

# From Conflict to Cooperation in the Nile Basin

*Simon A. Mason*



# Environment and Cooperation in the Nile Basin (ECONILE), Downstream Perspective

“This study of the Eastern Nile Basin is an essential reading for anyone interested in a comprehensive analysis of conflicts about Nile water use. Water quantity and quality data are judiciously set in relation to the national and international water management strategies of Egypt and Sudan to highlight present developments in the Basin. The innovative Dialogue Workshop methodology demonstrates how direct stakeholder interaction can enhance cooperation in international river basins.”

*Alexander J.B. Zehnder, Professor, Director of the Swiss Federal Institute for Environmental Science and Technology (EAWAG)*

“The thesis is highly valuable in the methodological approaches used for multi-track conflict management as applied to the Nile Basin. The added value of the thesis on the Nile Basin is that it has taken four years of laborious work to try and test this methodology and to get rewarding “lessons learned”. Action research and dialogue instruments are uniquely tried, thus enabling more interactive participation of wider circles of independent people in problem solving.”

*Magdy A. Hefny, Egyptian Ambassador to Ethiopia (1991–1995), Director of the Regional Center of Studies and Research of Water Ethics, Egypt*

“Meticulously and professionally tackling issues of conflict and cooperation over water in and between Egypt, Sudan and Ethiopia, Mason’s work is indispensable for national, regional and international researchers, academics, development agencies and policy makers concerned with the Nile Basin. In short, it is a well-researched, balanced, valuable, and, above all, a timely work.”

*Atta El Battahani, Professor, Chairman of the Department of Political Science, University of Khartoum, Sudan*

“This work not only merits originality for introducing conflict sensitive interviewing methodology and for the application of interactive problem-solving dialogue workshops, but also for discovering and expounding constructive perspectives for interstate cooperation on the shared Nile waters.”

*Yacob Arsano, Professor, Department of Political Sciences and International Relations, Addis Ababa University, Ethiopia*

“This study has developed a great scientific harmony between different environmental and political issues.”

*Waleed Hamza, Professor, Chairman of the Biology Department, United Arab Emirates University, UAE*

“The coordinated yet independent ECONILE studies are a unique example of the advantages of focusing different disciplines and academic cultures on the analysis of a specific conflict. Bias is minimized, problem-solving capacity is maximized, and context-sensitivity/generalizability are better balanced.”

*Kurt R. Spillmann, Professor Emeritus, Director of the Center for Security Studies and Conflict Research 1986–2002, Swiss Federal Institute of Technology (ETH Zurich)*

“This study on the eastern Nile represents an in-depth assessment of all aspects that need to be seriously taken into consideration in order to foster cooperation and transform conflict in an international river basin.”

*Günther Baechler, Head of Conflict Prevention and Transformation (COPRET) Division of the Swiss Agency for Development and Cooperation, Swiss Foreign Ministry*

# From Conflict to Cooperation in the Nile Basin

Doctoral Thesis ETH number 15211.

FROM CONFLICT TO COOPERATION IN THE NILE BASIN.  
Interaction Between Water Availability, Water Management in Egypt and Sudan,  
and International Relations in the Eastern Nile Basin. Conflict Sensitive Interviewing  
and Dialogue Workshop Methodology.

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2003

SIMON A. MASON

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ETH ZURICH

2004

*Dedication*

To all the people in Egypt, Sudan and Ethiopia  
who took the time to talk with me and teach me about the waters of the Nile,  
who taught me how people can cooperate over scarce resources

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Environment and Cooperation in the Nile Basin (ECONILE)

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# Preface

Simon Mason's PhD thesis on the Eastern Nile represents an in-depth assessment of all aspects that need to be seriously taken into consideration in order to foster cooperation and transform conflict in an international river basin. Technical, relational as well as psychological aspects of integrated river basin management are synthesized. In addition, lessons are drawn from interactive problem-solving workshops that brought stakeholders from Egypt, Sudan, and Ethiopia together. This makes the work interesting for scientists, practitioners, experts in peace negotiations, as well as for policy-makers.

The innovative approach to the transformation of international river conflicts was made possible by a unique set-up and the action-oriented research process. The Environment and Cooperation in the Nile Basin (ECONILE) project was designed as two independent yet coordinated PhD studies: Simon Mason focused on the downstream perspective (presented here), and Yacob Arsano on the upstream perspective (see Arsano 2004) of water use in the Nile Basin. I have greatly cherished working with these two scholars during the four years of their PhD studies, as well as watching them work together in a mutually very enriching manner.

While their research projects always remained independent of each other – indeed, actually disagree on some interesting points – both their studies greatly benefited from their intensive discussions and mutual support, a key to their sustained curiosity and dedication to the Nile. Cooperation was thus not just the focus of their research, but also an inherent ingredient in how it was carried out! The same spirit also marked the ECONILE meetings with my colleagues Kurt R. Spillmann, Alexander J.B. Zehnder and Andreas Wenger. Our different backgrounds and openness to the process meant that the input of each of us was not only fruitful in supervising Simon Mason and Yacob Arsano – but also proved to be an enriching learning experience for all of us.

A brief summary of the similarities and differences of the two studies highlights the benefit of this upstream/downstream approach to international rivers. The upstream study places greater emphasis on the need to develop a legal framework than the downstream study, arguing that this is central to enable equitable sharing. The downstream study, in contrast, sees the role of legal agreements more as a codification of cooperation, once such cooperation exists. Both studies agree that there are many possible ways of enhancing cooperation, that national water management in the respective countries directly determines international water relations, and that institutional development (e.g. Nile Basin Initiative) plays a key role. Both scholars also agree that the Nile basin countries are heading towards cooperation; Mason is more optimistic than Arsano concerning the progress already made since the Nile Basin Initiative was initiated in 1999. These differences, in part, reflect the different downstream (Egypt and Sudan) and upstream (Ethiopia) approaches to the Nile question. Other differences are more a result of their different disciplines. Mason focuses on environmental issues and the role of communication in international cooperation, while Arsano examines the historical and cultural

perspectives and the role of (absent) legal frameworks. Both studies therefore present complete works in themselves, and yet a more comprehensive view is given by reading both of them.

One final note to the critic of ‘research as an ivory tower endeavor’: these studies represent a counter example! The following study, for example, does not just focus on understanding the problem, but more importantly on how communication can develop options to deal with it. The series of interactive problem-solving workshops that were initiated (see chapters 3 and 8) have continued beyond completion of the PhDs, showing how research can initiate action that outlasts publication. As such the ECONILE project represents two key aspects that I believe are at the heart of conflict transformation. First, that there are *always* options to enlarge the pie. A zero sum game means one has not looked hard enough at alternatives. Second, analyzing a conflict is not enough, constructive interaction with those people who are directly involved is essential in order to move from research to action.

Günther Baechler, Bern, June 14. 2004

Dr. Günther Baechler, Director of the Swisspeace Foundation (1988–2000) and present Head of Conflict Prevention and Transformation (COPRET) Division of the Swiss Agency for Development and Cooperation, Swiss Foreign Ministry.

## Summary

The following thesis deals with conflicts and cooperation over water resources in the Eastern Nile Basin, seeking to answer how large groups of people can use scarce resources in a cooperative and sustainable way. The availability of water resources and water use and management in Egypt and Sudan are examined. Perceptions concerning international water relations in the Eastern Nile Basin are assessed using explorative expert interviews, a conflict-sensitive research method. Seventy interviews were carried out in Egypt, Ethiopia and the Sudan. A Dialogue Workshop was organized with the aim of a joint publication on the subject by academics from the respective countries. The workshop emphasized the role of communication in understanding different perceptions.

The guiding principle of the study is the participatory approach: conflict analysis and transformation require direct participation of the involved actors. The Ph.D. was developed and carried out in the project “Environment and Cooperation in the Nile Basin” (ECONILE) as a tandem Ph.D. with a southern partner from Ethiopia. The Dialogue Workshop publication had authors from different sides of the conflict working together to develop an all-inclusive view of the issues and lessons learned.

A dichotomy between national and environmental system boundaries can cause conflicts. National politics in the Nile Basin have continually ignored the fact that the peoples of the Nile Basin are bound together by shared environmental resources. The water resources for irrigation and hydroelectric power production are finite, erosion upstream effects sedimentation of reservoirs downstream, and floods and droughts know no political boundaries. Water pollution is at present mainly a national challenge, international pollution can be avoided by early preventative action.

In contrast to these environmental necessities of cooperation, there have been few political and economic cooperative efforts in the basin until recently. Indeed, much of the environmental conflict literature of the 1980s and 1990s deals with the potential of scarce resources to cause conflict and even war. This study argues that the problem of international water conflicts is not one of war, but rather unsustainable development resulting from the absence of cooperation. Poverty, migration and intra-national conflicts may follow.

Cooperation in the Nile Basin started moving in the 1990s because Ethiopia accepted a project-by-project approach, and Egypt accepted talking about a legal framework. A discussion and negotiation forum was created to talk about legal issues, while simultaneously cooperation in the form of concrete projects has started, e.g. hydroelectric power production. Official and non-official representatives of the Nile countries met in different fora, e.g. in the series of Nile 2002 Conferences, enabling mutual learning about each other's perceptions and interests. By focusing on interests (underlying reasons for what people want) rather than on positions (fixed way of reaching what one wants) the number

of options that can satisfy the different interests is increased and compatible solutions can be developed more easily. The legal debate between Egypt's historic rights versus Ethiopia's territorial rights are positions that express each country's interest in having a long-term secure water use right that is accepted by the other countries. The challenge of the negotiating committee is to develop a legal and institutional framework without falling into the pitfall of only debating positions, i.e. contradictory legal principles and doctrines.

The Nile Basin indicates that the shift from a focus on positions to interests requires a "this at the same time as that" approach, instead of a "this before that", or "this on condition of that" approach. An integrated and systemic approach to international river management does not necessarily contradict a functionalist approach, i.e. a step-by-step approach that deals with one problem at a time at a lower management level. The development of a joint vision mobilizes energy and clarifies the goal. This can help to coordinate more specific problem-oriented activities. Combining the integrative power of a guiding vision with the practicability of the project-by-project approach can enhance their overall effectiveness.

Besides changes in the context, e.g. the end of the Cold War, the shift towards interest-based cooperation in the Nile Basin occurred, according to many of the interviewed experts, through a process of "dialogue accumulation". Dialogue accumulation refers to the result of numerous meetings between representatives from the different conflict parties over the years in various formal and informal settings. While one meeting may have little impact, together they have an influence. The coordination of the third party (the World Bank, UNDP and Canadian International Development Agency (CIDA)) has played an important role both in facilitating communication and in providing financial resources.

Communication can lead to cooperation; cooperation is a prerequisite of sustainable development. Pre-conditions for communication to work are that there is a potential benefit for each actor and a certain power symmetry. The Eastern Nile countries can more effectively deal with environmental issues, better access financial resources, and in the long term safeguard their water resources, through cooperation. The power symmetry is given to a certain degree in the Eastern Nile Basin in that Egypt is economically more powerful, and Ethiopia as the upstream country is geographically more powerful. A future framework for cooperation in the Nile Basin consists of Egypt focusing on demand-side management and supporting development upstream; and Ethiopia implementing supply-side management and committing to minimizing the negative impacts on the downstream countries.

Methodologically, our study shows that a Dialogue Workshop between representatives of the conflict parties can clarify issues at stake in an environmental conflict and support the development of a research network. As part of dialogue accumulation, a Dialogue Workshop can facilitate the understanding of different perceptions, facilitate communication and enhance cooperation in an atmosphere of trust and confidence.

# Acronyms

ADR	Alternative Dispute Resolution
CIDA	Canadian International Development Agency
D <sub>3</sub>	Forum for developing the “Nile Basin Cooperative Framework” for management of the Nile
ECOMAN	Environmental Change, Consensus Building and Resource Management in the Horn of Africa
ECONILE	Environment and Cooperation in the Nile Basin
ENCOM	Eastern Nile Council of Ministers
ENCOP	Environment and Conflict Project
ENSAP	Eastern Nile Subsidiary Action Program
ETB	Ethiopian Birr; 8 Birr is approximately equivalent to 1 US\$, 2002
EVDSA	Ethiopian Valleys’ Development Studies Authority
FAO	Food and Agriculture Organization of the United Nations
HEIT	Human Environment Interaction Triangle
HEP	Hydroelectric power
Hydromet	Hydrometeorological survey of the catchments of lakes Victoria, Kyoga and Mobuto Seseko
ICCON	International Consortium for Cooperation on the Nile
IGAD	Intergovernmental Authority on Development
IGO	International Governmental Organization
ILC	International Law Commission
IMF	International Monetary Fund
km <sup>3</sup> /year	=BCM/a=billion cubic meters per annum=1’000’000’000 m <sup>3</sup> /year
MPN	=most probable number
NBI	Nile Basin Initiative
NCCR NS	National Center for Competence in Research, North-South, Research Partnerships for Mitigating Syndromes of Global Change
NDA	National Democratic Alliance (of different parties in Sudan)
NEL	Nile Equatorial Lakes
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NGO	Non-Governmental Organization
Nile COM	Council of Ministers of Water Affairs of the Nile Basin States
Nile SEC	Nile Basin Initiative Secretariat
Nile TAC	Nile Basin Initiative Technical Advisory Committee
NRBAP	Nile River Basin Action Plan
PJTC	Permanent Joint Technical Committee (between Egypt and Sudan)
POE	Panel of Experts
SAP	Subsidiary Action Program

SHI	State Hydrological Institute, Russia
SPLA/SPLM	Sudanese People's Liberation Army/ Sudanese People's Liberation Movement
SVP	Shared Vision Program
TECCONILE	Technical Cooperation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin
UN	United Nations Organization
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
WMO	World Meteorological Organization, A United Nations Specialized Agency
WRI	World Resources Institute

# Glossary

*Actual renewable water resources (ARWR)*: is the maximum theoretical amount of water actually available for a country. It is computed by adding the sum of internal renewable water resource (IRWR) and incoming flow originating outside the country's borders minus abstraction in upstream countries and the volumes allocated through formal or informal agreements or treaties between countries (AQUASTAT database).

*Action research*: Action research is a three-step spiral process of 1) planning which involves reconnaissance, 2) taking actions, and 3) fact-finding about the results of the action (Lewin 1948).

*Conflict*: "A social conflict arises when: 1) at least two parties interact in an incompatible way; 2) at least one of the involved parties intends or ignores the negative impacts on the other party stemming from the interaction; and 3) at least one of the involved parties experiences damage from the interaction." This definition allows for a continuum between low and highly escalated conflicts, unlike definitions based for example on the number of battle deaths. Yet it is a sharper definition than "conflict = competition", or "conflict = accident/unintentional damage". The definition combines the aggressor aspect from Coser's, and the recipient aspect of Glasl's conflict definition:

"For the purpose of this study, [the term social conflict] will provisionally be taken to mean a struggle over values and claims to scarce status, power and resources in which the aims of the opponents are to neutralize, injure or eliminate their rivals." (Coser 1956: 8).

"A social conflict occurs when: 1) at least two parties interact in such a way that at least one of the parties experiences incompatibility in their interaction, and 2) the damage resulting from their incompatible interaction is seen as stemming from the other party. Interaction is understood as interaction of thought and/or feeling and/or will *and* action (action can be speech, perceptions alone are insufficient)" (freely translated from Glasl 2002).

*Conflict management*: A generic term that refers to all interventions in a conflict with the aims of solving problems, transforming relations, and changing structures (adapted from Glasl 2002).

*Conflict party*: see parties.

*Conflict-sensitive interviewing*: Interviews that are sensitive to both sides of the conflict, to the social relevance, and that take the impact of the study on the studied and on the researchers into account. In the present study "conflict sensitive" is also used to denote the transformative/solution-oriented goal of the interviews (adapted from Smyth, Robinson 2001)

*Conflict-sensitive research*: A Conflict-sensitive research strategy seeks to 1) minimize bias through a dual approach (two researchers, one on each side of the conflict),

2) increase trust through accountability and transparency to both funding agencies and the people one is involved in for the research, 3) guarantee the safety of the researchers and those researched through confidentiality where necessary, and 4) enhance applicability and acceptability of conflict management options through participatory conflict analysis (adapted from Smyth, Robinson 2001).

*Conflict transformation:* Conflict transformation acknowledges that conflict is a part of life, the aim is to transform destructive forms of dealing with conflict to constructive ones. It focuses on understanding perceptions and improving relationships by empowering actors and supporting recognition of each other (Bush, Folger 1994, Lederach 1995).

*Cooperation:* Cooperation is understood as distinct from harmony (where the policies pursued by each actor automatically facilitate the attainment of the goals of the other actor) and definitely as distinct from discord / conflict. Cooperation “requires that the actions of separate individuals or organizations – which are not in pre-existent harmony – be brought into conformity with one another through a process of policy coordination”. (Keohane 1994, Jägerskog 2003).

*Dialogue accumulation:* The result of numerous meetings between representatives from the different conflict parties over the years in various formal and informal settings. While one meeting may have little impact, together they have an impact (Hefny 2002).

*Dialogue workshop:* In Dialogue Workshops, non-official representatives of the conflict parties meet in an informal setting facilitated by a third party with the aim of non-polemical conflict analysis, transformation of antagonistic relationships, joint action, or problem-solving (Ropers 2000, Kelman 1999).

*Environment:* This term will be used here to refer to the natural resources and ecosystems upon which humanity is dependent on for survival, e.g. freshwater systems, terrestrial systems, seas, oceans, atmosphere and biodiversity. Non-renewable resources, such as mineral oil, are only included in this analysis if their use leads to the degeneration of the environment.

*Environmental conflicts:* a) *Environmentally induced conflicts* are socio-economic, political conflicts caused by environmental degradation and/or scarcity of natural resources (adapted from Libiszewski 1999, Baechler et al. 1996a, Homer-Dixon 1999). b) *Environmental use conflicts* can be defined as incompatible interactions (objective and subjective divergences in positions and/or interests related to actions) between two or more human actors (e.g. individuals, groups or countries) over the use of an environmental system. At least one of the human actors experiences damage and perceives this as resulting from the other human actor; and at least one of the human actors ignores the negative impacts of his/her/their actions, or seeks to neutralize or harm the other actors (unintentional accidents that are not ignored do not make a conflict).” (adapted from Trolldalen 1992, Glasl 2002 and Coser 1956).

*Environmental conflict management*: Interventions in an environmental conflict with the aim of solving the problems as perceived by the actors, transforming their relationships, and enhancing ecological sustainability.

*Feddan*: 0.42008 hectares (ha).

*Global Syndrome Approach*: Integrated approach to the study of clusters of core problems of global change, indicating specific patterns of non-sustainable development (NCCR-North South 2002).

*Grounded theory*: Theory grounded in systematically analyzed data. The aim is not to test hypotheses, but to construct theories in order to understand phenomena. Research begins by focusing on an area of study and gathering data from a variety of sources, including interviews and field observations. Once gathered, the data are analyzed using coding and theoretical sampling procedures. When this is done, theories are generated, with the help of interpretive procedures (Dick 2002).

*Interaction*: The interaction between two or more human actors (individuals or groups) entails “points of contact” involving all the actors. It is characterized by the following three dimensions: 1) power symmetry/asymmetry between the actors, 2) rules and laws governing the relationship, 3) negotiations and communication patterns between the actors seeking to reconcile different interests (Ury, Brett, Goldberg 1988).

The interaction between the human system and the environmental system is characterized by a limited adaptive capacity (resilience) of one system to changes in the other system. Negative impacts resulting from the limited adaptive capacity are difficult to foresee and prevent in time.

*Interest*: “Interests are the underlying desires and concerns that motivate people to take a position. While their position is what they say they want, such as “I want to build my house here!”, their interests are the reasons why they take that particular position (“because I want a quiet lot with a good view of the city”). Often parties’ interests are compatible, and hence negotiable, even when their positions seem to be in complete opposition.” (CRC 1998, Fisher, Ury, Patton 1991).

*Internal renewable water resources (IRWR)*: This refers to the part of the water resources that is generated from endogenous precipitation. It is computed by adding up surface runoff and groundwater recharge occurring inside a country’s borders (AQUASTAT database).

*Main Nile*: Nile downstream of Khartoum, after the Blue and White Nile join together in Khartoum.

*Mediation*: Mediation is a way of transforming and/or resolving conflicts with the support of an even-handed third party that is accepted by all the involved conflict parties. The mediator structures and guides the process, facilitates communication between the conflicting parties and seeks to empower the parties in resolving/transforming their conflict. The mediator does not provide any solutions. Win-win solutions are developed by the conflict parties themselves (adapted from Wüstenhube 1999).

**Model:** A schematic description of a system, theory, or phenomenon that accounts for its known or inferred properties and that may be used for further study of its characteristics (American Heritage Dictionary 2000). This also lays the underlying assumptions open to debate.

**Natural renewable water resources (NRWR):** This term refers to the sum of IRWR and incoming flow originating outside a country's borders; it is computed by assessing the long-term yearly average of flow without any human-induced abstraction (AQUASTAT database).

**Need:** A condition or situation in which something is required (American Heritage Dictionary 2000). In this context 'needs' refer to basic needs, e.g. the need for independence (security, economic well-being, control over one's life) and relatedness (a sense of belonging, recognition, relationship). According to the human needs theory, conflicts can only be resolved in the long term if basic needs are satisfied (Burton 1990).

**Parties:** People or groups of people involved in a conflict. Conflict parties (disputants) are people who are in conflict with each other. "A 'third party' is someone who is not initially involved in the conflict, but who gets involved to try to help the disputants work out a solution (or at least improve the situation by communicating better or increasing mutual understanding.) Examples of third parties are mediators, arbitrators, conciliators, and facilitators." (CRC 1998)

**Perception:** Insight, intuition, or knowledge gained by taking in "seizing" stimuli from the physical and non-physical (abstract, symbolic) world. We can only absorb a limited excerpt of the stimuli we are exposed to. Different people may have different perceptions of similar stimuli. The meaning attributed to a perception is not derived from the physical context alone. Perceptions influence human behavior and change over time (Hillig 1996). Here perceptions refer to the different knowledge, views and interpretations people have of an issue.

**Position:** A position is a fixed solution to a conflict suggested by one party that is often incompatible with the position of the other party. Positions are what people have decided upon, interests are what caused them to decide (Fisher, Ury, Patton 1991).

**Rentier state:** "A state reliant not on extraction of the domestic population's surplus production but on externally generated revenues, or rents, such as those derived from oil. In this perspective, a rentier state is based on a rentier economy 'in which income from rent dominates the distribution of national income, and thus where rentiers wield considerable political influence. Since the rent (i. e., the income derived from the gift of nature) dominates the significant amount of the GDP, a rentier state generally lacks a productive outlook.'" (Kuru 2002).

**River basin:** the area of land from which all surface run-off flows through a sequence of streams, rivers and lakes into the sea at a single river mouth, estuary or delta (Directive 2000).

**Stakeholders:** "Stakeholders are people who will be affected by a conflict or the resolution

of that conflict. This includes current disputants, and also people who are not currently involved in the conflict but might become involved because they are likely to be affected by the conflict or its outcome sometime in the future.” (CRC 1998).

*System:* A system is a set of elements interrelating in a structured way. The elements are perceived as a whole with a purpose. A system’s behavior cannot be predicted by analysis of its individual elements. The properties of a system emerge from the interaction of its elements and are distinct from their properties as separate pieces. The behavior of the system results from the interaction of the elements, and the interaction between the system and its environment (System + Environment = A Larger System). The definition of the elements and the setting of system boundaries are *subjective* actions (SSI 2003).

*Theory:* “Theories consist of good ideas about how things work.” (Bernard 1994). This includes an assumption and a predictive value: if a then b. Theories are useful to reduce work by focusing and structuring the research; they are misleading when they focus the research on the wrong issues.

*Third Party:* See parties.

*Violence:* This term is used here to describe the abusive use of force intended to compel or hurt people. “Violent conflict” is thus a wider definition than “armed conflict”. It can be applied to the personal, institutional or structural level (Nohlen 1998: 225, Galtung, Hoivik 1971).

*Virtual Water:* Water that is imported in the form of food. It is easier to import water in the form of food, e.g. cereals, than it is to transport water. “Virtual water” can be approximated by the following rule of thumb: 1 kg of bread requires about 1000 liters of water for its production, 1 kg of meat is approximately equivalent to 4’000 liters (Allan 1997; Yang, Zehnder 2002).

*Watercourse:* This term encompasses a system of surface waters and groundwater with a physical relationship to each other (Convention 1997).



# 1 Introduction

The guiding question of this thesis is how large groups of people can use scarce water resources in an equitable, peaceful and sustainable way. According to David Seckler (1999): “Water scarcity is now the single greatest threat to human health, the environment and the global food supply.” Besides the qualitative aspect of water, e.g. polluted water affecting human health, the available quantity of water has a direct impact on a region’s potential to produce food. Conflicts over scarce water resources may arise between countries sharing the same river, accentuating the threat of running dry. World wide there are about 260 major river basins that cross national boundaries, responsible for 85% of the earths run-off and draining about 45% of the earths surface (UN 1997, Wolf et al. 1999).

## 1.1 The Nile Conflict

The Nile River is shared by ten countries (Egypt, Sudan, Ethiopia, Eritrea, Tanzania, Uganda, Burundi, Rwanda, D.R. Congo, and Kenya, map 1.1, table 1.1) and is home to more than 160 million people; the population is growing by 2–3% per year. The Nile Basin covers an area of 3.1 million km<sup>2</sup>, of which 1% is urban, 2% are covered by forest, 3% by wetlands, 3% by open water, 4% by shrub, 5% by irrigated cropland, 10% by cropland, 30% by desert/semi-desert and 42% by grassland. The Nile River is the longest river in the world and flows for 6’600 km, traversing more than 31 degrees of latitude (NBI 2001: 1, 8-9, 13). Measured at Aswan, the Nile River had a yearly average flow between 1869 and 1984 of 87.1 km<sup>3</sup>/year (SHI 1999). 86% of the Main Nile’s water stems from the Ethiopian highlands in the Eastern Nile Basin, the rest originates mainly from the watersheds of the equatorial lakes. Many countries in the Nile Basin are highly dependent on the Nile’s water, as they are situated in an arid or semi-arid region. More than 95% of Egypt’s water stems from the Nile, which means that it depends on rainfall outside of its territory. Egypt has therefore always closely observed Ethiopia’s water development plans. Ethiopia’s irrigation plans are of great concern since they could reduce the water flow in the Nile. Currently, Ethiopia’s economic capacity does not yet allow full implementation of its irrigation plans. Ethiopia’s present food production is dependent on rain-fed agriculture, which is unreliable because of the irregularity of the seasonal rains. The irregularity in rainfall and water flow is a characteristic of the entire Nile Basin, but especially of the Eastern Nile Basin as this sub-basin does not have a large reservoir similar to Lake Victoria, source of the White Nile, that can act as a buffer. The periodic fluctuations in the Nile’s flow are demonstrated by the two extremes of 1916 with a water flow of 120 km<sup>3</sup>/year, and 1984 with a flow of 42 km<sup>3</sup>/year measured at Aswan (Collins 1990: 402).

There are four main development needs concerning water use in the Nile Basin:

- 1) water for irrigation and hydroelectric power production (HEP);
- 2) prevention of floods;
- 3) watershed management, minimization of erosion and siltation of reservoirs; and
- 4) prevention of water pollution.

The national capacity to address these issues is limited. Eight of the ten countries of the Nile Basin (Egypt and Kenya are the exceptions) are among the category of the 47 “least developed countries” world-wide (ECOSOC 2001). On the international level, the absence of a basin-wide water agreement has caused tensions between the riparian states and hindered access to international development support. The principles of colonial water agreements, especially the principle of “acquired rights”, are upheld by Egypt and rejected by most of the upstream countries. Egypt and Sudan are committed to the only non-colonial water agreement in the basin, the “Agreement between the Republic of the Sudan and the United Arab Republic for the full utilization of the Nile waters,” signed at Cairo, 8 November 1959. The agreement allocates 55.5 km<sup>3</sup> water/year to Egypt and 18.5 km<sup>3</sup> water/year to Sudan, under condition that the Nile flow, measured at Aswan, remains the same (Agreement 1959). The upstream countries, however, do not consider the Agreement of 1959 to be relevant for them, as they were not invited to the negotiations that led to the agreement and did not sign it. Many international development banks require the consent of all affected riparian countries before financing development projects on international rivers, thereby protecting the geographically weaker downstream states (World Bank 1994). A lack of consent from the downstream states can hinder development upstream, one of Ethiopia’s main concerns (Lemma 2001).

The focus of our study is on the Eastern Nile Basin, Egypt, Sudan and Ethiopia, because the main water use conflict exists between the countries of this sub-basin. While forming part of the Eastern Nile Basin, Eritrea is only treated in summary, similarly to the other Nile countries, as it is not a major contributor to or dependent of the Eastern Nile Basin<sup>1</sup>.

The challenges posed by the water conflict in the Eastern Nile Basin can be summarized as follows:

1. A finite amount of water resources stands to be used by a population that is increasing by 2–3% annually.
2. The Nile countries’ national socio-economic and political capacity to find alternatives to present water use trends is limited.
3. There is no agreement on water allocation between the riparian countries that is accepted by all. Egypt and Sudan uphold the principle of “acquired rights” and the validity of the Agreement of 1959, the upstream countries seek to negotiate a new Nile waters agreement.

1 The runoff of Eritrea is estimated to be about 2.2 km<sup>3</sup>/year (FAO 1997).

4. There have been diplomatic tensions and instances of threatening and concerned rhetoric<sup>2</sup> between the countries of the Nile, especially between Egypt and Ethiopia.
5. International investment in water resource development has been blocked, due to disagreement between the countries.
6. The downstream countries are concerned about a decrease in water flow due to upstream water resource development.
7. The upstream countries are concerned about the downstream countries hindering their water resource development.

This thesis aims to highlight the “hard” (environmental) and “soft” (political) factors influencing the Nile conflict, and examine how the conflict is being dealt with in recent years, especially since 1999. It focuses on whether, and if yes how, a situation of conflict over scarce resources can be transformed into a situation of cooperative resource use.

*Table 1.1: Area of Nile Countries in the Nile Basin*

Country	Total area of the country (km <sup>2</sup> )	Area of the country within the basin (km <sup>2</sup> )	As % of total area of basin (%)	As % of total area of country (%)
Burundi	27'834	13'260	0.4	47.6
D.R. Congo	2'344'860	22'143	0.7	0.9
Egypt	1'001'450	326'751	10.5	32.6
Eritrea	121'890	24'921	0.8	20.4
Ethiopia	1'100'010	365'117	11.7	33.2
Kenya	580'370	46'229	1.5	8.0
Rwanda	26'340	19'876	0.6	75.5
Sudan	2'505'810	1'978'506	63.6	79.0
Tanzania	945'090	84'200	2.7	8.9
Uganda	235'880	231'366	7.4	98.1

Data: FAO 1997a.

- 2 In 1979, President Anwar Sadat said: “The only matter that could take Egypt to war again is water.” (Dawoud 2001). In 1985, when he was Egypt’s minister of state for foreign affairs, Boutros Boutros-Ghali was quoted as saying: “The next war in our region will be over water, not politics” (Vesilind 1993). Haile Selassie was quoted as saying: “We have already explained the plans under construction to utilize our rivers as an essential step in the development of agriculture and industry, it is of paramount importance to Ethiopia, a problem of first order that the waters of the Nile be made to serve the life and the needs of our beloved people, now living and those who will follow us in centuries to come. However, generally Ethiopia may be prepared to share this tremendous God-given wealth of hers with friendly nations neighboring upon her, for the life and welfare of their people, it is Ethiopia’s sacred duty to develop the great watershed which she possesses in the interests of her own rapidly expanding population and economy” (Ethiopian Observer, 1958: 93, quoted in Arsano 2004).

Map 1.1: The countries of the Nile Basin are shaded



## 1.2 Study Objectives

This thesis is part of the project “Environment and Cooperation in the Nile Basin” (ECONILE). The overall goal of the ECONILE project is to understand how the countries of the Nile are dealing with the challenge of cooperative use of shared resources, to support their search for viable water management options and to intensify cooperation between the Nile countries. ECONILE aims at observing, analyzing and learning lessons from present steps towards cooperation in the Nile Basin, such as undertaken within the framework of the Nile Basin Initiative (NBI). ECONILE is independent of the NBI as it is funded by the Swiss Federal Institute of Technology, ETH Zurich, and the NCCR North-South’s Individual Project 7 “Environmental Change and Conflict Transformation”<sup>3</sup>.

ECONILE consists at its core of two Ph.D. studies. Both examine the use and management of water in the Eastern Nile Basin, but each with a different focus and from a different starting point. The upstream thesis (Arsano 2004) focuses on Ethiopia’s national water management and examines international water relations in the Nile Basin from Ethiopia’s point of view. The downstream thesis (this one) focuses on water availability and management in Egypt and Sudan, and international water relations from the downstream point of view. The objective of having two Ph.D. studies is to enable an independent study of the upstream and downstream perceptions, positions and interests, before comparing them at a later stage. Two independent but coordinated studies can make a conflict analysis more even-handed and objective. We thereby seek to minimize bias (i.e. taking sides for one or the other of the conflict parties) and enhance the applicability and acceptability of the study’s results. Conflicts are characterized by biased information coverage, science can contribute to conflict management by minimizing bias and providing “objective” information to stakeholders and third parties. An applied objective of the two Ph.D. studies is to provide a “neutral” analytical background for the planned Nile Dialogue Workshop series, especially for the moderators of the workshops.

The particular aims of this (downstream) thesis are to:

1. Develop theories, approaches and methods to assess and manage environmental conflicts.
2. Examine the “hard” quantitative aspects influencing the conflict: the water quality, hydrology and use of water in the Eastern Nile Basin, especially in Egypt and Sudan.

3 National Center for Competence in Research (NCCR) North-South “Research Partnerships for Mitigating Syndromes of Global Change” Individual Project 7 “Environmental Change and Conflict Transformation” (NCCR N-S IP7, <<http://www-north-south.unibe.ch>>).

3. Assess the “soft” factors on the national level influencing the conflict: the political and economic strategies in Egypt and Sudan that affect how they use and manage water.
4. Assess the “soft” factors on the international level influencing the conflict, learn lessons about how the conflict is being managed, and support the transformation from conflict to cooperation.
5. Generalize the results by comparing them with other river basin conflicts, and synthesize results of our study.

### 1.3 Research Questions

To reach the goal of this ECONILE thesis, five groups of questions need to be answered:

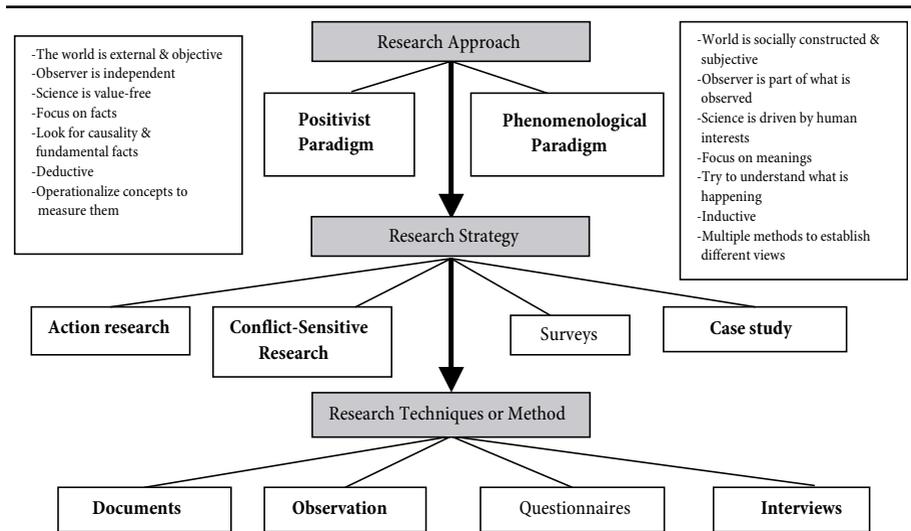
1. Theoretical and Methodological: What theories, approaches and methods are there to assess and manage an international water conflict?
2. Environmental: What is the state of water resource quality, availability and withdrawal in the Eastern Nile Basin?
3. National: What are the national policies and socio-economic factors that influence the use and management of water resources in Egypt and Sudan? How are these factors influencing international conflict and/or cooperation?
4. International: What are the downstream (Egyptian, Sudanese) perceptions, positions, interests and management options concerning international water issues in the Eastern Nile Basin? What lessons can be learned from the recent steps towards cooperation in the Nile Basin? Can, and if yes how can, a Dialogue Workshop support the transformation from conflict to cooperation in the Nile Basin?
5. Generalization and synthesis: How do the factors influencing success and failure of international river management in the Nile Basin compare with those in the Rhine, Mekong and Euphrates/Tigris? What can be learnt from synthesizing the results of this thesis?

### 1.4 Research Approach

The different hierarchical levels of research approach, research strategy and research technique or method are summarized in diagram 1.1. Some examples for each level are given in the diagram, and those strategies and methods that are used in this study are marked in bold, so as to position this study in the context of social and natural science approaches.

Research in this study follows both the positivist<sup>4</sup> and phenomenological<sup>5</sup> research paradigm<sup>6</sup> in different parts. The characteristics of these two research paradigms – based on assumptions of how the world works – are listed in diagram 1.1. The study is interdisciplinary and eclectic in nature, i.e. it uses methods and theories from different disciplines, depending on their usefulness to this given case. The interview technique to grasp different perceptions of experts is closer to the phenomenological paradigm: “The important reality is what people perceive it to be.” (Taylor, Bogdan 1998: 3). On the other hand, the work of data-tracking (e.g. figures on sedimentation rates and water quantity) and interviews focusing on factual information is to be positioned in the positivist tradition. As shown in the next chapter, environmental conflicts always have a physical and a human/societal dimension, both “soft” factors and “hard” facts have to be included. The importance given to this is reflected by having supervisors from both the social and natural sciences, and by using elements from both the positivist and phenomenological paradigm. As the study progressed, the phenomenological approach became increasingly important.

Diagram 1.1



Approach, strategy and method are hierarchically dependent on each other. There are two basic research approaches (positivist and phenomenological) within which different research strategies are used, each strategy makes use of different or all research techniques. The approaches, strategies and techniques used in this study are marked in bold. Conflict-sensitive research is defined in the glossary. Source: Maclaran 1999.

4 “The positivist seeks the *facts* or *causes* of social phenomena apart from the subjective states of individuals.” (Taylor, Bogdan 1997: 3)

5 “...tradition within the social sciences concerned with understanding the social actor’s frame of reference.” (Taylor, Bogdan 1997: 22)

Within the two broad *research approaches*, the positivist and the phenomenological one, different *research strategies* are used. The following research uses a case study strategy and elements of action research in the form of a Dialogue Workshop. Both the case study and the action research are characterized by the use of a conflict-sensitive research strategy that seeks to 1) minimize bias through a dual approach (two researchers, one on each side of the conflict), 2) increase trust through accountability and transparency to both funding agencies and the people one is involved with for the research, 3) guarantee the safety of the researchers and those being researched through confidentiality where necessary, and 4) enhance applicability and acceptability of conflict management options through participatory conflict analysis (Smyth, Robinson 2001).

There are different types of case studies – multiple and single. Multiple and comparative case studies have a high degree of generalization (external validity), whereas single case studies are more in-depth and the results therefore more applicable to the case studied as the particular context is given greater priority. The strategy to be used here belongs to the category of in-depth case studies. In fact, it presents only half of the case under consideration. It consists of the downstream study of the ECONILE project and it complements the upstream case study carried out by Arsano (2004). The aim of separately examining the upstream/downstream perspectives is to highlight the different conflict/cooperation perceptions and interests found in these two regions. Carried out by two separate researchers, this dual approach enables an in-depth study of the different water development strategies chosen by the upstream/downstream countries. A comparison of these different positions, interests and perceptions will then be carried out in a second stage. The incompatibilities between the upstream/downstream perspective, the positional bias, and the effects of the chosen water development strategies can thus be better clarified. Having two researchers do research on two sides of the same conflict is one of the principles of a conflict-sensitive research strategy (Smyth, Robinson 2001). According to the literature overview carried out so far, such a dual approach to international river conflicts has not been carried out in this way before (for an overview of river management case studies see Marty 1997). The separate but joint research in the upstream and downstream setting also serves as the foundation for the international interaction of stakeholders in a Dialogue Workshop. The evaluation of the workshop's effectiveness can be improved by this research design, as perceptions assessed in the region can be compared to perceptions expressed in the workshop.

At a level beneath the research strategies – at the level of “nuts and bolts” about how to go about things – interviews, document studies, and observation *techniques/methods* will be used (diagram 1.1). Qualitative interviews will be used to try and gather factual information as well as perceptions of how the people in the countries of the Nile perceive the situation. Document studies will be used to complement these interviews. Participant observation will be used as part of the Dialogue Workshop evaluation.

## 1.5 Outline of the Thesis

This thesis is structured in the following way:

*Section I* introduces the theories and methods used in the thesis. Chapter two in this first section gives a review of some of the literature on environmental conflicts and conflict management, embedding the study into the wider conflict research context. It ends with the Human-Environment Interaction Triangle (HEIT) model and hypothesis that are used as guidelines for our research. Chapter three describes the two main methods applied, the conflict-sensitive interview technique and the Dialogue Workshop method. By integrating approaches from the field of conflict management, these methods combine and adapt existing social science methods to the aims of our study.

*Section II* gives an overview of the environmental factors influencing the conflict, the factual “hard” basis concerning water quality, availability and withdrawal in the Nile Basin, especially in Egypt and Sudan. Although this section focuses on the environment, it is not possible to discuss environmental factors in this context without mentioning how human beings use how much water for what. A society and its environment are inseparably linked. Economic factors are therefore included in this section, especially factual aspects grasped by numbers. The softer economic and political strategies influencing these numbers are dealt with in section III. We differentiate between water quality (chapter four) and quantity (chapter five) as this has implications on the dynamics and management of a water conflict. Generally, water quality conflicts are easier to manage than water quantity conflicts (Libiszewski 1999).

*Section III* serves as an intermediary section between the environmental aspects of the Nile Basin (section II), and the international debates over the Nile waters (section IV). It focuses on Egypt and Sudan, and their economic and political water management strategies. The national strategies and development programs partly explain and partly react to the water withdrawal and availability described in the previous section. National water management constraints and opportunities drive international water relations; understanding some of the processes within a country is therefore a prerequisite to understanding the international situation.

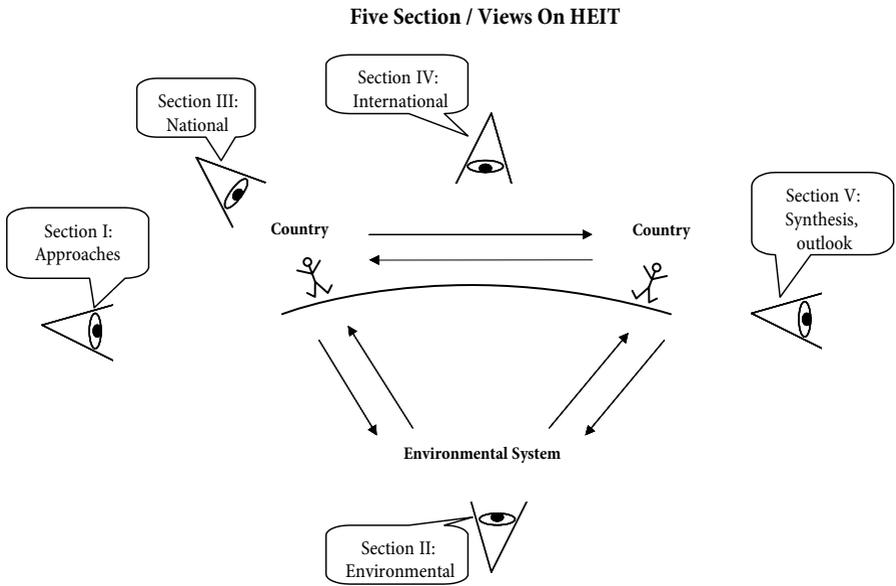
*Section IV* deals with the international relations in the Eastern Nile Basin. Compared to the previous sections that primarily analyze already available literature and data, and are only to a lesser degree based on interviews in Egypt and Sudan, section IV contains the more innovative aspects of this thesis. Chapter seven is based on 70 interviews in the field carried out by the author, not primarily with the aim of finding out what the “objective” truth is, but in order to find out what the “truth” is as perceived by the actors from their various perspectives. Chapter eight describes and evaluates how the Interactive Problem Solving Workshop method was applied in the Nile Basin within the ECONILE project. According to our knowledge, it is the first time this method was applied in this form to an international river conflict. Within the ECONILE project, the upstream and downstream Ph.D. studies serve as the basis for this Dialogue Workshop. They provide background information for the moderators and establish a network of

water experts that can be used as a pool from which workshop participants could be selected.

Section V generalizes some of the lessons learnt, by comparing the Nile Basin with other international river basins (Rhine, Mekong, and Euphrates/Tigris). Chapter 10 synthesizes the results of our study, and ends with an outlook. It brings our study's results to bear on the guiding question of how the Nile riparians can deal with scarce resources in a cooperative and sustainable way.

The five sections of this thesis are also represented schematically in diagram 1.2, by five “eyes”, different views on the same Nile Basin system, modeled as a Human-Environment Interaction Triangle. The model is explained in the following section. The HEIT model will guide us through the thesis, each section has a different focus onto the same human-environment system.

Diagram 1.2



The Nile Human-Environment Interaction Triangle can be viewed from different angles, each of the five sections of this study represents one of the different angles/views represented by an eye.

# Section I

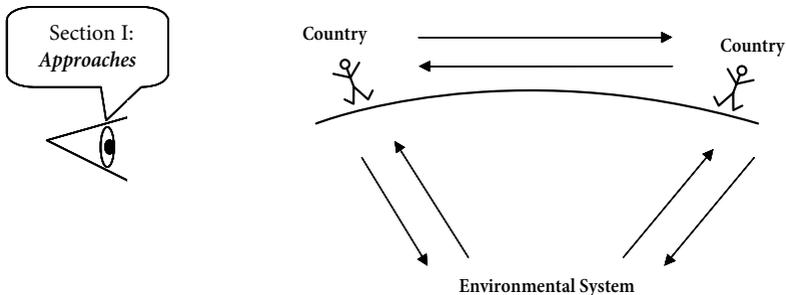
## Theoretical and Methodological Aspects of Conflict Management

The following section describes the theories and methods used to structure the analysis and to develop conflict management methods that will be used later on in the study. Conversely to a purely “grounded theory” approach, an overview of the literature and theories in the field of environmental conflict management is given in order to learn from the research of others. We focus on the environmental and communicative/psychological aspects of conflict management, rather than on legal or policy oriented approaches. Chapter two develops the Human-Environment-Interaction Triangle, seeking to model the systemic interaction between at least two human actors (in this study three countries) and the environmental system (in this study the waters of the Nile Basin) that stand in a conflict or cooperative relation with each other. Chapter three develops the Interactive Problem-Solving Workshop method, exploring how it can be adapted to an environmental conflict. The implementation of the Nile Dialogue Workshop is described in chapter eight, after the various aspects of the Nile human-environment system have been analyzed in the intermediary chapters, serving as background information for the workshop.

*Diagramm I.1*

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### **Section I: Focus on Theoretical and Methodological Aspects of Conflict Management**



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*Theoretical and methodological approaches of the Nile HEIT Study*



## 2 Environmental Conflicts and Their Management

Chapter two gives an overview of some of the literature on environmental conflicts and on different approaches to managing them. This branch of conflict research seeks to answer two questions. The first question dealing with environmentally induced conflicts asks when and how scarcity of renewable resources and degeneration of the environment lead to violent conflict (section 2.1). The second question concerning environmental conflict management<sup>1</sup> asks how large groups of people can use scarce renewable resources in a cooperative way (section 2.2). Both sections end with the principles from the reviewed literature that will be used for our Nile study. These principles are synthesized and developed in the Human Environment Interaction (HEIT) Model and HEIT hypotheses.

This branch of conflict research is referred to with terms such as “environmental conflicts” (Libiszewski 1992, Trolldalen 1992, Diehl, Gleditsch 2001), “ecological conflicts” (Martinez-Alier 2001), “environmental conflict management” (Mason, Spillmann 2003) “environmental conflict resolution” (Trolldalen 1992, Wolf 1997) or, in a broader sense, “environmental security” (Barnett 2001). Wars over non-renewable resources such as mineral oil are normally referred to as “resource conflicts”; they are to be distinguished from “environmental conflicts” over renewable resources and will not be discussed here. The destructive effect of violent conflicts and war on the environment is not examined either (see ICRC 1998). Here we focus on regional conflicts and cooperation, e.g. between neighboring countries of a shared river basin, and on conflict dynamics and the involved communication patterns. The more long-term legal policy issues, regime formation or structural causes of environmental conflict is not of concern in this literature overview (see UNESCO-EOLSS 2002, and Schellenberg 1996).

Conflict terminology is in general ill-defined (see glossary). Conflict is defined here as a situation where at least two parties interact in an incompatible way, so that at least one of the parties experiences damage from the incompatible interaction as stemming from the other party, and at least one of the other parties ignores the negative impacts of their interaction, or wilfully seeks to neutralize or harm the other party (adapted from Glasl 2002 and Coser 1956: 8). Conflicts can be categorized or described by numerous dimensions, for example: 1) The issue at stake (e.g. resources, self-determination); 2) The actors (e.g. state, non-state); 3) The form of the conflict (e.g. latent, manifest, violent, and non-violent conflicts); 4) The causes of the conflict (e.g. acquiring or defending

1 Conflict management is used as a generic term that refers to all interventions in a conflict. It seems to be the best translation of “Konfliktbearbeitung”, literally translated as “working on the conflict”. The term “conflict management” has been criticized for its connotation of control and top-down approach. It is, however, more generic than “conflict resolution” or “conflict transformation” which both have a school of thought behind them.

material and non-material values); 5) The arena in which the conflict takes place (e.g. local, international, river basin, or forest area) (Glasl 2002, Baechler 2002, Austin, Fisher, Ropers 2001).

## 2.1 Environmentally Induced Conflicts

Two research groups in the 1990s were pivotal in launching research on the environment as a cause of violent conflict (diagram 2.1): the Environment and Conflicts Project (ENCOP) group headed by Günther Baechler and Kurt R. Spillmann, and the Toronto group headed by Thomas Homer-Dixon. Both groups reached similar conclusions, even if they used somewhat different definitions and research methods. ENCOP defined environmental conflicts in the following way: “Environmental conflicts manifest themselves as political, social, economic, ethnic, religious or territorial conflicts, or conflicts over resources or national interests, or any other type of conflict. They are traditional conflicts induced by an environmental degradation. Environmental conflicts are characterized by the principal importance of degradation in one or more of the following fields: 1) overuse of renewable resources; 2) overstrain of the environment’s sink capacity (pollution); 3) impoverishment of the space of living.” (Libiszewski 1992, Baechler et al. 1996a). Thomas Homer-Dixon and the Toronto group used the following definition: “Environmental conflicts are violent conflicts that are caused by environmental scarcity in interaction with a variety of, often situation-specific, contextual factors. Environmental scarcity appears in three forms: demand-induced scarcity (i.e. scarcity arising from increases in demand caused by, for example, population growth); supply-induced scarcity (i.e. scarcity arising from reduced total availability of certain resources due to degradation or depletion), and structural scarcity (i.e. scarcity arising from the unequal distribution of, or access to, resources).”<sup>2</sup>

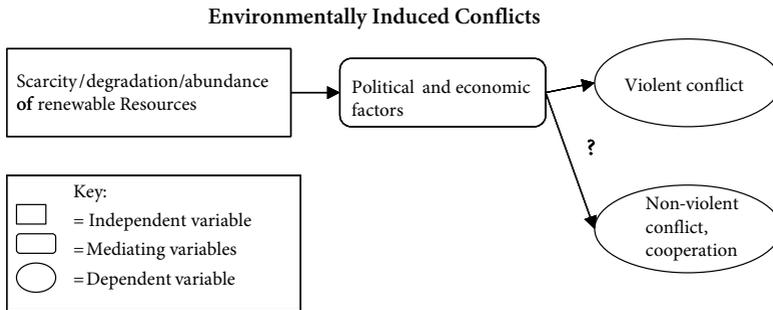
While both research groups focused on the causal relationship between the environment (renewable resources) and violent conflicts, the difference between the two definitions lies in the terms “degeneration” versus “scarcity”.

The ENCOP group differentiated between the following types of environmental conflicts (which frequently overlap in reality): center-periphery conflicts, ethnopolitical conflicts, internal and cross-border migration conflicts, global environmental conflicts and international water conflicts (Baechler et al. 1996a).

International water conflicts may arise over river basins that cross national boundaries. Conflict lines frequently form between upstream and downstream users of the river: particularly if the cost and benefit of water used for hydroelectric power production (HEP) or irrigation are asymmetrically distributed. Another example is the effect of upstream pollution on downstream regions. An adequate water supply is often a question of “national security” or even survival. Since most large rivers flow through more than

<sup>2</sup> Homer-Dixon, in an email to the author 05.04.2002.

Diagram 2.1



*Research on environmentally induced violent conflicts seeks to answer the question: How does scarcity of renewable resources and human induced degradation of the environment, together with economic and political factors, lead to violent conflict?*

one country, they create a situation of competition between riparian states, especially in arid or semi-arid countries. Water can be captured as it is a sizeable resource. River development projects in shared river basins often lead to a clear distinction between the privileged and the disadvantaged group. Since the benefit or disadvantage is definable, it can be transformed into a political instrument (Baechler et al. 1996a).

The conflict potential of international river basins varies considerably. According to Frey, (1984, quoted in Frey 1993: 61) the conflict potential in a river basin is characterized by the constellation of the following factors: 1) The importance of the water supply for the riparian states; 2) The power of the riparian states, mainly military; and 3) The upstream/downstream position of the riparian states. A volatile situation exists when the downstream country has great interest in the water supply, when it has a powerful military, and when the upstream countries also have a relatively strong interest in the water resource. Frey compares the Jordan, Euphrates and the Nile and concludes that "The Nile has the greatest long-term conflict potential of all, other things equal"<sup>3</sup> (Frey 1993: 62). From the perspective of 2002, this assessment has proven to be wrong, as there are cooperative steps being made in the Nile Basin, while the conflict potential over water seems to be the greatest in the Euphrates/Tigris basin (chapter 9).

Despite the conflict potential of international rivers, there have been no major armed conflicts over water at the level of the nation state during the second half of the Twentieth Century. Violent conflicts over water have, however, occurred within states. It must be kept in mind that the relationship between water stress and armed conflict is complex, and that water is often only one factor among others causing and perpetuating conflicts (Allan, Nicol 1998). Basing his analysis on historical, strategic, hydrological and economic argumentation, Wolf (1997) also warns against over-dramatizing the potential

3 As long as military power and dependence stay as they are at present in these countries.

of water as a cause for war. Nevertheless, he states that "...while "water wars" may be a myth, the connection between water and political stability is certainly not. The lack of a clean freshwater supply clearly does lead to instability, which, in turn, can create an environment more conducive to political or even military conflict..."

For analytical purposes, Libiszewski (1999) used a typology of water conflicts in relation to the different water uses: 1) conflicts over absolute distribution of water resources (e.g. water has been consumed, taken out of its natural hydrological cycle); 2) conflicts over the relative distribution of water resources (e.g. water is used for energy generation resulting in a seasonal change in flow patterns); and 3) conflicts over pollution or degradation of water resources. The first conflict type is generally the most difficult to resolve.

So far we have focused on international rivers, the conflict potential of these rivers is related to the water scarcity in the countries through which these rivers flow. The following statement of the World Water Council (1999: 7) indicates the magnitude of water scarcity worldwide: "The scarcity of water is a recent phenomenon in world history. In the 1950s only a handful of countries faced this problem. Now at the end of this century, an estimated 26 countries with a population of more than 300 million people suffer this fate. Projections for the year 2050 show that 66 countries with about two thirds of the world population will face moderate to severe water scarcity. The consequences of water shortages on economic and social development, political stability and preservation of life are immeasurable." The main reasons for this are viewed in population growth, a change in consumption habits and a deterioration of the water quality in some areas (Biswas 1997).

