary (*"Case study articles"*). [24]

The summaries conclude with recommendations related to appropriate institutional adaptation and policies to bring about greater human security and reduce conflict.

Future scenarios of hydro-security

A huge amount of uncertainty is present in all climate change predictions based on existing hydro-climatic models. Its social, political and economic implications are even more obscure. To explore future prospects and potential concerns of human security and to identify necessary adaptations arising from water-related hazards and socio-political conditions, scenario-analysis can be a useful tool. Scenario analysis describes the process of analysing alternative possible futures (referred to here as "scenarios") that can arise out of potential social or environmental changes.

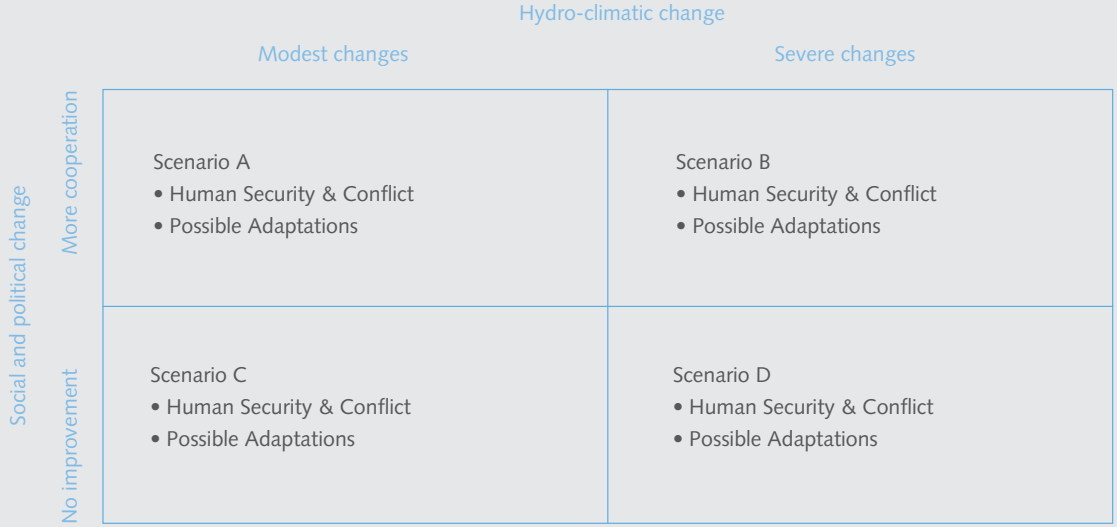
A scenario does not aim to represent an exact picture of the future, but rather alternative future outcomes of social and/or environmental developments. In each CLICO case study a scenario workshop was conducted to explore alternative future scenarios for human security and conflict. The construction of scenarios takes into account both hydro-climatic and socio-political changes (see Box 14). Building upon expert opinions a range of future human security outcomes can be identified, given the uncertainties associated with future climatic changes and socio-political and economic development pathways. Based on each scenario recommendations for institutional adaptation to enhance human security now and in the future are proposed.

23 See Appendix – List of Deliverables: D2.4 for a complete list of all hydro security profiles of CLICO.

24 See Appendix – List of Deliverables: D2.5 for a complete list of all case study articles of CLICO.

Box 14: Scenario construction by the means of multi-stakeholder workshops

The methodology based upon which the scenarios were developed is set out in Goulden and Porter (2011). Representing alternative potential futures, four scenarios were constructed based on two trends for both climate change and anticipated socio-economic and political developments. In workshops held in each case study area, stakeholders (experts in the field related to human security) discussed potential impacts on human security, identified the range of possible reactions and adaptive measures for each scenario and described vulnerable groups that lack the capacities to adapt to such changes. Using this method the future´s complexity can be reduced by identifying two axes of possible development, by capturing possible outcomes and by combining those into four potential futures.



Scenarios presenting a possible future with regard to climate change were all derived from the IPCC A1B climate model with a time boundary from 2041 to 2069, in order to guarantee comparability of findings in between the different case studies. The dimension of socio-political change was conceptualized using the concepts of conflict and cooperation and proposing a more conflictive, respectively more cooperative future to the workshops´ participants.

Case study Jordan River basin

"In the Jordan river basin water is disputed between Palestinian and Israelis as well as between different economic sectors within the same countries."

Map 5: Case study Jordan River basin (overview) Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 6: Case study Jordan River basin (detail). Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap

6.2.1 Jordan Basin

The Jordan Basin is an international river basin with Lebanon, Syria, Israel, Jordan and Palestine as co-riparian countries, though most of the Jordan basin lies within Jordanian and Palestinian territories. It is one of the most densely populated and most water-scarce regions in the world. Since 1967 the Jordan Valley and the West Bank have been occupied by Israel, imposing a wide range of restrictive measures on Palestinian settlements. Agriculture is the main economic activity across the Basin and is particularly vulnerable to a number of restrictions such as confiscation of agricultural land, restricition on developing water resources, dependence on Israel to provide agricultural inputs such as fertilizers or irrigation equipment, prevention of building new wells etc. Consequently, living conditions have deteriorated with a poverty level of 60 per cent and a high unemployment rate (21 per cent). Israel controls most of the water resources, leaving Palestinian settlements in a situation of chronic water shortage – average water use is 50 l per person per day and in the marginalized Bedouin communities about 20 l per person per day. The Jordan Basin represents perhaps the most cited case of past hydro-conflict and water continues to be a source of tension. Israel, Jordan and Palestine all depend on the Jordan basin and the impacts of climate change are likely to aggravate the situation. The following summary is based on the hydro security profile of the Jordan Basin (Tamini, 2012) and the case study article (Tamimi and Abu Jamous, 2012):

Focus of research

The Jordan Basin research concentrated on the part of the basin which is within the West Bank borders and is subsequently referred to as the "Jordan Valley". Research conducted on the case study highlights, in the context of water scarcity and climate change, the most important socio-economic trends and conditions. It underlines the main drivers behind the historical hydro-conflict at local and trans-boundary scales. The case study article discusses the potential and associated challenges of implementing an integrated water resources management plan[25] for all sectors under uncertain socio-economic, political and climate change conditions.

Climate and climate change drivers

The Jordan Basin is characterized by an arid to semi-arid climate. Average rainfall since 1990 is significantly lower than in previous periods and droughts have been more frequent while populations have grown. Under the A1B scenario, projected changes in precipitation are similar for the upstream and the western midstream parts of the basin. A decrease in precipitation by 10–11 per cent is anticipated for 2031–2050 relative to 1980–1999 and by 18–19 per cent for 2049–2069 relative to the 1961–1990 period. There is uncertainty regarding the midstream projections compared the upstream projections as five out of 20 models project a precipitation increase for the midstream area for 2031–2050. However, as shown by the A1B scenario, in both the midstream and upstream sites only one of the 16 downscaled GCMs projected a precipitation increase for 2040–2069. A 2.4 °C change in temperature is found for the latter projection.

Socio-political and economic drivers

The Jordan Valley and the rest of the West Bank have been under Israeli occupation since 1967. Occupation has impacted on all aspects of Palestinian life and exacerbates the vulnerability of the Palestinian population of the Jordan Valley to other threats, such as impacts of climate change and reducing their adaptive capacity to such risks. The predicted climate related risks are likely to increase the vulnerability of Palestinians to food and water

25 IWRM promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the ecosystem (GWP, 2004).

insecurities and limit their capacity to deal with these risks. Occupation, with a wide range of restrictive measures, impinges on every aspect of daily life and constitutes a breach of international humanitarian law, international human rights law and the law of self-determination. The consequences of occupation include: land confiscations and closures, property demolitions, restrictions on movements of people and goods (including through checkpoints and curfews), diversion of water resources, restrictions on the maintenance and development of Palestinian water infrastructure, exploitation of the tourism and mineral sectors, restrictions on building, expanding or improving structures, restricted access to utilities and basic services, control of inhabitants' residential status, extremely harsh restrictions on living conditions and since 2000, an increased Israeli military presence.

Vulnerable groups and their characteristics

The main vulnerable groups identified through the Jordan Valley case study are 65 communities of 28,246 people which belong to the governorates of Jericho and Al Aghwar, Nablus and Tubas. These communities are found to have low resilience and to be highly vulnerable to external changes such as drought. Residents in the Jordan Valley rely mainly on livelihoods vulnerable to climate change, including herding and agriculture. Following agreements signed in 1995 between Israel and the Palestinian Liberalization Organization (PLO), the West Bank was divided into three areas: A, B and C. In area C, which was to remain for an interim period under Israeli military and civil control, Israel has capitalized on its denominations to consolidate occupation in these areas by putting in place harsh water policies restricting access to water, which has promoted a humanitarian crisis. Jordan Valley inhabitants have over 81 per cent of their area classified as area C which implies very difficult living conditions (JICA, 2008).

Hydro- and human security concerns

The location of the Jordan River Basin including part of Israel and part of the Palestinian territory of the West Bank, parts of Lebanon, Syria and Jordan makes it one of the most unstable and conflict-driven parts of the world (GENI, 2011). Water is considered to be one of the main causes of conflict in a region with an arid climate and low and variable precipitation as well as extremely limited water resources. Consequently, water plays an extremely important role in the region's dynamics. The legal framework surrounding water issues in Palestine has changed often over the last 100 years and has been influenced by historical and political developments such as the British mandate Law in Palestine (1922–1948), Jordanian legislation (1948–1967), Occupation of the West Bank by Israel (1967), the Oslo Agreement (1992) and Oslo II Agreement (1995) which have shaped the region. A potential final agreement on water matters will inevitably have to be connected to the peace negotiations in the region. Major problems emerged through the Oslo II Agreement and are documented by the Palestinian Hydrology Group (PHG, 2008). The problems were identified as: the Palestinians not being allocated their share of water resources, the Palestinian Authority (PA) not obtaining a 'real' authority over water management in the Occupied Palestinian Territory (oPT), the PA being territorially obstructed, a final status of negotiations not having taken place yet and the existence of ambiguous terminology in the manuscript. The latter factors and the status of water resources becoming scarcer in the region have brought the regional conflict to a local level; this conflict has emerged between users in the Jordan Valley, particularly between the domestic and agricultural sector. The Ein Sultan springs, utilized for domestic and agricultural purposes has been identified as one of the water sources where conflict between users is most prevalent.

Socio-political relations: Level of cooperation at the local and regional scale	Moderate climate change – 1–1.5 °C increase in temperature and 15% decrease in precipitation	Extreme climate change – 2–2.5 °C temperature increase 20% decrease in precipitation; floods and droughts
Non-cooperative water management	**Scenario A: "Changes for the better"** *Impacts* → Peace agreement exists that defines a fair water allocation. More water allocated to Palestinian communities; → Local conflicts over unlicensed groundwater wells, personal property of water resources, intensive groundwater abstraction are resolved; → The agricultural sector receives sufficient water to enhance food security. *Possible adaptations* → Monitoring of climate change (cc) impacts and identification of policy options. Regional cooperation in adopting adaptation measures; → Distribution of new technologies throughout the region; → Establishing a "Water Users Association" in cooperation between the Palestinian National Authority and local councils to manage water and ensure cooperation; → Fully integrated management of water resources in the Jordan River Basin.	**Scenario B: "Amelioration of climate change impacts"** *Impacts* → Increased possibility of extreme events such as floods and droughts. *Possible adaptations* → Higher budgets required to boost technical and institutional capacity of all authorities, institutions, projects and NGOs; → Desalination plants and irrigation with properly treated wastewater will make up for the lack of natural water availability; → Regional cooperation will enhance the implementation of necessary large scale projects to work on non-conventional water resources to reduce the gap between supply and demand for all uses; → Cooperation between local stakeholders will lead to better management and allocation of available water between sectors and users; → Insurance and compensation for the most vulnerable (farmers, herders, etc).
Cooperative water management	**Scenario C: "Status quo"** *Impacts* → Increasing water scarcity due to growing demand; → The water sector suffers from a lack of institutional structure, mismanagement of the resources and imbalanced water allocation; → A further increase in salinity due to the intensive abstraction from groundwater wells; deterioration of the water quality; → Food security is threatened due to insufficient water allocated to the agricultural sector; livelihoods especially farming and herding are threatened; → Increasing rural-urban migration; → Increase in poverty rates and family fragmentation. *Possible adaptations* → Lack of adaptive capacities due to ongoing Israeli occupation of Palestinian territory, little control over water resources; → Improve water allocation and increase efficiency and transparency of water management; → Fully integrated management needed; → Better monitoring of cc impacts.	**Scenario D: "Worst case scenario"** *Impacts* → An increase in water scarcity for domestic use and agriculture leads to more conflicts between users and regional conflicts; → Increasing water prices severely impact vulnerable groups; → Forced rural–urban migration; → More regional water conflicts, as Israeli restrictions on the Palestinian water shares are amplified; → Negative environmental impacts (desertification, deforestation, loss of biodiversity); → Costs of living and poverty rates raise; → Agriculture is seen to be particularly affected, regional instability and infrastructure collapses. *Possible adaptations* → Subsidizing the agricultural sector and other income sectors such as tourism; → Reconsidering the water tariff system, improving water pricing; → An increase in non-conventional uses of water resources.

Table 7: Scenario focus group workshop results. Source: Tamini (2012).

Concerns for human security in future: scenario workshop

Fourteen experts representing different authorities and NGOs attended the focus group workshop to discuss four future scenarios and their foreseen impacts on water and human security and what kinds of adaptive measures are needed.

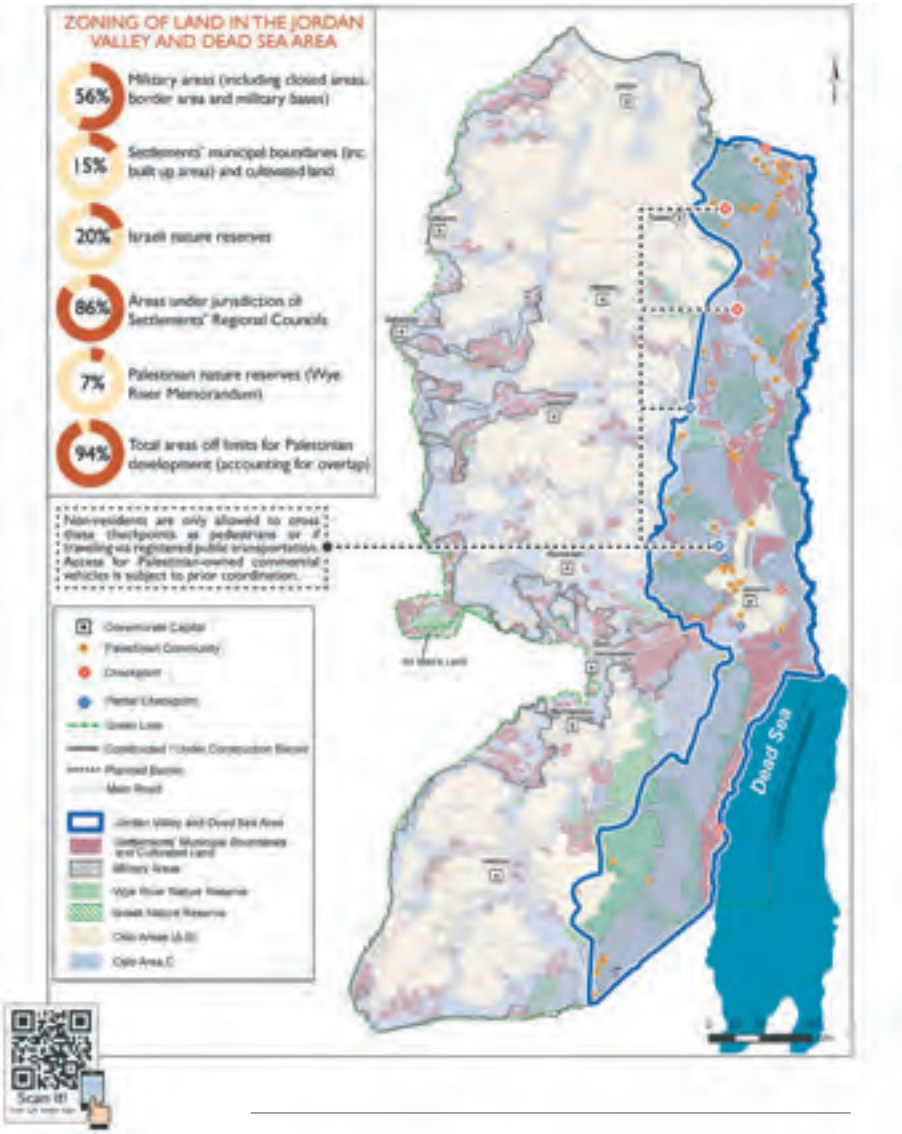
Case study article: The implementation of integrated water resources management under uncertain socio-economic, political and climate change conditions

The case study article discusses the potential current and future challenges of implementing integrated water resources management[26] (IWRM) under uncertainty in the Jordan valley. It applies an indicator-based approach to analyse the most important trends, tensions and possible transitions based on quantitative and qualitative data derived from participatory approaches. The data covered socio-economic information, water supply and consumption, uncertainties, impact of uncertainties, institutional arrangements and performance, trends in national strategies and policies. Trends of socio-economic uncertainties related to population growth, economic performance and governance, ongoing water-related tensions between Israel and Palestine over water allocation and micro conflicts that will accelerate due to climate change are all obstacles to the implementation of IWRM and the creation of a national climate change adaptation policy (Tamini and Abu Jamous, 2012).

Recommendations, suggested policies, adaptation, institutions

The Jordan Basin research recommends that the following policies be adopted to achieve a more effective and fairer water management cooperation, which deals with the current critical situation: the development of an understanding both at the grass roots level and at the leadership level of the interdependence of all people living in the region and of the shared environment, an understanding of the constraints and sensitivities of shared resources and the institutionalization of dialogue between different stakeholders in each country. The establishment of a Palestinian Jordan Valley organization which mirrors what exists in Jordan and is an equal counterpart when engaging in dialogue and cooperation with other parties is also advocated. Finally, research carried out on the implementation of integrated water resources management under uncertain socio-economic, political and climate change conditions highlights the need to: have stability and socio-economic development in order to develop the IWRM concept in the West Bank, have a clear future strategy for IWRM and good governance conditions to develop a climate change adaptation strategy that should comply with national and regional IWRM plans and be part of future confidence building measures at the national and trans-boundary level (Tamini, 2012; Tamini and Abu Jamous, 2012).

26 IWRM promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the ecosystem (GWP, 2004).



Map 7: The Jordan Basin. Source: Dominique Del Pietro. (UNEP/DEWA/GRID-Geneva))

Case study Gambella National Regional State, Ethiopia

"One of the least populated regions in the country and one of the poorest regions of Ethiopia, although rich in water and other natural resources."

Map 8: Case study Gambella National Regional State, Ethiopia (overview). Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 9: Case study Gambella National Regional State, Ethiopia (detail). Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap

6.2.2 The Baro-Akobo Sub-Basin of the Eastern Nile, Gambella National Regional State, Ethiopia

The regional state of Gambella is situated in the southwest of Ethiopia. It is one of the least populated regions in the country and although rich in water and other natural resources, one of the poorest regions of Ethiopia with 58 per cent of its population living in poverty. It is estimated that 85 per cent of the population reside in rural areas and that their livelihoods are based on seasonal agriculture and agro pastoralism. Local ecosystems such as land, water and animal resources play a crucial role in maintaining these livelihoods, which are vulnerable to changes in the timing and intensity of rainfall as well as temperature. Such changes could disturb crop and pasture growth, change water availability for human and animal consumption, cause substantial changes in ecosystems that are relied upon for gathering and for fishing, influence the prevalence of water-borne disease vectors and alter transportation routes and thus access to markets for agricultural inputs and outputs. A number of historical, geographical and political factors that influence the political economy of the region render adaptation and adjustment to climate change complicated. Gambella is part of an international river basin (the Baro-Akobo River, which traverses Gambella and is a key tributary to the Nile). Consequently, policies and projects within Gambella are strongly influenced and tied to the international relations and hydro-politics between Ethiopia, Egypt, Sudan and now South Sudan. At the sub-national level, identity politics and questions regarding territory influence the choice of climate change adaptation policies and responses to them. Ethnic relations in the region are tense and have been exacerbated by a large number of refugees entering Ethiopia as the result of the Sudanese civil war, by political movements within Ethiopia and by cross-border cattle raiding. A new movement to lease land to large-scale agri-businesses (primarily foreign) and to resettle villages in the region, add to these already stressed socio-political relations. This political economy influences the selection of adaptations to climate change and also the perceptions and reactions of the population to those policies. This summary rests upon the hydro security profile of the Baro-Akobo Sub-Basin of the Eastern Nile (Milman et al., 2012a) and the case study article (Milman and Arsano 2012).

Focus of research

The Ethiopia case study investigated how human security in the Gambella region is influenced by potential impacts of climate change and the socio-political context. Furthermore, the case study article investigated how the politics of the region determine the focus of adaptation and demonstrated their differential and contradictory impacts on four arenas of human security: a) elements of water security, b) temporal aspects of water security and livelihood security, c) personal, state and community security and d) differentiated geographies economic security which privilege the national and international scale.

Climate and climate change drivers

Ethiopia experiences highly variable rainfall which follows a 20-year cyclical pattern: wet in the mid-1970s and mid-1990s, but dry in the mid-1980s and mid-2000s (Funk, Senay et al. 2005). Diverging results from models on projections of future precipitation in Gambella are found. In the highlands the majority of the models (14 out 16 for B1 and A1B, 13 out of 16 for A2) forecasted an increase in precipitation for 2040–2069, relative to 1961–1990. In Gambella town, 11 (B1) or 9 models (A1B, A2) projected an increase while the other models projected a decrease in precipitation. In the downstream plains, about half of the models projected an increase in precipitation (9 models for B1 and 8 models for A1B, A2). For temperature, the projected median change for scenarios A1B and A2 exceeded 2 °C for all three locations (Bruggeman et al., 2012a). The climate processes that affect rainfall in Eastern Africa were examined by Williams and Funk (2011). Their findings point to a continuity of the observed decreasing precipitation trends for the March–June rainfall season and concluded that their results contradicted the results of the GCMs.

Socio-political and economic drivers

The socio-political context is a critical determinant of the climate change adaptation and human security conditions in Gambella. The region is characterized by very low levels of development. A lack of infrastructure, a history of political instability and low levels of human capacity have translated in an incapacity to exploit the existing large amount of natural resources present in the area, thereby hampering the region's progress in terms of socio-economic development. As a consequence of this, Gambella is poorly adapted to present climate variability. Two main policies exist that aim to reduce vulnerabilities: the Villagization program[28] and the Agricultural Development Led Industrialization (ADLI). Ethiopia is characterized by an ethnically federated political system, revealing the importance of ethnicity when considering politics, socio-economic development, human security and adaptation in Gambella. Five indigenous groups and one settler population are present in the region with the Anyuae and the Nuer being the most populous and politically dominant population groups. Shifting demographics have led to tensions over land ownership, government positions and resources allocation as these are tied to proportional distributions of population, with much of the existing tensions being related to relationships between and within ethnic groups and the federal government. Local and NGO entities have lobbied the government in order to develop a land use plan for the region (Interviews 2011). While steps towards this are being reached in the Gilo sub-basin efforts at developing a plan for the entire state have yet to be initiated (Interviews 2011). Finally, energy production in the future may also have an impact on land availability and use due to potential petroleum fields and the region's large potential for hydro-power (TAMS-ULG, 1997).

Vulnerable groups and their characteristics

With the majority of the Gambella population living in poverty and practicing traditional livelihoods, all of Gambella is vulnerable to the potential impacts of future climate change. The high dependency of the population on ecosystems means that changes in temperature and precipitation patterns which will impact plants and the wildlife could greatly reduce the wellbeing of the population. No ethnic group is thought to be more at risk than others, however, certain factors such as geography and gender influence vulnerability. Remoteness of the region, including a poor transportation system, makes geography a determinant of vulnerability in the region. Populations living in more dispersed settlements and closer to the border with Sudan are more vulnerable to violence due to cattle raiding. Women, children and the elderly are identified as a further vulnerable group within the Gambella population. During episodes of conflict, assets including crops, livestock and household goods are destroyed and key persons involved in livelihoods production are frequently killed or injured. Once the men are harmed, the women/children and elderly are at risk, not just due to a lack of food but because of lower standards and certain cultural practices. It also greatly affects their ability to respond to climate variability.

Hydro- and human security concerns

Climate change and conflict interact in the form of a two-way relationship in Gambella. Historical and present tensions have contributed to a heightened vulnerability to climate change. Competition over the use and control of territory, including land and other existing resources is a major source of conflict. The arrival of new populations, refugees, highlander settlements and domestic and international agricultural investments have the potential to aggravate inter-group tensions (Arsano, 2003; Feyissa, 2011; Interviews 2011). The loss of property and assets has reduced the capacity of displaced persons to undertake adaptive actions and generated feelings of insecurity and competition which mean that adaptation policies that rely on changes to land and resources may be contested. Additionally, increased flooding or increased droughts may intensify competition or perceptions of scarcity of land and water resources, consequently strengthen-

27 Relocation of 45000 households from 4 emerging regions into existing or new villages. Provision with farmland, infrastructure and assistance.

ing existing conflicts. The multiple ethnicities and cultures which characterize Gambella have played a role during the formation of the present-day Ethiopian state, leading to multiple dimensions of conflict in the region. Existing conflicts can be classified as intra-group, inter-group, indigenous-settler and cross border, though these conflicts are often connected and spill over into one another. Climate change's influence is important in this context with climate variability influencing land needs, as during droughts access to rivers is essential and during floods mobility out of flood plains is necessary. The official establishment of borders with static and frozen territorial zones between any groups is problematic. Effective land use policies that have been put forward will aid the situation, but will encounter obstacles in the resolution of the situation due complex perspectives, emotions and the historical context.

Concerns for human security in future: scenario workshop

This outlook of future human security concerns is based on a scenario focus group workshop that took place in October 2011 in Gambella. Representatives of the regional government, NGOs, church groups and agricultural investors discussed the foreseen impacts related to human security and adaptation for each scenario.

Case study article: Climate adaptation in highly vulnerable regions: The politics of human security in Gambella, Ethiopia

The case study article addresses the politics of adaptation and investigates their differential and contradictory impacts on four important arenas of human security, including "elements of water security", "temporal aspects of water security and livelihoods security", "personal, state and community security" and "differentiated geographies economic security". It raises important questions about how the country will apprehend climate change's future impacts on its already vulnerable population. The researchers advance that strategies such as the Villagization programme and the ADLI policies employed to improve certain dimensions and entities, could potentially have antagonistic consequences leading to maladaptations in other groups. In Gambella, indigenous groups rely primarily on natural resources, but the federal government sees these practices as unsustainable and recommends a transformation for the development and well-being of the population, which privileges the national and international scale. Hence, these policies give preference to some aspects of human security while creating new vulnerabilities in other aspects. The result of this complex political economy is that adaptive responses have resulted in an increase rather than a decrease in tensions in the region (Milman and Arsano, 2012).

Recommendations, suggested policies, adaptation, institutions

The international community tends to represent the nation state as the main entity responsible for addressing climate change within its boundaries. This perspective implicitly supports the action of the central government and has implications at the sub-national level where national-level governments are unstable or contested. The case study research highlights a need for a deeper discussion on the political economy of adaptation policy, particularly regarding how the distribution of authority, voice and power influence the ultimate outcomes of climate adaptation decisions. Although addressing the risks posed by climate change may require more than an incremental response, transformative actions have widespread implications. As seen by responses to the Villagization programme in Ethiopia, the question of who and what is prioritized in transformative action and how decisions to take such action are made merits careful consideration.

The participants of the Gambella climate change scenarios focus group as well as other policy experts in Ethiopia commented that they felt existing policies are good in Ethiopia, but what is required is harmonization across those policies (in particular, those related to land use and resource use). Also, sufficient monitoring, compliance and legal enforcement of existing policies are lacking. Consequently, current policies are ineffective. Thus, the focus group and policy experts recommended additional measures are needed to address root causes (insufficient financial resources, distrust, missing expertise, etc.) of vulnerability (Milman and Arsano, 2012; Milman et al., 2012).

Socio-economic change: Livelihood change and knowledge

"Like present day" *Slight increase in temperature, precipitation patterns as of 2000–2010*

"Extreme variability" *Slight increase in temperature, more erratic rainfall, shifts in seasons, higher frequency of floods and droughts*

"Slow Change" – Slow increase in extension activities; government policies less equitable and effective, similar livelihoods

"Transformation" – Rapid increase in research and extension; government policies are more equitable and more efficient, more market-oriented livelihoods

Scenario A: "Change for the worse"

Impacts

- Poverty increases, leading to a decrease in living standards and insufficient food supply;
- Malnutrition and the outbreak of epidemics decrease life expectancies;
- CC-induced rural to urban migration; underprepared urban areas;
- This scenario results in rising inequality, not well addressed by weak policies. This imbalance and increasing competition could lead to conflict.

Possible adaptations

- Tested and well implemented adaptive policies are needed;
- Involvement and participation of communities;
- Specific technologies and research to reduce impacts of hydro-climatic changes;
- Additional measures: Population-control, controlling urbanization, resettlement out of flood plain.

Scenario B: "Doomsday situation"

Impacts

- Similar impacts as in Scenario A, but more severe;
- More poverty, shorter life expectancies, widespread famine, diseases and malnutrition, lack of clean water, migration to highland areas, more conflicts, less investment in agriculture.

Possible adaptations

- Adaptation measures are similar to those in Scenario A, but more aggressive;
- Transformation of agricultural practices, different cropping systems and technologies (e.g drought resistant or early maturing crop varieties, soil and water conservation techniques, afforestation);
- Drainage systems;
- Improvement of information, awareness and planning for better preparedness (e.g. Flood maps);
- Formation of global alliances for technology and knowledge transfer;
- Government involvement.

Scenario C: " Best case"

Impacts

- Living standards increase, lower impacts of diseases;
- Food systems are more productive with lower production costs;
- Better technologies available, particularly biotechnology;
- Easier access to information;
- Policies are fairer, actually enacted and inequalities decrease.

Possible adaptations

- Strengthening early warning systems, *in-situ* conservation practices, more information sharing and participation;
- Greater capacity to implement suggested adaptation.

Scenario D: "Slight improvements"

Impacts

- Livelihoods are improved and new technologies for traditional livelihoods exist;
- Agricultural production remains dependent on weather conditions;
- Greater reliance on imported food;
- Urban areas and the industrial sector benefit more than rural areas and the agricultural, fishing and forestry sectors.

Possible adaptations

- Similar to adaptations in A, B, C but greater implementation capacities;
- Soil conservation, afforestation, drainage and improved infrastructure design;
- Information and knowledge sharing;
- Improved market access, food storage, processing and distribution would be useful adaptations.

Table 8: Scenario focus group workshop. Milman et al. (2012a).

Case study Cyprus

"Rural communities under drought and climate stress in Cyprus."