Environmentally induced violent conflicts include the following characteristics:

- They are *multi-causal*. The environment only causes conflicts in interaction with certain economic and political factors (Baechler et al. 1996a, Homer-Dixon 1999).
- There is a strong tendency of *conflict inversion*: Conflict "channels" are elements that group people and create identification. An example of this is ethnicity. As the conflict escalates, channels may become more important than the original environmental cause – an inversion takes place in the sense that what used to be an important factor becomes unimportant, and vice versa (Suliman 1997).
- The conflict arena is normally defined by the *physical environment* rather than only through political boundaries. The clash between the "natural" and "political" boundaries is often at the center of the problem. The largest 260 rivers that cross international boundaries and drain about 45% of the earth's surface, for example, are mainly managed on the national level (Baechler, Spillmann 1996c, Mason, Spillmann 2003).
- The *long-term time frame* of environmental changes and their implications for society do not fit political time frames. The effects of environmental change on

society are also normally not linear; rather, they are marked by thresholds, after which the damage may be irreversible. Ecologically sustainable development is a form of conflict prevention (Homer-Dixon 1991).

- Violent environmental conflicts are generally limited to *developing countries*. People are often directly dependent on renewable resources for their subsistence, and these countries are also less resilient in dealing with increased scarcity. The conflict line often lies between modern technological and traditional subsistence forms of resource use, i.e. small fishers versus large fish trawlers or subsistence farmers and nomads marginalized by large scale mechanized farming (Baechler et al. 1996a).
- *Non-state actors* are frequently involved. Most violent environmental conflicts are intra-national conflicts. Indeed, this is true for all present-day violent conflicts: of the 25 major armed conflicts in the year 2000, all but two of them were internal (SIPRI 2001). Environmental conflicts often effect different layers of society, from the government down to the grassroots (Baechler et al. 1996a).

The causality between environmental scarcity and violent conflicts is debated. Three general criticisms can be differentiated: 1) methodological and theoretical criticism; 2) criticism of the weight given to environmental degradation or scarcity as a factor causing conflicts; and 3) criticism given to the importance of conflict rather than to the other consequences of environmental degradation.

### 2.1.1 Methodological and Theoretical Criticism

The methodological criticism follows the debate between the positivist and phenomenological approaches (diagram 1.1). The first give greater priority to the external reality, facts and linear causality; the latter gives greater priority to meanings, inter-linkages and understands reality as something that is constructed by the observer and involved actors. Gleditsch (2001, in Diehl, Gleditsch 2001) points out that the case studies of the Toronto and ENCOP groups were chosen without the independent variable, environmental scarcity, or the dependent variable, conflict, being left open. Thus, some sort of link was guaranteed from the start. Schwartz, Deligiannis and Homer-Dixon (2001, in Diehl, Gleditsch 2001) answer with a plea for methods that are not just quasi-experimental, because many real-life problems cannot be addressed this way. They argue that “process-tracing”, i.e. a detailed step-by-step analysis, is an effective way of understanding causal mechanisms, how scarcity can lead to violent conflict.

A second phase of environmental conflict research has integrated some of the methodological criticisms, thus attempting greater flexibility of the independent or dependent variable. The more recent research also looks at cases where environmental scarcity has led to cooperation, rather than mainly at examples that have led to violent conflict (Baechler, Spillmann, Suliman 2002, this study). As a follow-up to the very clear and consistent findings that environmental conflicts are multi-causal, environmental

conflict research has also begun to use the “Syndrome Approach”<sup>4</sup>. This approach was first developed by the German Advisory Council on Global Change (WBGU 1999) and is rooted in the systems approach, which focuses on the *interactions* taking place between different factors.

### *2.1.2 Criticism of the Weight Given to the Environment as a Causal Factor*

This criticism is based on the optimistic outlook that the environment is not as badly off as everyone says, that there is a technological ‘fix’ to every problem, and that market forces will regulate the demand for scarce resources through price signals. However, an analogy to human health modifies this optimism. According to the World Health Organization, about 4 million people die per year due to unclean drinking water, lack of hygiene and bad sanitation (UN 1997). The technology to solve such problems exist, but it is not used due to poverty. Where a liberalized market structure has been introduced in developing countries, poor people are often worse off than before, since the regulatory framework is faulty and the needs of the poorest are not sufficiently protected (Perry, Rock and Seckler 1997). In other words, it is not a problem of lacking technology or liberalized markets, but of a suitable political and legal framework to guide these instruments. Inadequate social structures leading to “structural violence” (Galtung, Hoivik 1971) cannot be solved through technological remedies alone. Nevertheless, the technological approach gives us an awareness of the enormous potential to solve problems, once a suitable political framework is in place. An assessment of the International Water Management Institute, for example, estimates that half of the world’s additional water demand in the year 2025 could be covered by increases in irrigation efficiency (Seckler et al. 1998).

Besides stating that the environment is not as badly off as the doomsday prophets have predicted, this block of criticism also gives greater weight to other factors causing conflict besides the environment, e.g. ethnic, economic or ideological factors. This argument is valid and has to be taken into account in a case-by-case manner. In conflict research there is always the danger of falling into the mono-causality trap, whatever the one factor may be. A multi-causal and systemic approach to conflicts would partly answer this criticism. One approach that attempts to systemically link the environment to violent conflicts is the concept of “environmental discrimination”, i.e. how social systems control the access to scarce resources (Baechler 1999).

### *2.1.3 Criticism of the Weight Given to Different Consequences of Degradation*

This criticism points to the many consequences of environmental degradation besides conflict, such as internal and international migration, poverty, sickness or unemployment. While these non-conflict consequences are often less dramatic and therefore less pres-

4 For example, NCCR IP7 Environmental Change and Conflict Transformation, <http://www.nccr-north-south.unibe.ch> (11.06.2002)

ent in the media, their contribution to human suffering is tremendous. There are more environmental refugees than war-related refugees across the globe: “The land and water crisis in river basins contributed to the total of 25 million environmental refugees last year, which for the first time exceeded the number of war-related refugees. By 2025, the number of environmental refugees could quadruple.” (Serageldin 2000). When facing the choice of fight or flight, flight seems to be more frequent in relation to decreasing renewable resources (Spillmann 2000). This also indicates that environmental degradation and scarcity may often cause conflict much further down the line, e.g. as a consequence of migration in a far-away country, when the environment as a cause is no longer visible. Indeed, the long-term and often invisible nature of many of the effects of environmental degradation is possibly a reason why the environment is not given greater priority in politics and public awareness.

Despite the enormous non-conflict related causes of human suffering, there is an extremely pressing reason for greater human expertise on environmental and general conflict management: the opportunity costs of humanity’s present way of dealing with conflicts is very high. In 1994 the World Game Institute estimated the annual global military spending at 1 trillion USD. They estimated that 25% of this would suffice for global programs to prevent soil erosion (24 billion USD), stabilize population (10.5 billion USD), stop deforestation (7 billion USD), stop ozone depletion (5 billion USD), provide clean safe energy (33 billion USD) and water (50 billion USD), prevent global warming (8 billion USD), prevent acid rain (8 billion USD), eliminate illiteracy (5 billion USD), provide health care (15 billion USD), provide shelter (21 billion USD), retire developing nations debts (30 billion USD), and eliminate starvation and malnourishment (19 billion USD) (Fisher, 1997). The comparison of the annual world military spending with the annual costs of programs to alleviate some of the major sources of human suffering, as mentioned above, is a compelling argument for societies to look for alternatives to their present militaristic way of resolving conflicts. It is a plausible hypothesis that one of the roots of migration, poverty etc., is a lack of cooperatively managed resources. In other words, a shift of focus from the environment as a cause of conflict to the environment as an issue in cooperative conflict management is called for.

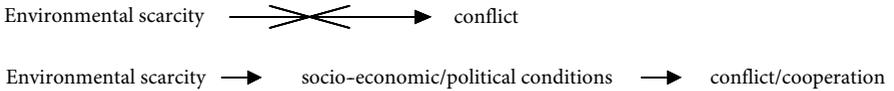
#### *2.1.4 Relevance for Our Study*

What can be learnt from the research done on environmentally induced violent conflict and the criticism summarized here? First and foremost, the multi-causality of environmental conflicts needs to be given due consideration. Environmental scarcity does not lead directly to conflict. As shown in diagram 2.2, the socio-economic and political way of dealing with scarcity is the explanatory or mediating factor between scarcity and conflict/cooperation.

An examination of the socio-economic/political conditions alone, conversely, would also fall short of assessing and understanding the situation. The physical reality has to be fully comprehended if the viability of chosen political strategies is to be assessed. The

physical reality should therefore be taken into consideration in choosing the area to be studied: for example a natural river basin, such as the Nile Basin and not the political borders of one country. The following study is therefore structured into three steps: analyses of the assessment of environmental resources, assessment of the socio-economic and political management on the national level, and only then, an analysis of the state of conflict or cooperation on the international level.

*Diagram 2.2*



*Scarcity and conflict are not directly linked. The economic and political context shapes this linkage*

Different authors disagree on the Nile's potential for conflict or cooperation; some estimate the conflict potential to be high (Frey 1993), while others think this assessment to be exaggerated (Wolf 1997). The methodological criticism concerning the required flexibility of the dependent variable (cooperation/conflict) is therefore taken into account in this study. Gleditsch's methodological suggestions of more statistical or experimental approaches are not followed. Rather, an in-depth case study and Homer-Dixon's "process-tracing" approach is used, as it seems more applicable in a study where policy relevance is given a higher priority over the development of a generalized theory.

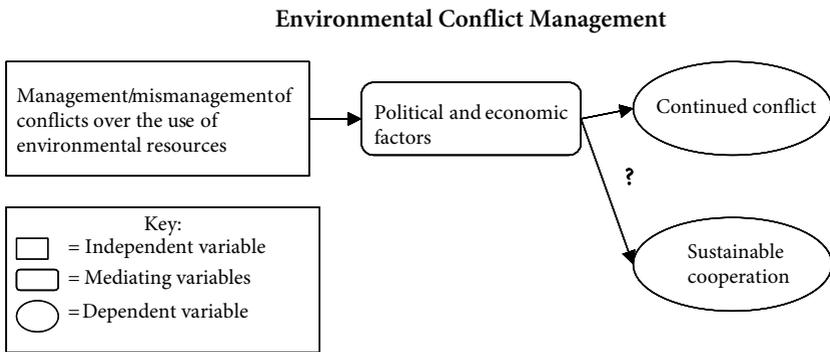
The criticism concerning the weight given to environmental scarcity as a direct factor is only partly applicable to our study. With a relatively fixed amount of renewable resources and a growing population, water scarcity is definitely a problem in a semi-arid and arid area, such as in Egypt and northern Sudan. There is little debate about this fact. The "technological fix to every problem" idea will, however, be examined. The multi-causality of conflicts will also be taken into consideration, and non-environmental factors will be included.

Following the criticism about the importance given to conflict versus the other effects of environmental degradation, our study will focus on the cooperative management of scarce resources (environmental conflict management), rather than on the environment as a root cause of conflict (environmentally induced conflicts).

## 2.2 Environmental Conflict Management and HEIT Model

While the debate over the environment as a cause of conflict continues, there remains an urgent need for more insight into how such conflicts can be managed with the consequence of a better problem-solving potential. Similarly, while the debate on the causes of climate change is ongoing, the pragmatic stance is that humanity has to reduce its polluting habits; since by the time human-induced climate change is proven, it will be too late for precautionary actions.

Diagram 2.3



*Environmental conflict management seeks to answer the question: How can people use scarce renewable resources sustainably and in a cooperative way?*

Environmental conflict management refers to all kinds of interventions in a conflict over the use of natural resources and the degeneration of the environment. It has the aim of solving the problems as perceived by the involved actors, transforming the hostile relationship between them into a cooperative relationship, and enhancing ecological sustainability (diagram 2.3). Different to general conflict management, this definition includes the criteria of environmental sustainable cooperation.

Three types of questions can be asked in sustainability research (Hirsch 2003):

- 1) Why do certain processes occur the way they do? This systems knowledge uses empirical and theoretical methods;
- 2) What are the "right" things to do? This target knowledge includes a value, political judgment and cannot be dealt with scientifically; and
- 3) How can the "right" thing be done? This transformative knowledge focuses on the means to get to the target, taking the systems knowledge of point one into account.

Research focusing on environmentally induced conflicts seeks to answer the first kind of question, while research on how to manage these conflicts focuses on the third question.

The value judgement that conflicts should be dealt with non-violently and sustainably, i.e. the definition of the target, is assumed to find a wide consensus.

The following section first looks at the difference between the causes and influencing factors in a conflict, as this is a key difference between research on environmentally induced conflicts and research on environmental conflict management. This is followed by a section on the characteristics of conflict management in general and of environmental conflict management in particular.

### *2.2.1 Difference Between Root Cause and Influencing Factors*

To deal with the question of conflict management, a shift away from the focus on causes of conflict – which may no longer be apparent – to a focus on the inter-linkages of factors influencing the conflict in the present moment needs to take place. This shift also entails focusing on the future solution rather than on the past problem<sup>5</sup>. Definitions of “environmental conflicts” are needed that focus more on conflicts over resource use rather than on the causal relationship between scarcity and violent conflict. Jon Martin Trollaldalen’s (1992: 3) definition, for example, focuses on the utilization of international natural resources: “International environmental conflicts are conflicts of interest that arise from the utilization of natural resources in one country which has negative environmental consequences for another country or group of countries”. In the following we also use a definition that focuses on utilization, but that is not limited to the international arena. We use a conflict definition that grasps the continuum between cooperation and a highly escalated conflict: “Environmental conflicts can be defined as incompatible interactions (objective and subjective divergences in positions and/or interests related to actions) between two or more human actors (e.g. individuals, groups or countries) over the use of an environmental system. At least one of the human actors experiences damage, and perceives this as resulting from the other human actor; and at least one of the human actors ignores the negative impacts of his/her/their actions, or seeks to neutralize or harm the other actors (unintentional accidents that are not ignored do not result in a conflict).” (adapted from Mason, Bichsel, Hagmann 2003, Trollaldalen 1992, Glasl 2002 and Coser 1956).

For conflict solving, one needs to know the factors influencing the conflict dynamic. These influencing factors may not always be the same as the root causes of the conflict. A conflict over access to resources, for example, may develop into a conflict along ethnic lines, as ethnicity is used to group people to fight for their interests. Over time the ethnic factor may become more important than the original cause of the conflict. Suliman (1997) has termed this process conflict inversion. In this example, ethnicity would be termed

5 In the mediation of conflicts between individual people this solution-oriented approach can go so far as to argue that a mediator does not need to know anything about the conflict causes or even what the conflict is about. The conflict parties know what it is about, the mediator simply has to support them in activating their resources and finding solutions (Fackler, Flucher, Murbach 2002).

an influencing factor. Influencing factors can effect the outcome of a conflict without influencing the initiation of the conflict. One can argue that “influencing factors” are also causes, but influencing factors interact with each other, whereas causal factors imply a one-way influence only.

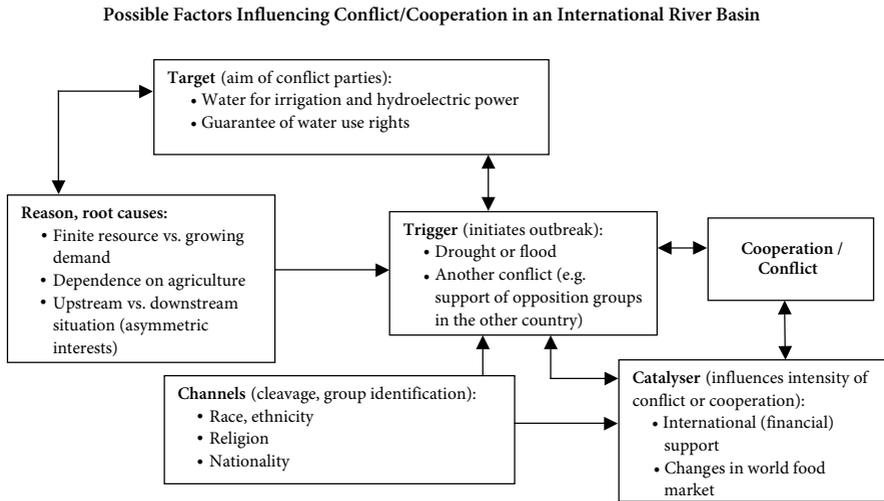
The difference becomes clearer if one differentiates between different types of “causes” (here they would be termed influencing factors) of a conflict. In the Multiple Causal Role Model, Baechler (1999) differentiates between reasons (root causes), targets or the aims of the conflict parties, channels that group people together, triggers that initiate a new level of conflict or cooperation, and catalysts that influence the intensity once the conflict is underway. Research in environmentally induced conflicts tends to focus on causes in the sense of reasons, or root causes. Environmental conflict management focuses on all these different types of “causes”, or influencing factors, and the possible interactions between them.

Baechler’s model has been adapted to an international river basin in diagram 2.4. Some possible factors that could influence conflict and cooperation in a river basin are listed.

- *Root causes:* An increase in cooperation in the basin could be positively influenced by decreasing the concerned countries’ dependence on agriculture, i.e. by addressing one of the root causes of the conflict.
- *Catalyser:* Increasing international support of cooperative initiatives could also enhance cooperation. This second strategy would not be addressing the cause of the conflict directly, but it would still be influencing the level of conflict/cooperation in the basin.
- *Trigger:* International support could also be augmented by a conflict that is triggered by a series of droughts or floods. Even if the average flow stays the same, and thus the root causes of the conflict have not changed, the system could shift to new forms of interaction.
- *Channels:* Nationality could be viewed as a possible channel in this setting, e.g. people are mobilized by pitting different national interests of water use against each other. The ‘channels’ in diagram 2.4 are linked with one-way arrows, as the factors forming group identity do not seem to be directly influenced by the environment.
- *Target:* An example of a target could be the national policy of a country that aims at using water for irrigation. This target is influenced by the root causes, but it also influences them according to how far water development projects have been implemented.

In summary, the focus on influencing factors looks at the present manifest issues of the conflict, how the factors interact, and what the possible conflict outcomes are. The aim of this shift in focus from “causal factors” to “influencing factors” is to develop and assess possible conflict management strategies.

Diagram 2.4



*Environmental conflict management does not just focus on the root causes, but also on the other factors (target, trigger, channels and catalysers) interacting with each other and together leading to conflict or cooperation. Adapted from Baechler (1999: 114).*

### 2.2.2 Characteristics of General Conflict Management

General conflict management can be subdivided into military (e.g. peace enforcement, peace-keeping) and non-military conflict management, which in its turn can be divided into two broad areas: those dealing with legal and institutional frameworks and structural causes, and those involving cooperative negotiations and interactive conflict management (Fisher 1997: 12). The cooperative approach addresses the interests of the involved parties directly, as well as the dynamics of conflict and cooperation affecting the relationship between them. The three forms of conflict management (military, legal and cooperative) give greatest importance to the aspects of power, rules and interest-satisfaction, elements that are present in all conflicts management efforts (Ury, Brett, Goldberg 1988). Military intervention is often needed in highly escalated conflicts where mutual destruction can only be avoided by outside intervention (Glasl 2002). The conflict between Israel/Palestine could be taken as an example. As this high form of escalation is rare for international environmental conflicts, the military form of problem solving will not be discussed here. Our study will focus mainly on the cooperative form of conflict management. Nevertheless, different forms of conflict management are often complementary. After a constructive change in communication and the development of a solution that takes the different interests of the conflict parties into account, the points agreed on need to be formulated in a legal document and the relationship institutionalized. In an international

river basin, for example, a transitional and legally unbinding form of cooperation has to be transformed into a river commission with international legality if any concrete action is to be expected (Wolf 1997, Marty 1997).

“Multi-Track Diplomacy” (Diamond, McDonald 1991), “Alternative Dispute Resolution” (Scimecca in Sandole, Van der Merwe 1993), “Unofficial Conflict Management” (Berman, Johnson 1977), “Conflict Transformation” (Bush, Folger 1994) and “Interactive Problem Solving” (Kelman 1993) are some of the names found in literature describing distinct aspects of cooperative conflict management. The leading question is not who is right or wrong (a legal question), and neither who is more powerful (a military or economic question), but whether there are ways of transforming the conflictive relationships and finding “win-win” solutions to satisfy the interests of all parties involved.

One debate within this field is how much to focus on settlements and problem-solving and how much on process, perceptions and relations. The problem-solving school is represented by the Harvard University’s Program on Negotiation (Fisher, Ury, Patton 1991), by empiricists such as Bercovitch (1996), or researchers dealing with international river treaties such as Wolf (2000). The process-oriented school is more focused on transforming conflicting perceptions and relationships, by empowering actors and supporting recognition of each other (Bush, Folger 1994, Väyrynen 1991, Burton 1990, Kelman 1999<sup>6</sup>, Fisher 1997, Lederach 1995). Bush and Folger call this process and relationship orientation “conflict transformation”. Raimann (2001), on the other hand, uses the term “conflict transformation” to refer to a mixed approach that integrates the outcome or problem-solving school and the process-oriented school (which she also calls the conflict resolution school). She includes structure-oriented approaches in the term “conflict transformation”. Lederach (1995) defines conflict transformation in a similar way to Bush and Folger. According to Lederach: “Transformative peacemaking, then, empowers individuals and nurtures mutuality and community”. The main difference between Lederach’s understanding and that of Bush and Folger is the level of conflict transformation: the inter-group and interpersonal level respectively (Burgess, Burgess 1997). There is, as of now, no clear and widely accepted definition of conflict transformation. Our study will use Bush and Folgers’ and Lederach’s definition as it is conceptually sharper than Raimann’s integrative definition. For an integrative or generic term, the older term “conflict management” will be used; it is understood to imply “working on conflicts” similar to the German term: “Konfliktbearbeitung” (Austin, Fisher, Ropers 2001).

An example of the settlement-oriented school is “Alternative Dispute Resolution” (ADR). It has been defined by Gail Bingham, Aaron Wolf and Tom Wohlgenant (1994) to refer to “a wide variety of consensual approaches with which parties in conflict voluntarily seek to reach a mutually acceptable settlement.” ADR is often used in an intra-nation context, especially in the West, and refers to the “alternative” to traditional,

6 Kelman uses the word “Interactive Problem-Solving Workshop”. He sees the problem to be solved as the perceptions and conflicting relationship between the parties. Thus the terminology of problem-solving versus process orientation is not consistent.

official, legal or power-oriented conflict management methods. Many elements of ADR are specific to the Western culture, for example, the assumption that a third party involved as a mediator has to be neutral, impartial and an outsider to the conflict. In other cultures, conversely, the third party is often an insider and partial, although he or she is normally viewed by both sides as being even-handed (Wehr, Lederach 1996). The term “Multi-Track” is less antagonistic and more frequently used in the international context; it refers to the different tracks or layers of society that may be involved in conflict analysis and management. Such complementary conflict management approaches grew out of the realization that official diplomacy is limited, especially in “deep-rooted” and “protracted conflicts”<sup>7</sup> (Azar 1990). The Multi-Track approach aims to assist intergovernmental negotiations by compensating for the constraints of such official negotiations, e.g. the need to seem strong or the limitation of continually having to refer to the official governmental policy (Kelman 1999).

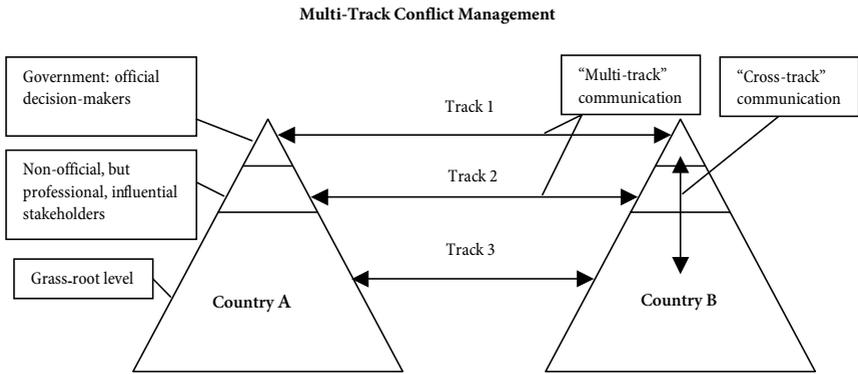
Some of the main principles of the non-antagonistic conflict management approaches are summed up below. While there is a wide agreement on most of the points, they are not accepted by all conflict researchers and activists. The relative importance given to the respective principles is debated.

Some aspects and principles of consensual conflict management:

- *Conflict resolution* calls for a non-adversarial framework, an analytical approach and a problem-solving orientation. The use of threats is condemned. The minimal requirement for conflict resolution is the recognition of the opponent’s right to exist (Wüstehube, Baechler 2002). The smaller the power asymmetry between the parties and the greater the will of the parties to cooperate, the better the chances are that negotiations will lead to success (Sandole, van der Merwe 1993).
- *Conflict transformation* seeks to *empower* the involved parties to express and fight for their interests, while at the same time supporting *recognition* of one another and the validity of the other parties’ interests. A conflict is transformed from a hostile to a cooperative mode through a change of perception and relationship between the involved parties (Bush, Folger 1994).
- *Multi-track conflict management* focuses on the synergies between conflict management by officials (track one), unofficial, yet expert, informal representatives of society (track two), and efforts on the grass-root level (track three) (diagram 2.5). Track two has been defined as “informal interaction between members of adversarial groups or nations which aim to develop strategies, influence public opinion, or organize human resources in ways that may

7 The term “protracted conflict” refers not only to the period of time in which the hostile interaction is lasting, but also to the involvement of basic needs such as national (or ethnic) identity, security and distributive justice. It is supposed that these values cannot be easily suppressed, but continue to be pursued in the long term by all means available (Azar 1990).

Diagram 2.5

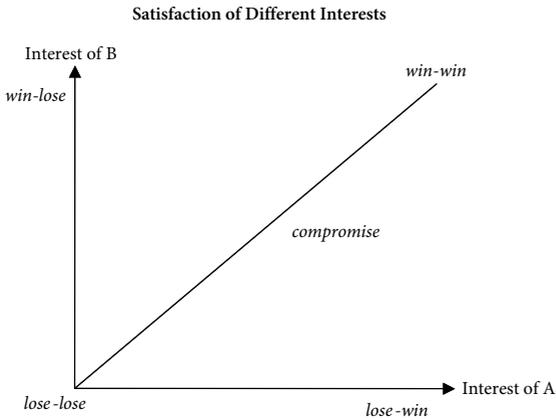


*“Multi-Track” = communication between different tracks of different countries, “Cross-Track” = communication between different tracks within one country. Track one (official), track two (non-official) and track three (grass-root) diplomacy or conflict management are complementary.*

help resolve the conflict” (Montville, in McDonald, Bendahmane 1987: 7). The advantages of each track are used in order to develop and implement solutions accepted by all levels of society. Unofficial experts, who meet each other in informal settings, are often more flexible about developing and brainstorming management options, as they do not need to defend fixed official policies (Fisher 1997).

- *Interactive conflict management* is based on the experience that creative energy is set free when people interact with each other in a cooperative way: the brainstorming phenomenon. Furthermore, conflicting parties should participate directly in jointly shaping a solution as they know the situation best and will more easily stick to agreements they were active in formulating (Fisher 1997).
- *Positions do not equal interests*: Positions are what people say they want, they are fixed formulations of an underlying interest and are often mutually incompatible between the conflicting parties (e.g. position of A and B: “the pond is mine”). Shedding light on the underlying interests (why people want what they say they want), however, can open a way forward to finding mutually compatible management options (e.g. interest of A: “I want to use the pond for my thirsty cattle”; interest of B: “I want to use the pond for fishing”). Needs underlie interests and are even more compatible. According to the Human Needs Analysis approach, a conflict cannot be resolved in the long run without satisfying basic human needs (e.g. food, security, shelter, relationships etc.). (Burton, Dukes 1990; Fisher, Ury, Patton 1991).
- *Power, rules and negotiations*: All human relationships are characterized by the respective power of the parties, the rules governing their interaction, and

Diagram 2.6

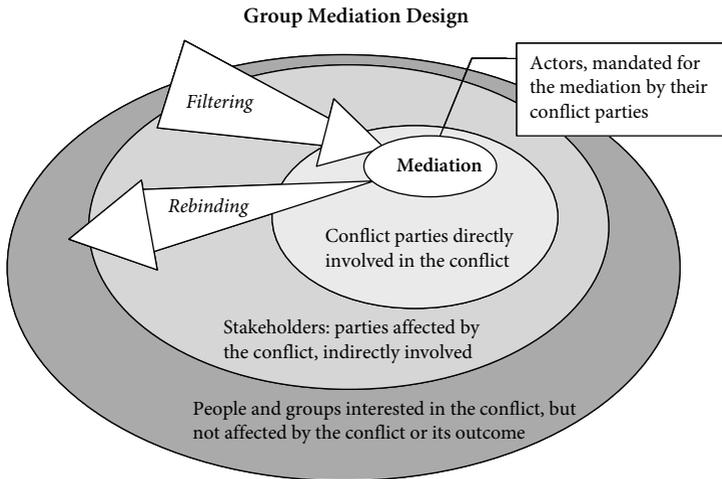


The further along the x-axis a solution is found, the more the interests of actor A are satisfied. The same applies for actor B along the y-axis. A win-win solution is graphically represented by a dot on the top right of the diagram: all of A's and all of B's interests are satisfied (adapted from Miall, Ramsbotham, Woodhouse 1999)

negotiations between the parties. Negotiations must take the power and legal frameworks of the parties into consideration (Fisher, Ury, Patton 1991).

- “Win-win” solutions are mutually acceptable solutions whereby the interests of both actors A and B are fully satisfied (diagram 2.6). Legal solutions to a conflict often result in win-lose solutions. Lose-lose situations are often the result of highly escalated conflicts, where mutual destruction is preferred to giving in to the other party (Fisher, Ury, Patton 1991).
- *The AAA (Arena, Actors, Aspects) model* structures the analysis of a conflict into Arena, the system boundaries of the conflict (e.g. a river basin), Actors (e.g. government and non-government) and Aspects; the term “issues” is also often used. For the actor analysis, typical descriptions include their level of power (= potential to influence the process and other actors), their positions, interests, needs and perceptions (Baechler 1999).
- *Facilitation by a trained third party* is needed when a conflict has escalated above a minimum level. The third party acts as a repository of trust and facilitates cooperative interaction between the parties. A third party's type of intervention depends on the level of escalation, starting with prevention and moderation, continuing with facilitation and mediation, and ending with peace enforcement and peace-keeping in highly escalated conflicts. Conflicts are more easily managed the less escalated and protracted they are. Mediative conflict management approaches require a certain degree of power asymmetry (Glasl, 2002).

Diagram 2.7



*Mediation with groups starts with the design (not in the diagram), filters actors and issues into a manageable number for the mediation and then rebinds the actors that took part in the mediation into their socio-political context (Inmedio 2003, Kerntke 2004).*

- *The design of a conflict management process* requires taking the context of the conflict into account. Mediation between conflict parties that represent groups involves steps to ensure that groups mandate actors from their group to represent them during the mediation, and that these people are reintegrated into their groups after the mediation. Four steps are involved: 1) Design the conflict management architecture (who are the actors, in what forums do they meet, what is the timeframe?). This preparation has been called “pre-mediation”. 2) Filter the many involved actors and issues until one arrives at a manageable number, this can happen for example with forums open to everyone. 3) Guide the actual negotiation or mediation process. 4) Support the transfer of the settlement and rebinding of the actors involved in the mediation back to their greater socio-political context (Inmedio 2003, diagram 2.7).
- *Peaceful alternatives:* Most peaceful conflict management approaches require the good will of both parties. Peaceful non-cooperation, however, may work independently of the opponent’s good will. When power asymmetry between conflict parties is great, rules are non-existent or unjust, and the opponent is not open for negotiations, some people have successfully used peaceful non-cooperation, such as Mohandas Karamchand Gandhi: “I non co-operate in order that I may be able to co-operate. (...) It harms no one, it is non-co-operation with evil, with an evil system and not with the evil-doer” (Iyer 1986: 47). The key is to differentiate between the person and the problem: to non-cooperate

with destructive behavior, while seeking to win the person behind this behavior for one's cause.

- *Fight or flight reaction:* Humans react to stress and adversity with a fight or flight behavior. People's perception of reality is narrower in a conflict situation than under normal conditions, the adversary is often viewed in stereotypical ways. Conflict management aiming to increase the width of perceptions and management options therefore seeks to help the conflict parties to relax and to shift their constricted way of perceiving the 'other' (Spillmann 2002, Glasl 2002).
- *The subjective perception* of a conflict of the involved parties is also a "reality" that influences a conflict, and not just the "objective" issues (Glasl 2002, Jervis 1976).

The last three principles will be explored in more depth as they are a key element of psychological conflict theories. This distinguishes them from other social science theories, which are often based on assumptions of "rational" human behavior. In order to survive, fight or flight reaction patterns developed in the process of evolution. Another form of behavior, more recent in evolution, is the capacity to cooperate within the "in-group" in the face of adversity – a characteristic of many animals living in social groups. Cooperative behavior is therefore not just culturally learnt, but part of humanity's survival repertoire, developed in the process of evolution. Sigmund Freud (1915) expressed this in his statement: "Hate, as a relation to objects, is older than love", i.e. aggression as a basic form of behavior goes back very far in evolution, while "cooperation" based on individual relationships between animals that interact socially in a group is a more recent phenomenon in evolution (Spillmann 2002).

Conflicts demonstrate the emotional, and at times irrational elements in human behavior, both of a negative kind in the form of destructive, antagonistic behavior, as well as in the positive form of creative cooperation in the face of great odds (e.g. Nelson Mandela who came out of prison seeking reconciliation rather than revenge). Kurt R. Spillmann and Kati Spillmann (1997) describe the psychological dynamics in a stress situation as follows: "We can, however, predict that under stress, fear, and threatening conditions, older drive and reflex reactions will be the stronger reactions and will predominate over more recently evolved, culturally shaped behaviors such as reason, analysis, and insight. Our rational abilities do not then become turned off, but they are placed at the service of the more primitive and undifferentiated perceptual and behavioral patterns, a situation comparable to the rider who has lost control over his horse and must simply go where his horse leads him. On the outside, however, this is not always apparent; in other words, even an extremely emotional or biased reaction to a supposed opponent can be presented very intelligently."

In the evolutionary past of the human species, when people were faced by danger, they survived by reacting within split seconds in a fight or flight modus. The speed of reaction necessitated the reduction of many other capacities, such as the power to think

or feel in a differentiated way. This pattern of behavior still remains with us, even if it no longer serves us well. When we are involved in a conflict, many of our normal capacities of differentiation are reduced, we start seeing life in black and white rather than in various shades of color. One of the tasks of conflict management, therefore, is to help people to relax. By decreasing stress and the fight or flight behavior, our capacity to perceive our opponent and the situation in a differentiated way returns; this is a key component to successful conflict transformation. Based on the assumption of the importance of the psyche, one of the greatest challenges of conflict management does not only concern the economic regulation or mathematical allocation of scarce resources, but the form of communication between the parties. Conflict management should therefore aim at: "maintaining human relationship...through conflicts" (Spillmann, Spillmann 1997).

The focus on human relationships can also be used by one conflict party (party A), aiming at winning the opponent (party B) over. Three requirements are needed: 1) good will of party A towards one's opponent, party B. Non-violence is not effective if it is used to cover fear and impotence: "Violence is any day preferable to impotence" (Ghandi in Merton 1964: 37); 2) Scrupulous obedience to society's laws by party A; only then, and in well defined circumstances, is party A in a position to judge which rules are unjust (Ghandi in Iyer 1986: 216); and 3) The opponent, party B, has to have a minimal acceptance of party A's right to existence, if peaceful-non-cooperation is to work (Wüstehube, Baechler 2002). It has been argued that the impact of non-cooperation is limited in a totalitarian system. In non-totalitarian societies, peaceful non-cooperation can be a powerful tool leading to negotiations, as the aim of this form of resistance is not to defeat the opponent, but to win him/her over.

The importance given to relationships and perceptions follows the phenomenological approach. Reality is constructed by peoples' perceptions of reality. "In a phenomenological study, the researcher tries to see reality through an informant's eyes." (Bernard 1994: 15). Perception is used here to mean insight, intuition, or knowledge gained by taking in "seizing" stimuli from the physical and non-physical (abstract, symbolic) world (Hillig 1996). The importance of studying perceptions was pointed out by Robert Jervis (1976): actors' perceptions of circumstances and other actors crucially shape their choices about how to compete or cooperate. Jervis did not ignore the influence of external circumstances, rather he saw the impact of the external reality as being mediated by an actor's perception or misperception of it (Snyder 1999).

### *2.2.3 Characteristics of Environmental Conflict Management*

Environmental conflict management is still young and is often characterized by the application of general conflict management principles to an environmental conflict. Yet there are some important differences. One of the main differences is the importance of including both the "soft elements" of human behavior and interaction, and the "hard facts" of the physical environment. Environmental conflicts take place in an overlap of human and environmental systems, while general conflicts take place only in the human

“system”. This idea has been developed in the Human Environment Interaction Triangle (HEIT) model in section 2.4. The challenges of a cooperative approach in the triangle between an environmental system and at least two human systems are:

- *Time dimension:* A long-term time perspective is necessary to be able to deal with issues of sustainability. Trees take one hundred years to grow; politicians are elected for four years. The time scale of elected politicians or groups of people fighting to survive does not correspond to the long-term time scale of sustainability.
- *Space dimensions:* State boundaries do not normally correspond to the boundaries of the environmental system. Management is only effective if the environmental system's boundaries are taken into account, as negative side effects of economic and social activity effect the whole environmental system and are not limited by political boundaries.
- *Inclusion of “hard” and “soft” elements:* It is difficult to create a joint problem definition, since scientific data and their interpretation are uncertain. One should not separate fact-finding and technical analysis from the main negotiation efforts. Neither should the “soft elements” of the conflict, e.g. the perceptions and the relationship between the parties, be ignored, as the best technical solutions can only be implemented if people accept and support them. “Hard” factors (e.g. water quality and quantity) are needed to assess the various potential human uses and adaptive capacity of the environmental system.
- *Stakeholder involvement:* A multiplicity of parties and delegations are represented in the negotiations. As many legitimate representatives as possible should be involved.
- *Multiple issues:* Issues are not limited to environmental problems, but encompass economic, social, cultural and political questions.
- *Institutionalization:* Solutions developed in a process of negotiation need to be institutionalized.

(Baechler et al. 1996a; Mason, Spillmann 2003)

Multi-Track conflict management is relatively new and untried in the field of international river conflicts (see Wolf 2000, and Delli Priscoli 1992). Although its applicability can, to a certain extent, be addressed by rational argument based on theoretical considerations, the method needs to be made more operational in order to be able to base conclusions on. “Without a much larger body of systematic, empirical evidence, it is simply not possible to know how influential and useful the (interactive conflict resolution) method is.” (Fisher 1997, brackets added). Further research and theorizing are thus required to develop and validate these kinds of complementary conflict management methods.

Specific to conflict management over water resources, the differentiation between supply-side and demand-side management of water resources seems to have an influence on conflicts. In general, as scarcity increases, a country begins with supply-side management, increasing the primary available amount of water (Ohlsson 1999). Dams

reduce the water lost to the sea, swamp canalization reduces the water lost through evaporation, and diversion of rivers outside of their natural river basin can augment the water in a specific area. Supply-side management is characterized by large-scale technical projects with a great environmental impact. As a second step, demand-side management becomes more important (Ohlsson 1999). Demand-side management has been defined as “Implementation of policies or measures which serve to control or influence the demand” (EEA 2001). This kind of management is characterized by human beings adapting their technology and consumption habits to the environment, rather than adapting the environment to their consumption needs. In this sense, demand-side management follows the argumentation of the HEIT model, namely that the environment has a limited adaptive capacity (diagram 2.8). Besides efficient technology, the institutional, legal and economic framework becomes increasingly important in demand-side management.

Demand-side management can be divided into efficiency gains within each sector and efficiency gains achieved by reallocating water from one sector to another (SEI 1997: 24). In the agricultural sector, the technology of drip irrigation uses water more efficiently than flood irrigation, an example of intra-sector efficiency increase. As water becomes more scarce, it may be reallocated between sectors according to its highest economic value, an example of inter-sector efficiency increase. Food is imported, for example, allowing for less water to be used in the agricultural sector. This saved water can then be used in the industrial sector where it has a higher economic return value. Yet a further demand-side management strategy aiming at increasing the availability of water would be a change in consumption habits. On a 100% vegetarian diet, for example, the earth's water resources could feed three times more people than on a diet where 20% of the calories are supplied by meat (Zehnder 1997). Consumption-oriented demand-side management addresses the affluent 20% of the world population that has a large adaptive potential.

A model developed by Ohlsson (1999) argues that international conflicts over water resources are to be expected mainly on the supply side. Dams that are built to increase national water resources potentially take these away from the downstream country. Demand-side management on the other hand decreases tensions between countries, according to Ohlsson, as this management strategy focuses on the water users within the country. This is why conflicts in relation to demand-side management are more likely to be found on the intra-national level. According to Ohlsson, as water becomes more scarce, countries are forced into demand-side management, and a shift from international water conflicts to intra-national water conflicts is to be expected. The model does not answer what happens in a water conflict if demands are not met, neither by supply- nor by demand-side management.

### 2.2.4 *Eight Principles Used In The Study*

Eight principles from the above section on conflict management and environmental conflict management will be used explicitly:

1. The Multi-Track approach will be used to make use of different stakeholders' input and multiplier capacity, and to increase the applicability of the research findings. This will influence the choice of interview partners and workshop participants.
2. The interactive approach is the basis for the interactive dialogue workshop planned at the end of our study.
3. The systems approach to conflict management focuses on influence factors rather than one-way causal relationships. The systems approach is a guiding principle in our study. Questions in the interviews, for example, will be developed in an iterative way during the interviews.
4. The distinction between positions, interests and needs will be used as an analytical tool in the conflict assessment.
5. The principle of peaceful non-cooperation seeks to examine what peaceful options a riparian country has if the other riparian country is not willing to cooperate.
6. The participatory approach, focusing on stakeholders' perceptions, will be implemented by interviewing people in Egypt, Sudan and Ethiopia.
7. The importance given to collecting hard facts as well as soft factors influences what and how information is gathered, e.g. on the availability of renewable resources.
8. Our study will look at the impact of supply-side and demand-side water management on conflict and cooperation, seeking to verify Ohlsson's model.

These eight principles, or "theories"<sup>8</sup>, underlying the following study are summarized below in table 2.1, in order to lay open the assumptions of the proposed study, the "motivation" and the reason why we went about this study the way we did.

8 Theories consist of good ideas about how things work, they include assumptions, beliefs and axioms. They give an idea about how two variables influence each other, if A then B. This relationship can be tested to a varying degree. The better the predictive value, the better the theory. Theories help to decrease work, as the theory focuses the research on the essential (Bernard 1994: 50).

Table 2.1: "Theories" used in this study

Source	Assumption	"Theory"
Multi-Track conflict management (Diamond, McDonald 1991, Burton 1990, Kelman 1993)	Non-official actors need to be included in conflict resolution.	If you include non-official actors in a conflict resolution process, a wider range of management options can be developed and there is a greater chance that options will be accepted.
Interactive conflict resolution (Fisher 1997, Kelman 1993)	When people interact, perceptions change, ideas are created.	If people interact in a safe environment, their perceptions of each other change. Options developed are more creative and applicable.
Systems theory (Jervis 1997)	Real-world systems are influenced by the interaction between factors, not by mono-causalities.	If actors are not aware of feedback mechanisms and the interaction of factors, then the system is more likely to lose equilibrium through their actions. If you change one factor in a system, other factors will also be influenced.
Harvard's Program on Negotiation (Fisher et al. 1991)	Interests are more important than positions. All human interactions are characterized by power, rules and negotiations.	If you focus on positions, you end up with win-lose situations; if you focus on interests, you end up with win-win situations. If a relationship is characterized by the right "mix" of power, rules and negotiations, conflicts can be avoided.
Peaceful non-cooperation (Ghandi in Iyer 1986: 47)	Fight the problem, not the person. An opponent can be "won over" to one's cause.	If you have good will towards your opponent, respect law, and your opponent accepts your right of existence, peaceful non-cooperation can be an alternative to negotiation, or bring an unwilling opponent to the negotiation table.
Psychological conflict theories (Glasl 2002, Jervis 1976, Spillmann 1997, Fisher 1997)	Subjective reality influences objective reality.	If you only analyze a conflict from an "objective" point of view, you will not understand the conflict perpetuation. If you take a participatory approach and include perceptions you are more likely to find applicable management options.
Environmental conflict management (Baechler 1996, Mason, Spillmann 2003)	Both hard and soft factors are important.	If soft factors (perceptions) and hard factors (adaptive capacity of an environmental system) are taken into consideration in an environmental conflict, you are more likely to find applicable management options.
Water conflict management (Ohlsson 1999)	Supply- and demand-side management of water resources influences conflicts.	When water scarcity increases, countries move from supply-side management to demand-side management, this corresponds with a shift from international to intra-national water conflicts.

### 5.5.5 *Description of the HEIT model*

The Human Environment Interaction Triangle (HEIT) model is used to schematically describe the conflict management and environmental conflict management theories presented above in an integrated fashion. The idea is to use it for the further study of the characteristics of a human-environment system such as the Nile Basin.

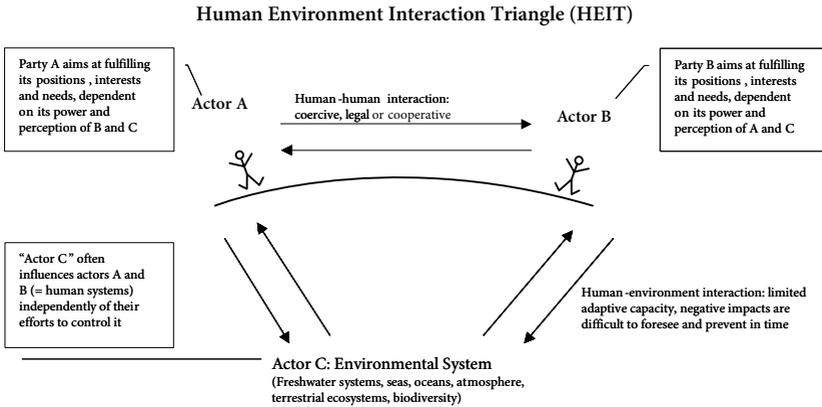
It takes a minimum of two parties to create a social conflict. An environmental conflict, however, always has three “actors”. The environment being the – often not represented – third actor. In the HEIT model this is shown by a triangle between the human actors (or actor groups) in conflict and the environmental system involved in their conflict (see diagram 2.8). Modeling the human system separately from the environmental system is a consequence of the influence of the Judeo-Christian-Islamic cultural way of viewing God as creator, and human beings as caretakers of nature. There are other ways of viewing nature, dependent on one’s cultural and religious background. According to Mark Patrick Hederman (2002), the gift of the Judeo-Christian tradition was to cut the umbilical cord between nature and human beings. Once God was seen as being outside of nature, humans no longer had to live in fear of the spirit in the tree who would punish them if they cut the tree. Hederman does not try to excuse the negative impacts this has had on the planet, but he points out its basic potential: freeing the human being from fear to changing his/her environment.

The HEIT model does not depart from an anthropocentric attitude to the environment; the leading question is still about human survival and well-being. The way the environment effects society is understood as a physical consequence and not as an “act” motivated by some invisible will of nature, i.e. “nature striking back”. Yet the environmental system can effect society or respond to the actions of the human actors independent of their efforts at controlling it. When I kick a football I can predict what will happen, whereas when I kick a dog, the reaction is harder to predict. The independence and low predictability of the environmental system allows it to be modeled as a “third actor” involved in environmental conflicts. The word “actant” is another word used to refer to human and non-human beings that “act”, e.g. in the Actor-Network-Theory (Latour 1997). The time, space and physical dimensions in which human beings effect the environment are often different to those in which society is affected by the environment. Thus rivers are managed within political rather than within watershed boundaries, politicians are in office for a few years, while forests and soils take hundreds or thousands of years to regenerate, and the capitalist paradigm aims at a continuous growth on a physically finite planet. In this sense, the HEIT model is in line with strong ecological sustainability, i.e. renewable resources have to be left for future generations. They cannot be fully substituted by economic assets (Minsch, Eberle, Meier, Scheidewind 1996).

Human-environment interaction can be characterized by two extremes: on the one hand humans adapting nature and the environment to their needs (e.g. using resources to build and heat a house), on the other hand human beings adapting themselves, their

lifestyle, to the limited adaptive capacity<sup>9</sup> of the environment (e.g. reducing resource use and pollution by wearing warm clothes in winter) (Mason 1999). In the HEIT model we assume that a balance between these two extremes is needed, taking the adaptive capacity of each system into account.

Diagram 2.8



*Environmental conflicts always involve at least three subsystems or “actors” (two human systems and one environmental system). Societies are vulnerable to environmental conflicts if and when the adaptive capacity of at least one of the three systems is inadequate. Actors A or B represent an individual actor or an actor group, e.g. a country.*

Actors A and B symbolize actor groups, for example, two countries sharing an international river basin. A and B attempt to manage the conflict over the use of the environment directly in the human system (top part of diagram) through coercive means, in legal and institutional frameworks or in cooperative negotiations. Their interaction is influenced by their positions, interests and needs, as well as by the economic, political, geographical and military power at their disposal and their perceptions of each other and the environment. Actors A and B are also linked indirectly through the environmental system the conflict is about. Actor A may consume more water, for example, leaving less for B. Due to the complexity of the human-environment interaction, it may be easier to share the costs and benefits of a specific resource *use*, rather than the resource itself. The time when water is used, or the costs and benefits of a hydroelectric power plant, for example, are easier to share than the amount of water in the river (Wolf 2000). Actor C can “act” towards the human system (actors A and B), for example, in the form of the negative impacts of floods and droughts or the impact of changes in the ozone layer.

8 With the term “adaptive capacity” of a system, we refer to changes a system can make without the negative impacts of the system being too great or the system being irreversibly damaged. “Adaptive capacity” is a relative term that often requires normative judgements.

The impacts are difficult to foresee in detail, and without an immanent need, management practices are not changed to prevent negative effects in time. A good example is the climate debate. The effects may continue long after the cause affecting the human system has been controlled. The ozone layer will reach its original thickness only in the mid 21<sup>st</sup> century, although the chloro-flouro-hydrocarbons have already been fully banned in 1987 in Montreal.

Summing up different points discussed in the literature review above and integrating them in the HEIT Model, the following hypothesis can be formulated:

*HEIT Hypothesis:*

Environmental conflict management in the sense of sustainable cooperation is successful when it takes the eight principles (table 2.1) into due consideration.

*HEIT Propositions:*

Against the hypothesis above, one can formulate the following propositions: Environmental conflict management is successful when:

1. Both official and non-official actors are involved in the management process in a series of interactive events (dialogue accumulation);
2. A systemic approach is used, focusing on the links between human and environmental systems;
3. Due to the complexity of the system, the costs and benefits of resource use are shared equitably rather than the resources themselves;
4. Actors focus on interests and needs rather than on positions;
5. Negotiations and legal, institutional frameworks are used rather than coercive means;
6. There is a degree of symmetry in power between actors A and B. Power includes political, economic and environmental aspects (e.g. the upstream position is geographically more powerful than the downstream position), one form of power can compensate for another form of power;
7. Conflict parties are aware of their alternatives (e.g. peaceful non-cooperation) to negotiations and/or coercive means of satisfying their interests;
8. The actors' perceptions (subjective reality) of the conflict are taken into account;
9. The environmental systems (objective reality) are dealt with in a long term-time horizon, in adequate spatial units, and within the limits of their relative adaptive capacity;
10. Demand-side management has long term priority over supply-side management.

These propositions are compared to the real world situation in the Nile Basin, as it was presented in the Nile Dialogue Workshop and in the following study (chapter 8).

*HEIT Indicators:*

Due to the complexity of the HEIT model, it is not possible to take all the variables into account. We have to live with a certain imperfection in this study and will test the HEIT hypothesis with a number of indicators, or groups of indicators, only:

- The frequency of official and non-official interactive events between two or more riparian countries;
- The stated aim of integrated river management and/or a functionalist approach in the documents of an international river forum;
- The existence of a legal framework in an international river basin;
- The use of proportionate or fixed forms of sharing water resources in river agreements;
- The geographical (upstream/downstream position and actual renewable water resources), economic (GDP) and political (representation in international water fora) power of a riparian actor, relative to another riparian actor;
- The degree of fit between environmental and human systems when managing a river basin (e.g. are all riparian areas of a natural watershed included in the river commission?).

One of the aims of our work is to see how far the HEIT model is a useful tool for developing cooperation in the Eastern Nile Basin and how far the HEIT indicators can explain the success or failure of international river conflicts (chapter 9). The final synthesis of this study uses the HEIT model to develop a framework for cooperation in the Nile Basin (chapter 10).



## 3 Research Methodology

The following chapter presents the methods used in this thesis: 1) Conflict-sensitive, explorative expert-interviews and 2) Dialogue Workshops. The interviews were used to collect perceptions and factual information in the first phase of the research. The Dialogue Workshop was used during the last phase of the research, as an action research element. The methods were not used in their “pure” form, i.e. as presented in the literature. The following chapter examines how they have been developed to suit the requirements of our study.

### 3.1 Conflict-Sensitive Interviewing: Explorative Expert-Interviews

What method can be used to collect different perceptions of issues and actors in a conflict? The aim of such a method would be to gather facts as well as personal interpretations of these facts. We seek to answer this question here, based on the literature of qualitative social science research, conflict-sensitive research, and the experiences of the ECONILE project. Because it is based on the ECONILE project, the method is “emergent”, i.e. emerging out of the research, rather than only out of literature. Rather than focusing on hypothesis testing, the method can be used to develop grounded theory, a theory that accounts for the situation as it is, that is responsive to the research situation one is focusing on (Dick 2002). The section is structured according to the following three questions: 1) What are the characteristics of explorative interviews as described in the available literature on the topic? 2) How were explorative expert-interviews carried out and developed as a conflict-sensitive method in the ECONILE project? and 3) How “scientific” is the method?

#### 3.1.1 *Characteristics of explorative interviews*

There are estimates that 90% of all social science investigations use interviews in one way or another (Briggs 1986). According to Atteslander (1995: 135), “The important difference between an everyday conversation and a scientific interview is that the interview is not only systematic and carried out with an aim, but that the whole interview process is accompanied by a theoretical framework.” The varied application of interviews partly explains why the categorization and terminology of interview techniques – apart from the broad distinction between qualitative and quantitative – is difficult and inconsistent in literature.

Some possible criteria for differentiating qualitative interview techniques are the following:

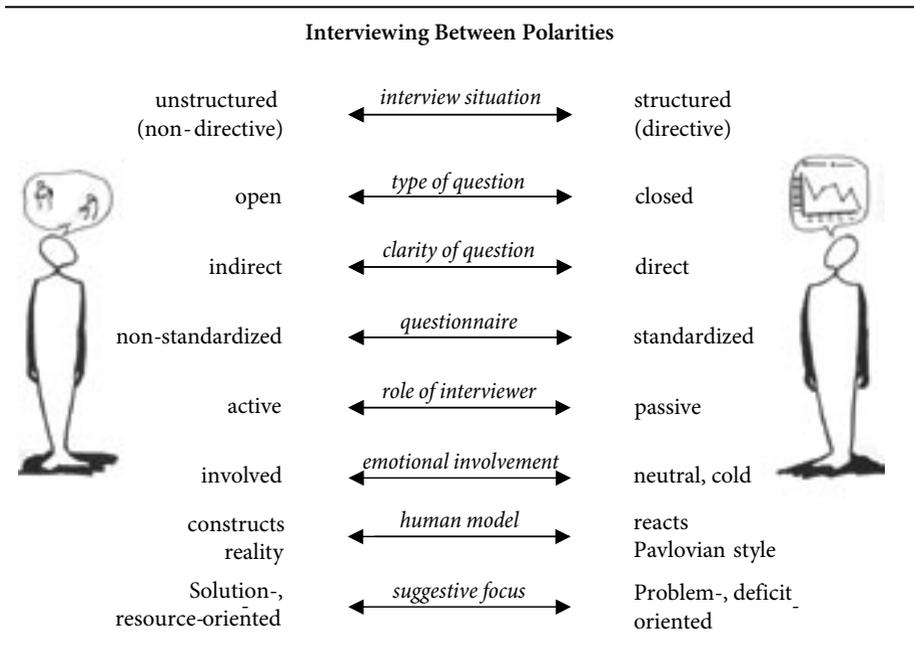
- What is the target group? Examples are: “clinical interviews” (Morrison 1995), “expert interviews” (Atteslander 1995: 171-173), and “key informant interviews” (USAID 1996).
- What is the size of the interview group? E.g.: “group interviews”, or “one to one interviews”, sometimes also called “depth interviews” when they are minimally structured (Walker 1985: 4).
- How is the interviewed person viewed? Examples are viewing the interviewed person as a:
  - vessel of answers / opinions: “survey interview” (Converse, Schuman 1974)
  - vessel of emotions: “creative interview” (Douglas 1985)
  - vessel of productive knowledge: “active interview” (Holstein, Gubrium 1997).
- What is the focus of the talk? Examples are:
  - “problem-oriented”; the focus of the interview is about a specific topic.
  - “solution-oriented”; the focus of the interview is about how to solve a problem or conflict, which may itself be unclear.
  - “narrative” (Atteslander 1995: 176) or “life-story”; e.g. the subject speaks freely about his/her life history (Taylor & Bogdan 1998: 87).
  - “focused”; the interviewed person receives a topic before the interview appointment, e.g. a film that then will be discussed in the interview.

All these interview techniques include aspects that can be situated along a continuum between different extremes (diagram 3.1). During the course of an interview different aspects can be applied. Thus an interview may start with open questions and move on to more closed questions at a later stage in order to find out specific details.

The interviews used in this study are *semi-structured*. Atteslander (1995) cautions against using the word non-directive or non-structured, as all conversations have some structure. Furthermore, the interviewed person can be confused if the aim of the interview is unclear. Nevertheless, since one often does not know where the main problem lies in a conflict, flexibility enables the exploration of new ground. The word *explorative* describes the interview technique used in this thesis. This refers to exploring new ground (the normal meaning of “explorative interviews”), as well as producing new ideas in the brainstorming part of the interview focusing on the solution of the conflict (similar to the “active interview” of Holstein, Gubrium 1997). Finally, the interviews are carried out with *experts*, in this sense they are similar to key informant interviews as defined by USAID (1996). This definition is closer than others to describing the interview technique used in our study (box 3.1).

Where on the continuum of the dimensions of diagram 3.1 do the tools used in conflict-sensitive explorative expert-interviews lie? *Open questions* are used as they are helpful in getting people to talk freely as opposed to closed questions that can be answered

Diagram 3.1



*Aspects of interviews can be positioned between different polarities. Pictures: Kalkur Mamta, Sampark 2001.*

**Box 3.1: Definition of “key informant interviews”**

“Key informant interviews are qualitative, in-depth interviews of 15 to 35 people selected for their first-hand knowledge about a topic of interest. The interviews are loosely structured, relying on a list of issues to be discussed. Key informant interviews resemble a conversation among acquaintances, allowing a free flow of ideas and information. Interviewers frame questions spontaneously, probe for information and take notes, which are elaborated on later” (USAID 1996).

with a “yes” or “no”. Open questions typically begin with a “w” word: what, why, who or wherefore. An example is: “What are the most pressing environmental issues in this country?” Closed questions often begin with a verb: “Does the solution to the problem lie in more communication?” Choice questions can be used to test hypotheses; they are more directive and suggestive than open questions, but they still leave more space for answering than closed questions.

*Indirect questions* are a useful tool in a sensitive situation since they avoid addressing the issue bluntly. Indirect questions are more normal in cultures that give a high value to being polite and not confronting people directly (“high-context” cultures, see Cohen 2001), as is the case in many non-Western cultures. There is, however, the danger of lack of clarity with indirect questions.

Conflict management, rather than just conflict analysis, is one important focus of explorative expert-interviews as a conflict-sensitive interview technique. An important tool in this context is the use of *resource questions* that seek to mobilize and bring to light resources that can be used to get closer to a solution. Instead of asking deficit-oriented questions: “Why is there little cooperation?” or “What is the cause of the conflict?” thus making the person interviewed focus on negative aspects, one could ask: “Why is there not less cooperation?” or “What is happening to strengthen cooperation?” Resource questions can often be combined with a circular way of asking them, for example: “Assuming that the conflict has been solved, from what behavior would your former competitor (or the politicians in your country) realize that things have changed?” This jolts the person being interviewed into a different mind-set and may bring up new ideas or ways of seeing things (Fackler, Flucher 2002). Many people are concerned about asking questions that are too suggestive. Yet it is important to realize that all questions are suggestive to a certain degree as they suggest to the person what they should be thinking about. Rather than trying to avoid suggestive questions at all costs, one should rather be conscious of the direction one is heading the interview in. As Bernard (1994: 218) points out: “Any question an interviewer asks leads an informant. You might as well learn to do it well”. An interview that focuses on conflict management, therefore, can use resource questions, i.e. solution-oriented questions that point to resources or efforts in the direction of cooperation.

Paraphrasing what the person has said is a useful way to check back if we have correctly understood the intended message, it also gives the person one is talking to the assurance that one is being attentive (Rosenberg 1999). Furthermore, it is perhaps one of the best ways to interrupt someone. By repeating in a condensed form what one has heard, the person we have interrupted may well realize his or her message has arrived, and they do not need to talk further on that issue.

There are also other ways of getting information other than by asking questions. Bernard (1994: 214) describes the art of probing for information: to stimulate the interviewed person to produce more information without injecting oneself too much into the process. A direct question is often not the best way. He suggests remaining silent (silent probe), summarizing what has been said (echo probe), grunting “uh-huh” or “yes” now and again (uh-huh probe), or asking a long question, as long questions tend to produce long answers (long question probe).

Depending on which phase the interview is in, the role of the interviewer moves from being *active* in the relationship-building phase to more *passive* (if the interviewed person talks freely) in the information-gathering phase to again being active in the final exchange and wrap-up phase. Throughout the interview, the interviewer is active due

to the lack of predetermined structure. The interviewer has to think of questions as the talk proceeds and fit his or her main questions into the context of the talk. "The role (of the interviewer) entails not merely obtaining answers but learning what questions to ask and how to ask them." (Taylor and Bogdan 1998: 88. brackets added). It is helpful to carefully plan the beginning and end of an interview, as these are somewhat artificial or delicate phases, while the middle of an interview is taken care of by the dynamism of the talk (Fackler, Flucher 2002).

The interviewer must find a natural degree of *emotional involvement*. In all cases, emotional engagement in the sense of a keen interest is an absolute must. Especially in delicate situations, people need to feel that what they are saying is being affirmed by the interviewer. The relationship should always have priority over the neutrality that is demanded by positivist-oriented interviews. Atteslander (1995: 166) points out that neutrality can provoke uncertainty or mistrust on the side of the interviewed person which then "contaminates" the gained information exactly in a way the neutral interviewer tries to avoid. Objectivity in this context has to be given a different meaning: "We start with the experiencing person and try to share his or her subjective view. Our task is objective in the sense that we try to describe it with depth and detail. In doing so, we try to represent the person's view fairly and to portray it as consistent with his or her meanings" (Charmaz 1995: 54 in Silverman 1997: 100).

Finally, since the perception of the situation is of greatest importance in the context of a conflict (Gasl 1990), the *human model* behind these kinds of interviews is a "Stimulus-Person-Reaction" rather than a Pavlovian "Stimulus-Reaction" model (Atteslander 1995).

### *Finding people to interview, stages of field work*

How does one go about finding people to interview and how many does one need for a representative study? "The size of the sample in an interviewing study is something that should be determined toward the end of the research and not at the beginning. In general, however, you will find that there is an inverse relationship between the number of informants and the depth to which you interview each." (Taylor, Bogdan 1998: 93). People to be interviewed can often be found through snowballing, getting to know some people and asking them to introduce you to others. Taylor and Bogdan (1998: 93) point out that this may minimize the diversity of the people you contact. If you start with at least someone from each main sector of your target population this is not such a danger, e.g. an individual from administration, one from an NGO, one from an international organization and one from a university.

Bernard (1994: 159–164) describes different stages of fieldwork:

- 1) The *initial contact* is experienced by many in an euphoric way. In some cases, however, the culture shock and the feeling of not being welcomed and wanting to go home as soon as possible can come very fast.
- 2) Even amongst those who had an easy and good start, nearly all anthropologists report some sort of feeling of *depression and shock* very soon, one or two weeks

after the initial contact. “A person outside his or her culture is like a fish outside of water”. Bernard advises task-oriented work. Knowing that such feelings are normal is already a help. Sensitivity for other cultures is possible if one is critical of one’s own culture, as that is a precondition for not seeing one’s own culture as the only way to do things in the “right” way.

- 3) *Discovering the obvious* happens when the research gets going. One often starts working non-stop, seeking out each informant. The feeling of discovery is elating, one may become over-preoccupied with protecting the “vital” information one has discovered.
- 4) The *mid-field work break* is necessary to regain focus and it is also often helpful for the people you are working with; they also need a break from you.
- 5) Adapting the original research design to the experiences you have gained so far helps you to *focus* in this stage of data gathering.
- 6) In long field-work (one year) a second break is advisable. Whatever the length of the stay, the field-work normally ends in frantic activity when you realize that there are still non-obvious things to discover.
- 7) *Leaving the field* should be done when the research is no longer exciting, i.e. you are no longer discovering something new. It is important to leave the field in an appropriate way, taking time for good-byes, expressing appreciation for any help you got. Often relationships last years after the field-work, as people you have come in contact with have become your friends.

(Bernard 1994)

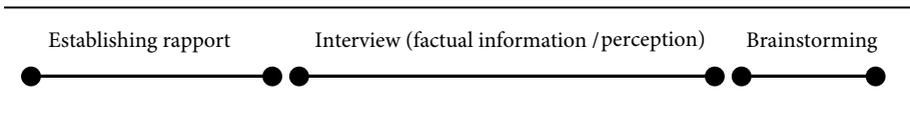
### 3.1.2 *Conflict-Sensitive Interviewing: Experiences From the Field*

The following section describes the method of *explorative expert-interviews* as a *conflict-sensitive research method* as it was developed and carried out in the field (or city to be precise). Conflict-sensitive research aims to be sensitive to both sides of the conflict, to the social relevance of the research, and to the impact of the study on those studied as well as on the researchers themselves (Smyth, Robinson 2001: 209). While there is a lot of research being done on conflicts, there is very little literature on conflict-sensitive research methods. In the available literature on such research methods, two things seem clear: first, that the accountability of researchers to their donors as well as to the populations they work with has to be improved, and second, that there is little neutral space in a conflict situation, and that it is therefore important to work with researchers on the other side (Smyth, Robinson 2001). The second issue was taken into consideration in the design of this study by having two Ph.D.s, each focusing on a different side of the conflict. The first issue is dealt with in this section. Method reflectivity is included to increase transparency and accountability and thus contribute to the emerging field of conflict-sensitive research methods. It is in this light of method reflectivity that the following section should be read.

In Egypt I had four contacts before I went, and “snowballing” from there, I ended up with 30 interviews. While it was hard to get going at the beginning, at the end there was not enough time to interview all the people I had contacts for. The habitual way for making appointments is different in Egypt, Sudan and Ethiopia than it is in Switzerland. It is difficult to make appointments far (e.g. a week) in advance. Yet the advantage was that people were very flexible in the moment, and appointments could often be made a day after making the first phone contact. If the first contact by telephone was not successful, for example, because the number was wrong or the phone line was down, the best alternative proved to be to physically go to the office of the person or institution. I was affiliated to a research institute in every country (University of Alexandria, University of Khartoum, and University of Addis Ababa). This was vital for opening doors, especially when seeking interviews with technocrats and government representatives. When asking questions on a delicate subject, people want to know where you are coming from and why you are asking. It was therefore very helpful to have an academic affiliation in the country. It was also extremely supportive to have a supervisor in the country I was doing research in; he helped in making the first contacts and in pointing out where I was culturally blind.

I had three aims in the interviews: 1) to gather factual information, 2) to understand perceptions and 3) to explore and brainstorm management options. The interview process was influenced by these aims, as well as by the cultural context. Roughly there were three phases: 1) establishing a good working relationship, 2) the actual interview phase, gathering factual information and perceptions, and 3) the wrap-up phase with a more natural exchange between two people (see also Spillmann 2001 in the interview below and diagram 3.2). If a brainstorming atmosphere came up, it was likely that this happened in the last phase.

*Diagram 3.2*



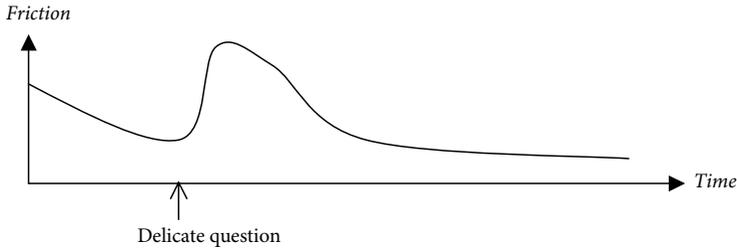
*Phases of an explorative expert interview.*

The cultural context meant that the interview did not start with an “ice breaker” question and sometimes not even with stating one’s aims, but by drinking tea and talking about the tourist sites of the country or a similar subject. Talking about the beauties of the country sets a good atmosphere. In giving weight to positive aspects one is not just being polite, but is more importantly in line with solution-oriented conflict management, i.e. by focusing on positive aspects a more creative atmosphere is developed than by focusing on what is going wrong. Establishing a good relationship requires building trust. Armarkolas (in Symth, Robinson 2001) has referred to the way a researcher tries to understand and influence the impression the researcher gives to the people in the field

as “impression management”. One’s impression will only hold over time if it is genuine and authentic, however. The next step after the informal introduction phase was to speak about the purpose of the interview (Ph.D. research, which subject, what aim) and if it was not obvious, I would also tell my vis-à-vis that nothing he or she said would be quoted without checking back if they agreed. Transparency of motives (as well as humor, in relation to issues that are not sensitive) helped me build rapport.

After having established a good working relationship, gathering factual information, perceptions and interpretations of facts was the next step. Starting with factual questions proved to be helpful, as they were not so sensitive. I developed the questions as the interview developed, adapting them to the answers that were given. Later on the talk often shifted naturally to questions that were of a more political nature, where perceptions are involved. At this stage I often declared my interest in the opinion of the vis-à-vis and not just in “objective” facts. Finally, when the interview closed, some talks developed into an exchange of ideas. This appeared to be a kind of brainstorming phase, where new ideas or ways of seeing things were explored. If I was asked, I always shared my perceptions of the situation truthfully, in a non-offensive way. The point of this brainstorming phase was not to test any ideas, gather perceptions or factual information (as this would be influenced by my input), but rather to generate hypotheses. The last phase also served to wrap up the interview and move back into a normal form of communicating with each other. In many cases I went back for a second interview with the same person, which was often more informative than the first.

After a few mishaps I became sensitive to delicate key words in the subject area and either began to use them consciously to trigger information, or avoided them as they could complicate matters. If tension did come up between myself and the other person, the best strategy was to back down. I am the guest, the person who is being interviewed is the host. The code of conduct should follow from this. Tension only came up in maybe 2 of the 70 interviews. In one case the tension eased when I explained more about the purpose and background of the study. This required first intuitively finding out what the antipathy stemmed from and then checking back to see if I had guessed correctly. It turned out that I had not been clear enough about my purposes at the beginning of the interview. The other strategy for easing tensions was to pass on the responsibility to my supervisors, i.e. to tell the person that this study and set-up were the idea of my supervisors and that I was just the Ph.D. candidate carrying out the field-work. My supervisors were interested in learning about cooperation over water resources, and the Nile seemed to them to be a good example to do this. In one case a technocrat told me politely he could only talk to me with an official letter of introduction from a high political level. After the interview it can be helpful to draw a tension graph (x axis = time, y axis = tension or friction) for oneself and try to pin-point what set the friction off, see diagram 3.3.

*Diagram 3.3**Friction graph, visualizing tension development during an interview.*

People in a politically sensitive situation often have enough trouble without an interviewer causing more problems. I therefore tried to leave the person I had interviewed in a good atmosphere, in so far as I could influence this. Sometimes I offered to send a book on this or that subject as a sign of appreciation for the time they took. As Spillmann (2001, interview below) points out, however, one should not be too modest and avoid difficult issues in one's questions; the style is more important than the content. Often circular questions are useful: "Some people say ... what do you think about that?" or "I often hear the opinion that ... how do you see this?". The bottom-up approach, including a certain amount of "naiveté", proved to be helpful and honest, as I was there to gain from the experience and knowledge of the person who I was talking to. People are usually very willing to share their knowledge when one is honest about one's purposes. A useful guiding principle is to tell oneself that one has something to learn from each person one meets. It is good to make it a habit to never use the words "but" and "no", confrontational words that often make people feel they are not being heard or taken seriously. Saying "yes" and "and" does not mean that one agrees with everything, but that one has heard what the other is saying (Rosenberg 1999).

Concerning recording the interviews: the advice given to me by my supervisors was not to tape the interviews, but to take notes in order to take the sensitivity of the subject into account. During some interviews I was also asked to put the pen down and not to take any notes. If the person I had interviewed had not asked me not to take notes, I found it helpful to write up the notes I had taken during the interview as soon as I could after the interview, often in a café nearby, while the information was still fresh. As background information I usually noted date, name, address, duration of interview and atmosphere, omitting name and address if it could cause a security problem. Instead, I devised a code that could be reconstructed later, fitting the interviews with the correct name.

Back at home I typed the interviews into an electronic form (MS word program), and thus could search for a key word and find all the interviews and statements where it popped up. Chapter 7 shows how I have tried to present these interviews. This follows suggestions from my supervisors and Bernard (1994: 363): "Qualitative data analysis depends heavily on the presentation of selected anecdotes and comments from infor-

ments – quotes that lead the reader to quickly understand what it took you months or years to figure out”. When the information in the thesis is based on interviews, the name of the person is not given, due to the political sensitivity of water-related issues. However, the nationality, the working environment (e.g. academia, technocracy, IGO, NGO) and the date is stated in brackets. A question that is politically sensitive should be treated with care, as Bernard (1994: 220) points out: “First, there is no ethical imperative in anthropology more important than seeing to it that you do not harm innocent informants who have provided you with information in good faith”. Conflict-sensitive research methods can learn a lot from methods used in anthropology; I was surprised how stages of field-work in anthropology, as described by Bernard (1994), were similar to my field-work. The feeling of being a guest, of receiving more than one is giving in return, was both a humbling as well as an extremely enriching experience.

The following lessons can be learnt from my experiences:

- 1) Field research is always different to the way it is described in the textbook. Conflict-sensitive research methods should give higher priority to social relevance than to scientific or “textbook” correctness. This should not be covered up during the write up, however. Research that is very “scientific”, on the other hand, should also be challenged about its relevance to the real world. One way of doing this would be by asking practitioners in the field (practitioner review), rather than solely relying on the quality control of academic peer review.
- 2) The research methods of anthropology are often more useful for this kind of field-work than those of political science, as they focus on individual perceptions rather than general theories..
- 3) One way of carrying out conflict-sensitive interviews with the dual aim of conflict analysis and the exploration of conflict management options is to split the interview into a fact and perceptions finding section, and a more informal exploring and brainstorming of management options section. Using solution-oriented resource questions can be a useful tool in this second phase.
- 4) Trust is the key to good interviews, especially when one is dealing with politically sensitive issues. It takes time and patience on the part of the researcher to build a working relationship, this has to be based on honesty about ones motives. Manipulative or paternalistic “top-down” research should be avoided. Less interviews of a good quality are therefore more valuable than many of a superficial nature.
- 5) The interviewer should be aware of delicate issues. Delicate issues should not be avoided, but they need to be addressed with caution. By being blunt or offending the person one is talking to, one can destroy trust and may lose contact with a person who may have had something valuable to tell you. The interviewer should remain aware of how he or she is being perceived by the person he or she is talking to. It is important to remain attentive and open as one can learn something from every person one talks to.

- 6) When one lacks a detailed outline of questions, one is more open to explore new ground. Explorative interviewing can be viewed as an iterative process, where the interviewer is influenced by the person he or she is interviewing in a systemic way. The interviewer formulates a question based on a hypothesis, listens to the answer, adapts his or her hypothesis, and formulates a new question. In this way the interviewer is not the only “leader”, but he or she is also led by the person being interviewed.

### 3.1.3 *How scientific is the method?*

The following section examines the validity, reliability, generality, bias and social relevance of the interview method used in our study. Table 3.1 summarizes these five criteria as well as the degree to which the method is considered to satisfy them.

*Method validity* refers here to how far the researcher has gained access to the knowledge and meanings of the informants (Maclaran 1999). If sufficient interviews are carried out, groups of perceptions on an issue start to repeat themselves, an indication of method validity (Bernard 1994: 164). This was the case in our study. Validity was also checked by having supervisors from each country comment on how far the relevant issues were covered by the interviews. Method validity can therefore be considered to have been sufficiently reached (‘medium degree of satisfaction’ in table 3.1).

*Reliability* asks if similar observations will be made by different researchers on different occasions (Maclaran 1999). Such a prerequisite is more difficult to attain, as all the interviews of this thesis were carried out by the same person. The low method reliability can be partly compensated through triangulation. Triangulation uses three different methods to check the congruence of the acquired knowledge (Trochim 2002). In this study, triangulation occurred through: 1) interviews, 2) literature and media reviews, and 3) the Nile Dialogue Workshop. In conclusion, the method reliability is considered to be low, while being partly rectified by triangulation (‘low degree of satisfaction’ in table 3.1).

The *generality* of the knowledge acquired and ideas generated by this interview method is low, as the whole outlook is context-specific (‘low degree of satisfaction’ in table 3.1). The generality of the lessons learned concerning the method, however, is much greater, as the method can be adapted to many other situations and regions.

*Bias* is understood as a “tendency on the part of a researcher to produce data, and/or to interpret them, in a way that inclines towards erroneous conclusions which are in line with his or her commitments” (Hammersley, Gomm 1997). More specifically, bias can be understood here as “conflict bias”, i.e. the researcher is not neutral or even-handed towards the different conflict parties. The researcher favors one viewpoint concerning a conflict over another. I have tested for bias by sending relevant chapters of my study to experts from the different sides of the conflict (‘low degree of bias’ in table 3.1).

The data and information gained by this method concerning perceptions is “soft”. One professor I talked to in the Nile Basin said a Ph.D. on the subject is difficult because

it is politically sensitive and the available data is hard to access. On the other hand, the issue is arguably important ('high degree of satisfaction' in table 3.1). Bernard (1994; 218) argues that one starts with soft methods to develop hypotheses in areas where no other method is possible and later moves on to "harder" and more rigorous methods for testing them. A criterion that will be called "social relevance" or "policy relevance" is described by Silverman: "We concentrate on whether we are consistently right or wrong. As a consequence, we may have been learning a great deal about how to pursue an incorrect course with a maximum of precision." (Silverman 1998). The same criterion is described by LaPiere: "Yet it would seem far more worthwhile to make a shrewd guess regarding that which is essential than to accurately measure that which is likely to prove irrelevant." (LaPiere in Taylor and Bogdan 1998).

In grounded theory, rigor can be understood as the method's responsiveness to the situation one is researching. The adequacy of a method is judged by if it works and if it helps people manage their situation better and understand their experience better (Glaser 1998, Dick 2002). Following this definition, the rigor of the method is high.

*Table 3.1: The Scientific Value of the Conflict Sensitive Explorative Expert-Interview Method*

Criteria	Definition	Degree to which the explorative expert-interview method satisfies the criteria	Improvement
validity	The degree to which the researcher has gained access to the knowledge and meanings of the informants.	medium to high	Local supervisors
reliability	The degree of similarity between similar observations made by different researchers on different occasions.	low	Triangulation
generality	The degree to which ideas & theories generated in one setting can be applied in other settings.	low	Comparative approaches
bias (lack of neutrality)	The degree to which one actor group of the conflict is being favored above the other.	low	Stakeholder feedback, checking results with the conflict parties
social relevance	The importance of the study subject in relation to questions of society/basic human needs.	high	Practitioner feedback
rigor/ responsiveness	Degree to which the method is responsive to the research situation, its "fitness" and potential to help people make sense of their experience	high	Stakeholder feedback

Definition of criteria: Maclaran 1999, LaPiere in Taylor, Bogdan 1998, Dick 2002.

As an example of an explorative expert-interview, the interview below is given in full. Unlike in the countries of the Nile, this interview was recorded on tape, and is therefore more accurate. It is not on the subject of the Nile, but on the subject of how to interview. It gives an example of an interview and at the same time serves as a format to pass on the experience of one of my supervisors on interviewing people about conflicts and politically sensitive subjects.

### 3.1.4 Interview with Kurt R. Spillmann: “Interviewing people about conflicts”

Simon Mason interviewing Prof. Dr. Kurt R. Spillmann, from the Center for Security Studies and Conflict Research, ETH Zurich. Seilergraben 49, CH-8092-Zurich. Date: 14.05.2001. Place: in his office. Duration: 40 minutes. Atmosphere: very good. The interview was done after the author had carried out 30 of the 70 interviews in the Nile Basin.

SM: I have some questions on interview technique: what is the aim?; what must one keep in mind?; what is the difference between an interview with someone in a conflict or politically sensitive situation, and interviews that are done in more everyday situations?

Is it OK if I record you? Of course I will let you read and check it before distributing it. I would like to use the interview for my Ph.D. chapter on methods used in ECONILE.

KRS: If you start an interview, it is important to learn as much as you can about your person's background. As we know from Herbert Kelman<sup>10</sup>, try to learn about their views, positions, interests and needs. It is important to bring this out, because people are often not aware of what their own positions and needs actually are.

Initially, it is very important to make people feel comfortable and to state more or less what the aim of the interview is. Approach them very carefully, tell them broadly of the purpose of the conversation. You may not have to reveal all your interests, your background interests, but formulate the aim in such a way that they can accept it. It is important that they don't feel threatened or fear that you may use the material for any kind of purpose they don't know about. Ask them if they feel comfortable talking with you, whether there are subjects they would like to leave out – but these questions should not be asked too early.

The hard part is always to tackle the real conflict, because some people deny that there is a conflict. Don't make statements of your own: “Would you agree that...” Always ask real questions that leave the answer completely up to your vis-à-vis. Don't make implied value judgments that force your vis-à-vis into a certain position. Formulate questions in as neutral a way as possible. Also avoid polemic evaluations yourself, so that he or she will avoid polemics too. Focus on the material issues, if you can. If you have a one to one interview you can try and bring out the subjective background of the person that, as I mentioned at the beginning, is also of importance.

10 See: Kelman 1999

SM: And do you prepare questions or question spontaneously as you go along?

KRS: I think it is necessary to prepare questions, but at the same time to be flexible. Circle round the subject if necessary, without boring or annoying your vis-à-vis of course. Always accept what he or she says, never contradict, even if you have evidence to the contrary about what is said. But you can approach him or her maybe with a contradicting view, you know about, e.g., “The German magazine ‘Der Spiegel’ said...., what do you think about that?” or “How do you square your view with that view?”. Or quote a scientific journal, if you want to have a strong argument: “Scientists such and such have done research and come up with the figure such and such, or the thesis that...”. Never say that these are facts, but quote a source of the differing figures, observations or opinions.

SM: What do you do if they ask you for your view of things, a direct question: “How do you see the situation?”, if they want your personal assessment?

KRS: I think that depends on what stage of the conversation you are in. Be as reluctant as possible to make personal statements. Make a statement to the extent that you believe in the possibility of “win-win” situations. Or “That after bringing more light into the nuances of the situation, it would be possible to find a compromise that would bring benefits to both sides.” Try to avoid ideological or clear-cut value statements, except if you are addressed on very clear-cut human rights issues for instance, then I think I would frankly say “yes, every person has a right to ..., but on the other hand one has also to look at the broader picture and so forth”. But very carefully! People feel offended very rapidly if you make a statement that does not harmonize with their own convictions.

SM: I was reading a book on interview techniques, and they were saying there is a danger in saying anything personal because you then influence or change the scientific value of the interview. But in putting the relationship as the first priority, I find myself often saying things I knew they would probably like to hear. A sort of affirmation of the situation, honest things, but picked out to elicit the “I agree” response.

KRS: That is true, that is a tendency that we all have. Most of us prefer agreement to disagreement. But here we have to be careful not to give in to this tendency. The object of our pursuit is not to appear as a nice person, but much rather to develop a deeper understanding of the person and the issues involved in a given conflict. I would like to come back to the point I made earlier. Once you have established some trust, then invite comments on statements that are not in line with this person’s viewpoint: “Such and such an author said... what do you make of that?”

SM: So at the beginning you would concentrate more on the relationship and maybe affirm what he is saying...

KRS: Yes, and understanding his position, needs and concerns...

SM: And then later become very discreetly more confrontational, if at all.

KRS: Or inquisitive in a way.

SM: What do you do when you realize there is an emotional reaction, you have touched a delicate subject?

KRS: Don't try to stop the other person from articulating the emotions, but put it down so you know where the raw nerve is. Find out where your partner does react emotionally, because an emotional reaction is the best indicator that you are getting close to a serious part of the problem. Help people to express themselves. People in these kinds of situations tend to be repetitive. Try to help them to reflect, to circle the issue, to bring out different aspects of it and maybe to differentiate between aspects they cannot accept at all and aspects they may accept.

SM: How legitimate do you think it is when a talk moves from an interview to more of a discussion. In the talks I had, especially towards the end, it would become more an exchange – a very open discussion.

KRS: I think that then the interview is over. If you want to use the material for research then you should not get involved personally. Because if you move from creating an atmosphere of trust to inquiring about critical points, being as probing as possible, it is tempting to slide into an exchange of points of view, but by doing so you would lose your stance as a nonpartisan interviewer. Thus, if you have to continue this relationship as a working relationship, then probably you should hold back, trying to restrain yourself in the interaction as much as possible.

SM: Another thing: when you do such interviews, do you take notes or do you record? How do you guarantee the accuracy?

KRS: I think it is helpful to record, but often it is not possible, due to various reasons. Often people don't feel at ease knowing that their replies are being recorded, thus they hold back certain thoughts or aspects of the problem. So while it may seem theoretically that the tape recorder is more accurate than notes, it may well be the other way round under these circumstances.

I think one of the indispensable skills an interviewer has to develop is to be able to follow a line of thought of another person, to tune in to the world of the interviewee and to be able to recapture the key elements and arguments afterwards.

SM: Even taking notes, some people asked me not to take notes.

KRS: No notes, no taping, no nothing. It is enough that I am talking with you!

SM: You once mentioned reading between the lines, when one is trying to understand a delicate subject that is not expressly said in so many words. How do you do that?

KRS: Often it is a useful tool to repeat a sentence. “You just said such and such – could you tell me more ...”. Or you may rephrase a statement as a question: “I may not have understood you correctly, what do you mean by that?” Work with their own sentences. Also to make them feel that you are trying to understand them. As I said before: never contradict, but keep repeating statements and invite them to elaborate.

SM: But then the interpretation of it is very delicate, the in between-the-line kind of interpretation?

KRS: Of course it is difficult, but try to get their own formulations as often as possible, with as many examples as possible. I think they may come up with variations that can make it more clear as to how they really feel about a subject.

SM: What would then also be the aim, when you start an interview, mainly information or perceptions or ..., what are you looking for?

KRS: As an interviewer I aspire to get as complete a picture as possible: fact and figures, perceptions and personal interpretations of these facts and figures. I don't think the one goes without the other. The interesting thing is who interprets facts and figures in which way. If you have an expert in front of you, you might start an interview by saying: “I have come here working on a research project dealing with this and this subject. I would like to understand the facts about this subject, but I would also like to know better and understand the positions of key people in this context. And as you are an expert, I am sure I could gain insight and learn more about the facts as well as appreciate your particular assessment of the situation.” So you can have both, more insight into facts and figures, as well as their personal interpretation of these facts and figures.

SM: What if someone starts attacking your legitimacy to ask such questions, e.g., “You have nothing to do with it, why are you asking such questions?”

KRS: I would never counter such a question by saying “No, I am not attacking you”. But I would try to answer with another question and ask him or her: “Why do you think this could be dangerous in your case?” Try to find out why he or she perceives this interest as negative. Or you could frankly say, “I never thought of looking at my research in such a way, why do you think that outside concern has to be so detrimental to your best interests?”

SM: But very cautiously?

KRS: Very. Because we should never forget: “The subjective reality is the reality that matters.” This is a key sentence in our work. Reality is a very complicated thing, varying from person to person. If you look at the natural sciences, there you have a different situation. There you have an “object”, something really outside of the observer that can be measured, isolated, and brought to react with clearly defined other objects. That is what quantitative, empirical social scientists are so desperately trying to do, to get a hold on hard data for human relationships. But human reality – and that includes social and political reality – is defined individually, subjectively. We only have a certain amount of overlap in our definitions of reality. In dealing with conflicts, different perceptions of reality clash, and this is what we have to work with, this is our point of departure.

SM: In dealing with this, if you realize that it's never exact, what can you do? Doesn't the method become very wishy-washy?

KRS: Yes it does. You can collect data about things you can count or measure. These are the easy things. But sometimes opinions clash, even where you have clear agreement on facts. Proposals for tentative solutions may offend values or may conflict with perceived basic needs. Then it gets very controversial. I would think there is no possibility to have a laboratory situation as is found in the natural sciences. Even if you ask ten or a hundred people the same question, they react differently, according to their individual understanding of the question. And this individual understanding in turn is conditioned by their upbringing, their life history and other factors. If you avoid looking at these difficulties you run the risk of overlooking conflicting perceptions that don't necessarily show on the surface.

SM: So how much direction do you give to a talk in an interview and how much do you let it take a life of its own?

KRS: I tend to let it take on a life of its own, to let it develop individually, subjectively and just keep in mind what the important questions are so as not to miss posing them. I may have a little check-list, the smaller the list is, the less threatened people will feel. I usually tend to let it go and to rephrase my own questions in such a way that they fit in with the course of the ongoing discussion. If you have 10 or 20 interviews you can find a set of questions you find useful to repeat. The answers may lead to a body of empirical data about central issues.

SM: It does not happen often, but sometimes people only give you a short answer, they do not start talking openly. What do you do then?

KRS: Well, you might either circle the subject with other questions. Of course you have

to be knowledgeable enough to bring in a new aspect or a tiny variation to the original question so that it still looks like a new question, although it is the old one rephrased. If you basically have the feeling that this is a person you can talk to more or less openly, then you might address the questions openly and say “Did I touch on a difficult subject that makes it hard for you to answer freely?” But this needs a basis of trust, you need to have established a good relationship with that person. Sometimes it is useful to arrange for a second interview, so that you are recognized as familiar. If an interviewer proceeds carefully, people can build up trust even in the course of one interview. Next time they might open up more freely.

SM: While the interview is going on, your awareness is at the same time evaluating your own reactions and the reactions of the other person. What is the inside observer, the observer voice inside yourself, doing at the same time?

KRS: I think it is a useful controlling measure. Observe yourself! That is what Freud called the counter transference: observing yourself in addition to observing your vis-à-vis, observing mainly your own (emotional) reactions. Observe your own reactions, but don't show them. Ask yourself: what did he touch upon? What does my inner response indicate about my position to the problem? It is important not to confuse one's own inner position with the position of the interviewee and not to project one's own perception onto the interviewee, thus becoming manipulative and involved instead of being understanding and clarifying.

SM: So you have three points to focus on. One is the content, one is the person you are interviewing, and one is yourself?

KRS: Yes, indeed. I think the easiest part of it is to focus on data, where you can establish a common denominator, common ground. The second part is to see the person's point of view, to put yourself into the shoes of the other and to get a feeling of his or her perception of the problem and the difficulties in the conflict. And then of course your own reactions, but I would just strictly use them as a methodological tool which may alert you to a particularly difficult aspect of the problem.

SM: As a kind of alarm signal?

KRS: Exactly. But remember: don't speak about your own emotional reactions and perceptions with the interviewee. But don't hesitate to ask difficult or confrontational questions when you feel a need for clarification.

SM: In that inquisitive part it is very difficult to know how far one can go.

KRS: That is true. It is a skill you have to develop. Look at the newspaper people: they are

usually much more aggressive than we are, but their goal is completely different. They look for headlines, we look for understanding and solutions. Our wording of the questions should always be soft. In the media they would tell you the opposite: be aggressive in your wording to provoke an intense answer. The interviewers from the press have very little time. We have more time, our job is not too simplify things for mass consumption, but actually to differentiate views and interpretations of facts as well.

SM: If you wait for them to offer what they know, you can't really demand an answer, so you have to tempt it out of them?

KRS: Exactly, that is the word: tempt. Tempt them to expose as much as they know, as much as they can. Of course some people who are in a certain office can't be very open, but most people I found are actually more than willing to share their knowledge and their views and their values even. But they have to trust you. This is the first part, that you establish a certain trust.

SM: How do you do that?

KRS: Well by telling them: "I will not print whatever you don't wish to be printed. I use you as an expert and if I should quote your view, I will check back with you. If you don't wish to be quoted in any respect I will just use it as background information." Make them feel safe.

SM: Maybe as a last question, the difference between these delicate interviews and other interviews. What do you have to be the most careful about? There is a lot of literature on qualitative interviews, so I am also trying to find out the difference between a normal qualitative interview and one which takes place in this delicate political sphere?

KRS: Again, I think it is a question of trust, that you do not threaten the person you want to interview. By indicating that you won't use the material in any way that he or she wouldn't like, by only asking questions that lie within the range of what he or she wants to say. If you try honestly to understand the other one's thinking about a particular problem, people are usually ready to share their views with you. Try honestly to understand them and not to force them into statements that they don't actually want to make. The way you dress is also important. Dress well, it shows respect.

SM: Good, thank you very much! As an afterthought, what would be your main guiding principle in such delicate situations?

KRS: My most important tool in such situations is intuition. Be led by intuition for the details, but be well prepared so that you do not miss important points.

### 3.2 Dialogue Workshop: Interactive Problem-Solving

One multi-track conflict management method used in international conflicts is the Dialogue Workshop or Interactive Problem-Solving Workshop method, described in this section. The method's applicability is examined, followed by a summary of its criticisms and limitations. The applicability of the method to an environmental conflict such as over water issues in the Nile Basin is discussed, including a possible way to evaluate and implement the method. The evaluation the Nile Dialogue Workshop organized in August 2002 is given in chapter 8.

#### 3.2.1 Description of the Dialogue Workshop Method

"Interactive Problem-Solving Workshops" (Kelman 1999), "Interactive Conflict Resolution" (Fisher 1997) or "Problem-Solving Workshops" (Burton 1969), or the more generic term "Dialogue Workshops" (Ropers 2002) are a form of multi-track diplomacy, i.e., non-official representatives of the conflicting parties meet in an informal setting facilitated by a third party with the aim of non-polemical conflict analysis, transformation of antagonistic relationships, joint action or problem-solving (Ropers 2000, Kelman 1999). Such a workshop usually takes place over a period of about two to five days. A limited number of people are involved, about six to twelve, to enable face-to-face interaction. The workshop is usually moderated or facilitated by a third party, who often is also the initiator of the workshop (Ropers 2000). The workshop is confidential; no one is quoted without his or her express permission. This provides the opportunity to talk and brainstorm freely (Fisher 1997).

The term 'Dialogue Workshop' will be used in the following, as the eclectic nature of the approach is of interest here, rather than the "schools" of practice behind more specific terms such as the Interactive Problem-Solving Workshop method as developed by Burton and Kelman. The following description is, however, greatly influenced by their approach. Kelman's Interactive Problem-Solving Workshops have two aims: First, the participants are to gain insight into the conflict and the complexity of the opponents' perceptions, thereby increasing the breadth of possible strategies. Second, the changes on the individual level are to be fed back to the political level through the participants' input (Kelman 1999). Workshops with a "cross-track" orientation also have a third aim of linking different "tracks" within one party together, e.g. communication between the official, non-official and sometimes also grass-root levels of one country (Ropers 2000). Having representatives of Track 1 and 2 (or also, but less usually, Track 3) at a workshop enables communication between the tracks, as well as making a *diffusion of knowledge* between the tracks possible. This is represented by a vertical line in diagram 2.5.

The reason for this cross-track approach is to enlarge the basis of participating actors in contact with the other side, as well as to generate acceptance for an ongoing peace process, thereby increasing its impact. President Sadat, for example, undertook great efforts on the Egyptian Television to win his own people over for the Camp David peace

agreement of 1978<sup>11</sup>. Another example was the peace talks in 2002 in Mashakos, Kenya, concerning the Sudanese civil war. Many Sudanese felt that not all the relevant parties attended the peace talks, thereby limiting its impact (IRIN 2002).

Participants of a Dialogue Workshop are generally chosen due to their knowledge about the issue, their influence, and their readiness to accept different views<sup>12</sup>. The argument for the non-official character of such workshops is that stakeholders are often more flexible in an unofficial setting, away from the eye of media, than when they are defending a predefined position. In this way room is given to develop new ideas. A balance needs to be found between the advantages and disadvantages of Tracks 1 and 2. The more official the participants, the better the transfer of workshop results to the wider political context. Often these participants are also more knowledgeable about the ongoing official processes. The advantage of having less official participants, on the other hand, is that they are generally more flexible in their views. If participants hold an official position, it has to be made clear that they attend the workshop in their individual capacity and not as a representative of a government or institution. This has also been termed Track 1.5, i.e., communication between officials in their personal capacity. This Track lies between Tracks 1 and 2 (Ropers 2002).

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*Box 3.2*

***Workshop Ground Rules:***

1. Privacy and confidentiality
  2. Focus on each other (not on constituencies, audience, third parties)
  3. Analytic (non-polemical) discussion
  4. Problem-solving (non-adversarial mode)
  5. No expectation of agreement
  6. Equality in setting
  7. Facilitative role of third party
- 

*Ground rules of Interactive Problem-Solving Workshops. According to Kelman 1999.*

One of the rationales behind Dialogue Workshops is that conflicts have a social-psychological component: "While conflict arises out of objective and ideological differences, the escalation and perpetuation of conflict is typically fuelled by factors such as misperception and distrust" (Fisher 1997: 62). Other rationales for the interactive approach have been discussed in chapter one. These include: the creative brainstorming quality that direct interaction can help to foster, as well as the networking quality of bringing together different actors. Workshops can support the peace constituencies and cooperatively minded experts in a conflict context. Herbert Kelman pointed out the natural similarity of hardliners on the two sides of a conflict in disrupting peace initiatives. Following

11 In discussion with an Egyptian academic

12 Kurt R. Spillmann in discussion with the author, Spring 2000.

this line of thought, he points out the need to support cooperatively minded people on both sides. The ground rules of the workshop as carried out by Kelman are summed up in box 3.2 (Kelman 1999).

The assisting third party in a Dialogue Workshop is less active and invasive compared to a mediator; instead, the third party acts as a moderator or a facilitator. In a classical mediation, dialogue is at first not carried out directly between the parties, but takes place via the mediator. The mediator summarizes what party A has said, and party B hears it through the mouth of the mediator. An extreme form of this is shuttle mediation, where the mediator moves geographically to and fro between the parties. The phases of a classical mediation are:

- 1) *Introduction*: The mediator explains mediation and the neutral role of the mediator, the framework (talks about the talks) is set, e.g. confidentiality, no interruptions, no physical violence.
- 2) *Presentation of conflict issues*: each party then presents the conflict from his or her view point. The mediator points out similarities and differences, and summarizes perceptions.
- 3) *Clarification of conflict background*: The mediator encourages the conflict parties to express and clarify their motives, interests, wishes, fears and hopes. The mediator supports changes of perspective.
- 4) *Development of options*: The conflict parties develop options, e.g. by brainstorming.
- 5) *Agreement*: The chosen options are agreed on and the concrete next steps are fixed (what will each party do, how will it be done and by when?) (summarized from Wüstehube 1999).

In a Dialogue Workshop, however, face-to-face direct dialogue between the parties happens from the start. The process is also less formalized compared to a classical mediation. Mediative aspects are used, but many other skills are used as well. The following steps can be identified in a Dialogue Workshop: 1) contact, bringing the participants together, 2) understanding each other, 3) joint analysis, 4) speculative problem solving, 5) joint action (Ropers, Baechler 2002).

### 3.2.2 Method Applicability

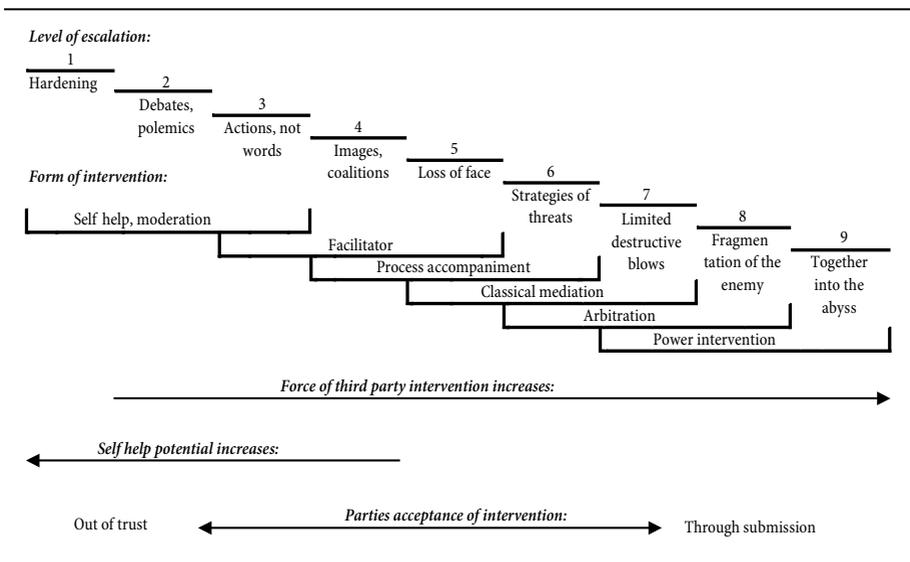
The method applicability is influenced by four factors: 1) the level of escalation of a conflict, 2) the power asymmetry between the parties, 3) alternative management options available to the parties, and 4) the legal, institutional and structural context of the conflict.

According to Glasl (2002), the form of conflict intervention in a conflict has to fit the level of escalation of the conflict. Interactive forms of conflict intervention are suitable in low- or mid-level escalated conflicts where the involved parties are still willing to sit together to discuss the conflict. As the level of escalation increases, the third party has to become more forceful in its form of intervention, because the potential for self-help

of the involved parties decreases. The forcefulness of an intervention therefore increases from level one, where the parties accept a conflict management intervention based on trust, to level nine, where parties often have to be forced to accept an intervention. The Dialogue Workshop method is useful up to level five of Glasl's escalation model, as the moderator or facilitator does not intervene against the will of the workshop participants (Glasl 2002, diagram 3.4).

The contingency model of Fisher and Keashly (1991, in Fisher 1997: 166), that was also partly based on Glasl's escalation model (1982), also suggests the use of different conflict management efforts depending on the level of escalation. These authors see consultation or interactive conflict resolution as suitable, either as pre-mediation to improve the relationships before mediation on the substantive issues begins, or in a later escalation stage as a form of conflict analysis (Fisher 1997: 167).

Diagram 3.4



*Form of Intervention Fits Level of Escalation.* Glasl views escalation as a downward movement, a spiral into the abyss. This is not a linear movement, but one over a series of plateaus and falls. Parties may stay in one phase for a while, before plummeting down to a further level of escalation. De-escalation requires an active effort: symbolized by the effort to move upwards away from the suction of gravity, the suction of the abyss. According to Glasl 1982, Glasl 2002.

The level of escalation of the "group" involved has to be differentiated from the level of escalation of an individual member of that "group". The Dialogue Workshop method may therefore be used with cooperatively minded people even if the conflict and other actors have escalated to a further level of escalation where the method would no longer work.

The questions of power asymmetry and BATNA (Best Alternative To a Negotiated Agreement) and WATNA (Worst Alternative To a Negotiated Agreement) are helpful in deciding if cooperative conflict management approaches can be applied in a given conflict. If one party is far more powerful than the other, or if one party's BATNA is large and WATNA small, then communication may help clarify things, but it is hardly likely to lead to a win-win solution (Fisher, Ury, Patton 1991).

Dialogue Workshops must take the power, legal and institutional context of the conflict into account. Only by taking structural factors into account, can the role of communication be assessed and the method applicability evaluated.

### 3.2.3 *Criticism of the Dialogue Approach*

There are two types of criticism: the first concerns the *importance* of communication in general, the second concerns the *effectiveness* of communication in a Dialogue Workshop format (Ropers 2002).

The first kind of criticism questions the importance of communication and instead, tends to see conflicts as a struggle for power. In this school of thought, power and structural factors causing a conflict are not seen as being greatly influenced by perceptions and differences of opinions. This sort of criticism applies to situations where the method is used without taking its applicability and limitations into account (section above). Mediators coming from the organizational development field rather than the social psychological discipline point to the importance of structural factors. Glasl (2002) who works on conflicts within or between organizations, for example, differentiates between friction, position and system-changing conflicts. Rather than negating the importance of communication, he points out that there is not much benefit to be gained from working on friction conflicts between an employee and his or her superior when the conflict originates from the structure of the organization. Thus, his answer to the question of structural factors is not that communication is unimportant, but that a conflict management effort has to focus on the actual problems and include the relevant stakeholders. Furthermore, the outcome of the mediation may not be a change in perceptions, but a change in an organization's organigram (Glasl 2002). On the international level this could mean that the output of soft communication would finally result in binding legal agreements (Wolf 1997). Another structure-oriented approach focuses on state reforms that aim to enhance state capacity in order to prevent conflicts or deal with them in a constructive way (Baechler 2001).

The second type of criticism is more concerned with the *how* rather than fundamentally with whether perceptions and communication are important (Ropers 2002). Based on the psychological considerations mentioned in chapter one, people in a conflict situation tend to react to conflict in an undifferentiated fight or flight mode. Glasl (2002) described two basic types of conflict "temperament": hot (explosive, confrontational, manic) or cold (implosive, avoids contact, depressive), reflecting the dominance of either the fight or flight behavior. Facilitating communication, therefore, has two basic aims: 1)

to help people to relax, and 2) to support constructive interaction. A trusting atmosphere can help to widen the horizon, enable the discovery of options, and move from a black and white form or perception back to a multi-faceted way of seeing the conflict. What can help to achieve these aims is the informal setting of a Dialogue Workshop, in which no media is present, the participants can speak out without fearing loss of confidentiality, the facilitators support and encourage participants to gain access to information if required etc.

Ropers (2002) answers the second type of criticism concerning the effectiveness with nine lessons learned. These are based on his own experience as well as on studies by Spencer (1998), Mayer et al. (1999), Haumersen, Radmacher and Ropers (2002) and Wolleh (2000):

- 1) The aim of a problem-solving workshop can only be achieved within the framework of a *long-term process* of work and learning.
- 2) The *choice of the initial participants* is very important. Moderate and mainstream people may be the best participants to get some meaningful exchange going, hardliners may be integrated at a later stage.
- 3) The greatest challenge of dialogue projects is not the mastery of communication and facilitation skills, but the *organizational input*, the finances and organization to get the participants attending. This is especially true for a long-term series of workshops.
- 4) The third party has an *ethical responsibility* for the intentional and unintentional consequences of any workshops they organize. In highly escalated or protracted conflicts, the main task is to minimize any security risks to the participants.
- 5) The intervention methodology of Dialogue Workshops should be set on a *broader and more flexible basis*. This allows for different tracks to be taken into consideration, as well as different phases and escalation levels of a conflict. In addition, it enables the process to benefit from the experience of other related disciplines (adult education, counseling, supervision etc).
- 6) One method that is being used frequently is to encourage a change of perspective by *reflecting on a similar conflict* that the participants are not directly involved in. It is easier to see the point of view of the other party in such a case, and to have a less prejudiced appraisal of the overall situation.
- 7) As the effect of workshops on the macro-political level is hard to assess, it is important to examine the impact on the *meso-social level*. Increasing the ownership of the dialogue process is a key measure. This may include different pre and post activities, e.g. capacity-building or local back-up forums. Another measure of success is the expansion of the circle of participants in terms of numbers and/or movement towards the official level.
- 8) Dialogue processes need to be *institutionally anchored*, especially when the third-party initiator is replaced in the long-term process by the participants

increased ownership. This can be done for example by governmental or semi-governmental commissions, joint task forces etc.

- 9) The promotion of a dialogue-based dispute culture between, as well as within, the parties is maybe the most important contribution of the dialogue approach.

### *3.2.4 Applicability of Method to an Environmental Conflict: the Nile Basin*

Fisher (1997) lists some 24 interactive conflict resolution interventions on the international arena between 1965-1995; no environmental conflicts are included. There are many examples of interest-based negotiations concerning the shared use of natural resources on the intra-national level (Weidner 1998), but fewer on the international level (see Mason, Spillmann 2003 and Trollalden 1992). Jerome Delli Priscoli (1992 and 1996) highlights the need to combine water resource management, international relations and Alternative Dispute Resolution (ADR). He especially focuses on the third-party possibilities of supporting this: "While lenders and donors certainly cannot solve all the world's problems, they can assume a leadership role in encouraging and facilitating early collaborative and participatory efforts among parties that would otherwise conflict" (Delli Priscoli 1996: 33).

As argued in chapter one, environmental conflict management can use instruments developed in the context of general conflict management and adapt them to the specifics of an environmental conflict. For example by including questions of sustainability, or involving participants from all the countries of the natural system (e.g. the watershed). Translated into the design of the workshop, this could mean having participants and moderators from the social sciences, natural sciences and/or engineering sciences involved, in order to take the social, economic and environmental realities of the case into consideration. Furthermore, it could involve moderators having a solid information background concerning the physical reality of the case.

The applicability of the Dialogue Workshop approach to an environmental conflict will be examined in more depth in relation to the Nile Basin. How can a Dialogue Workshop be used in the context of the Nile Basin? To answer this, the following questions need to be answered (questions summarized in box 3.3):

*Box 3.3****Questions concerning the micro- and meso-level before the workshop:***

1. What is the level of escalation of the conflict? Is a Dialogue Workshop an appropriate tool?
2. What tracks are already active in the conflict management process, and which tracks should be involved in the workshop?
3. How can the transfer of the workshop output to the wider political and social context be supported by the workshop design?
4. How can the specifics of the conflict, e.g. an environmental conflict, be taken into account in the workshop design, in the choice of moderators, participants and venue?
5. How do people involved or effected by the conflict view the Dialogue Workshop method? What are the ideas concerning the adaptation of the method to their specific case? How do they view potential organizers, moderators?

*Questions concerning Workshop Needs and Design Evaluation*

Q: What is the level of escalation of the conflict? Is a Dialogue Workshop an appropriate tool?

According to the conflict assessment undertaken in this study, as well as according to the developments of the official process in the Nile Basin Initiative, international relations in the Nile Basin are in a pre-conflict phase or have been viewed as a low escalated conflict. According to the Glasl (2002) escalation model, level three is reached when actors no longer believe that talking helps and when they go ahead with unilateral actions. While the Toshka project in Egypt and the micro-dam developments in Ethiopia can be seen as such unilateral actions (Waterbury, Whittington 1998), these are not directly aimed at harming the other party. Hindering development banks from supporting dam development upstream can, however, be viewed as an action indicating level three escalation. Threatening language was used, such as by Boutros Boutros-Ghali in 1985 or President Sadat in 1979, yet there was no *strategy* of threat repeated over a long period of time, which would have been an indication of level six. There have also been no recorded instances of loss of face, i.e. dehumanizing the opponent, an indication of level five. Ethiopians could also view the dominance of Egyptians in international water fora as an example of Egypt seeking to form coalitions supporting their downstream position. Images and coalitions are an indication that level four has been reached at times. Conversely, there is the will to communicate, as Marawan Badr, the Egyptian Ambassador to Ethiopia, said in July 23 1998 (Gelaw 1998): “We are saying that we should sit together and discuss the issue.” Thus, the Nile conflict is viewed as being on a low level, on level one, two, to maximum four, where direct communication and the Dialogue Workshop method can be used.

Q: What tracks are already active in the conflict management process, and which tracks should be involved in the workshop?