Map 10: Case study Cyprus (overview)
Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 11: Case study Cyprus (detail).
Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap

6.2.3 Cyprus

Cyprus ranks among the top 20 water scarce countries in the world with average renewable water resources of about 440 m³/year per capita. High variability of rainfall and significant inter-annual variability occur together with a 14per cent reduction in average annual precipitation for 1971–2011, relative to 1902–1970 (CMS, 2012). This has led to cuts in water supplies to households during drought years and a severe reduction of water supplies for agricultural use, strongly affecting the livelihoods of agricultural communities. As a result of the 2007/2008 drought, water had to be imported by ship from Greece. Irrigation farmers are the main water users in Cyprus and responsible for 60 per cent of the total water demand – rising in drought years. Given this situation, the case study conducted an assessment of hydro-security for the southern part of Cyprus, assessed the vulnerability of rural communities to water scarcity and climate change and investigated the adaptive capacity of the tourism sector. This summary is based on the hydro-security profile of Cyprus (Bruggeman et al., 2012b) and two case study articles (Charalambous et al., 2012; Bruggeman et al., 2012c):

Focus of research

The Cyprus case study deals with the southern part (63.8%) of the island, which is under control of the government of the Republic of Cyprus (PIO, 2010). It assesses how human security in the country is affected by changing environmental (hydro-climatic) and socio-political conditions and suggests institutional changes that could enhance human security. Furthermore, it investigates how the tourism industry, which is the backbone of Cyprus' economy, will adapt to the changing climate and lower availability of water (Charalambous et al., 2012).

Climate and climate change drivers

The weather in Cyprus is characterized by a strong Mediterranean climate with a wetter western part and dryer eastern one. The country is prone to severe droughts and floods with high variable precipitation patterns. Climate change projections for both the eastern and western parts of the island are similar. For the A1B scenario, a 12–13 per cent decline in precipitation is anticipated for the period from 2031–2050 comparable to the 1980–1999 one. All three scenarios for 2040–2069 relative to 1961–1990 have projected average decreases between 15 and 19 per cent. The projected temperature rise under the A1B scenario is 2 °C in the eastern part of the country and 1 °C in the western part for the 2031–2050 period, relative to 1980–1999.

Socio-political and economic drivers

Accession of Cyprus to EU membership and ensuing implementation of European institutions and policies contributed to an improvement in accountability, transparency and public involvement in the country. In particular, the adoption of European policies such as the Water Framework Directive, Groundwater Directive, Flood Directive and the Common Agricultural Policy led to a policy favouring a more sustainable management of natural resources. In addition, participation in EU bodies, committees, sponsored research and projects sensitized members of government and government authorities to environmental issues. However, the implementation of programmes and policies is hindered by the existence of extensive clientelism and favoratism with political parties being identified as the centre for clientelistic networks. The absence of an academic tradition, with the first public university established less than 20 years ago and the lack of independent investigations by the press have contributed to this trend.

Vulnerable groups and their characteristics

In Cyprus, the main vulnerable groups affected by climate change and water scarcity are irrigation farmers, rain-fed farmers and livestock holders. These groups are highly reliant on water resources with irrigation farmers using approximately 60 per cent of Cyprus' total water demand (Karavokyris et al., 2010). The tourism sector is also highly dependent on water resources but only uses 4 per cent of the total 252 mm^3 annual demand of the country and has adopted a range of measures to adapt to water scarcity. During drought years the primary sector is the first one to be hit by water cuts, leading to an important decrease in surfaces planted with annual crops. Additionally, droughts years and highly variable precipitation strongly impact rain-fed crop production. Mountain communities are found to be the most vulnerable due to their dependency on agriculture and their limited adaptive capacity.

Concerns for human security in future: scenario workshop

The workshop was held at a high school in a rural mountain location in Cyprus. The scenario discussions were preceded by a presentation on climate change and water adaptation options. The majority of the 39 participating students believed that the more extreme hydro-climatic change scenarios were more likely, with a slightly higher number identifying the less cooperative scenario (D) as the most likely. Moving from scenario A to D, the percentage of students that considered current government organizations capable of solving problems reduced from 34 to 13 per cent, while the thrust in universities and research organizations decreased from 66 to 29 per cent. The students emphasized the need for cooperation among all institutions. Thirty years from now, approximately half of the students (49 per cent) would like to live in a mountain community (scenario A), with a slight reduction under scenarios B and C, to 42 per cent under scenario D. The percentage of students that would move to the city decreased from 38 per cent (A) to 18 per cent (D), while a larger percentage (39 per cent) considered moving abroad under scenario D. The students were obviously concerned about the future but there was also a spirit to stay in their country and combat the problems.

Case study articles: Investing in climate change adaptation: An index to score the vulnerability of rural communities to water scarcity and climate change and water management by the tourism sector on the island of Cyprus in the face of climate change

The first case study article aimed to assess the relative vulnerability of rural communities in Cyprus to water scarcity and climate change with a new integrated index. Following the definition of the IPCC, vulnerability was determined by the community's exposure to climate stress, its sensitivity and adaptive capacity. Climate exposure was evaluated by average annual precipitation and temperature extremes, while the sensitivity of the community was derived from its land and water resources. A livelihoods-based approach was used to determine the community's adaptive capacity and 12 indicators were identified to assess the community's human, social, financial and physical capital. The index was applied to the 415 communities that cover the Republic of Cyprus. The results highlighted the diverse natural and social conditions of this drought-prone island, with the more vulnerable communities located predominantly in the mountains (Bruggeman et al., 2012b).

The second case study article studies the tourism sector in Cyprus and identifies current practices of tourist accommodations in Cyprus to adapt to climate change. A survey of accommodations in both parts of Cyprus revealed that some efforts have been made to reduce water consumption and increase water use efficiency, but awareness of climate change in general is low, which raises concerns related to future water management. Although the North has been already affected more seriously by water

Socio-political conditions

	Moderate	Extreme
More co-operative	**Scenario A** → no reduction in precipitation → 1°C increase in temperature → efficient use of irrigation water → sufficient water for domestic needs and small businesses	**Scenario B** → 30% reduction in precipitation → 3°C increase in temperature → no water for irrigation → efficient use of water for domestic use and small businesses
More conflictive	**Scenario C** → no reduction in precipitation → 1°C increase in temperature → unreliable irrigation water supply → problems with domestic water supply	**Scenario D** → 30% reduction in precipitation → 3°C increase in temperature → no water for irrigation → regular cuts in domestic water supply

Table 9: Description of scenarios. Source: Bruggeman et al., 2012b.

shortages than the South, partly resulting from inefficient water management at the governmental level, neither expect negative impacts of water shortages on the tourism sector (Charalambous et al., 2012).

Recommendations, suggested policies, adaptation, institutions

A number of recommendations to deal with future climate change impacts are made in the Cyprus case study. It is suggested that proper legislation to combat corruption is needed. Cooperation and shared decision-making on water resources management with the Turkish controlled part of the island could also provide a more secure future for the island. With regard to the agriculture sector, leadership is required to bolster agricultural research and extension systems, converting it into a progressive, client-oriented system that could develop climate-resilient, environmentally-friendly and economically-efficient agricultural technologies in close cooperation with local farmers. Additionally, strong, independent research and educational institutions that deal with climate change science and environmental research and technology development need to be developed. Finally, a more robust and objective investigative media is also seen as an important addition to Cyprus' development (Bruggeman et al., 2012b; Charalambous et al., 2012).

Case study Intercontinental Biosphere Reserve of the Mediterranean (IBRM)

"Cooperation between two countries (Spain and Morocco) with different political and institutional contexts to preserve the natural and cultural diversity of the region."

Map: 12: Case study Intercontinental Biosphere Reserve of the Mediterranean (IBRM) (overview)
Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 13: Case study Intercontinental Biosphere Reserve of the Mediterranean (IBRM) (detail).
Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap

6.2.4 Intercontinental Biosphere Reserve of the Mediterranean (IBRM), Morocco-Spain

IBRM brings together two countries with different political and institutional contexts in a joint effort to preserve the natural and cultural diversity of the region. The IBRM which was created in 2006 is situated in the Western side of the Mediterranean basin shared by Spain and Morocco. It extends over Europe and Africa and covers an area of one million hectares. There are 556,359 inhabitants within the limits of the reserve, but the reference population which includes surrounding towns bordering the IBRM is 719,293 inhabitants. Demographic pressures coupled with rapid socio-economic and technological transformations have resulted in increasing land use change and a deficit of the existing structural water resources causing alterations in the hydrological cycle. While the IBRM shares comparable natural and biophysical conditions on both sides, human activities have led to very different land cover patterns and differences that are also noticeable in the extension of protected areas as well as cropland cover on the Spanish and Moroccan side. Climate change projections point to the increased likelihood of water scarcity, resulting in droughts in the region as well as conflicts among users, which question the capacity to uphold the current management philosophy of water resources on both sides of the reserve. This summary is based on the hydro-security profile of the IBRM (Abdul Malak et al., 2012) and a case study article (Pascual et al., 2012).

Focus of research

The case study aims to assess the territorial vulnerability of water resources in the region and future climate change effects on hydro-ecological systems and human security. It also assesses to what extent the current IBRM institutional and management framework could face challenges of human security expected in this area in the context of changing hydro-climatic conditions. The vulnerability assessment was based on matching climate projections, hydro-ecological models and the socio-economic dimension of water use and management.

Climate and climate change drivers

Droughts are the main climate change hazards present in the IBRM case study. Under the A2 scenario, a maximum precipitation decrease of 17–18 per cent in 2040–2069 relative to 1961–1990 is projected for both sides of the biosphere reserve (Bruggeman et al., 2012). Projected temperature increases, for the same scenario are 2.4 °C for Morocco and 2.3 °C for Spain between 1961–1990 and 2040–2069. Projected rises in temperature under the B1 lower emission scenario are expected to total 1.8 °C in the Moroccan part and 1.7 °C in the Spanish one. It is anticipated that these climatic stresses will strongly impact the water resource availability through decreasing water runoff and aquifer recharge (Bruggeman et al., 2012). The hydro-ecological assessment carried out in the IBRM case study points to future scenarios that have a more arid climate and more frequent water scarcity in the biosphere reserve.

Socio-political and economic drivers

Strong socio-economic differences between Spain and Morocco highlight the need to employ specific policies to tackle global IBRM challenges. The presence of the European Union is a key component that distinguishes both countries of the IBRM. In spite of the differences between Spain and Morocco, partnerships relating to stability, security and sustainable development between both states have grown. EU policies such as the Euro-Mediterranean process or the European Neighbourhood Policy (ENP) have contributed to this enhanced partnership. In addition, Spain and the Andalusia region have established co-operation programmes where Morocco was one of the main beneficiaries. Both countries are presently concluding a common management framework that would provide better management of water resources in the IBRM. Other policy specific endeavours include

the national scale strategy on the Spanish side and the EU climate policies and the development of local level climate change adaptation projects on the Moroccan side. Nonetheless, challenges to an effective water policy in the context of climate change are related to responses focusing on drought *ex-post* rather than *ex-ante* anticipatory measures, such as a lack of a deficient water monitoring system which prevents the collection of precise knowledge on existent water resources and limited and difficult to implement measures to cope with long-term drought and water scarcity. Finally, both countries are characterized by weak cooperation among different institutions, and by a fragmented role of the state, the administrative regions and the river basin authorities, often resulting in conflicts and slowing down the implementation of existing legislation.

Vulnerable groups and their characteristics

The different socio-economic situation observable between both countries of the IBRM translates into a higher dependency on natural resources in Morocco than in Spain. The principal vulnerable groups identified in the IBRM case study are rural communities who rely on agriculture, farming and forest services. In the Moroccan part of the Reserve, the unfavourable weather conditions, such as drought, constitute one of the main threats to farmers' income as traditional agriculture and extensive farming still remain one of the main means of subsistence for a majority of the population living there. Two strategies have been adopted to cope with the consequential worsening of livelihoods: on the one hand, the development of unsustainable agricultural practices (overgrazing, illegal cannabis crop in higher gradient slopes, forest overexploitation) that cause soil degradation (Moore et al., 1998; Barrow and Hicham, 2000) and on the other hand a rural exodus to coastal cities (Bennis and Tazi Sadeq, 1998). In the Spanish part of the Reserve, subsistence farmers and people working in the tourism sector have also been recognized as the main vulnerable groups (Mestre Barceló, 1995; Roberts, 2002). Frequent droughts give rise to serious losses and injuries in the forestry, cropping and pastoral sectors, while water supply shortages to villages and extreme summer temperatures affect the tourism sector (Méndez, 2008). It is foreseen that migration from rural areas to cities and to other countries of the EU could potentially increase through climate change impacts (Fermin, 2009a; Fermin, 2009b). Forests on both sides of the reserve are quite vulnerable while future conditions are favourable for shrublands. Further impacts of rising temperatures and decreasing temperature in the area include the development of certain species of mosquitoes and related diseases (Ceccato et al., 2007; Viner and Agnew, 1999) as well as a threat to the sustainability of ecosystem services aggravated by the over-use of natural resources.

Hydro and human security concerns

A particularity of the IBRM is that most conflicts arise between the periphery of the reserve and the population living inside. On the Spanish side, water conflicts have arisen between the rural areas inside the reserve and the tourism on the coast. On the Moroccan side, migration from rural areas to nearby cities and tourism to a lesser extent have resulted in an increasing demand for water in the adjacent areas of the reserve. The water reservoir/sources in the IBRM are one of the main sources of supply for neighbouring areas whose main activities are focused on tourism and industry rather than agriculture. The Mediterranean region is facing mounting pressure on water resources, especially in the coastal zones (Fornés et al., 2005). This pressure originates from the doubling of regional water demand and consumption, through population growth, agricultural intensification, economic and social development, touristic pressure and overconsumption of water resources leading to water scarcity (ENPI, 2007; Benoît and Comeau, 2005). Signs that the Mediterranean basin has a limited capacity to cope with socio-economic and agricultural demands in periods of drought are on the rise. Extensive droughts that took place in the mid 1990s led to a stop in agricultural production as water reserves were not able to cope. In addition, climate change will lead to an intensification of these pressures

Photo 1: IBRM.
Source: D. Pascual.

on the Mediterranean basin (Magnan et al., 2009). Human activities in the region will be impacted by climate change through threats to ecosystems, water resources, soil and space. Climate change's impact translates into a new source of uncertainty reinforcing a common constraint in terms of public decisions. Elevated stress on natural resources in the IBRM stem mainly from the region around it and also from some practices of its residents. The common strategy from both countries to create the Reserve is seen as a sustainable development strategy to improve the management of its natural resources and conserving the natural and cultural diversity of the region (Molina and Villa, 2008).

Concerns for human security in future: scenario workshop

Four future scenarios for the year 2040 were developed and adapted to the local conditions of each side of the IBRM and a separate scenario workshop was conducted in each site. The participants assessed the main effects of each scenario on human security and water availability and identified the vulnerable population groups or sectors and proposed adaptive measures.

Photo 1: IBRM. Source: D. Pascual.

Slight CC – *Similar annual rainfall but higher variation in seasonality. Slight increase in mean annual temperature*

Strong CC – *significant decrease of annual rainfall (by 17% in the A2 scenario). Changes in seasonal rainfall pattern. More than 2 °C increase of mean annual temperature*

Social and Political Change: Distribution of Water Resources

Cooperative Future – Equitable Distribution among Sectors

Conflictive Scenario – *Inequity in allocation of water resources*

Andalusia
Hydro-climatic change by 2040: Droughts, changes inprecipitation and increase in temperature

Scenario A: "Potentially beneficial changes"

Impacts

- Moderate decrease of available resources;
- A slight increase in mean temperature will favour the extension of the tourist season, particularly on mountainous and rural tourism. However, higher development of coastal areas may pull the rural population to migrate to the coast with the consequent loss of local knowledge and identity;
- Decreased water availability for touristic uses will affect the supply for tourist resorts;
- Changes in seasonal precipitation patterns will increase the risk of flash floods;
- Reduced crops production will provoke changes of types of cultivated crops;
- Equitable distribution of resources implies good ecosystem services and decrease of externalities;
- Higher temperatures will affect cork regeneration and will increase fire risk and forest diseases, damaging the forest sector.

Possible adaptations

- Benefits are dependent on the correct implementation of policies and on the research and implementation of adaptive measures;
- Basin reforestation, fluvial restoration, more fast-flood resistant infrastructure, artificial recharge of groundwater.

Scenario C: "Current situation"

Impacts

- Water supply will be prioritized for the tourism sector at the expense of agricultural use and ecosystems;
- Water shortages might affect farmers and rural households;
- Inequity in access to water between different stakeholders prevails and rural migration to the coast continues, causing a loss of cultural and natural values;
- Coastal areas cover water demands by making new wells and diverting water from the Reserve.

Possible adaptations

- Fulfilment of current laws and normative and accomplishment enforcement;
- Introduce tourist taxes and effective water pricing; strengthen the common IBRM institutions.

Scenario B: "Most likely future"

Impacts

- Human security concerns under this scenario are similar, yet stronger than in scenario A;
- Lower precipitation and higher temperatures will cause a significant decrease of available resources.

Possible adaptations

- Raise awareness about water scarcity to facilitate adoption of unconventional techniques such as water reuse and desalinization, in parallel with improvement of infrastructure efficiency and reduction of consumption;
- More cooperation and participation is foreseen. This will benefit the rural population, support sustainable tourism and protect natural resources;
- Strengthening public administration in water governance is needed to guarantee water use equity and regulation fulfilment.

Scenario D: "Worst future"

Impacts

- The scenario is rather unlikely as the country has water regulations that control water distribution;
- A significant decrease of available resources will increase inequity between the rural and the coastal population;
- Rural exodus to coast due to ongoing water scarcity, resulting in abandonment of rural areas and a loss of local knowledge within the Reserve;
- Lower water availability will impact negatively on water quality, increasing water purification costs;
- Increase of flash-flood risk forces the development of new infrastructures, having negative impacts on ecosystems;
- Reduction of arboriculture (olives, chestnuts) and cork production and promotion of greenhouse agriculture;
- Increase of fire risks, the spreading of forest diseases and alien species;
- Changes in land use modify the landscape, with potentially negative impacts on tourism.

Possible adaptations

- Agriculture: shift to crops with higher water efficiency, more efficient technologies to reduce demand;
- Reinforce the law and anticipate future threats;
- Raise awareness about water scarcity favouring the reduction of water demand, the questioning of unsustainable infrastructure (golf courses) and the positive perceptions on certain water management practices (use of wastewater);
- Development of new and more efficient technologies.

Case study: Water vulnerability assessment to climate change in the Intercontinental Biosphere Reserve of the Mediterranean (Morocco-Spain)

The case study investigates the territorial vulnerability of water resources in the IBRM and the future climate change effects on hydro-ecological systems and human security. The article firstly analyses current and potential future impacts of climate change on various water-sensitive sectors and evaluates the present degree of adaptation as well as the adaptive capacity of these sectors to climate change. It then draws conclusions on the vulnerability of the IBRM by considering potential impacts, adaptation degrees and adaptive capacity and assesses to what extent the current IBRM institutional and management framework could address challenges to human security expected in this area. The vulnerability assessment was carried out based on climate projections, the application of a hydro-ecological model, as well as the participation of stakeholders and local experts to discuss a set of future scenarios of climatic and social changes. The IBRM vulnerability degree to global change was identified and relevant adaptation strategies and actions for local and national policy-makers were put forward. The authors suggest an integrated implementation framework in addition to the shared IBRM management plan and the national strategies in both countries in order to adapt to global change effects in the region (Pascual et al., 2012).

Recommendations, suggested policies, adaptation, institutions

Based on the present policies, strengthened institutional coordination is required in both countries in order to implement a common framework concerning climate change adaptation. Such directive needs to be adapted to both sides of the Reserve, guiding the sustainable planning, management and control of water resources at the basin level. For the IBRM as a whole, new institutions are not needed, but stakeholders suggested moving in the opposite direction: simplification of existing institutions, elimination of duplicities and cooperation among institutions. More concretely, the fulfilment of current laws and their enforcement, encouraging public participation and population co-responsibility in water management, promoting more efficient water technologies and solutions, improving the link between research, the public sector and private sector, introducing tourist taxes and effective water pricing, strengthening the IBRM common institutions and promoting *ex-ante* adaptive measures rather than *ex-post* measures are recommended. On the Spanish side, it is suggested to: improve the management of natural and forest areas, improve the existing infrastructures, take into account the need for monitoring networks, consider alternative water sources and improve the technical level of the public administration. Finally, on the Moroccan side, the following measures are advised: the integration of local knowledge in development planning (empowerment of civil society), the implementation of reforestation plans and natural systems preservation, the promotion of low water consumption irrigation systems, the use of alternative water sources in extreme scenarios, such as desalinization and re-use of wastewater, the change to crop species and varieties well-adapted to drought conditions and the reinvestment of economic benefits of water sector in the conservation and protection of natural resources (Pascual et al., 2012; Abdul Malak et al., 2012).

Table 10: Scenario focus group workshop. Results from Andalusia. Source: Abdul Malak et al. (2012).

Page 130: Table 11: Scenario focus group workshop. Results from Morocco. Source: Abdul Malak et al. (2012).

Slight CC – *Similar annual rainfall but higher variation in seasonality. Slight increase in mean annual temperature*

Strong CC – *significant decrease of annual rainfall (by 25% in the A1B scenario); changes in seasonal rainfall patterns, more than 2 °C increase of mean annual temperature*

Social and Political Change: Distribution of Water Resources

Cooperative Future - Equitable Distribution among Sectors

Conflictive Scenario – Inequity in allocation of water resources

Morocco
Hydro-climatic change by 2040: Droughts, changes in precipitation and increase in temperature

Scenario A: "Potentially beneficial changes"

Impacts

- Moderate decrease of available resources;
- A slight increase in mean temperature will favour the extension of the tourist season, particularly in mountainous and rural tourism;
- Increase of human impacts (e.g. pathogens);
- Relevant effects on ecosystem functioning: increase of forest decline effects, species migration and fire risk;
- Salinization of groundwater and decrease in availability;
- Increased demands of agricultural products for export (to Spain and other countries), increased water consumption;
- Changes in seasonal precipitation patterns will increase the risk of flash floods.

Possible adaptations

- Conscientiousness of the society;
- Integration of local knowledge in adaptation strategies: promotion of local products, craft, promotion of association and cooperatives;
- Basin reforestation and biodiversity preservation;
- Promotion of low consumption irrigation systems (dropping) through economic tools (e.g. subventions).

Scenario C: "Current situation"

Impacts

- Water supply will be prioritized for the development of non-sustainable agricultural practices (e.g. expansion of illegal cannabis crops);
- Increased environmental problems: soil erosion, soil fertility depletion, high water consumption;
- Land use changes produced by the strong economic competition of illegal crops with other alternative crops;
- Rural exodus to coast due to ongoing water scarcity and land degradation, loss of cultural and natural knowledge;
- Decrease in water quality and quantity;
- Changes in biodiversity and disappearance of species.

Possible adaptations

- Improve research on the impact of cannabis cultivation;
- Fulfilment of current policies and laws and reinforce their application;
- Persecution of cannabis trade to reduce production.

Scenario B: "Most likely future"

Impacts

- Human security concerns under this scenario are similar, yet stronger than in scenario A;
- Lower precipitation and higher temperatures will cause a significant decrease of available resources.

Possible adaptations

- Implementation of water adaptation strategies in all economic sectors;
- Strategies to ensure food security for population, rural development and equitable distribution of positive and negative externalities.

Scenario D: "Worst future"

Impacts

- The scenario is rather unlikely as the country has water regulations which control water distribution;
- A significant decrease of available resources will increase inequity between the rural and the coastal population;
- Rural exodus to coast due to ongoing water scarcity, resulting in abandonment of rural areas and a loss of local knowledge within the Reserve;
- Loss of biodiversity, changes in species distribution and spreading of alien species;
- Severe land degradation and erosion processes;
- Positive effect in salt production;
- Threatens to food security: shortage of food is a major driver of migration and may accentuate internal and external exodus.

Possible adaptations

- Fulfilment of current policies and laws and reinforcement of their application;
- Persecution of cannabis trade to reduce production;
- Shift to autoctonus species for both agriculture and forestry more adapted to arid conditions;
- Development of new and more efficient technologies and improvement of existing infrastructures;
- Reduction of water consumption and recuperation of traditional practices and local knowledge;
- Reinvest the benefits from water management into the preservation and conservation of the resource.

Case study North and South Sudan

"Frequently referred to as an example 'climatic conflicts', it is the legacy of a long history of violence that drivers vulnerability to climate change."

Map 14: Case study North and South Sudan (overview) Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 15: Case study North and South Sudan (detail). Source: GADM Vers. 2.0; CIESIN- GRUMPv1; ESRI World Imagery Basemap

6.2.5 North and South Sudan

Sudan is often cited as one of the first 'climate conflicts' in reference to the violence and insecurity that occurred in the three Darfuri states, although this claim has been the subject of much critique. Sudanese history has been marked by a nearly continuous history of violence. In 2005 a Comprehensive Peace Agreement (CPA) was signed and aimed at ending 50 years of conflict. On 9 July 2011, the Republic of South Sudan (RSS) successfully seceded from the north. However, the secession saw the emergence of new tensions and conflicts over contested borders, resources, territories and the fuelling of internal conflicts as a result of separation between both states. To carry out a comprehensive examination, this case study also considers the Republic of Sudan in the investigation. The recent state formation, human security, division and hydro-climatic factors are also salient factors of the research. The arid to semi-arid climate in Sudan has meant that it is traditionally exposed to a high level of climatic variability, requiring the adaptation of pastoral migration routes. Droughts and famines occurred in the 1970s and 80s, while floods occur regularly. Adaptation to water-related hazards in the context of conflict and endemic political instability has induced environmental and social stresses in the host communities and has been reported as producing conflicts between farmers, pastoralists and other forms of subsistence. This summary is based on the hydro-security profile of Sudan (Hoffmann and Selby, 2012) and a case study article (Selby and Hoffmann, 2012).

Focus of research

Sudan is frequently referred to as an example of a country where violence and insecurity originate in climatic conditions, such as increasing water scarcity, frequent droughts and erratic rainfall. The Sudan case study re-assesses this assumption and investigates the relationship between the division associated conflicts and threats to human security arising from hydro-climatic stressors. It provides an in-depth analysis of the contemporary and historical conflict dynamics by investigating three sets of potential links between environmental scarcities and conflict (1) over the transboundary resources of the Nile Basin; (2) over internal Sudanese environmental shocks and resource scarcities; and (3) over internal Sudanese projects agricultural and water development (Selby and Hoffmann, 2012).

Climate and climate change drivers

Historically, Sudan as an arid to semi-arid country has been exposed to many climate related hazards, such as regularly occurring droughts and floods. Rainfall ranges from almost zero in the arid north to almost 900 mm annual average in the regions bordering South Sudan. Long-term declines in rainfall have been observed over 50-years with losses of rainfall between 15 and 20 per cent (Funk et al., 2011). South Sudan has a climate similar to an equatorial or tropical climate, characterized by a rainy season of high humidity and large amounts of rainfall followed by a drier season. Together with spatial inequalities, temporal (i.e. seasonal) variability is one of the defining features of North and South Sudan's climate. For the future no drastic change in annual average rainfall is predicted but slightly wetter and warmer conditions are predicted for both states as well as an increasing degree of spatial and temporal variability, including more weather extremes.

Socio-political and economic drivers

Rainfall is crucial for all livelihoods as the majority of the population earn their livelihood from farming, pastoralism or agro-pastoralism. Traditional livelihoods have developed a high degree of resilience and suitable adaptation strategies to deal with the prevalent climatic variabilities but the specific socio-political conditions have made them more vulnerable. War and displacement have destroyed many traditional practices, complicated traditional adaptation strategies and led to environmental degradation in some places. Adaptation of pastoral routes and the

spread of mechanized schemes have triggered conflict between farmers and herders as traditional conflict resolution mechanisms were politically compromised (Bronkhorst, 2011).

Both North and South Sudan are faced with large numbers of Internally Displaced Persons (IDPs) and returnees placing additional pressure on environmental resources, most of them still located in Darfur. In addition to people displaced by conflicts in South Kordofan and Blue Nile, returnees from Khartoum's large urban South Sudanese population settle in vastly different environments as part of the return programme. This results in new dynamics and patterns of migration and different sets of problems. In the North uncertainties have increased in the wake of the Arab Spring. Since independence in July 2011, bilateral relations between the newly established RSS and the remaining northern state have gradually escalated into a series of informal wars. With around 40 per cent of the budget allocated to the security sector, the loss of almost the entire state revenue bears direct implications on the security situation and the RSS's ability to govern itself. The incomplete state and peace building processes hamper economic development and contribute to a continued dependency on humanitarian relief efforts by the international donor and aid community that in turn lack coordination.

Vulnerable groups and their characteristics

As the entire population is exposed to risks arising from ongoing conflicts, indentifying particularly vulnerable groups can be problematic. Vulnerability is not only related to direct exposure to armed conflict, but also includes effects such as displacement, disruption of traditional migration routes and cultural relations or trade relations caused by these conflict and more indirect impacts such as price hikes and water and food insecurity. Displaced people, returnees and other migrants suffer not only from physical threats by direct exposure to violence but also hydro-climatic stresses including water supply and sanitation issues, food insecurity and the frequent exposure of settlements to flooding,

particularly in the wet season. Furthermore, displaced communities may fail to adapt to unfamiliar environments as they lack knowledge of traditional coping mechanisms for new environments. Mobile populations such as pastoralists, cattle herders and farmers engaged in shifting cultivation depending on seasonal migration for their livelihoods can be identified as particularly vulnerable. Rural-urban migration has exacerbated inequalities in urban settings, with the access to basic services, such as the provision of water in sufficient quality and quantity being frequently disrupted.

Hydro- and human security concerns

Due to the complex history of Sudan's conflicts and the multiple ways they relate to environmental and climatic factors, the case study focused on three sets of conflicts: local community conflict, North-South division conflict and regional conflict related to the Nile basin. With the end of the war resulting in the independence of South Sudan, most casualties now result from community type conflicts such as conflicts around access to land, insurgencies in the peripheries as well as cattle theft. Particularly the latter form of conflict has triggered inter-tribal conflicts and warfare, especially in Jonglei state. Urban land conflicts around Juba are increasingly formulated in tribal terms with indigenous Equatorian tribes accusing Dinka members of 'land grabs' in the capital. The previous decades of conflict have destroyed traditional forms of conflict resolution and with the new institutions of governance still underdeveloped, there is a power vacuum with hardly any conflict resolution mechanisms in place.

North-South Division conflicts (violent as well as non-violent) broke out around Abyei and along the new border between the two main conflicting parties, the state armies Sudanese Armed Forces (SAF) and the Sudan People's Liberation Army (SPLA). While UNIFSA units now provide security in Abyei, Blue Nile and South Kordofan states face a high level of conflict between the SPLA-North and the SAF. International observers reported killings, bombardments and ethnic cleansings forcing many people to flee. Tightly connected to this escalating "war by proxy" are unsolved questions related to the end of the comprehensive peace agreement (CPA), in particular the allocation of oil revenues and disagreements over the final border demarcation. The last type of conflict related to the Nile water sharing is a non-violent form of conflict. The Nile water allocation poses a set of complex legal and political questions. Ethiopia and other upstream countries are trying to establish a Cooperative Framework Agreement (CFA) that would reduce Egypt's and North Sudan's water allocation.

Concerns for human security in future: scenario workshop

This outlook on future human security concerns is based on a scenario focus group workshop, which aims at the assessment of climate change impacts on society, human security and conflict constellations in North and South Sudan.

Table 12: Scenario focus group workshop. Source: Hoffmann and Selby (2012).

Hydro-climatic change: Changing patterns of precipitation

Stable climate, availability of natural resources to secure livelihoods and human security | *Changing climate, increasing environmental variabilities and risks, scarcity of resources*

Socio-economic and political (in-) stability and availability of resources for human security and livelihoods

Political stability | Political instability – Violent conflict on domestic and interstate level

Scenario A: "Promising future with drawbacks"

Impacts

- Improved overall security situation and fiscal stability allowing investments in infrastructure improvements and fostering economic development;
- This leads to higher rates of urbanization and a higher participation of actors in markets with positive outcomes on food security;
- Contributes to transition from semi-traditional livelihoods to modern state;
- Human security is perceived to be particularly at risk due to the rapid transformation of traditional livelihoods along with poorly planned and supervised investment activities.

Possible adaptations

- To mitigate future conflict risks well-considered land use planning and conservation efforts by the relevant authorities are needed;
- This would require improved data collection, sharing and knowledge exchange between government institutions.

Scenario B: "Continued vulnerability with adaptation"

Impacts

- Continued vulnerability and higher exposure to floods and droughts;
- Due to the political stability these effects and threats to food security can be mitigated by infrastructure investments and large-scale adaptation investments, e.g. to increase agricultural production;
- Involvement of FDI.

Possible adaptations

- Infrastructure investments need to ensure distribution of water, particularly of the Nile water to vulnerable areas, ensuring flood control and taking care of unintended side effects;
- Improved planning processes including feasibility studies and community involvement are emphasized;
- Early warning systems for flood protection were proposed.

Scenario C: "Political Instability and Small-Scale Agriculture"

Impacts

- Continued conflict and support by humanitarian organizations slows economic development down;
- Stable climatic conditions lead to good harvests and availability of natural resources.

Possible adaptations

- Despite the government's priority on large-scale infrastructure investments for increased agricultural production, developing small scale agriculture might be more feasible under political instability and conflict conditions;
- To address the current lack of agricultural activity, de-politicized demobilization efforts, as well as re-education related to farming skills is needed

Scenario D: "Worst Case Scenario"

Impacts

- Continued security breakdowns hamper long term planning and infrastructure investments for effective water management and food security;
- Rainfall variations reduce harvests;
- Environmental degradation changed cattle routes, which in tandem with climatic variabilities can lead to conflict;
- Unregulated migration driven by the search for economic opportunities.

Possible adaptations

- Strong dependency on international donors and the aid community, who need to improve their coordination of activities to avoid negative side effects;
- Shortcomings of existing policies are related to their implementation, rather than to missing policies.

Case study article: Beyond 'Scarcity', 'State Failure' and 'Under-Development': Rethinking Water, Climate Change and Conflict in North and South Sudan

Based on a thorough review of the concepts of 'scarcity', 'state failure' and 'under-development', the case study article analyses three different lines of conflict to understand the links to environmental change: (1) conflicts over the transboundary resources of the Nile Basin; (2) conflicts over internal Sudanese environmental shocks and resource scarcities; and (3) conflicts over internal Sudanese agricultural and water development projects. The qualitative research on water-conflict relations draws upon fieldwork conducted in South Sudan in 2011 and 2012 as well as interpretations of existing literature on Sudanese history, environment and political economy. The article elaborates on potential future developments and how these might impact vulnerability and the adaptive capacity of South Sudan.

Results indicate that abundance of water seems to be a much stronger conflict driver than scarcity in general, but it is important to understand the socio-historical contexts within which conflicts are embedded. The authors find that the state agency is key to understanding conflicts in both Sudans and that this can be best described as a process involving multiple local, national and global agents and structures and the complex and multi-facetted ways in which societies are integrated into the global political economy (Selby and Hoffmann, 2012).

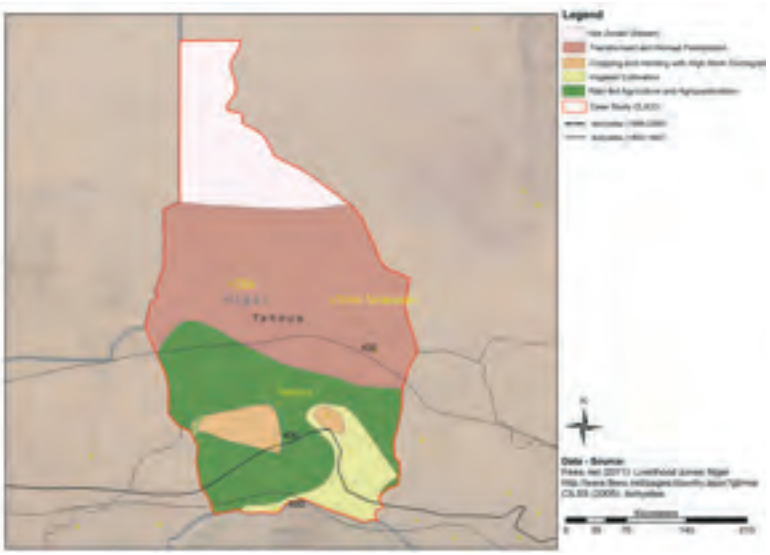
Recommendations, suggested policies, adaptation, institutions

The most important step towards improving human security in both Sudans is the strengthening of independent state institutions by increasing effectiveness, public accountability and allowing for unlimited access to justice. In the long run, this would allow for greater participation in decision-making processes and diminish social and political discontent, reduce armed opposition and allow for democratic processes and freedom of expression. A more accountable public order and implemented rule of law is a precondition for socially and environmentally sound planning processes with a focus on climate change adaptation. The diversification of livelihoods away from the security sector (applies mostly to South Sudan) and economic activities to lower dependence on hydrocarbon revenues is recommendable for both states. Donor and other aid activities require a higher degree of coordination (Hoffman and Selby, 2012; Selby and Hoffmann, 2012).

Case study Tahoua Region of Niger

"Highly vulnerable to changing environmental conditions with a growing number of conflicts between pastoralists and agro-pastoralists."

Map 16: Case study Tahoua Region of Niger (overview) Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.



Map 17: Case study Tahoua Region of Niger (detail). Source: Fews net (2011).

6.2.6 Tahoua region, Niger

Niger is primarily an agrarian economy where the majority of the country's 16 million people are employed in rain-fed agricultural cultivation or livestock rearing. Both pastoral and agricultural livelihoods are highly dependent on ecosystem services, making them vulnerable to changing environmental conditions and resulting in frequent food insecurities. Frequent droughts and climatic variability require continuous humanitarian assistance in many parts of the country. Rainfall quantities and patterns dictate the limits of pastures and crop cultivation and strongly influence the degree to which the rural population relies on either activity. Changes in environmental conditions together with demographic, social, political, institutional and economic changes have altered the livelihoods in Niger. Changes in seasonal movements of population and herds, together with agriculturalists spreading their fields northwards into contested land, result in increasing difficulties for pastoralists seeking water and pasture in the south, especially along traditional livestock routes as well as in crop damages. These changes are leading to growing conflict. Conflict is concentrated along an unmapped-border: the 350 mm isohyets which delineates the two respective land use activities (Lycklama, 2000; Mohamadou, 2005; Bernus, 1970). Furthermore, the cultural ties that used to support these two dependent cultural groups are weakening (Rossi, 2009).

Focus of research

The case study identified adaptation measures and adaptive capacities of pastoralists and agro-pastoralists in the region of Tahoua to losses of ecosystem services and rainfall variability and illustrated the role of institutions in governing access to resources, avoiding conflicts and framing adaptation.

Climate and climate change drivers

According to future climate outlooks, high spatio-temporal variability in rainfall patterns will increase. Since the 1990s, small-to large-scale droughts have occurred every two to five years (Hengsdijk and vam Keulen, 2002). Flooding of valleys and watersheds is recurrent and often destructive. Temperature has gradually increased since the 1970s with particularly high temperatures from 1990–2007 (Agrhymet, 2007). The climate outlooks for the A1B scenario for Tahoua suggest a slight increase in rainfall on average but a change in precipitation patterns: less rainfall during the rainy season and more rainfall during the dry season (Bruggemann et al,. 2012a). The livelihoods of the two dominant groups in the case study area, pastoralists and agro-pastoralists depend strongly on natural resources and are directly affected by variability in rainfall.

Socio-political and economic drivers

Democratization and decentralization processes in Niger are creating a more pluralistic governance structure where elected actors and the colonial established chefferies (customary officials) respond to similar needs of the population. The dualistic nature of leadership weakens the whole governance process through varied interpretations of laws, incongruent decision-making and corruption. The diverse cultural groups in Niger including the Hausa, Fulani and Tuareg compete for resources, political influence and power. The current policy frameworks for governing rural spaces, in particular the "Rural Code", are meant to secure access to water and land for rural producers and avoid conflicts; however, sometimes lack of enforcement or poor interpretation leads to some adverse effects. For instance, the code makes it easier for farmers to declare land and enforce their rights than it is to declare a pastoral space. The "Water Code" particularly interferes with the system of priority use rights in the home territories of the pastoralists in the pastoral zone as it manifests that access to water is open for all. Additionally, some former Tuareg

rebel groups in the North of the country who once fought for political influence, prevention, support in times of crises and access to resources, are now contributing to banditry and illegal activities to survive. These drivers not only impact the country's long-term stability but also further weaken the pastoralists' access to resources while encouraging them to conform to agropastoral livelihoods and take up farming.

Vulnerable groups and their characteristics

Both pastoral and agro-pastoral livelihoods are highly vulnerable to climatic changes. Food insecurity is a prevalent threat affecting on average 1–3 million people in Niger per year (FEWS net, 2012). Many farmers need additional food when stocks are already depleted due to flooding or drought, and have adapted by purchasing livestock as "insurance" against food insecurity (Toulmin, 1983; Bassett and Turner, 2007). Mobility makes pastoralists well adapted to variability and erratic rainfall, however recurrent droughts coupled with increasing numbers of animals (many of which are owned by agropastoral households) cause overgrazing in the pastoral zone and are contributing to increasing animal losses during drought and thereby threatening pastoral livelihoods. As a result, many pastoralists have transitioned to partial or full sedentary lifestyles. Both pastoralists and agropastoralists must send several family members abroad to work and supplement household income. Migrant workers and smallherd pastoralists are considered to be the most vulnerable groups (Snorek et al., 2012a).

Concerns for human security

Increasing agro-pastoralism is a widespread adaptation to environmental hazards and climatic variability but also to socio-economic and demographic pressures. As a result, many pastoralists transform their livelihoods and become sedentary

Photo 3: Small livestock of Gidan Ahmad guided by Fulani shepherd into plateau millet fields. Source: J. Snorek.

agro-pastoralists. Farmers practice agro-pastoralism through keeping livestock locally and/or sending their herds with herders on transhumance. Cultivation dominates in water-rich areas such as seasonal lakes or valleys but is also expanding into both the official pastoral zone and designated livestock routes. Livestock and farming are thus in competition for access to land and water and former social and cultural institutions designed to govern limited resources are met with greater challenges. Conflicts that evolve are related to the ways in which resources are distributed and accessed (mainly pasture, water and cultivated land) as well as changing social and cultural moralities in the Sahel (Blench, 1996; Fratkin, 1997; Hendrickson, 1997; Lycklama, 2000; Thébaud and Batterbury, 2001; Peluso and Watts, 2001b; Turner, 2004; Mohamadou, 2005).

Concerns for human security in future: scenario workshop

Following this context, 12 experts, members of the commission on pastoralism, experts in hydrology, experts in meteorology, policymakers, and practitioners met in Niamey to explore future hydro-security, conflict conditions and outcomes on 13 December 2011. The results of this discussion are reported below.

Case study article: Divergent adaptation to climate change and changes in ecosystem services: A pastoral-agricultural case study of Niger

Using the example of pastoral and agricultural communities in northern and southern rainfall zones of Niger, the case study illustrates the role that institutions play in managing the adaptive capacity of historically divergent natural resource users faced with changes to ecosystem services. One hundred fifteen qualitative interviews with sedentary agriculturalists and agro-pastoralists, semi-nomadic and nomadic pastoralists and community leaders from both customary and democratically-elected posts, have identified the human and climate-related factors that have caused significant losses of ecosystem services for both pastoral and agricultural activities and the consequent adaptations of both groups. The research has shown that agro-pastoral communities of dominant ethnic groups in the South and pastoral groups possessing greater economic and natural resources in the North have greater adaptive capacity and exhibit more divergent adaptations[28]. Contributing to this, local and departmental institutions are attempting to secure agricultural fields against crop damage through increased payment for crop damage by pastoralists. Residues from agricultural fields (primarily millet and sorghum stalks) became a commercial product that is now sold to pastoralist instead of letting them graze freely. In response to the contestation over pasture and water in the northern pastoral zone, pastoralists are building wells in their home territories (which permit the control of the surrounding space) and changing their patterns of transhumance (Snorek et al., 2012b).

Recommendations, suggested policies, adaptation, institutions

Based on both the current conditions of hydro insecurity and the predictions developed in the scenario workshop, it is recommended that current legislation be more effectively enacted and better communicated to the key rural groups. Institutions are already in place, but roles and responsibilities of the authorities need to be streamlined. Lack of resources and under-capacity is a major problem for many authorities. Farming activities are favored over pastoralism by many institutions and the legislative framework to securing pastoral livelihoods needs to be implemented (Snorek et al., 2012a; Snorek et al., 2012b).

28 The term divergent adaptation describes a situation in which the successful adaptation of one group causes a positive, negative or neutral change of another group's adaptive capacity.

Table 13: Scenario focus group workshop results. Source: Snorek et al. (2012a).

Hydro-climatic Change: Drought and flooding 2031–2050

Social and political change: Protection of common space	*No change in the frequency of drought/flood events*	*Increase in drought/flood events*
No change in the current rate of settlement, cultivation and fencing off of the pastoral (common) spaces	Scenario A: Average → *Very unlikely*	*Scenario B: Worse* *Impacts* → Pastoral space will increasingly be lost to agricultural production, because farmers seek available land in the North and migrate; → Degradation takes place due to climatic changes and unsustainable use by farmers, leading to declines in yield; → With decreasing yields livestock numbers will increase, further degrading pastoral spaces and reducing the adaptation possibilities of pastoralists; → Slow cultural and economic transformation of vulnerable pastoralism to agro-pastoralism and loss of cultural values, lifestyles and indigenous knowledge; → Increased demand for fodder and commercialization of fodder, limited livestock mobility and value, greater land scarcity; → Shift from rain-fed farming to irrigated farming with impacts on water resources. *Outcome on conflict/cooperation:* → During the transition period more conflict will arise between continuing pastoralists and former pastoralists over land use and crop damage; → Once the regime of agro-pastoralism has been established, the necessity to cooperate will dominate; → Other experts held a contrary opinion that greater adoption of agro-pastoralism would aggravate conflict and competition over land and water resources.
Protection of current formally and informally designated pastoral (common) spaces by institutional and social structures	Scenario C: Optimistic → *Very unlikely*	Scenario D: Average *Impacts* → Continuation of pastoralism, preservation of pastoral lifestyle and culture; → Protection of the space indirectly causes pastoralists and agro-pastoralists to increase the size of herds producing further degradation; → Stagnation of crop expansion, new livelihoods evolve; → Scarcity of farming land increases its value (land market, speculation) and may induce an amelioration of land use techniques (soil conservation, fertilizer, irrigation) and more sustainable practices; → Higher value of agricultural products, commercialization of fodder; → More climate adapted livestock (camels, goats) and new itineries of pastoralists to meet changing rainfall conditions; → Expansion of wells in pastoral zone due to more users. *Outcome on conflict/cooperation:* → Continuation of the current patterns of conflict, e.g. conflict in home territories between pastoralists and herders but also around the issue of crop damage.

Case study The Ebro Delta in Spain

"Water use and management has historically been a crucial issue in the Delta."

Map 18: Case study The Ebro Delta in Spain (overview)
Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 19: Case study The Ebro Delta in Spain (detail).
Source: GADM Vers. 2.0; CIESIN- GRUMPv1; ESRI World Imagery Basemap

6.2.7 Ebro Delta, Spain

The Ebro Delta, situated on the north eastern Mediterranean coast of Spain is host to a population of 154,555 inhabitants (IDESCAT, 2010). An important part of the Ebro Delta population works for the primary sector with jobs mainly linked to irrigated rice production and the fishing industry. Tensions between different water using communities, such as irrigation communities, the fishing and shellfish farming sectors, conservation organizations and the scientific community could be aggravated by a decrease in water availability. Floods which have historically resulted in the breakdown of irrigation canals around every five years are also a significant water hazard and have led to a loss of capacity to regulate water availability for agriculture use as well as being a hazard for human settlements. Water use and management as well as changes with regards to water management and its conditions have historically been a crucial issue in the Delta and influence changes in the central economic activities and natural environment of the Delta. The decrease of available water could further increase tensions between local institutions (e.g. irrigation communities vs. fish and shellfish sectors localized in bays), but also between institutions upstream and the Basin coordination institution ("Confederación Hidrográfica del Ebro", CHE). The existing tensions could be further sparked by a reduction of available water. This summary is based on the hydro security profile of the Ebro Delta (Boyero and Zografos, 2012) and a case study article (Albizua, 2012).

Focus of research

The Ebro Delta case study explored how climate change impacts interplay with current socio-political conditions and to what extent this influences human security, local perceptions regarding future water availability and the potential for social tensions and conflict. It also seeks to reveal, using Q methodology, discourses and perceptions on vulnerability, adaptation, human security and governance related to climate change held by inhabitants of the Ebro Delta and decision makers (Albizua, 2012).

Climate and climate change drivers

The main water hazards the Ebro Delta faces are drought, coastal regression and salinization. Floods have historically also been a major water-related hazard in the area. The main climate-related changes affecting the Delta are likely to be changes in the surface level of the Mediterranean Sea. Under the A1B scenario, for the 2031–2050 period relative to 1980–1999, anticipated changes in annual precipitation for the Delta area are almost equivalent to those of the upstream area (6–7 per cent). For the A1B and A2 scenarios for 2040–2069 relative to 1961–1999 not all models for the Delta pointed to a decrease in precipitation. Model results find a steady decrease in precipitation for the upstream areas. With regards to mean annual temperature an increase is envisaged to be similar throughout the basin. Between 1961–1990 and 2040–2069, the median of the model projections pointed to a 1.6 °C possible increase for the B1 scenario and a 2.2–2.4 °C for the A1B and A2 scenarios (Bruggeman et al., 2012a).

Socio-political and economic drivers

Wetlands in Spain have historically been known for their harsh living conditions, remoteness and the occurrence of diseases have lead to their seclusion. Rice production was bolstered in the Delta from the beginning of the 19th century, taking off more substantially in the second part of the 20th century. A lack of infrastructure in the area has developed local grievances and a strong perception by locals that they are ignored by the administration (Bel, 2008). This situation is viewed by them as one of unequal power distribution in the decision-making process leading to growing territorial imbalances. The 2001 National Hydrological Plan (PHN) that attempted to implement water transfers from the Ebro river towards other areas of the country has reinforced the feeling of distrust towards the way the government manages water in the region.

The existence of multiple institutions is characterized by a lack of coordination and information flow in their activities. For example, each time a new measure is introduced, poor or lack of communication has led to concerns voiced by local people on the nature of the activities undertaken by those institutions (Interview: Public Administration). In addition, the Ebro hydrographical basin, which is managed by the national administration (Ebro Hydrographical Confederation) includes numerous stakeholders in water management. These different stakeholders have diverse interests, principles and influences which have led to power imbalances when dealing with interest representation in decision-making. Conflict of interest has emerged on issues surrounding the environmental flows of the Ebro river between different institutions dealing with water management. Proposals at various levels have rendered it difficult to obtain a consensus on the matter. Instead, European institutions benefit from positive local perceptions due to their past, locally favourable involvement with environmental policy in the area.

Vulnerable groups and their characteristics

The quality and quantity of available water resources and water hazards play a crucial role in determining vulnerability in the Ebro Delta. The principal vulnerable groups in the Ebro Delta are those working in the primary sector. However, climate change's impact could affect the whole Ebro Delta population. The rice sector, mostly a middle class income sector characterized by self-employment of mainly male Spanish nationals, comprises one of the most vulnerable groups in the area. Coastal regression and the advance of the salt wedge threaten a certain perimeter of the Delta, increasing vulnerability. Another key vulnerable sector is the fish-shellfish sector mainly situated in the bay areas. It is also characterized by self-employment of mainly male Spanish nationals with low-medium qualifications and low-medium income. This sector is found to be more vulnerable than the rice sector due to the impossibility of complementing their jobs with other ones. The third vulnerable group identified is that of inhabitants of urbanized centers like the villages of Riumar and Poble Nou. These are mostly residential and touristic areas. Losses of personal and tourism assets are the main impacts in these areas.

Hydro- and human security concerns

Five key milestones of conflict and cooperation processes in the water management of the Ebro Delta were identified over the three last decades. This has been done through a comprehensive media and secondary data review and in-depth interviews. The first milestone identified is the 1981 mini-water transfer agreement that allowed farmers to sell part of the water allocated to them thus providing them with some material and political influence over water resource management in the area. The second milestone is found to be the attempt to dry up the lagoon in the Bombita farm in 1982, one of the last pools of high ecological value in the Delta. This attempt fomented a popular movement to halt the project, which after negotiations with the regional government lead to the creation of the Natural Park of the Ebro delta in 1983 (Interviews: Natural Park and member of popular movement). The third, fourth and fifth milestones are tensions in water management which emerged in the last decade and were focused on water transfer plans through the development of the 2001 PHN and the ensuing PDE which opposed it. Research conducted through the Ebro Delta case study highlights the fact that conflict and cooperation processes co-existed and interacted with each other in a dynamic way through all historical milestones.

Concerns for human security in future: Scenario workshop

Eleven stakeholders including representatives from agriculture, environmental organizations, tourism, administration and education as well as social movements discussed impacts related to human security and water availability, vulnerable groups and adaptive capacity for the Ebro Delta during a scenario focus group workshop that took place in 2011 in the village of Deltebre.

Hydro-climatic change by 2042–2069: Rainfall, droughts and coastal regression

Water management

	Little change – *Slightly less precipitation and slight increase in temperatures*	Strong changes – *Severe decline in rainfall and strong coastal regression*
Same water management planning and increase of water concession	**Scenario A: " A chance"** *Impacts* → Upstream water use is likely to increase given the current water management, decreasing water availability and quality in the Ebro delta; → In combination with a decreased availability of water, productivity will decrease, while prices of rice, fish and shellfish sectors will increase, leading to higher rates of unemployment and loss of competitiveness of the local productive sectors; → Impacts on the tourism sector are ambivalent (loss of beaches vs. longer summer season); → Salinization and coastal regression will change ecosystem dynamics and particularly impact the rice cultivation negatively leading to losses in biodiversity and environmental degradation. *Possible adaptations* → Public participation and real enforcement of local interests; → Reinforce existing institutions (in particular the Commission for Sustainability); → Improve coordination, transparency and involve European Union institutions.	**Scenario B: "A reality"** *Impacts* → Similar impacts as in Scenario A, but of stronger intensity; → Potential disappearance of primary sector, a significant reduction of jobs and income, as well as negative impacts on the tourism sector; → Loss of socio-cultural heritage in addition to natural heritage-losses; → Severe degradation and salinization of soils; → Food availability may decrease, while diseases may increase; → Coastal regression and possible conflicts over relocation and tensions due to inadequate management of the situation; → Due to these changes, social cohesion could be reinforced, but also conflicts of interest around water management are possible. *Possible adaptations* → Reinforce existing institutions; → Management measures and capacities to ensure adaptation to CC are generally viewed with suspicion; → Yet, the establishment of a social movement demanding respective adaptation measures is not envisaged.
New hydrological plan, including water transfer	**Scenario C: "Other delta"** *Impacts* → Lower water availability in the Delta will reduce the availability of food with potential negative impacts on health and nutrition, particularly rice cultivation will be lost; → Deep transformation of the Delta with respect to change in livelihoods, identity, ecosystem and landscape changes; → Migration processes; rural-urban migration; → Social cohesion against water transfer plan. *Possible adaptations* → Reinforce existing institutions (distrust they can provide solutions); → Adaptation capacities will be insufficient due to the weak political representation of the needs of the Delta and unequal power distribution; → New local reactions against water transfer program articulated through social movements (PDE); → Expectation for European Commission intervention.	**Scenario D: "Slight Improvements"** *Impacts* → A complete loss of the socio-political heritage as the primary sector vanishes completely; → Large parts of the Delta´s population are predicted to migrate. *Possible adaptations* → Massive distrust for the administration whether or not it is able to handle the consequences; was expressed → Reinforce existing institutions; → Migration management plans to control rural-urban migration; → Expectation for European Commission intervention.

Table 14: Scenario focus group workshop results. Source: Boyero and Zografos (2012).

Case study article: A value based approach to vulnerability and adaptation to climate change. Applying Q-methodology in the Ebro delta

The Ebro case study article looks at vulnerability and adaption to climate change by taking values and perceptions of affected people and decision-makers into account. By applying Q methodology, the authors identify different perceptions between those affected and decision makers.

Five discourses were identified which relate to perceptions on vulnerability, adaptation, human security and governance, social justice and security. Inhabitants and decision makers place different values on these discourses which call for a compromise between them. For inhabitants, expert scientific knowledge and economic arguments should have a much greater stake in the debate than they currently do. All discourses agreed that the opinion of scientists should be seriously taken into account in decision-making and policy formulation, clearly reflecting trust in expert knowledge and its application. Inhabitants however, fear being "disposed of water" (Albizua and Zografos, 2012:15) for uses outside the Delta and in spite of state-led adaptation efforts. This seems to confirm Zeitoun and Warner's (2006) finding that "silent conflicts" are often caused by excessive water use, transfer or contamination by hydro-hegemonic actors (Albizua, 2012).

Recommendations, suggested policies, adaptation, institutions

The Ebro Delta study underlines several issues which should be considered in the light of future climate changes in the area. In order to reduce the possibility of securitizing water resources, enhance human security and gain people's trust in public institutions, it is necessary to address the relevance of water transfers for adaptation management, i.e. that such transfers could further exacerbate vulnerability. They also call for more dialogue and deliberation between inhabitants and those managing resources to address differing perceptions. A suggestion to reinforce the competence of the Commission of Sustainability of Terres de l'Ebre was put forward in interviews with stakeholder focus groups. Finally, a key approach to restore the trust of the local people with regards to their perception of being historically marginalised would be by specifying the environmental flow of the Ebro River, taking into consideration the final stretch of the river (Boyero and Zografos, 2012; Albizua, 2012).

Case study Seyhan basin of Turkey

"Highly vulnerable to climate variability and home to an already marginalized group in society: migrant seasonal agricultural workers."

Map 20: Case study Seyhan basin of Turkey (overview) Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 21: Case study Seyhan basin of Turkey (detail). Source: GADM Vers. 2.0; CIESIN- GRUMPv1; ESRI World Imagery Basemap

6.2.8 Seyhan River Basin, Turkey

The Seyhan River Basin in Turkey is situated in the Eastern Mediterranean which is a region extremely vulnerable to climate change. The River Basin covers a surface of approximately 25,000 km² and is the second biggest river drainage basin area in the Eastern Mediterranean after the Nile. It is one of the most productive agricultural regions in Turkey and Europe, characterized by rain-fed agriculture mid- and upstream and irrigated agriculture in the lower flat region. In addition, Seyhan has historically been an important location for the production of wheat and cotton which are important crops for the Turkish economy.
The main hydro-climatic threats identified are an increased intensity and frequency of droughts and the salinization of soil. Both of these threats are adding up to excessive groundwater extraction and the use of drainage waters for irrigation. Further projections include a decrease in rainfall, a decrease in water resources, reduced snowfall, an increased occurrence of droughts, an increase in evapotranspiration, and increases in average temperatures (Watanabe, 2007; Şen et al., 2008). The manifestation of these impacts combined with an increasing population and an increase in water demand will negatively affect agricultural production in Seyhan. Migratory agricultural laborers are particularly vulnerable to variations in climate and unexpected shocks as these conditions change the demand for labor. This summary is based on the hydro security profile of the Seyhan basin (Turhan, 2012a) and a case study article (Turhan, 2012b):

Focus of research

The Seyhan River Basin research focused on the lower/downstream parts of the basin which are fed by the Seyhan River. The case study analysed threats on water and human security and their interconnectedness at a local level in the context of future expected climate change impacts in this region (Turhan, 2012a). The Seyhan case study looked at governmental adaptation policies and their impacts on a particular vulnerable group: migrant seasonal agricultural workers (Turhan, 2012b).

Climate and climate change drivers

The Seyhan Basin is characterized by a predominant Mediterranean climate with mean annual rainfall across the basin of 640 mm, mean annual evapotranspiration of 1560 mm and a mean annual temperature of 18.8°C. Under the A1B emission scenario a 10 per cent decrease of precipitation is found for the irrigated coastal plain and for the upstream area. This decrease was anticipated by all 20 models. A more severe reduction in precipitation, downstream rather than upstream, was found in the three scenarios for the 2040-2069 timeframe. Fujihara et al. (2008a) predicts changes in runoff by in the basin decreasing from 228 mm for the 1990s to 109 mm and 89 mm in 2070-2080, an increase in temperature of (2.0–2.7°C) and a decrease in precipitation of (25–29 per cent). Under the A2 scenario Fujihara et al. (2008b) anticipated a higher frequency of droughts conditions (2070-2099) and a reduction in the frequency of floods.

Socio-political and economic drivers

The Lower Seyhan region (as part of the broader Çukurova region) has been at the forefront of agricultural transformation and has been a constant stage of confrontation between populations, global agricultural markets and an example of state-led developmentalism in Turkey. An increase in the demand in cotton during the late Ottoman Empire shaped Egypt and Turkey to emerge as cotton producers and was the driving force in the region for the development of a labor-intensive agriculture and a decreased abundance of sharecropping in the region (Toksöz, 2009; Toksöz, 2000). In the period following World War II (WWII), Çukurova (Low Plain in Turkish) was characterized by the extensive immersion of capital and mechanization in agriculture (Özu-urlu, 2010). Turkey's IMF and OECD membership after WWII brought widespread changes in national agricultural policies undertaken after the 1950s. Turkey acquired an agricultural provision role in the new world system in post WWII (Ünsal, 2004). A significant amount of modern agricultural tools and intensification of

agriculture in the basin led to a demand for cheap labour. Since the 1950s in the Seyhan region, the precarious working and living conditions of seasonal agricultural migrants have been debated. However, little has changed in terms of the demand for cheap and precarious labour in spite of the changes of export-led agriculture. The 2001 agricultural reform implementation project (ARIP) that followed the 2001 economic crisis in Turkey had a strong impact on agriculture in the country with the replacement of agricultural subsidies with direct income support. This lower part of the basin has the highest rate of unemployment in Turkey with 19,1 per cent (TURKSTAT, 2011). It is undergoing changes in agricultural employment through increasing mechanization and a shift from capital-intensive crops such as maize to labour-intensive crops such as watermelon. It has been pointed out that this may trigger social problems (DPT, 2004; TURKSTAT, 2009; Sabah, 2011). This region's economy is mostly made up of agriculture, textile industry, paper and pulp industry, chemicals industry, machinery and logistics (Çukurova Development Agency, 2010: 211).