Since Track 1 is already involved in the framework of the Nile Basin Initiative (Nile-COM, Nile-TAC)<sup>13</sup>, there is little point in having a workshop on this level. The series of Nile 2002 Conferences, that some see as initiating dialogue on the Nile Basin and getting the dialogue process going, can be viewed as a Track 1 and Track 2 effort, as both official representatives and non-officials attend. Because these conferences are large, some 400 people, a moderated Dialogue Workshop on Track 2 would be of a very different nature. It would focus on the direct interaction of a much smaller group in an informal setting. Track 3 has only been included minimally so far. The Nile Discourse<sup>14</sup> is such an endeavor that is being launched to include Tracks 2 and 3 concerning issues such as capacity-building, involvement of civil society etc. The IUCN is planning to enable a secretariat in Entebbe, Uganda, for NGOs dealing with Nile issues. The problem with Track 3 is that the basis is so broad that a small workshop with representatives would have little impact. Lederach (1997) suggests a “middle-out” approach to solve this dilemma: using Track 2 to link and influence Tracks 1 and 3. If the three aims of a Dialogue Workshop are recapitulated: 1) increasing the participants’ understanding of the other side, 2) output to the wider conflict context and 3) cross-track links, then a Dialogue Workshop in the Nile Setting should include Track 1.5 and Track 2. In this way, official representatives in their personal capacity, or non-official representatives that can influence Track 1 (e.g. as consultants) or 2 (e.g. by teaching in universities, giving speeches on television) would be included.

Again, all efforts on the various tracks are complementary and have to be kept up over a long period of time, as suggested by the concept of *dialogue accumulation* (Hefny 2002). Dialogue between different actors and representatives over a long period leads to an accumulation of communication that gradually leads to a breakthrough and acceptance of a different mode of international interaction. On the other hand, one also needs to take the phenomena of *dialogue fatigue* into account, i.e. the various actors getting tired of all the communication efforts (Ropers 2002).

Q: How can the transfer of the workshop output to the wider political and social context be supported by the workshop design?

The question of transfer of a workshop output depends very much on the specific situation. A jointly written document is often avoided in more highly escalated conflicts, as this may cause problems to the participants. As the situation in the Nile Basin is cooperative, however, a joint publication could be a more tangible outcome that would increase the potential impact on the wider political and civil context. Furthermore, according to the literature overviewed by the author, there are no academic publications written jointly

13 Nile Basin Initiative [www.nilebasin.org](http://www.nilebasin.org) (26.09.02)

14 International Discourse of the Nile Basin [www.nilediscourse.org](http://www.nilediscourse.org) (26.09.02)

by experts from the different countries of the Nile Basin. The conference proceedings of the Nile 2002 Conferences are an accumulation of different papers, but they are not written with a similar concept in mind. The Nile Basin Initiative publications (NBI 2001) come closest to this, but they are of a Track 1 nature, aimed at donors, rather than written by academics for a wider target public.

Q: How can the specifics of the conflict, e.g. an environmental conflict, be taken into account in the workshop design, in the choice of moderators, participants and venue?

A key requirement of environmental conflict management is to include both hard and soft factors. Inviting participants from different disciplines is one way to increase the importance given to the political, social and physical realities. It may also be helpful for moderators to represent the different disciplinary backgrounds besides their basic training in moderation and mediation skills. It is advantageous to have background material in order to have knowledge of the issues at stake. One way of doing this is to use PhDs to research the case and prepare material for the moderators. The natural systems boundary should be taken into consideration as far as possible when choosing the participants, e.g. by inviting people living in the different states that are part of the natural system, such as a watershed or sub-basin. In the case of the Nile, the Eastern Nile Basin sub-basin was chosen, with experts from Egypt, Sudan and Ethiopia. Eritrea was left out, because even if it is part of the Eastern Nile Basin, it is only a minimal contributor to the runoff of the Eastern Nile System and is also not greatly dependent on it.

Q: How do people involved or effected by the conflict view the Dialogue Workshop method? What are the ideas concerning the adaptation of the method to their specific case? How do they view potential organizers, venue, participants and moderators?

One of the key questions raised by people when asked about the workshop method is how it fits in the official / non-official continuum. The academic characteristic of the workshop is one way to place it outside of government activities on the one hand and local NGO activities on the other hand. NGO representatives viewed the work on the intra-national level as their primary focus. Although they were also interested in an international NGO network, they did not have much knowledge about the issues at stake in the international arena. The NGO Track has been taken up in the Nile Discourse, supported by World Bank, IUCN and others, to increase their expertise, as well as to open the Nile Basin Initiative to their input.

The academics interviewed generally thought it was important to have experts who were close to the official cooperative process and knowledgeable about the process, as well as participants from a more purely academic background. The idea of a joint publication was developed in discussion with experts from the Nile Basin in order to give the workshop a tangible aim and indeed a "raison d'être". A joint academic publication would be complementary to the other activities going on, rather than trying to do what

is already being done. Switzerland in general and the academic institutions in particular were seen as objective and unbiased. The choice of participants was carried out in close coordination with the experts of the Nile, thus making sure a knowledgeable and cooperatively minded group would come together that could also rely on already existing relationships between the different participants.

In conclusion, this analysis suggests organizing a Dialogue Workshop on Track 1.5 to Track 2. The objectives of the workshop are therefore twofold:

- a) To enhance cooperation in the Nile Basin and prepare a joint publication between academics from Ethiopia, Egypt and Sudan.
- b) To adapt the method of Dialogue Workshops and Interactive Problem-Solving Workshops to an environmental conflict situation and evaluate the method for the use of mitigating environmental conflicts in general, and upstream-downstream conflicts in particular.

Key questions as preparation for a Nile Dialogue Workshop, set to the potential participants before the workshop, were:

1. What are the interests and needs of your country concerning the use and management of water resources in the Nile Basin (minimum and maximum options)?
2. What does your country expect from international cooperation, and what is it prepared to offer in order to enhance cooperation?
3. Over which issues is there, from your point of view, a consensus between the three countries concerning the use and management of water resources in the Nile Basin?
4. What are the still open questions?
5. What are the options to deal with these open questions?

### *3.2.5 How To Evaluate The Planned Dialogue Workshop*

Mitchell (in Sandole & van der Merwe 1993: 78–94) distinguishes between micro-, meso- and macro-level theory when examining interactive workshops. Micro-level theory looks at the relationships between the workshop structure and procedure, and its effect on the participants, micro-level questions are summarized in box 3.4. Meso-level theory looks at the outcome of the workshop and focuses on its impact on the dynamics of the conflict, e.g. questions in box 3.5. According to Anderson, Olson (2003) the effectiveness of peace practices on the meso-level can be measured by the degree to which the participants develop their own initiatives, results are institutionalized, participants learn to resist polemics, and security is increased. Macro-level theory uses theories about conflict causes, origins and solutions and tests them in the workshop setting. Meso-level theory is seen as more difficult to develop than micro-level theory. The dif-

faculties of meso-level theory are linked to the lack of empirical evidence concerning the effectiveness of such workshops in relation to the resolution of a conflict (Fisher 1997). Micro-theory concerns formative evaluation, e.g. evaluation of the workshop process, and meso-theory concerns summative evaluation, e.g. evaluation of the outcome and impact of the workshop (Trochim 2000).

The evaluation of the workshop process (micro-level) will follow the idea of triangulation, using three independent ways for evaluating a Dialogue Workshop: a “triple check”. In the planned workshop the three evaluation inputs will stem from the observation of the process by the author of this thesis, the feedback from the participants after the workshop, and the self-evaluation of the moderators. Interviews beforehand will not be carried out, as this could interfere with the process. The aim of having a joint publication makes the potential of transferring what happened in the workshop to the actual political and academic discussion more concrete, and may thus be a building block for the future development of meso-theory, or outcome and impact evaluation.

The implementation of the Nile workshop followed the three steps of action research (Lewin 1948):

1. *Planning*: Planning and preparation entailed two PhDs on the Eastern Nile Basin and contacts with experts in the countries on the issues involved, as well as on the applicability of a Dialogue Workshop (“filtering”, diagram 2.7). It also included discussions over the concrete aims of such a workshop and the relationship between the official and non-official actors. From the beginning, the participatory approach was chosen.
2. *Action*: Organization of the Dialogue Workshop, in this case, a two-day workshop.
3. *Evaluation*: The evaluation of the workshop was based on observation, moderators’ self-assessment, and participants’ feedback. The workshop publication enabled the workshop impact to be partly evaluated and also linked it to the wider context (“rebinding”, diagram 2.7).

The evaluation of the Nile Dialogue Workshop is carried out in chapter eight. The succeeding chapters on the environment, national and international aspects of the Nile conflict served as the basis for the moderators of the Nile Workshop. The field research for these chapters also enabled the formation of a network of water experts, from whom workshop participants could be invited.

*Box 3.4****Questions concerning the micro-level, the process evaluation during the workshop:****Workshop in general:*

1. Were the aims of the workshop clearly set and reached?
2. Were the ground rules set and adhered to?
3. Was there ever a creative “brainstorming” atmosphere?
4. What was the balance between focus on the past vs. focus on the future?
5. What was the balance between one-way presentation and interaction?
6. What was the balance between communication between the different country representatives vs. communication between the representatives of one country? Could any instances of “cross-track” communication be observed, i.e. a diffusion of knowledge between the tracks?
7. How were specific environmental issues taken into consideration (sustainability, natural systems boundaries)?
8. How were sticky issues dealt with? What helped to create a relaxing atmosphere?
9. What went well, what went badly, what were decisive turning points, and why?
10. How were cultural aspects taken into consideration during the workshop?

*Participants:*

11. How was the tone of the participants during the workshop in comparison to their written work and/or their style during public conferences (impact of informality)?
12. Did all participants participate actively during the workshop?
13. What was the disciplinary (social, natural and engineering science) and Track (1 and 2) mix of the participants?
14. Were there moments when the recognition of other perceptions and interests was expressed by the participants?
15. How far did the participants differentiate between positions, interests and needs, as well as between different issues?
16. How well were participants from the other countries seen in a differentiated or stereotypical way?
17. How were the participants satisfied with the organization and venue?
18. What was the participants’ overall satisfaction with the workshop?

*Moderators:*

19. What did the moderators do to initiate certain subjects?
20. How did the moderators deal with unforeseen occurrences?
21. How did the moderators support recognition and empowerment?
22. What did the moderators do to structure and visualize the process?
23. Were the moderators all-inclusive and even-handed with the different parties?
24. How did the participants rate the moderators?

Sources of some of the questions: Inmedio/COPRET/Deza 2002, Ropers 2002, Baechler 2002, Fisher 1997: 238-240, Mason, Spillmann 2002.

*Questions concerning workshop process evaluation*

*Box 3.5*

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***Questions concerning the meso-level, output and impact evaluation after the workshop:***

1. How far did the workshop enhance the peace constituencies, i.e. the network of cooperatively minded actors?
  2. How did the workshop fit into the wider context of different dialogue initiatives on the different tracks; was it part of the “dialogue accumulation”?
  3. How was the workshop outcome transferred to the wider political and social context? How was it received by the wider context, by academics, politicians and other actors (e.g., the donor community)?
  4. Were any follow up activities carried out?
- 

*Questions concerning workshop outcome and impact evaluation*

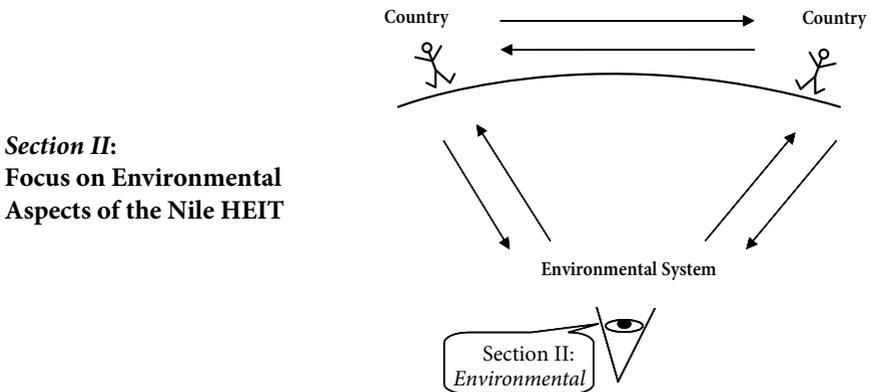


# Environmental Aspects of Conflict Management

The previous section has shown that environmental conflicts are not caused by one factor, and neither by a linear sequence of various factors. Environmental conflicts are systemic: environmental, socio-economic, and political factors interact with each other, together leading to changing balances of conflict and cooperation. One cannot analyze all factors at once, however. The HEIT approach analyzes one factor, keeping in mind how it interacts with the other factors. This is represented in the HEIT model with the shifting “eye”; we focus in different sections of this thesis on different aspects of the human-environment interaction, while still keeping our eyes open to the other aspects present in the background.

The aim of this approach during the next three sections on environment, national and international aspects of water conflict management, is to understand the Nile case both from a natural and social science point of view, and explore possible entry points for conflict management. Where in the system is an intervention the most likely to lead to a more sustainable and cooperative form of interaction? The following section focuses on the environmental aspects of the Nile conflict, the “hard” factual basis, i.e. the physical reality with its limitations and opportunities. The section is divided into water quality and water quantity aspects, as they each have different implications for resource and conflict management.

*Diagram II.I*



*Environmental view of the HEIT system*



## 4 Freshwater Quality

This chapter is an assessment of the water quality issues in Egypt and Sudan. Other countries of the Nile Basin will be included in so far as they effect the downstream countries. The situation in other river basins illustrate the importance of water quality in international river conflicts. The water conflict in the Rhine was to a large extent over water quality, increasing industrialization and lack of water treatment upstream that led to negative impacts downstream. In the Euphrates/Tigris basin, irrigation schemes affect the salinity of the river water, with negative international impacts. The level of industrialization in the Nile Basin is lower than in the Rhine Basin, and irrigation is less developed in the upstream Nile countries, compared to the Euprates/Tigris basin. Yet both industrialization and irrigation are increasing in the Nile Basin. Is water pollution increasing in the Nile Basin? If yes, what are the implications for conflict management?

Changes in freshwater quality can be assessed by comparing the changes in different areas (spatial trends) and by comparing them in one area at different times (temporal trends). Furthermore, the quality can be compared to international clean water standards. The difficulty of such comparisons is that the data base is very small and it is often not possible to compare the different data sets because of the lack of detail information on flow, season, and methods applied. Methods used in gathering data measured in 1906 may well differ to data measured in 2003. We still include data over a long time period, even if some of samples of some of these years are not comparable, as a trend over many years may appear. The section first focuses on the water quality in various environmental systems (rivers, lakes, reservoirs, wetlands, groundwater) and then on the human causes of pollution (industrial, municipal and agricultural).

### 4.1 Rivers

Different *spatial and temporal trends* can be identified in the River Nile (RN). The quality of the RN decreases as it proceeds downstream, especially downstream of Cairo. In the delta the concentrations of salts, organic matter, nutrients, fecal coliform, heavy metals and pesticides are high (NBI 2001: 22). The following spatial overview focuses on the Blue and White Nile in Khartoum, and the Main Nile between Aswan and Cairo, in Cairo and downstream of Cairo (table 4.1).

In the Blue Nile<sup>1</sup> the amount of total *suspended solids* is higher than in the White Nile. This is because the Blue Nile originates in the Ethiopian highlands, where high relief

1 “The Blue Nile” as a term refers to the brownness stemming from the high concentration of suspended solids.

energy persists, inducing both natural and human-made erosion of soil and weathered bedrock. As a consequence, inorganic particles such as silt and clay are held in suspension by water turbulence during the flood season between June and November. During the low flood season, the Blue Nile water is clearer than the White Nile because very little surface runoff is contributed from the Blue Nile. In the flood season of 1906, for example, the Blue Nile had approximately six times more suspended solids than the White Nile (table 4.1). Estimations of the suspended matter reaching Lake Nasser/Lake Nubia vary between 60–110 million tons per year (Waterbury 1979, in Ahmed 1994: 21), 96 million tons per year (ILEC 1999), 124 million tons per year (Moattassem et al. 1993b: 411) and 134 million tons per year (Abu Zeid 1987: 172). The sediment load mainly precipitates in the southern part of the reservoir in Sudan. Out of the 4500 ppm of silt flowing into Lake Nasser/Lake Nubia, only 45ppm/day go to Egypt, thus 134 million tons of silt are deposited in Sudan per year (Ali 2003). Since the Aswan High Dam was built, the amount of suspended solids downstream of Aswan has decreased dramatically, as Lake Nasser acts as a settling tank eliminating about 98% of the sediment load (Moattassem et al. 1993b: 411). As a consequence of fewer suspended solids in the river water, the sun's rays penetrated further through the water, causing an increase in algae growth downstream of Aswan Dam. Algae growth also increased due to higher levels of nutrients (agriculture and urban effluent) in the river water (Moattassem et al. 1993a: 432).

Upstream of the Aswan Dam, the sediment load of the Nile is less influenced by the construction of dams, as the reservoirs do not provide over-year storage like the Aswan Dam reservoir. Especially at the beginning of the high flood period between June and September the dams are opened, “flushed”, to let the greatest part of the sediment load pass through. The fluctuations of sediment load of the Blue Nile vary considerably from one year to another. The data base is not sufficient to indicate if there is a long-term trend. In 1906 a sediment load of 22 million tons was measured on the Blue Nile at Burri, Khartoum (Elgadir 1982: 22)<sup>2</sup>. Before construction of the Roseires Dam on the Blue Nile, the average annual suspended sediment of 134 million tons (46% sand, 53% silt and clay) was measured between 1954 and 1955 by the Ministry of Irrigation as preparation for the construction of Roseires Dam (El Khalify 1985: 32). The reference is not specific about where this was measured; it can be assumed that the measurements were taken somewhere around the future dam location, i.e. 400 km upstream of Khartoum. Another study on the Blue Nile measured 36 million tons of sediment (57% sand and silt, 43% clay) transported past Khartoum in 1968, and 69 million tons (61% sand and silt, 39% clay) of sediment in 1969 (El Bedri 1970, in El Khalifa 1985: 33).

In the Ethiopian part of the Nile Basin, 405 million cubic meters of topsoil are estimated to be discharged annually into the Blue Nile, 120 million cubic meters into the Atbara (Tekeze) (Ethiopian Valleys' Development Studies Authority, in Arsano 2004) and

2 Elgadir gives the figure in 372 ppm (mg/l), the total amount was calculated using the water flow amount for 1906 (SHI 1999).

10 million cubic meters into the Baro-Akobo (Ethiopian Valley Development Authority 1991, in Woube 1995: 26).

Comparing the estimated sediment load in Ethiopia with the sediment load arriving in Lake Nasser leads to new questions. The density of inorganic material in a dry sediment is about 1'000-1'200 kg/m<sup>3</sup>, thus the Ethiopian figures (in cubic meters) would correspond to about 445 million tons/year (Blue Nile), 132 millions tons/year (Atbara/Tekeze) and 10 millions tons/year (Baro-Akobo)<sup>3</sup>. The figures are much higher than the sediment load measured in Sudan or arriving in Lake Nasser, indicating that the estimates are wrong or that vast deposition happens between the measurement localities in Ethiopia and Sudan/Egypt.

One way of checking these figures is to compare them with other assessments based on sediment concentration. The sediment load in the Atbara increased from 5g/l in 1969/1970 to 8 g/l in 1989/1990 due to agricultural intensification in the Ethiopian highlands. At a flow of about 12 km<sup>3</sup>/year, the sediment load of the Atbara in 1990 was 88 million tons. The sediment load of the Blue Nile is 392 million tons, assuming the sediment load ratio of the Blue Nile is similar to the Atbara (El Swaify, Hurni 1996). El Swaify and Hurni (1996) estimate that 90% of the Nile sediments stem from the Atbara and Blue Nile, from a catchment area of 332'000 km<sup>2</sup>, i.e. only 16% of the Nile Basin area. Thus according to these two different estimates, the sediment load stemming from the Ethiopian highlands varies between approximately 500 million tons/year (El Swaify and Hurni 1996) and 587 million tons/year (Ethiopian Valleys' Development Studies Authority, in Arsano 2004).

The *pH* of a water system influences many chemical and biological processes. It is stable in the Nile River, both spatially and temporally, and normally lies between 7.5 and 8.5, which is in the normal range for drinking water according to the WHO (1997, table 4.1). The highest measurement found in the surveyed literature was 9.4 during the low flood season, when the phytoplankton is at its seasonal maximum; the high rate of photosynthesis means a high consumption of carbon dioxide, and as a consequence a rising pH (El Khalifa 1985: 34-35).

Sinada and Abdel (1984, in Ahmed 1994: 20) found in 1969-1970 that neither the Blue nor the White Nile were thermally stratified, which indicates that the water is fully mixed and supplied with oxygen. In both rivers the *temperature* fluctuates between 16.8 and 29.5 degrees Celsius. Besides the seasonal fluctuation, there is also a daily fluctuation, e.g. on the 29. April 1982 the temperature varied between 23 degrees Celsius at 6 am and 28 degrees Celsius at 4 pm (Ali 1982, in El Khalifa 1985: 31). In Egypt the River Nile varies between 15-20 degrees Celsius in the winter; in the summer the river water reaches 25 degrees Celsius (Moattassem et al. 1993a: 415).

3 Estimate of density based on an email exchange with Hans Hurni spring 2004.

Table 4.1: Spatial Trends: River Water Quality in Sudan and Egypt

Parameter	White Nile, Khartoum, 1992 (n=5, t=6) (a)	Blue Nile, Khartoum, 1992 (n=5, t=6) (a)	Main Nile, between Aswan–Cairo, 1991, 1992 (n=29, t=2) (b)	Water in Cairo, 2001 (n=3, t=1) (f)	Nile Delta, downstream of Cairo, 1991, 1992 (n=5, t=2)	Freshwater norm (a)/ World Health Organi- zation guideline for drinking water quality = WHO
<i>Physical indicators:</i>						
Total suspended solids (mg/L)	61 (g)	372 (g)	5–60		15–100 (b)	
Total dissolved solids (mg/L)	141–177	156–180	100–250	200	300–400 (b)	
Turbidity, nephelometric turbidity units (NTU)			4–45	24.3	4–45 (b)	
<i>Chemical indicators:</i>						
pH	7.6–8.3	7.5–8.1		7.67		6.5–8.5 (WHO) (e)
Electrical conductivity ( $\mu\text{S}/\text{cm}$ ) (sensitive to dissolved solids and temperature)	221–242	225–260	200–300	300	450–750	50–500 (a)
Total alkalinity ( $\text{CaCO}_3$ , in mg/L)	90–113	90–150				
Total hardness (calcium carbonate mg/L)	40–85 (av. 70)	60–117 (av. 83)	120		120	soft: 0–60 med: 60–120 hard: 120–180 (a)
Calcium, $\text{Ca}^{2+}$ (mg/L)	8–16	10–35	15–35		30–50	
Magnesium, $\text{Mg}^{2+}$ (mg/L)	9 (av.)	8 (av.)	5–10		5–30	
Sodium, $\text{Na}^+$ (mg/L)	18–20	14–25	10–40		45–70	<200 taste level
Potassium, $\text{K}^+$ (mg/L)	8–10 (av. 9.3)	5–10 (av. 7.5)	5–8		6–8	<10 (a)
Chloride, $\text{Cl}^-$ (mg/L)	10–20	10 av.	1–15	80	30–80	<250 (WHO) (e)
Sulphate, $\text{S-SO}_4^{2-}$ (mg/L)	25–35	15–33	5–30		40–75	<250 (WHO) (e)
Nitrates, $\text{N-NO}_3^-$ (mg/L)	0	0	1–4	3.63	2–8	<10 (WHO) (e)
Nitrites, $\text{N-NO}_2^-$ (mg/L)	0	0	0–0.55		0.02–0.17	<0.1 (e)
Phosphate, $\text{P-PO}_4^{3-}$ (mg/L)			0–0.5		0.1–1.1	
Dissolved oxygen (DO) (mg/L)	7.62–8.06	6.1 – 8.7	3–11 (b) / 7.3 (c)	7.6	2 – 8	>4 (a)
Chemical oxygen demand (COD) (mg/L)			1–25		5–45	
Biological oxygen demand (BOD) (mg/L)	3.5–5.	3.06–4.8	0.1–7 (b) / 2.5 (c)		2–8.5	<2 (a)
<i>Biological indicators</i>						
Total coliform (counts/100 ml) (Membrane filtration (a))	64–432 (a)	64–412 (a)	1–25		1–33	<3 (a), 0 (WHO) (e)
Faecal coliform (counts/100 ml) MPN (Membrane filtration (a))	2.6–9 (a)	2.4–8.8 (a)	0.1–12		1–16	0 (WHO) (e)

*Table explanations: First two columns on the left give water quality parameters in Sudan, the rest in Egypt; the further right the column, the more downstream. Key: n = number of different locations samples were taken at, t = number of times the sample was taken. Figures indicate average (av.) or range (min.–max. measurement) over time and sample number. Data: (a): If not specified otherwise: data of the White Nile and the Blue Nile based on six probes between 15.5.1992–30.7.1992; White Nile: Average of 5 stations 3, 6, 10.5, 25 and 45 km from the confluence of the Blue and White Niles. Blue Nile: average of 5 stations, 3, 3.5, 12, 25 and 40 km from the confluence; (MPN = most probable number) Ahmed 1994. (b): If not specified otherwise: Moattassem 1993a. Measurements downstream of Cairo were taken between 1'000–1'200 km from Aswan. (c) Hassan et al. 1998.*

(e) EEA 2002 (level for  $\text{NO}_3^-$  is 50 mg/l, this corresponds to 10 N- $\text{NO}_3^-$ ). (f) Gupta 2001. measurements taken at 7 km north, 1 km north and 5 km south of the main water treatment plant in Cairo. (g) Elgadir 1982, average from 12 monthly measurements in 1906 ( $t=12$ ) in Khartoum ( $n=1$ ).

*Conductivity* is a measurement of the water's ability to conduct electric current; it is sensitive to the amount of dissolved solids and temperature. The dominant cations in the River Nile are sodium and calcium and the most dominant anion is bicarbonate (Moattassem et al 1993a: 421). Conductivity and the total amount of dissolved solids are an indication of water salinity. In Upper Egypt salinity values are in the order of 150 mg/l and increase along the Nile River to 250 mg/l at Cairo. Salinity increases, especially downstream of Cairo, because of the intensive agricultural, domestic and industrial pollution. The salinity of water discharged into the Mediterranean and Northern Lakes ranges from 2'000 to 3'000 mg/l (El Kady, Millette 2002). This corresponds to about five times more chloride, three times more sulphate, twice as much magnesium, sodium and calcium and two to three times higher conductivity downstream of Cairo compared to the river between Aswan and Cairo (table 4.1). A minimal discharge of water into the Mediterranean is maintained in order to discharge highly saline water that can no longer be used for agricultural purposes.

In Sudan, the total amount of dissolved solids and conductivity is lower during the high flood season than during the low flood season (Ahmed 1994: 22). The higher evaporation rates in the dry low flood season result in a concentration of dissolved solids (Elgadir 1982: 140). The measurements of Ahmed (1994: 45) in 1992 indicate that the conductivity of the Blue Nile and White Nile in Khartoum are similar (table 4.1). In Egypt, Moattassem et al. (1993a: 414) note that there is an increase in pollution loads when the closure period of the canals in January to February ends, as the accumulated pollutants from the irrigation drains are released into the river.

The concentrations of *nitrites* and *nitrites* in Sudan are not problematic, the measured zero concentrations of nitrates are an indication of the detection level of the measurements rather than the non-existence of nitrates. The low nitrate concentration shows a good oxygen supply and small to moderate load in organic matter (table 4.1 and 4.3). High nutrient levels in Egypt have resulted from an increase in urban effluents and agricultural fertilization after the Aswan Dam was built – fertilization to increase productivity and replace the nutrients from the Nile flood. The concentration of sulphates and nitrates more than doubles downstream of Cairo (table 4.1). The nitrite level is in a range where it can become toxic for fish.

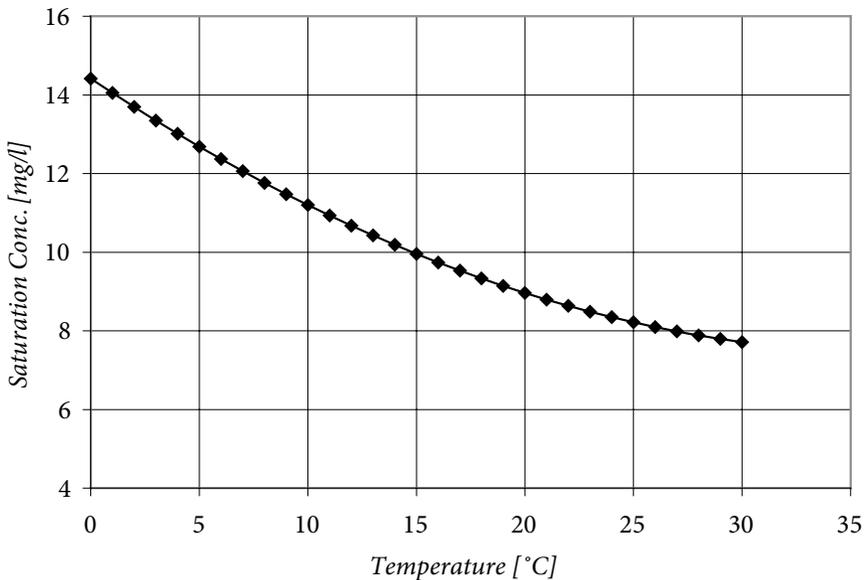
*Biological Oxygen Demand (BOD)* and *Dissolved Oxygen (DO)* values reflect the concentration of organic pollutants in the water. The BOD corresponds to the amount of organic matter that can be bio-chemically degraded by microorganisms – using the dissolved oxygen in the process under normal laboratory conditions (20° C, no light). Water with a BOD of less than 4 mg/l can be considered as organically unpolluted, and water with a BOD of above 10 mg/l as polluted. The highest BOD values found in the surveyed literature were in the Nile delta with a BOD of 8.5 mg/l. The Nile water does therefore not seem to be very polluted with organic matter. However, it has to be kept in

mind that the Nile is never stratified and thus oxygen is supplied from the atmosphere to the whole water body. This oxygen supply allows a fast degradation of organic matter. Despite the high oxygen supply rate, the DO values in the river go down to 3 mg/l, which is far below the oxygen saturation of 8–10 mg/l at temperatures of 15–25°C (Nile in winter 15–20°C, in summer up to 25°C) (diagram 4.1). The DO values in the Nile indicate a high organic load to the river which can not be grasped with the BOD values. The DO values in Sudan have hardly changed between 1955 and 1992.

In the Blue, White and Main Nile the *Total Coliform* and *Faecal Coliform* concentration is more than 10 times higher than recommended by the World Health Organization for drinking water quality (WHO 2001). There is, however, a considerable difference between river water quality and drinking water quality. In Sudan the amount of coliform increases during the flood, an indication of large organic pollution due to the high concentration of inorganic nutrients and organic matter in the mud and the wash-in of fecal residues from fields, local toilet systems and sewers.

Diagram 4.1

Oxygen Saturation of Water at different Temperatures



Oxygen saturation of water at different temperatures at sea level. Data: Stumm, Morgan 1996.

Measurements of *lead* and *cadmium* in the area of greater Cairo indicate that water treatment facilities effectively reduce concentrations of lead by 33% and cadmium by 53% (Mohamed, Osman, Potter and Levin 1998). Concentrations of both lead and cadmium in drinking water are below internationally accepted drinking water standards (table 4.2). Lead and cadmium usually absorb to particles; if the amount of suspended matter is large, less lead and cadmium will be found in the water. Lead and cadmium may be possible contaminants of soils and agricultural products.

There seem to be few changes in the water quality in Sudan over the years. There are, however, contradictory measurements of the increase/decrease in the amount of suspended matter (table 4.3).

Up to date, the pollution in countries upstream of Egypt and Sudan that is transported by the Nile into the downstream countries is negligible. There is the potential threat of industrial or transport accidents. The Sudd swamps in South Sudan act as a natural barrier, giving water from the equatorial lakes regions flowing through the swamps time for self-regeneration. The city of Addis Ababa is drained by the Awash River, which is not part of the Nile Basin, thus none of the pollution from this city arrives in Sudan or Egypt.

Table 4.2 Cadmium and Lead in the Greater Cairo Region

Parameter	Greater Cairo, ppb (a)	Freshwater norm (= FN) / guideline for drinking water quality (= DW), ppb.
<i>Cadmium in raw water</i>	4.15 ( $\pm 0.88$ )	<10 guideline in irrigated waters (FAO) (c)
<i>Cadmium in drinking water</i>	2.2 ( $\pm 0.63$ )	<3 (WHO recommendation) DW (c)
<i>Lead in raw water</i>	29.6 ( $\pm 8.74$ )	1–10 (estimate of global mean in rivers and lakes) 6–34 (US lakes) FW (b) 100 ppb in effluent water (c)
<i>Lead in drinking water</i>	9.93 ( $\pm 0.05$ )	<10 ppb (WHO recommendation) DW (c)

Data: (a) Mohamed, Osman, Potter and Levin 1998. Samples from four water treatment plants at Imbaba, Giza, Naniial El-Roda and Maady. Monthly samples taken between January 1993 and August 1994. An integrated sample of raw water was taken from the surface to 4 meters near the water intake point. (b) US Environmental Protection Agency. (c) EEA 2002.

Table 4.3: Temporal Trends in River Water Quality in Sudan

Parameter (mg/l), average or range (min-max. measurement) over time and sample number	1906-1907 (W. N. Khartoum, t=17, n=1) (a)	1906-1907 (B. N. Khartoum, t=17, n=1) (a)	1955-1956 (W. N. Khartoum, t=7, n=1) (a)	1955-1956 (B. N. Khartoum, t=7, n=1) (a)	1974-1977 (B. N. Sennar, t=36, n=1) (a)	1980 (B.N. Burri, t=12, n=1) (a)	1992 (W. N. Khartoum, t=6, n=1) (b)	1992 (B. N. Khartoum, t=6, n=1) (b)
Suspended solids	27.5-167.27 (av. 65)	2.4-1'964 (av. 264)				20-9'100 (av.948)		
Solids in solution	112-216.5	96.8-166.1		85-140			141-177	156-180
Temperature °C			17-27	18-29	20.3-32 (av. 27)	24-35		
Nitrogen Nitrites N-NO <sub>2</sub> <sup>-</sup>	0	0				0-0.006	0	0
Nitrogen Nitrites N-NO <sub>3</sub> <sup>-</sup> (mg/L)	0.024-0.285	0.018-0.707	0	0			0	0
Magnesium, Mg <sup>2+</sup>	3.81- 13.29	4.37- 11.81	5-10	5-10	1.2-14.4	1.92-8.4	av. 9	av. 8
Sodium, Na <sup>+</sup>	10.32-37.03	3.8-15.7					18-20	14-25
Potassium, K <sup>+</sup>	6.7-22.01	1.29-2.86					av. 9.3	av. 7.5
DO			5.7-8.1 (av.6.8)	5.1-10.4 (av. 7.5)			7.62-8.06 (av. 6.7)	6.1-8.7 (av. 6.7)
BOD			2.9-8 (av. 5)	0.4-5 (av. 3)			3.5-5 (av. 3.8)	3.06-4.8 (av. 3.7)
pH			7.6-8.3	7.4-8.4	7.5-8.5	7.9-9.2	7.6-8.3	7.5-8.1

From left (1906) to right (1992) the measurements of water quality in Sudan become more recent.  $n$  = number of different locations samples were taken in,  $t$  = number of times the sample was taken. Figures indicate average (av.) or range (min.-max. measurement) over time and sample number. B.N.=Blue Nile, W.N.=White Nile. Data: (a): Elgadir 1982, (b): Ahmed 1994.

## 4.2 Lakes, Reservoirs and Wetlands

About 3% of the Nile Basin is covered by lakes and 3% by wetlands. These wetlands and lakes are threatened by drainage (for agriculture), filling (for waste disposal and settlements), dredging and stream canalization (for navigation and flood protection), hydrological alteration (for canals), groundwater abstraction, siltation, and discharge of pesticides, herbicides and sewage (NBI 2001: 8–20).

During years of high floods, such as in 1999, the Nile River is flushed of its pollutants. This is not the case for the lakes and wetlands of Egypt which are of a much poorer quality (table 4.4). Lake Manzala receives some 845 million m<sup>3</sup> of drainage water every year containing industrial wastewater from some 80 factories in the greater Cairo area (EC 1999: 8). The coastal lakes, also known as the Nile Delta Lakes, are shallow (av. depth 1.10 m), with a salinity varying from fresh to brackish in the sea-ward direction. The total surface area of these lakes is <50% of what it was 30 years ago due to land reclamation and urbanization. At the end of 1985, the fish production of these lakes represented 50% of the Egyptian annual fish yield; this has declined since then due to the wastewater discharge into these lakes (Hamza 1999: 5).

Table 4.4: Lake Water Quality in Egypt

Parameters	L. Mariut	L. Edku	L. Burullus	L. Mamzalah
Area (km <sup>2</sup> )	62	109	350	650
Depth (cm)	50–150	40–220	50–200	50–100
Annual water discharge (lower than inflow, due to evaporation) (km <sup>3</sup> )	2.06	2.37	3.20	6.70
Trophic status	Hypertrophic	Mesotrophic	Mesotrophic	Hypertrophic
Water residence time (days)	10	21	42	32
Lakes receive water and effluent from A = agriculture, I = Industrial, S = Sewage, G = Groundwater.	A, I, S, G	A	A	A, I, S, G

Table 4.4. shows the water quality parameters of four shallow lakes in Northern Egypt. The hypertrophic lakes are recipients of sewage. The water residue time is short, due to the lakes' connection with the Nile River and irrigation systems and the high evaporation rates. Table according to Hamza 1999: 5.

The concentration of suspended solids in Lake Nasser reservoir is about five times higher during the flood period than during the low flood period (table 4.5). The measurements taken after the flood in Lake Nasser are similar to measurements made in Sudan during high flow, and the measurements taken before the flood are similar to measurements made in Egypt downstream of Aswan. Moattassem et al. (1993b) compare studies of the water quality of Lake Nasser over a twenty-year period between 1972 and 1992 and states that the pH levels are stable and that the total amount of dissolved solids has increased by about 10%. Furthermore, according to these studies there is a slight concentration increase of cations (Ca, Mg, Na, K) for the period before the flood, but no change after

the flood. Similarly there is no change of the anion concentration after the flood but slight changes before the flood.

Table 4.5: Reservoir Water Quality, Lake Nasser

	Temp. °C.	Velocity of lake water flow to dam (m/sec.)	Turbidity (NTU)	Suspended solids (mg/l)	Conductivity (µS/cm)	pH	Dissolved oxygen (mg/l)	Phosphate, P-PO <sub>4</sub> <sup>3-</sup>
Nov. 1991 (after flood)				200–250				
May 1992 (before flood)	27–36	0.1–0.55	20–80	10–80	265–285	7.3–8.2	6–8.6	0.05–0.20

	K <sup>+</sup> (mg/l)	Ca <sup>2+</sup> (mg/l)	Mg <sup>2+</sup> (mg/l)	Na <sup>+</sup> (mg/l)	Cl <sup>-</sup> (mg/l)	NH <sub>3</sub> (mg/l)	N-NO <sub>3</sub> <sup>-</sup> (mg/l)	N-NO <sub>2</sub> <sup>-</sup> (mg/l)
Nov. 1991 (after flood)	3	19–25	6–12	8–40	2.9–12.8			
May 1992 (before flood)	7–8	40–46	10–20	22–25	8–11	0.1–0.4	6–12	0.1–2.2

Water quality parameters before (May) and after the flood (November) are compared in Lake Nasser. November 1991: six depth samples were taken from three points on the cross section at four locations along Lake Nasser. May 1992: three depth samples were taken from three points on the cross section at eight locations along the lake (the high NH<sub>3</sub> values are a result of samples being taken from the surface as well as the reservoir floor, where there is less oxygen). NTU = nephelometric turbidity units. Data from Moattassem et al. 1993b.

The velocity and turbidity decreases from the inlet towards Aswan. This also goes hand in hand with the deposition pattern in Lake Nasser: most of the deposition occurs between 370 km and 470 km upstream of Aswan in Sudan (Mottassem et al. 1993b: 192). The total lake capacity is 162 km<sup>3</sup>. The dead storage space of 31.6 km<sup>3</sup> lies below the sluices and is designed for sediment accumulation, leaving the water above the dead storage line available for usage. With an average inflow of about 134 million tons of sediment per year, the sedimentation in Lake Nasser was estimated to amount to 60 million m<sup>3</sup> annually, and measured to be 60–70 million m<sup>3</sup> annually (Abu Zeid, El-Schibini 1997: 213). According to these figures, it would take about 400–500 years for the dead storage to be filled up. The problem is therefore not the absolute amount of sediments, but *where* the sediments are deposited. If sediments are deposited unevenly and accumulate above the dead storage line, they can influence the flow of the water, in the worst case causing the water to leave the present lake bed. Heavy siltation occurs 360–430 km south of the dam, where siltation beds have already emerged in the live storage zone (Abu Zeid 1987: 172).

Much of southern Sudan is covered by swamps, the Sudd (19'200 km<sup>2</sup> in 1980, Howell et al. 1988), the Machar Marshes (6'500 km<sup>2</sup>, Howell et al. 1988) and the Bahr al Ghazal swamps. The upper Nile wetlands of Sudan are one of the largest wetland areas in the world, the size varies greatly according to low and high flood years (Keddy 2000). It is the home

to numerous South Sudanese tribes and also an important habitat for migratory birds. Unlike the wetlands in Europe, these wetlands are not threatened by industrialization and modern agriculture, at least not until the upstream countries in the great lakes region industrialize further. The most likely modification of the Sudd area could come from canals built for navigation and to minimize the water lost to evaporation. The Egyptian and North Sudanese construction of the Jonglei canal, however, was terminated by an attack of the Sudanese People's Liberation Army in 1983 (see chapter seven). A newly emerging and increasing impact on the Upper Nile swamps is related to the recent oil activities which comprise oil exploration, extraction and transportation (Ali 2003).

### 4.3 Groundwater

The horizontal flow of deep groundwater in North Africa is relatively slow. It therefore takes a long time for deep groundwater deterioration in one country to affect the water quality in a neighboring country. Pollutants carried by international rivers can affect the groundwater of another country as water seeps through the river bed into the groundwater. The water quality of the River Nile upstream of Cairo is fairly good, however, so the pollution of groundwater in the Eastern Nile Basin is mainly a national problem. In the confined aquifers of the Sahara, however, groundwater abstraction in one country may influence the piezometric surface<sup>4</sup> in a neighboring country leading to a drawdown cone<sup>5</sup>. This may result in a change in the hydrodynamic situation with potential water quality problems in a neighboring countries, e.g. salinity problems. Chad, Niger, Egypt and Sudan share the Nubian Sandstone aquifer (CEDARE 2001).

#### *Groundwater quality in Egypt*

Six aquifer systems can be identified in Egypt, each according to their geological structure:

1. "The Nile aquifer system, assigned to the Quaternary and Late Tertiary, occupies the Nile flood plain region (including Cairo) and the desert fringes.
2. The Nubian Sandstone aquifer system, assigned to the Paleozoic-Mesozoic, mainly occupies the Western Desert.
3. The Moghra aquifer system, assigned to the Lower Miocene, mainly occupies the western edge of the Delta.

4 In a confined aquifer the piezometric surface is the static level of water in wells, it is an imaginary surface formed by measuring the level to which water will rise in wells of a particular aquifer (Michigan State University, Wellhead Protection Program, Glossary).

5 The drawdown is the vertical distance groundwater elevation is lowered, due to the removal of groundwater. The distance between the static water level and the surface of the cone of depression (Michigan State University, Wellhead Protection Program, Glossary).

4. The Coastal aquifer systems, assigned to the Quaternary and Late Tertiary, occupy the northern and western coasts.
5. The carstified Carbonate aquifer system, assigned to the Eocene and to the Upper Cretaceous, outcrops in the northern part of the Western Desert and along the Nile system.
6. The fissured and weathered hard rock aquifer system, assigned to the Pre-Cambrian, outcrops in the Eastern Desert and the Sinai Peninsula.” (RIGW, 1993. In Attia 1999).

Of these aquifers the Nile aquifer system is the most threatened by anthropogenic pollution, because the population of Egypt is concentrated in the Nile Valley<sup>6</sup>. The Nile aquifer system is a renewable water source as it is recharged by the Nile River. Groundwater quality depends on the quality of the recharge source and the cleaning ability of the aquifer. The water quality of the Nile aquifer reflects the water quality of the Nile River, i.e. the spatial trends discussed above.

*Table 4.6: Nutrients and Coliform concentrations in Wells near Domestic Areas*

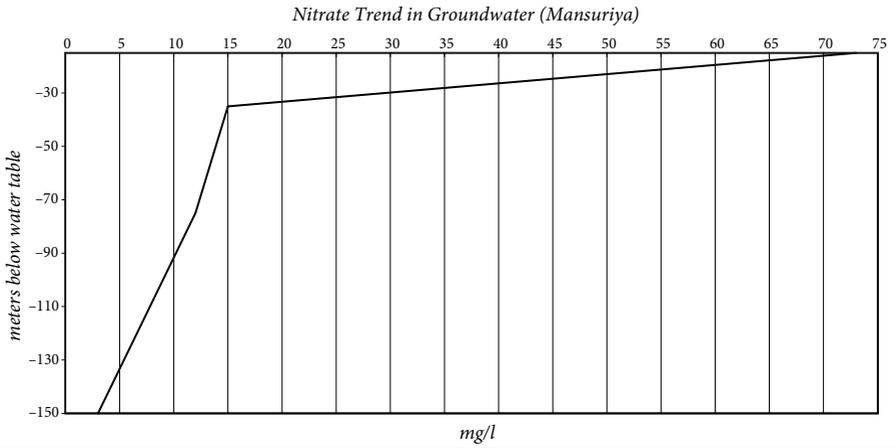
	Well depth (m)	Total dissolved solids (mg/l)	K <sup>+</sup> (mg/l)	NO <sub>3</sub> <sup>-</sup> (mg/l)	Total Coliform (counts/100 ml) MPN	Faecal Coliform (counts/100 ml) MPN
Belbeis, wastewater drain	5–12	1'340	24	16	216	1
Shibin El Kanater, urban	19–20	1'120	8	1	1'200	8
Beni Suef, urban	4–15	1'240	97	4	65	63
Imbaba Cairo, urban	9–21	1'800	13	2	12	0
Abu Rawash, urban	7–22	930	33	9	378	72
Gabal el Asfar, irrigation	5–12	1'420	15	61	352	25
Giza, urban	11–14	820	12	8	450	135

*Samples taken between May and July 1998 in seven wells. MPN = Most Probable Number. Data: Khater 1991: 147.*

In the urban and sub-urban areas, the majority of the pollution comes from domestic and industrial sources (Attia 1999). The total coliform concentrations measured in seven wells by Khater et al. (1991) were 4 to 400 times higher than the WHO drinking water standard (table 4.6). Three forms of contamination are possible: through the soil, along the well or inside the well (Khater et al. 1991: 148). The principal type of groundwater pollution near the coast is saline water intrusion from the sea. There are estimates that this effects nearly a third of the delta. The flood plain along the banks of the Nile and delta is effected by the Nile water which is loaded with salts, agro-chemicals and other ions, mainly coming from agricultural activities (table 4.7).

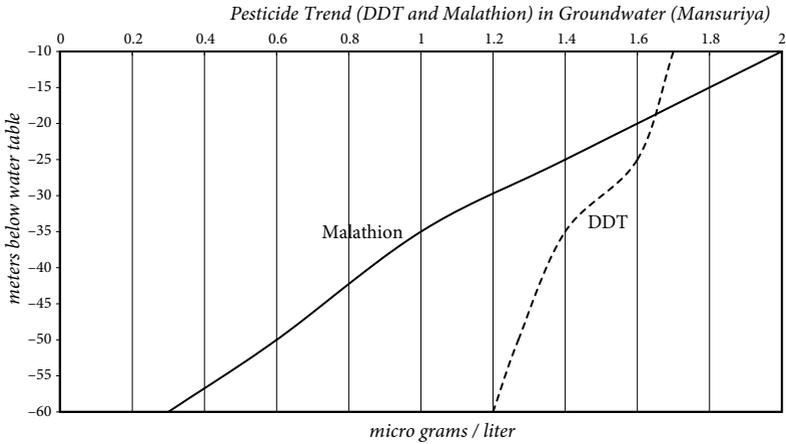
- 6 11.3% of the population of Egypt is concentrated in Cairo, 8.9% in the coastal governorates (including the northern portion of the Western Desert), 40% in the Delta governorates, 34.4% in the Nile valley (Upper Egypt) governorates, and the rest distributed among the remaining area of the country (Attia 1999).

Diagram 4.2



Nitrate Trends in Groundwater at Mansuriya. Diagram according to Attia 1999.

Diagram 4.3



Trends of DDT and Malathion in Groundwater at Mansuriya. Diagram according to Attia 1999.

Table 4.7: Nutrient and Pesticide concentrations in Wells in Agricultural Areas

	Well depth	NO <sub>3</sub> <sup>-</sup> (mg/l)	PO <sub>4</sub> <sup>3-</sup> (mg/l)	NH <sub>4</sub> <sup>+</sup> (mg/l)	Pesticides Chloro (DDT) (µg/l)	Pesticides Phosphorus (Malathion) (µg/l)
El Mansuriya, shallow groundwater	5m	110	0.03	2.9	5.7	5.3
El Mansuriya, deep groundwater	33m	2.5	0.02	4.1	8.1	1.5
Tahrir/Bustan, shallow	28m	8	0.02	1.9	0.5	4.2
Tahrir/Bustan, deep	62m	4	0.01	2.7	0.6	3.4
Benha, shallow	25m	6	0.01	1.6	0.4	2.5
Benha, deep	51m	10	0.01	1.8	0.3	0.6

Detection limits for pesticide analyses were not well determined. Samples taken between March and June 1990. Average from the results of 21 wells. Data: Khater et al. 1991: 149.

Persistent pesticides such as DDT are prohibited, as they accumulate in the food chain and may be toxic or exhibit endocrine disrupting effects (having hormonal effects or inhibiting them). Traces of DDT can still be detected in groundwater under the old cultivated lands, with concentrations reaching 1.6 µg/l at 25 meters depth (Attia 1999). The use of fertilizers has increased since the Aswan High Dam construction in order to increase agricultural productivity and replace the Nile silt (diagram 4.5); there also seems to be an increase in dosage (Khater et al. 1991: 148). The concentrations of nitrates, malathion and, to a lesser degree, also DDT decrease vertically below the water table (Attia 1999, diagrams 4.2 and 4.3). Nitrates may percolate through the soil from the agricultural land. The nitrate concentrations in the groundwater at 15 meters below the water table in Mansuriya are eight times higher than those in the Nile River (table 4.1) – drinking water quality is reached at about 20 meters below the water table in this case.

The quality of the groundwater at the fringes of greater Cairo is worse than at the center, as it is also effected by agriculture and the municipal waste disposal happens through pits, as is typical for rural areas. It is also in this area where groundwater is the main source of drinking water (Attia 1999). Deep groundwater (>25 m) is normally microbiologically safe, as it is protected from surface pollution (Khater et al. 1991: 150).

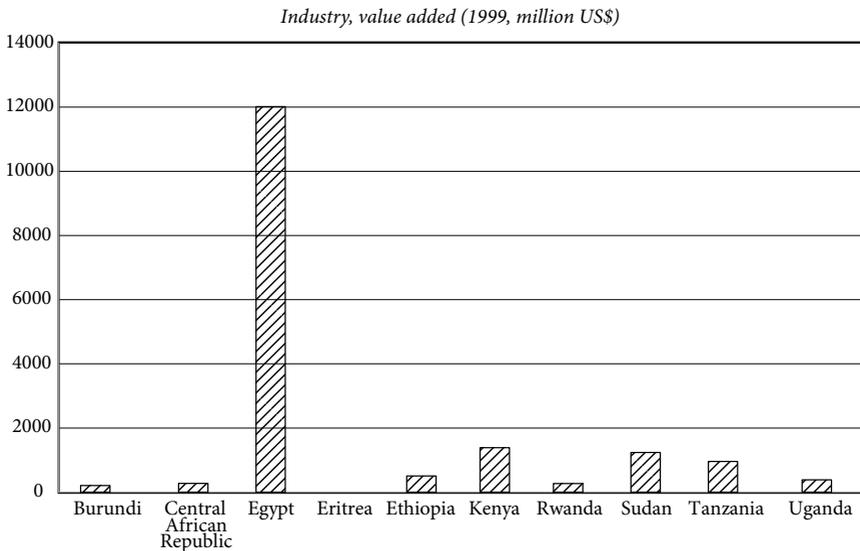
#### 4.4 Industrial Causes of Pollution

Egypt's relatively large industrial output compared to that of the other Nile countries is an indication that it may be the main industrial polluter of the River Nile (see diagram 4.4). Since the 1998 pollution prevention program, however, it is safe to assume that Egypt's treatment facilities are of a higher standard than those in the other countries in the Nile Basin.

In Egypt about 47% of the BOD resulting from organic pollution stems from the food industry, followed by 17% from the textile, 12% from the metal and 9% from the chemical industries (World Bank 1998). Around 50% of Egypt's industrial activity is concentrated

in Cairo. The industries of Cairo use about 162 million cubic meters of freshwater per year and discharge about 130 million cubic meters per year (Attia 1999). There are estimates that 0.75 tons of heavy metals are discharged per day (EC 1999: 9). A national survey in 1997 showed that 34 industrial facilities were discharging polluted waters into the Nile at a rate of 100 million cubic meters per year. These facilities produce fertilizers, chemicals, oil, soap, iron, steel, sugar, cement and petroleum products (see map 4.1) (Ebeid and Hamza 1999: P6.1–P6.21)<sup>7</sup>.

Diagram 4.4



*Comparison of the value added from the industrial sector in the ten Nile Basin countries. Industry corresponds to International Standard Industrial Classification divisions 10–45. It comprises value added in mining, manufacturing, construction, electricity, water and gas. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Data: World Bank 1998.*

Since 1998 environmental laws were enforced to a greater degree, reducing the amount of industrial effluent that was discharged directly into the River Nile. Law enforcement in the other fresh water bodies is still pending (Attia 1999). The Nile Pollution Prevention Program seems to have been partially effective. According to a media report, 34 companies had met the deadline for compliance set by Law 4 of 1994 by 1999 (Ahram 1999), but according to El Kady and Millette (2002) most of the industries are still discharging their wastewater without treatment into the waterways. The input of organic matter

<sup>7</sup> Nile Pollution Prevention Program at a cost of LE 350 million, i.e. 103 million US\$.

into the Nile remains alarming. According to the European Commission's report on the environment in Egypt, the total amount of organic matter discharged in the effluent of industrial plants into the Nile equals 270 tons/day – which corresponds to the untreated sewage from more than 6 million people (EC 1999: 8). While Sudan has no program similar to the Nile Pollution Prevention Program in Egypt, it passed an Environmental Protection Act in 2001. This umbrella law facilitates the stipulation of sectoral environmental conservation laws (Ali 2003).