Vulnerable groups and their characteristics

The most vulnerable groups identified in the Seyhan research are predominantly but not entirely the most economically fragile ones. The first vulnerable community is that of small farmers who own less than 5 ha of land, as average land holding in the area is of 7.43 ha (Provincial Directorate of Agriculture, 2011). Farmers are vulnerable to price fluctuations, market dependency, changes in mean temperatures and a decrease in precipitation (Bruggeman et al., 2012a). In addition, a shift of the cultivation season will reinforce this vulnerability through an increased need for irrigation, decreased water availability for irrigation and increased evapotranspiration. The second vulnerable group in Seyhan has been identified as migrant seasonal agricultural workers whose year-round income depends on the sustainability of labour-intensive agriculture in the region. This category of workers migrate to the region for sowing, setting up greenhouses, hoeing and harvesting of products, mainly cotton, fruits and vegetables, as negotiated between agricultural intermediaries and landowners. Seasonal agricultural workers face high environmental risks and socio-economic marginalization in the lower Seyhan River basin.

Hydro- and human security concerns

The lower Seyhan River basin is not characterized as being a particularly conflict-prone area. Its nature as an internal basin with no transboundary claims over water use and well-established irrigation scheme managed mainly through WUAs, makes it currently hard to claim competing interests over water. As a result, it is difficult to anticipate future conflicts, due to extreme weather events or water related tensions becoming apparent in the region. In spite of this, some tensions that exist along the lines of class-based or ethnicity-based conflicts could be further exacerbated by the anticipated changes in the climate affecting agricultural productivity in the region. The main factors which are expected to increase vulnerability to climate change in the area are: dispossession of rural communities, continued demand for cheap labour and ethnic segregation as well as trade, globalization and geopolitical changes. Rural-urban migration flows have induced an important pressure on employment, services provision, housing, social security and urban safety (Aydın and Toksabay Esen, 2010). Recurrent tensions that emerge between farmers and workers due to delays in payments and conditions have not led to significant confrontations between both groups. These conflicts have remained silent due to the marginalization of and the control over seasonal workers. The most substantial conflict-related event took place during the 2007 strike organized by the Çukurova Agricultural Labour Intermediaries' Association (Birgün, 2007).

Photo 4: Housing conditions . Source: E. Turhan.

Concerns for human security in future: scenario workshop

The scenario workshop was held in Karataş' Chamber of Agriculture with 10 stakeholders representing WUAs, land owners, provincial and local administration. The key concepts "water security" and "human security" were understood by participants as follows: water security was mainly seen as the timely provision of quality water in adequate amounts, while human security was defined in close connection to human welfare and human well-being.

Case study article: How to disappear completely: Migrant agricultural labour, climate change adaptation and neoliberal state intervention in Turkey

The case study article focuses on the political economy of capitalist development in Turkey and analyses how the "state" can create and maintain vulnerability of particularly vulnerable social groups, a field of research that is generally under-represented. The case study looks at migrant agricultural workers and how they are affected by governmental interventions addressing climate change adaptation in Turkey. The main research question it aims to answer is to what extent these interventions impose certain adaptation strategies on migrant agricultural workers and whether these imposed strategies differ from their own preferences. Using the Seyhan basin as a case study, observations and semi-structured interviews were conducted to reveal the perspectives of migrant seasonal workers, landowners and state officials on climate change adaptation. This was then compared to the results of a policy analysis of two main policies relevant in the climate change adaptation context (Turkey's National Climate Change Adaptation Strategy and Action Plan and the Strategy and Action Plan for Improving Work and Social Lives of Seasonal Migratory Worker).

The results suggest that the state imposes a particular adaptation pathway to migrant agricultural workers, but does not address equity or human security improvements for this group. The government failed to take into account the values of this group which has contributed to manifesting their vulnerability to climate conditions. The paper argues against a top-down reductionist neoliberal state intervention to climate change adaptation to avoid further marginalization of migrant seasonal agricultural workers (Turhan, 2012b).

Recommendations, suggested policies, adaptation, institutions

In order to deal with the potential future impacts of climate change in the lower Seyhan River Basin it is recommended that a better coordination of social policy and climate change policy under the Adana Governorship be implemented as current policy interventions that deal with seasonal agricultural workers do not address anticipated changes in the climate and environmental risks. It was also suggested that an overarching human security monitoring committee under the governorship be established as an innovative step. This committee could manage the interlinkages and overlaps between the different areas of social, agricultural and environmental policy (Turhan, 2012a; Turhan, 2012b).

Hydro-climatic change: Drought, salinization, sea level rise

Social and political change: Subsidies, direct income support	Moderate increase in intensity and frequency of droughts, ongoing salinization	Strong increase in intensity and frequency of droughts, ongoing salinization
No change in subsidies and direct income support	"Continuation of status quo" *Impacts* → Population decreases due to rural-urban migration; → No drastic changes in life styles; → Lower crime rates and a more secure life with less competition for resources; → Perceived as the most likely scenario. *Possible adaptations* → An increase in agricultural subsidies would slow down rural-urban migration.	"Outmigration"´ *Impacts* → Most participants expected negative impacts; → Competitiveness would be highly limited due to climatic changes and increased input costs; → Seasonal workers will not be needed and will migrate out. *Possible adaptations* → Change of cropping patterns towards vegetable farming and irrigation.
Removal of subsidies, open access to markets	"Open markets scenario" *Impacts* → Under the current scheme of direct income support policies the state neither encourages producers to increase their productivity nor to adapt to changing conditions; → Removal of subsidies and free market access would boost production as there are comparative advantages in the case study; → Investments will be encouraged (e.g. greenhouses, irrigation techniques). *Possible adaptations* → Investments of farmers to increase efficiency and production.	"Shifts in production patterns" *Impacts* → Decreased stream flow and difficult access to irrigation water; → Freer access to global markets may lead to positive effect on productivity; → Fewer outmigration and more employment. *Possible adaptations* → Economic chances due to open markets may make up for the negative impacts due to climatic changes; → Shifting the focus on production of canned food for exports; → Establishing greenhouses to produce vegetables for canned food in local industries; → Investments in efficient irrigation techniques.

Table 15: Scenario focus group workshop results. Source: Turhan (2012 a).

Case study Ras Sudr in South Sinai

"One of Egypt's vulnerable areas with respect to the impact of climate change, particularly threatening the unique traditions, knowledge and livelihood systems of Bedouins."

Map 22: Case study Ras Sudr in South Sinai (overview) Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 23: Case study Ras Sudr in South Sinai (detail). Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap.

6.2.9 Ras Sudr, South Sinai

The state of Ras Sudr situated on the Golf of Suez in the South Sinai has been identified as one of Egypt's vulnerable areas with respect to the impact of climate change. The Bedouins who live in Ras Sudr are one of the many ethnic groups in Egypt with unique traditions and livelihood systems and are contributing to the ethnic diversity of the state. Dependent on agriculture as their main livelihood activity, they are particularly affected by climate change due to the fragile desert ecosystem and lack of alternative, innovative measures which might facilitate adaptation to climate change. Flash-floods and droughts are the main impacts experienced by the state (Kassas et al., 1991; Williams and Billing, 1996; Nicholson, 2005; IPCC, 2007). Flash-floods in the area have resulted in severe destruction of infrastructure such as roads, houses and other facilities. Debris and sediments brought on by the floods have affected fields and arable land and resulted in the destruction of irrigation pipes and irrigation wells. In addition, clashes and conflict between the Bedouins and government officials emerged due to the Bedouin's accusations against the government. They claim the government officials lack the competency to secure the area against flood hazards, mismanage the water resources, fail to make use of the volumes of water brought by the flash-floods, and resist against what was perceived as imposed adaptation legislation. Water scarcities have also led to clashes between different Bedouin families involving well ownership and well drilling. The Ras Sudr state is also very vulnerable to the outcome of droughts which have impacted the natural rangeland vegetation, production of rain fed crops and other crops irrigated by shallow wells such as vegetables, and fruit trees. This summary is based on the hydro security profile of Ras Sudr (Tawfic Ahmed, 2012a) and a case study article (Tawfic Ahmed, 2012b):

Focus of research

The Ras Sudr research aimed to look at the vulnerability of the study area and to understand and envision how communities would adapt to climatic changes. It investigates the society of Sudr (mostly Bedouins) and the current institutional framework of adaptation while looking at conflicts and security issues and how they relate to climate change and the hydrologic situation there. Furthermore, it applied the livelihood vulnerability index to urban and rural communities in Ras Sudr to assess risks, analyze adaptation options and develop future adaptation strategies (Tawfic Ahmed, 2012).

Climate and climate change drivers

The main hazards which the Ras Sudr state experiences are flash floods and droughts. Ras Sudr is characterized by an extremely arid climate with long and hot rainless summers and mild winters. The average annual precipitation in the Sinai is less than 40 mm, providing very limited water to the vegetation. Dangerous flash floods occur through intensive rainfall events. A reduction in the rainfall amounts is found through climate projections but there is a large uncertainty indicated through the range of 16 GCM projections for the A1B and B1 scenarios. Milewski et al. (2009) found, through the use of the SWAT watershed model and identified precipitation events, a relatively high surface runoff (17.1 per cent of the average annual precipitation) and for groundwater recharge (15.7 per cent) for watersheds in the Sinai Peninsula.

Socio-political and economic drivers

The Bedouin community is exemplified as always having had its own distinct social organization and certain distinguished cultural characteristics (ILO, 2009). Bedouins have been found to be suffering from a lack of political and legal recognition, the consequences of this leading to their marginal presence in the imagination of mainstream society (Library of the Congress, 2006). Ras Sudr experienced a growing influx of non-Bedouin populations, which has been a cause for several problems as their arrival was perceived as a challenge to the Bedouin's sovereignty in the area and led to frequent clashes and feelings of mistrust between both groups. Sudr is governed by the local counsel which is made up of members from various districts. Social and economic affairs in the area as well as people's welfare have been affected by incompetent governance. The tourism industry has been an important feature of the area. The flourishing tourist industry, the establishment of tourist villages and the influx of tourists have greatly influenced life in Ras Sudr. Tourism has had a great impact on the Bedouin standard of living, bringing new job opportunities. The January 2011 Revolution in Egypt, which led to the demise of then President Mubarak, brought a state of defiance in the Bedouin community. The safeguarding of law and order became hard to maintain as conflicts between Bedouins and authorities, including police forces, have taken on a different perspective and reinforced the difficult relationship these groups have with each other. These changes in the political arena have enabled Bedouins to make many claims for their civil rights.

Vulnerable groups and their characteristics

The quantitative vulnerability assessment based on the livelihood vulnerability index documented that particularly rural communities are significantly vulnerable to climate change. Already existing factors such as: prevailing poverty, gender oppression, ethnic discrimination, political powerlessness and high rate of unemployment are markers of pre-existing vulnerability in Sudr (Winser, 1992; Cannon, 1994; Kelly and Adger, 2000). The highly sensitive ecosystems with extreme climatic variability mixed with those factors makes them strongly vulnerable. Drought has had a large impact on agriculture and grazing activities. This coupled with the inability of institutions to respond to this threat has left affected populations to deal on their own with the catastrophic impacts and has forced many Bedouins to migrate to distant places (e.g. to the more hospitable valleys). The migration of male Bedouins, who sometimes leave their families behind, increases the vulnerability of those left behind. In some cases Bedouins leave the Sinai altogether with temporary migration being undertaken as a response to the flash-floods that affect the floodplain areas. Women in Ras Sudr are amongst the most vulnerable groups to the impact of climate change. This is due to their role in grazing and fetching water, as well as household issues. Women are required to travel longer distances to fetch water for the family, or for their herds to graze, leading to economical losses (interviews with Bedouin). Big farms are also identified as being vulnerable due to the severe losses they experience following floods. The Bedouin through the destruction of crops and croplands by flash floods and droughts and the ensuing limit in supplies and increase in prices are particularly vulnerable. Finally, climate change affects the health of the Bedouins through water scarcity, lack of sanitation and the spread of communicable diseases.

Hydro- and human security concerns

In Ras Sudr both conflict and cooperation have been observed. Protests have erupted between local government and the Bedouins, due to the former's inability to respond to the impacts of droughts, counterproductive legislation, the restriction on drilling new wells, the withdrawal of metering groundwater and adaptation package. New types of conflicts between Bedouin families have emerged due to the regular occurrence of water scarcity. Faced with chronic unemployment, some Bedouins have turned to growing illegal narcotic plants. In the aftermath of the 2010

flash floods, a wave of anger was ignited in the Bedouin community against the government as there was widespread destruction and the population was cut off from major services. Flash flood waves destroyed piping systems and damaged and destroyed crop production through the pollution. The construction of businesses in flood prone areas, which land was sold to businessmen by Bedouins, and the subsequent destruction of these, led to bitter disputes between both groups. However, cooperation also took place between Bedouins during the 2010 flash floods, Bedouins from the upland sent warning messages to other tribes in the floodplains about the flash floods.

Concerns for human security in future: scenario workshop

The scenario focus workshop was conducted to explore the impacts on the environment, local counsel and conflict outcomes derived from four future scenarios. The information gathered during the scenario workshop was supplemented with information collected through questionnaires distributed to various stakeholders in the area.

Case study article: Vulnerability of Sudr to climate change, livelihood index. An approach to assess risks and develop future adaptation strategy

The case study article aims to assess the vulnerability of urban and rural communities to climate change including drought and flash-floods. Using DFID's (2008) definition, vulnerability is considered as an indication of people's exposure to external risks, shocks and stresses and their ability to cope with and recover from the resulting impacts. Employing the Sustainable Livelihoods Approach, which looks at five types of household assets—natural, social, financial, physical and human capital, the livelihood vulnerability index is constructed to measure household livelihood security in the context of climate change. Results reveal high capabilities of both, urban and rural communities, to deal with climate change related threats due to a high adaptive capacity (Tawfic Ahmed, 2012b).

Recommendations, suggested policies, adaptation, institutions

A number of recommendations to improve adaptive capacity of the Sudr population in light of climate change are made. It is suggested to: dedicate a Disaster Management Unit exclusively to climate change related disasters, with proper training of staff on proactive responses to disasters; to incorporate poverty alleviation campaigns in adaptation frameworks, since poverty is one of the main obstacles to successful adaptation; to deal with unemployment as it is a serious hurdle to adaptation strategies; to integrate local knowledge in adaptation policies, building on the wealth of knowledge and the experience they collected over the years on flash flood prediction and management; to make industries in Sudr meet their corporate responsibility goals, such as providing funds, supports and contributing to awareness raising campaigns as well creating job opportunities; to establish a national central committee for the management of flash-floods; and to incorporate flash-floods in the integrated water management plan on regional and national levels. In addition, a major plan to build a new canal in the centre of the flood pathway is put forward. Finally, it is recommended to promote new agriculture planning in Sinai, encouraging Bedouins to grow olives rather than vegetables and fruits.

Furthermore, undertaking more in-depth vulnerability assessments based on rich sources of information in relevant fields would be useful to target future efforts to reduce vulnerability, exposure and sensitivity drawing from various experiences and practices (Tawfic Ahmed, 2012b).

Table 16: Scenario focus group workshop results: Source: Tawfic Ahmed (2012a).

Hydro-climatic Change: Frequency and Impact of Flash-floods

Social and political change: Flashflood management	No increase in intensity and frequency of flash-floods	Flash-floods increased in intensity and frequency
No change in flashflood management	**Scenario A: "Business as usual"** *Impacts* → Serious destruction by flash-floods, unused flood water; → The local counsel lacks the ability to cope with the situation (e.g. no early warning system); → Drought-prone parts of Sudr suffer even more from unproductive fields, causing financial losses, widespread unemployment and deteriorating living conditions; → Water scarcity leads to serious hygienic impacts even cases of death; losses of grazing land, forces Bedouins to sell herds and fuels the existing tensions between Bedouins and Government; → Unemployment of young Bedouin leads to increasing illegal activities. *Possible adaptations* → The major obstacle for reducing vulnerability is the inefficiency of early warning systems and a lack of sound planning for flood management; → Public participation in flood management is seen as inadequate.	***Scenario B: "More pressure"*** *Impacts* → Growing conflicts between investors/oil companies and Bedouins and between Bedouins and non-Bedouins; → Potential conflict between Bedouin and large Int. Oil Companies. Serious oil spills and environmental damage as pipelines are frequently being hit by flash-floods; → Poor management of flash-floods results in some areas swamped, attracting mosquitoes, triggering erosion; → Flash-floods damage wells restricting their use; → Many non – Bedouin settlers demand land. This dynamic leads to future conflict. *Possible adaptations* → Poor flood management by local authorities; flashflood intercepting structures not appropriate; → Bedouin interests are often disregarded; → Flashflood adaptation plans for investors/oil industry missing.
Sound flashflood management	**Scenario C: "Administrative learning effects"** *Impacts* → Early warning system in place and functional, special crisis task force established; → Flashfood user association, well user associations to improve management; → The council tackles increasing water scarcity and soil salinity that have negatively affected crop production leading to a rise in food prices; → Water scarcity leads to environmental degradation. *Possible adaptations* → Acknowledge local knowledge, promotion of water-efficient crops (e.g. olive) and medical plants to maintain biodiversity; → Import food from Egypt's mainland to alleviate tensions around food prices; → Support young Bedouins; → Meter water consumption and free basic water; → Loans from the agriculture bank and cooperative insurance system to enable Bedouin to deal with drought.	**Scenario D: "Worse circumstances but better management"** *Impacts* → Flash-floods are managed in a way that takes advantage of water abundance; → The counsel has introduced measures to minimize environmental impacts of flash-floods; → Conflict and dispute minimized. *Possible adaptations* → Women should play a major role in the design of flashflood management; → Awareness campaigns to be prepared for flash-floods; → An insurance scheme covering the loss of Bedouins and reducing conflicts; → Establishment of the Water Security Contingency Group (WSCG), maximizing benefits of flash-floods while minimizing possible threats, conflicts and damage; → Oil industry and pipelines are placed in safe areas.

Case study Sarno in Italy

"Sarno Valley in the Campania region suffered a tragic landslide on 5 May 1998 with long-term impacts on Sarno."

Map 24: Case study Sarno in Italy (overview)
Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 25: Case study Sarno in Italy (detail).
Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap.

6.2.10 Sarno, Italy

Italy is a country accustomed to natural disasters and especially prone to hydrogeological risks. The Campania region has been identified as one of the vulnerable regions in the country, as 86 per cent of the municipalities have experienced landslides and/or have alluvial-risk prone zones within their territory (Legambiente, 2008). The Sarno Valley in the Campania region suffered a tragic landslide on 5 May 1998. The municipality of Sarno was the most affected out of five municipalities by debris flows and has subsequently been associated with the tragedy. Weak landslide risk management was put forward in the aftermath of the event (Scolobig, 2010). There is high uncertainty with regards to the impact of climate change and precipitation as a key stressor of hydrogeological risks such as landslides. The main livelihood activities in Sarno are retail and wholesale business followed by the agriculture and building sectors (Urbistat, 2010). Vulnerability in Sarno is defined by location ("Exposure") rather than any other criteria. Conflict emerged between citizens and governmental organisations around the idea of resettlement. This social tension is characterized in the case study as political conflict over adaptation measures. This summary is based on the hydro- security profile of Sarno (D'Alisa 2012a) and a case study article (D'Alisa, 2012b):

Focus of research

The Sarno case study looked at the linkages between climate change and rapid flow slides hazards, in particular the type of landslides which affected Sarno in May 1998. It investigated the main characteristics of the vulnerability of the locality, presented the main conflicts which arose following the catastrophe and analyzed the local conception of human security. It examined the institutional setting which materialized following the catastrophe and proposed some recommendations to improve future institutional capacity in the area. Finally, it demonstrated how the large scale state-led intervention after the Sarno tragedy, 'depolicitized' the issue and subsequently failed to provide a long-term solution for it (D'Alisa, 2012b).

Climate and climate change drivers

The main hazard discussed in the Sarno case study is rapid flow slides. Landslides struck the Sarno valley in 1998 causing 160 casualties and 33 million € of damage. Changes in amount and intensity of rainfall are among the factors that increase landslide risks and damages. Under the A1B scenario, annual precipitation is projected to decrease by 9 per cent for 2031-2050, relative to 1980-1999. For all three scenarios for 2040-2069, relative to 1961-1990 an increase in average annual temperature that ranges between 1.6 and 2.2°C is found (Bruggeman et al., 2012a). A study by Mazarella and Diodato (2002) on the occurrence of alluvial calamities related to abrupt slippings of the volconoclastic mantel affecting Sarno reveals that the future changes in rainfall distribution could impact the occurrence of landslides. Rainfall thresholds have been found useful in preparing early warning systems (Rossi and Chirico, 1998; Wieczorek and Glade, 2005; Papa et al., 2011). However, the relationship between climate and landslides is very complex.

Socio-political and economic drivers

Sarno's history is linked to the hemp cultivation and water engines which made it a manufacturing city at the beginning of the 19th century. This production was stopped after the Second World War, leading to the loss of Sarno's primary position as a manufacturing city in the region and its own production system. In the 1960s and 1970s, a food processing industry and fruit and vegetable market emerged. In the region, the majority of household economic resources were invested in private building construction. Unauthorized construction grew and agricultural grounds were dotted with new buildings. The town authorities never approved a town plan and several amnesties were granted by the national government for infringement of local building regulations. The number of abandoned buildings tripled from 1982 to 1991 and in 2005 one in ten apartments in Sarno were inhabited (Boeri et al., 2005). The growth of the city towards the base of the mountain has multiplied the number of ex-

posed buildings and infrastructure in the hamlets of the city. It is estimated that abandoned buildings in Sarno could house more than 3,000 people (Boeri et al., 2005). However, the regional and municipal governments ignored the available accommodation for people that lost their houses during the 1998 mudslides and they did not offer alternative areas for resettlement. Consequently, the only possibility was to rebuild in the same area that was affected or subsidize the buying of flats wherever citizens wished. Sarno's economy today is primarily based on retail and wholesale business. The agricultural and building sectors are the next largest sectors (Urbistat, 2010). Sarno and the Campania region are characterized by low-income earnings with income per capita in 2009 being on average almost 61 per cent of the national Italian income per capita.

Vulnerable groups and their characteristics

Vulnerability in Sarno is mostly influenced by location rather than other characteristics. The tragic rapid flow sides that took place on 5 May 1998 caused the death of 160 people, 115 injured, 1210 homeless and extensive infrastructural damage in the municipalities surrounding the Pizzo d'Alvano massif. Following this tragic event the Emergency Commission Structure (ECS) undertook a series of measures to reduce the vulnerability of the affected people: passive measures, which reduce the probability of mudslides reaching human settlements and assets, such as the building of canals and tanks to contain mudflows coming down the mountainside and active measures, which reduce the probability of the occurrence of an event, such as stabilizing the mountain ridge with environmental engineering techniques. The construction of retaining tanks reduced the vulnerability of exposed buildings in two hamlets of Sarno. Copertino et al. (2005) find that most of the people living in Sarno and the 14 municipalities where the passive infrastructure have been installed are now less vulnerable. A study ordered by the Minister of Interior in 1998 following the Sarno tragedy indicates that 212 municipalities out of 515 are at risk of different flow slides (Cascini, 2005). Out of the 212 municipalities the ECS intervened in 15 municipalities leaving the remaining 187 still vulnerable to the occurrence of rapid flow slides.

Hydro- and human security concerns

In the aftermath of the mudslides a state of emergency (D.P.C.M. 108/1998) was declared and a series of laws were passed to respond to the crisis such as the Ordinance n° 2787 (Ord. n° 2787/1998) which established the main roles for the management of the emergency and forbid the municipality from building any settlements in the area at risk. In addition, the Decree 132/99 approved the rebuilding ban in the same area where mudslides occurred and which was delimited by the Red Line. Finally, Article 6, paragraph 4, (DL 132/99) sets out, that municipalities together with the region or the province should indicate the area for the resettlement of the people whose buildings were destroyed or seriously damaged. The idea of resettlement caused significant conflict between citizens and governmental organisations. The object of discord emerged around the right to rebuild houses in the same place, which certain citizens demanded and the national government forbid and the planning of resettlement set through national law. The debate extended over the following years, but as time passed the motivation of the Associate Committee for Sarno (CRS) and of the people supporting the right to return home lost its value as after years of living in different places the desire to come back home dwindled. For instance, in 2011 in Episcopio, the most impacted hamlet of Sarno, most of the houses that were rebuilt appeared deserted with only 50 per cent of the people having returned to the locality.

Future hydro- and human security concerns: scenario workshop

The workshop was held in Sarno on 23 September 2011 with eight participants (experts in environmental engineering and geology, victim associations and technicians of the relevant governmental authorities). A scenario has been discussed in which

the increase of extreme precipitation is followed by an increase in the amount of investment dedicated to hydro-geological risks, such as rapid flow of land slides. Twelve proposals emerged:

1. To finance research in order to ascertain the historical and scientific causes of the events in Sarno
2. To educate the community to adopt a more ecological relationship with its own territory
3. To make the community aware of the territorial risk it lives in
4. Constitute a permanent Territorial Presidium, which takes care of the landslides and stands guard against hydro-geological risks
5. To improve the circulation of information and extend the space of scientific dissemination, with the aim of guaranteeing better participation and a consequential diminishing of the vulnerability of artefacts and people
6. To activate in the short run, local civil protection systems, understood as a system of information, training, planning and detection of alert conditions
7. To invest in knowledge of the effects of landslides
8. To constitute a security pact, with a trans-generational view, with the aim of incrementing institutional capacity and the perception of security in the community
9. To constitute a re-settlement pact and implement an institutional setting for a political discussion on this issue.
10. To revise the Civil Protection warning system in order to make it more effective, through implementing real time rainfall measures using radar detection systems
11. To guarantee the maintenance of preventative structural interventions carried out in the territory, with the aim of achieving no net increase in the territory's risk and vulnerability
12. To implement a preventative campaign for the economic actors of the area at risk, with the aim of stopping them and increasing the vulnerability of the area as a result of their activity.

Some of the participants were afraid that in scenarios B and D the social pressure could diminish and as a consequence the institutional effort to deal with hydro-geological risks could also diminish. Thus, what is needed they argued, is a proper cultural revolution in terms of the institutional capacity to develop a political vision, aiming to undertake a sustainable path where the money coming from national or European organizations to face hydro-geological risks are not wasted in actions thatdo not have any advantages in terms of prevention and protection of the territory. What is needed is a strong collaboration between citizens and policymakers that is undertaken at different levels, above all for the most vulnerable people, through the mediation of people locally recognized as trustworthy and belonging to their own social sphere. This will help rebuild a different culture of risk, which will better re-orientate the behaviour of the community in a participatory setting. The risk of scenarios C and D is a technocratic drift, led by the policymakers who delegate decisions to the technicians in order to save themselves from having to take any future responsibility. As a consequence, the emergency is overcome without a clear political vision of adaptation, with the consequent risk that the implementation of huge structural interventions decreases short-term vulnerability but increases it in the long-term, because it does not discourage the increase of the people and buildings exposed to the risk.

For one of the participants, it was very difficult to differentiate the proposals in different scenarios, in fact, she mentioned that the hydro-geological risk in Campania is already very serious now, implying that future climate changes will not change the priorities of the action to be implemented. Another particpant argued that the main difference between the scenarios with more investments (A and B) and the ones with less investment (C and D) depends on the kind of interventions implemented. In the latter, passive interventions prevail, i.e. mitigation measures that do not reduce the probability of the event but try to reduce its impact, examples of which are the canalization and the mud tanks built down the mountainside. The former, because of

higher investment, can be characterized by active interventions, i.e. mitigation measures that reduce the probability of detachment of the unstable mantle; however, they are more difficult to realize and more expensive than the passive interventions.

One participant was against resettlement because it destroys the cultural roots of the town and disregards the scientific knowledge that can secure the people, provided it does not only favour those interested in economic gain. Other participants thought that resettlement was the only way to decrease the risk and the vulnerability of the people even if it is very difficult politically. Some differences emerged that were related to the cost of re-settlement proposals; some believed that the resettlement measures are expensive, so they can be implemented only for the scenarios A and B, thus it cannot be the top priority for other scenarios. Several actors expressed anxiety regarding scenario D, i.e. a decrease in the perception of the risk could diminish the level of alert of the institution because of weaker pressure from citizens; this will imply returning to the same level of attention existing before the event in Sarno occurred. However, the development of integrated responses by all the territories affected by the same risk and vulnerability is what really matters in implementing an effective plan of action.

One participant did not express any preference for the proposals because, according to him, what is most relevant to underline is that the Sarno Basin and some other areas of Campania are characterized by very high hydro-geological risks and the presence of this hazard demands a robust and permanent institutional response, regardless of climate change.

Case study: Human Security in a Loose Territory: Insights from the (Quasi) Northern Campania Region

This case study article examines and evaluates the effectiveness of the massive scale state-led intervention adaptation process (technological and institutional) following the 1998 environmental disaster in Campania, as a way of shedding light and problematizing the dynamics, conflicts and efficacy of post-disaster adaptations. In the article Gramsci's reasoning about the state as a theoretical framework is used to analyse the Sarno case. The article synthesizes the agenda of the human security literature and discusses the danger of an apolitical approach to the state in narratives of future (climatic) changes. It presents the political, societal and environmental context in which Italy developed its human security agenda while outlining the Sarno case study. Finally, it discusses how the Italian state actually intervenes to guarantee human security in its region and concludes the paper by discussing the necessity to re-politicize the framing of the state as well as the discourse of human security literature. The authors contend that having a strong theory of the state will eschew the de-politicization adrift in the climate change researcher's position and will better situate policy suggestions to improve human security in the future. They show how the extraordinary and massive scale intervention that followed the Sarno tragedy, and which is typical of institutional responses towards environmental tragedies in many other parts of the world, "de-politicized" the problem at hand and as a result, failed to solve it in the long-term (D'Alisa, 2012b).