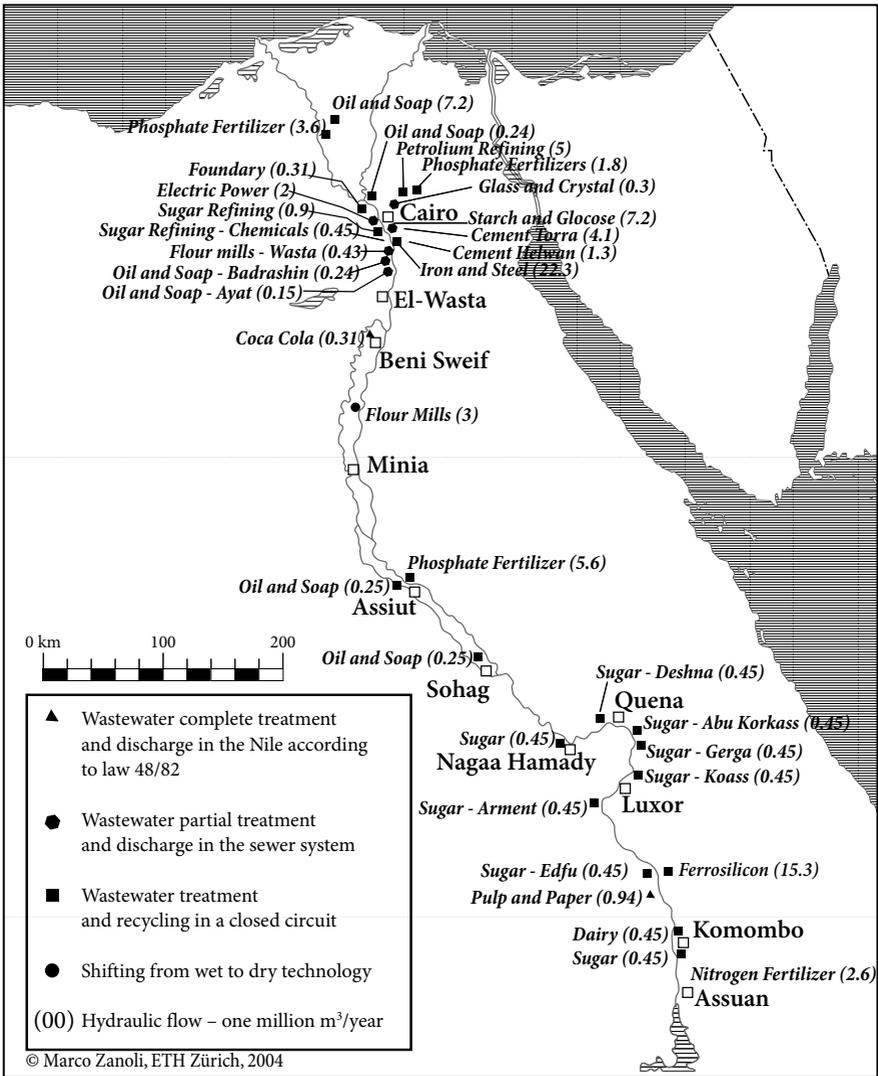
#### 4.5 Municipal Causes of Pollution

About 25% of Egypt's population is connected to sewage services (El Kady, Millette 2002). The problem is that the expansion of the sewage system often lags behind the expansion of the water supply system. In the sewage system of greater Cairo, between 15% and 20% of the conveyed sewage flow is lost due to lack of rehabilitation and leakage. Water is also lost in the water supply system because expansion is often given priority over maintenance. Thus, in 1995 it was estimated that 40% of the delivered water was being lost through seepage. Efficiency should have increased since then due to large investments, but it is likely that a large amount is still being lost (Attia 1999). A simple leaching pit is typical in areas not connected to the sewer system. The wastewater may either percolate to the groundwater table, be collected by vacuum trucks that empty the waste into a channel or onto agricultural land, or, if regular emptying is not available, the inhabitants have to enter the pit to manually remove the sludge. At present, only half of the wastewater collected in greater Cairo receives biological treatment. One problem is that water consumption and wastewater generation habits of the non-sewer areas are rapidly adopting the habits of the sewer-served areas, although they are not as well equipped (Attia 1999).

#### 4.6 Agricultural Causes of Pollution

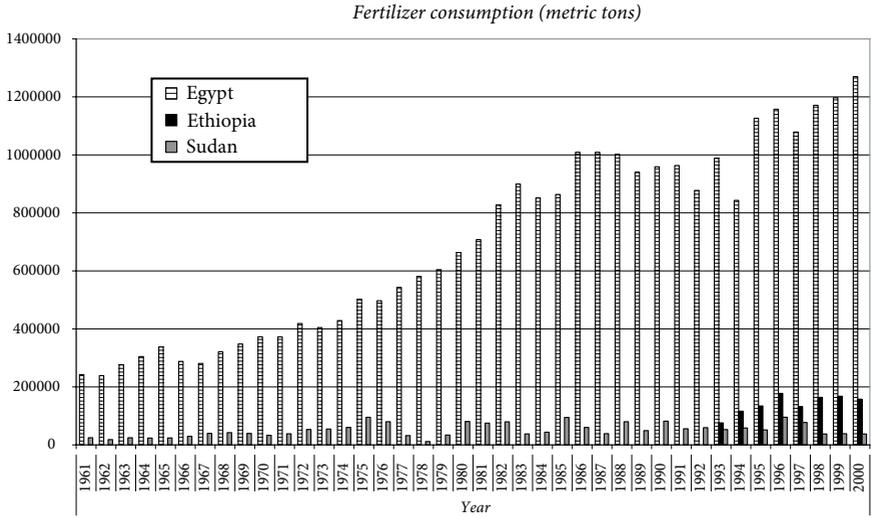
The use of fertilizers quadrupled in Egypt during the last three decades. In 1993 877'000 tons (86% of total fertilizers) of nitrogenous, 113'000 tons (11%) of phosphorus and 29'000 tons (3%) of potassium fertilizers were used in Egypt, i.e. about 340 kg/ha and year (MALR, Economic Affairs Sector. In Abu-Zaid 2001: 19–20). In 2000 the total fertilizer consumption was about 1.3 million tons (diagram 4.5). Eutrophication problems due to nitrogen and phosphorus residues are a consequence of the excessive use of fertilizers. The use of pesticides was cut in Egypt by 90% during the last 15 years due to the removal of subsidies and the replacement with other pest management alternatives (diagram 4.6) (Ebeid, Hamza 1999: P6.5). Developments in what types of pesticides are used also means that they act more selectively, and thus smaller doses can be applied with an equivalent effect (World Bank 1998).

Map 4.1



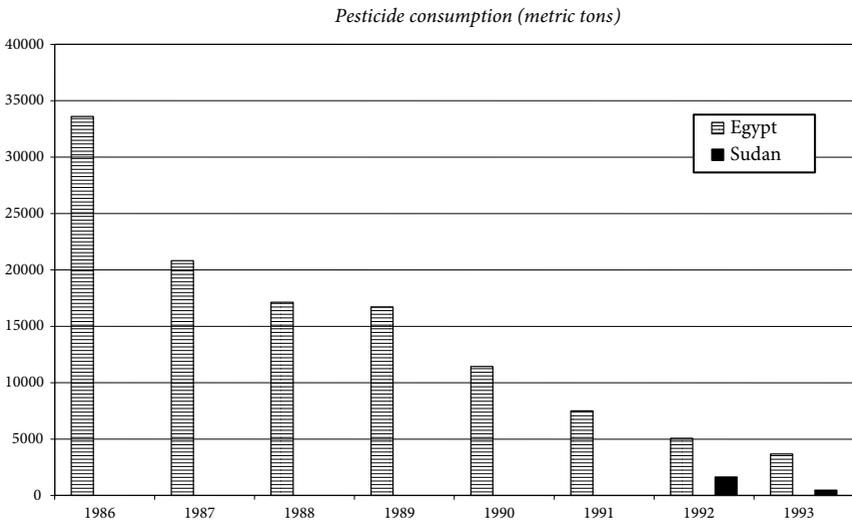
Nile Pollution Prevention Program. Different sources of pollution according to industry are marked. Effluent flow from these industries is given in million m<sup>3</sup>/year. Map according to Ebeid and Hamza 1999: P6.6.

Diagram 4.5



Fertilizer consumption in Egypt, Ethiopia and Sudan between 1961–2000. Data: Food and Agriculture Organization, Production Yearbook and data files. World Bank 1998.

Diagram 4.6



Pesticide consumption in Egypt, Ethiopia and Sudan between 1986–1993. Data: Food and Agriculture Organization, Production Yearbook and data files. World Bank 1998.

The amount of applied irrigation water is normally higher than the amount that evapo-transpirates. The excess water carries salts and chemical residues with it as it percolates into the groundwater. The concentration of pollutants in the water decreases during this process. A number of pesticides persist, however. A farmer's knowledge on which types of chemicals should be used, and when and how frequently he should apply these fertilizers and pesticides is decisive in mitigating pollution of the groundwater (Attia 1999).

Egypt is the main consumer of fertilizers and pesticides in the Eastern Nile Basin. In 1993 Egypt consumed about ten times more fertilizer and eight times more pesticides than were used in Sudan (diagrams 4.5 and 4.6). If one includes all ten countries of the Nile Basin in the comparison, Egypt uses about three times more fertilizer than all the other countries together (FAO in World Bank 1998).

The use of herbicides to control submerged weeds in canals and water hyacinths in drains (which, if not cleared, can choke irrigation systems) has caused serious environmental hazards (FAO 1997). The Egyptian Institute Of Weed Control and Channel Maintenance (IWCCM) estimates that about 25'000 km of channels are infested with weeds. Mechanical or biological control is the most practical technique with the least environmental hazards. Using new mechanical techniques (e.g. the Automatic Prier), attempts are being made to reduce the water lost through evapo-transpiration from the present 50 million m<sup>3</sup>/year to 20 million m<sup>3</sup>/year (Sherif and Ashraf 1999).

#### 4.7 Water-Borne Diseases

The total coliform and faecal coliform counts in the River Nile and in wells, both in Sudan and in Egypt, indicate that bacterial diseases are a problem. In urban areas the drinking water is partially treated, but the figures of water supply coverage are contradictory. According to the World Health Organization, the coverage of clean water supply and sanitation is much greater than according to other estimates (table 4.8). According to the WHO (2000), 80–91% of the rural population of Egypt has sanitary coverage. The UNCCD (1999: 13), on the other hand, states that 25% of the rural population is "considered as having some sanitary facilities". See also section 4.5. on the municipal causes of pollution.

In Sudan the expansion of irrigated agriculture went hand in hand with an increase in water-borne diseases such as Malaria and *Schistosomiasis* (Bilharzia). A good breeding ground for Anopheles mosquitoes and Bilharzia spreading snails is given through the continuous presence of water in irrigation canals. Nation-wide in Sudan, malaria is one of the most prevalent diseases with a prevalence of 20% in 1985 (El Khalifa, Nour 1991). Malaria is one of the most serious diseases in the Gezira irrigation scheme (800'000 ha) located between the Blue and White Nile upstream of Khartoum. It is estimated that 20–40% of the out-patients are effected and that this disease is the cause of 20.3% of the total deaths in local hospitals (El Khalifa, Nour 1991). It is estimated that 7–8 million persons are infected by malaria in Sudan annually, 30–40'000 die annually and 40%

of the Ministry of Health budget goes to drugs and treatment (Ali 2003). Other water related diseases in Sudan include: Typhoid, guinea worm (Dracontiasis), River blindness (Onchocerciasis) and Kala azar (Leishmaniasis) (Ali 2003).

Table 4.8: Water Supply & Sanitation Coverage in Egypt, Sudan and Ethiopia, 1990, 2000. (WHO 2000).

Country and year	% urban water supply coverage	% rural water supply coverage	% total water supply coverage	% urban sanitation coverage	% rural sanitation coverage	% total sanitation coverage
Egypt 1990	97	91	94	96	80	87
Egypt 2000	96	94	95	98	91	94
Sudan 1990	86	60	67	87	48	58
Sudan 2000	86	69	75	87	48	62
Ethiopia 1990	77	13	22	58	6	13
Ethiopia 2000	77	13	24	58	6	15

Egypt, except for a few pockets in some of the oases, is free of the malaria-carrying mosquito (*Anopheles gambiaensis*). Its spread is seen as a potential impeding danger, however, since the spread of agricultural projects with settlements of farmers and fishermen could create the possibility for the mosquito to become endemic, as is the case in Sudan (Sobhy 1993: 222).

*Schistosomiasis* has been known in Egypt for a long time as a consequence of untreated water being discharged in irrigation channels as well as human bathing and cleaning activities in the open waterways. With the Aswan High Dam there was a change in the irrigation scheme in upper Egypt from seasonal to perennial irrigation. This also brought with it an increase in the prevalence of urinary *schistosomiasis*. In northern Egypt there was an increase in the *schistosomiasis* carrying snails as well. Because the current is slower, there was an increase in vegetation growth, and less snails were washed out into the sea than used to be the case during the flood period (Sobhy 1993: 221–222).

## 4.8 Conclusion

*Spatial trends:* Water quality is a problem around urban centers and in the Egyptian delta. Pollution increases downstream, especially downstream of Cairo. Main pollutants are nutrients, salts, pesticides and microbes. Concentrations of cadmium and lead in the Nile in Cairo are similar to those in rivers in other industrialized countries. In general, the river water quality is better than that of many other water bodies (close to surface groundwater and delta lakes), especially in high flood years, because the river is flushed periodically. High concentrations of fertilizers and salts in irrigation drainage water are likely to be the main challenges in the future.

*Temporal trends:* Water quality parameters in Sudan have been fairly stable over time; there are contradictory assessments of the trends of sediment load. In Egypt there is a trend towards using less quantities of pesticides because they are now more specific. The amount of fertilizers used is increasing. The treatment of industrial wastewater has increased since about 1998 due to stricter law enforcement. There are indications that the sediment load of the Atbara increased between 1970 and 1990.

*International Conflict Implications:* The international implications of water pollution in the Nile Basin are negligible up to the present day, as the main water pollution happens in the most downstream country. In the future, however, with an increase in industrialization upstream, it is advisable to monitor the water quality in different countries of the Nile Basin with similar methods and adjust preventive measures accordingly. Monitoring water quality now would enable a baseline analysis of the “natural” water quality, upon which future trends influenced by human activities (e.g. large-scale irrigation causing high concentrations of salts) could be compared to.

The international water use conflict in the Nile Basin is not over water pollution. Any investments to prevent water pollution could ease the problem on the national level, especially around urban centers. Sediment loads, a water quality factor affecting the water quantity stored in reservoirs, is a major international problem. Since about 90% of the Main Nile sediments stem from the Atbara and Blue Nile basins (covering about 16% of the Nile), watershed management seeking to ease the international impacts of erosion and sedimentation should focus on this area of the Nile Basin.



## 5 Assessment of Water Quantity

According to the political debates of the Nile conflict discussed in the literature and the media, the water conflict in the Nile Basin is related to the allocation of water quantity between the various countries. With a limited amount of river water and increased demand due to population growth, one can hypothesize that tensions over water allocation will increase in the future. A water conflict may be exaggerated or underestimated by only examining the political manifestation of the conflict. Data on the physical availability and withdrawal of water is therefore required. For conflict management, any trends concerning the import of “virtual water”, the efficient utilization of water (more crop per drop), or irrigation developments upstream, would indicate possible entry points to ease the pressure on the internationally shared water resources. This chapter therefore looks at the availability of water in the Nile Basin, then at the present and projected withdrawal of water in Egypt, Sudan and Ethiopia in the agricultural sector, and ends with a section on the problems of siltation, as well as those of floods and drought.

### 5.1 Water Availability

The climate of the Nile countries varies from rainforest, temperate climate to semi-arid regions and desert. While in some countries of the Nile rainwater is available, in others, such as Egypt and Northern Sudan, the Nile River is almost the only renewable source of freshwater.

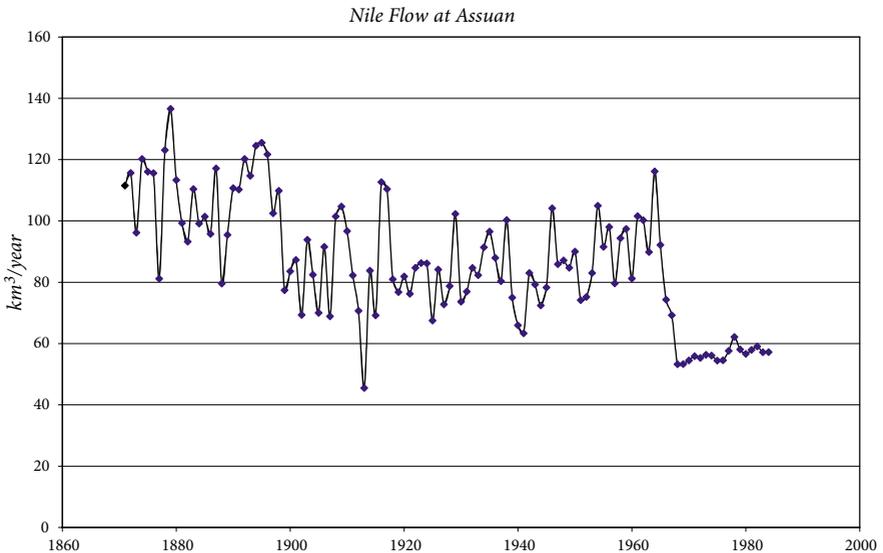
The average flow of the Nile between 1899 and 1959, upon which the agreement of 1959 between Egypt and Sudan was based, was  $84 \text{ km}^3/\text{year}$ . The average flow between 1869 and 1984 was  $87.1 \text{ km}^3/\text{year}$  (SHI 1999). The extreme values of 1916 ( $120 \text{ km}^3/\text{year}$ ) and 1984 ( $42 \text{ km}^3/\text{year}$ ) and the flow of the other years up until 1965 at Aswan (diagram 5.1) demonstrate the fluctuations of the Nile flow (Collins 1990: 402). In the 1980s fears were expressed that precipitation over the Nile watershed was decreasing as part of global climate warming. Indeed, the annual amount of precipitation in the Nile watershed decreased between 1965 and 1984. Since 1984, however, the yearly amount of precipitation began to increase again (Conway 2000: 59–60). The effects of a global climate change are difficult to predict, but there are indications that global warming means greater climatic fluctuations, e.g. storms, droughts and floods (Watson et al. 1997).

#### 5.1.1 Water Availability in Egypt

The Aswan High Dam, completed in 1968, has changed the river flow regime of the Nile in Egypt into a human controlled river. This enables the protection in high flood years

(e.g. 1964, 1975) and preservation of water from wet years for dry years (e.g. 1972, 1982). The Nile is the only source of renewable freshwater in Egypt, other than small amounts of rainwater on the coast and flashfloods in wadis. The mean annual rainfall of 18 mm ranges from 0 mm/year in the desert to 200 mm/year in the northern coastal region (Aquastat 1997a). According to the agreement of 1959 with the Sudan, Egypt has the right to use 55.5 km<sup>3</sup>/year from the main Nile measured at Aswan (Agreement 1959: SECOND. 4).

Diagram 5.1



*Nile flow measured at Aswan. The last natural flow of the Nile below Aswan was in the year 1965. Data: SHI 1999.*

The quantity of fossil groundwater in the Nubian Sandstone Aquifer is estimated at 150'000 km<sup>3</sup> water (UNEP 2002). The rate of abstraction from the Nubian sandstone aquifer is estimated at 1.029 km<sup>3</sup>/yr in Egypt, 0.851 km<sup>3</sup>/yr in Libya, 0.406 km<sup>3</sup>/yr in Sudan, and a negligible amount in Chad (CEDARE 2001). The depth of up to 1'500 m and the quality of the water, however, means that it is problematic to use this in great quantities. Fossil groundwater storage in the Western Desert is estimated at 40'000 km<sup>3</sup> (salinity 400–700 ppm) (Abu Zaid 1991: 20). One has to differentiate between fossil groundwater and the groundwater from the Nile aquifer. The latter is renewed by the Nile River and by irrigation water, and can therefore not be considered as separate from the Nile. The groundwater storage capacity in the Nile Valley and Delta system is estimated at 200 km<sup>3</sup> (salinity: 800 ppm) and 300 km<sup>3</sup> respectively (Abu Zeid 1991: 20). The wells

in Egypt are concentrated along the North coast, the Red Sea coast, Sinai and in the South Western Desert. The other source of groundwater recharge stems from Sudan; this is estimated at  $1 \text{ km}^3/\text{year}$  of groundwater (Aquasat 1997). At present desalination of saltwater produces about  $0.03 \text{ km}^3/\text{year}$ . At a cost of  $0.5\text{--}2 \text{ US\$/m}^3$  it is too expensive for agricultural use (Egypt 1999: 49).

While a minimal increase is possible on the resource side by increasing desalinated water, withdrawing more fossil water and minimizing losses to the sea, the main increase in availability can be gained in re-use and efficiency increase. Thus on the national level, re-use and efficient water utilization have the highest priority. According to Egyptian estimates, an additional  $20.9 \text{ km}^3/\text{year}$  could be made available through recycling water, by changing irrigation techniques and adopting water efficient crops and cropping patterns (El Quosy, Tarek 1999: EGY-18.8) (table 5.1). This is equal to 30% of the water that is being used at present. The water balance of Egypt shows that the available water supply is sufficient for the future, at least until the year 2017. However, without the  $55.5 \text{ km}^3/\text{year}$  quota, it will be difficult to ensure a sufficient supply (table 5.1). Egypt already now imports about  $15 \text{ km}^3$  “virtual water”/year, i.e. water in the form of food (table 5.6).

Table 5.1: Egypt's Water Availability and Demand

	1999 ( $\text{km}^3/\text{year}$ )	planned by 2017 ( $\text{km}^3/\text{year}$ )
Nile water, according to the 1959 agreement between Sudan and Egypt	55.5 (a)	55.5 (a)
Fossil groundwater	0.5 (a) to 0.9 (e)	1.2 (b) to 3.3 (d)
Rain	1.4 (a)	1.4 (a)
Desalinated water	0.03 (a)	0.5 (b)
Water lost to the sea	-4 to -1 (c)	-0.3 to 0 (a)
<b>Total available</b>	<b>53.4 to 58.3</b>	<b>58.3 to 60.7</b>
Re-use / increase in efficiency:		
Recycling of drainage water	4.3 (a)	9 (a)
Recycling of sewage water	0.4 (a)	2.5 (a)
Nile-groundwater (reused Nile-water)	2.6 (d) to 4.8 (a)	4.9 (d) to 7.5 (a)
Improved irrigation system	0.5 (a)	3 (a)
Changed crop sorts and patterns		3.5 (a) to 4.2 (b)
<b>Total amount of water that can be used</b> (=Total available + recycling, efficiency increase)	<b>61.2 to 66.6</b>	<b>81.2 to 86.9</b>
Use:		
Agriculture	56 (a)	66.6 (e)
Municipal	3 (a)	6.8 (e)
Industry	6 (a)	12.4 (e)
<b>Total use</b>	<b>65</b>	<b>85.8 (e)</b>

*Loss due to evaporation from irrigation canals ( $2 \text{ km}^3/\text{year}$ ) is not calculated separately, but as part of the water used for agriculture. Evaporation from Lake Nasser ( $10\text{--}13.7 \text{ km}^3/\text{year}$ ) is taken into consideration in the 1959 agreement in addition to the  $55.5 \text{ km}^3/\text{year}$  (Abu Zeid 1987: 180). Sources: a) Egypt 1999. b) El Quosy, Tarek 1999. c) Hamza 1999. d) Hefny et al. 1991: 102–103. e) Elarabawy 2002.*

### 5.1.2 Water Availability in Sudan

A significant aspect of the water resources of the Sudan is that more water flows into the country ( $107 \text{ km}^3/\text{year}$ ) than flows out of it (Kamal 2001, map 5.2). This is because potential evapotranspiration exceeds rainfall throughout Sudan except in the extreme south. The average annual rainfall is 436 mm (Aquistat 1997b). Map 5.2 shows the in- and outflows of Nile water in Sudan<sup>8</sup>. The Nile reaches central Sudan with about  $93 \text{ km}^3/\text{year}$  and the border to Egypt with about  $84 \text{ km}^3/\text{year}$  (Sudan 2000: 3). About  $32 \text{ km}^3/\text{year}$  of the Nile flow is lost due to evaporation from the swamps in the south of Sudan (Sudan 1999: 1). Many plans to augment the total amount of water in the Nile Basin hinge around these evaporation losses in the Sudd or in the swamps of the Sobat, on Ethiopian territory. Through canals, the retention time of water in the swamps would be reduced, and thus less water would be lost to evaporation.

According to the agreement of 1959 with Egypt, Sudan has the right to  $18.5 \text{ km}^3/\text{year}$  of the Nile water at the frontier with Egypt, further south in central Sudan this corresponds to  $20.55 \text{ km}^3/\text{year}$  (FAO 1997a). Sudan also has  $2 \text{ km}^3/\text{year}$  of non-nilotic waters and estimates its rechargeable groundwater at  $5 \text{ km}^3/\text{year}$  (Sudanese Ministry of Irrigation 1998). Water scarcity in Sudan is a question of quantity *and* timing, as the reservoir capacity amounts to only 17% of Sudan's share according to the agreement of 1959. The seasonal fluctuations of the Nile River in Sudan are shown in table 5.2, with high flows between August and November and low flows between December and July.

Table 5.2: Nile Flow in Selected Areas in Sudan, numbers are given in  $\text{km}^3/\text{year}$

River Location (and station)	Average Annual Discharge	Average Maximum Monthly Discharge	Average Minimum Monthly Discharge
Bahr el Jebel upstream of the Sudd (Mongalla)	29.3	3.0 (Aug.)	1.9 (Feb.)
White Nile – upstream of the Sudd (Swamps)	15.5	1.4 (Oct.)	1.2 (June)
Sobat at mouth (Hillet Doleib)	13.7	2.0 (Oct./Nov.)	0.3 (April)
White Nile – Khartoum (Mogren)	25.7	3.2 (Oct.)	1.4 (July)
Blue Nile (Roseires)	50.7	15.6 (Aug.)	0.3 (April)
Mail Nile – downstream Khartoum (Tamaniat)	76.7	16.9 (Aug./Sep.)	2.2 (April/May)
Atbara – at mouth	12.1	5.6 (Aug.)	0.1 (Dec./June)
Main Nile – Egyptian border	86.4	21.8 (Sep.)	1.9 (May)

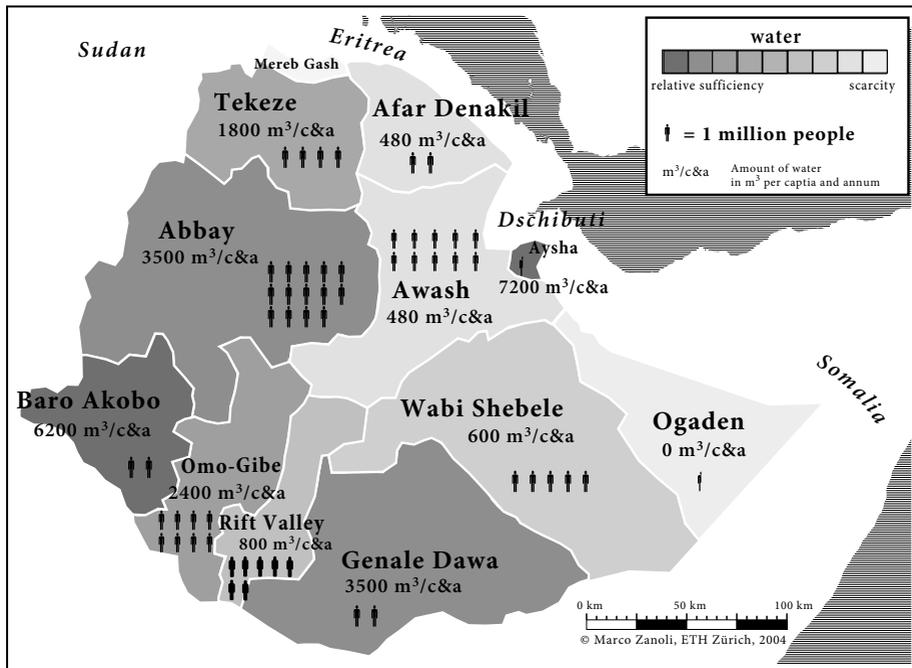
According to Kamal 2001.

8 For further hydrological data, see Sutcliffe, Parks 1999.

### 5.1.3 Water Availability in Ethiopia

Precipitation in Ethiopia amounts to 110 to 122 km<sup>3</sup>/year (Ethiopia 1999, 2000). The average annual rainfall is 744 mm, although there is a great regional variance from 100 mm along the border with Somalia and Djibouti to 2'400 mm in the southwest highlands (Aquistat 1995). The highlands of Ethiopia constitute about 50% of the country's area; nearly 90% of the population lives there (Ethiopia 2000: 1). Approximately 75% of the annual precipitation occurs between June and September (Conway 2000). Ethiopia estimates that only 3% of the annual runoff from Ethiopia remains within its territory. As 70% of the total Ethiopian water resources are found in the Ethiopian part of the Nile Basin, this means that a great amount of the run-off flows unused across its borders into the neighboring Nile countries (Ethiopia 2000: 2). Map 5.1 shows that the regional distribution of water in Ethiopia is very irregular. In 1997 about 24 million people, or 44% of the population, lived in river basins with less than 1'000 m<sup>3</sup>/capita and year of water: A situation that is considered to indicate chronic water scarcity. The uneven distribution within one year is even more important, however, as famine may occur if the rains do not coincide with the growing season.

Map 5.1



Water and population distribution according to river basins in Ethiopia in 1997. Data: Hagos 2000.

Map 5.2



Projected water scarcity in the Nile Basin Countries in the year 2025 (data from table 5.3)

### 5.1.4 Water Availability in the Nile Basin

About 14% of the Nile flow measured at Aswan originates from the equatorial lakes region<sup>9</sup>. The Nile Basin covers only a very small part of the territory of some of the countries, such as the Democratic Republic of Congo (1%), Kenya (8%) and Tanzania (9%) (table 1.1). In other countries, such as in Burundi and Rwanda that lie nearly totally within the Nile watershed, the water resources are predominately renewed within the country, so that the dependence on other countries is small. According to a rule of the thumb, a country is considered as being absolutely water scarce if it has less than 500 m<sup>3</sup>/capita & year, as chronically water scarce with 500–1'000 m<sup>3</sup>/capita & year and as water stressed if it has between 1'000–1'700 m<sup>3</sup>/capita & year. With more than 1'700 m<sup>3</sup>/capita & year, water resources are considered to be relatively sufficient (Falkenmark 1993). In 2002 Burundi, Egypt, Kenya and Rwanda fall in the category of chronically water scarce countries, and Eritrea in the group of water stressed countries. The uneven distribution of water resources in Ethiopia demonstrates, however, that care is needed when using these classifications, as they do not take the geographic distribution of water resources within a country into account. The projected situation of the Nile countries in the year 2025 is demonstrated on map 5.2. According to these projections, D.R. Congo is the only country in the Nile Basin in 2025 to enjoy a situation of relative water sufficiency.

Table 5.3: Water and Land Resources in the Nile Basin

Country	Precipitation (a) km <sup>3</sup> /year	Total internal renewable water resources (a) km <sup>3</sup> /year	Total actual renewable water resources (a) km <sup>3</sup> /year	Dependency ratio (a) %	Total actual renewable water resources (d) m <sup>3</sup> /capita + year 2002	Total actual renewable water resources (e) m <sup>3</sup> /capita + year 2025
Burundi	33.9	3.6	3.6	0	537	310
D.R. Congo	3'618.12	900.0	1'283.0	30	23'628	12'242
<b>Egypt</b>	51.37	1.8	58.3	97	<b>829</b>	<b>610</b>
Eritrea	45.15	2.8	6.3	56	1575	940
<b>Ethiopia</b>	<b>936</b>	<b>123.2 (b)</b>	<b>123.2 (b)</b>	<b>0 (b)</b>	<b>1'867</b>	<b>1'068</b>
Kenya	401.91	20.2	30.2	33	947	722
Rwanda	31.93	5.2	5.3	0	654	427
<b>Sudan</b>	<b>1'043.67</b>	<b>9.5 (c)</b>	<b>28.0 (c)</b>	<b>66 (c)</b>	<b>859</b>	<b>605</b>
Tanzania	1'012.19	82	91.0	10	2'473	1'572
Uganda	284.5	39	66.0	41	2'661	1'486

Sources: a) If not specified otherwise: Aquastat database. b) Ethiopia 2000. c) Hamad 2002. d) Population figures from UNFPA 2002, water amounts from previous columns. e) Population figures from UNFPA 2000, water amounts from previous columns. Egypt, Ethiopia and Sudan are marked in bold to ease the comparison of these countries which are the focus of our study.

9 Eritrea belongs to the East Nile system and its contribution to the Nile is small: 2.2 km<sup>3</sup>/year (FAO 1997).

Table 5.4: Present Use and Potential of Irrigated Area and Hydroelectric Power Capacity

Country	Potentially irrigable land in the Nile Basin (1000 ha) (c)	Irrigated land in the Nile Basin (c) / total in the country (d) (1000 ha)	Land use for agriculture in the country (d) (1000 ha)	Installed hydroelectric power (MW) (a)	Potential hydroelectric power (MW) (+ = in addition to already installed) (a)
Burundi	80	0 / 74	2'200	40.8	+ 120
D.R. Congo	10	0 / 11	22'880	23.1	2'600 (outside the Nile Basin)
Egypt	4'420	3'078 / 3'300	3'300	2'845	+ 138
Eritrea	150	15 / 22	7'467		
Ethiopia	2'220	23 / 190	30'600	410 (b)	30'000 (in the entire country) (b)
Kenya	180	6 / 67	25'820	2	+ 355
Rwanda	150	2 / 4	1'615	34	+ 121
Sudan	2'750	1'935 / 1'950	126'900	238	+ 1'380
Tanzania	30	10 / 155	39'650	337	+ 4'500
Uganda	202	9 / 9	8'610	180	5'000
Total	10'182	5'078 / 5'771	246'162		

Source: a) If not specified otherwise: Egypt 2000: 7–10, b) Ethiopia 2000. c) FAO 1997a, d) FAO 2000c. The irrigated area in the Nile Basin is smaller or the same as the irrigated area in the entire country. The difference between (c) and (d) is partly due to the year of the data, thus (c) and (d) should be the same for Egypt.

### 5.1.5 Potential to Increase the Availability with Supply-Side Projects

How much water could be made available in addition to the existing amount in the Nile Basin by supply-side projects? Various projects have been discussed over the last hundred years, either concerning where the water is stored to minimize evaporation from reservoirs, or related to building canals through wetlands to reduce evaporation from them. The Century Storage Scheme aimed at over-year storage in order to increase the available water by 36.5–39.5 km<sup>3</sup>/year by damming water in Lake Victoria, Lake Idi Amin and Lake Tana. It was never implemented due to technical and diplomatic constraints, e.g. siltation and the problem of coordination between nine countries (Waterbury 1979). Egypt opted for the Aswan Dam that also served as over-year storage and increased the available amount of water by 32 km<sup>3</sup>/year (water that had up to then been lost to the sea). From Egypt's point of view, the Aswan Dam had the advantage that the water was stored on its national territory and was therefore not dependent on the upstream countries. The great disadvantage of storing water in Egypt, however, is the high evaporation rates, about 10–13.7 km<sup>3</sup>/year (Abu Zeid 1987: 180).

From 1958 to 1963 the US Bureau of Reclamation and the Ethiopian Ministry of Public Works and Communication carried out a study on the development potential in the Ethiopian portion of the Blue Nile Basin. About 434'000 ha were identified for irrigation purposes and this irrigation was estimated to require 6 km<sup>3</sup>/year of water.

The four HEP dams would have a generation capacity of 25 billion KWh, three times that of the Aswan High Dam (table 5.4). Due to the higher altitude and the volume to surface area ration, less water would evaporate than if it were stored in Egypt. Water savings were estimated to be in the range of the amount of water required by Ethiopia for all the irrigation projects in the study of the Bureau of Reclamation, i.e.  $6 \text{ km}^3/\text{year}$  (Whittington, McClelland 1992).

Projects on the Upper White Nile to build canals through the wetlands of Sudan are estimated to be able to increase the total amount of available water by  $18 \text{ km}^3/\text{year}$  (Jonglei I: 3.8, Jonglei II: 3.2, Machar Marshes: 4, Bahr el Ghazal: 7; Whittington, McClelland 1992). The Jonglei Canal is discussed in length in numerous documents (Howell, Lock, Cobb 1988, Collins 1990) and will only be examined briefly here. John Garang, later to become head of the Sudanese People's Liberation Army, wrote his PhD at Iowa University on the Jonglei Canal. In it he mainly criticized the limited development strategies that would make the canal benefit Northern Sudan and Egypt rather than the local populations where the project was to be implemented (Collins 1990: 383). The project was jointly planned by Egypt and Sudan to make use of  $4.7 \text{ km}^3/\text{year}$  water ( $3.8 \text{ km}^3/\text{year}$  measured at Aswan), usually lost through evaporation, to be shared equally between Sudan and Egypt (Collins 1990: 317). A canal was to be built through the swamps to minimize the retention time of water in the swamps and thus increase the total amount of water for irrigation projects further north. 267 km of the canal were built when the civil war broke out in 1983 (Collins 1990: 401). The project did not have the support of many groups in South Sudan and it was also debated internationally, as the impacts on the environment and local population were unclear. Whittington and McClelland (1992) calculated the opportunity costs at 500 million US\$ per year or about 5 billion US\$ lump sum, suggesting that international agencies could pay for the upkeep of Europe's most important southern range for migratory birds. Nevertheless, from the point of view of Egypt and northern Sudan, the project had the potential to enhance cooperation between the two countries and increase the amount of available water for irrigation, while at the same time benefiting the local populations. As Sudan has until now not used its water from the 1959 agreement quota, however, it is likely that Egypt is more interested in the project than Sudan, at least until water scarcity increases in Sudan. Should the Mashakos peace process succeed, peace could enable the Jonglei Canal idea to be revived. It is likely that in this case the impacts on the environment and local population will be reconsidered in depth, and the project adapted (Sudanese academic 2001).

In the framework of the Nile Basin Initiative, further water development projects are envisaged, such as the "Baro-Akobo Multi-Purpose Water Resources Sub-Project" in Gambela, South-eastern Ethiopia on the Ethiopian-Sudanese border. Estimated water savings are about  $4 \text{ km}^3/\text{year}$ . The three countries, Egypt, Sudan and Ethiopia seem to be agreeing on building a canal through the swamps, allocating the additional water to Egypt and Sudan and allocating an equal amount from the Blue Nile river to Ethiopia (Ethiopian academic 2001). It seems that some lessons were learnt from the Jonglei Canal experience. Different stakeholders have different priorities and interests, and the

interests of the people directly affected have to be taken into consideration. Thus besides increasing the water yield, the multi-purpose project aims at HEP, irrigation projects as well as enhancing the livelihood and income opportunities in the basin. Broad stakeholder consultation and involvement in the identification, planning and design phases are planned. The preparation of the project is estimated to cost 3 million US\$, and the implementation to be more than 400 million US\$ (Nile-SEC 2001: 25–26).

## 5.2 Water Withdrawal

Water scarcity can be measured by the physical availability of water in a country (see above) or by the amount of water that is withdrawn compared to the available amount of internal renewable and inflowing water from other countries. According to the UN (1997), countries that withdraw less than 10% of their available freshwater are considered as low water stress countries, countries with 10–20% withdrawal of their available resources as moderately water stressed, 20–40% as medium-high water stressed and more than 40% withdrawal is considered as highly water stressed. Egypt falls in the category of high water stress, Sudan as medium water stress, Rwanda as moderate water stress and the other countries fall in the category of low water stress countries (table 5.5). Another indication of water scarcity is the ratio of imported “virtual water” in relation to the availability of renewable water resources (table 5.6).

On average, the agricultural sector is responsible for 74.7% of the water withdrawal of the countries of the Nile Basin. In the case of Egypt and Ethiopia this amount is higher: 86% and in Sudan it comes to 94% (table 5.5).

According to the FAO, approximately 5 million ha are irrigated in the Nile Basin (98.7% of this is in Egypt and the Sudan, diagram 5.3), while the total potential area is about 10.2 million ha. The FAO estimates that the total irrigable land in the Nile Basin is larger than the water resources in the Basin available to irrigate them: “...the sum of the irrigation potential of the countries (of the Nile Basin) leads to a water deficit of over 26 km<sup>3</sup>/year, without considering possibilities of reusing water as indicated by Egypt and Sudan in their water balance, but after deducting the water “losses” in the Sudd region” (FAO 1997). The FAO bases its estimates on an average of 1200 m<sup>3</sup> per ha and year. While this estimation is speculative, it indicates that water and not the availability of agricultural land limit the expansion of irrigated agriculture. About 20% of the potentially irrigable area in the Nile Basin is found in Ethiopia (table 5.4). During the next 15 years, 120'000 ha of large-scale irrigation and 120'000 ha of small-scale irrigation have been planned (Arsano 2004). On average about 5'000 m<sup>3</sup> water per ha and year are used in Ethiopia (Waterbury, Whittington 1998: 158). Thus to irrigate the planned 240'000 ha in Ethiopia about 1.2 km<sup>3</sup>/year, or 1.6% of the water that Egypt and Sudan use from the Nile at present (74 km<sup>3</sup>/year) would be needed. If the total irrigable amount in the Ethiopian Nile Basin would be irrigated, about 2 million ha, however, some 11 km<sup>3</sup>/year would be needed.

The potential to develop hydroelectric power in the Nile Basin is enormous, and only about 11% of the estimated potential has been realized. The greatest development potential, about 58% of the total in the Nile Basin, is located in Ethiopia, due to the great differences in altitude. In Ethiopia, less than 2% of the hydroelectric power potential has been tapped (FAO 1997a, FAO 2000c).

Table 5.5: Water Withdrawal as Percentage of Water Availability.

Country	Year (b)	Total freshwater withdrawal, km <sup>3</sup> /year (a)	withdrawal / availability in % (a & table 5.3)	Estimated year 2000/capita withdrawal, m <sup>3</sup> (b)	Domestic use, % (a)	Industrial use, % (a)	Agricultural use, % (a)
Burundi	1987	0.10	2.8	14	36	0	64
DR Congo	1990	0.36	0.04	7	61	16	23
Egypt	1993	55.10	95.5	809	6	8	86
Eritrea							
Ethiopia	1987	2.21	1.8	31	11	3	86
Kenya	1990	2.05	6.8	68	20	4	76
Rwanda	1993	0.77	12.2	100	5	2	94
Sudan	1995	17.80	20.1	597	4	1	94
Tanzania	1994	1.16	1.3	35	9	2	89
Uganda	1970	0.20	0.3	9	32	8	60

Data: (a) WRI 1999 (b) Gleick 1998.

Table 5.6: Net Food Imports and Virtual Water Equivalent

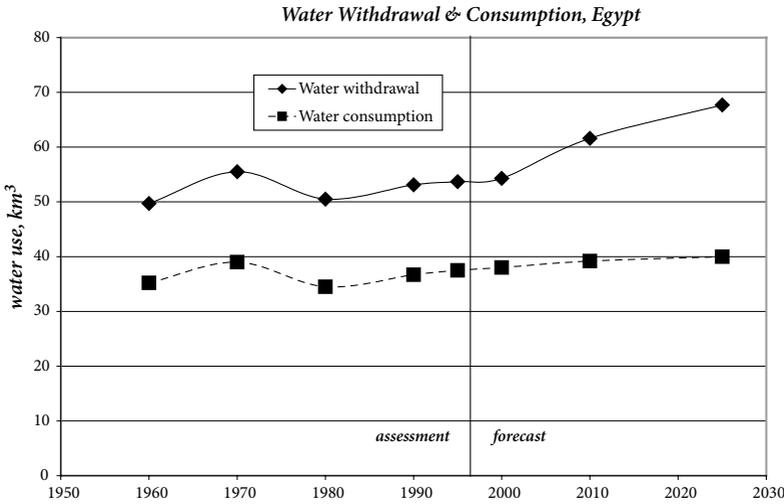
	Egypt	Ethiopia	Sudan
Average annual domestic cereal production, 1995–99, kg/capita	243	136	150
Average annual net cereal imports 1995–99, kg/capita (or as water equivalent, m <sup>3</sup> /capita) (a)	139	8	14
Average annual virtual water embedded in net non-cereal agricultural food imports, 1995–99, m <sup>3</sup> /capita (b)	80	3.2	-5
Average annual virtual water embedded in meat, animal fat and milk imports, 1995–99, m <sup>3</sup> /capita (c)	17	0.04	2
Sum of average annual virtual water imports, m <sup>3</sup> /capita	236	11.24	11
Ratio of virtual water imports to renewable resources	0.27	0.006	0.01

a) The conversion ratio is 1 kg of cereal to 1 m<sup>3</sup> of water. b) Based on net imports of sugar, oil crops, vegetable oils, pulses and starchy roots. Calculations according to Yang, Zehnder (2002). c) For meat and animal fat: 1 kg of product weight is equivalent to 4 m<sup>3</sup> of water. For milk: 1 kg of milk is equivalent to 0.5 m<sup>3</sup> of water (Yang, Zehnder 2002). Data for production and import of different products from FAO, 2003.

5.2.1 Water Withdrawal in Egypt

In the year 2000 Egypt withdrew<sup>10</sup> about 54.3 km<sup>3</sup>/year and consumed<sup>11</sup> 38 km<sup>3</sup>/year (SHI 1999). Water that is not lost to evapotranspiration can be used more than once, the amount available for end use in Egypt was considered to be about 60 (Egypt 1999) to 70 km<sup>3</sup>/year in the same year (Farag 2000). Diagram 5.2 shows estimates for projected increase in water withdrawal and consumption in Egypt.

Diagram 5.2



Water withdrawal and consumption in Egypt, SHI 1999.

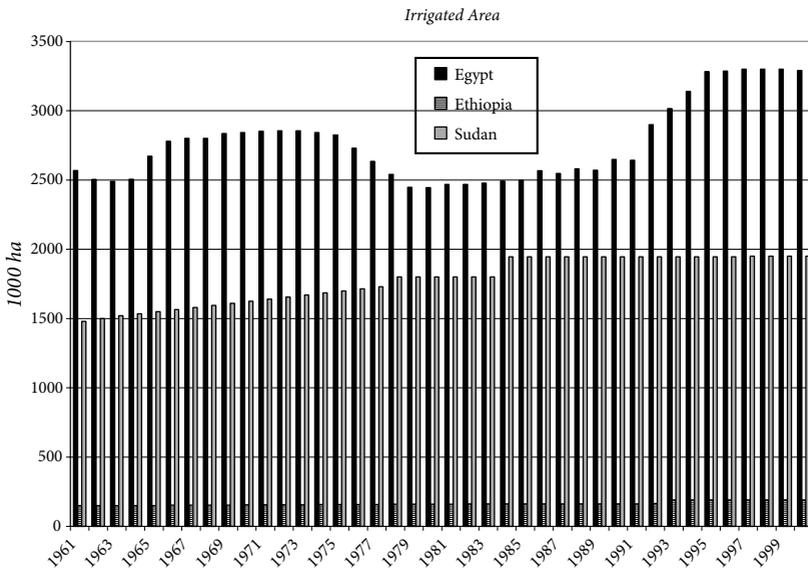
If one takes UN medium population growth projections for Egypt and assumes that per person the same amount of water will be used as at present, then the amount of required water in the year 2017 would be 83 km<sup>3</sup>/year. Elarabawy (2002) estimates the water demand in 1917 to be 88.4 km<sup>3</sup>/year. This could be covered by the projected water availability in the year 2017. The amount of water withdrawal is directly linked to the amount of irrigated land, since 86% of the water is used for irrigation (industry: 9.2%, municipal: 4.6%). This is reflected in the similarity of curves between diagrams 5.2 and 5.3 with a first peak around 1970 and a second one in the year 2000.

The Minister of Water Resources, Abu Zeid, estimates that the 55.5 km<sup>3</sup>/year quota will not suffice for a population above 90 million, which will probably be reached around

- 10 Water withdrawal = water is taken out of the natural rivers, lakes, groundwater and reservoirs for purposes of human use.
- 11 Water consumption = water is consumed, used up mainly through evapotranspiration in agricultural production.

the year 2020. Some options of dealing with this, according to his personal opinion, are birth control, desalination and using less water in the agricultural sector (Middle East Times 2001). Using less water in the agricultural sector would mean importing more food. At present Egypt imports about  $15 \text{ km}^3$  “virtual water”/year ( $236 \text{ m}^3/\text{capita} \& \text{ year}$ ) in the form of food, which makes up about 21% of its available water (table 5.6)

Diagram 5.3



Irrigated area in Egypt, Ethiopia and Sudan 1961–1999. FAO 2000c.

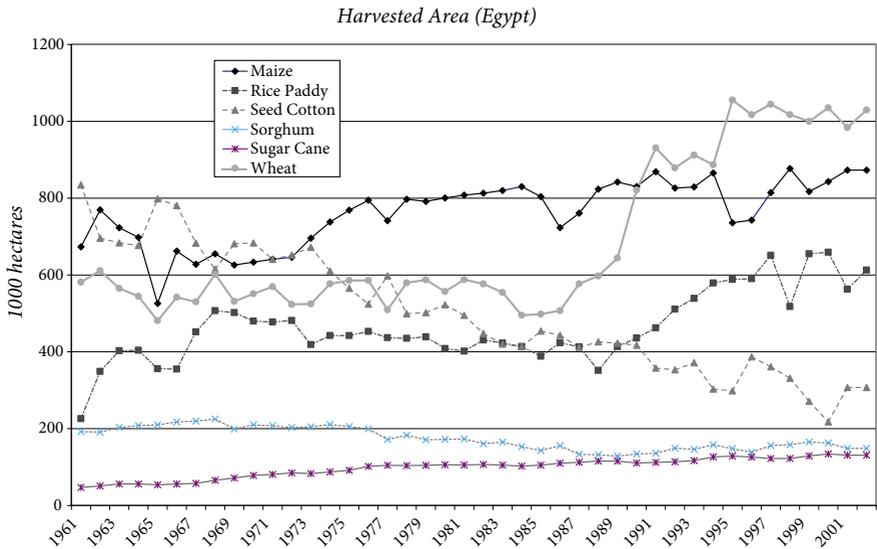
Besides water withdrawal for agriculture, industry and municipality, water is lost through evaporation from reservoirs such as Lake Nasser ( $10 \text{ km}^3/\text{year}$ ) and the  $31'000 \text{ km}$  of irrigation channels ( $2 \text{ km}^3/\text{year}$ ) (Aquistat 1997a). The agreement of 1959 accounted for this amount in addition to the quotas of  $55.5 \text{ km}^3/\text{year}$  and  $18.5 \text{ km}^3/\text{year}$  for primary withdrawal for Egypt and Sudan, respectively. With new projects in the Sinai and the Southern Western Valley Development project (often called Toshka for short), not yet clearly assessed amounts of water could be lost to evaporation.

### 5.2.2 Agriculture and Water Consumption in Egypt

Water withdrawal is directly influenced by the area, yield, production and water demand of the main crops. This section begins with a general overview, followed by a more in-depth analysis of some of the main crops, aiming to understand why these crops are grown and how much water they consume. The section ends with a description of

the two main production systems in Egypt on the old (irrigated area for thousands of years) and new lands (irrigated in recent years, land regained from the desert). Projects to expand agricultural production that will increase the amount of water used occur almost entirely on the new lands.

Diagram 5.4



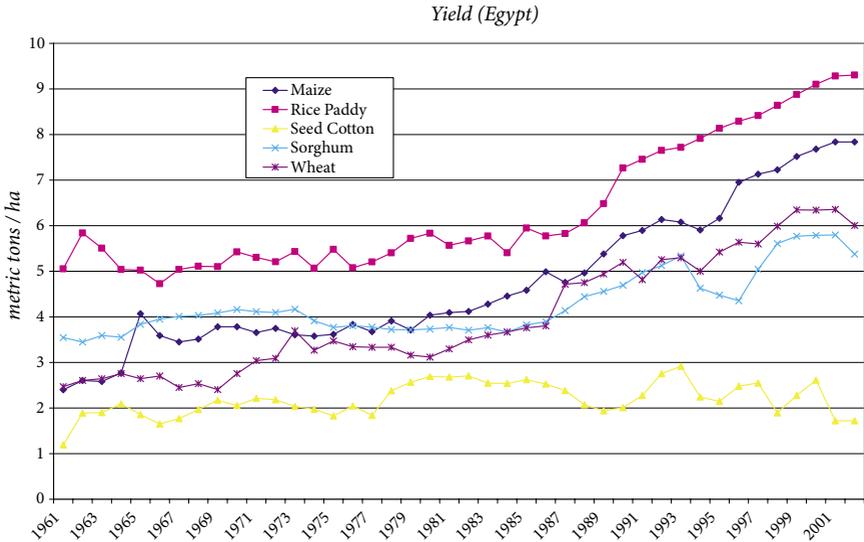
Harvested area of six crops in Egypt from 1961–2001. FAOSTAT 2002.

Cotton, wheat, rice, maize and berseem<sup>12</sup> account for 80% of the area in crops (Enien et al 2000: 2) and about 60% of the water consumption of the agricultural sector in Egypt (EAAE 2002: 3). Since 1960 the area covered by wheat and maize has increased in Egypt, while the area under cotton has decreased (diagram 5.4). In the same time period, the yields of the main crops have increased, except that of cotton seed<sup>13</sup> which has remained the same (diagram 5.5). Production trends follow a similar pattern: the production of the main crops increased steadily, except for sorghum and cotton seed (diagram 5.6). Production increases in wheat covered the increased demand, the total amount of imported wheat has therefore remained constant over the last two decades (diagram 5.7). Rice is the greatest water consuming crop and consumes about 15% of the

12 Trifolium alexandrinum, a clover grown for forage for livestock and to improve the soil quality.  
 13 FAOSTAT does not always give the statistics for seed cotton and cotton lint separately. The area under cultivation is similar, however, as both products come from the same plant. Cotton seed, the seed of the plant, is used to make oil and meal, whereas cotton lint, the long white seed hairs, is used to produce textiles.

total agricultural water consumption in Egypt (diagram 5.8). Applied water takes into account the consumptive use as well as all sorts of water losses at field level; sugarcane and rice have the greatest water requirement for applied water (diagram 5.9). Rice and sugarcane are the two main problematic crops from a water efficiency point of view.

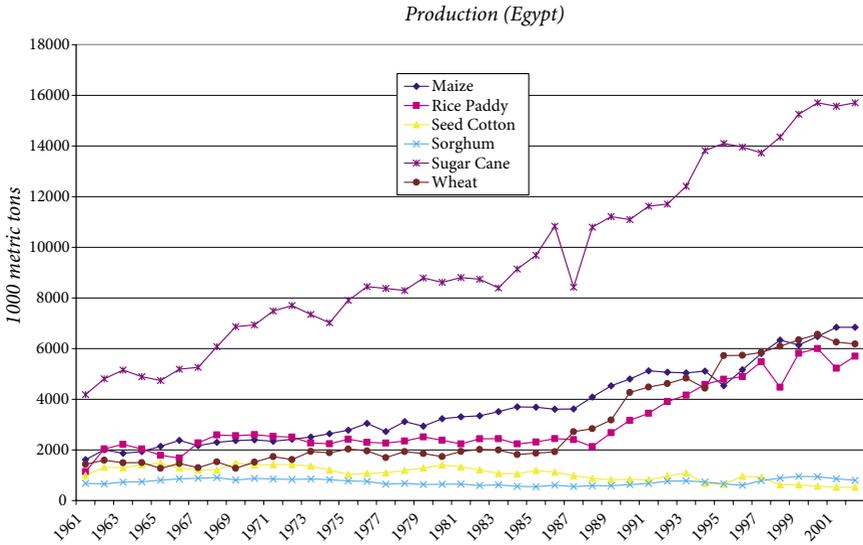
Diagram 5.5



*Yield, i.e. production per hectare of five main crops in Egypt. Sugarcane is left out, as its high yield would distort the graphic's scale; in 1961 its yield was 89 metric tons/ha, in 2002 it was 119 metric tons/ha. FAOSTAT 2002.*

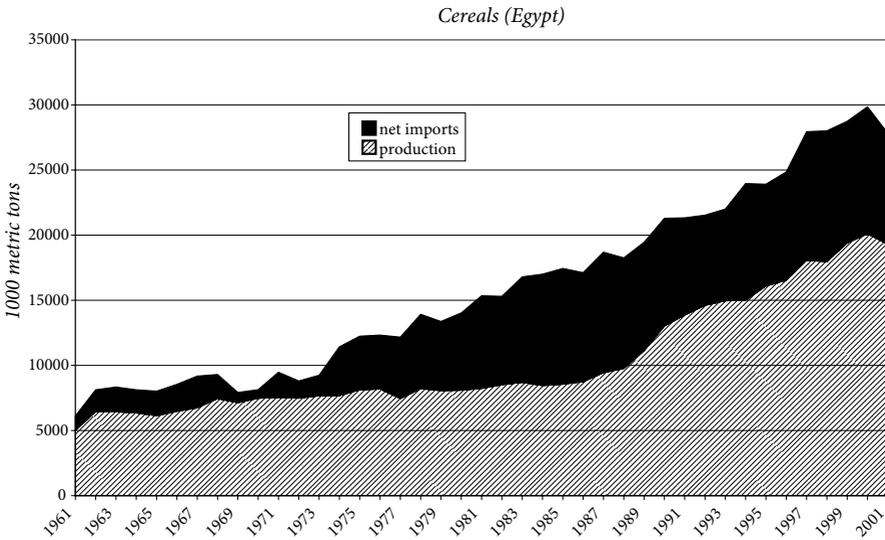
Besides political and economic factors, reasons for changes in harvested area, yield and production in the agriculture of Egypt are a result of technological developments. The Aswan High Dam allowed for perennial irrigation, up to three crops a year, and a secure water resource from 1970 onwards. At the same time, fertilization from the natural flooding of the Nile River was replaced by the application of artificial fertilization (diagram 4.5). The rate of application of basic nutrients such as nitrogenous (N), phosphorus (P) and potassium (K) fertilizers in Egypt is 372 kg/ha and year, compared with the world average of 28 kg/ha and year (Enien et al 2000: 267).

Diagram 5.6



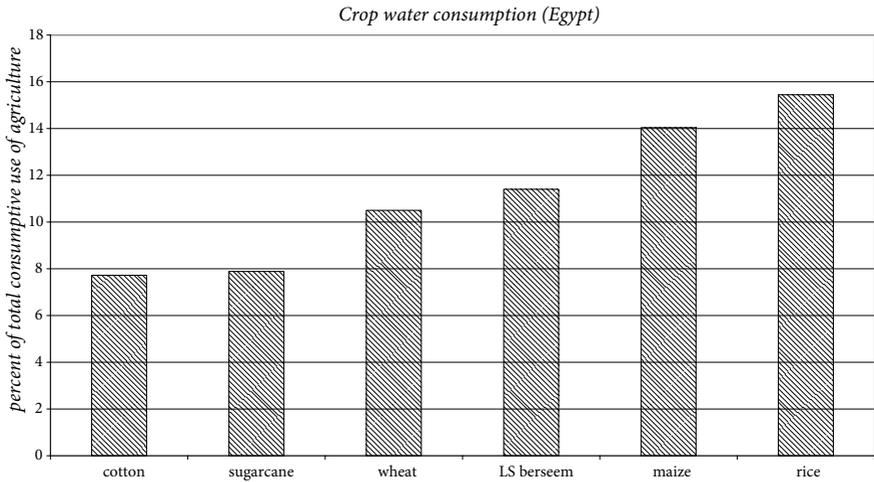
Production of six main crops in Egypt between 1961–2001. FAOSTAT 2002.

Diagram 5.7



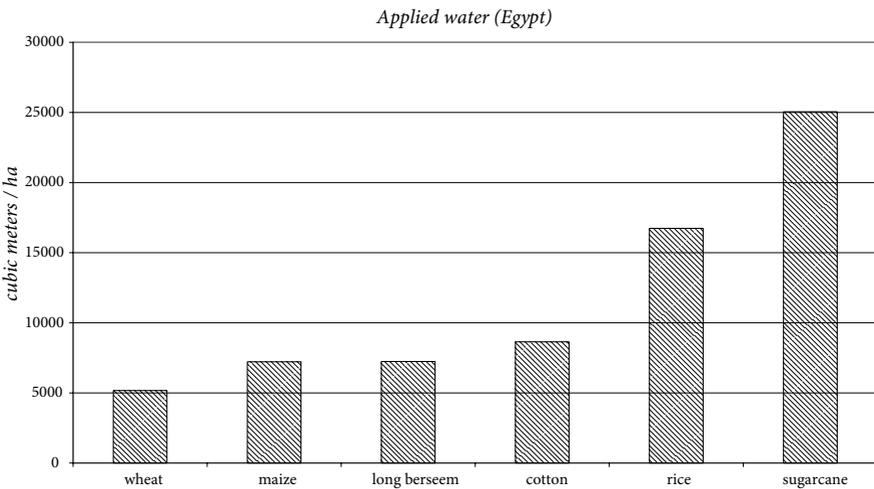
Comparison of exports, imports and production of cereals in Egypt. FAOSTAT 2002.

Diagram 5.8



Crop water consumption of six main crops in Egypt. Mahdy 1996. In: EAAE 2000: 3.

Diagram 5.9



Amount of water applied to fields under cultivation of six main crops in Egypt. Bulletin of Irrigation and Water Resources, CAMPAS March 1995. In EAAE 2000: 3.

*Cotton*

Cotton, a summer crop, is responsible in Egypt for about 7.7% of the total water consumption of the agricultural sector, about 5.5% of the water withdrawal for agriculture, or about 4.7% of the total water withdrawal of the country. About 2.6 km<sup>3</sup> water were applied to cotton fields in 2002 (EAAE 2000: 3, FAOSTAT 2002, WRI 1999). The steady decrease in cotton production and harvested area since the 1960s is a result of: 1) susceptibility to diseases; and 2) a long-term decline in the relative price of cotton versus other crops, as well as price uncertainty in recent times.

Cotton pests increased from 8 species in 1965 to 14 in 1980, due to the intensive use of pesticides (Abu Zeid 1997). Twenty years ago there was a movement toward organic farming of cotton in Egypt, one of the main reasons was to avoid pesticide poisoning of farmers. During the last twenty years the Egyptian average yield of raw cotton remained stable despite a continued increase of pesticides applied. Today nearly 80 percent of Egypt's cotton cultivation applies biological pest control, and the Ministry of Agriculture has forbidden aerial sprays of pesticides on cotton (Scialabba 2000).

In order to balance the world market price volatility, the Egyptian government guarantees farmers a floor price for seed cotton; this is set before or at the time of planting (March). The lint cotton export prices on the other hand are set by the Alexandria Cotton Exporters Association (ALCOTEXA) and are announced at the beginning of the marketing season (September), based on the international cotton market. If the floor price, the minimum price, for seed cotton exceeds the lint cotton export prices, trade in seed cotton becomes unprofitable. The government encourages ALCOTEXA to set Egyptian lint cotton export prices at high levels relative to the seed cotton price as well as the price of the American Pima. This policy protects cotton farmers from volatile export prices, but at the cost of the money spent in the Cotton Prices Stabilization Fund and a build-up of large lint cotton stocks. The government then carries the risk of world market price fluctuations, rather than the farmer. When the government does not announce guaranteed prices, as in 1998/99, farmers may be discouraged from growing cotton (Helmy 2001: 3). The government is interested in cotton exports as it is second only to oil in importance for foreign exchange earnings for commodity exports (ITF 2001). Egyptian cotton still commands over one third of the world market for long-staple and extra-long staple cotton (HRW 2001). Publicly owned mills and textile factories employed an estimated 4.5 million people in 1997, another reason why the government wants to keep its influence on the cotton market. The cotton seed producer prices are set by a ministerial committee from the Ministry of Agriculture, the Ministry of Trade and Supplies and the Ministry of Public Enterprise along with the exporters. In general the Ministry of Agriculture wants to set a high price to benefit its farmer constituency, while the Ministry of Trade and Supplies and the Ministry of Public Enterprise, that control the milling, want to purchase the cotton at the lowest price (Mehyar 1999).

### *Wheat*

Wheat, besides sorghum, is one of the main cereal crops in Egypt. About 5.3 km<sup>3</sup> water were applied to wheat fields in 2002; this corresponds approximately to 10.5% of agricultural water consumption, 11% of the agricultural water withdrawal, and 9.6% of the total water withdrawal (EAAE 2000: 3, FAOSTAT 2002, WRI 1999). About 1 million ha were under wheat cultivation in Egypt in 2002. For total food self-sufficiency about 1.7 million ha would be needed. Some Egyptians say that this should be done – but it would happen at the cost of other crops.

The self-sufficiency rate of wheat improved from about 25% in 1982 to about 60.4% in the year 2000 (MOA 2000, SIS 2001b). This result is due to the high price of wheat and the development of technology. The ratio of wheat market price to international price improved from 0.48 in 1982 to 1.00 in 1994 (SIS 2001b). Due to the high price, applied value of irrigated water is the highest for wheat in comparison to other primary crops (table 6.3). Despite the process of liberalization, millers still get a subsidy for producing lower grade flour, which has been LE£ 60–70 per ton (ca. 20 US\$/ton) since the early 1990s. Liberalization in the milling sector is a sensitive issue, as the 1977 riots in Cairo followed an attempt to reduce bread subsidies (Noeman 1999). The link between the mill subsidies and the success of the Egyptian wheat production is something to look into in more depth.

At present, Egypt imports about 40% of its wheat (diagram 5.7) and has made efforts to move away from its 90% dependency on imports from the USA during the 1990s by also importing wheat from Australia, France, India, Turkey and Argentina (Arabic News 1998). United States Agriculture Secretary Dan Glickman called for open Egyptian markets and noted that Egypt is America's "number one wheat market". Following US lobbying, Egypt backed down in 1997 from a decree requiring imported wheat and grains to carry proof that they were not genetically engineered (Hauser 1997). Such pressures are at variance with the free market idea and are an educative example of the power of a food exporting country over the will of a food importing country.

### *Sugar cane*

Sugar cane, like rice, is a water intensive crop and about 3.4 km<sup>3</sup> of water per year are used for this. Sugar cane is responsible for 7.8% of the agricultural water consumption, 7.2% of the agricultural water withdrawal and 6.2% of the total water withdrawal of the country (EAAE 2000: 3, FAOSTAT 2002, WRI 1999). Other estimates of the water withdrawn for sugar cane cultivation are higher, e.g. up to 38'000 m<sup>3</sup> of water per hectare; in 2002 about 130'000 ha of sugar cane were under cultivation, in other words 4.9 km<sup>3</sup>/year of water or about 9% of Egypt's total water withdrawal (Egyptian academic 2000). Sugar cane is one of the main crops in southern Egypt, and like rice is one of the crops where there is still a fair amount of state intervention. To limit water use, areas under sugar cane cultivation have been limited to about 126'000 ha. For social reasons, sugar cane has not been further limited, as many people are employed in the production or manufacture of sugar. 200'000 farmers depend on the industry, which provides employment to 33'000

workers in sugar-extracting factories (Mekay 1999). In 1999 Egypt had a five percent tariff on imported sugar, while the WTO agreement would allow a 30% tariff (Emad, Middle East Times 1999). In January of 2000, the import tariff on raw and refined sugar was raised to 26%. The government also guarantees prices and low interests to sugar cane farmers (Pomeory et al. 2000). There was a policy to move towards more sugar beat, but this is not easy to implement. Sugar cane is grown in south Egypt, an area that is traditionally politically sensitive, so that reforms are carried out with care. Measures are being taken to gradually replace sugar cane factories with sugar beat factories (Egypt 2002). The government policy aims to reduce the production of sugar cane and rice production in order to save water.

### *Rice*

Rice is the single main water consuming crop in Egypt, responsible for 15.4% of the total agricultural water consumption, 21.5% of the agricultural water and 18.5% of the total water withdrawal of the country. About 10.2 km<sup>3</sup> water were applied to rice fields in 2002 (EAAE 2000: 3, FAOSTAT 2002, WRI 1999). About 420'000 ha and 630'000 ha were used for rice production before 1950 and in 2000 respectively (Egyptian academic 2000, FAS 2000). The government has (unsuccessfully) limited the area under rice cultivation to 378'000 ha (FAS 2000) at the national level, allocated in specific governorates in the northern Delta. This should be sufficient to satisfy national demand, provide some rice for export, and prevent soil salinization and seawater intrusion (Egypt 2002: 3). This is to be achieved through giving licenses and fining farms that grow more than they are allowed. But due to its high profitability, and the social and political considerations, violation fines are often suspended – thus encouraging farmers to expand the areas under rice cultivation (Egyptian academic 2000, FAS 2000). Furthermore, measures are being taken to replace the presently used varieties of rice with new shorter-life varieties which have a higher productivity and use less water due to their shorter growing season. There is a 20% tariff on rice imports. Although rice, a submerged crop, is problematic in respect to high water consumption and is therefore limited like sugar cane, there are some environmental benefits in reclamation areas due to its capacity to leach salts from the soil (EAAE 2000).

The water consumption figures of rice and sugar cane, combined with the calculations of value added per cubic meter of water (about 2–3 times lower than for wheat, section 6.2.1) illustrate why Egypt has a policy of trying to minimize rice and sugar cane production. By addressing these two crops there exists a water saving potential of up to 23% of the agricultural water consumption and 24% of the total national water withdrawal.

### *Old and new lands*

The agriculture of Egypt can be divided into old and new lands. The old lands are along the Nile River and the delta, whereas the new lands are the newly reclaimed lands that used to be desert. All new lands use modern technology, e.g. sprinkler or drip irrigation, an average of 14'000 m<sup>3</sup> of water/ha and year are used. The new lands mainly grow cash

crops, e.g. fruit and vegetables both for the local and international market. According to an Egyptian technocrat, the most suitable irrigation system on the old lands is flood irrigation because of the clay soils, even if it is less water efficient than the technology used on the new lands. The old and new agricultural lands together amount to about 3.2 million ha. Of this, the old land comprises 2.5 million ha. There are 750'000 ha of already existing new lands on the northwest coast. Furthermore, there is the potential of an additional 1.4 million ha in Toshka, the desert oases, along the east and north coasts, and in North Sinai. Groundwater is being used – even if at times inefficiently – in the reclaimed areas in the north-west, near the desert road Alexandria-Cairo (Egyptian academic 2000).

Agricultural cultivation on the new lands takes a different approach than traditional farming, and the farmers are mainly graduates from universities. The high level of technology is only used for the water saving procedures. For the rest of the farming activities, normal labor-intensive practice is the norm. As a consequence a wide spectrum of workers are to be employed, skilled as well as un-skilled laborers. Products from the new lands include vegetables, fruit, aromatic plants and flowers, both for local consumption and for export. Agriculture in these areas is expensive, so the economic return has to be high. Nevertheless, in north Sinai some wheat and barley is grown. In the new lands the holdings are a minimum of 8.4 ha (20 feddans). In the old lands more than 80% are small holdings of 0.4–0.8 ha (1–2 feddans) (Egyptian academic 2000). Making the desert useable for agriculture is called desert reclamation. The estimates of the costs to reclaim 1 hectare are between 11'000 and 22'000 US\$. This is needed to make the land productive; it does not include the costs of maintaining it (Egyptian academics 2000). According to one academic interviewed by the author, the new lands reclamation is primarily a social project to create living space and work, and is only as a third or fourth priority an economic endeavor. In the sense that the farmer is not directly subsidized, it is economic, but indirectly the farmer is supported because the infrastructure is subsidized.

Old crop patterns remain in the old lands due to tradition, e.g. clover (for animals) wheat, rice, and barley. If one lives in the rice belt, one farmer alone cannot change his cropping pattern, as rice needs flooding, corn needs drainage and so the farmers continue growing the same crop in the area they live in (Egyptian academics 2000).

Some of the suggestions arising out of an assessment of national water availability and withdrawal are summarized below. Many of the points are debated, as discussed in the next chapter.

- Efficiency increase in the agricultural sector: use more efficient technology and irrigation patterns, reuse water, minimize crops that use a lot of water (rice, sugar cane).
- Increase farmers' awareness of water efficient agriculture through greater participation, cooperatives, extension work, training and information campaigns.
- Support off-farm job opportunities through tourism, industrialization, and the service sector.

- Guarantee a high degree of self-sufficiency through yield increase; liberalize the market to increase farmer initiative and agricultural production.
- Use groundwater and together with Toshka create a Western Valley. Make the desert green through irrigation expansion for agriculture, jobs and living spaces.
- Develop irrigated agriculture in Sudan in joint ventures.
- Minimize evaporation from swamps upstream to increase the total supply of water (Jonglei Canal).
- Import “virtual water”, i.e. water in the form of food.

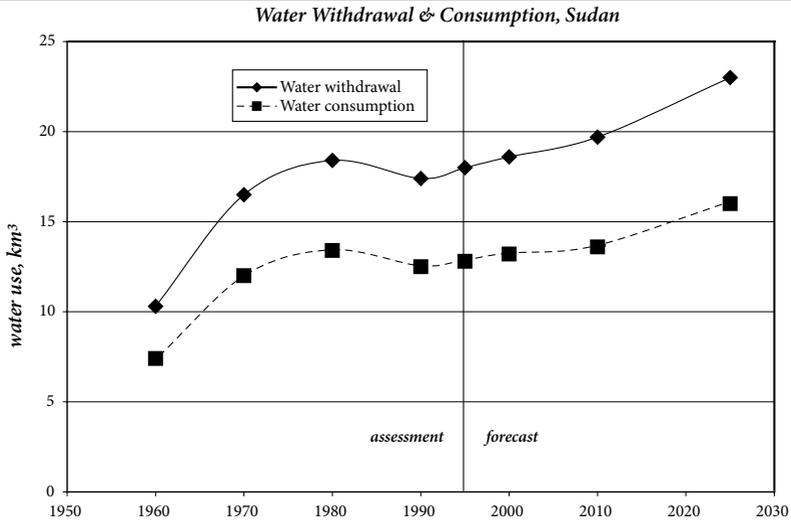
### *5.2.3 Water Withdrawal in Sudan*

Sudan withdrew 18.0 km<sup>3</sup>/year in 1990 and consumed 12.8 km<sup>3</sup>/year in the same year (SHI 1999) (diagram 5.10). Sudan does not use the amount (20.55 km<sup>3</sup>/year, which is equal to 18.5 km<sup>3</sup>/year measured at Aswan) allocated to it by the 1959 agreement, but lets about 4–5 km<sup>3</sup>/year flow unused across its border.

### *5.2.4 Agriculture and Water Consumption in Sudan*

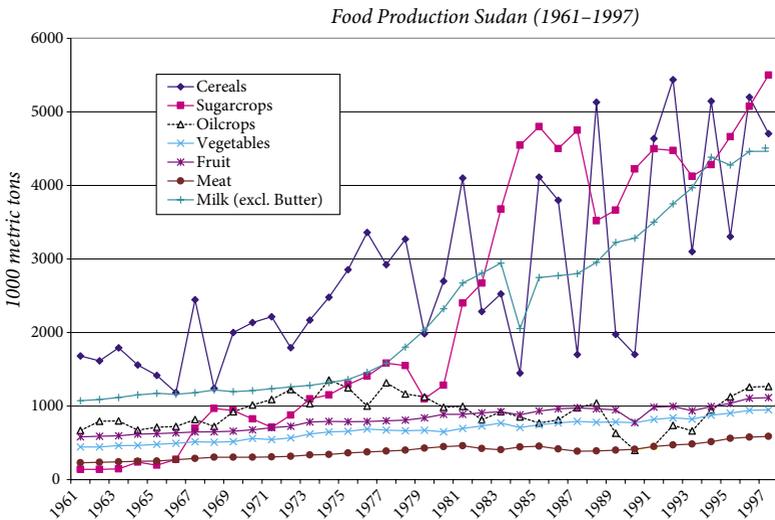
The agriculture of Sudan can be subdivided into five areas: irrigated agriculture, rain-fed mechanized farming, rain-fed traditional farming, pastoralism and forests. The agricultural sector contributes to about 40% of the GDP (table 6.2). Crops contribute 18%, and animal products 20% of the GDP (Abdella 2001). Forests are the source of 71% of the energy requirements in Sudan (NFI 1998). The irrigated area in Sudan amounts to about 2 million ha and constitutes less than 15% of the cropped area, yet it produces around 64% of the crops' contribution to the GDP (Sudan 1999). An indication of the priority given to agriculture is the amount of investment for research in agriculture, which amounts to only 0.0019% of the GDP (Abdella 2001). Nevertheless, about 70% of the economically active population still work in the agriculture sector (table 6.2).

Diagram 5.10



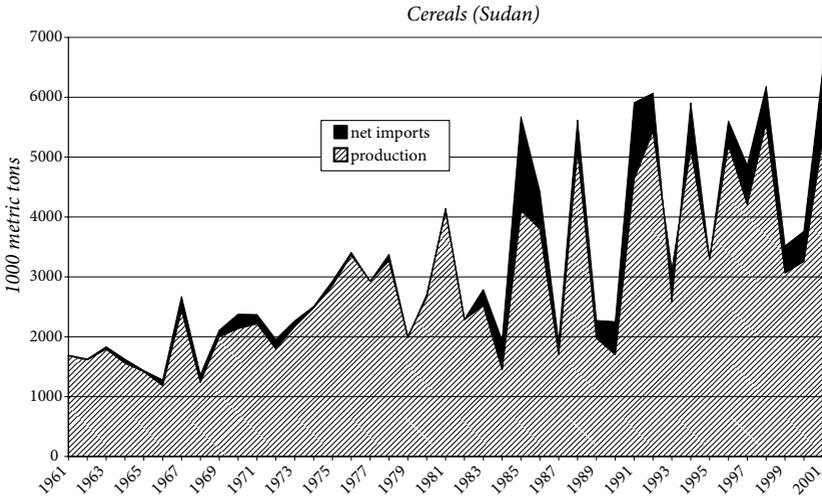
Water withdrawal and consumption in Sudan. SHI 1999.

Diagram 5.11



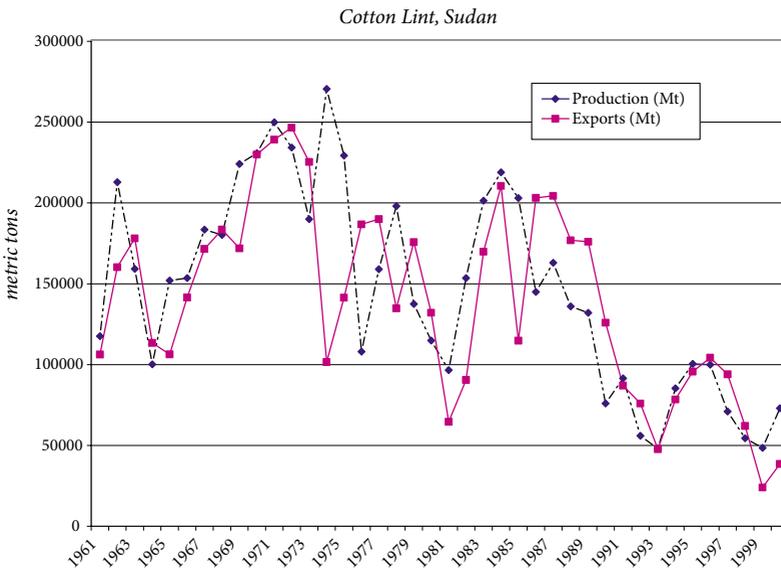
Food production of seven crops in Sudan between 1961-1997. FAOSTAT 2000.

Diagram 5.12



Cereal production in Sudan, sorghum makes up about 80% of the cereals. FAOSTAT 2000.

Diagram 5.13



Production and export of cotton lint in Sudan. FAOSTAT 2000.

### *Irrigated Agriculture*

The agricultural policy of Sudan has long focused on the irrigation sector, partly because of its importance as a foreign exchange earner, partly because of its reliability and sustainability, and partly because it has an inherent need for a central form of control as opposed to subsistence agriculture or rain-fed mechanized farming (Sudan 1999, Awad, Ahmed 1999: P1a. 3). The fluctuations in rain-based cereal production in Sudan (diagram 5.12) compared to irrigation-based production in Egypt (diagram 5.6) demonstrate the vulnerability of rain-fed agriculture.

The total irrigated area in Sudan is about 2 million ha. If the water resources are not considered, but only the suitable land resources, then there would be about 4.8 million ha (Aquastat 1997b) to 84 million ha (Hamad 2002) of land suitable for irrigation in Sudan. If the water resources are taken into account, the potential is about 2.8 million ha (without taking the Jonglei Canal into consideration). Sudan is an ideal country for irrigation. There are large areas with fertile soils such as between the Blue and White Nile, and the terrain in large areas is very flat. In the higher areas towards the border with Ethiopia and in the areas South of Khartoum that get more rainfall, the evapotranspiration rate is less than in Egypt, so that less water is used and soils are not endangered by salinization.

There are two types of irrigation schemes in the Sudan – the Nile flood and pump schemes, and the national irrigation schemes, e.g. Gezira, Rahad, New Halfa (also known as Khashm Al-Girba) and Suki, which constitute 63% of the total irrigated area (Awad, Ahmed 1999). The major crops in these schemes are cotton, wheat, groundnuts, sugar cane, sorghum, vegetables and fruit. The Gezira scheme used to mainly grow cotton; with the liberalization, other crops are now becoming increasingly important, such as wheat, oil seeds, sugar cane and vegetables (diagram 5.11). The cotton lint production in Sudan steadily declined from the 1970s onwards (diagram 5.13). Besides the economic significance of the irrigation sector, it is also an important source of employment. In the Gezira scheme, established in 1925, for example, 100'000 tenant farmers and their families are engaged, with more than a half million seasonal workers (Ahmed 1993).

The aim of the agriculture policy in the irrigation sector is to increase the production by the expansion of irrigated areas and an increase in efficiency. One of the main ways of increasing the efficiency of the irrigation schemes is by removing the silt and weeds from the canals (see photo 5.1). This should be done on an annual basis, but it is often neglected (Aquastat 1997b). According to a study by the World Bank, siltation of canals and mismanagement led to a drop in cropping intensity in the Gezira Scheme from 75% to 57% between 1976–1989. The lack in investment in the up-keep of the scheme means that its full potential has not been realized (Aquastat 1997b). The responsibility for dealing with siltation lies in the responsibility of quasi-public monopolies that benefit from foreign earnings from the cotton exportation. The decrease in cotton production and exportation may be part of the reason why the finances for the up-keep of the canals has decreased (Sudanese academic 2001).

In summary, irrigated agriculture in Sudan has an enormous potential both economically as well as in creating employment. It is a sustainable form of agriculture that seems to be well suited to its environment. One of the main challenges of the irrigation sector in Sudan is not insufficient water, but upkeep and how to deal with the siltation of the canals. These problems have to be dealt with by the management of these schemes in cooperation with the tenants. On a more long-term macro level, however, siltation is also an area that could foster cooperation between Sudan and Ethiopia. Through watershed management in Ethiopia as well as dams to regulate the flow, the problem of siltation could partly be eased.

*Photo 5.1*



*Gezira irrigation scheme. Siltation and weeds in small canals disrupt the flow. Photo: S. Mason 2001.*

### *Rain-fed Mechanized Agriculture*

The rain-fed mechanized farming on the clay soils in central Sudan probably presents the most problematic form of agriculture in Sudan. Although it has no effect on the water resources of the country as it is not dependent on river water, it leads to the depletion of soils and related problems such as desertification. It is included in this section on the water withdrawal in Sudan because rain-fed agriculture is often stated to be an alternative to irrigated agriculture. This section shows that rain-fed agriculture is not invariably advantageous. The example of large-scale rain-fed mechanized farming in Sudan rather demonstrates the alarming destruction rain-fed agriculture can cause if it is not managed by an appropriate legal framework that prohibits the unsustainable use of the soil.

Large-scale, rain-fed, mechanized farming in Sudan is a low-cost and high-risk form of agriculture. There are little incentives to conserve the resource base. No fertilizers are used; risks and uncertainties include pests, such as rats, no rain, army invasions or ban-

dits. The soil is ploughed by tractors, the area is seed spread, and then hopefully the rain falls. If it does not rain, no large investments are lost. Later it is harvested mechanically or manually. Farms are often hundreds of kilometers from where the farmer lives, as a consequence he is more of a business manager than a farmer, and only visits his farm for some two to three months a year. There is no attachment to the area, no infrastructure to keep him there. When the soil is exhausted, the farmer moves on. It takes about 30 years for the soil to regenerate, but only if there is rain (Sudanese academic 2001).

Rain-fed mechanized farming was started in 1944 by British soldiers to provide food during the Second World War. In 1945 about 5'000 ha were cultivated this way (Mahmoud 1984). Now there are estimates that 4.6–5 million ha, an area larger than the size of Switzerland, are being cultivated with rain-fed mechanized farming (Suliman 1999). There are, however, also estimates that another 5 million ha are being cultivated illegally (Mougrabi 1995, in Suliman 1999). The increase in number of tractors in use in Sudan is an indication of the increase (diagram 5.14). The state employees setting up laws and regulations for the rain-fed mechanized farming system were often the same people who later invested in such farms. As a consequence regulations were lax and land lease rates low. While there is a law that 10% of the land should be covered by forest, there is little enforcement thereof (Sudanese academic 2001).

A normal size for a farm is about 1'000 feddans (420 ha), so 100 feddans should be covered by forest. If one calculates that on this area of about 50 ha one could potentially produce 25 tons of sorghum a year with a farm gate price of 1 ton = 45 US\$, then about 1075 US\$/year would be lost if it is left under forest cover (calculations based on figures from FAOSTAT for the year 1995). According to one Sudanese academic in an interview with the author, the yield can be double that amount. This would fit better to the estimates of O'Brien (1978 in Ahmed 1993), who estimated that in 1975 a farm of 1'000 feddans (420 ha) could make a net benefit of 20'000 US\$.

The property rights in Sudan mean that land is leased to the farmer at a very low price. It is cheaper to lease the land and then move on to lease a new area than to sustainably cultivate the same piece of land over a long period of time. The result is an overused soil. If one estimates that the yield is about 12 sacks/feddan when a farmer starts, then about 5 to 10 years later, the yield will have decreased to maybe 1 or 2 sacks/feddans. There are some farmers who use the land for two to three years, leaving the rest of their land fallow, and then they rotate, leaving time for the soil to regenerate. But mostly the land is used for 10–25 years, until the topsoil is lost and then the farmer moves on (Sudanese academic 2001). This farming system had drastic effects not only on the environment, but also on pastoralists living in the area (Mahmoud 1984). As one Sudanese academic said: "In the North destruction happens through farming, in the South through the war".

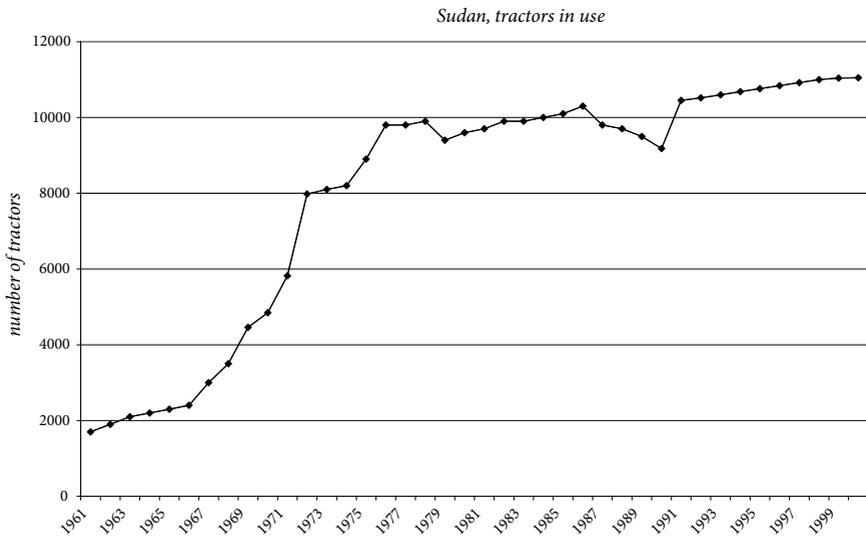
There have been some efforts by the government to change this situation. The forest authority has had some success, but reforestation amounts to about 10% of the deforestation. In 1968 the Mechanized Farming Corporation was established by the government to supervise and aid the farmers and later they were also entrusted with the demarcation of land. It is not the farming method as such that is the problem, but the incentives and

lack of law enforcement that have made Sudan's large-scale mechanized farming unsustainable. According to Mahmoud (1984), half of the World Bank's loans in 1974/75 went into the mechanized farming sector. No World Bank loans and no direct government subsidies support this farming system today, yet it has developed into a self-carrying system (Sudanese academic 2001). About 65% of the sorghum is produced with rain-fed mechanized farming, i.e. it is the most important means of cereal production for Sudan. If there is a bad year and less than 3.5 million tons of Sorghum are produced, there is a food gap, and cereals have to be imported (Abdella 2001).

Suggestions by Sudanese academics to make large-scale rain-fed mechanized farming more sustainable are:

- A clear and enforceable land use plan is required that sets limits to the expansion of large-scale rain-fed mechanized farming.
- The land use plan should not be drawn or enforced by the same people who benefit from implementing it in a lax way.
- Higher land leasing prices that reflect the value of the land should be set in order to encourage farmers to use the soil sustainably.
- Infrastructure is needed to attract farmers to live where they work.
- Investments and technical innovations (e.g. in pest control, soil fertility, shelter belts or direct seeding techniques) are needed to reduce the risk of poor harvests, to prevent soil degradation and to make farming more profitable.

Diagram 5.14,



Increase in number of tractors in use in Sudan. FAOSTAT 2002.

The other agricultural sectors, traditional farming and pastoralism, are only shortly summarized here, although they are very important as livelihood support systems. Pastoralism is well suited for the Sahel zone, as long as overgrazing is prevented. The mobility of the animals is adapted to the irregularity of rainfall. Traditionally, herds move south in the summer and north in the winter. One of the main sources of conflicts concerns the passage routes through farming areas. The troubles in Sudan have greatly effected the passage routes and grazing grounds of pastoralists. Conflicts may arise between different forms of land use. In the case of Sudan this includes conflicts between pastoralists and traditional farming, between pastoralists and mechanized farming, and between mechanized and traditional farming. Because the area of irrigated agriculture is fixed, conflicts between pastoralists and irrigated farming are less common. Land use plans and their enforcement would be essential, but they do not exist yet (Sudanese technocrat 2001). Case studies on environmental conflicts in the Horn of Africa showed that modern and traditional forms of dealing with these conflicts need to be synthesized (Baechler, Spillmann, Suliman 2002).

### 5.3 Siltation of Reservoirs

The Nile countries are not only linked by common water resources; the problems of mainly soil erosion upstream and sedimentation downstream are also closely interconnected. In Ethiopia average erosion rates from small catchments between 100 and 3000 ha vary from 2 tons/hectare and year (t/h&y) on grassland in Maybar/Wello, to 70t/h&y in the Simen Mountains in North Gonder to 110t/h&y in Anjeni (Herweg, Ludi 1999). Often the average of 40t/h&y is used for soil erosion from cropland slopes in the Ethiopian highlands, yet the effect of re-deposition of eroded material on the foot of the slopes is hard to assess. Furthermore, the relationship between erosion and soil fertility is not linear; many years may go by without a noticeable effect of erosion losses, as long as there is still some organic material left (Belay Tegene, 1986). Then, when this organic material is fully washed away, the fields may have to be abandoned abruptly; the difficulty is to know when this will happen (Ludi, 2004). The sediment loads of the Blue Nile and Atbara are discussed in section 4.1.

Downstream a large part of the sediment load is deposited in the reservoirs, in the Aswan High Dam reservoir. According to recent estimations, about 124 million tones (Moattassem et al. 1993b: 411) to 134 million tons (Abu Zeid 1987: 172) are deposited annually. It is estimated that the dead storage space in the Lake Nasser reservoir will be filled in the next 200 to 500 years. In Sudan the reservoirs are much smaller. The storage capacity of Roseries Dam was reduced due to sedimentation by 34% in 30 years (Abbas 2000: 2). Especially dams on rivers originating from the Ethiopian highlands suffer from a reduction of storage capacity due to silt accumulation in the reservoirs (table 5.7). Jebel Aulia dam is now, after the Aswan High Dam was built, mainly used to maintain water levels for pumping irrigation schemes upstream. According to the 1959

agreement, the total storage capacity of Sudan – excluding Jebel Aulia – represents only 17% of Sudan's share, whereas Egypt's storage capacity is three times its allocated share (Sudanese Ministry of Irrigation 1989: 2). Sudan has plans and has begun to higher the Roseries Dam by about ten meters, but due to the economic and political situation, the termination of this project has been postponed frequently. Oil has now also developed into an alternative energy source that competes with hydroelectric power.

*Table 5.7: Reservoir Capacity in Sudan, Past and Present.*

Dam	Year of commission	Capacity design km <sup>3</sup>	Capacity 1998 km <sup>3</sup>
Sennar Dam, Blue Nile	1925	0.93	0.37
Jebel Aulia, White Nile	1937	3.00	3.00
Khashm El Girba, Atbara River	1964	1.30	0.60
Roseries, Blue Nile	1966	3.35	2.20

*Sudanese Ministry of Irrigation 1998.*

## 5.4 Floods and Droughts

Since the Aswan High Dam was built, floods and droughts are no longer a problem for Egypt, although it did experience high flow years where excess water had to be dealt with. In 1998 the water in Lake Nasser reached a record of 180.27 meters and the Toshka depression had to be used for the overflow. The Toshka depression has a capacity of 120 km<sup>3</sup>. The critical level is 183 meters. The last maximum level was reached in 1996 at 178.5 meters. Fifty houses were destroyed in Atfih village near southern Cairo, when the Nile burst its banks (Reliefweb 1998).

The situation in Ethiopia and Sudan in high flood years is often much more serious as they do not have the reservoir capacity to dam large amounts of water. A distinction has to be made between flash-floods, i.e. floods caused by sudden heavy rains, and the rise in water levels, i.e. riverine flooding. In one day in 1988 it rained more in Khartoum than the normal yearly average. The damage was enormous. There is a high frequency of droughts and floods in Sudan, where a total of 14 million people have been affected by droughts and floods since 1975<sup>14</sup>. According to the World Food Program, drought threatened 16 million lives in Ethiopia, South Somalia, northern Kenya, Eritrea, and Djibouti in the year 2000. For the countries in the Nile Basin in general and the Horn of Africa in particular, the repetition of droughts over the years indicates that it is a chronic problem (table 5.8).

The distinction between chronic and emergency famines enhances the potential to react adequately. There are efforts on the part of the international donor community to commit food aid on a long-term planned basis to address the chronic famines. This way

14 Based on Reliefweb (2001) and further postings on Reliefweb: <<http://www.reliefweb.int>> (01.12. 2001).

countries do not only have to depend on last minute catastrophes presented in the world media to get donations flowing – when aid is often too late. The natural fluctuations of rainfall causing drought and floods are not the only reason why large numbers of people suffer. The resilience and coping strategies of these countries are often insufficient, due to the high dependency on subsistence agriculture, the low level of economic development and the political instability of these countries. The settlement patterns have an impact on the number of people affected by floods. The series of dry years between 1978 and 1987 meant that 3 million people resettled near the Nile and in urban areas in the Sudan (NBI 2001). An increase in settlements in the Nile flood plain, however, means that more people are vulnerable in high flood years.

*Table 5.8: Examples of Drought in the Nile Basin*

Country	Year	Number affected, in need of external assistance
Ethiopia	1973	3 million
Rwanda	1976	1 million
Sudan	1984	8.4 million
Ethiopia	1984	7.8 million
Uganda	1988	600'000
Sudan	1991	8.6 million
Ethiopia	1991	6.2 million
Kenya	1992	2.7 million
Tanzania	1992	800'000

*Data: Reliefweb 2000*

## 5.5 Conclusion

### *Limitations*

Physical water scarcity is a major limiting factor for agriculture in Egypt. At the moment the basic limiting quantity is the 55.5 km<sup>3</sup>/year quota of the 1959 agreement, which is also not accepted by the upstream countries, except for Sudan. This quota should suffice to meet the needs of 90 million people, a figure which is projected to be reached around the year 2020. More drastic changes than those planned now will probably be necessary in the future, e.g. using less water in the agricultural sector. The dead storage of the Lake Nasser reservoir will only be filled in about 200 to 500 years, it is not seen as a limiting factor yet. Egypt is sufficiently protected from the negative effects of droughts and floods by the Aswan High Dam.

There would be sufficient water resources in Sudan and Ethiopia to feed their populations, although the uneven geographical and temporal distribution of these water resources are a limiting factor to using these effectively. Sediments filling up reservoirs in Sudan is

decreasing the already small storage capacity and impeding hydroelectric power usage and irrigation. In Ethiopia there are similar problems, except that the reservoir capacity is much smaller to begin with. The Jonglei Canal demonstrates that international water development projects can lead to intra-national conflicts if the local impacts are not sufficiently taken into consideration.

### *Opportunities*

Only about half of the potentially irrigable land in the Nile Basin is already being irrigated, while only about a tenth of the total hydroelectric power potential of the countries of the Nile (not just on the Nile River) has been tapped so far. In Ethiopia the situation is even more extreme, only about 2% of the hydroelectric power potential is being used. The potential for development is enormous.

Next to the option of using groundwater and desalinizing salty or brackish water, there is a greater potential in increasing the efficient use of water, reusing water and moving away from crops that need a lot of water. It is estimated that an additional 20 km<sup>3</sup>/year can be made available in Egypt through such means, this equals about 30% of the water being used at present in the country. Ultimately there is the option of using less water in the agricultural sector. As more than 85% of the water used in Egypt, Ethiopia and Sudan is used in the agricultural sector, the greatest saving potential is found here. There is also the possibility of increasing the total amount of primary available water by decreasing the water lost to evaporation, e.g. by drying up swamps. The societal, economic and ecological side effects of such projects have yet to be considered, however. Importing virtual water is one way out of the water scarcity dilemma, but dependency on the international food market thus increases. Egypt is importing an additional 21% of its available water (55.5 quota plus virtual water) in the form of food (virtual water).

While sedimentation in reservoirs is an unwelcome phenomenon and reservoirs are therefore periodically flushed, there are ideas on how to use this fertile soil, e.g. farming on islands in the reservoirs or “mining” the sediments from the reservoir. In the long term there is the option of decreasing the erosion rates through better watershed management.

From this assessment of the water quantity in the Eastern Nile Basin, the potential for conflict is apparent, as an increasing number of people use a finite quantity of water. The average water availability in the Eastern Nile Basin is projected to decrease from 1200 m<sup>3</sup>/capita & year in 2002, to 760 m<sup>3</sup>/capita & year in 2025. There is also an asymmetry in water availability and water withdrawal between the countries of the Eastern Nile Basin. The actual renewable water availability of Ethiopia (1867 m<sup>3</sup>/capita & year) is twice as big as that of Egypt (829 m<sup>3</sup>/capita & year). Yet the Ethiopian water withdrawal (31 m<sup>3</sup>/capita & year) is 26 times smaller than that of Egypt (809 m<sup>3</sup>/capita & year). The difference in water withdrawal demonstrates Ethiopia's dependency on rain and Egypt's dependency on irrigation.

What are the implications for conflict management? Competitive use of limited water is one potential implication, yet one must also highlight the potential of supply- and

demand-side management to ease tensions between competitive users, both within and between countries. We now have a first idea of the technological possibilities to increase water on the supply-side (4–28 km<sup>3</sup>/year) and demand-side (>20 km<sup>3</sup>/year through efficiency increases, and already today 15 km<sup>3</sup>/year through “virtual water”). The challenge is how the national economic and political strategies can enable some of these technological options; this is the focus of the following section.

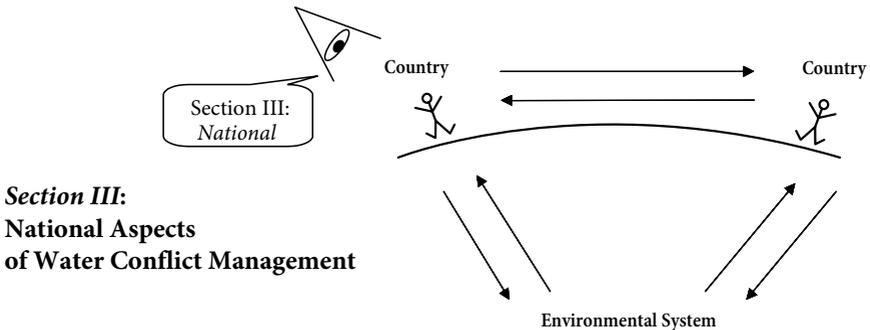


## Section III

# National Aspects of Water Conflict Management

The previous section gave us a view of the environmental opportunities and constraints in the Nile Basin, the following section examines the policies and strategies the Nile countries use to maximize the benefits and minimize the limitations of the environment. We focus on agriculture, as this sector uses the greatest amount of water. This section on the national determinants of water conflict management serves as preparation for chapters seven and eight on international relations in the Nile Basin. To understand the international debate and water policies in the Nile Basin, we have to first obtain a clear view of the national needs and water management practices that largely define the national positions and interests.

*Diagram III.1*



**Section III:  
National Aspects  
of Water Conflict Management**

*Focus on "soft" aspects of agriculture on the national level*



## 6 National Water Use and Management

The use and management of water resources is related to agricultural policy, national economy, social stability, political framework, international relations as well as urban and rural development and sanitation. In the following chapter we comment on the link between water and agriculture. Subsequently a more in-depth analysis is made for the cases of Egypt and Sudan concerning their agriculture sector and how it relates to their national water policy. The situation in Ethiopia is dealt with superficially, as it is extensively treated by Arsano (2004). Chapter five gave an overview of the physically measurable aspects of the agricultural sector, chapter six also focuses on the agricultural sector, but on the “soft” aspects: policies, prices, self-sufficiency rates, strategies and water development projects.

Abrams (2001) defines policy in the following way: “Policy is the set of decisions, made ultimately by the highest political level in a country after a process of dialogue and consultation, which determine what and how things will be done in any given sector” and “Policy is mixture of politics, practice and pragmatism”. He sees vision, political endorsement, technical expertise, stakeholder engagement and realism as key factors in the policy process. The term public policy refers to the interaction between different state, non-state and private actors, aiming to resolve a collective problem in a concerted manner (adapted from Knoepfel et al. 2001: 28). Public policy is viewed as an iterative process: 1) emergence of a problem, 2) agenda-setting, identification of the problem’s collective, political character, 3) formulation and adoption of a policy to deal with the problem, 4) implementation of the policy, 5) evaluation of the policy (Knoepfel et al. 2001: 39).

Policy reform is an internal process. While external experts may be used, ultimately policy is a national sovereign matter, as only national experts can take the specific circumstances of the country into sufficient consideration (Abrams 2000). Policy dialogue on the national and international level, however, can enrich a policy reform process. Therefore this chapter does not aim to conclude with policy recommendations; it will try to contribute to the understanding of the national policies and the international water policy dialogue.

### 6.1 The Link Between Agriculture and Water Management

World wide, agriculture is the main consumer of water. In Egypt, Sudan and Ethiopia more than 86% of the water withdrawal from the Nile is used for irrigated agriculture. Water availability therefore has a direct influence on national food security. According to the FAO, all the countries of the Nile Basin, except Egypt, suffer from malnutrition (table 6.1). All countries of the Nile Basin, except Uganda (during some years), are net

importers of cereals. Resources such as land and water, as well as the general political and economic situation, play crucial roles.

*Table 6.1: Food security in the Nile Countries*

	Proportion of population undernourished 1996–1998: (a)	Reasons for food emergency (FAO 2000) (b)	Cereal import, kg/capita+year, 1989–98 (pop. 1998) (c)	Human Development Index value 1997 (d)	Population in millions 2002 (e)
Burundi	65%	Civil strife, population displacement	6.21	0.324	6.7
D. R. Congo	60%	Civil strife, population displacement	8.05	0.479	54.3
Egypt	5%	No information	128.69	0.616	70.3
Eritrea	65%	War-displaced people and returnees, drought	64.86	0.346	4
Ethiopia	50%	Drought, large number of vulnerable people, Internally Displaced people (IDP)	9.18	0.298	66
Kenya	40%	Drought	22.41	0.519	31.9
Rwanda	40%	Insecurity in parts	18.61	0.397	8.1
Sudan	20%	Civil strife in the south	23.16	0.475	32.6
Tanzania	40%	Successive poor harvests in several regions	6.80	0.421	36.8
Uganda	30%	Civil strife in parts, drought	3.14	0.404	24.8

*Source: a) FAO 2000b. b) FAO 2000a. c) FAO 2000c. d) UNDP 2000. Human Development Index includes indicators for life expectancy, adult literacy, combined primary, secondary, tertiary gross enrolment ratio and Gross National Product per capita, e) UNFPA 2002.*

An important factor influencing the management of water in arid regions is the predominant understanding of food security in these countries. The World Bank defines food security as “Access by all people at all times to enough food for an active healthy life” (USAID 1992). While the aim is clear, there are different understandings as to how to reach this goal. A widely held interpretation of food security concentrates on self-sufficiency, i.e. to be independent of the international market. Self-sufficiency does not necessarily have to be understood in the context of one country; it can also be applied to a region in order to use the comparative advantages of the various countries. Examples of this are efforts in the Arab world (Moneim 2000) and – at least as an idea – in the Nile Basin<sup>1</sup>. Food security can also be understood differently in that a country does not have a negative food or trade balance. Strawberries, for example, or industrial goods are exported for a high price and cereals imported instead. It is easier to import water in the form of cereals than it is to transport water. The so-called “virtual water”<sup>2</sup> is calculated by the following

1 “Nile Vision Exercise” during the VII Nile 2002 Conference, Cairo, March 15–19, 1999.

2 The term “virtual water imports” was coined by Allan (1997).

rule of thumb: 1 kg of bread needs about 1'000 liters of water for its production. In the Eastern Nile Basin, Egypt imports 13 times more virtual water than Ethiopia (table 5.6). International water experts therefore often stress the importance of industrialization in water scarce countries to allow them to develop the economic capacity to import food from water abundant regions. According to Zehnder (1999):

“Food exporting countries (with few exceptions these are industrialized countries) need to give greater support to the industrialization of water scarce countries in the coming years. Otherwise the migration pressure to countries with abundant water and food will increase.”

A further understanding of food security also includes the socio-economic and political stability of a country or region. According to this understanding, it is only meaningful to speak of food security when equity and stability are given. Hunger is often not a question of quantity, but of infrastructure and the institutional capacity of a country or region to distribute food. On a global scale, this definition of food security could also include a stable world market price and free access to cereals (Yang, Zehnder 2002, Ohlsson 1999: 239).

The predominant understanding of food security in Egypt, Sudan and Ethiopia can be positioned somewhere between that of food self-sufficiency and a balanced trade in foodstuffs, i.e. equal economic value of food exports and food imports. Food security is not understood as a situation of no trade deficit (equal economic value of imports and exports), because agriculture plays an important role in the economy and culture of these countries. The socio-economic importance of the agricultural sector is indicated by its contribution to the GDP and by the large percentage of the population working in the agricultural sector. As mentioned above, agriculture is responsible for 86% of the water withdrawal (table 6.2). Moving from an agriculture based economy, importing non-food goods seems to be culturally more accepted than importing food. The surplus of agricultural products, e.g. cotton in Egypt and Sudan, and coffee in Ethiopia, can be used for industrial development.

*Table 6.2: Importance of the agricultural sector in Ethiopia, Egypt and Sudan*

	Ethiopia	Egypt	Sudan
Employees, agriculture, male (% of economically active population) in 1990 (a)	86	35	64
Employees, agriculture, female (% of economically active population) in 1990 (a)	86	52	84
Agriculture, value added, % of GDP in 1998 (a)	52	17	40
Water withdrawal, agriculture (% of total water withdrawal) (b)	86	86	94

Source: a) World Bank 2001, b) WRI 1999.

## 6.2 Egyptian National Water Management

Changes in agricultural and water policy are intricately linked to social consequences, and this especially in an environment where the enormous pressure of population growth and other related problems such as unemployment<sup>3</sup> are a pertinent destabilizing factor. Parallel to the search for more living space outside the Nile valley and Delta are considerations of social stability and perhaps also of international security. The south of Egypt should benefit from economic development, as it is traditionally a trouble spot far from the administrative and economic center of Cairo. Developing and populating Sinai is planned in order to end its isolation from the rest of Egypt (SIS Sinai) and possibly also to mark it as belonging to Egypt. It was disputed and occupied territory in the six-day war with Israel. Agriculture is the main water consumer in Egypt, but changes to increase the water efficiency are difficult as irrigated agriculture is an inherent part of the culture, with many thousands of years of history.

### 6.2.1 *Agricultural Policy in Egypt*

The present agriculture policy of Egypt is guided by the following principles, quoted from the Ministry of Agriculture (MOA 2000):

1. "Gradually removing governmental controls on farm output prices (this does not preclude government voluntary guarantee prices for some strategic crops); crops' areas; and procurement quotas.
2. Increasing farm gate prices to cope with international prices.
3. Removal of farm input subsidies.
4. Removal of governmental constraints on private sector in importing, exporting and distribution of farm inputs to compete with the Principle Bank for Development and Agricultural Credit (PBDAC).
5. Removing governmental constraints on private sector in importing and exporting agricultural crops.
6. Gradually diverting the role of the PBDAC to financing agricultural development projects.
7. Limitation on state ownership of land and sale of new land to private sector.
8. Confining the role of the Ministry of Agriculture (MOA) to Agricultural Research, Extension and Economic Policies.
9. Adjusting the land tenancy system.
10. Adjusting the interest rate to reflect the commercial rate.
11. Adjusting the foreign exchange rate to reflect the real value of local currency."

This market-oriented policy was initiated in the late 1980s. It differs from the prior policy of greater state intervention, state-controlled agriculture included land reform policies,

3 The official unemployment 1999/2000 in Egypt: 7.4% (MoE 2000b).

subsidies, taxes and control over pricing, crop patterns and marketing (Harik 1998). The market-oriented process was mainly initiated as a response to outside pressure. In 1991 the Economic Reform and Structural Adjustment Program and the Structural Adjustment Loans agreements were signed in order to stabilize the economy and head towards a market-based economy (Korayem 1997: 1). The policy of liberalization and deregulation is still in the process of implementation, in some areas at a slow pace.

In the agricultural sector the slow pace is partly due to the different underlying understandings of food security. There are different opinions about what food security means and how to achieve this. On the one hand the means of reaching food security is seen through greater food self-sufficiency, and on the other hand through a net balance in imports and exports. Arguments for self-sufficiency are the following:

- *Dependency*: Egypt has had negative experiences in the past when it was dependant on a foreign power, such as the United Kingdom. Who guarantees that imports increase with the same speed as population growth? One Egyptian academic said: "It is psychologically not possible to trust the world market." The aim is therefore to only import the most necessary goods. The idea of importing food and paying for this with the development of industry and tourism is seen as a theoretical idea because of the need for security. As one academic interviewed in Egypt said: "What if you have a problem with the country you are importing food from? They can stop the imports."
- *Social factors*: Forty years ago the person/land ratio was about 0.5 acre/capita. Today the ration is about 1/10 acre per capita. Irrigation is a very old tradition in Egypt. Most Egyptians cannot imagine Egypt without agriculture. It is part of the culture, part of their identity. Working places are also an important factor. In addition, tradition plays a role, people on the north coast, for example, are used to eating rice every day. Many Egyptian academics say that one cannot forbid this, implying that one must grow rice and not import it.

Arguments for imports and exports, as well as the virtual water argument, are of an economic nature:

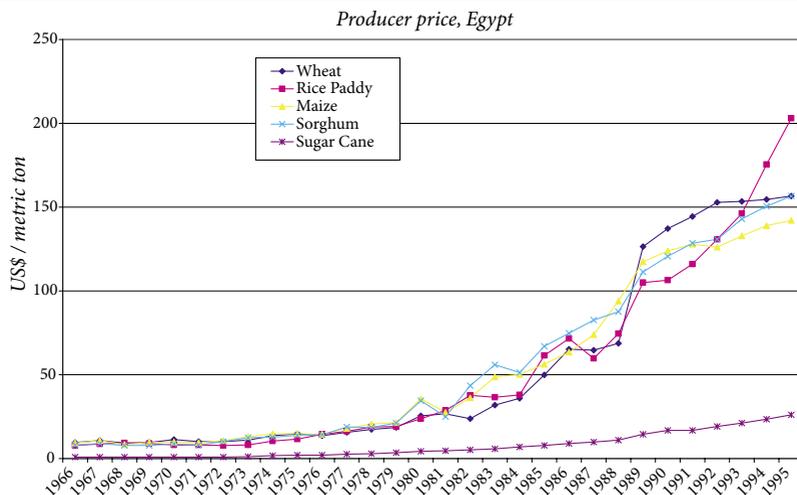
- A European academic working in Egypt for more than twenty years said that the idea of food security through self-sufficiency is "archaic". The US has for a long time been pushing in the direction of comparative advantage. According to him, no one seriously considers the old form of food security, i.e. self-sufficiency, citing that even countries like Holland, with a lot of agricultural resources, import wheat. According to the opinion of an Egyptian academic, water is equal to money, and the optimal resource use is the one that creates the highest economic return. He also stated that one cannot only consider economic factors. Social and cultural considerations need to be taken into account as well as.