Implications for adaption: Recommendations, suggested policies, needed institutions

No measures to withstand the impacts of climate change in Sarno and in Campania are being taken, as future climate change is unlikely to change the priorities of political action. Recent studies have tried to demonstrate that potential future changes in rainfall patterns in Southern Italy can act as amplifiers of vulnerability and human insecurity in areas already affected by rapid flow slides (Bucchignani and Mercogliano 2010, Bigano and Pauli 2010). Recommendations include the need for investments to diffuse more flexible adaptation measures at different scales. The proposed 204 million euros by the Inter-Ministerial Committee for Economic Planning (CIPE in Italian) to face hydrogeological

instability in Campania should be used as preventive investments and not *ex-post* interventions. The regional government should simplify the regional Civil Protection System and the use of external consultants in order to avoid the overlap of responsibilities by different governmental bodies and clarify the definition of duties for each institution and organization. The development of an agile civil protection system characterised by a smooth access to information and an appropriate setting for the implementation of citizen's pro-active involvement is recommended. In the light of inconsistent resettlement policies in the region, a proper political discussion on resettlement in Campania is essential to develop a possible 'resettlement pact' for the whole region and improve the human security of the region, which is affected by different environmental hazards. In addition, structural measures such as preventative actions based on an effective early warning system and on the pro-active participation of citizens are needed to reduce vulnerability in the area. It is also suggested that the Regional Assessor to Public work and Civil Protection of Campania should spend funds received from CIPE to establish a permanent Territorial Presidium with the goal of dealing with the landslides and watching over and preventing future hydrogeological risks while improving the information flow and developing the space for scientific dissemination, thereby guaranteeing better participation and reducing the vulnerability of people and assets. Finally, it is put forward that to guarantee human security one should not go beyond the states but should try to shape new forms of state intervention, otherwise the continuous use of state of emergency will silence any other political body trying to prevent the future impacts of climate insecurity (D'Alisa, 2012a; D'Alisa 2012b).

Case study Greater Alexandria in Egypt

"A city housing many vulnerable population groups, which might become trapped in places highly exposed to sea level rise."

Map 26: Case study Greater Alexandria in Egypt (overview). Source: World Light Gray Basemap: Esri, DeLorme, NAVTEQ.

Map 27: Case study Greater Alexandria in Egypt (detail). Source: GADM Vers. 2.0; CIESIN-GRUMPv1; ESRI World Imagery Basemap

6.2.11 Alexandria, Egypt

A rising number of employment opportunities presented by Alexandria's growing industrial secto has lead to in-migration, which together with the city's natural growth rate is expected to increase Alexandria's population by 65 per cent by 2030. The city stretches 32 km along the coast, lying at 0-40 meters above sea level, which makes it vulnerable to coastal hazards such as flooding and storm surges, coastal erosion and climate change induced sea level rise (SLR). Particularly the rural hinterland of Alexandria, lying below sea level and already vulnerable to climate change impacts is becoming increasingly urbanized. These areas (Abu Quir, Lake Maryut) house vulnerable population groups, which are trapped in places highly exposed to SLR. These groups are likely to be trapped in unsafe conditions due to their dependence on place-based Ecosystem Services and precarious livelihood conditions that make them immobile. The ongoing political and institutional changes in Egypt's governance system pose significant challenges for preventive resettlement. As many parts of Greater Alexandria lie below sea level (see blue area, Map 15), preventive resettlement of the exposed and trapped population may become a realistic adaptation strategy to avoid human security risks in the future. This summary draws from the hydro security profile of Alexandria (Gebert, 2012) and a case study article (Gebert et al., 2012). The case study article in Alexandria focused on the challenges associated with large scale preventive resettlement and dealt with the anticipation of vulnerabilities that arise from preventive resettlement in response to SLR.

Focus of research

The case study focused on the challenges associated with large scale preventive resettlement and particularly dealt with the analysis of potential new vulnerabilities that arise from resettlement in response to sea level rise .

Climate and climate change drivers

Egypt is considered one of the top five countries globally expected to be mostly impacted by 1 m SLR. Global scenarios forecasting sea level rise in the Mediterranean show high uncertainties with a variance of 50–140 cm until 2100 (Pirazzoli in Umgiesser et al. 2011). Due especially to the heavy concentration of settlements built in low-lying areas, SLR in Greater Alexandria affects large parts of the population, economic entities and infrastructures.

Socio-political and economic drivers

The 'Arab Spring' is the result of decades of kleptocratic authoritarian rule, where government authorities existed primarily to increase their own personal wealth and political power at the expense of the population. During this period under Hosni Mubarak, the state neglected its role as a "service deliverer" to its citizens by failing to ensure equity-based resource distribution, transparent and participatory decision-making and law enforcement. "Services" were only delivered and resources shared amongst influential groups, the private sector and the extended family network of regime stakeholders. Consequently, long-term economic depression, friction between the socially and economically disadvantaged majority of population and the private-political elites culminated into social unrest unfolding into Egypt's revolution and leading to regime collapse (Anderson, 2011). The development and reorganization of the state's architecture and social relations are highly uncertain, although analysts are predicting a redistribution of power based on a more people-centered political system, which also promotes the development and implementation of people-centered climate change adaptation strategies.

Vulnerable groups and their adaptive capacities

When analyzing the groups that are most likely to be exposed to SLR, both coastal-rural and rural households living directly at the north-eastern coast of Alexandria along Abu Quir Bay and the urban communities living along the coastal fringes of eastern Alexandria are highlighted as the most vulnerable.
The households living along Abu Quir Bay are mainly either marine or lake fishermen who garner their income based on ecosystem services and live at the main entry points of SLR and storm surge inundation. Other vulnerable rural households are those farmers living in Alexandria's hinterlands and close to Lake Edko. Certain socio-economic parameters indicate that low educational levels, low access to formal financial resources and reliance on place-based ecosystem services related to farming or fishing produce highly vulnerable conditions in relation to the anticipated severe exposure to SLR in the coastal-rural populations of Alexandria. Yet despite the high exposure to SLR, there are several characteristics that mitigate the impacts of the potential exposures. While this population has less access to formal social security schemes, they have good access to informal loans via social capital formations. Also, despite their comparable low level of formal education they have a relatively high degree of climate change awareness, which promotes engagement in climate change adaptation activities, such as the participation in relocation programs. How the overall configuration of adaptive capacities shape the response to rising sea levels and storm surge impacts is difficult to say, but the results show that a large proportion of people and communities might remain highly exposed and thus would have to be assisted to reorganize their livelihoods in hydro-insecure areas (relocation).

Hydro and human security concerns and scenarios in the context of SLR

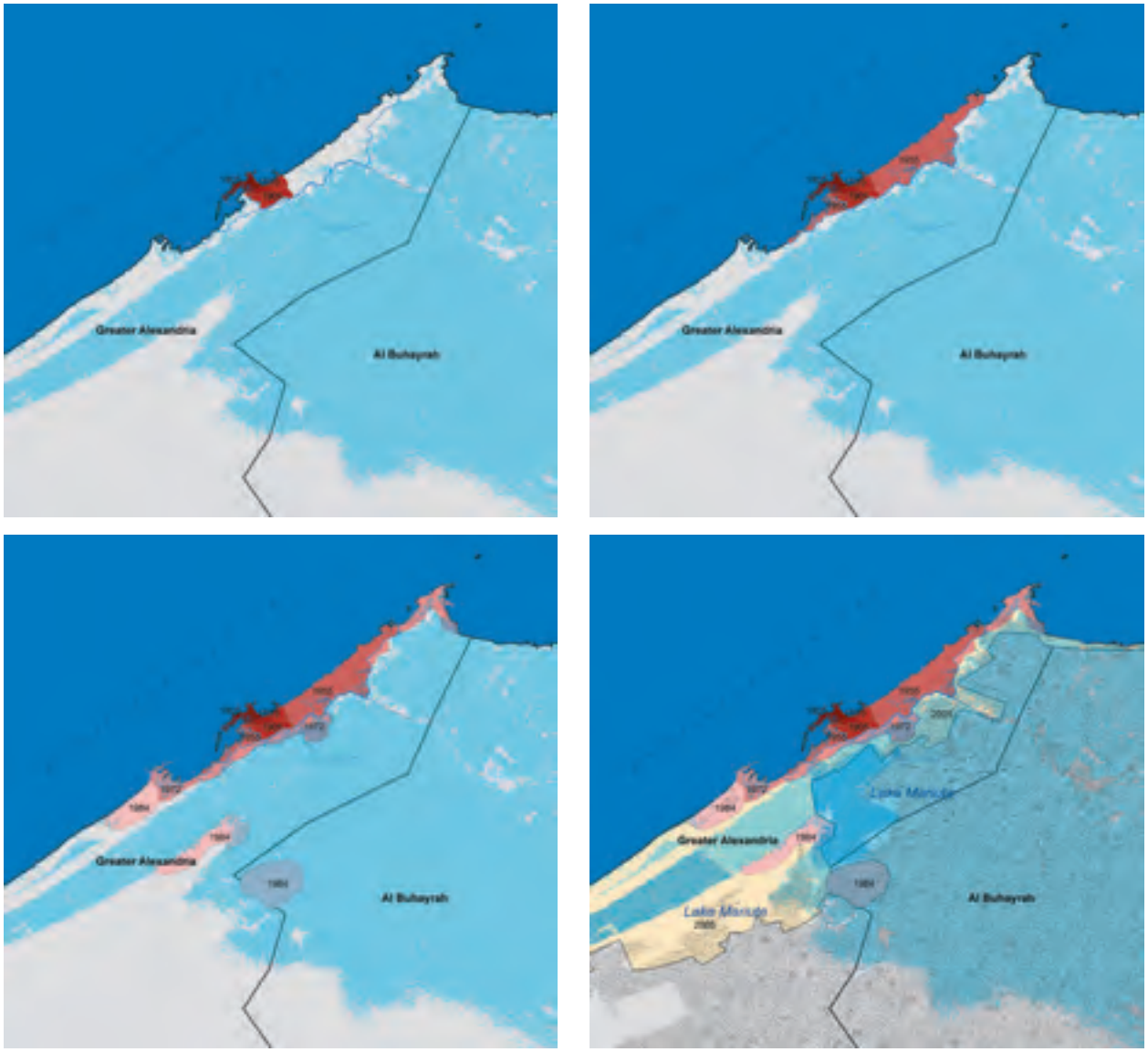
Large parts of the Governorate of Alexandria (North-Western delta region) lie below sea level. Without adaptation, extreme events and their effects triggered by SLR could lead to a semi-permanent inundation of urban areas below sea level (The World Bank, 2011). Current urbanization trends of Greater Alexandria show a continuous increase in exposure to SLR: The city expands from the slightly elevated and safe city centre not only westwards but also into the SLR exposed rural hinterland from Lake Maryut to Abu Quir, due to uncontrolled and informal construction. Since the 1960s, rapid urbanization at the expense of agricultural land occurred at an annual rate of 1.4 per cent (Aziz, 2008; Salem et al., 1995). If such a rate continues in the future, by 2060 Alexandria's exposed hinterland is projected to be fully urbanized. If no protection system is implemented, large parts of the North Western Nile delta will become partly and probably inhabitable, whereas at the same time vulnerable groups are trapped due to their limited adaptive capacity to migrate themselves and reorganize their livelihoods. Besides the risk of displacement, major human security concerns are related to the risk of livelihood deprivation in the course of resettlement. Based on the current conditions future hydro-security, potential conflict and outcomes in the context of relocation were discussed during an expert workshop in December 2011 in Alexandria:

Table 17: Scenario focus group workshop results. Source: Gebert (2012).

Hydro-climatic change: Sea Level Rise (SLR)

Social and Political Change: Democratic development in Egypt

	Moderate SLR: Frequent storm surge inundation of the coastal strip (0.5m SLR)	Extreme SLR: Regular or permanent flooding of 700m² in the area of Greater Alexandria (>1m SLR)
More conflictive: Continuation of the current autocratic and corrupt governance system: Unregulated intensification of land use and exposure due to weak governance leading to rather ad-hoc and ex-post adaptations	**Scenario A: "Further deterioration"** *Impacts* → *Lobbying and corruption* affecting land use patterns is likely to continue, leading to increased exposure and vulnerability, especially to increased temporary floods; → The privatization of public space, the absence of coastal flood risk management, low protection levels of companies against storm surge inundation are seen to be ultimately leading to a *disaster of local and national concern;* → Particularly the local ecosystem based and exposed population will suffer disproportionally as a result of inundation induced pollution, salination and damage to infrastructure. *Possible adaptations* → Resettlement in the area is not considered necessary; → Adaptation requirements to increased storm surge risk include building up and maintaining protective structures, such as improving the Abu Quir sea wall, beach nourishment, preventing private companies from damaging natural protective structures and raising awareness and implementing early warning systems; → Continued cooperation between the political and economic elite based on corruption and marginalization of rural households leading to potential conflict between groups sharing the same resources.	**Scenario B: "Worst case scenario"** *Impacts* → Exposure is intensifying due to *continuously weak law enforcement* and a high degree of corruption leading to the continuous issuance of permissions to settle in the most exposed area of Alexandria; → Continuous economic growth is expected to *attract a growing number of job seekers;* → Low risk awareness, lacking risk assessment and risk management capacities is regarded to further *increase vulnerabilities* in the area; → Especially *tensions over access to land* and water resources could possibly occur between social groups in the process of uncontrolled displacement and resettlement of large quantities of population into safe areas. *Possible adaptations* → Resettlement of the population is regarded as a viable way to reduce overall vulnerability of the population. Yet is expected that if this process is badly implemented by an autocratic regime, social tensions may arise between re-settlers and government authorities/ re-settlers and guest communities and also on the inter-state level as a result of interstate migration flows.
More cooperative: Democratic development path and more efficient governance performance: More regulated ex-ante exposure reduction	**Scenario C: "Optimistic scenario"** *Impacts* → It is expected that with a new more re-distributive governance architecture and politicized civil society, the main challenges associated with storm surge risks will be taken up and participatory solutions found. In this scenario hydro-security can be maintained or even improved by large scale coastal protection efforts; → Although hydro and human security is envisaged to be achieved as a result of adaptation, conflicts are seen to most likely arise when respective policies are enforced. *Possible adaptations* → Adaptation to SLR and storm surge is anticipated to be successfully implemented after the revolution and the establishment of a people centered governance system; → Adaptation to increased storm surge is regarded to be achieved by the implementation of structural protection measures; → Furthermore restricting development in exposed areas is seen as a necessary adaptation measure; → The implementation of structural protection measures is expected to be accompanied by a redefinition of land use leading to potential resettlement of communities.	**Scenario D: "Improved governance/severe SLR"** *Impacts* → The impacts of SLR by one meter are expected to turn into a "national catastrophe" having regional implications such as inter-state migration; → Unregulated, chaotic transformations and battles over scarce resources are regarded to be the sources of conflict between all relevant groups of society and the government and between governments that also could turn into violent conflicts *Possible adaptations* → Possible adaptations include a restriction of settlements, better law enforcement, mainstreaming climate change into Environmental Impact Assessment (EIA) and land authorization as well as designing incentive systems for currently exposed economic entities to resettle and redirect urban development to safe areas; → Ex-ante adaptation efforts are not expected to succeed entirely, especially due to the need to abandon the entire hinterland of Alexandria; → Strategies on how to cope with large quantities of displaced people.



Map 28: Urban expansion (1805–2005) and exposure to 1m (blue area) SLR in Alexandria (Source: own map based on data from National Authority for Remote Sensing and Space Sciences (NARSS) in Egypt and Department of Environmental Science at the Faculty of Science from the University of Alexandria)

Case study article: Emerging Risks: Sea level rise and potentially forced and planned relocation – Case study from Greater Alexandria, Egypt

The CLICO case study in Alexandria focuses on the challenges associated with large scale forced and planned relocation and particularly deals with the analysis of potential human security risks that arise from planned relocation in response to SLR. It proposes a conceptual framework for an *ex-ante* assessment of potential human security concerns in response to SLR and tests it empirically in Alexandria: (1) by exploring the conditions and processes that increase the exposure of Greater Alexandria to SLR in the future; (2) by assessing the conditions and factors that make households trapped in the exposed areas; (3) by identifying preferences of trapped population regarding relocation programmes and governmental assistance and (4) finally by assessing human security concerns and comparing preferences of trapped people with potential future "real world conditions" such as the capacity of institutions, existing policies and laws, the geographical settings, and economic development trends. Although hydro security might be achieved through relocation, overall human security might be at stake if governments fail to ensure income and housing security for their affected citizens due to being overburdened by managing large scale relocation programmes (Gebert et al. 2012).

Recommendations, suggested policies, institutions

Due to the lack of certainty of the rate sea level rises and the impacts storm surges will have on the urban and rural landscape in Alexandria, adaptation measures cannot be justified that hamper today's economic growth or socio-economic well-being in this region. Thus, adaptation to SLR in Greater Alexandria can only be achieved when policies facilitate a win-win situation with regard to improving peoples living conditions today but at the same time ensuring hydro security for vulnerable groups in the future. Examples include the liberalization of the housing market, aiming at creating more easy access to housing today that in the long-term also allows SLR-induced resettled communities to better access adequate housing in safe areas. Moreover, win-win solutions also include creating income opportunities other than agriculture or fisheries for vulnerable groups, since these sectors are declining compared to other sectors. Although difficult, policies aiming at redirecting city growth into absolutely safe areas in Greater Alexandria are favourable. In this context, the determination of risk zones and the integration of climate risk management tools, such as climate proofing, into spatial and regional planning are required. In the cases where relocation has been chosen as the favourable adaptation strategy, people-centered relocation plans need to be developed by taking into account vulnerable group's specific needs and preferences, also to ensure high rates of participation into relocation programmes to avoid unregulated mass displacement. Therefore, an efficient and corruption-free governance system that ensures people-centered service delivery is an essential precondition (Gebert, 2012; Gebert et al., 2012).

7. Synthesis

The notion that human security is multidimensional and is shaped by a range of socio-political, economic and environmental factors (UNDP, 1994) is corroborated by the CLICO research. CLICO advances the understanding of how the different social, political, economic and environment contexts interplay. Due to the complexity of the relationships within the multitude of contexts highlighted in the CLICO research, this synthesis chapter identifies the predominant factors that are present under different socio-environmental conditions and contexts.

This chapter is based on the research results of all CLICO work packages. In a first step it presents generic findings in a comparative manner to synthesize the main research findings, before addressing the project's initial research questions (see Chapter 2.2). The chapter draws from Goulden and Grainger (2012) and Gerstetter and McGlade (2012).

7.1 Findings

1. Drivers of human security and vulnerability in the context of socio-ecological interactions

Climatic and hydrological, socio-economic, institutional and political factors are all drivers of human security but their relative importance depends on the context (Gerstetter and McGlade, 2012). Economic conditions and political freedom are seen as factors more closely linked to human security than environmental pressure (Kallis and Zografos, 2012). This complexity of socio-ecological interactions validates the CLICO approach, which does not suggest direct causal relations between climate change, human security and conflict but explores various perspectives at various scales and contexts and draws from a variety of methods to unfold the climate change, water and human security nexus.

Climate change – An additional threat to human security

Among policymakers climate change is widely perceived as an *additional threat to human security and an additional risk for conflict, rather than the singular or primary factor.* With regard to the results from CLICO, stakeholders were concerned about environmental risks, but in many cases were dismissive of the comparative importance of climate change in light of existing drought and environmental conditions, socio-economic capacities and political tensions. However, the added pressure of climate change, combined with key social (e.g., development needs, lack of financial capacity, population growth) and political (e.g., state conflict, existing resource disputes, mistrust) factors, was commonly seen as amplifying human security and conflict risks. Prior disagreements over water between users and uses are anticipated to increase the likelihood of and serve as the basis for potential conflict under changing environmental conditions. *When conflicts and tensions already exist between parties, competing demands for water resources are more likely to exacerbate them* (Gerstetter et al, 2012a). However, this is not necessarily the case, because measures aimed at mitigating the impacts of climate change are sometimes already in place (e.g., producing water from non-conventional sources in Israel).

Vulnerabilities and mechanisms at play

A number of mechanisms underpin how risks and vulnerabilities amplify each other at different scales. Social vulnerabilities are in many cases linked to issues of social justice and human rights. The Niger, Seyhan and Gambella case studies show how *social marginalization can worsen vulnerability to climate stresses and insecurity. Pre-existing tensions* between different ethnic groups, in addition to food insecurity, poor service provision and already existing vulnerability to climate impacts amplify risks at various scales in Ethiopia. In light of these factors, climate change is a *"multiplicative stressor"* in Gambella (see Milman and Arsano, 2012, p. 8). In the case of Ras Sudr, the *isolation of the Bedouin population, illiteracy, low awareness of climate change and a sensitive ecosystem* are factors that increase vulnerability to climate change (Tawfic Ahmed, 2012). Negative human security outcomes and increased vulnerability have resulted from the *stifling of political debate and conflict* with regard to response strategies to environmental hazards by a hegemonic state in Sarno, Italy (D'Alisa, 2012b). Hydro and human insecurities do not only originate locally and nationally but are also shaped by the *global political economy and global geopolitical structures*, such as in the case of Ethiopia (Milman and Arsano, 2012) and Sudan (Selby and Hoffman, 2012). Long term socio-political insecurities linked with aspects of the political economy play an important role in hydro (in)security. *The political economy of an area determines which adaptive responses and aspects of human security will be prioritized.*

2. Links between adaptive capacity, adaptation and human security

Impacts of climate/water stresses were investigated in the context of societal response, including adaptation to these changes. Thereby, the research focused on the mutual impacts and the respective outcomes for human security and conflict arising from the *diversity of adaptation strategies followed by different actor groups in society and by governments through their policies.* Adaptation can occur and be driven by a single or a multitude of different actor groups and levels, often categorized as the individual, household or social group, private sector and state bodies. Thereby, impacts on human security can evolve from the way these different societal groups interact. States govern adaptation processes within their policy and institutional frameworks (IPCC, 2001) and interact with civil society as well as with specific adaptation processes that occur within and between social groups (see Snorek et al., 2012b) or the private sector.

To understand drivers of adaptation and their outcomes, investigating the specific and dynamic modalities of adaptive capacities of different actors within an adaptation process is important. This includes looking at the role of civil society as well as the role of states in shaping adaptive capacities and adaptation processes. The research found that great differences in *adaptive capacities of different social groups* exist and that the impacts occurring during adaptation processes may themselves increase or decrease conflict risks or cooperation.

Divergent and maladaptation

Many CLICO case studies have shown that adaptation can reinforce and increase inequality but also increase equality between different groups (see Box 15). Throughout the CLICO research, there have been indications of tensions (e.g., Ebro Delta) or conflict (e.g., Niger) emerging through unequal effects of adaptation between different social groups – sometimes triggered by state-led adaptation. Factors that play a role in shaping adaptation outcomes are manifold and highly context specific. The CLICO project has used and developed the concepts of divergent adaptation and maladaptation to measure impacts on adaptive capacity and identify the factors that shape unintended adaptation outcomes.

→ *Divergent adaptation* is a concept that describes those adaptations that promote the adaptive capacity of one individual, group or community, potentially leading to a reduced, unchanged or improved adaptive capacity of an alternative individual/community in a shared ecosystem. One outcome related to processes of divergent adaptation is the reinforcement of existing inequalities and the creation of new inequalities. The case study in Niger (Snorek et al., 2012b) is a prominent example of how the successful adaptation of one group evolves at the expense of another group. Agro-pastoralism has become a widespread adaptation to environmental as well as socio-economic and demographic pressures even in the former purely pastoral zones of Niger. These drivers together with an insufficient institutional support weaken pastoralists' access to resources. Agro-pastoral communities from the dominant ethnic groups and the pastoral groups in the North with greater economic power have a greater adaptive capacity and exhibit divergent adaptations.

→ Maladaptation describes poor or inadequate adaptation. More specifically, in the context of this research, it refers to action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups (Barnett and O'Neill, 2009). In Alexandria, in order to avoid the negative impacts of SLR and associated floods, relocation programmes may result in new livelihood risks if not properly planned and conducted (Gebert et al., 2012).

State-led policy for adaptation and adaptive capacity

Many case studies confirm that state architectures, institutional structures and their functioning greatly determine a community's level of adaptive capacity (see Box 16). *What role could governments play in climate change adaptation, given the conditions on the ground?*

Different perspectives on the role of the state in adaptation and what constitutes adaptive capacity were adopted throughout the research. Gerstetter el al. (2012) reveal that the state has an overarching role in managing adaptation for individuals, organizations and communities and in setting the framework governing adaptation actions, with some countries where the state rather than individuals is the entity promoting adaptation. Often, state-led adaptation is referred to as being more planned and structured than individual or civil society adaptation. But the evidence shows that within a complex vertical and horizontal state architecture, where multiple stakeholders take independent and interest driven decisions, mutually conflicting and amplifying adaptation decisions can reveal unintended effects. These effects influence a state's adaptive capacity in regards to the impacts such adaptation decisions have on the human security of

Box 15: Empirical examples of the diversity of adaptive capacity and its effects for different social groups

- In Gambella, the loss of property and assets of displaced persons has greatly reduced their adaptive capacity and generated feelings of insecurity and competition for resources (Milman and Arsano, 2012).

- In Sudan, violent conflict and resulting displacement have destroyed many traditional livelihoods and adaptation practices leading to environmental degradation and widespread vulnerability and insecurity among the population. Displaced households are lacking knowledge on how to cope with the new environments they are facing; in addition, their low adaptive capacity makes them particularly vulnerable (Hoffmann and Selby, 2012).

- In Niger, pastoral communities have been well adapted to the prevalent climatic uncertainties they need to tackle, but socio-economic and political conditions, such as lack of institutional enforcement, have increased competition for resources. The adaptations of farmers and agro-pastoralists have lessened the adaptive capacity of pastoralists. As a result, many pastoralists transform their livelihoods and become agro-pastoralists (Snorek et al., 2012b).

- In Ras Sudr (Egypt), frequent droughts and the inability of institutions to respond to this threat have left the affected populations unprotected. Unable to adapt, many Bedouins migrated to distant places leaving those left behind in even greater vulnerability (Tawfic Ahmed, 2012).

- The international climate change adaptation community supports governments' roles in climate change planning (UNFCCC, NAPAs). However, they have varying capacities to implement effective adaptation policies and the research revealed that governments could be weak in implementing adaptation policies.

specific social groups (e.g., marginalization of groups). Thus, also within governments the design of adaptation policies and their implementation are generally determined by the heterogeneity of existing interests (political economy) and power relations, norms, values, cultures and individual behaviour, as well as existing social and institutional frameworks. Important factors such as politics, power relations, marginalization of groups and economy determine which adaptations are prioritized, how adaptation policies are formulated and implemented and influence the outcomes and the ways in which adaptation occurs.

→ States can facilitate adaptation, particularly if people are unable to adapt by themselves. This is exemplified by the case study in Alexandria, where people are trapped in conditions that make them unable to adapt on their own.

→ Government-led adaptation can also have a range of negative or unintended impacts when they are insufficiently implemented as is the case in Niger; when they transform existing traditional adaptations as in Gambella; when they influence or even suppress individual adaptive capacity as described in Sarno; and generally, when there is a mismatch between the preferences or needs of affected people as in the Gambella and Ebro case studies (see also Box 16).

In Seyhan, inadequate state policies shifted the responsibility of adaptation to individuals and migrant agricultural workers who were unable to change the socio-economic structures and conditions that govern them. This meant that these already vulnerable groups were only able to adapt in ways that made them even more marginalized than before. In Gambella, strong state adaptation did not reflect and address the needs of the entire population.[29] Similarly, the values and preferences of people affected by climate change impacts in the Ebro Delta in Spain are underrepresented in governmental strategies.

29 In Gambella indigenous groups relying primarily on natural resources are forced by the government to transform their livelihoods for the development and well-being of the population, which privileges the national and international scale rather than the needs and perceptions of indigenous groups (Milman and Arsano, 2012).

Box 16: Examples of how state-led adaptation can impact the human security of their citizens

- Turhan (2012b) demonstrates that due to inadequate state policies the responsibility of adaptation falls upon individuals who are themselves powerless to change structures and conditions that are responsible for their marginalization. Vulnerable groups can become more vulnerable, reinforcing the social hierarchies and marginalized status of certain groups (Turhan, 2012b, Snorek et al., 2012b);
- Milman and Arsano (2012) demonstrate how state development and adaptation policies perceive traditional livelihoods as 'backward' and unconducive to economic growth, failing to recognize the role mobility plays in these traditional societies as a resilience strategy in response to climate variability;
- The lack of enforcement of policies in Niger resulted in individuals being insufficiently supported in their adaptation efforts (Snorek et al., 2012b);
- State-led securitization of adaptation can increase human insecurities. This was explored in the Sarno research (D'Alisa, 2012b) where de-politicization of decision-making can silence some voices. In the Ebro Delta, a related similiar, potential securitization danger was identified (Albizua and Zografos, 2012).

A key determinant of human security is the degree to which people's preferences and the benefits they receive from state-led planned adaptation programmes are matched. In failing to consider the different *preferences and contexts*, state-led adaptation can fail to meet the adaptation needs of certain parts of the population (Gebert et al., 2012; Milman and Arsano, 2012; Turhan, 2012b). The political economy within a country also influences adaptation decisions and the design of adaptation policies (Milman and Arsano, 2012; Turhan, 2012b).

Box 17: Capacity of governments to lead adaptation processes

- The South Sudan case exemplifies how low government capacity and the resulting high dependency on international donor and aid communities, with regard to nation and peace building, contributes to the difficulty of a consolidated and coordinated effort to implement adaptation policies.
- The Arab Spring Revolution in Egypt is another example of governmental reorganization processes that weaken the current ability of the state to implement adaptation strategies in the short term. However, a successful transformation to a redistributive and people-centered government system might in the long-run increase the adaptive capacity of the country.

The improvement of the adaptive capacity of state institutions can be a crucial factor for improving the adaptive capacity of populations (see Box 17). But in many cases, multiple uncertainties translated into barriers to planning adaptive responses, while in others institutional and infrastructural capacity gaps and poor access to data strongly affected the development of adaptive capacity (Selby and Hoffman, 2012). Furthermore, social and political discussion on the useful role that well-established civil security/protection and social security systems can play in the prevention of water-related hazards and response seems to be often absent (Kallis and Zografos, 2012). Exchanging ideas on values, representation and voice, equity and *fair distribution of risks and impacts* are also crucial for determining adaptive responses to climate change and human security (Adger, 2010; Adger, 2010 in Turhan, 2012b). *Currently, political and societal dialogue about the dimensions and scales of human security prioritized by certain policies at the expense of other dimensions and a debate about policy alternatives for addressing uneven impacts are missing.*

Adaptive capacity and uncertainty

Uncertainty in climate change impacts is a key factor influencing climate change adaptation, policy formulation and institutional set-ups. Uncertainty may exist regarding environmental and climate factors. Existing climate and hydrological models have difficulties predicting the future and planning and management have to deal with the contradictory results of those models. Uncertainty also stems from social dimensions and interactions (including political aspects), economic development and technological progress as well as factors such as political instability, transformation or conflict, complicate adaptation planning and management.