Egypt seeks to find a balance between the market-oriented and the self-sufficiency goals in the agricultural sector. It has a “Development strategy of self-sufficiency through the expansion of crop and foodstuff production.” (MOE 2000a), but the Ministry of Economy also states: “the agricultural sector has potential to achieve significant growth through the liberalized economic environment” (MOE 2000a). Egypt produces about 60% of its cereals, the rest is imported, partly a result of the compromise between self-sufficiency and economic considerations. If Egypt used its entire agricultural area for cereals it could be practically self-sufficient. Through the growth of cash crops, however, a higher return per drop of water is achieved. If the entire area were used for cash crops, Egypt’s dependency on other countries for basic food supplies would be greater, although its economic power would increase. This would only be possible by creating off-farm opportunities. Developed countries show that agriculture remains important in the economy, even if it employs fewer people.

#### *Agricultural economy*

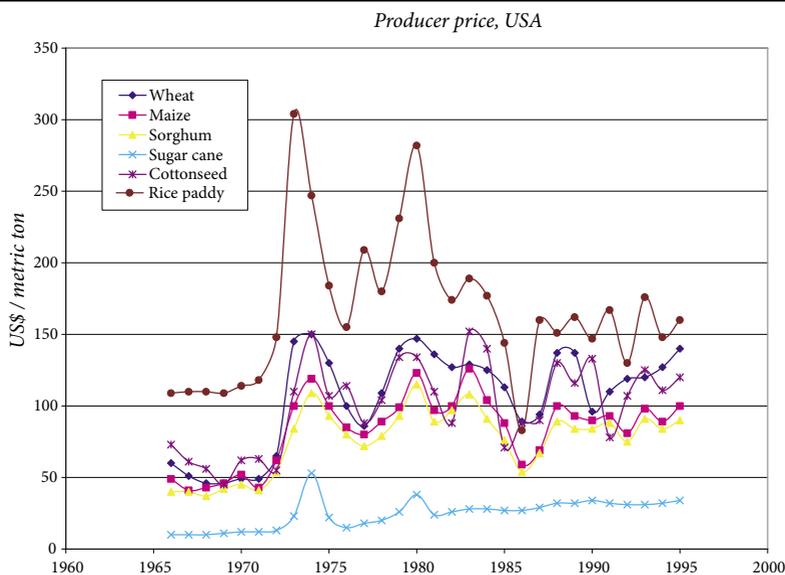
Partly as a result of the liberalization process, the agricultural growth rate has increased from 2.6% in the 1980s to 3.4% in the 1990s (IFAD 2001 and MOE 2000b). Yet Egypt remains a major importer of agricultural goods. Thus in 1998 agriculture contributed to 33% of Egypt’s trade deficit (Bush 2001). The liberalization policy has had different effects on different crops. Generally it seems to have caused an increase in the cropped area, yield and production (chapter five). There is a clear increase in production for all crops except sorghum and cotton. The downward trend for area under cotton seems remarkably constant and seems not to have been influenced by the liberalization of the 1990s. The fluctuations of the producer price (price paid to the farmer) in the USA compared to that in Egypt prior to about 1985 indicate the stabilizing effect of Egyptian state control (diagrams 6.1 and 6.2). The impact of liberalization at the beginning of the 1980s falls in line with the increase in producer prices. It should be noted that the changes in producer prices also went hand in hand with changes in input subsidies that are not presented below. Self-sufficiency of wheat reached 60.4% in the year 2000 (MOA 2000, see section 5.2.2). Egypt enjoys self-sufficiency in rice, vegetables, fruits, dairy products, poultry, eggs and fish (diagram 6.3) (MOA 2000).

Diagram 6.1



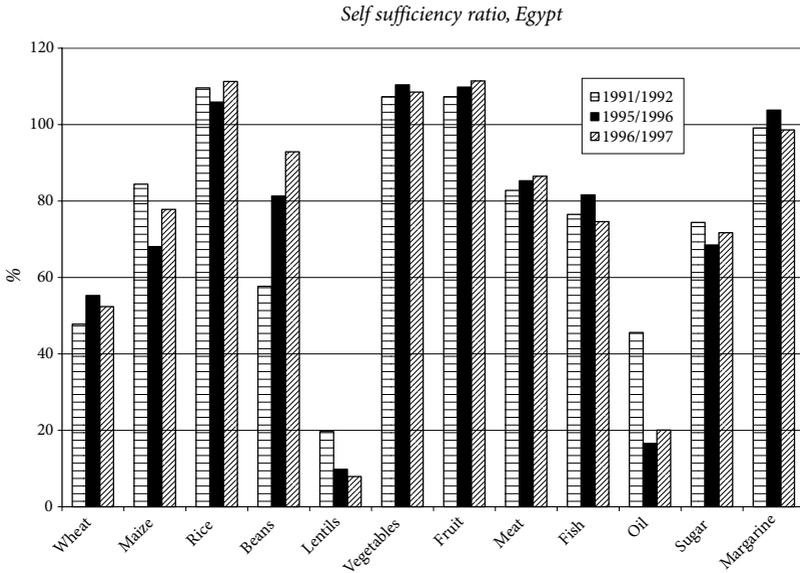
Farm gate price (price paid to farmer) of some crops in Egypt. The farm gate price of seed cotton is not included as it distorts the scale; in 1967 it was 31 US\$/metric ton, in 1995 it was 696 US\$/metric ton. (average conversion rate: 1 Egyptian pound = 0.29 US\$). FAOSTAT 2001.

Diagram 6.2



Farm gate price, price paid to farmer, of some crops in USA. FAOSTAT 2001.

Diagram 6.3



*Self-sufficiency rate of major crops and commodities in Egypt (Abu Zeid 2001, data on self-sufficiency is from the Ministry of Planning, year plan 93/94, 96/97, and 97/98). By the year 2000 wheat self-sufficiency reached 60.4% and fish 100%. Data: MOA 2000.*

The producer price for a specific crop does not always correspond to the level of added value per unit of water for this crop. As long as water is free, a farmer is guided primarily by the producer price and not by the economic value added per unit of water (table 6.3). Thus, if the relations do not go hand in hand, the lack of economic incentives for water efficient crops can be one factor why water wasting crops such as rice and sugar cane are grown. The value added in the cultivation of wheat and berseem is about three times as high as in sugar cane, and two times as high as in maize or rice cultivation (table 6.3).

*Table 6.3: Real value of applied water in US\$/m<sup>3</sup>*

	rice	sugar cane	maize	cotton	wheat	long season berseem
1986	0.01595	0.01102	0.0116	0.00696	0.03451	0.03335
1987–1990	0.02001	0.01305	0.02407	0.01102	0.04321	0.03451
1991–1996	0.01711	0.01073	0.01508	0.01856	0.03451	0.03219

*Data: EAAE 2000.*

The financial value of irrigation water increased during the 1986–96 period (table 6.3). The inverse U shape pattern of this increase can be explained by the changes in producer prices during this period (EAAE 2000). The producer price of cotton increased between

1991 and 1996 in comparison to the general leveling off of the producer prices of wheat, maize and sugar cane. Thus cotton is also the only crop that does not follow the inverse curve, but rather shows a steady increase (table 6.3).

The production and self-sufficiency increases shown in the diagrams above indicate that the present liberalized agriculture policy is successful. Nevertheless, criticism has been addressed concerning the effect of this policy on small-scale farmers and rural employment. Furthermore, the export orientation has been questioned as Egypt's imports include commodities with a low price elasticity demand<sup>4</sup>, such as wheat, sugar and edible oils, while exports are marked by high price elasticity (Bush 2001).

### 6.2.2 Water Development Projects

Water development and land reclamation projects aim to 1) increase food security and exports from cash crops, 2) create living spaces, 3) create jobs, 4) compensate for land lost to urbanization, and 5) stabilize regions in the periphery. Since living space is very limited, the government sees itself as being responsible to seek new living areas so that Egypt can free itself from the Nile valley corset. The population of Egypt is increasing at present by 1.2 million individuals per year (UNFPA 2000). At the moment less than 5.5% of Egypt's territory is populated, this means that about 70 million people live in an area that is about the size of Switzerland (SIS Mega Projects). 70'000 ha/year are lost to urbanization – i.e. about the size of 70'000 large football fields per year (Elarabawy 2002). With the help of mega development projects, the populated area should increase to 25% (SIS Mega Projects). In the next 20 years Egypt plans to expand its agricultural area by 1.43 million ha. These large projects to reclaim land from the desert in Sinai, the west and southwest of Egypt, are integrated projects that include the development of industry, cities and tourism (box 6.1). Security concerns may also play a role in the motivation of mega-development projects. According to the Financial Times (2000), this involves maintaining Egypt's share of Nile water now rather than later, creating a populated buffer against Israel, and similarly populating a large area close to Sudan.

There is a discussion concerning the Environmental Impact Assessments (EIAs) of land reclamation projects. In general the widely held opinion is still that EIAs only show the negative aspects of a project and should therefore be avoided. Some academics say that there was no serious EIA on Toshka, while the government claims that many studies were made. For the North Sinai development project there is an EIA from 1992 by Euroconsult. According to this EIA, the project would have positive impacts on the socio-economic conditions in the area, it could improve the land tenure and land registration possibilities for settlers and develop new agro-ecological habitats. Furthermore, the project would help the fixation of moving sand dunes. Negative impacts could be expected concern-

4 Products have a low price elasticity when the demand stays more or less constant even when the price changes. Products have a high price elasticity when a change in demand goes hand in hand with changes in the price.

ing the loss of natural habitats and increased pressure on remaining natural habitats for flora and fauna. There is also the potential of loss of known and unknown historical and archeological evidence. Additional negative impacts were expected concerning the displacement of existing population and land use activities (Euroconsult 1992).

In the following, the projects are first described, then the criticism of the project is reviewed, followed by the arguments countering the criticism.

*South Western Development Project, Toshka:*

The South-Western Development Project, imprecisely called Toshka project for short, is located in the southwest of Egypt. 0.97 million ha of agricultural land are to be reclaimed in the “Southern Valley”. President Hosni Mubarak called the project “Egypt’s project of the century”. In a speech given at the inauguration of the project in 1997 he said:

“Once again, there emerges Egypt’s innovating and daring spirit, calling upon all Egyptians to join forces behind a new national super-project and to take part in a glorious feat of construction, adding a further achievement to the history of a nation that has accomplished many miracles.” (SIS 1997).

*Box 6.1: Fact sheet about mega projects in Sinai and Southern Valley (Toshka).*

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***Mega National Development Projects:***

National Development for the Development of Sinai, 1994–2017.

*Aims:* total population in Sinai: 3.2 million, work for 800’000 by the year 2017, total investment: 20 billion US\$. *Agriculture:* 1. Phase N. Sinai 168’000 ha, 3 km<sup>3</sup> water/year (Al Salaam canal) 50% with reused water and 50% Nile water. 2. Phase: 32’000 ha East of the Suez Canal, 0.42 km<sup>3</sup> water/year. 3 Phase more long-term, after the project in the south of Egypt has been realized: 105 000 ha East of the Suez Canal (SIS National development).

The Southern Valley (Toshka) Development Project.

*Aims:* creation of 2.8 million job opportunities (SIS 2001a), industry areas, towns and various tourist attractions, e.g. safari and rallies. About 3 million (Gulf Business 1999) to 6.3 million (SIS 2001a) people should find a home. Total investment by 2017: 80 billion US\$ financed to 20–25% by the government and the rest through private investments (SIS Mega Projects). *Agriculture:* 1. Phase: 227’000 ha, longer term in the Southern valley 0.97 million ha using 5.5 km<sup>3</sup> water/year from Lake Nasser pumped from “Mubarak Pump Station” at a cost of 448 million US\$ (Financial Times 2000) with a pumping capacity of 25 million m<sup>3</sup> water per day, using 375 MW/h. In addition, various projects using groundwater: e.g. 84’000 ha East Owainat and Darb Al-Arb’ain. In the new agriculture areas no insecticide and chemical fertilizers are to be used (SIS Mega Projects). The first stage of Toshka was inaugurated in January 2003, at the moment there are 10’000 workers involved in the project (Farak 2003).

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The idea of the “New Valley” came from President Nasser, reviving an old Egyptian dream to leave the old valley. The original Nasser New Valley was planned in the north-west, using groundwater. Wells were drilled in the north-west desert and groundwater gushed out, the pressure soon sank, however. It was found that there was not enough groundwater. President Mubarak adapted the New Valley idea, now in the south-west. There is suitable land for agriculture west of Aswan, near the Sudanese border (Egyptian academic 2000).

The Mubarak Pump Station, the largest in the world according to the Guinness Book of Records, will pump up to  $5.5 \text{ km}^3/\text{year}$  of Nile water to make the desert green. The pump near Lake Nasser will pump water into a main canal that further on has 4 branches. The pump was commissioned to be finished by mid-2002; the two first pumping stations of 21 started operation in 2002 to irrigate 25'000 ha (SIS 2002). The main source of water to compensate for the  $5.5 \text{ km}^3/\text{year}$  used in the project will come from efficiency increase. On top of this, an additional  $2 \text{ km}^3/\text{year}$  of deep groundwater and desalination of  $0.5 \text{ km}^3/\text{year}$  of brackish groundwater will have to be utilized (Elarabawy 2002). The project therefore means that Egypt will not use more than the  $55.5 \text{ km}^3/\text{year}$  quota of Nile water, and it is thus generally viewed in Egypt as a project that does not have any international implications. In a first phase 227'000 ha are to be irrigated. Egypt and the United Arab Emirates are the main investors. The Egyptian government is building the infrastructure; private investments are taking care of drainage, leveling, and the preparing of the ground. Saudi Prince Walid Ben Talal Ben Abdel Aziz (KADCO company), for example, spent 43 million US\$ on 42'000 ha by 2002 (SIS 2002). Some 25'000 ha have been reserved for new graduates from universities (SIS 2002). The economic viability of this project was questioned by the opposition party Al Wafd:

“The Wafd Party is not against the idea of launching national mega-development-projects. In times of economic stagnation, some countries resort to the implementation of such projects in a bid to promote business activity and break off recession. The question is: Does this apply to Toshka? The answer, deplorably enough, is ‘no’”Ayman Nour, Wafdist deputy (Essam El-Din 2000).

Rushdi Said wrote a book in Arabic on the Nile where he also criticized the project. He suggested cultivating an area adjacent to the already cultivated one. He also suggested increasing the productivity of water. The total value of agricultural production in 1999 in Egypt was 20 billion US\$ (MOA 2000).  $47 \text{ km}^3$  water/year are used for agriculture, thus the agricultural value of water is about  $0.42 \text{ US}/\text{m}^3$ . He compared it to other countries that had a much higher economic return per cubic meter. He argues that one should maximize the economic return, e.g. by growing medicinal plants (Egyptian academic 2000). According to the Financial Times (2000), the international investment bank Flemings, based in London, downgraded Egypt to “underweight” in March 2000 after judging that mega-projects were putting an unbearable strain on the country's finances. Waterbury and Whittington (1998) calculate the opportunity costs of the  $5.5 \text{ km}^3/\text{year}$  of water to be spent on the Toshka project, and estimate that this water would suffice

for municipal and industrial purposes for 333 new cities with a total population of 65 million people. Another form of criticism concerns less the project as such, but more the timeframe in which it will be realized. According to conservative plans, no Upper Nile Development Projects will be implemented before 2025 (Elarabawy 2002).

Questions concerning the Toshka project can be grouped as follows (based on interviews and media articles, such as ArabicNews 2002, Schemm 1999, Financial Times 2000, Farag 2003)

1. *Cost & investment:* One of the main problems is the volume of investment. Estimates of the cost vary considerably, but are estimated to be about 80 billion US\$ for the total project. There is limited clarity about the figures. Foreign investment is to cover 80% of the infrastructure. As the costs increase, however, investors become more cautious. There are also problems of insufficient liquidity in Egypt, which is also part of the recession. It seems that the Minister of Economy in 2000 told the president that if Egypt continues in the path of mega-projects it has set out on, this would cause economic problems. Thus, it seems that the Toshka project is being implemented at a smaller size. Foreign companies were given a deadline by when they should develop the land. The downscaling is going towards cultivating areas closer to the core of the project and giving up the areas farther away.

“Work began at Toshka on 9 January 1997, one of five “mega-projects” launched under former Prime Minister Kamal El-Ganzoury. But by the time he was ousted from office in 1999 the projects had been blamed for creating the foreign-exchange shortage that eventually forced the government to devalue the currency. Critics also cited the fact that parliament’s Agricultural and Irrigation Committee had been excluded from the pre-approval round of debates; that the capital-intensive nature of the project makes it a poor provider of job opportunities and that the project is simply too expensive for a country of Egypt’s means.” Farag (2003).

2. *Water shortage:* What is the impact of channeling 5.5 km<sup>3</sup>/year to the project? There will be 5.5 km<sup>3</sup>/year less for the old lands. This is about 10–15% of the supply of the Nile for agriculture. There are different strategies to make up for the lost water.
  - Rationalize: The government is aiming at reducing crops that use a lot of water, such as rice and sugar cane. It is, however, difficult to change long-standing agricultural practices.
  - Recycling of sewage water; this may have negative side effects, e.g. on health.
  - The use of groundwater: The availability of groundwater is finite, some estimate that after 50 years, pumping groundwater in the south-western desert becomes uneconomic.

3. *Energy shortage*: Energy used for pumping (up to 375 MW/h) takes energy away from other uses.
4. *Adverse climate & environment*: The south-west of Egypt is hot at day and cold at night – it is difficult to attract people. In the environment in Upper Egypt, the temperature varies between 35–50 °C. There is a lot of sand dune movement, and water evaporation is high because of the heat. The underground water in this area is also not available continuously, there are different pockets of groundwater. This makes integrated development difficult. One of the aims of the project was to relocate 3 million people and build towns. The scheme, however, calls for big companies, high-tech and capital intensive development. An open question is how much labor capacity this will require. Highly skilled labor is needed. How can this be expected of 3 million people? Their lifestyle would be of a highly skilled, capital intensive, high tech nature. Many think that only large-scale agricultural enterprises will be able to survive.

According to the government, the project was examined in 147 studies and found to be viable (Essam El-Din 2000). The goal of the project is not primarily an economic one, considerations of social stability also play a very important role. The former head of the National Water Research Center, now the Minister of Irrigation and Water Resources, Abu Zaid, said that Toshka is an unconventional project. Therefore, rolling planning and continuous adaptation is needed. It is not conventional in the sense that you plan the project and then implement it. This explains the changes in the area that was planned to be cultivated, the change in the time frame of implementation, and the change in costs. According to Abu Zaid, all the adjacent areas to the Nile Valley have already been covered with land reclamation projects, therefore Toshka is the best area for land reclamation of the still available land. The reclamation cost per hectare in areas nearer to the Nile Valley amount to 8'300 US\$/ha; in Toshka it will not exceed 11'000 US\$/ha according to official estimates. Unofficial estimates predict that it could be up to twice as high. The operational cost is estimated not to exceed 216 US\$/ha; 50% for pumping costs, 50% for labor wages, infrastructure, depreciation rates etc. Investors will pay between 0.01 US\$ and 0.02 US\$ per cubic meter of water. One hectare should attract labor for 4 rural workers, plus eight job opportunities related to the services sector (SIS 1999). While high-tech irrigation schemes will need skilled labor, most of the manual work such as harvesting will use unskilled labor forces. A study of the World Bank confirms that the project will yield an output of about 8%; according to the Ministry of Irrigation and Water Resources, this output could be higher, in the range of 11–13%, depending on the crops (SIS 1999). Thus, the government argues that the project is economically viable and that the population pressure is so great that the Toshka project is necessary to create living areas, jobs and food security.

“...under the pressing overpopulation problem entailing a progressive dependence upon imported food from abroad, Egypt has to continue a sustained horizontal expansion in the agricultural field exploiting to the maximum all the available water resources in order to satisfy all the food needs of the people, or at least minimize Egypt’s foreign dependence in this respect.” (SIS 1999).

Arguments for the Toshka project, also from many academics in Egypt, point out that under the present population and living space pressures, the project is not a question of choice, but an unavoidable project that is in a process of self-correction in its implementation. Many water experts in Egypt argue that the location of the Toshka project is given because barrages on the Nile River cannot manage more than a certain amount of water during excess flood years; thus, excess water has to be used in the south-west of Egypt. Before the Toshka project was implemented, the natural Toshka depression was used as a spillway in high flood years (Egyptian academic 2000). Many Egyptians also pointed out that while there is a strong movement against large-sized development projects in the west, it is simply impossible to send small farmers out to do land reclamation (Egyptian academics 2000).

There is now a more or less open debate about Toshka, with a lot of contradictory opinions. In general there seems to be more agreement about the development project in north Sinai (box 6.1). Nevertheless, the debate about Toshka and the economic constraints seem to be having a positive influence on the implementation of the project. According to Abu Zaid, Egyptian irrigation experts are not divided over the Toshka project; some may have remarks over some issues, but not concerning the core of the project (SIS 1999). In relation to criticism over Toshka, President Mubarak said:

“I accept criticism,” but also: “I believe that no nationalist Egyptian who loves his country would cast doubt on a project which is being carried out as a fact.” (Schemm 1999).

In summary, Egyptian interests in social stability (employment and living space), self-sufficiency, water efficiency, economic viability and foreign exchange earnings influence how water is used in the agricultural sector. The national food security strategy of Egypt is influenced in particular by the following points:

- *The dominance of cash crops on new lands:* The new lands are all used for high investment agriculture. Due to economic considerations, cash crops with a high economic return are planted. Cash crops such as organic fruit and vegetables are partly sold on the national market. When they are sold on the international market, however, they are not grown for food security, but in order to gain foreign exchange earnings. Thus the new lands – this includes Toshka and Sinai – contribute to basic food security indirectly, mainly in the sense of aiming at a net balance in agricultural trade and *not* by achieving self-sufficiency in cereals. Growing wheat on land reclaimed from the desert is too expensive and is only being done on a very limited scale. Egypt has to a large extent avoided inefficiencies of the sort Libya and Saudi Arabia were involved in: growing wheat on unsustainable groundwater resources.

- *An increase of cereal production on old lands:* In the old lands, a compromise is sought between self-sufficiency and export crops. Production of wheat has increased, while the production of cotton remains stable, indicating that this compromise over the years has tended towards keeping or increasing the level of self-sufficiency of cereals, rather than promoting cotton. World market prices of cotton and wheat also play an important role. The bread subsidy can be seen as stemming from considerations of social stability and have supported the production of wheat.
- *The limitation of rice and sugar cane:* The agricultural policy has aimed at limiting rice and sugar cane in order to save water losses. So far this policy has not been very successful, as considerations of social stability outweigh considerations of water efficiency.
- *The positive effects of market-oriented economy:* The effect of market liberalization on agricultural production has been positive. The liberalization of the agricultural sector has progressed cautiously, however, in order to maintain social and political stability. The rapid transformation of the former Soviet Union from a state-controlled to a liberalized economy has been seen as an undesirable model which should not be copied.
- *The economic viability of large-scale projects:* The National Mega Development Projects are being debated within Egypt, especially concerning their economic viability. Integrated development seems to have better chances in the Sinai project than in the south-western desert. The general debate concerning such projects, however, is not if they should be undertaken, but how they should be undertaken. Due to economic constraints, the Toshka project seems to have been downsized from its original plan. It is being implemented, but not as fast as was originally anticipated. If the project would be fully implemented, the effect on the water availability could be problematic, especially in the long run as the use of fossil groundwater is unsustainable.

### 6.2.3 National Water Policy

The Ministry of Water Resources and Irrigation (MWRI) of Egypt is mandated to control and manage all the surface and subsurface water resources in Egypt. The MWRI develops its policy in an evolutionary process. This evolving policy, for example, had to take into account the delay in the construction of the Jonglei Canal that was stopped in 1983 and that would have increased the available water resources in Egypt by 2 km<sup>3</sup>/year. The target of earlier water policies was to provide water for large land reclamation projects such as in the Sinai and in Southern Valley. The per capita share of cultivated land dropped from 0.21 ha/person in the beginning of the last century to 0.05 ha/person at its end (Elarabawy 2002). One of the main aspects of the water policy until 2017 is the aim to shift from a green revolution to a blue revolution, i.e. to increase the productivity per drop of water. A further innovation is to focus more on demand-side management and to improve the water quality (Elarabawy 2002). The ministry's policy is subdivided into

three areas: 1) water quality protection, 2) optimal use of available water resources, and 3) international cooperation with the Nile Riparian countries (Egypt 2002: 2). The last issue is dealt with in chapter seven, and will therefore be left out here.

#### *Water Quality Protection*

The water quality protection policy of Egypt is a combination of preventive measures, water treatment facilities and quality monitoring. Discharge limits were set in Law 48 of 1982: Protection of the River Nile and its Waterways; this has been revised since. Some of the gaps in the legislation were filled by Law 4 of 1994: Law for the Protection of the Environment. The limited compliance rates are related to the costs and the limited infrastructure devoted to compliance oversight. On the side of prevention, subsidies on fertilizers and pesticides were removed and some persistent chemicals used in agriculture were banned. The National Water Quality Monitoring Program aims at integrating existing water quality activities with a coordination of institutional efforts. There are 300 locations for surface water and 230 for subsurface monitoring that provide the baseline for analyzing trends and developments. Urban drains have been classified according to water quality status. This classification can help to optimize drainage water harvesting and the mixing of drainage water with fresh water for agricultural purposes, as well as help to identify points and areas where pollution mitigation actions are needed (Egypt 2002).

#### *Optimal Use of Available Water Resources*

The optimal use of available water resources is targeted with a multi-faceted package of policies that range from encouraging technical solutions, such as the use of closed pipelines to transfer water to the new lands, to economic instruments, such as cost recovery through greater farmer participation. Policies aim at an increased efficiency in irrigation, cost recovery of infrastructure, the use of water efficient crops (e.g. less rice and sugar cane), groundwater use, the reuse of agricultural drainage water and sewage water, the desalination of brackish water and the harvesting of rainfall and flash floods (Egypt 2002).

The economic analysis above shows that water consumption and economic return varies for different crops. In order to enhance the cultivation of water efficient crops, an indicative crop mix for each region in the country is in the process of being designed. This is to be based on the climatic conditions, the soil characteristics and the availability of water resources in terms of quantity and quality. Farmers will be supported to follow this plan, and those that do not may have to pay for excess water (Egypt 2002: 4).

Water pricing is not a policy option in Egypt, both for religious and cultural reasons (Farag 1999). What is an option, however, is the cost recovery of infrastructure. According to Abu Zaid, economic consideration of water has to take into account: a) the cost of infrastructure, b) the economic, social, environmental and cultural value of water uses that differs from country to country and c) the protection of the poor (Farag 2000). This

can also be combined with a greater participation of the private sector and farmers in the operation and maintenance of the irrigation system (Egypt 2002: 3).

Egypt's water policy until the year 2017 (quality, optimal use and international negotiations) is estimated to satisfy the water demand of about 90 million people. According to projections this number will be reached by about the year 2020. When the population grows above 90 million this water policy of demand-side management (quality and optimal use) and supply-side management (international negotiations to secure or increase basic water supply) *within* the agricultural sector will no longer be sufficient to cover the water requirements of Egypt. At such a point, if not before, it is therefore likely that a shift of water from the agricultural sector to other sectors will occur in order to satisfy municipal and industrial water requirements (Middle East Times 2001).

The contribution of the agricultural sector to the GDP of Egypt decreased from 40% in the 1960s to 30% in the 1970s to about 16% in the 1990s (FAOSTAT 2002). However, about 36% of the labor force is still employed in the agricultural sector (El Quosy, Tarek 1999: EGY-18.3). It is also interesting to note that 48% of the World Bank's investment in Egypt is in the agricultural sector (World Bank 2002). The importance given to the agricultural sector both by the water policy of Egypt as well as by the World Bank does not seem to be in proportion to its economic significance. This prioritization can only be understood by also including non-economic factors, e.g. factors such as social stability and food security. It seems that the social stability factor is the main cause, since the new lands can only reach the aim of food security indirectly, as many of the crops will be for export.

The focus on the agricultural sector can also be partly understood by the apparent failures in other sectors. The example of the vulnerability of the tourist sector to regional tensions is a case in point. The industrial sector has also not taken off. Partly because the companies are state-owned, privatization has moved ahead slowly and there is also a lack of skilled labor. While many experts envisioned that Egypt would follow the Tiger states of Asia, it remains the pussycat on the Nile (Behery 1997). Compared to Ethiopia, however, Egypt is far more industrialized. From a negotiation point of view, the economic asymmetry is partly compensating for the geographic asymmetry, where Ethiopia is in a stronger position.

#### *6.2.4 Reallocation of Water*

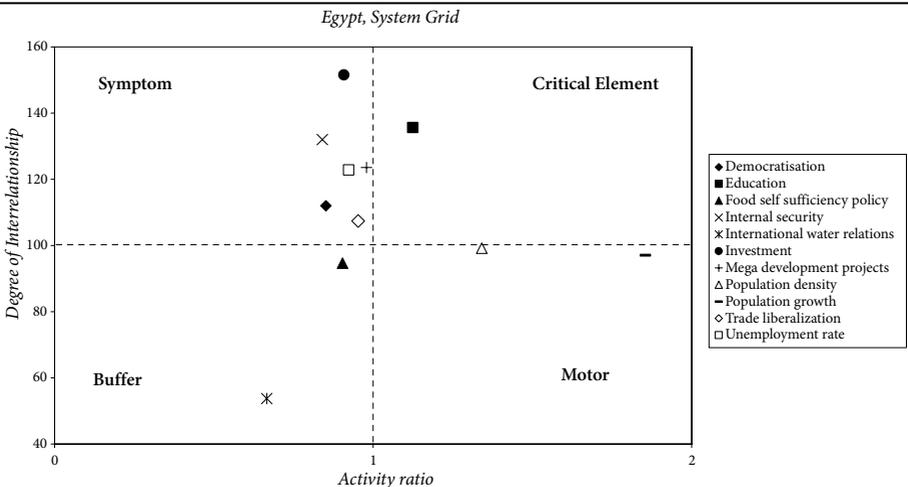
When water becomes scarce, the supply of water can be increased, water can be used more efficiently within the irrigation sector, or water can be reallocated from the irrigation sector to the municipal and industrial sectors. Water reallocation is influenced by the different economic values of water in the different sectors. From a focus on supply-side management (e.g. Jonglei Canal to increase the supply of water), the water policy of Egypt has moved in the direction of increased irrigation efficiency. In the long run the Egyptian water policy will move in the direction of inter-sector reallocation of water:

“Unless the first phase of Jonglei Canal is accomplished by 2017 together with extensive deep (irrecoverable) groundwater abstraction in the deserts and Sinai, and desalination of brackish groundwater and seawater abstraction; it will be impossible to satisfy municipal and industrial needs without modifying the horizontal expansion plan to eliminate some areas.” (Elarabawy 2002).

In order to examine different options that would support a reallocation of water, different context factors concerning development in Egypt are examined. The assessment in the form of an influence matrix was carried out by six Egyptian academics, graduates of Political, Economic and Computer Sciences from the American University of Cairo. They filled out the matrix separately, after which the averages were used to make the system grid presented below (method described in Herweg, Steiner 2002 and Scholz, Tietje 2002 ). This group represents a high-income urban elite, active in business, academia and politics. They are not active in the agriculture or water sector. In this sense they can be seen as a control group to the water and agriculture experts interviewed by the author, who see the water issues from a different perspective.

According to the assessment of this group of academics, population growth is the most effective factor for changing the system “Egypt”, followed by population density. International water relations and the food self-sufficiency policy were viewed as having little impact on the system. The group of academics viewed investment and democratization as symptoms, factors that are influenced by many other factors in the system, but that do not influence many other factors. Education was viewed as a critical element: it changes many things but may also create many unexpected side effects (diagram 6.4).

Diagram 6.4



Based on six influence matrices filled out by Egyptian academics, December 2002.

What options, or points of entry, could support a long-term policy of reallocating water from the agricultural sector to the industrial or municipal sectors; how applicable are these options using the assessments in diagram 6.4 as a guideline? Some examples are discussed below:

1. A regulation of the international cereal market could minimize the vulnerability of importing countries to market fluctuations. Ideas in this line are an international regime (Yang, Zehnder 2002, Ohlsson 1999) or a go-between company that buys the cereal on the world market and sells it to the countries that need it at a free market price without any political strings attached<sup>5</sup>. Changes in the food self-sufficiency policy, according to the system grid, would not greatly influence the system, but would also not have any large unexpected effects. The advantage of such a “buffer” is that it is easy to influence, so that a change here could support the inter-sector reallocation of water. While its effects on the whole “system” in Egypt may be small, its effect on water allocation could be great.
2. Enhance regional economic integration in the Nile Basin to make use of the comparative advantages (see the next chapter). The system grid does not include regional economic integration as an element. The element of international water issues is related and indicates that this factor could be viewed as a buffer – easy to influence, but with little effect. Similarly to a change in self-sufficiency policy, no great impact on the system is to be expected.
3. Work towards an easing in the tensions between the Arab world and the West, as well as an integration of opposition movements into the political system. This could stabilize the political situation. With stability and security, Egypt would have an enormous employment potential in the industrial sector as well as in the service sector, e.g. tourism. Democratization and internal security in the system grid are viewed as symptoms; they are not easy to influence, as they are dependent on many factors, and they do not greatly influence the system. Following this assessment, efforts in the line of democratization and internal security would not be easy points of entry to support inter-sector water reallocation, or indeed any change in the system.
4. Enable the education of skilled labor that could support the economic diversification and industrialization of the country. The system grid places education as a critical element. Thus it would have a large impact, at the same time it is not easy to influence.
5. Clarify the different aspects of food security. Questions to be discussed in the media and at public conferences are: Is agriculture on the new lands a form of food security, or is the main aim of these projects of an economic nature? What are the advantages and disadvantages of an inter-sector reallocation of water? Awareness campaigns are a form of education. The system grid views this as a critical element.

5 In discussion with Alexander J. B. Zehnder, EAWAG Kastanienbaum, August 2002.

6. Birth control has been suggested as a way to deal with water scarcity (Middle East Times 2001). According to the system grid, any changes in population growth would have a great impact on the whole system. As it is not influenced by many factors, it is also an ideal entry point from a theoretical point of view. Here the shortcomings of the theory become apparent, however. Population growth was assessed as being strongly influenced by education by five of the six academics who filled in the influence matrix, more frequently than any of the other factors. Education in its turn, however, is influenced by many other factors, making population growth a difficult entry point. Both the levels of education and population growth rates only change slowly. People who will have children in the next 15–20 years are already born.

In summary, a transfer to inter-sector water reallocation could be supported by a change in food self-sufficiency policy and a change in international water relations. More influential but also more difficult, would be a changes in the area of education. This could influence off-farm job opportunities and population growth and could therefore have a major impact. According to the assessment of this group of academics, efforts aiming directly at democratization and increasing internal security are difficult to initiate and do not have such a great impact on the system. The assessment of these six academics may be taken as an indication that the present preoccupation of the world, and especially of the US, with terrorism as a form of internal insecurity may be misplaced, as internal insecurity is rather a symptom of an ailing system, rather than an entry point where change can be initiated.

### 6.3 Sudanese National Water Management

Sudan would have ample resources to feed its population, as well as having the potential to export agricultural goods. Sudan was long hoped to be the bread-basket of Africa or the Arab world, yet it has largely fallen short of these aims. The bread-basket strategy was partly a result of the vested interests of the ruling coalition at that time. A kind of tripartite coalition between the Sudanese elite driven bureaucracy, Arab capital and Western technology was formed to encourage an export-oriented agriculture (El Battahani 2003, Mahmoud 1984). For many years now Sudan has had to import food, however (see table 6.1). Some reasons for this are: misguided policy, low technology, drought, and low level of infrastructure (Sudan 1999). The political instability and the war in south Sudan are further factors.

The discovery and exploitation of oil in Sudan have led to a decreasing importance of the agricultural sector to the economy of Sudan. Some academics fear that Sudan will follow the oil-based economies of the Gulf countries and develop into a ‘rentier’<sup>6</sup> state.

<sup>6</sup> ‘A state reliant not on extraction of the domestic population’s surplus production but on externally generated revenues, or rents, such as those derived from oil.’ (Kuru 2002).

Signs of a rentier economy existed already before the discovery of oil, partly because of the economic role played by remittances sent by the Sudanese in the Gulf and Arabia, and partly because of the state structure that reinforced the rentier state structure of colonial Sudan. This has implications for water resource development, as a rentier economy is not as inclined to develop the agricultural sector (El Battahani 2003). Despite these tendencies, rain-fed agriculture remains very important in Sudan, unlike in Egypt, although the fluctuations in precipitation make the production in this sector unpredictable.

### 6.3.1 *Agricultural Policy*

The focus of Sudan's agricultural policy has changed over the years. Before independence, irrigated agriculture had predominately commercial (colonial) objectives, especially the production of cotton. After independence in the late 1950's, food security, social developments and the creation of employment opportunities became the major objectives of the national agricultural policy. This included a policy of subsidized water supply (Awad, Ahmed 1999: P1a. 3). In the late 1970s and 1980s the IMF structural adjustment programs (SAPs) aimed at a shift to export-oriented agriculture (Hussein 1991). In the 1990s government subsidies for water supply were gradually withdrawn. One of the main aims of the agricultural policy of the 1990s was food self-sufficiency, achieved through market liberalization (Sudan 1999).

The prolonged transformation from subsistence farming to cash crop farming has been continuing for a long time. The combination of resource exploitation by traders, e.g. in the form of large-scale mechanized rain-fed agriculture, and the SAPs of the International Monetary Fund (IMF) caused a shift in the focus of the agricultural sector from the domestic market to the international market (Suliman 1999). In the period 1978–84 Sudan concluded five agreements with the IMF; these aimed at curbing government deficit, reducing inflation, increasing capacity utilization (by rationalizing the use of foreign exchange) and promoting economic growth (Hussain 1991). This policy also encouraged cotton production on irrigated areas to increase net foreign exchange earnings, rather than growing wheat for the domestic market. Hussain (1991) and Suliman (1999) point out the detrimental effect of the SAPs to the economy of Sudan. The policy seems to have been ineffective according to diagram 5.6 as it did not change the general long-term decrease in cotton lint production and exports, neither did it effect the general long-term increase in cereal production, see diagram 5.7. The low levels of cereal production in 1984, 1987 and 1990 were lower than in the previous 16 years; this could be an indication of the negative effect of the SAPs on stable cereal production in Sudan.

A new set of economic reforms in the agricultural sector began in 1992, mainly focusing on irrigated agriculture. Different to the high level of government involvement, the new "...economic policy is based on economic liberalization, privatization, free market, cost recovery and cost effective criteria" (Sudan 1999: 2). Farmers are charged the actual cost for providing water for irrigation, system and operation maintenance. Positive experiences

were made, e.g. a greater decentralization of the administration and encouragement of farmer participation. The productivity of wheat, sorghum (diagram 5.11) and groundnuts increased, but the net return as percent of cost for wheat decreased. The net return for cotton reached a peak in 1994/95 and has since decreased; this has been attributed to the taxing policy (Awad, Ahmed 1999: P1a.3). This partly explains the decrease in cotton production (diagram 5.13).

Some negative side effects were also observed mainly due to how the reforms were implemented, i.e. “ill-conceived ideas on privatization and lack of coordination between those who dictate the measures and those who translate them into work plans.” (Awad, Ahmed 1999: P1a.3). Lessons learned from this process are:

- Large-scale agriculture requires large investments. The sudden withdrawal of government financing led to a decrease in cropped areas.
- Water supply charges were calculated on the basis of area and not on the volume of water used, thus efficiency increase was less than expected. Recently the government accepted the proposal of the Irrigation Water Corporation (IWC) to provide its services on a whole-sale basis, enabling volumetric charging up to the head of minor canals (serving ca. 100 farmers).
- “The economic reforms were not accompanied by adequate institutional and legal reforms and human resources capacity building.” (Awad, Ahmed 1999: P1a.12).

### 6.3.2 *Water Development Projects*

Water Development Projects in Sudan on the supply-side can be broadly subdivided into dams for HEP and irrigation projects, and projects such as the Jonglei Canal to increase the total amount of water by reducing the water lost in the swamps of southern Sudan (section 5.1.5). The Ministry of Irrigation and Water Resources has the sole authority for surface water assessment and development in Sudan (Aquistat 1997b).

The Nile River is a closed system, i.e. practically no water is lost to the sea. Yet Sudan can still only store 17% of the amount it could use according to the 1959 agreement with Egypt (Sudanese Ministry of Irrigation 1998). Sudan plans to build two dams and heighten one existing dam. The main aim of the construction of the Hamadab Dam at a cost of 1.72 billion US\$ at Merowe on the Main Nile after the inflow of the Atbara river is to increase the hydroelectric power capacity of Sudan by 1250 MW, tripling the total electricity production of the country (table 5.4); some water will also be diverted for irrigation purposes (Taban 2002). The heightening of Roseries Dam on the Blue Nile aims to compensate for the capacity of the dam that was lost due to siltation and to increase the storage capacity to a total of 7.3 km<sup>3</sup>. This project is important to safeguard water for the irrigation schemes that are dependent on it, such as the Gezira scheme. Furthermore, across the Atbara River the Siteit Dam is planned to increase irrigation

capacity (MOFA, Sudanese Ministry of Irrigation 1998). In 1998 the Ministry of Irrigation and Water Resources in Sudan was involved in developing the Great Kenana Agriculture Project, 420'000 ha and Rahad Phase II, 210'000 ha, plus other smaller irrigation projects in the Northern and Nile River States and Central Sudan (Sudanese Ministry of Irrigation 1998).

### 6.3.3 *Debates Effecting National Water Policy*

The water policy of Sudan aims at: 1) increasing the country's hydroelectric power production, 2) making water available for irrigation, 3) increasing the efficiency of existing irrigation schemes, and 4) forecasting and preventing floods (Sudanese academics and technocrats 2001). In the context of the Nile Basin Initiative, international cooperation over the waters of the Nile is being pursued (see next chapter). The use of water is effected by the following policy debates and challenges:

- *The debate between the advantages and disadvantages of irrigation expansion versus irrigation rehabilitation.* Freeing the canals from silt in the existing schemes would be one of the main rehabilitation measures, allowing the existing schemes to be used optimally. Irrigation expansion is a long-term goal in order to use the Sudanese water quota, to increase the food security and to generate employment.
- *Focus on the domestic versus the international market, and the question of state subsidies for the agricultural sector versus its taxation.* The priority given to the irrigation sector over other agricultural sectors shows an interest in producing cash crops for the international market.
- *The amount of investment and research given to irrigation versus rain-fed agriculture.* Pastoralism alone is a greater contributor to the GDP than the other agricultural sectors combined. This indicates that greater priority should be given to pastoralism. Part of the explanation why this is not the case is because nomadic people are not as easily managed by a central state as a sedentary population. War, drought and expansion of rain-fed cultivation have affected pastoralism in Sudan.
- *The question of how to forecast and prevent the negative effects of floods.* The ministry is active in different forecasting systems; these could be improved by cooperation with Ethiopia on flood relevant data. The settlements in the flood zones are being addressed as part of the preventive actions.
- *The priority given to HEP or oil as a source of power.* Oil exploitation in South Sudan has a major impact on the Sudanese economy, as well as on the civil war. Once there is peace and the question of how to divide the oil revenues is solved, the question will arise whether Sudan should follow the Gulf oil-based economic model, or if it should use its resources to enhance economic diversification. The construction of Merowe Dam is an indication that Sudan will continue to rely on HEP as a source of electricity in the future.

## 6.4 Ethiopian National Water Management

The national water management of Ethiopia is not the subject of this study, however, a short summary is included in order to help understand the perceptions of Egyptian and Sudanese versus Ethiopian water development projects (chapter 7). For a detailed analysis, see the study by Arsano (2004) that examines the Ethiopian water development in detail.

Famine is maybe the harshest reality that is pushing Ethiopia to use its abundant water resources better. At present Ethiopia uses about 3% of its runoff, the country's agriculture is predominately based on rain (Ethiopia 2000). Ethiopia has the world's highest incidence of malnutrition; over two million Ethiopians are chronically food insecure. Furthermore, up to 10 million people are vulnerable to temporary food-insecurity (WFP 2002). According to the Disaster Prevention and Preparedness Commission (DPPC), 6.8 million people in Ethiopia were in need of emergency food aid at the end of 2002 (Kalebbo 2002).

There are two kinds of famine: a) the sudden unexpected famines that have to do with unusual rainfall conditions, and b) the chronic famine that comes every year, i.e. one knows in advance how many millions will be short of food (e.g. about two million). Chronic famine, an indicator of economic underdevelopment, calls for long-term development rather than jumping from one emergency to the next. The various governments, however, are only in power for a short period of time; they only have short-term priorities and they are not held accountable for their failures. Furthermore, it is easier to get international money for the emergency famines, as the international community responds to public opinion in the West rather than to needs in a far away country. Chronic famines are therefore often declared as emergency famines. The international community and media are co-responsible for the failure of adequately dealing with famine. Present steps of funding organizations to plan for food aid years in advance on a regular basis is one step in the right direction (Ethiopian IGO worker 2001).

Food aid can be made in the form of cash or food. The advantage of cash is that one can buy food from the local market and thus support the local farmers. There were unfortunate cases where food aid in the form of food destroyed the prices of the local market so that local farmers could not sell their products. The advantage of food aid in the form of food is that food is maybe easier to keep track of; it is easier for money to vanish into someone's pocket than a sack of cereal (Non-Ethiopian IGO worker 2001). In the end, however, it is the international community which is happy to get rid of its surplus agricultural products that decides in which form food aid is given. Beggars cannot be choosers. Without food aid there would be migration, so food aid could be seen as an interesting instrument for the Ethiopian government as well as for the international community to keep people artificially where they are, even if the livelihood system they are used to can no longer feed them. There is little doubt that food aid can hinder development and initiative, but there is even less doubt that one has to do all one can to

prevent people from dying: A dilemma of emergency versus development (Ethiopian academic 2001).

“There are people who are born and who only think about food all day long because they do not have enough. Twenty years later they still only think about food all day long because they still do not have enough; that is not life. Life is more than barely surviving. I have become a pessimist. If Ethiopia would find oil, become rich and stop begging, I could die tomorrow in peace.” Ethiopian IGO worker (2001).

The key question in the context of this study is what role irrigation can play in alleviating poverty and famine in Ethiopia, and how much water this would consume.

The general opinion of the people interviewed in Ethiopia by the author was that irrigation is an important part of the solution, but certainly not the only way forward. Diversification of the economy to make jobs in the non-agriculture sector available is perhaps the single most important effort in alleviating poverty. Large-scale irrigation could provide for a stable food production, especially to compensate for no harvest in years when there is no rain. Similarly to the new irrigation schemes in Egypt and Sudan, it is not clear how far these irrigation schemes would focus on the domestic or on the international market. The agriculture policy of Ethiopia has the aim of self-sufficiency in basic food stuffs, it can therefore be assumed that large-scale irrigation would focus on the domestic market if the government is influential as to which crops are grown.

The capacity for large-scale irrigation to employ many people is limited. If one takes as a comparison the Gezira scheme, then large-scale irrigation of about 1 million ha can employ 100'000 workers and half a million seasonal workers. If the full irrigation capacity in the Nile Basin in Ethiopia would be implemented, about 200'000 workers and 1 million seasonal workers could be employed. With a population increase of more than a million per year, the scope of such large-scale irrigation to absorb human work force is limited. The success would therefore heavily depend on how far such projects would include service, industry and infrastructure projects, similarly to those that are planned in the Toshka valley in Egypt. There are further obstacles to large-scale irrigation: highlanders do not like to live in the low land where most of the large-scale irrigation land would be, the climate is different and there are problems such as malaria. People already live in many of these areas and are dependent on the environment for their survival. Without careful compensatory measures, conflicts between new settlers and the indigenous population could arise. Obstacles, however, are here to be surmounted, but it is important to take them into account when planning and implementing such projects (Ethiopian academic 2001).

The potential of small-scale irrigation (up to 200 ha) and farm-scale ponds (1–2 ha) is enormous. Negative side effects are more easily dealt with, and the technological know-how is such that farmers can build the micro-dams. Ethiopia has had some success and some failures in its micro-dam strategy, one of the main problems being the siltation of the micro-dams. Micro-dam development has to therefore be combined with watershed management and reforestation of the catchment area in order to be successful. There

are also success stories in a very small farm-scale pond approach that seeks to integrate different aspects. A manual for development agents following this integrated and community-based approach was written by Carucci, Nedessa and Yirga (1999).

A comparison to other international river basins shows that it is typically the downstream countries with little rain that first develop irrigated agriculture, such as Iraq or Egypt. With increasing populations, the upstream countries have only recently seen themselves pushed to irrigate. Besides this general consideration, Arsano (2004) points out some of the national and international reasons why Ethiopia has not yet further developed its water resources. On the national side, the history of cold war alliances, changing regimes, civil war, the war with Eritrea, political instability and limited economic capacity have been some of the reasons why Ethiopia has not yet given a high priority to implementing water development projects. The conditions of international funding agencies enable downstream countries to veto water development projects upstream. The "Operational policy 7.50" (OP 7.50) of the World Bank, for example, calls on riparian states to come to an agreement over projects that have an effect on each other (World Bank 1994). As financial support is made dependent on cooperation, OP 7.50 can create economic incentives that can motivate riparian countries to cooperate. Due to the veto power of a downstream country, OP 7.50 can also hinder water development upstream, however.

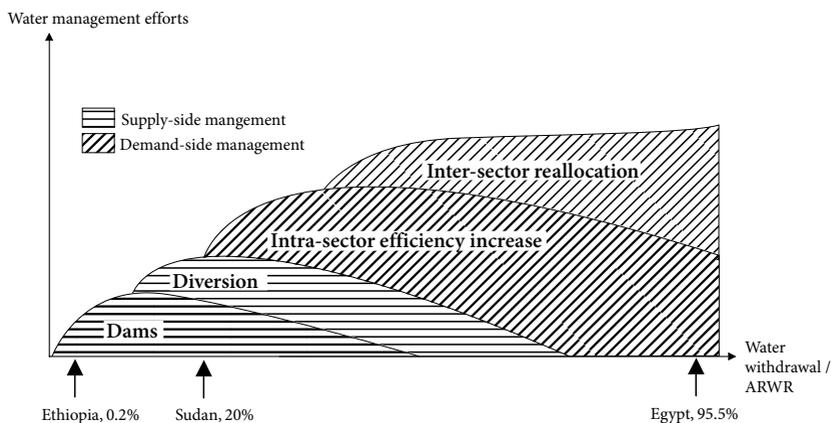
It is estimated that 2.3 million ha can be irrigated in the Ethiopian Nile Basin. According to Arsano (2004), Ethiopia's national water utilization program during the next 15 years aims at 120'000 ha of large-scale irrigation and 120'000 ha of small-scale irrigation. On average, about 5'000 m<sup>3</sup> water per ha and year are used in Ethiopia (Waterbury, Whittington 1998: 158); that would mean the planned projects would need about 1.2 km<sup>3</sup>/year, or 1.6% of the water which Egypt and Sudan use from the Nile at present (74 km<sup>3</sup>/year). If the total amount of 2.3 million ha would be irrigated, 11.5 km<sup>3</sup>/year would be used, which is 15% of the water that Egypt and Sudan use at present. Thus, in the near future very little water will be used; in the long run there is a potential of reducing the water flowing downstream. There are of course different options for compensation, both on the supply-side (Jonglei Canal, Gambela project, dams in the highlands where water evaporation rates are lower than if water is stored in Lake Nasser) and on the demand-side (e.g. in the form of increased irrigation efficiency "more crop per drop") (chapter five).

The short summary of water development in Ethiopia has shown that irrigation in Ethiopia has a very important role to play in stabilizing agriculture, especially for years when the rainfall is limited. Similar to Sudan, but unlike Egypt, water is not a limiting factor. There are many indications that the economic and political contexts are the decisive factors that have hindered the use and development of Ethiopia's water resources.

## 6.5 Comparison of Egyptian, Sudanese and Ethiopian Water Management

A country's water scarcity situation may be positioned on a continuum from a small ratio of water withdrawal/actual renewable water resources to a high ratio of water withdrawal/actual renewable water resources. This is linked to the continuum of limited water infrastructure (e.g. dams) and institutional capacity to highly developed infrastructure and institutional capacity (termed water management effort in diagram 10.1). Positioning Egypt, Sudan and Ethiopia in this diagram visualizes the different challenges the countries are faced with: Ethiopia with supply-side management, and Egypt with demand-side management. Egypt is interested in supply-side management, such as the Jonglei Canal and the Gambela project, yet these are projects *outside* of Egypt's territory. Within Egypt, water management is focusing on increased efficiency. Sudan has built some dams and is planning still further dams; it is only slowly beginning to address the question of efficiency increase in the agriculture sector. Ethiopia, on the other hand, still has a very limited water storage capacity; it is therefore mainly focusing on supply-side projects.

Diagram 6.5



The countries are placed on a scale according to the percentage of water withdrawal/actual renewable water resources (from table 5.5). The water management effort differs accordingly, as the degree of water withdrawal increases, the water management moves from supply to demand-side management (examples of supply- and demand-side management are given qualitatively only).

According to the model developed by Ohlsson (1999), as water scarcity increases, countries move from supply- to demand-side management and water conflicts shift from the international to the intra-national arena. This model may work if constructing dams is the only supply-side management approach considered. For the diversion of water to

reduce evaporation from swamps, however, supply-side management seems to also have the potential to foster international cooperation, such as between Egypt and Sudan in the case of Jonglei, and between Ethiopia, Sudan and Egypt in the case of the Gambela project. On the intra-national level, the Jonglei canal led to conflict. These examples contradict Ohlsson's model, and indicate that conflict is not directly linked to supply- or demand-side management. The water quantitative analysis of chapter five, however, indicates that the potential of demand-side management is greater in the long term than that of supply-side management.

## 6.6 Conclusion

A national policy must be clear about its water requirements, both in the present and the future, to "stake a claim" to the rightful proportion and fair share of water (Abrams 2001). Successful negotiation is only possible when each country is clear about its needs and interests. These are influenced by different water requirements of the agricultural, municipal and industrial sectors, as well as of the environment, navigation and tourism (Abrams 2001).

Of the three countries examined, Egypt developed its water policy earlier than the others and is also more clear about its different options and what it aims at. It has been more successful in implementing its policy than the other countries. The mega development projects, however, are challenging Egypt's participatory policy formation and evaluation processes, and implementation is proceeding slower than planned. Nevertheless, until the year 2017–2020 Egypt's water policy allows the increasing demand of water to be met. Afterwards increased supplies or an inter-sector reallocation of water will be unavoidable. Both for present and future national water policies, Egypt is dependent on the good will of upstream countries. It thus has a strong interest in cooperation. Its aims are to safeguard the 55.5 km<sup>3</sup>/year quota, and if possible to engage in supply-side projects in order to increase the available amount of water.

Both Sudan and Ethiopia have only recently given more priority to the development of their national water policies. One Sudanese academic said that the strength of Egypt lies in it having a clear policy over which there is a broad national consensus. The water policy cycle in Sudan is often interrupted, i.e. projects are planned but not implemented. The delayed rehabilitation of the Gezira scheme or the heightening of Roseries Dam are examples of this. Decisions have been taken, but actions follow only very slowly – not least of all because of the troubles in the south. The example of the planned and only partially implemented Jonglei Canal also shows that there is a problem in the lack of support from the affected population. Sudan does not have a pressing water shortage, rather a shortage of the economic and political capacity to use the available resources. Sudan will cooperate internationally to gain access to international finances for building dams, managing siltation problems and increasing irrigation efficiency.

The situation in Ethiopia is similar to Sudan. Due to the limited economic and political capacity, projects are planned but not implemented. The country has to find a consensus over different water development options, e.g. the weight given to HEP versus irrigation, the priority given to pond-sized, small-scale or large-scale irrigation projects (Arsano 2004). Ethiopia has two options for developing its water resources: to cooperate internationally in order to gain access to finances, or to strike bilateral funding agreements with countries outside of the basin and go ahead unilaterally. The conditions made by international development banks can prevent upstream development. Thus, if the downstream countries do not cooperate, Ethiopia is likely to go ahead on the bilateral path.