Uncertainties, often in combination with poor data availability, challenge governance structures at all political levels but particularly in transboundary basins, where values, perceptions and behaviour between co-riparian nations may differ. Mechanisms to address uncertainty in transboundary agreements exist and research by Fischhendler and De Bruyne (2012) reveals that in transboundary agreements, conflict resolution mechanisms have the potential to consider future uncertainty, improve flexibility, impose commitments and address potential disputes, but that they are underrepresented. In order to formulate adaptation strategies, systems need to be able to manage high uncertainty and remain dynamic enough to adapt to changing conditions (Ostrom, 2005; Pahl-Wostl, 2009; Snorek et al., 2012b).

3. Cooperation and conflicts

Cooperation

Slightly more cooperative events than conflictive ones were recorded in the database of water-related events at the sub-national scale while half of these events were neither cooperative nor conflictive (Bernauer et al., 2012). However, only very few instances of direct links between human (in)security and cooperation could be observed. Instances of cooperation were reported between Morocco and Spain (Pascual et al., 2012), Greek Cypriot and Turkish Cypriot communities. In the event of the Red/Dead Sea Canal being approved, potential for collaboration between Israel, Jordan and Palestine could occur (Gerstetter et al., 2012). Through the common framework and cooperation channel of the Intercontinental Biosphere Reserve of the Mediterranean (IBRM), stability, security and sustainable development have increased in the region (Abdul Malak et al., 2012).

But as pointed out in the Ebro Delta case study, certain types of collaboration, e.g., a forced-upon agreement on water transfers, may only strengthen unequal situations (Albizua and Zografos, 2012) instead of mutually beneficial cooperation (Zeitoun and Warner, 2006). Cooperation may come at a certain cost; in the context of international treaties, transaction costs are induced by interactions between different states (Boadu, 1995). Transaction costs (such as negotiating, monitoring and enforcement costs) rather than any environmental variability or an individual's adaptive capacity are determinants of decisions to cooperate or not in the face of conflict as exemplified in the case of Israel (Fischhendler and De Bruyne, 2012; Fischhendler and Katz, 2012).

Conflicts

Conflicts studied through the CLICO project take many different forms ranging from low level, 'silent' or latent conflict such as in the Ebro Delta (Albizua and Zografos, 2012) to conflict involving violence such as in Niger (Snorek et al., 2012b) and Gambella (Milman and Arsano, 2012). The severity, time scale and level of violence of a conflict can add considerable vulnerability as the Jordan West Bank (Tamimi and Jamous, 2012), Gambella (Milman and Arsano, 2012) and Sudan (Selby and Hoffman, 2012) case studies demonstrate. The versatility of conflict as a social phenomenon can result in it being beneficial, helping to reduce vulnerability and improving adaptive capacity in certain situations such as those that are oppressive (see e.g. Kallis and Zografos, 2012), as in cases of "adaptive" conflicts between herders and farmers in the Western Sahel (Turner, 2004).

Drivers of conflicts

Evidence for *violent water-related conflicts is extremely rare* (Bernauer et al., 2012). Most case studies and the large N study point towards *stronger links between political, economic and social factors and water-related conflict than between climate-related variables and water conflict.* The large N study finds that demand side drivers and 'restraint' factors (e.g., political system and political stability) are more important than climatic variables that influence the supply of water. Thus, the nature of conflict is partly influenced by the degree of political freedom (Böhmelt et al., 2012). In democratic countries where a 'political space' for disputes is induced by economic prosperity and political freedom, low-level conflicts are more likely, while violent conflicts are far more prevalent in non-democratic settings. In addition, consensus building processes, which can be described as cooperative- may emerge through low-level conflict in democracies. However, the debate of alternatives may be muffled even in democratic countries through the securitization of relevant issues (Albizua and Zografos, 2012; D'Alisa, 2012b). In Seyhan, class-based conflicts have been prevented through the lack of organization and union membership of seasonal migrant workers (Turhan, 2012b). In the Palestinian Territories human security and an inadequate access to water is shaped by transboundary tensions, political and social tensions and uncertainties in combination with capacity constraints (Tamimi and Jamous, 2012).

Evidence drawn from several CLICO case studies suggests that *conflict emerges through societal responses to hydro-climatic stress rather than the impacts of hydro-climatic stresses themselves* (Albizua and Zografos, 2012; Milman and Arsano, 2012; Snorek et al., 2012b, Gebert et al., 2012). For example, in the Israeli-Palestinian conflict over water, Bar-On and Gerstetter (2012) observed that many stakeholders and experts believe climate change will have a much lower impact on water availability for Palestinians than the ongoing political conflict between the two countries over water allocations. However, the negative impact climate change will have on human security may also increase the possibility of conflict between different social groups of the West Bank region (Tamimi and Jamous, 2012). For the case of Sudan, Selby and Hoffman (2012) even suggest that water and climate conflict may be related to an abundance of water resources rather than to climate-induced water scarcity. But factors influencing conflict are multi-scalar and may develop over large time scales, as in the case of Sudan, with political and historical factors predominantly affecting conflict and environmental vulnerabilities (Selby and Hoffman, 2012).

Altogether, there is a lack of evidence to confirm that climate change and water scarcity cause conflict. However, as all these assessments are based on the investigation of past events, *it is possible that in the future these relationships might change.*

Policies and mechanisms to address conflicts

Hardly any policies explicitly target the link between climate change, water conflicts and human security and policies directly aiming at conflict reduction are missing (Gerstetter et al., 2012). There are however, a wide range of policies that support adaptation and are thus indirectly useful to prevent or reduce conflicts in the light of climate change. In Sarno for instance, future climate change does not seem to be changing the priorities of political action. This may result in a situation where existing policy measures to address hazards are insufficient to deal with the additional impacts of climate change as well as with conflict mitigation and resolution (D'Alisa, 2012b; Gerstetter et al., 2012a).

The CLICO research demonstrated that Conflict Resolution Mechanisms are underrepresented in transboundary institutions and treaties, although growing uncertainties in the face of climate change might make disagreements between riparian nations about the management of the shared water resources more likely. The costs associated with decision-making for institutional change, implementing institutional reforms and policy changes and set-up of new institutions are an important factor that can hinder the adoption of conflict resolution mechanisms (Fischhendler and De Bruyne, 2012).

7.2 Key findings related to the initial research questions

This section provides more details on the seven research questions (see Chapter 2.2) that CLICO aimed to answer. The following table (Table 18) summarizes the key findings that the CLICO research has generated for each research question. This summary has been used as input for developing the three main themes of CLICO findings as presented previously.

Question 1a. What is the relative importance of environmental risks compared to social and political factors?

A range of factors shape water availability and vulnerability to climate change in the different CLICO case studies:

- Socio-economic pressures, a growing population and a reduction in water availability (IBRM);
- Transboundary tensions, political and social tensions and uncertainties in combination with capacity constraints (Jordan basin);
- Bedouin population in South Sinai: Isolation of the Bedouin population, illiteracy and low awareness of climate change, fragile ecosystem influenced by climate variability, strong local knowledge of the ecosystem by the Bedouins (South Sinai).

Question 1b. What are the mechanisms by which these risks and vulnerabilities amplify each other at different scales?

The following different mechanisms were identified:

- Social vulnerabilities are linked to issues of social justice and human rights where social marginalization can worsen vulnerability to climate stresses and insecurity (Niger, Turkey, Ethiopia);
- Social and political factors can increase the human insecurity of rural populations as well as their vulnerability to climate impacts (Seyhan);
- Human security is affected by a variety of factors such as pre-existing tensions between different ethnic groups, food insecurity, poor service provision and vulnerability to climate impacts; climate change can act as a "multiplicative stressor" (Ethiopia);
- 'Divergent adaptations' that improve the adaptive capacity of some groups while reducing that of others can occur (Niger);
- Planned state-led relocation may reduce risks associated with flooding but may also increase vulnerability through displacement and removal of sustainable livelihood strategies (Sarno, Alexandria, Ethiopia);
- The degree to which people's values regarding their social and natural environment are considered in state-led planned adaptation priorities and initiatives is a key determinant for successful and legitimate human security planning policy (Ebro Delta, Alexandria);
- The securitization (securitization refers to the framing of an issue "in terms of security… drawing on perceptions of national, local or individual (in)security" (Zeitoun, 2007: 115, as cited in Goulden and Graininger, 2012)) of issues by the state can aggravate human insecurity linked to environmental hazards through the de-politicization of issues and the minimization of alternative disaster responses and adaptation strategies (Sarno, Ebro Delta);
- Multiple uncertainties related to the future of the environment and social and political conditions hinder relocation responses (Alexandria).

Question 2. How do political, economic, environmental and climatic factors exacerbate or mitigate water-related conflict?

- Human security can be negatively impacted by climate change which may also increase the possibility of conflict between different social groups of the region (Jordan basin);
- Uncertainties of one type, such as political ones, can overlap and have an impact on water uncertainties. Other factors such as the type of persons involved in the negotiations and the type of cooperative mechanisms proposed play a role in the outcome in terms of increased cooperation or conflict. Certain actions intended to reduce physical uncertainty may generate other uncertainties, hindering cooperation (Fischhendler and Katz, 2012), while in other situations shared water-related threats to human security can provide incentives for more cooperation;
- Political and historical factors predominantly influence conflict and environmental vulnerabilities rather than resource scarcity induced through environmental change (Sudan);
- Water-related conflict originates from the current political and economic context, with conflict emerging as a political response to the marginalization of certain groups' livelihood needs over others and exacerbated by environmental change (Niger);
- Class-based conflicts have been prevented through the lack of organization and union membership of affected groups, e.g., seasonal migrant workers in Seyhan;
- Differing perceptions between those affected and decision makers about the proper scale of concerns need to be addressed by adaptation interventions to reduce chances of water-related conflicts (Ebro Delta);
- Research does not reveal climatic factors directly shaping conflict; however, socio-political interactions in the region are influenced by current policies originally intended to decrease vulnerability to climate stresses and lead to new insecurities and opportunities for conflict (Ethiopia).

Question 3. How does human security (or lack of it) affect the demand for cooperation?

- Instances of cooperation were reported (Morocco and Spain, Greek Cypriot and Turkish Cypriot communities) as well as potential for collaboration (Israel, Jordan and Palestine);
- Certain types of collaboration premised upon security arguments, e.g., a forced-upon agreement on water transfers, may only strengthen unequal situations (Ebro Delta);
- Transaction costs rather than environmental variability or an individual's adaptive capacity are determinants of decisions to cooperate or not in the face of conflict (Israel and Palestine).

Question 4. Under what conditions may conflict reduce rather than exacerbate vulnerabilities?

- Uncertainties may lead to vulnerability-reducing cooperation in negotiations over transboundary water management (Israel and Palestine) as sustained by theory (Keohane, 2005; Zeitoun and Mirumachi, 2008);
- In transboundary agreements conflict resolution mechanisms have the potential to consider future uncertainty, improve flexibility, impose commitments and address potential disputes (Fischhendler and De Bruyne, 2012).

Question 5. What constitutes the capacity of states and their institutions and other organizations to implement change, or even radical change necessary under times of stress?

- Weak implementation of current laws and policies, duplication among institutions, low levels of public participation and absence of the local population priorities in water management are obstacles to effective management (IBRM);
- Customary hierarchical institutions have enhanced institutional capacity but in other cases institutions have had negative influence increasing the potential for conflict (Niger);
- The 2011 political events hindered the short-term capacity of institutions to develop adaptive relocation policies effectively to face sea level rise (Alexandria);
- Institutional and infrastructural gaps are resulting in poor environmental management and human insecurity (Sudan and South Sudan). The strengthening of state institutions can be a major factor for both countries to withstand hydro-climatic stresses and may help future adaptation and development planning related conflicts (Selby and Hoffmann, 2012);
- The role of the state and societal transformations administered by states where transformation adaptive agendas for agriculture and livelihoods have given preference to certain lifestyles and aspects of human security over others are questioned (Ethiopia);
- The failure to deal with the root causes of disaster and to implement long lasting measures to ensure the human security of the population was caused by the state's massive scale intervention (Sarno).

Question 6. What interventions might be suitable for reducing risks and improving human security associated with climate and water related stressors, either by reducing the vulnerability of the system and increasing its adaptive capacity or by modifying the hazards?

- Restructuring negotiations, through the separation of the roles of politicians and technical professionals and integrating climate change adaptation measures in the future national and transboundary IWRM plans (Jordan basin);
- It is crucial to understand and integrate different values and perceptions of climate change in adaptation planning as well as pushing for more dialogue (Alexandria, Ethiopia, Seyhan);

- The need for greater participation and integration of local knowledge when putting together interventions is important (Pascual et al., 2012) as well as the need for institutional appropriateness (Niger). Still, the important role state interventions play in shaping adaptation of individuals and communities needs to be highlighted (Gerstetter et al., 2012);
- Challenges linked to relocation can be overcome if they are integrated into previous and current institutional frameworks (Alexandria);
- The direct effects of climate change but also the indirect processes that could aggravate those effects should be integrated into adaptation policies.

Question 7. Under what conditions might policies of adaptation to perceived or experienced climate change impacts increase the vulnerability of some groups and/or exacerbate social conflict?

- State managed adaptation policies have further alienated actors already disapproving of the state (Ethiopia) (Vidaurre and Tedsen, 2012). Two key policies: The Villagization Programme and Agricultural Development Led Industrialization have had negative impacts on human security and have aggravated existing tensions in the region (Ethiopia);
- State-led adaptation policies shifted the responsibility of adaptation to the individual (Turkey). Policies and interventions reinforce the marginalized position of migrant groups in Turkey as they overlook values, perceived adaptation needs and the root causes responsible for the vulnerability of those groups (Turkey);
- Multiple institutions and actors may lead to a reduction of vulnerability of a group while reducing the adaptive capacity of another (Niger). Insufficiently planned adaptation (e.g., relocation) would increase insecurity of a group while reducing their adaptive capacity (Alexandria);
- Conflict and environmental degradation matters should be scrutinized through the lens of a history of neglect and exploitation linked to the nature of the state agency (Sudan). Therefore, it is probable that adaptation in the region shapes and contributes to conflict.

Table 18: Selected answers to the seven research questions based on CLICO findings. Source: based on Goulden and Grainger (2012).

7.3 Conditions for successful adaptation

Perspectives play a large role in the outcome of adaptive responses with diverging values and preferences leading to different adaptation outcomes. Tensions and maladaptation risks emerge when differing values, perspectives, cultures and traditions are ignored (Albizua and Zografos, 2012; Gebert et al., 2012; Milman and Arsano, 2012; Turhan, 2012b). Although scientific knowledge is both crucial and well-accepted as central for designing effective responses to climate change, tensions may also emerge in cases where expert and scientific knowledge are privileged over other types of knowledge (Albizua and Zografos, 2012). While open processes of adaptation planning and development, which include diverse perspectives, can enhance policy legitimacy and effectiveness (Albizua and Zografos, 2012; Pascual et al., 2012), the less powerful may end up facing manipulation even within deliberative processes (Chilvers, 2009). This suggests that deliberative processes are not a *panacea per se* as they may have controversial normative effects upon social practices (Zografos and Howarth, 2010).

In order to overcome barriers to transboundary water cooperation, Fischhendler and Katz (2012) propose restructuring negotiations through the separation of the roles of politicians and technical professionals. Furthermore, in the future, national and transboundary integrated water resources management (IWRM) plans should have the capacity to integrate climate change adaptation measures, leading to increased confidence on all matters (Tamimi and Jamous, 2012). However, for interventions to be effective it is important to consider the household level and to incorporate individuals in climate change adaptation (Albizua and Zografos, 2012; Paavola and Adger, 2006; Renn and Schweizer, 2009).

Values, representation, voice, equity and fair distribution of risks are also crucial to determining adaptive responses to climate change and human security (Adger, 2010; Adger, 2010 in Turhan, 2012b). A lack of understanding of value-based approaches can be responsible for maladaptive responses (Albizua and Zografos, 2012), as illustrated by the examples of Alexandria, Gambella and Seyhan (Gebert et al., 2012; Milman and Arsano, 2012; Turhan, 2012b). Through their Ebro Delta case study, Albizua and Zografos (2012) assert that an essential part of policymaking resides in acknowledging people's values and perceptions of climate change and calling for more dialogue, debate and deliberation so that a variety of views can be integrated into in adaptation decision-making.

The need for greater participation and integration of local knowledge when putting together interventions is proposed by Pascual et al. (2012), while the important role state interventions play in shaping adaptation of individuals and communities is highlighted by Gerstetter et al. (2012). In Niger, institutional appropriateness is emphasized when dealing with vulnerability reduction and sustaining adaptive capacity (Snorek et al., 2012b).

Challenges linked to relocation in Alexandria could be overcome if they are integrated into previous and current institutional frameworks (Gebert et al., 2012). Finally, Albizua and Zografos (2012) suggest that not only the direct effects of climate change, but also the indirect processes that could aggravate those effects should be integrated into adaptation policies.

Concerns were raised over adaptation that changes existing livelihoods significantly (Milman and Arsano, 2012; Gebert et al., 2012) as these had negative consequences for human security and increased vulnerability of the rural population in Gambella (Milman and Arsano, 2012). Through the case studies of Alexandria (Gebert et al., 2012) and Gambella (Milman and Arsano, 2012) a well-balanced adaptation is advocated.

Key messages

Climate and hydrological factors, socio-economic, institutional and political factors are all drivers of human security but their relative importance depend on the context. There are great uncertainties when assessing the relative importance of environmental risks as compared to social and political factors. Political, economic and social factors seem to be more important drivers of water-related conflict than climate-related variables. However, in the future these relationships might change. States and state-led adaptation were found to play a prominent role in affecting human security: states can greatly facilitate adaptation, but policies are also prone to adverse effects.

Adaptation can both reduce and exacerbate insecurities for certain groups, although this depends to a great extent on factors such as power relations, existing marginalization and governance (role of the state). There are also varying capacities of states to implement effective adaptation policies. Analysing the political economy in an area or country helps to understand state-led adaptation. Currently, political discussions about winners and losers of climate change and adaptation and which dimensions and scales of human security are prioritized at the expense of others is often absent.

State-led adaptation

- Can facilitate adaptation, particularly if people are unable to adapt on their own (e.g., Alexandria);
- Can completely transform existing traditional adaptations (Gambella);
- Can lead to unintended consequences;
- Is often found to be insufficiently implemented (Niger);
- Might not reflect the preferences or needs of affected people (Gambella, Ebro);
- Can influence/suppress individual adaptive capacity (Sarno).

Inequality in bearing the costs and benefits of climate change and adaptation policies

- Can reinforce or enhance existing inequalities and marginalization of different social groups;
- Marginalized groups are more likely to be ignored by governments and adaptation policies (migrant agricultural workers in Seyhan, Turkey or Bedouins in Egypt).

Conflict and cooperation

According to CLICO research, there are slightly more cooperative than conflictive water-related events. However, in CLICO research, cooperation is less represented in case studies. With regard to conflicts, CLICO investigated a diverse set of 'conflict-contexts':

- Not yet existing but future potential conflicts related to sea level rise (Alexandria);
- Silent conflicts (Ebro);
- Frequent and sometimes violent conflicts (Niger, Gambella);
- Political conflicts arising from short-term politically-derived development goals vs. long term adaptation needs.
- Uncertainty poses severe governance challenges:
- Environmental/climate factors: difficult to predict the physical impacts of climate change and models lead to contradictory results;
- Social factors: socio-economic development, political instability, transformation and existing conflict(s) are very difficult to forecast.

Table 19: Key project messages. Source: Authors

7.4 Summary

The synthesis chapter focused on presenting all the key research results from the CLICO project and has done so by answering all seven research questions (see Goulden and Grainger, 2012, for more details) which underpin it.

The first section of this chapter was arranged around the presentation of the findings. The findings themselves were divided into the following themes: (1) the complexity of socio-ecological interactions that influence human security, vulnerabilities and conflicts; (2) the role of adaptive capacity and adaptation and the drivers of conflicts and cooperation; and (3) state-led adaptation, political economy, concepts of divergent adaptation and maladaptation, as well as issues around securitization.

The second and third section looked at the negative impact adaptation can have on livelihoods and human security as well as the conditions necessary for successful adaptation. Findings include: a need to strengthen state institutions and a need to better understand the link between political uncertainty and the ability of state institutions to deal with insecurities. The chapter finished with a call for more social and political dialogue around values, perceptions and fairness with regard to climate change adaptation.

8. Policy Recommendations

CLICO research has shown that the climate-water-security nexus is highly context-specific, because it depends on the various social, economic, political and environmental factors and the institutional landscape within and between countries. Consequently, what a policy in a specific country should look like and what concrete issues, population groups and sectors should be addressed is highly context-specific. However, from the research carried out, certain overarching and more general insights can be garnered on how to improve adaptive capacity in the face of climate change related hydro-hazards and the issues that suitable policies should take into account when addressing human security and conflict prevention in the context of climate change.

CLICO research confirms the important role of the state in climate change adaptation

The government has a certain function in planning and facilitating adaptation by providing the regulatory framework that governs adaptation actions taken by individuals, groups and institutions/organizations. State-led adaptation can be very useful where population groups are trapped in insecure living conditions and are often unable to adapt. Selby and Hoffmann (2012) find that improving the adaptive capacity of state institutions is an important way of improving the adaptive capacity of populations. However, in some cases, government policies encouraging state-led adaption presents a significant risk to certain populations as shown by Milman and Arsano (2012) and Turhan (2012b). These examples suggest that states may sometimes be unable to capture the diversity of livelihoods, preferences and the social, political and environmental context framing adapta-

tion, particularly in the case of marginalized groups (Milman and Arsano, 2012; Turhan 2012b). The way authority, interests and power are distributed and inter-connected at different levels of government also impacts the types of adaptation policies that can be implemented.

Bearing this in mind, the recommendations for policymakers are made at local and national level with additional recommendations specifically addressed to international policymakers. These range from stressing the importance of increasing policy relevant scientific knowledge and mechanisms for its dissemination, to strengthening accountable institutions, to the development of normative frameworks that guide the mainstreaming of conflict sensitive approaches and policies as well as the implementation of sector specific measures. The following recommendations are mainly based on Gerstetter et al. (2012b) and Gerstetter and McGlade (2012), but also draw from insights derived in other CLICO work packages.

8.1 Increase knowledge and knowledge sharing by strengthening research capacity and information transfer

Conduct vulnerability and socio-economic impact assessments of (potential) adaptation policies

→ *Assess the root causes of vulnerability:* In-depth vulnerability assessments based on rich sources of information in relevant fields are needed to target future efforts to reduce vulnerability, exposure and sensitivity. It is useful to draw on various lines of research and interdisciplinary research methods and build upon existing experiences and practices in various contexts. It is essential to tailor research according to the scale at which it is needed (from local to transboundary) depending on the type of effects of climate change and existing adaptation efforts.

→ *Assess socio-economic impacts of a range of different adaptation options and policies:* Here, continued research drawing from the research approaches used in CLICO is needed to identify adaptation trade-offs including potential "winners and losers" prior to the implementation of adaptation policies as well as evaluating the interaction of the planned adaptation measures with existing policies. Useful theoretical concepts when examining these trade-offs are the concepts of "divergent adaptation" (Snorek et al., 2012b) and maladaptation (e.g. as applied in Milman and Arsano, 2012). Impact assessments should include all elements of human security, including personal, state and community security, at differentiated geographical/administrative and time scales (short-term vs. long-term) (Milman and Arsano 2012; Vidaurre and Tedsen, 2012). The potential impacts of adaptation measures on all parties should be thoroughly understood, considered and well-balanced before adaptation policies are implemented (Gerstetter et al., 2012b).

Advance knowledge management, sharing and transfer

Measures that facilitate information and knowledge sharing are recommended to increase the overall capacity of decision makers to deal with climate change adaptation. An improved dialogue between the scientific and policymaking communities is necessary to improve linkages between policy needs and research activities as well as to enhance the accessibility of scientific knowledge to policymakers. Sharing information also contributes to increased cost-effectiveness of adaptation measures as it saves time and money when building on existing knowledge to address the same challenge. Recommendations include:

- Provide scientists with easy access to data from multiple sources by *advocating open-access to information and data*;

- *Increase the capacity of state institutions to integrate scientific knowledge into decision-making*, thereby improving the link between research, the public sector and private sector. This will also serve to increase knowledge transfer from science to policymaking for the purpose of developing comprehensive, evidence-based climate change adaptation policies and strategies that address the root causes and consider dynamics of vulnerabilities and low adaptive capacity to climate change;

- Collaborate with the scientific community to develop *decision support systems* for policymakers to improve their ability to make quick and well informed decisions;

- Share and disseminate knowledge within regions and with others who face similar challenges at a global level. For instance, form *global alliances for data and knowledge sharing* but also systematically acknowledge *local knowledge/expertise and facilitate access to it.*

Raise awareness on climate change impacts, vulnerability and human (in-) security

- Improve awareness of water-related impacts of climate change among the general population: raising public awareness of climate change impacts helps to ensure that citizens are conscious of climate-induced risks. This can help increase acceptance of measures that might initially be unpopular, such as establishing 'no-build zones' that prohibit construction in areas vulnerable to flash flooding and increase participation in resettlement programmes for people already living in areas that are flood-prone or exposed to sea level rise.

- Advocate the concept of good citizenship in terms of the public's rights, duties and responsibilities.

- Water-saving and alternative water-usage campaigns addressing the demand side of management can educate people on measures such as freshwater-reuse and can help reduce water needs. Demand side factors are important factors that influence the likelihood of water-related conflicts (Bernauer et al., 2012). Addressing these factors and reducing demand for water can contribute to maintaining or improving human security in the future in the face of increased natural scarcity of resources.

- Early awareness of the impacts associated with climate change can also help sectors take adaptation measures well in advance. Where tourism is of economical importance, there is a need to raise awareness of climate change in this sector in order to adapt to reduced future water availability (Charalambous et al., 2012).

8.2 Promote and strengthen accountable and functioning institutions

The development of accountable and functioning institutions requires the responsible use of political power and equity-based management of public resources by the state. This essentially means that effective institutions are dependent on the interaction between democracy, social welfare and the rule of law. Economic and political factors as well as political economy have been shown to be important in affecting adaptive capacities and conflicts (Milman et al.; 2012b, Böhmelt et al., 2012). Poorly co-ordinated, corrupt institutions with badly trained staff are unlikely to be able to develop and implement effective policies to counter the effects of climate change. Thus, in the case of systemic institutional and governance issues, climate change and human security can most effectively be addressed once these underlying issues are resolved (Gerstetter et al. 2012b).

→ *Improve transparency and functioning of institutions:* Reinforce existing institutions but also consider the need to reinvent/rethink the way in which they contribute to policy implementation. In addition, where trust in the institution is low, its legitimacy may need to be repaired, or, the institution may need to undergo a complete restructurization.

→ *Draw on existing local institutions, social structures and networks:* Strong social networks exist (e.g., at the community and family level) and can be strengthened to facilitate adaptation to climate change (although these should not be a substitute for state supported adaptation). Involving communities in the management of natural resources can facilitate adaptation. In many places, there are traditional mechanisms for conflict resolution at the local or community level. These mechanisms should be used to help resolve local conflicts over resources, irrespective of climate change (Gerstetter et al., 2012b).

→ *Implement and enforce existing policies for climate change adaptation:* Rather than creating new policies where appropriate policies are already existant, many of the case studies show that the focus should be placed on their implementation (Gerstetter et al., 2012).

→ *Improve capacity to implement:* Ensuring effective policy implementation often lacks the necessary political will, human resources (particularly in regional level governments) and communication and coordination structures. This can be improved by clarifying and reducing the overlap of responsibilities by different governmental bodies (e.g., Snorek et al., 2012b), as well as by increasing training, awareness-raising and capacity-building, particularly at the sub-national level.

→ *Introducing "co-responsibility":* Facilitate and encourage the empowerment of affected groups to increase their participation in adaptation decisions with regard to policy design and implementation. CLICO research has shown that there are many benefits of participatory decision-making and that there is a need to improve participation processes to ensure that the values and perceptions of all groups are reflected and that responsibilities are shared (e.g., see Pascual et al., 2012, regarding water management, Albizua, 2012). CLICO research has highlighted several examples where the interests and values of marginalized affected groups are excluded in state-led adaptation processes (Tamini, 2012; Turhan, 2012b; Milman and Arsano, 2012). Since these groups are trapped in political and economic marginalization, it is difficult to decrease their vulnerability to climate change without empowering them first (Gerstetter and McGlade, 2012). Maintaining or increasing existing inequalities also increases the risk of conflicts or tensions (e.g., D'Alisa, 2012b). Thus, targeted strategies to reduce inequalities are needed (Gerstetter et al., 2010). Moreover, by increasing participation, *local knowledge can be included* in adaptation policies which will improve the applicability and efficiency of these policies (Tamini, 2012). For example, small-scale farmers and pastoralists have adapted to changing and often adverse environmental conditions for centuries. This type of traditional, local knowledge and capacity alongside traditional technologies can often be used effectively to support and inform state-led climate change adaptation measures (Gerstetter et al., 2012b) to synergize state-led and individual adaptation efforts. The consideration of bottom-up approaches, such as the inclusion and consideration of indigenous water management systems as well as locally developed adaptation mechanisms, needs to be acknowledged and synthesized (Gerstetter et al., 2012).

8.3 Cooperation and conflict resolution

→ *Increase cooperation:* As the CLICO research on transboundary basins has shown, communication, coordination and cooperation have proved to be essential features of adaptive capacity. While many institutions in transboundary basins have developed good cooperation practices at the national level, mechanisms for cross-border social dialogue at the local level are often lacking. The levels and intensity of cooperation is related to a complex range of historical and political influences (Goulden and Grainger, 2012). It is important to ensure that cooperation takes place on the ground by those directly affected and that functional local institutional mechanisms support all cooperative action at the various scales. However, cooperation should not silence necessary political and social debates over appropriate response and adaptation strategies to environmental hazards (D'Alisa 2012), but rather open opportunities for increased exchange of perspectives, values and concerns. Measures to find compromises in cases of diverging values of different actors include conflict resolution mechanisms.

→ *Adopt conflict resolution mechanisms*: At the national level, various adaptation policies (particularly related to agriculture and water management) indirectly address human security concerns, while adaptation policies that explicitly address conflict are often missing (Gerstetter et al., 2010). Conflict resolution tools have proven to be effective for managing the uncertainty inherent in climatic and human systems but there is currently a systematic lack of conflict resolution mechanisms in transboundary institutions. (Fischhendler and De Bruyne, 2012). This finding can be explained by the prevalence of high transaction costs in existing transboundary agreements (e.g., costs related to negotiating between states). Measures that reduce transaction costs, such as data sharing and shared norms, make the adoption of conflict resolution mechanisms more likely and are useful measures to increase the overall adaptive capacity to climate change of transboundary basins. Conflict resolution mechanisms are not only useful at the transboundary level, but also for other areas of political concern.

8.4 Mainstreaming

→ *Integrate socio-economic and political concerns and measures into existing policies:* The research revealed that improvements to socio-economic (e.g., economic development and redistribution, social security) and political (e.g., levels of democracy, political stability) conditions are more likely to reduce the vulnerability of specific groups, ensure human security and make water conflict less likely (Gerstetter and McGlade, 2012). Climate change is a cross-cutting issue that rarely fits neatly into a specific ministry, which suggests the need for broader integration of adaptation relevant issues into existing policy sectors (Gerstetter et al., 2012b).

→ *Harmonize and coordinate policies to create synergies:* Framing adaptation measures in a way that is relevant to current socio-economic or political debates (e.g., in the context of economic crisis) is important and can increase political will to push adaptation higher up the political agenda. Capitalizing on cross-sectoral synergies (e.g., see social, agricultural and environmental policy in Turhan, 2012b) that save resources and increase policy impact further encourages political support. Furthermore, sector-specific guidelines on standards for climate adaptation measures can help ensure that all institutions and departments can fully and practically integrate adaptation concerns into their day-to-day work routines (Gerstetter et al., 2012b).

→ *Promote ex-ante measures and long-term planning for adaptation:* Uncertainties related to climate change impacts and what shapes individual adaptation efforts to address them, will present challenges for governmental planning and early action. However, a case can be made for swiftly initiating adaptation efforts and for incorporating adaptation into mid- and long-term planning, including the promotion of *ex-ante* rather than *ex-post* adaptive measures (Pascual et al., 2012). As exemplified by the Alexandria case study, resettlement may become a viable adaptation option to sea level rise in the future and governments need to ensure income and housing security for the relocated population. With the systemic problems inherited in the housing market and current agricultural development trends in Egypt, policymakers need to tackle these issues now to be able to maintain human security for the affected population in the future (Gebert et al., 2012).

→ *Incorporate flexible planning into existing policy cycles:* Taking into account projected climate change impacts in planning (climate proofing) is challenging due to the uncertainty associated with predicted figures. But flexible planning can also take the form of modular implementation (e.g., designing measures so that they can be easily modified in view of future requirements) where possible increasing their robustness to change. In this way, adaptation needs can be taken into account in long-term strategies. At the same time, strategies should accommodate the need for systematic evaluation at shorter intervals, according to developments on the ground and new scientific insights (i.e., following adaptive management approaches). Incorporating periodic reviews in strategies and legislation can ensure that this happens and improved or additional knowledge on climate impacts can be regularly incorporated into the planning cycle (Gerstetter et al., 2012b).

→ *Develop cross sector and inter-institutional early warning and response mechanisms on climate change impacts and conflict risk:* For enhancing flexible planning, early warning systems (EWS) on emerging climate change and conflict risks can be a powerful tool. Many EWS in place draw mainly from natural sciences and are technically designed to exactly forecast observable hazardous events, such as floods or droughts. However, taking into consideration the complexity of evolving climate change impacts which affect coupled socio-ecological systems, coordinating platforms that take into account changes and trends in societies by collecting socio-economic information are more adequate. These platforms should include representatives from all relevant sectors and institutions. Such a platform can help to periodically exchange knowledge and perceptions on sector specific trends that when linked and put into causal relations reveal potential upcoming conflict risks and risks to human security. Here, the most climate change-sensitive sectors (e.g., agriculture, urban planning and water management) shall be encouraged to develop mechanisms for coordinated threat anticipation and responses. This also requires the smooth exchange and integration of data, allowing for monitoring long-term and creeping climate change processes with greater ease and the development of multisector approaches towards early warning. Moreover, appropriate settings are required to ensure people's pro-active involvement in spreading early warnings and in the elaboration of preparedness and response strategies.

8.5 Sector specific measures

→ *Strengthen social security systems and civil protection:* CLICO research has pointed to the importance of social security and civil security institutions in reducing vulnerabilities to climate change (Gerstetter and McGlade 2012). Social security systems provide important assistance to reducing vulnerability to climate change and related

hazards. Advanced and functional social security and welfare systems support people to better cope with the negative impacts of hydro-hazards and increase their capacity to adapt to climate change. Though it is still the responsibility of an individual or a community to adapt ,Therefore, state adaptation strategies should include strong social safety nets. Well-functioning civil protection and disaster response agencies, access to public hospitals and affordable health insurance will put people in a much better position when faced with hazards. Unemployment support and other social policies facilitate adaptation if people need to reorganize their livelihoods in the face of climate change hazards.

→ *Agriculture:* A recommendation derived from the results of many case studies is the need to increase the adaptive capacity of agricultural-based livelihoods by maintaining land productivity and access to water in sufficient quality and quantity. Basin reforestation, fluvial restoration and conservation efforts need to be integrated into long-term land-use planning. This needs to be accompanied by shifts in crop types to those with higher water efficiency (e.g., crop varieties that are drought-tolerant) and the use of more efficient technologies in irrigation. Some case studies recommend facilitating farmer investments targeted at increased efficiency in agricultural production to avoid facing water shortages and increased competition. Large, water-intensive agricultural developments, such as irrigation projects, should also be assessed for their potential impact on the vulnerability of different groups. Such projects can increase the food and economic security of farmers while at the same time threaten human security in areas beyond the location where development is taking place (e.g., downstream effects of reduced water availability for human populations and the environment). Finally, comprehensive land use and resource policies need to be well-monitored with a focus on compliance and enforcement.

→ *Water management:* Ensuring fully integrated management of water resources based on equitable water allocation can increase efficiency and transparency in water management (Tamini, 2012):

- Strengthen cooperation at all levels: cooperation between local stakeholders can lead to better management and allocation of available water between sectors and users. Regional cooperation can enhance the implementation of large scale projects to work on non-conventional water resources to reduce the gap between supply and demand for all uses (IBRM, Jordan).

- Raise public awareness about water scarcity to facilitate the adoption of unconventional techniques such as water reuse, as well as the improvement of infrastructure efficiency and reduction of consumption. Water pricing may be a useful measure to increase awareness and set incentives for water saving and efficiency.

- Put flood control measures in place and increase levels of preparedness for floods and droughts. Develop response plans and communicate them well at all scales (Sarno).

8.6 Migration and resettlement

Uncontrolled rural to urban migration has been mentioned in many case studies as a threat to human security. The emigration of labour and therefore the lack of labour force and expertise in rural areas may decrease agricultural production (e.g., in river basins such as IBRM in Morocco and Andalusia) and contributes to the decline of traditional livelihood systems with potential negative impacts on regional food security. In urban areas increased immigration overburdens the provision of public services and employment, leading to an increase of informality and vulnerability to natural hazards.

Appropriate measures should be taken to manage migration sustainably and to direct migrants away from exposed areas when policies fail to make agricultural livelihoods more attractive. For example, restricting settlements in very exposed areas or designing incentive systems for voluntary resettlement into safe areas should be given priority. It is also important to ensure that long-term urban planning acknowledges climate change impacts and promotes development in safe areas. For all these measures, an informed and structured political discussion on resettlement, values and priorities by all affected actors is essential (Gebert et al., 2012).

8.7 Infrastructure investment for disaster risk reduction

The construction and maintenance of protective structural and non-structural hazard resistant infrastructure (e.g., against flooding) can be useful but requires careful evaluation by applying cost-benefit analysis to anticipate and mitigate necessary trade-offs. Often, ecosystem- based solutions serving as natural buffers, such as to control flooding in oases, are more sustainable and also increase the resilience of the ecosystems of an oasis (e.g., Morocco's adaptation project on Oasis restoration and resilience building (Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement, 2012)).

In addition, infrastructure investments are needed that ensure the sustainable and fair distribution of water as well as water use efficiency. Desalination plants using properly treated wastewater and taking care of environmental impacts may become a useful option for some case studies located in coastal regions (Gerstetter et al., 2012b). Many more recommendations addressing the specific conditions and needs in the case studies can be found in chapter 6.2.

8.8 Recommendations for international policymakers

The following list of recommendations is particularly addressed to policymakers at the international level and taken from Gerstetter et al. (2012b).

→ *Strengthen support so that it becomes systematized, substantial and sustainable*

- Systematize support from the international community and focus on longer-term, interconnected interventions for positive outcomes in sustainable development, climate adaptation, conflict prevention and protection of human security;
- Strengthen large-scale and long-term finance for climate change adaptation and provide technical support and capacity-building for developing countries to meet the sometimes complex and expensive requirements, both for obtaining finance and for absorbing the finance being provided;
- Develop cooperative and transboundary infrastructure to protect the immediate human security of migrants and people who are internally displaced by direct or indirect impacts of climate change, human security threats and conflict. Reduce the vulnerability, exploitation and illegal passage of migrants through livelihood diversification for traffickers who may themselves have turned to these activities due to climate change impacts (e.g., on farming);
- Raise awareness among policymakers on the need to act on less obvious and creeping impacts of climate change, such as drought and sea level rise rather than focusing on sudden high-impact events, such as floods. Provide support for developing longer-term programmes in this regard (Gerstetter et al., 2012b).

→ *Recognize and respect the boundaries of international action*

- Build trust between donors and beneficiaries by supporting global action at the United Nations level and ratifying and respecting international agreements on climate change and the environment;
- Ensure that donors' and recipients' strategic frameworks, wishes and needs are increasingly aligned (in accordance with the 2005 Paris Declaration and the 2008 Accra Agenda for Action for aid effectiveness).

→ *Be aware of the impacts of support and finance*

- Consider the potential effects that support and finance for adaptation or cooperation over water resources can have for creating new conflict or exacerbating existing tensions when planning policy interventions;
- Continue to improve inter-agency cooperation and coordination both within the United Nations and amongst international donors, to avoid overlap and duplication of effort;
- Focus on technical assistance by providing and supporting exchange of scientific information, technical and financial support and capacity-building. Particular attention should be placed on carrying out these activities at the regional and local level to avoid the sometimes over-politicized nature of high-level regional cooperation that can pose barriers to information exchange. Where interaction is at a higher level, international actors should highlight and seek to bring forth the benefits of joint water resource management based on international law.

→ *Provide implementation assistance*

- Solutions should be demand-driven and based on in-depth analysis of the context to ensure their effectiveness;
- Advocate for information to be placed in the public domain and exchanged without restrictions. Provide supportive mechanisms and platforms for global level information-exchange;
- Assist countries with climate change adaptation by issuing guidelines on best practices;
- International NGOs and donors can use their non-governmental position to advocate better cooperation between states over transboundary water management.

8.9 Addressing all levels: Elaborate a normative framework for adaptation

The research has proved that adaptive actions by individual actors and/or the state often lead to trade-offs, some negatively impacting the human security of different groups. Individual adaptation strategies and state-led adaptation policies may positively change a specific dimension of human security for particular beneficiaries, however vulnerabilities for others, such as marginalized groups, or on other dimensions of human security may be created or reinforced (e.g., Milman and Arsano, 2012; D'Alisa, 2012; Snorek et al., 2012b).

Thus, the elaboration of a normative adaptation framework that safeguards which dimensions of human security are traded off against others, is needed. Identifying "winners" and "losers" of adaptation in the short as well as in the longer run is a pre-requisite to to ensure equity-based and sustainable adaptation policies in which negative and positive impacts are well-balanced.

Such a framework developed by and applied to different policy levels (at international as well as national and local levels) can provide guidance for assessing the trade-offs and risks associated with adaptation and generally improve the governance of climate adaptation. This would include in-depth research, political and social dialogue about appropriate principles of adaptation to ensure legitimacy, equity and justice in state-led adaptation. Such a framework can be built upon the concept of divergent adaptation and enriched with various widely accepted principles and approaches, such as community and human security, "do-no-harm" and conflict sensitive approaches, as well as the precautionary and human rights principle. Moreover, the temporal aspects of a normative framework are important to consider by acknowledging the trade-offs between urgently needed short-term development goals and long-term adaptation requirements.

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Appendix I: List of deliverables

Work Package 1

D. 1.1 Updated CLICO Conceptual Framework
Partner responsible: University of East Anglia (UEA)
D. author(s): Marisa Goulden and Kate Porter

D. 1.2: Case Study Protocol
Partner responsible: Universitat Autònoma de Barcelona (UAB)
D. author(s):Giorgos Kallis

Work Package 2

D. 2.1: Climate Outlooks for CLICO Case Study Sites
Partner responsible: The Cyprus Institute
D. author(s): Adriana Bruggeman, Panos Hadjinicolaou, and Manfred A. Lange

D. 2.2: Climate Change Projections for Cyprus
Partner responsible: The Cyprus Institute
D. author(s): Panos Hadjinicolaou, Adriana Bruggeman, Jos Lelieveld, Stelios Pashiardis, and Manfred A. Lange

D. 2.3 Climate Change and Water Scarcity in Cyprus, Impacts and Adaptation
Partner responsible: The Cyprus Institute
D. author(s): Adriana Bruggeman, Katerina Charalambous, Manfred A. Lange, and Panos Hadjinicolaou

D. 2.4: Hydro Security Profiles – Case Studies

Case study name: Intercontinental Biosphere Reserve of the Mediterranean (Morocco–Spain)
Partner responsible: Centre de Recerca Ecològica i Aplicacions Forestals CREAF
D. author(s): Dania Abdul Malak, Jaume Fons, Eduard Pla, and Diana Pascual

Case study name: Cyprus
Partner responsible: The Cyprus Institute
D. author(s): Adriana Bruggeman, Katerina Charalambous, Manfred A. Lange and Panos Hadjinicolaou

Case study name: Ebro Delta
Partner responsible: Universitat Autònoma de Barcelona (UAB)
D. author(s): Diana Calvo Boyero and Christos Zografos

Case study name: Alexandria, Egypt
Partner responsible: United Nations University (UNU-EHS)
D. author(s): Niklas Gebert

Case study name: The Jordan Valley
Partner responsible:Palestinian Hydrology Group for Water and Environmental Resources Development
D. author(s):Abdelrahman Tamimi

Case study name: Gambella, Ethiopia
Partner responsible: Addis Ababa University (AAU), University of East Anglia (UEA)
D. author(s): Anita Milman, Yacob Arsano, and Marisa Goulden

Case study name: Sarno, Italy
Partner responsible: Universitat Autònoma de Barcelona (UAB)
D author(s): Giacomo D'Alisa

Case study name: Seyhan River Basin
Partner responsible: Universitat Autònoma de Barcelona (UAB)
D. author(s): Ethemcan Turhan

Case study name: Sudan
Partner responsible: University of Sussex (UOS)
D. author(s): Clemens Hoffmann and Jan Selby

Case study name: Niger
Partner responsible: United Nations University (UNU-EHS)
D. author(s): Julie Snorek, Fabrice Renaud, and Julia Kloos

Case study name: Jordan Basin
Partner responsible: Palestinian Hydrology Group (PHG)
D. author(s): Abdelrahman Tamimi and Sireen Abu Jamous

D. 2.5: Case Study Journal Articles

Title: Emerging Risks: Sea Level Rise and Potentially Forced and Planned Relocation – Case Study From Greater Alexandria, Egypt
Partner responsible: United Nations University (UNU-EHS)
D. author(s): Niklas Gebert, Julia Kloos, Jörn Birkmann, and Therese Rosenfeld

Title: Water Vulnerability Assessment to Climate Change in the Intercontinental Biosphere Reserve of the Mediterranean (Morocco–Spain)
Partner responsible: Centre de Recerca Ecològica i Aplicacions Forestals CREAF
D. author(s): Diana Pascual, Eduard Pla, Jaume Fons, and Dania Abdul Malak

Title: Water Management by the Tourism Sector on the Island of Cyprus in the Face of Climate Change
Partner responsible: The Cyprus Institute
D. author(s): Katerina Charalambous, Hakan Djuma, Adriana Bruggeman and Manfred A. Lange

Title: Values-Based Approach to Vulnerability and the Adaptation to Climate Change Applying Q Methodology in the Ebro Delta
Partner responsible: Universitat Autònoma de Barcelona (UAB)
D. author(s): Amaia Albizua

Title: The impact of uncertainties on cooperation and conflict in transboundary water: the case of Israeli-Palestinian negotiations
Partner responsible: Hebrew University of Jerusalem (HUJ)
D. author(s): Itay Fischhendler and David Katz

Title: The implementation of integrated water resources management under uncertain socio-economic, political and climate change conditions
Partner responsible: Palestinian Hydrology Group for Water and Environmental Resources Development (PHG)
D. author(s): Abdelrahman Tamimi, and Sireen Abu Jamous

Title: How to disappear completely: Migrant agricultural labor, climate change adaptation and neoliberal state intervention in Turkey
Partner responsible: Universitat Autònoma de Barcelona (UAB)
D. author(s): Ethemcan Turhan

Title:Vulnerability of Sudr to Climate Change, Livelihood Index, An Approach to Assess Risks and Develop Future Adaptation Strategy
Partner responsible: Suez Canal University
D. author(s): Mohamed Tawfic Ahmed

Title:Beyond 'Scarcity', 'State Failure' and 'Under-Development': Rethinking Water, Climate Change and Conflict in the New Sudans
Partner responsible: University of Sussex (UoS)
D. author(s): Clemens Hoffmann and Jan Selby

Title: Divergent adaptation to climate change and changes in ecosystem services: A pastoral-agricultural case study of Niger
Partner responsible: United Nations University (UNU-EHS)
D. author(s): Julie Snorek, Fabrice Renaud, and Julia Kloos

Work Package 3

D. 3.1: Domestic conflicts and Cooperation ("events") dataset
Partner responsible: Swiss Federal Institute of Technology Zurich (ETHZ); Peace Research Institute Oslo (PRIO)
D. author(s): Thomas Bernauer, Tobias Böhmelt, Halvard Buhaug, Nils Petter Gleditsch, Theresa Tribaldos, Eivind Berg Weibust, and Gerdis Wischnath

D. 3.2: Journal article on domestic event data and dataset
Partner responsible: Swiss Federal Institute of Technology Zurich (ETHZ); Peace Research Institute Oslo (PRIO)
D. author(s): Thomas Bernauer, Tobias Böhmelt, Halvard Buhaug, Nils Petter Gleditsch, Theresa Tribaldos, Eivind Berg Weibust, and Gerdis Wischnath

D. 3.3: Geo-referenced Dataset Combining Events Data and Explanatory Variables
Partner responsible: Pease Research Institute Oslo (PRIO) and Swiss Federal Institute of Technology (ETH) Zurich
D. author(s): Thomas Bernauer, Tobias Böhmelt, Halvard Buhaug, Nils Petter Gleditsch, and Theresa Tribaldos

D. 3.4: Journal article reporting on regression results and outlier case studies of domestic conflict dataset
Partner responsible: Swiss Federal Institute of Technology (ETH) Zurich; Peace Pesearch Institute Oslo (PRIO)
D. author(s): Theresa Tribaldos

Work Package 4

D. 4.1: Review of international and national policies and institutional frameworks
Partner responsible: Ecologic Institute
D. author(s): Christiane Gerstetter, Eleftheria Kampa, Katriona McGlade, and Krista Timeus
Contributing Authors: Dania Abdul Malak, Adrianna Bruggermann, Maria Berglund, Katerina Charalambous, Giacomo D'Alisa, Marci Fiedler, Jaume Fons- Esteve, Manfred Lange, Naglaa Loutfy, Emily McGlynn, Fabrice Renaud, Therese Rosenfeld, Steffen Schwörer, Christoph Stefes, Mohamed Tawfic Ahmed, Julie Snorek, Abdelrahman Tamimi, Ethemcan Turhan, Rodrigo Vidaurre, and Lars Wirkus

D. 4.2: The effectiveness for policy frameworks for addressing climate-induced risks to human security and conflict – report on stakeholder perspectives and demands
Partner responsible: Ecologic Institute
D. author(s): Christiane Gerstetter, Katriona McGlade, Rodrigo Vidaurre, Elizabeth Tedsen, and Haran Bar-On

D. 4.3: Policy frameworks to address climate-induced risks to human security and cause of conflict – recommendations
Partner responsible. Ecologic Institute
D. author(s): Christiane Gerstetter, Rodrigo Vidaurre, Elizbeth Tedsen, Katriona McGlade, and Lucy Smith

Work Package 5

D. 5.1: Toolkit of mechanisms to reduce uncertainty in international water treaties
Partner responsible: Hebrew University of Jerusalem (HUJ)
D. author(s): Alena Drieschova and Itay Fischhendler

D. 5.2: Journal article on the comparative content analysis of international water treaties
Partner responsible: Hebrew University of Jerusalem (HUJ)
D. author(s): Itay Fischhendler and Charlotte De Bruyne

D. 5.3: Geo-referenced database of adaptive capacity indicators for shared river basins
Partner responsible: University of East Anglia (UEA)
D. author(s): Anita Milman and Lisa Bunclark

D. 5.4: Journal article on comparison of the adaptive capacities of different shared basins
Partner responsible: University of East Anglia (UEA)
D. author(s): Anita Milman, Lisa Bunclark, Declan Conway, and Neil Adger

D. 5.5: The Choice of Mechanisms in Governing Uncertainty in Water Treaties: A Booklet for Policymakers and Researchers
Partner responsible: Hebrew University of Jerusalem (HUJ)
D. author(s): Itay Fischhendler and Charlotte De Bruyne

Work Package 6

D. 6.1: Report "Climate Change, Human Security and Hydro-conflict: Regional Assessment and Policy Guidelines for Mediterranean Europe and Neighbouring Regions

Partner responsible: United Nations University (UNU-EHS)

D. author(s): Julia Kloos, Niklas Gebert, Therese Rosenfeld, and Fabrice Renaud

Contributing Authors: Abdul Malak, Dania (CREAF), Adger, Neil (UEA), Albizua, Amaia (ICTA, UAB), Arsano, Yacob (PSIR, AAU), Bar-On, Haran (Ecologic Institute), Berglund, Maria (Ecologic Institute), Bernauer, Thomas (ETHZ), Böhmelt, Tobias (ETHZ), Bruggeman, Adriana (CyI), Bunclark, Lisa (UEA), Buhaug, Halvard (CSCW, PRIO), Calvo Boyero, Diana (ICTA, UAB), Charalambous, Katerina (CyI), Conway, Declan (UEA), D'Alisa, Giacomo (ICTA, UAB), De Bruyne, Charlotte (HUJ), Djuma, Hakan (CyI), Drieschova, Alena (HUJ), Fischhendler, Itay (HUJ), Fons-Esteve, Jaume (CREAF), Gerstetter, Christiane (Ecologic Institute), Gleditsch, Nils Petter (CSCW, PRIO), Goulden, Marisa (UEA), Grainger, Sam (UEA), Hadjinicolaou, Panos (CyI), Hoffmann, Clemens (UOS), Jamous, Sireen Abu (PHG), Kallis, Giorgos (ICTA, UAB), Kampa, Eleftheria (Ecologic Institute), Katz, David (HUJ), Lange, Manfred A. (CyI), Lelieveld, Jos (CyI), McGlade, Katriona (Ecologic Institute), Meyer-Ohlendorf, Nils (Ecologic Institute), Milman, Anita (UEA), Pascual Sánchez, Diana (CREAF), Pashiardis, Stelios (Cyprus Meteorological Service), Pla Ferrer Eduard (CREAF), Porter, Kate (UEA), Selby, Jan (UOS), Smith, Lucy (Ecologic Institute), Snorek, Julie (UNU-EHS), Tamimi, Abdelrahman (PHG), Tedsen, Elizabeth (Ecologic Institute), Tribaldos, Theresa (ETHZ), Turhan, Ethemcan (ICTA, UAB), Vidaurre, Rodrigo (Ecologic Institute),Weibust, Eivind Berg (CSCW, PRIO), Wirkus, Lars (BICC), Wischnath, Gerdis (CSCW, PRIO), Zografos, Christos (ICTA, UAB)

Work Package 7

D. 7.2: Policy Brief 1 – Climate change, hydro-conflicts and human security: achievements of and gaps in current policies

Partner responsible: Ecologic Institute

D. author(s): Rodrigo Vidaurre, Maria Berglund, and Nils Meyer-Ohlendorf

D. 7.5: Policy Brief 2 – Policy-making in the face of climate change, water conflicts and human security

Partner responsible: Ecologic Institute

D. author(s): Christiane Gerstetter and Eleftheria Kampa

D. 7.6: Policy Brief 3 – Will there be More Water Conflicts as the Climate Changes?

Partner responsible: Ecologic Institute

D. author(s): Christiane Gerstetter and Rodrigo Vidaurre

D. 7.10 Policy Brief 4 – Climate change, water conflicts and human security in the Mediterranean, Middle East and Sahel – Findings and recommendations from the CLICO FP7 SSH research project

Partner responsible: Ecologic Institute

D. author(s): Christiane Gerstetter and Katriona McGlade

Appendix II:
Synthesis report and CLICO deliverables

CHAPTER 1 "INTRODUCTION"

Work package 1

Goulden, M. and K. Porter (2010): Updated CLICO Conceptual Framework. Unpublished CLICO deliverable.

Work package 7

CLICO Policy Briefs 1–4

Vidaurre, R., Berglund, M. and N. Meyer-Ohlendorf (2010): Climate change, hydroconflicts and human security: achievements of and gaps in current policies. CLICO Policy Brief 1. Ecologic Institute, Berlin.

Gerstetter, C. and E. Kampa (2011): Policy-making in the face of climate change, water conflicts and human security – CLICO Policy Brief No. 2. Ecologic Institute, Berlin.

Gerstetter, C. and R. Vidaurre (2012): Will there be More Water Conflicts as the Climate Changes? - CLICO Policy Brief No. 3. Ecologic Institute, Berlin.

Gerstetter, C. and K. McGlade (2012): Climate change, water conflicts and human security in the Mediterranean, Middle East and Sahel - Findings and recommendations from the CLICO FP7 SSH research project. CLICO Policy Brief No. 4. Ecologic Institute, Berlin.

CHAPTER 2 CONCEPTUAL FRAMEWORK

Work package 1

Goulden, M. and S. Grainger (2012): Integrated theory of hydro-climatic security. Unpublished CLICO deliverable.

Kallis, G., and C. Zografos (2012): Hydro-climatic change, conflict and security. CLICO theoretical paper.

CLICO Policy Briefs 1–4 (see above)

CHAPTER 3 "CLIMATE CONDITIONS AND CLIMATE CHANGE OUTLOOK"

Work package 2

Bruggeman, A., Hadjinicolaou P. and M. Lange (2012a): Climate outlooks for CLICO case study sites. CLICO Working Paper No. 11. Available online: http://www.clico.org/working-papers.
Hydro security profiles

Abdul Malak, D., Fons-Esteve, J., Pla, E. and D. Pascual (2012): Hydro-security profile Intercontinental Biosphere Reserve of the Mediterranean (Morocco-Spain). CLICO Climate Change, Hydro-conflicts and Human Security, Unpublished CLICO deliverable.

Boyero, D. C. and Zografos, C. (2012): Ebro delta hydro-security profile. Unpublished CLICO deliverable.

Bruggeman, A., Charalambous, K., Lange, M. and P. Hadjinicolaou (2012b): Cyprus hydro-security profile. Unpublished CLICO deliverable.

D'Alisa, G. (2012a): Case study profile Sarno in Italy. Unpublished CLICO deliverable.

Gebert, N., Kloos, J., Birkmann, J. and T. Rosenfeld (2012): Emerging risks: Sea level rise and potentially forced and planned relocation - Case study from Greater Alexandria, Egypt. Unpublished CLICO deliverable.

Hoffmann, C. and J. Selby (2012): Hydro-Security Profile-Case Study Sudan. Unpublished CLICO deliverable.

Milman, A., Arsano, Y. and M. Goulden (2012a): Hydro-Security Profile: the Baro-Akobo Sub-Basin of the Eastern Nile, Gambella National Regional State, Ethiopia. Unpublished CLICO deliverable.

Snorek, J., Renaud, F. and J. Kloos (2012a): Case study profile Niger. Unpublished CLICO deliverable.

Tamini, A. and S. Abu Jamous (2012): Jordan basin Hydro-Security Profile. Unpublished CLICO deliverable.

Tawfic Ahmed, M. (2012): Case study profile Ras Sudr. Unpublished CLICO deliverable.

Turhan, E. (2012): Seyhan River Basin. Case study Hydro-security Profile. Unpublished CLICO deliverable.

CHAPTER 4 "POLICIES AT THE NATIONAL AND INTERNATIONAL LEVEL"

Gerstetter, C., Kampa, E., McGlade, K. and K. Timeus (2011): Review of international and national policies and institutional frameworks. CLICO Deliverable 4.1. Ecologic Institute, Berlin.

Gerstetter, C., McGlade, K., Vidaurre, R., Tedsen, E. and H. Bar-On (2012): The effectiveness for policy frameworks for addressing climate-induced risks to human security and conflict – report on stakeholder perspectives and demands (short version). CLICO Deliverable 4.2. Ecologic Institute, Berlin.

Gerstetter, C., Vidaurre, R., Tedsen, E., McGlade, K. and L. Smith (2012): Policy frameworks to address climate-induced risks to human security and cause of conflict – recommendations. CLICO Deliverable 4.3. Ecologic Institute, Berlin.

CHAPTER 5 "TRANSBOUNDARY INSTITUTIONS UNDER CONDITIONS OF UNCERTAINTY"

Work package 5

De Bruyne, C. and I. Fischhendler (2012): The Adoption of Conflict Resolution Mechanisms in Water Agreements: A Transaction Cost Approach. Available online: http://www.lund2012.earthsystemgovernance.org/LC2012-paper263.pdf.

Milman, A., Bunclark, L., Conway, D. and W. N. Adger (2012): Adaptive Capacity of Transboundary Basins in the Mediterranean, the Middle East and the Sahel Tyndall Working Paper 151.

Fischhendler, I. and C. De Bruyne (2011): Journal article on the comparative content analysis of international water treaties. CLICO deliverable 5.2.

Fischhendler, I. and C. De Bruyne (2012): The Choice of Mechanisms in Governing Uncertainty in Water Treaties: A Booklet for Policymakers and Researchers. CLICO deliverable 5.5.

CHAPTER 6 ASSESSMENTS OF HYDRO-SECURITY

Work package 3

Bernauer, T., Böhmelt, T., Buhaug, H., Gleditsch, N.P., Tribaldos, T., Berg Weibust, E. and G. Wischnath (2012): Water-related intrastate conflict and cooperation. (WARICC): A New Event Dataset, International Interactions: Empirical and Theoretical Research in International Relations, 38(4): 529–545.

Böhmelt, T., Bernauer, T., Buhaug, H., Gleidsch, H.P., Tribaldos, T. and G. Wischnath (2012): Demand, Supply, and Restraint: Determinants of Domestic Water Conflict and Cooperation.

Tribaldos, T. (2012): Conflict and Cooperation over Domestic Water Resources: Case Study on Morocco. CLICO Working Paper 10. Available online: http://www.clico.org/working-papers.

Work package 2

Hydro-security profiles (see above)

Case study articles:

Albizua, A. and C. Zografos (2012): A value-based approach to vulnerability and adaptation to climate change. Applying Q methodology in the Ebro delta. Unpublished CLICO deliverable.

Bruggeman, A., Deems, H. J., Lange, M. A. and G. Kallis (2012c): Investing in climate change adaptation: an index to score the vulnerability of rural communities to water scarcity and climate change, with an application to Cyprus. Unpublished CLICO deliverable.

Charalambous, K., Djuma, H., Bruggemann, A. and M. Lange (2012): Water management by the tourism sector on the island of Cyprus in the face of climate change. Unpublished CLICO deliverable.

D'Alisa, G. (2012): Human Security in a Loose Territory: Insights from the (Quasi) Northern Campania Region, Unpublished CLICO deliverable.

Gebert, N., Kloos, J., Birkmann, J. and T. Rosenfeld (2012): Emerging risks: Sea level rise and potentially forced and planned relocation – Case study from Greater Alexandria, Egypt. Unpublished CLICO deliverable.

Milman, A. and Y. Arsano (2012): Climate Adaptation in Highly Vulnerable Regions: The Politics of Human Security in Gambella, Ethiopia. Unpublished CLICO deliverable.

Pascual D., Pla, E., Fons, J. and D. Abdul Malak (2012): Water Vulnerability Assessment to Climate Change in the Intercontinental Biosphere Reserve of the Mediterranean (Morocco-Spain). Unpublished CLICO deliverable.

Selby, J. and C. Hoffmann (2012): Beyond 'Scarcity', 'State Failure' and 'Under-Development': Rethinking Water, Climate Change and Conflict in the New Sudans. Unpublished CLICO deliverable.

Snorek, J., Renaud, F. and J. Kloos (2012): Divergent adaptation to climate change and change in ecosystem services: A pastoral-agricultural case study of Niger. Unpublished CLICO deliverable.

Tamimi, A. and S. Abu Jamous (2012): The implementation of integrated water resources management under uncertain socio-economic , political and climate change conditions. Unpublished CLICO deliverable.

Tawfic Ahmed, M. (2012): Vulnerability of Sudr to Climate Change. Livelihood Index- An approach to assess Risks and develop Future Adaptation Strategy. Unpublished CLICO deliverable.

Turhan, E. (2012): How to disappear completely: Migrant agricultural labour, climate change adaptation and neoliberal state intervention in Turkey. Unpublished CLICO deliverable.

CHAPTER 7 "SYNTHESIS"

Work package 1

Goulden, M. and S. Graininger (2012): Integrated theory of hydro-climatic security. Unpublished CLICO deliverable.

Kallis, G. and C. Zografos (2012): Hydro-climatic change, conflict and security. CLICO theoretical paper.

Work package 5

Fischenhendler, I. and D. Katz (2012): The impact of uncertainties on cooperation and conflict in transboundary water: the case of Israeli-Palestinian negotiations. (unpublished).

CHAPTER 8 "POLICY RECOMMENDATIONS

Goulden, M. and S. Graininger (2012): Integrated theory of hydro-climatic security. Unpublished CLICO deliverable.

Gerstetter, C., Vidaurre, R., Tedsen, E., McGlade, K. and L. Smith (2012): Policy frameworks to address climate-induced risks to human security and cause of conflict – recommendations. CLICO Deliverable 4.3. Ecologic Institute, Berlin.

CLICO Policy Briefs 1–4 (see above)

Chapter 2 Annexes

Title	Authors	Socio-ecological system Vul	AC/adapt
Work Package 1			
Hydro-climatic change, conflict and security.	Kallis and Zografos	✓	✓
Work Package 2			
Water vulnerability (Morocco-Spain).	Pascual et al	✓	✓
Water and tourism (Cyprus).	Charalambous et al	✓	✓
Value based approach (Ebro basin).	Albizua and Zografos	✓	✓
The impact of uncertainties: (Israel-Palestine).	Fischhendler and Katz		
Divergent adaptation (Niger).	Snorek et al		✓
IWRM implementation (West Bank).	Tamimi and Jamous		
Human security policy (Sarno).	D'Alisa and Kallis	✓	✓
Migrant agricultural labor, adaptation and state intervention (Turkey).	Turhan		✓
Climate change vulnerability (Sudr, Egypt).	Tawfic Ahmed	✓	✓
Forced and planned relocation (Greater Alexandria, Egypt).	Gebert et al	✓	✓
The politics of human security (Gambella, Ethiopia).	Milman and Arsano	✓	✓
Water, climate change and conflict (Sudan and South Sudan).	Selby and Hoffman	✓	✓
Work Package 3			
(WARICC): A new event dataset.	Bernauer et al		
Domestic water conflict and cooperation.	Böhmelt et al		
Work Package 4			
Review of policies and institutional frameworks (D4.1)	Gerstetter et al		✓
Stakeholder perspectives and demands (D4.2)	Gerstetter et al		✓
Policy vision and guidelines (D4.3)	Gerstetter et al		✓
Work Package 5			
International water treaties.	Fischhendler and De Bruyne		✓
Transboundary river basins Institutions.	Milman et al		✓

Key to abbreviated column headings:
Vul: Vulnerability *AC/adapt: Adaptive capacity and adaptation* *Con/coop: Conflict and cooperation*
HS: Human Security *Inst: Institutions* *SR: Social relations*
Know: Knowledge *Glob/reg: Global/ regional* *Nat: National* *Sub-nat: Sub-national*

			Political/Economic stressors					Scale		
Con/coop		HS	Inst	SR	Power	Interest	Know	Glob/reg	Nat	Sub-nat
✓		✓	✓		✓			✓	✓	✓
✓		✓	✓				✓	✓		
						✓			✓	
			✓	✓		✓				✓
✓					✓			✓		
✓		✓	✓	✓						✓
			✓				✓	✓		
		✓	✓		✓	✓				✓
			✓		✓				✓	
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		✓	✓	✓	✓	✓			✓	✓
✓		✓			✓	✓			✓	✓
✓			✓	✓	✓	✓		✓	✓	✓
✓		✓	✓		✓				✓	✓
✓		✓	✓		✓				✓	✓
✓	✓	✓						✓	✓	
✓	✓	✓						✓	✓	
✓	✓	✓						✓	✓	
✓								✓		
✓		✓						✓	✓	

Table 1: Mapping CLICO papers onto Conceptual Framework-Source: Goulden and Grainger (2012).

Title	Authors	Research Questions						
		1	2	3	4	5	6	7
Work Package 1								
Hydro-climatic change, Conflict and Security.	Kallis and Zografos	✓	✓		✓		✓	
Work Package 2								
Water vulnerability (Morocco-Spain).	Pascual et al	✓		✓		✓	✓	✓
Water and tourism (Cyprus).	Charalambous et al						✓	
Value based approach (Ebro basin).	Albizua and Zografos		✓	✓				
The impact of uncertainties: (Israel-Palestine).	Fischhendler and Katz		✓					
Divergent adaptation (Niger).	Snorek et al	✓	✓			✓	✓	✓
IWRM implementation (West Bank).	Tamimi and Jamous	✓	✓		✓			
Human security policy (Sarno).	D'Alisa and Kallis	✓	✓			✓		
Migrant agricultural labor, adaptation and state intervention (Turkey).	Turhan		✓					✓
Climate change vulnerability (Sudr, Egypt).	Tawfic Ahmed	✓					✓	✓
Forced and planned relocation (Greater Alexandria, Egypt).	Gebert et al	✓			✓	✓	✓	✓
The politics of human security (Gambella, Ethiopia).	Milman and Arsano	✓	✓			✓		✓
Water, climate change and conflict (Sudan and South Sudan).	Selby and Hoffman		✓			✓		✓
Work Package 3								
(WARICC): A new event dataset.	Bernauer et al	✓	✓		✓	✓		
Domestic water conflict and cooperation.	Böhmelt et al	✓	✓		✓	-		

Title	Authors	Research Questions						
		1	2	3	4	5	6	7
Work Package 4								
Review of policies and institutional frameworks (D4.1)	Gerstetter et al (a)	✓	✓			✓	✓	
Stakeholder perspectives and demands (D4.2)	Gerstetter et al (b)	✓	✓			✓	✓	
Policy vision and guidelines (D4.3)	Gerstetter et al (c)	✓	✓			✓	✓	
Work Package 5								
International water treaties.	Fischhendler and De Bruyne		✓			✓	✓	
Transboundary river basins Institutions.	Milman et al			✓	✓	✓	✓	

Table 2: Mapping CLICO papers onto the conceptual framework suggested questions. Source: Goulden and Grainger (2012).

Deliverables	Title of D.	Methodology	Data
Kallis and Zografos (2012)	Hydro-climatic change, conflict and security	Review paper	• Literature and some CLICO deliverables
Goulden and Grainger (2012)	Integrated theory of hydro-climatic security	Evaluation of the contribution of the research findings to the theory on hydro-climatic security – to assess the relationship between water-related climate risks and human security in order to propose a revised version of the conceptual framework and a set of key theoretical findings	• Literature and some CLICO deliverables

Table 3: Overview of Data and Methods.

Source: CLICO.

Work package 3: Large N statistical analysis of domestic conflicts

Deliverables	Title of D.	Methodology	Data
Bernauer et al. 2010	Domestic conflicts and cooperation ("events") dataset	Screening, sorting and coding of news and media reports about water-related events to construct WES (Water Events database)	• 78,000 media items of BBC monitoring from 1997-2009 covering 33 countries from the Mediterranean and Sahel region
Tribaldos 2012	Journal article reporting on regression results and outlier case studies of domestic conflict dataset	Semi-structured interviews with experts from the water sector in Morocco to validate the information obtained from the WARICC data using Morocco as a case study	• 19 interviews in regions where conflictive or cooperative events were reported in
Böhmelt et al. 2012	Demand, Supply, and Restraint: Determinants of Domestic Water Conflict and Cooperation	Regression-analysis to identify the factors that have an impact on the conflictive and cooperative outcomes of water-related events. (Prais-Winston Regression model with panel-corrected standard errors and an AR1 autocorrelation structure (Beck and Katz, 1995, 1996); Assessment of ability to actually predict countries' level of water-related cooperation or conflict using in-sample and out-of sample techniques)	• Time series cross-sectional data (WES, World Bank Development Indicators and others)

Work package 2: In-depth case studies

Deliverables	Title of D.	Methodology	Data
Pascual et al. 2012; Malak et al. 2012	Water vulnerability assessment to climate change in the Intercontinental Biosphere Reserve of the Mediterranean (Morocco-Spain); Hydro-security profile	Match a hydro-ecological vulnerability assessment with socio-economic considerations: SWAT model for the hydro-ecological assessment, CLICO climatic projections, socio-economic impact assessment based on stakeholder interviews and two scenario focus group discussions in Andalusia (Spain) and Morocco respectively	• Diverse data sources for climatic and hydrological data, soil, elevation and land use data; expert opinions/perceptions for scenario workshop
Charalambous et al. 2012; Bruggeman et al. 2012	Water management by the tourism sector on the island of Cyprus in the face of Climate Change; Hydro-security profile Cyprus	Questionnaire-based assessment of water supply and use under climate change in the tourism sector and literature review to identify climate and socio-economic drivers, vulnerable groups and conflict/cooperation	• web-based survey of 51 hotels
Boyero and Zografos (2012)	Hydro-security profile Ebro Delta (Spain)	Interviews and literature review to identify vulnerable groups, conflict and cooperation analyzed based on review of 50 articles and 15 in-depth expert interviews; A scenario focus group workshop	• A bibliographical review of some 50 articles in newspapers, magazines, etc. published at the local, regional and national level •15 in-depth interviews with water management stakeholders and relevant experts in this area
Albizua (2012)	A value-based approach to vulnerability and adaptation to climate change. Applying Q-Methodology in the Ebro Delta	Applies Q-methodology to identify areas of discourse, concourse, and degree of agreements by using statistical analysis and interpretation of results. The data was analysed using principal component analysis; A scenario focus group workshop	• 19 inhabitants of the delta and representatives of the public administration involved in water management were interviewed.

Deliverables	Title of D.	Methodology	Data
Snorek et al. 2012	Divergent adaptation to climate change and changes in ecosystem services: A pastoral-agricultural case study of Niger	The semi-structured and qualitative interviews were analyzed using AtlasTi, qualitative interpretive software to identify the impacts of divergent modes of adaptation to hydro-climate change on conflict and cooperation between pastoralists and agro-pastoralists; A scenario focus group workshop	• 115 qualitative interviews with sedentary agriculturalists and agro-pastoralists, semi-nomadic and nomadic pastoralists and community leaders from both customary and democratically-elected posts • Expert opinions/perceptions
Tamimi and Jamous (2012)	The implementation of integrated water resources management under uncertain socio-economic, political, and climate change conditions; Hydro-security profile Jordan valley	Based on primary and secondary data, several major indicators such as demography, income, unemployment, reform were selected to shed light on uncertainties and trends of conflict	• National level related data obtained from secondary sources (data related national indicators of socioeconomic, good governance, water supply • Household related data obtained from the field survey and interviews (Primary Sources)
D'Alisa (2012)	Human security in a loose territory: Insights from the (Quasi) Northern Campania Region; Hydo-security profile Sarno	Literature review and theoretical analysis based on the Gramscian theory of the state	
Turhan (2012)	How to disappear completely: Migrant agricultural labour, climate change adaptation and neoliberal state intervention in Turkey; Hydro-security profile Seyhan River Basin	Observation and semi-structured interviews of migrant seasonal workers, landowners and state officials to conduct a policy analysis of Turkey's national climate change adaptation Strategy and Action Plan and the Strategy and Action Plan for improving work and social lives of seasonal workers; A scenario focus group workshop	• 2 months of participant observation • 30 semi-structured interviews and many more casual encounters were undertaken in Karataş, Adana located in southern Turkey

Deliverables	Title of D.	Methodology	Data
Ahmed (2012)	Vulnerability of Sudr, Sinai, to Climate Change, Livelihood Index, An Approach to Assess Risks and Develop Future Adaptation Strategy;Hydro-security profile Sudr, South Sinai	A vulnerability assessment using the Sustainable Livelihoods Approach- a composite index, which looks at five types of household assets – natural, social, financial, physical, and human capital (Chambers and Conway, 1992), is conducted based on a household survey	• Equal number of rural and urban Bedouin, amounting to about 75–90 from each side were interviewed
Gebert et al. (2012); Gebert (2012)	Emerging Risks: sea level rise and potentially forced and planned relocation- case study from Greater Alexandria, Egypt; Hydro-security profile Alexandria	Literature review, household survey and survey based choice experiment for vulnerability assessment and identification of potential conflict lines in the context of governmental planned relocation; A scenario focus group workshop	• A quantitative survey of 500 households
Milman and Arsano (2012); Milman et al. (2012)	Climate Adaptation in highly vulnerable regions: The politics of Human Security in Gambella, Ethiopia; Hydro-security profile Gambella	Interviews, village-level discussions and scenario focus group workshop	• 76 interviews, 3 village-level discussions
Hofmann and Selby (2012)	Beyond 'Scarcity', 'State Failure' and 'Under-Development': Rethinking Water, Climate Change and Conflict in the New Sudans; Hydro-security profile Sudan	Literature review on the links between conflicts and environmental scarcities, qualitative and longitudinal approach for the analysis of water-conflict relations, interviews with experts from ministries, consultancies and NGOs	

Work package 4

Deliverables	Title of D.	Methodology	Data
Gerstetter et al. (2011)	Review of international and national policies and institutional frameworks	1. Screening of policies covering climate change, water resource or human security to identify types of policies through desk-based review of laws, regulations, reports, research and academic publications) 2. Case study approach on how policies and institutions can improve human security and reduce risks	• laws, regulations, reports, research and academic publications, background and semi-structured interviews
Gerstetter et al. (2012)	The effectiveness for policy frameworks for addressing climate-induced risks to human security and conflict – report on stakeholder perspectives and demands	Perception based assessment using the policy cycle approach as structuring concept: Agenda setting, policy formulation, implementation, evaluation. For each cycle component, a set of questions were posed aiming at evaluating the current framework and future demands with regards to the definition of effectiveness (mitigating water-related risks to increase HS and prevent conflicts). Assessing demands and expectations. Causal chains along which policies might intervene	• Qualitative data on policy frameworks and stakeholder perceptions in Ethiopia, Morocco, Israel and oPT, UN, EU level policies, more than 70 interviews (countries selected based on governance indicators "Voice and Accountability" and Government effectiveness".
Gerstetter et al. (2012)	Policy frameworks to address climate-induced risks to human security and cause of conflict-recommendations	Review and summary of different policy approaches for addressing hydro-climatic hazards and their impacts on human security and conflict; identification of numerous examples of best practices	

Work package 5

Deliverables	Title of D.	Methodology	Data
Fischhendler and De Bruyne (2012); Dri-eschova and Fischhendler (2011)	The Choice of Mechanisms in Governing Uncertainty in Water Treaties: A Booklet for Policymakers and Researchers basins; Journal article on the comparative content analysis of international water treaties; Toolkit of mechanisms to reduce uncertainty in international water treaties	Transaction cost approach and indicators for factors that drive transaction costs	• Transboundary Freshwater Dispute database (303 agreements worldwide)
Milman et al. 2012; Milman and Bunclark (2012)	Journal article on comparison of the adaptive capacities of different shared basins; Geo-referenced database of adaptive capacity indicators for shared river basins	Framework and indicators of adaptive capacity of transbound-ary basins in MMES region, cluster analysis to identify homogenous clusters of basins	• 42 basins

Chapter 4 Annexes

Country	Policy and adaptation examples
Cyprus	• Borehole Subsidy for Saving Potable Water: Facilitation of the construction of private boreholes for irrigation to reduce potable water consumption, thus addressing drinking water scarcity, a threat to human security. • The Nicosia Joint Sewerage Management Initiative: Cooperation between Greek and Turkish Cypriot community leaders to manage sewerage together.
Egypt	• Water Users Associations (WUAs): Development of a participatory irrigation management structure for increasing water use efficiency: Allocation, distribution and infrastructure management of water. • Early Warning System for Flash Floods: An EWS developed by the WRRI in the Sinai enabled Bedouins to keep on living in their homeland, even if exposed to flash floods. This allowed conflicts about relocation between Bedouins and the government to be settled.
Israel/Jordan	• Coastal desalination – Adapting to water scarcity: Droughts in the 1990s, increased stress on aquifer resources and increased urban water use. Water desalination plants are still in the process of being implemented, but are a policy-attempt to adapt to water scarcity in the region which could reduce water and therefore human insecurity. • Red Sea Dead Sea Water Conveyance: The jointly managed rehabilitation of the dwindling state of the Dead Sea can mitigate cross border water scarcity crisis and increase multilateral cooperation. The multi-lateral project aims to construct a pipeline that would transport 1.8 billion cubic meters of water from the Red Sea to the Dead Sea. The freshwater obtained from the desalination plant would be used to augment the water supplies of Jordan, Israel and the Palestinian Territories.
Italy	• National Civil Protection System: Awarenness programs enhancing self-help capacity to protect from floods and landslides dosier "Ecosystems at Risk": Monitoring of environmental conditions and risks: Provide guidance for risk management and disseminate best practices, such as relocation of assets and increasing drainage systems' performance • Local Management for Sustainability (GELSO) Database Initiative: Best practice collection of environmental sustainability. Initiative aims at facilitating networks for information exchange about climate change among local governments. In order to be included in the database, the practice must meet some quality requirements. Currently, drought and desertification issues are less than 1 per cent of the database and most are from the last 5 years.

Country	Policy and adaptation examples
Morocco	• Water law (1995): Its overarching goal is to use an integrated water resource management approach (IWRM) to integrate and coordinate the allocation and management of all water sources and users. In this way, this policy aims to help Morocco to adapt its management of scarce water resources, particularly important in the face of climate change. It includes several articles related to the protection and preservation of water resources, wastewater discharge and the reuse of treated wastewater. • The Green Morocco Plan (Plan Maroc Vert): The PMV aims to reinforce the agriculture sector and sets strategies for a more sustainable use of water resources for irrigation in the coming 15 to 20 years to improve water management as well as the welfare of its citizens. This could improve human security: firstly, by accelerating high value added agriculture and secondly by combating rural poverty. • National Climate Change Adaptation Strategy reinforces government action to deal with the effects of climate change. It is focused on strengthening inter-ministerial efforts, visibility and communication on inter-governmental actions and establishing and optimising inter-departmental management in these areas. At the operational level, the strategy involves the creation of a yearly record on greenhouse effects, technological networks to measure climatic indicators as well as increasing the capacities of people involved in climate change studies in addition to increasing public awareness of the impacts of climate change.
Niger	• Code Rural – Water and pastoral codes established a juridical framework for agricultural, silvicultural and pastoral activities in the perspective of territorial management, environmental protection, and support of inhabitants. It assures the security of rural producers through the recognition of their rights to land tenure and water and pasture access. Among its main points, it recognizes mobility as a fundamental right of herders, pastors, nomads and transhumants; deals with the prohibition of the seizure for private purposes of pastoral spaces that pertain to the public domain of the State and collectivities. The Rural Code created the so-called Land Commissions, they constitute a consultative framework for reflection and decision making in terms of natural resources management and conflict prevention. • National Action Program for Combating Desertification and for Natural Resources Management (PAN- LCD/GRN): Its main objectives are i) to identify factors that contribute to desertification and concrete measures to be taken to combat it and alleviate drought effects; and ii) create favourable conditions for the improvement of food security, the solution to the domestic energy crisis, the economic development of the population and their empowerment in the management of natural resources.
Palestine	• National Strategy for Water Sector Reform: The reform plan seeks to accomplish better management of the water sector by concentrating on the development of institutions that can run with optimal efficiency under the status quo and contribute to the establishment of a Palestinian state. The proposed strategy and reform plan will serve the entire water sector, the four major pillars of the plan are: water security, social security, transboundary cooperation and institutional and legal arrangements. This is the first comprehensive, participatory water plan since the establishment of the Palestinian Water Authority.

Country	Policy and adaptation examples
Palestine	• National Climate Change Adaptation Strategy: Its overriding goal is to identify the most effective means by which the Palestinian National Authority can enhance the capacity of the Palestinians to cope with current and future climatic hazards. Some of its main components are: current vulnerability assessments, future climate change risk assessments, proposed adaptation measures and information networks. This policy is relevant to this study because it represents the first decision taken by Palestinians to treat climate change and its effects on human security as a policy concern.
Spain	• The National Climate Change Adaptation Plan (PNACC): The plan's general objective is to evaluate the vulnerability of different socio-economic sectors and environmental systems that are sensitive to climate change, and to study the adaptation options for these sectors and systems. It is of relevance as it has a focus on water as a priority area as well as the implicit recognition of water as a cross-cutting issue in climate change adaptation policies in Spain. It is also of particular relevance as it explicitly addresses the human security dimension of climate change. • The AGUA Programme: The AGUA programme is of significance as it explicitly highlights climate change and its impacts on water resources in Spain as well as noting that actions are required to adapt to these changes. The main impact of the AGUA programme has been the increased desalination capacity of Spain, which reached 2.745.341m³ per day in 2009. • Drought Management Plans (DMP): Their specific objectives are to guarantee the availability of water that is required to "sustain population life and health". Through the prioritization of uses established by water policies and river basin management plans, it aims to avoid or minimize negative drought effects on the ecological status of water bodies and to minimize the negative effects on public water supply and on economic activities. The drought management plans are of relevance as they establish rules for water restrictions in emergency situations and can play a role in avoiding or alleviating conflicts between water users during an alert situation.
Turkey	• Law on Agricultural Insurance: It establishes an insurance pool to handle risks associated with hydro-climatic shocks to agriculture. This agricultural insurance policy is cost-effective as it provides a burden-sharing mechanism through state subsidies. It provides a significant state-supported economic back-up plan in case more frequently occurring hydro-climatic hazards present risks to the income and thus well-being of rural livelihoods. However, one of the biggest hydro-climatic threats, droughts, is yet to be included in the scheme. • Turkish National Strategy and Action Plan on Combating Agricultural Drought: It focuses on agricultural drought with considerations of future climate change, inefficient use of water resources and faulty agricultural practices. The main objective of NSAPCAD is to provide a comprehensive and inclusive policy that takes into consideration demand and supply management as well as the views of all relevant stakeholders. This represents a shift from crisis management to a long-term strategy for coping with droughts that will minimize the socio-economic impacts.

Table 20: National policies addressing climate change and human security. Source: Gerstetter et al. 2011.

Feature	Indicator	Metric
Authority	Formal Agreements River Basin Organizations (RBOs)	Formal agreements & geographic scope River basin organization & geographic scope
National level governance	National Level Political Capacity (Political Stability) Transparency, Accountability & Resources (National Governance)*	Political Stability Index Government Effectiveness Index
Common perspective	Shared Water Norms Transnational Networks/ Epistemic Communities (IGOs)	Signatory UN Convention on Non-navigational Uses of International Watercourses Shared membership inter-governmental organizations
Risk planning and provision	Mechanisms for Managing Uncertainty (Uncertainty)* Risk Preparedness	Specific elements of existing treaties and agreements Global Assessment Report on Disaster Risk Reduction: Hyogo Framework for Action
Basin information interchange	Mechanisms for Data Sharing (Data Sharing)* Liaisons Between Countries (Diplomatic Exchange)	Specific elements of treaties and existing agreements Diplomatic exchange
Linkages	Economic and Trade Interdependence (Trade Dependency)*	Regional trade (between co-riparians) as a percent of basin total trade Ratio of external to total renewable water

**Text in brackets represents shorthand name used in subsequent tables, where space does not permit use of full indicator name*

Figure 10: Overview of indicators. Source: Milman et al. (2012b).

Conflict Resolution Mechanisms (CRMs) and Modalities	Measurement
CRM Presence	Y/N
Type of CRM	Soft Law: negotiation or mediation Hard Law: arbitration or adjudication
Number of CRM	Low: ≤ 2 CRM High: ≥ 3 CRM
Institutionalization (Inst.)	Joint Commission, Arbitral Tribunal, Domestic Court, ICJ
Activation procedure of the CRM (Act.)	1. Consensus or Majority 2. Unilateral
Voting pattern of joint commission	0. Consensus, Issue ignored 1. Unilateral
Maturity	Averaged value of: Condition of CRM use: 0. Issue ignored 1. Breach, interpretation, periodical review, change in physic conditions, other CRM Activation procedure: 0. Issue ignored, majority, consensus 1. Unilateral Cost sharing method: 0. Issue ignored 1. Polluter pays, equally divided, third party, beneficiary pays, other CRM Institutionalization: 0. Not institutionalized 1. Institutionalized CRM Voting pattern: 0. Consensus, Issue Ignored 1. Majority, Unilaterally Average of values: < 0.50 = immature > 0.50 = mature

Figure 11: CRM Modalities and measurement . Source: De Bruyne and Fischhendler (2012).

Indicators	Coding Value	Unit of Measurement	Thresholds	Data Sources
Number of signatories	0. Bilateral 2. Multilateral	-	-	-
Hydrological variability	0. Low 1.High	Based on co-variance value of present runoff	Low: < 0.49 High: > 0.50	TFDD
Water stress	1. Water Stress 0. No Water Stress	Cubic meters of water/ person/year	Stress: < 1000 No Stress: >1000	FAO/Aquastat
External resource dependency threshold 1	1.Low 2.Mixed (asymmetry) 3. High	Percentage of external water supply	Low: < 50% Mixed: < 50% and > 30%	FAO/Aquastat
External resource dependency threshold 2	1.Low 2.Mixed (asymmetry) 3.High	Percentage of external water supply	High: > 50% Low: < 30% Mixed: < 30% and > 30% High: > 30%	FAO/Aquastat
Asymmetry of external resource dependency	0. Symmetry 1. Asymmetry	Percentage of external water supply	Symmetry: all < 50% or all > 50% Asymmetry: at least 1 < 50% and at least 1 >50%	FAO/Aquastat
Level of trust	0. Low (average value is negative) 1. High (average value is positive)	Basins at risk scale.	Low: -7 to 0 High: 1to 7	TFDD
Level of political freedom	1. Low 2. Mixed (Asymmetry) 3. High	Aggregated value of politi-cal freedom and civil-liberties	Low: 3 to 7 High: 1 and 2	Earth trends

Indicators	Coding Value	Unit of Measurement	Thresholds	Data Sources
Asymmetry of politicalfreedom	0.Asymmetry (at least 1 country differs in level of political freedom) 1. Symmetry (all same level of political freedom)	Idem	Idem	Idem
Level of adaptive capacity	0. Low 1. High	HDI Value	Low: 0 to .500	UNDP/HDI Index
Asymmetry of adaptive capacity threshold 1	0. Symmetry 1. Asymmetry	Idem	High: .501 to 1 Asymmetry: > .100 difference of HDI value	UNDP/HDI Index
Asymmetry of adaptive capacity threshold 2	0. Symmetry 1. Asymmetry	Idem	Asymmetry: > .070 difference of HDI value	UNDP/HDI Index
Colonial power (signatory)	0. No 1.Yes	-	-	TFDD

Figure 12: Data sources of each indicator.

Source: De Bruyne and Fischhendler (2012).

Dependent Variables	CRM Presence	Soft Law	Hard Law	Inst.	Number of CRMs	Act.	Mature
Independent Variables							
Number of signatories	.035	-.143	.097	.070	-.096	.157	.016
Hydrological variability	-.041	-.013	-.073	.029	.020	-.103	.015
Water stress	.316***	.050	-.036	-.113	.061	.102	-.091
Level of external resource dependency treshold 1	.142	.283**	.213	.164	.094	-.143	-.264**
Level of external resource dependency treshold 2	-.038	.291	-.273	.046	-.009	-.180	-.299**
Assymetry of external resource dependency	.018***	.267	-.133	-.071	.100	-.286	-.254**
Level of trust	-.089	.091***	.000	-.153	-.037	.363**	.276**
Level of political freedom	-.222***	-.073	.168	.028	0.012	.149	.239
Asymmetry of political freedom	-.310***	-.156	.150	-.223	-.224**	.165	.095
Level of adaptive capacity	-.004	-.209	.099	-.136	-.032	-.256	.114
Asymmetry of adaptive capacity threshold 1	-.216	-.089	-.018	-.101	0.073	-.020	1.-.086
Asymmetry of adaptive capacity threshold 2	.007	.181	.207	.236	.144	.088	.032
Colonial power	-.127**	-.415***	.150	-.136	-.128**	-.042	-.093

*Note 1: cell entries report ordered spearman correlation coefficients and significance levels p*** ≤ 0.05 (strong), p** 0.1 ≤ 0.05 (medium), p ≥ 0.1 (insignificant).*

Note 2: inst.= Institutionalization of the CRM, Act. = Activation procedure of the CRM

Figure 13: Correlation results.
Source: De Bruyne and Fischhendler (2012).

Report "CLIMATE CHANGE, WATER CONFLICTS AND HUMAN SECURITY: REGIONAL ASSESSMENT AND POLICY GUIDELINES FOR THE MEDITERRANEAN, MIDDLE EAST AND SAHEL"

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Funded by the European Commission, the three-year research project CLICO took an innovative multidisciplinary approach to fill knowledge gaps over the social dimensions of climate change. In particular, the project investigated whether hydro-climatic hazards such as droughts and floods exacerbate social tensions, intra- and inter-state conflicts in the Mediterranean, Middle East and Sahel, or if they provide a catalyst for cooperation and peace.

CLICO brought together 14 research teams from Europe, North Africa, Sahel and the Middle East consisting of some of the world's leading researchers in water resource, vulnerability and peace and security studies. This report extracts and synthesizes the research and main results from CLICO and presents a comprehensive regional assessment of the CLICO study area.