\* \* \*

Chapter five has shown that there are technological solutions to water scarcity, yet chapter six shows that the national capacity to implement these solutions is very limited, especially in Ethiopia and Sudan. What are the implications of this limited capacity, as well as of the environmental, economic and political asymmetry between the countries of the Eastern Nile Countries? Possible implications are:

1. The economic asymmetry compensates for the geographic asymmetry, leading to cooperation. Egypt is economically more powerful, Ethiopia is geographically more powerful, because it lies upstream. The “mix” of power assets leads to a level playing field, where consensual negotiations are possible.
2. Cooperation is hindered by the limited national capacity, and by the international economic and political asymmetry. Fragmented and weak negotiating partners are not successful in negotiations. According to this argument, Ethiopia and Sudan will only become active in negotiations when their national water policy is clear, and when they have the economic and political power to implement their policy on the national and international level, thereby making use of the water development potentials in their country. Accordingly, the two countries will focus on developing a national policy and strong economy before, or at least simultaneously to, negotiating a new Nile water agreement.
3. The implications for Egypt of being economically advantaged and geographically disadvantaged are either to hinder development upstream and thus attempt to block any changes in the water use regime, or to foster development upstream, aiming to negotiate a fair and long-term stable agreement. The analysis in the next chapter shows that Egypt has moved from a threatening “old school” to a more cooperative “new school”, following the realization that only cooperation and peace can guarantee its water security in the long term.
4. It is to be expected that Egypt will use its economic advantage to try and influence development upstream in such a way as to minimize negative impacts on Egypt; and that Ethiopia will use its geographical advantage to maximize economic support from Egypt and/or the international community.

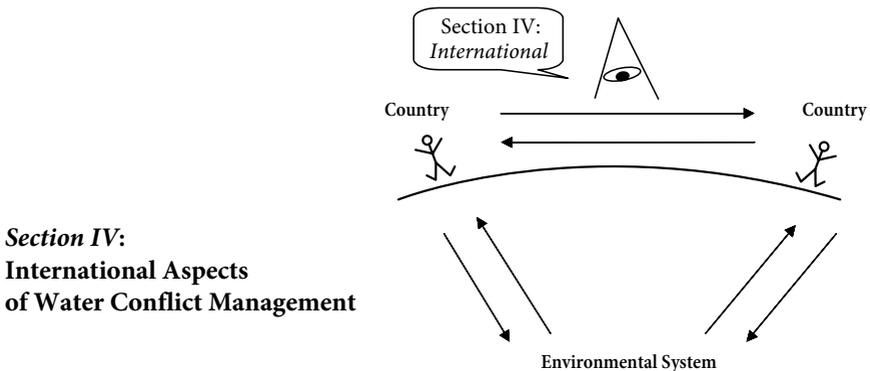


## Section IV

# International Aspects of Water Conflict Management

After assessing the environmental and national factors influencing international relations in the Nile Basin, the following section examines the conflicting and cooperative aspects of international relations more concretely. This follows a basic principle of conflict management, namely to deal with concrete situations, rather than with abstract or general problems. One can avoid and complicate conflicts by remaining on the general level. Chapter seven is structured according to issues related to the water conflict. For each issue the different Egyptian, Sudanese and Ethiopian perceptions are presented, using quotes from the interviews to exemplify them. Chapter eight concerns the action research component of the ECONILE study, presenting how stakeholders from Egypt, Ethiopia and Sudan met in the workshop on “Sustainable Management and International Cooperation in the Nile Basin”. While chapter seven assesses the different perceptions, chapter eight shows how an interactive workshop can enhance the understanding of the different perceptions.

*Diagram IV.I*



**Section IV:  
International Aspects  
of Water Conflict Management**

*Focus on the international relations*



## 7 International Water Relations in the Eastern Nile Basin

The conflict in the Nile Basin can be summarized in three sentences: Egypt is more than 95% dependent on water that stems from upstream countries; 85% of this water stems from the Ethiopian highlands. At present Ethiopia uses about 3% of its run-off, but it plans to use more in the future and is concerned that Egypt will hinder water development projects upstream. Depending on how upstream development is done, Egypt is concerned that less water could flow downstream.

According to our definition of conflict (see the glossary), we have 1) an incompatible interaction in the form of using shared water resources without agreeing on how to do this; 2) both Ethiopia and Egypt ignore the negative impacts to the other party stemming from unilateral development; and 3) both Ethiopia and Egypt experience damage, or threatened damage, in the form of blocked development funds or the long-term potential decrease in water flow.

While the apparent conflict and greatest difference in *positions* in the Nile are over legal water agreements (rights to use water), the actual *interests* and *needs* of the Nile countries are for projects on the ground that enhance economic development. Such projects include HEP (hydroelectric power) and irrigation schemes, projects to prevent floods, erosion and sedimentation of reservoirs, as well as schemes to avoid pollution.

The chapter starts by looking at the interests of Egypt, Sudan and Ethiopia for international cooperation. Next, it will look at Egyptian, Sudanese and Ethiopian perceptions of water development projects in Ethiopia. This is followed by examining the relations between Egypt and Sudan, the two “downstream” countries of the Nile Basin. How strong is the downstream alliance, and what issues affect the Egyptian-Sudanese relations? Water development projects in Egypt and Sudan have been discussed in chapter five and are not as contentious as those planned in Ethiopia. The more upstream a development project, the more countries are affected by it, and thus, the more contentious it is. The unity and peace processes in Sudan, however, are issues that strongly influence the water relations between Egypt and Sudan. Besides international issues within the Nile Basin, the Nile countries’ perception of outside players will be looked at with the example of the fears in connection with Israel becoming involved in water development projects in the Nile Basin.

After seeking to understand the non-legal aspects of the water conflict, the legal issues are addressed. There is no basin-wide legal agreement over water use in the Nile Basin; the divergent positions are discussed in the section on the Agreement of 1959 and international water law. The chapter ends with a discussion on questions related to future sharing of water resources, a section on the bilateral and multilateral examples of cooperation, obstacles to cooperation and possible options to overcome these obstacles. Ten “lessons learned” from recent steps towards international cooperation in the Nile

Basin are then synthesized, giving a first answer to our guiding question on how large groups of people can use scarce water resources in a peaceful and sustainable way.

The analysis of conflict issues and perceptions of these issues is based on 70 conflict-sensitive, explorative-expert interviews carried out by the author in Egypt, Sudan and Ethiopia (see chapter three on methods).

## 7.1 Interests in International Cooperation

The interests of Egypt, Sudan and Ethiopia in international cooperation over water resources in the Nile Basin are mainly dependent on their geographical situation and their economic development.

*Egypt*, the most downstream country in an arid environment, is totally dependent on the water resources of the Nile for its economy, especially its agriculture. Thus, interest in cooperation with upstream countries stems from this dependency and is a necessity to safeguard its lifeline. Due to the Aswan High Dam and its over-year storage, it is not so much a question of timing, but of quantities, i.e. the total amount of water arriving in Egypt. The water is mainly used for irrigation (86% of the water), but the Aswan High Dam also produces HEP which is important for the country's economy. Through cooperation, Egypt seeks to consolidate the present amount of water (formulated in the Agreement of 1959) and if possible to increase the amount of water available (e.g. Jonglei Canal). Egypt is interested in an open information policy with the upstream countries, as it is effected by any developments that take place there (Egypt 2000). Although pollution is so far only a problem around the urban centers in the Nile Basin, Egypt is interested in preventing it from becoming a problem in the future. Egypt has experience with water pollution and is the most active member in the Nile Basin on this issue, trying to manage and prevent international water pollution already at an early stage (NBI 2001, 71). Unlike Sudan and Ethiopia, where agriculture is limited by the economic development, in Egypt it is limited by the availability of water (El Quosy, Tarek 1999).

*Sudan*: The water problem of Sudan is a problem of lack of development. Besides the need for water for irrigation and HEP, there is also the need to protect the people living near the banks of the Nile from floods, especially during the two months of rain in the Ethiopian highlands. For Sudan there is therefore a quantity and a timing question. Because the reservoirs in Sudan are smaller than in Egypt, erosion upstream that leads to sedimentation is a more pressing problem. The irrigation channels are also effected by the heavy silt loads. Sudan is therefore interested in watershed management and any other method to minimize the sediment load (NBI 2001: 76). Similar to Egypt, an open information policy is important for Sudan, as it is also affected by developments upstream. Sudan has a less urgent interest than Egypt in securing its historic rights as it does not yet fully use its quota from the Agreement of 1959 (Sudanese academic 2001).

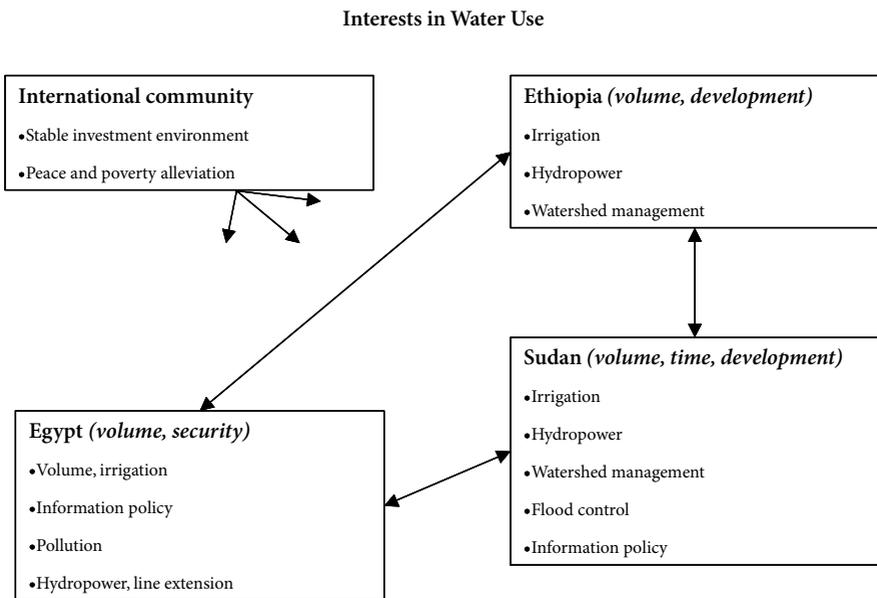
*Ethiopia*: Similar to Sudan, the interests of the country in water resources are guided by its need to develop; at present, it is a country plagued by poverty, famine and limited

access to reliable water resources. HEP and irrigation are the main interests of the country concerning water resources, and international cooperation is seen as a way to access international financial resources. If international cooperation does not work, Ethiopia still has the possibility of accessing finances through bilateral means with a country outside of the Nile Basin (Lemma 2001). Besides HEP and irrigation, the greatest interest of Ethiopia is in watershed management in order to minimize soil degradation and erosion (NBI 2001: 73).

*International community:* The international community is interested in a stable investment environment, political stability near the Middle East and in poverty alleviation (ICCON 2001, and Sudanese academic 2001).

All the interests of the different actors hinge around projects in the *upstream* area of the Eastern Nile Basin, see a summary of the different interests in diagram 7.1. Safeguarding water for Egypt and Sudan for irrigation in both countries depends on water development upstream. Erosion, sedimentation and watershed management are also mainly issues that need to be looked into in the Ethiopian highlands. The great differences in height in the Ethiopian highlands means that there is a great HEP potential. In the following section, some Egyptian and Sudanese perceptions of water development in Ethiopia will be examined, as well as some of the Ethiopian reactions to the points raised.

Diagram 7.1



*Interests of different actors in water use in the Eastern Nile Basin*

## 7.2 Water Development Projects in Ethiopia

The prevailing concern downstream that upstream countries will obstruct the waters from flowing downstream goes all the way back to biblical times (Erlich 2002 and Arsano 2004). However, in present times it is not a religious issue that is cause for worry, but the possibility of building dams for irrigation and HEP. The HEP potential in Ethiopia is estimated at about 30'000 MW, of which only 1.4% has been implemented so far (Ethiopia 2000). The installed HEP capacity in Switzerland is 13'170 MW, or merely 44% of Ethiopia's potential (Filippini et al 2002). The irrigation potential is 2 million ha in the Ethiopian Nile Basin (Ethiopia 2000). There is little consensus about how many of the proposed projects can and should be implemented. During the next 15 years, 120'000 ha of large-scale irrigation and 120'000 ha of small-scale irrigation have been planned (Arsano 2004). On average, about 5'000 m<sup>3</sup> water per ha and year are used in Ethiopia (Waterbury, Whittington 1998: 158), which would mean that the planned projects would need about 1.2 km<sup>3</sup>/year, or 1.6% of the water that Egypt and Sudan use from the Nile at present (74 km<sup>3</sup>/year). If all 2 million ha would be irrigated, some 11 km<sup>3</sup>/year, or 15% of what Egypt and Sudan are using, would be required.

*Egyptian perceptions:* The following factors ease Egypt's concerns in relation to Ethiopian water development: Firstly they perceive that the potential for large-scale irrigation is not very great – simply because of the terrain. Secondly, such projects are seen as difficult to execute because of the limited economic capacity and political instability in Ethiopia. Thirdly, there still remain questions as to whether large-scale irrigation would be appropriate, or if HEP would not create a greater economic return. Water falls during such a short season in Ethiopia that the physical obstacles to keep large parts of it in the country are perceived to be almost impossible. Famine in Ethiopia is not seen as a problem of limited water availability, but rather as a social-economic and political question. No one in Egypt denies Ethiopia's right to develop its water resources, but Egypt would like Ethiopia to develop its resources without impinging on the 55.5 km<sup>3</sup>/year quota allocated to Egypt in the Agreement of 1959 between Egypt and Sudan (Egyptian academics and technocrats 2000). Suggestions for water development in Ethiopia that seem advisable from an Egyptian perspective are the following points:

- 1) Development of non-Nile water resources. This seems logical from an Egyptian point of view, and it is not understood why Ethiopia aims at developing its Nile resources before it has used all its other river basins (Egyptian academic 2000).

“Both Sudan and Ethiopia have ample water resources outside the Nile Basin. The development of these resources could be more cost effective and less controversial”  
Rushdie (2001).

- 2) Development of hydroelectric power to support industrialization so as to be able to import food. HEP is estimated to have a higher economic return than irrigated

agriculture, and thus to be economically more sensible. Why not use the comparative advantages of the different countries – HEP in Ethiopia, irrigated agriculture in Sudan and Egypt? (Egyptian academic 2000).

- 3) Develop and increase the efficiency of rain-fed agriculture (Egyptian technocrat 2000).
- 4) Develop small-scale irrigated agriculture. This is feasible in a land like Ethiopia. In Egypt, it is not possible to do small-scale desert reclamation (Egyptian academic 2000).

The only real threat to Egypt concerning water development in Ethiopia is perceived to be the diversion of water outside of the Nile Basin areas. An infinite amount of water could be lost. Water diversion, however, is seen as being very expensive, and not very likely (Egyptian academic 2000). The Egyptian and Ethiopian view over water diversion out of the Nile basin is summarized in box 7.1. The Egyptian perceptions can be exemplified by the following two quotes:

“Fears that the construction of dams in a country like Ethiopia may decrease Egypt’s share of Nile water are unfounded because Ethiopia relies more heavily on seasonal rainfall than on the Nile’s water.” Abu Zaid, Egyptian Minister of Water Resources (1999).

“As far as we are informed there is no real possibility of building large dams in Ethiopia. One says it would be better in order to have lower evaporation rates, but security is also an important point, therefore Egypt has Lake Nasser within the boundaries of its territory.” Egyptian academic (2000).

What this Egyptian is referring to, is the comparison of storing water in the Ethiopian highlands versus in Lake Nasser in Egypt. Due to the surface/volume ratio and the cooler temperatures in the highlands, storing a similar amount of water in the highlands would mean a loss to evaporation of 5–6 km<sup>3</sup>/year, whereas one estimates that 10 km<sup>3</sup>/year are lost from Lake Nasser (Whittington et al 1995: 169).

Egypt is also interested in a greater exchange of information over water resources and metrological data. It is not clear whether Ethiopia is withholding information due to its lack of data or due to security reasons. As one technocrat said:

“Ethiopia is the black box in the Nile, it is hard to get data from them.” Egyptian technocrat (2000).

*Sudanese perceptions:* Many people interviewed in Sudan felt that Sudan can only gain from Ethiopia having dams on the Blue Nile, e.g. a series of dams like Roseries and Sennar, because the flow of the river would then be better regulated. This would reduce the danger of floods for Sudan, as well as reduce the sedimentation problem in Sudanese reservoirs. For Sudan the regulation of the water flow has a higher priority than the question of absolute water quantity. Any HEP surplus produced in Ethiopia could be imported and

*Box 7.1: Different perceptions of what is a “natural basin” and if it is legitimate to divert water out of it.*

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### *Diversion outside of a River Basin*

While on an international scale water is being diverted out of international river basins, there is a consensus in both Egypt and Ethiopia that water should not be diverted outside of the Nile Basin. The main argument is that there is not enough water for the population of the Nile Basin as it is, without decreasing the amount by diverting it into other basins (Egyptian and Ethiopian academics). There is, however, a different concern behind the Egyptian and Ethiopian perspective. Egypt does not want Ethiopia to divert water out of the Ethiopian part of the Nile Basin, as less water would arrive in Egypt. Ethiopia, on the other hand, does not want Egypt to divert water outside of the Nile Basin, as the more “fait accompli” projects are created on the ground, the harder it may prove to negotiate a Nile Basin agreement.

The question remains as to what is considered as the “natural Nile Basin”. Ethiopians, for example, question if using water for the Toshka project or the N. Sinai project can still be considered as using Nile water in the natural river basin. Egypt’s response to this is that in historical times the Nile had a much larger flood plain, and that freshwater shells can be found both in the Western valley and in N. Sinai, thus indicating that both projects are within the “natural” Nile Basin (Egyptian academic). This raises further questions, however. What are the boundaries of this way of looking at the Nile basin? If Sinai is included, are parts of Israel also included (see the section on the Israel factor)?

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used in Sudan. In other words, there are no worries about Ethiopia developing its water resources, whether for irrigation or for HEP.

“We in Sudan say to Ethiopia: ‘Use your water, and keep your sediments!’” Sudanese academic (2001).

Similar to academics in Egypt, the general opinion is that the terrain in Ethiopia is not suitable for large-scale irrigation projects. Concerning the different estimates of how much water Ethiopia could use, one Sudanese academic said he trusted the US Bureau of Reclamation estimates (433 754 ha in the Blue Nile Basin, about 6 km<sup>3</sup>/year) more than the official Ethiopian figures (2 million ha in the entire Ethiopian Nile Basin, about 11 km<sup>3</sup>/year). At the time, President Gamal Abdel-Nasser had asked the US for financing, but because the World Bank had set conditions, Nasser turned to the USSR, and the Aswan High Dam was financed by them. As a reaction in the context of the cold war, the US Bureau of Reclamation did the Ethiopian study; thus, they must have looked at all the possibilities. The official figure of irrigable land in Ethiopia, as well as in Sudan and other Nile Basin countries, however, could well be influenced by political considerations.

There are different opinions as to why Ethiopia has not further developed its resources. The economic return from investments needed for irrigated agriculture in an area that

has rain is less than in an area that is totally dependent on irrigated agriculture. The investments for the infrastructure are similar, but the infrastructure is not used during the rainy season. In a non-rainy area, the continual sunshine can make best use of the irrigation infrastructure. Irrigation may still be economically viable, but the availability of rain changes the calculation. The economic viability has to be calculated both in Sudan near the Ethiopian border, as well as in Ethiopia near the Sudanese border, where large-scale irrigation projects are planned (Sudanese academic 2001). It may therefore be more economic for Ethiopia to use small scale diversion, small dams and HEP. Besides topography, further reasons why Ethiopia does not develop its water resources are seen to be due to the economic and political situation.

Sudan is in a “sandwich” position between Egypt and Ethiopia and therefore naturally falls into a mediating role between the two countries. Depending on the personal background, Sudanese people feel closer to Egypt or to Ethiopia as is, for example, expressed in the following statement:

“Ethiopia is very close to us culturally, maybe even closer than Egypt. Our great grandfathers were Arabic, our mother is African? We have both inside us, so we understand both sides.” Sudanese technocrat (2001).

*Ethiopian perceptions:* Ethiopia is very aware of its need to develop its water resources to feed its people and create a better standard of living. Although Ethiopia is the water tower of Eastern Africa, there are problems of drought because the rainfall is unreliable and other forms of water use have not yet been developed. The development of water resources for HEP and irrigation on the farm-level (about 2 ha), the micro-level (<200 ha) and the macro-level is seen as one important part of Ethiopia’s development. One is well aware in Ethiopia, similar to what academics say in Egypt and Sudan, that famine is a result of the economic and political situation, and not primarily due to the shortage of natural resources. The questions raised by Egyptians and Sudanese concerning water development in Ethiopia are answered by most Ethiopians as follows:

1. Non-Nile river basins that do not have an effect on downstream countries have already been developed, e.g. the Awash valley. Many of Ethiopia’s rivers, also the non-Nile ones, flow into neighboring countries, thus making them all politically more delicate than internal rivers (Ethiopian academic 2001).
2. In general, there is agreement that HEP would have a greater economic return than irrigated agriculture (Ethiopian academic 2001). Some additional points need to be mentioned, however. First, the greater proportion of Ethiopians live in rural areas where there is no electricity. Thus HEP generation would mainly benefit the urban population. Second, Ethiopia’s development policy is based on agriculture: Agriculture Development Led Industrialization (ADLI). This strategy, formulated in 1991/1992, that focuses first on agricultural development and second on industrialization still remains the guiding principle. The goal of this strategy is self-sufficiency (Ethiopian technocrat 2001). While this is the official policy, it is debated among

academics, and many say that ADLI does not work. The goal of food self-sufficiency, however, is shared by many academics (Ethiopian academics 2001).

3. In response to the suggestion that one should increase the efficiency of rain-fed agriculture, there is a very wide consensus in Ethiopia that this needs to be done, *while also* developing all possibilities for irrigated agriculture: at the farm-level (a few hectares), at the micro-level (< 200 ha) in the north, and at the macro-level (~ 1000 ha) in the western lowlands and Rift valley. Rain-fed agriculture has to be developed in areas where rain is reliable and irrigation in areas where the rainfall is less reliable (Ethiopian academic 2001).
4. In response to the suggestion that one should focus on small-scale irrigation, the answer one generally hears is that there are strengths and weaknesses with small- and large-scale irrigation, and that both are necessary. With a population of more than 60 million, large-scale irrigation would only be a livelihood option for a small number of people. Problems to be surmounted are the hot climate in the flatter lowlands, malaria, lack of security near the border and lack of infrastructure. Furthermore, pastoralists already use the land there, so the government would have to create employment for these people first in order to prevent conflicts with newcomers using irrigation agriculture. The regionalization policy of Ethiopia is based on ethnicity and does not support migration between the regions; this is a further factor to be dealt with. Nevertheless, large-scale irrigation projects could be a stable element in the unstable agricultural sector, independent of climatic variations. It could produce cash crops for export or for the local market, such as vegetables and flowers. Combining large-scale irrigation schemes with HEP dams could increase the economic return from these dams (Ethiopian academic 2001).

Farm-level irrigation projects based on small ponds are a very applicable form in many areas. Micro-dams can be built by farmers themselves. The problem of sedimentation of reservoirs has already been experienced in such projects. The dead storage, e.g., may be filled within 10-20 years. The same is true for larger projects, but the larger the reservoir, the longer it takes to fill it up. On the other hand, the reservoirs behind micro-dams are easier to empty. Watershed management is seen as being of utmost importance for all types of dams. The final consensus concerning the different water development options is that a multi-pronged approach is needed (Ethiopian academics and technocrats 2001).

5. Concerning the movement of population in Ethiopia, Hagos (2000: 3) states:

“A serious and urgent decision is therefore required to either bring the population to where the water is or transport the water to where the population lives”.

About 36% of the Ethiopian population live in the Ethiopian part of the Nile Basin, the source of 70% of Ethiopia's water resources (Mason 2001). Resettlement is fraught with problems, not least of all the ethnically based regionalization policy. Past attempts at resettlement failed dismally, mainly because people were forced to relocate. Here again, a multi-pronged approach was proposed by most of the

Ethiopians interviewed: resettlement and rehabilitation of the few extremely over-used areas, coupled with a wide approach of efficiency increase in agriculture, land rehabilitation, pond and micro-dam development in the highlands, and large-scale irrigation projects in the lowlands. In addition, income alternatives for the masses are necessary, as it is unrealistic to resettle millions of people.

Many academics do not think that the topography poses a major problem in developing irrigated agriculture, rather, the economic and political situation are seen as the main hurdles. The government is not held accountable, and the present government is said to favor the Tigray region instead of the country as a whole. Ethiopians have at different times requested international financing from different development banks for the implementation of irrigation or HEP projects. According to many Ethiopians, these requests were blocked by the downstream countries.

“Although the need has always been there, Ethiopia has failed to develop its water resources to feed its needy population, mainly because of a lack of the required financial resources. Policies of international financial institutions like the World Bank, which have made it difficult for upper riparian countries to secure finance for development projects without the consent of the downstream riparian countries, have a significant contribution in this regard. (...) The downstream riparian states, therefore, have maintained the right to veto the development endeavors of the upstream states. As a result, upper riparian countries are naturally left with little choice other than to resort to a reciprocal measure of unilateralism.” Seifeselassie Lemma, Director for legal affairs of the Ministry of Foreign Affairs of Ethiopia (2001).

Besides not being included in the 1959 Agreement, this is the main grudge held by Ethiopians towards Egypt. It is thought that the West tends to side with Egypt because of Egypt's importance as a stable factor in the Middle East area. Egypt is seen in the West as a pivotal state, whereas Ethiopia is not. Concerning the frequently voiced fear in Egypt that Ethiopia might divert or prevent water from flowing downstream, Ethiopian academics are very clear that this fear is ungrounded, and that really Ethiopia only wants to develop its resources. In Ethiopia, as well as in Egypt and Sudan, there is a growing awareness that development can be enhanced through cooperation between the countries. The problem remains that cooperation is difficult. Politics in Africa are known to be unstable, and there is therefore not yet much confidence that the present steps toward cooperation between the Nile countries will really have an impact or be of a long-term nature (Ethiopian academic 2001).

“No one in Ethiopia sees the need to stop the water; even if we could, we do not want to make people starve.” Ethiopian academic (2001).

“The problem with the Nile countries is that the different national water policies and plans were made without considering the other countries. It is not good to

bring two studies together at the end to see how they fit, you have to start together with one study.” Ethiopian academic (2001).

“As indicated above, poverty is one of the main sources in our region for all the conflicts and mistrust. Hence it is legally and morally right for Ethiopia to use its share of the Nile Water Resources in order to alleviate poverty.” (Ethiopia 2000: 8)

“The Nile has got bread for everyone.” Reported to have been said by Haile Selassie.

Concerning the question of information exchange, Ethiopia says that Egypt is not being cooperative and does not inform them when they begin development projects on the Nile. In return, Ethiopia sees no obligation to inform Egypt. This point is open for negotiation, however (Ethiopian academic 2001).

Indirectly related to the Nile, Ethiopia has had cooperative as well as conflicting relations with Egypt in earlier times through the link between the Ethiopian and Egyptian Coptic Church (Erlich 2002). It is difficult to assess how far such “soft” cultural ties influence political relations between the countries still today (see box 7.2).

In conclusion, the different perceptions of water development in Ethiopia differ somewhat between Egypt, Sudan and Ethiopia, mainly in regards to the importance and probability of large-scale irrigation schemes. In general, Ethiopians see water development as more possible and important than the people interviewed downstream. There is also a lack of information among many academics in the downstream countries concerning the possibility for Ethiopia to develop non-Nile water resources, and the related impacts downstream. There may also be a tendency of urban academics to overestimate the impact of HEP on development.

After looking at some of the aspects of the relations between Egypt and Ethiopia and Sudan and Ethiopia concerning water issues, the next section looks at the relations between Egypt and Sudan in more depth, these two being the most downstream countries in the Nile. The relations between Ethiopia and Sudan will not be examined in more depth; for more on this see Arsano (2004) and El Zain (forthcoming). In general, relations between Sudan and Ethiopia are seen as fluctuating, depending on the momentary political situation. Sudan is in a very interesting position between Egypt and Ethiopia, as the ‘middle state’. The language, history and cultural similarity of North Sudan and Egypt are factors that create a “natural alliance” between Sudan and Egypt. On the other hand, the water and sediments come from Ethiopia, thus motivating Sudan to cooperate with Ethiopia.

*Box 7.2: Religion, independent of which one (Christianity, Islam, Judaism, etc.), can cause conflict if it is used as a means of expressing group identity, or support cooperation if it is based on a spiritual understanding of life, a "common ground" shared by all people.*

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### ***Religion Influencing Conflict and Cooperation***

Religion has the potential to support cooperation as well as cause conflict. In the Nile Basin there are examples of both. In the past, relations between Egypt and Ethiopia were greatly influenced by the relations between the Coptic Church of Egypt and Ethiopia. The Ethiopian Abun, head of the Ethiopian Coptic Church, was appointed by the Egyptian Patriarch up until 1959. Ethiopia benefited from the symbolic power stemming from this tradition, Egypt benefited by having influence on church and state policy in Ethiopia. An example of the conflictive use of religion was when Egyptian Copts used the threat of Ethiopians holding back the Nile flow (low flood years) in order to gain leverage over Muslims in Egypt (Erlich 2002).

The concern that one country supports the internal opposition in a neighboring country in the Nile Basin has been linked to religious extremism. Egypt accused Sudanese Islamic extremists for the attempted assassination of President Hosni Mubarak in Addis Ababa in 1995 (ArabicNews 1997). Since September 11, countries have gained international support for fighting opposition parities in the name of fighting international terrorism (Ethiopian academic 2003).

An example of the cooperative use of religion was that Christian Orthodox Ethiopia was the first country to welcome Muslims fleeing from persecution (Arsano 2004). Water has a symbolic aspect and is holy in many religions, in the Koran for example: "We made from water every living thing" (Surah El-Anbiya 21/30). Religion can be a unifying force between peoples and countries, if understood as Gandhi (1920) did: "Let me explain what I mean by religion. It is not the Hindu religion which I certainly prize above all other religions, but the religion which transcends Hinduism, which changes one's very nature, which binds one indissolubly to the truth within and which ever purifies. It is the permanent element in human nature which counts no cost too great in order to find full expression and which leaves the soul utterly restless until it has found itself, known its Maker and appreciated the true correspondence between the Maker and itself." The unifying potential of religion is independent of its denomination (Christianity, Islam, Judaism, etc.), it is rather influenced by the level of spiritual growth and the development of consciousness of a person or group of people (Peck 1998).

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### 7.3 Egypt-Sudan Relations

Relations between Egypt and Sudan are characterized by ups and downs. Critical points are raised more by Sudanese than by Egyptians experts. This is partly due to the big-brother (Egypt) versus small-brother (Sudan) situation. “The big brother can hit the small brother,” as one Sudanese academic noted. All Sudanese interviewed for this study were from North Sudan; the perceptions of the South Sudanese are therefore not included. Issues raised were:

- the Nile waters and the Agreement of 1959 (discussed in the section 7.5),
- the “troubles” in Sudan and Egypt’s interest in a unified Sudan,
- non-water related tensions between the countries, mainly about support for the other countries’ opposition,
- cooperative elements between the two countries and the “natural alliance” between Egypt and N. Sudan, and
- possible comparative advantages for the two countries.

#### 7.3.1 *Egypt’s Interest in a Unified Sudan*

*Egyptian perceptions:* The unity of Sudan is of greatest importance to Egypt, as 20% of the Nile arriving in Egypt flows through South Sudan, i.e. the White Nile from the equatorial lakes and the Baro-Akobo-Sobat from the Ethiopian highlands (Non-Egyptian IGO worker). Egypt has expressed fears that the independence of South Sudan would increase competition and conflict over the Nile waters (Farag 2003). Furthermore, plans to increase the total amount of water though minimizing evaporation from the Sudd swamps in the South of Sudan by building a canal would be easier in a united Sudan. The Jonglei Canal project was developed between Sudan and Egypt, and halted in 1983 due to troubles in the South of Sudan. The machine digging the canal was destroyed by the SPLA (Collins 1990). A project like the Jonglei Canal that would benefit Egypt is impossible without peace. Many Egyptians see the internal troubles in Sudan or between Ethiopia and Eritrea as the main obstacle to international cooperation in the Nile Basin. For this reason Egypt supports the moderate pragmatic sides in Sudan. Egypt has at different times offered its service as a third-party facilitator in the Sudanese civil war (Egyptian/Libyan initiative), as well as in the Eritrean-Ethiopian war (Egyptian academic 2000). The Egyptian-Libyan initiative launched in 1999 advanced nine principles, among others that the unity of Sudan should be preserved in light of “the historic responsibility to preserve the unity, security and stability of Sudan.” It did not include the principle of self-determination (unofficial draft, IRIN 2001).

*Sudanese perceptions:* Egypt’s interest in a unified Sudan is also seen by some Sudanese as the reason why Egypt seeks to work together with the moderate pragmatic side in Sudan, while others see it as a reason for Egypt to support the disruptive powers in the country and a weak regime (Sudanese academics 2001). The stay in exile in Egypt of Sadiq al

Mahdi, head of the Umma party and former prime minister of Sudan, and his subsequent more positive approach to Egypt (See Mahdi's book on the Nile) would seem to be an indication that Egypt is supporting the pragmatics in Sudan. According to one Sudanese academic interviewed (2003), the change in attitude of the Umma party towards Egypt relates in one way or another to a realignment of forces within the Umma, a realignment that on the one hand weakened the agricultural lobby/constituency within the Umma Party (who usually eye Egypt's interest in the Nile water with suspicion), and on the other hand strengthened the commercial, middle class constituency within the party.

Egyptian talks with John Garang (SPLA) and other opposition leaders, are an indication that Egypt seems to be trying to build up good relations with different stakeholders in Sudan, and is not just focusing on the present regime in Khartoum (Sudanese academic 2001). These signs may also indicate that Egypt is working on a long-term basis for good relations and is a moderating factor in the Sudanese situation.

Besides the role of Egypt and various parties within Sudan, the peace process in Sudan must also be viewed in the context of the unfolding events in the Middle East and North-East Africa, particularly after the overthrow of the Saddam Hussein's regime in Iraq (El-Battahani 2003). Some of the academics interviewed see Egypt's interest in a unified Sudan as being so strong that Egypt would be prepared to step in with a peace enforcement operation in order to keep the country unified, should there be signs that the South might separate from the North (Sudanese academic 2001).

"Egypt is in a difficult situation. It has been said that Egypt could intervene in Sudan militarily to keep unity if chaos and separation threaten, a form of peace enforcement." Sudanese academic (2001).

"For Sudan there is no hurry to have the Jonglei Canal built. It is more interested in leaving the swamps and fishing them, rather than in maximizing water." Sudanese academic (2001).

The question of Sudan's unity is also stated as an aim in the Machakos Protocol, July 20, 2002 (between the Government of Sudan and the Sudan People's Liberation Movement) (IGAD 2002):

That the unity of Sudan, based on the free will of its people, democratic governance, accountability, equality, respect, and justice for all citizens of Sudan are and shall be the priorities of the parties and that it is possible to redress the grievances of the people of South Sudan and to meet their aspiration within such a framework. (Part 1, 1.1, IGAD 2002)

The agreement, however, also states that the people of South Sudan have the right to self-determination, thereby balancing the aim of unity (Part A, 1.3., IGAD 2002). All academics in North Sudan who were interviewed for this study were for a united Sudan, but also for a change in government, as the present one is distrusted. A member of the National Democratic Alliance (NDA) said that the opposition parties in Sudan agreed

with the Machakos principles, but disagreed with the limited number of parties represented, as only the SPLA/SPLM and the Government of Sudan are part of the process. In relation to the Egyptian-Libyan initiative, the NDA favored the parties represented, but disagreed with the absence of the self-determination principle, and the absence of the principle separating state and religion. In the spring of 2003 the heads of the SPLA/SPLM, NDA and Umma party met in Cairo, giving their support for the Machakos process. As Sadiq al Mahdi, head of the Umma party, is influential, this is an important step in giving greater weight to the Machakos peace process. Sudanese parties also seem to have successfully encouraged Egypt to support the Machakos process, pointing out that the self-determination principle will not lead to the separation of Sudan if the transition period is managed adequately. By supporting the Machakos process, Egypt keeps some influence on the process, and Sudan gains Egypt's support, without which it cannot be successful in the long term (interview with NDA politician 2003).

### 7.3.2 *Non-Water Tensions Between Egypt-Sudan*

Relations have generally been good between Egypt and Sudan over water issues, even if they have been tense for reasons other than water. The disputed territory in the northeast, the "Halaib triangle", is an old *frontier dispute* between both countries. Some people in Sudan see it as a bargaining chip of Egypt, also in relation to the Nile water issue (Sudanese academic 2001).

Furthermore, there is still the *big-brother/small-brother relationship* between Egypt and Sudan, which is especially disliked by many Sudanese. The colonial strivings of Egypt toward Sudan, however, tend to be more of a nostalgic feeling that is felt by some, rather than a real issue. One of the main "non-water" reasons for tension between the countries is the fear and possibility of one country *supporting the internal opposition* of the other country. Relations, for example, were tense between the countries after the attempted assassination on President Hosni Mubarak in 1995 in Addis Ababa. Egypt accused Sudan of being involved in the attack (ArabicNews 1997). The Egyptian reaction could have been harsher; however, it seems that the Egyptian national interest in maintaining good relations with Sudan because of water issues has motivated Egypt to react with some degree of constraint (Sudanese diplomat).

This "spill-over" effect of water (pun intended), i.e., the effect that agreements over water lead to cooperation in other areas is, however, debated as the relations over the years have not been so smooth, and the Agreement of 1959 did not lead to economic integration. This may have been different had the Jonglei Canal been built, as both countries would have vested interests in a joint project (interview with Middle East water expert 2000). Agreements on water issues alone do therefore not seem to create a spill-over effect, whereas the joint economic development of water resources is more likely to do so.

### 7.3.3 Cooperative Elements Between Egypt-Sudan

There is a *cultural, religious and linguistic unity* between North Sudan and Egypt which is based on the Arabic language, Islamic religion and joint history (e.g. British colonialism). Already in the past, both Egypt and North Sudan were conscious of the need to integrate the South Sudan. Attempts to do this included scholarships for South Sudanese or support of mixed marriages between South Sudanese and North Sudanese or Egyptians. There was also a seasonal migration of Sudanese to Egypt during the summer and of Egyptians to Sudan during the winter as long as it was easy to get a visa (Sudanese academic 2001). Both Egypt and Sudan have access to the Arab market. In addition, Egypt is interested in expanding its economy towards Africa, and here Sudan is an ideal entry point. Part of the “natural alliance” between Egypt and Sudan is also the strength of joining forces between two downstream countries, so as to work more efficiently with other (upstream) countries.

In summary, the relations between Egypt and Sudan can be said to be good over water resources, but at times tense over other issues. Egypt is greatly interested and, in some form or another, involved in the question of Sudan’s unity because of the Nile.

*Box 7.3: Non-water conflicts and cooperative elements affecting relations between Egypt and Sudan.*

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#### *Summary of Egyptian-Sudanese Relations*

Conflicting elements in Egyptian-Sudanese relations:

- Dispute over Halaib triangle
- Foreign support of internal opposition
- Nostalgic Egyptian colonial sentiments: big-brother vs. small-brother mentality
- Historically different development path of S. Sudan versus N. Sudan with Egypt
- Dependency of Egypt on upstream country Sudan for water flow

Cooperative elements in Egyptian-Sudanese relations:

- Comparative advantages: water and soil in Sudan, know-how and labor from Egypt
- Cultural, religious and linguistic unity between North Sudan and Egypt
- Efforts towards integration: scholarships for S. Sudanese, South-North inter-marriages
- Egypt and N. Sudan working towards a unified Sudan (Jonglei Canal)
- Common access to Arab market
- Agreement of 1959, Permanent Joint Technical Commission

Common interests and “natural alliance” of two downstream countries versus other upstream countries

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## 7.4 The Israel Factor

As Egypt is a neighbor to Israel, questions of water conflict and cooperation also touch on this extra-basin region and the conflict in the Middle East. This mainly happens in two ways: 1) the potential Israel involvement in water development upstream is seen as a way of getting leverage against Egypt, and 2) plans to divert Nile water to Israel, or plans to sell water to Israel are seen as being unacceptable to the Nile countries.

*Egyptian perceptions:* In talking with Egyptians about different countries, emotions are highest when Israel is mentioned. While Egypt's relations with neighboring countries are seen as good by the Egyptians, Egyptian-Israeli relations have been described as cold peace or that they have working relations on the governmental level, but that there is still a deep antipathy on the level of the people (Track 3). Water as a *cause* for war in the Nile Basin is not a real threat, although it has been used as an example of a potential "water war" in literature (Frey 1993). If at all, a threat is perceived when Israel gets involved in the upstream countries and potentially uses water as an instrument to harm Egypt (Egyptian academics, technocrats and NGO workers 2000). The fears of the people are taken seriously by the government, e.g. when the Minister of Water Resources, Abu Zaid, visited Ethiopia in 2000, he stated publicly that Israel is only involved in water development projects in Ethiopia outside of the Nile Basin.

"Egypt's relationships with its neighboring countries are good; with Israel however there is a working relationship, but in the people there is still a hatred from the 1967 war. If Israel should build dams, or pass on water related know-how to Ethiopia, then this would be seen as an attempt of Israel to control Egypt and Sudan." Egyptian academic (2000).

"In discussing possible recourse to confrontation in securing our water needs, there remains the frequently repeated questions of Israel's schemes for the Horn of Africa and the African Great Lakes area. Obviously, such plans conflict with Egyptian and Arab interests in general. Nor is their existence debatable. The question, therefore, is how to deal with them. As I understand it, Egypt's policy on this point encompasses several interrelated principles. Above all, it is essential not to leave the field open to Israeli influence. Egypt must intensify its political and economic activity in the region through various cooperative endeavors." Abdel-Azim Hammad (2000).

In various discussions, Israel comes up as a receiver of Nile water. This was alluded to by President Sadat in December 17, 1979 when he talked about the "Peace Canal" that would bring water under the Suez Canal to Sinai and potentially to the Negev (Bleier 1997). The idea was rejected for various reasons. First, the people of Egypt were absolutely against selling water to their former enemy, Israel. If water were transferred it would include water for the Palestinians, and the worry was that Israelis might use them as hostages to prevent Egypt from turning off the tap in a crisis. Second, Egypt does not have enough

water itself, and selling water would go against the Koran that says water is a gift of life. Third, the upstream countries are very clearly against diverting water out of the Nile Basin, especially as the countries themselves do not have enough (see box 7.1 on diversion of water outside the Nile Basin). To relieve these worries about Egypt selling water to Israel, Egyptian President Hosni Mubarak has repeatedly stated that transferring Nile water to Israel is an impossibility (ArabicNews 1999).

*Sudanese perceptions:* Israel comes up in interviews with Sudanese people in a similar way as in Egypt in regards to their possible involvement in water development in the Nile. Potential Israeli involvement in upstream countries is met with distrust and seen as a possible threat to Sudan and Egypt. Another worry that exists besides involvement in the form of know-how exchange or financial support from Israel is the idea of Israel and Eritrea having an agreement on selling water to Israel. While many think this is a rumor, it does show the fears that are around.

“Sudan and Egypt must agree on the defense of the Nile against US and Israeli attempts to control the flow of the Nile. There must therefore be diplomatic solutions for the use of water between Egypt and Sudan, before their enemies can split the two countries.” Sudanese academic at a public speech in Khartoum (2001).

*Ethiopian perceptions:* From an Ethiopian point of view, the fear of Israel building dams in Ethiopia or supporting Ethiopia in aggressive policies towards Egypt seems to be unfounded. As described by Arsano (2004), the historical relations between Ethiopia and Israel show more signs of tension than cooperation. The Israel factor does, however, come up in a different form in Ethiopia: In one scenario a), the US supports Ethiopian HEP and irrigation projects under the cover of World Bank poverty alleviation and as a bargaining chip against Egypt in order to be able to exercise pressure in relation to Egypt's policy towards Israel. In another scenario b), the US abandons support for Ethiopia because it does not see it as being an important factor concerning Egypt and Egypt's peace with Israel.

It seems that Israel was involved in a bidding process for a water development project in Uganda, a project that was finally given to the Egyptian bidders (Ugandan newspaper, quoted by an Ugandan academic 2000). Thus, the subject also pops up in other upstream countries. The worry about Israeli involvement may be a motivation for Egypt to offer better bids, as it does not want Israel to expand its influence in the water development field in the Nile Basin.

In conclusion, the Israel factor seems to be a worry felt by many people. As far as the evidence viewed so far it is not a serious factor in reality. Israel is of course experienced in efficient irrigation techniques, and there does exist the potential of knowledge transfer that could benefit a more efficient use and thus *save* water. Nevertheless, worries concerning Israel – that often sound like conspiracy theories – reflect the conflict in the Middle East, and should be taken into consideration as such.

## 7.5 Agreement of 1959

After having looked at the *interests* of the Nile countries in cooperation at the beginning of this chapter, the following section looks at some of the divergent *positions* over water agreements in the Nile Basin. These positions are perhaps the most talked and written about manifestation of the “Nile conflict”.

### *Description:*

The “United Arab Republic and Sudan Agreement for the Full Utilization of the Nile Waters” was signed in Cairo on 8 November 1959 between Egypt (then called the United Arab Republic) and Sudan. The agreement created the legal foundation for allocating water between the two countries before building the Aswan High Dam. The dam was to increase the total amount of useable water by saving 32 km<sup>3</sup> water/year from being lost into the sea. The agreement allocated the net benefit of the Aswan High Dam project at a *ratio* of 14.5 (66%) to Sudan and 7.5 (34%) to Egypt – *under condition* that the average yield of the Nile river was to remain the same as between 1900–1959 (84 km<sup>3</sup>/year) and the losses of the project remained as estimated (10 km<sup>3</sup>/year). Under these conditions, Sudan would gain 14.5 km<sup>3</sup>/year and Egypt 7.5 km<sup>3</sup>/year. Adding this amount to their acquired rights, Egypt then had a total allocation of 55.5 km<sup>3</sup>/year and Sudan 18.5 km<sup>3</sup>/year. (Second, 4, full text see: Agreement 1959<sup>1</sup>).

The net benefit from the Sudd el Aali Reservoir mentioned in the previous item, shall be divided between the two republics at the ratio of 14.5 for the Sudan and 7.5 for the United Arab Republic so long as the average river yield remains in the future within the limits of the average yield referred to in the previous paragraph. (Second, 4, Agreement 1959).

If the average flow of the Nile were to increase in the future, it was agreed that any resulting net benefit would be divided between the two republics in equal shares (Second, 4, Agreement 1959). Given that the average yield and estimated losses may change, it was agreed that the net benefit was to be the subject of revision by the two parties at reasonable intervals to be agreed upon after starting the full operation of the dam (Second, 5, Agreement 1959).

As compensation for damage to Sudanese properties by the reservoir, Egypt agreed to pay Sudan 15 million Egyptian Pounds (about 43 million US\$) (Second, 6, Agreement 1959), and Sudan agreed to transfer the Sudanese population living in the area that was to be inundated (Second, 7, Agreement 1959).

In order to expand agriculture in the two countries, projects for the utilization of lost waters in the Nile basin were agreed upon. These included projects to prevent waters from being lost through evaporation in the swamps of Bahr El Jebel, Bahr el Zeraf, Bahr

1 The various sections and articles of the agreement are referred to by the numbers under which they appear in the agreement.

el Ghazal and the Sobat River. It was agreed that the net yield of these projects was to be divided equally between the two countries, and each was to contribute equally to the costs (Third, 1, Agreement 1959). A Permanent Joint Technical Commission (PJTC) was formed, to be financed by both governments in order to implement the projects (Fourth, Agreement 1959).

The two countries agreed on a joint view if negotiations with another riparian state were necessary or if another riparian country demanded a share of the Nile waters in the future:

If it becomes necessary to hold any negotiations concerning the Nile waters with any riparian state outside the boundaries of the two republics, the governments of the Sudan Republic and the United Arab Republic shall agree on a unified view after the subject is studied by the said Technical Commission. The said unified view shall be the basis of any negotiations by the Commission with the said states. (Fifth, 1, Agreement 1959).

As the riparian states, other than the two republics, claim a share in the Nile waters, the two republics have agreed that they shall jointly consider and reach one unified view regarding the said claims. And if the said consideration results in the acceptance of allotting an amount of the Nile water to one or the other of the said states, the accepted amount shall be deducted from the shares of the two republics in equal parts, as calculated at Aswan (Fifth, 2, Agreement 1959).

#### *Discussion:*

Three points stand out in the Agreement of 1959: a) The title of the agreement; b) The combination of historically acquired rights *and* new forms of allocation between the two countries; and c) The two countries agree on a unified view concerning the upstream countries over future negotiations or claims to the waters of the river Nile. This consolidates a “natural alliance” between the two most downstream countries and strengthens their position towards the upstream countries.

*The title:* “agreement for the *full utilization* of the Nile waters (italics added)”, as well as the sentence in the preamble: “as the Nile water agreement concluded in 1929 provided only for the partial use of the Nile waters and did not extend to include a *complete control* of the river waters, the two republics have agreed on the following: ... (italics added)” has led to some misunderstandings. The agreement was about the division of the net benefit of the Aswan High Dam and other such projects, as well as how the two countries would cooperate in future *vis-à-vis* the upstream countries. As this does not directly effect all countries of the basin, the title of the agreement does not seem appropriate from a basin management point of view. The agreement mentions that negotiations with upstream countries over the Nile may be necessary, thereby clearly indicating that the agreement does not intend to deal with the full or complete use of the Nile in the whole Nile Basin as this cannot be done by two countries alone for a river basin shared by ten countries. The difficulty may only be one of terminology, however, as the words “full” and “complete”

may not refer to the whole Nile river, but may be understood more in the sense of “use the waters at our disposal measured at Aswan as fully as possible.” It would be interesting to go back to the original Arabic, to see if the nuances in the words have been correctly translated into English.

The Agreement of 1959 must be understood in the context of the Cold War, with Egypt aligned with the USSR and Ethiopia with the USA and Great Britain. Due to the Cold War, a consensual agreement between the two countries was practically impossible at the time (Egyptian academic).

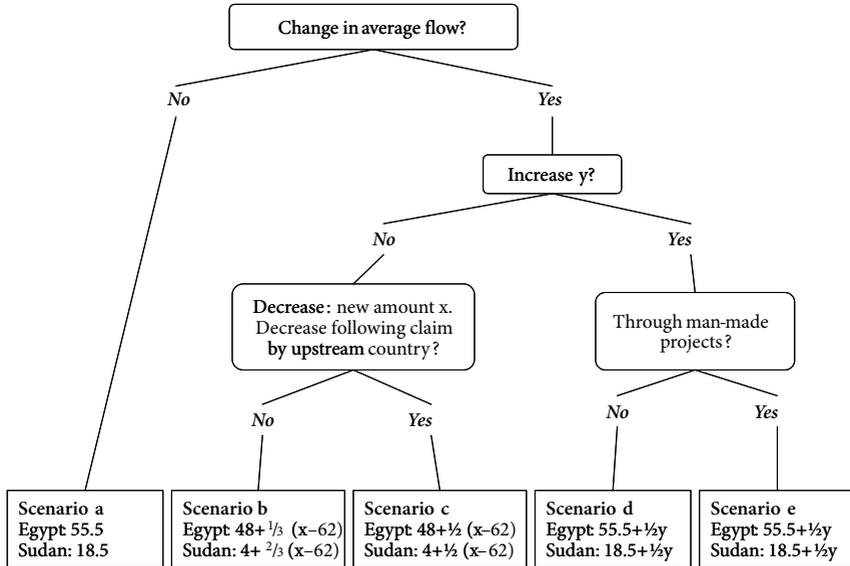
*The form of sharing:* The principle of historically acquired rights is used as a starting point and consolidated: 48 km<sup>3</sup>/year for Egypt and 4 km<sup>3</sup>/year for Sudan, as measured at Aswan, following the Agreement of 1929. Additional amounts of usable water are not divided in a ratio of 1:1 but in a ratio of about 2:1 to the benefit of the country that had less in the previous Agreement of 1929 (Sudan). Thus, historic rights are given some importance, but present needs and equity for the country that has less were also taken into consideration.

Because the division of the net benefits is done in the form of a *ratio* and not in the form of fixed amounts, upstream countries should not be as concerned about the Agreement of 1959 as seems to be the case in the media (e.g. Lemma 2001). The implications of agreeing on a ratio becomes clearer if one looks at five possible scenarios of change in water flow and the implications of this for Egypt and Sudan (diagram 7.2): a) average yield (84 km<sup>3</sup>/year) remains the same, b) there is a natural decrease of average yield, c) there is a decrease through upstream demands, d) there is a man-made increase through additional projects, or e) there is a natural increase of average yield.

- Scenario a: In this case Egypt gets 55.5 km<sup>3</sup>/year and Sudan 18.5 km<sup>3</sup>/year as measured at Aswan, i.e., under the conditions and calculations as foreseen in the agreement.
- Scenario b: By implication of dividing the net benefit according to a ratio and not a fixed amount, a decrease in average yield seems to mean that the new amount  $x$  minus the acquired rights (Egypt 48 km<sup>3</sup>/year, Sudan: 4 km<sup>3</sup>/year) and minus the loss from Lake Nasser (about 10 km<sup>3</sup>/year) would be divided up in a ratio of  $\frac{2}{3}$  to Sudan and  $\frac{1}{3}$  to Egypt. To illustrate: if the new average yield is 80 km<sup>3</sup>/year–52 (acquired rights, 48 plus 4)–10 (Lake Nasser loss) = 18. Of this  $\frac{2}{3}$  = 12 for Sudan, i.e., a total amount of 16; and  $\frac{1}{3}$  for Egypt = 6, i.e., a total amount of 54.
- Scenario c: If the decrease results from an accepted claim made by another upstream state, then the amount is deducted at a ratio of 1:1 from their shares. Thus if a claim is made of 4 km<sup>3</sup>/year, Egypt would be left with a total of 55.5–2 = 53.5 km<sup>3</sup>/year and Sudan with 18.5–2 = 16.5 km<sup>3</sup>/year.
- Scenario d and e: If the average yield increases, either through joint projects or due to natural changes, it is to be divided in a ratio of 1:1. To illustrate: if, for example, one takes the average between 1971 and 1999 which is 88 km<sup>3</sup>/year,

Sudan and Egypt would both be allocated an additional 2 km<sup>3</sup>/year, making Sudan's amount 20.5 km<sup>3</sup>/year and Egypt's 57.5 km<sup>3</sup>/year.

Diagram 7.2



*Implications of the Agreement of 1959 for Egypt and Sudan if the average yield of the Nile flow, measured at Aswan, changes. Water amounts in km<sup>3</sup>/year.*

Scenario a and e are discussed in literature (Collins 1990), scenarios b, c and d are less discussed, probably for the following reasons:

Scenario b seems unlikely. The longer range averages indicate a natural increase in the flow rather than a decrease. It is also not clear in the 1959 Agreement *how* the two countries would agree on the new average.

Scenario c seems unrealistic because the upstream countries do not accept the Agreement of 1959. A country like Ethiopia, for example, would not place a claim as foreseen in the Agreement of 1959 because they are not party to the agreement. To place a claim would be to admit the validity of the agreement – something that Ethiopia is unlikely to do. Scenario c is more likely, if the sentence “riparian states...claim a share” (Fifth, 2, Agreement 1959) is also understood to mean a claim that is not expressed officially, i.e. a unilateral project leading to a decrease in flow. This does not seem to be the case, however, a unilateral project leading to a decrease in flow would probably meet with a political reaction of the two downstream countries, and not be dealt with according to this article (Egyptian academic). Nevertheless, in theory, aiming at maximizing the

Egyptian quota, scenario b is better than an equivalent decrease resulting from a claim made by an upstream country (scenario c).

Scenario d is unlikely for the following two reasons: First, it is not clear in the Agreement of 1959 *how* new averages would be agreed upon. Second, although there are indications that the average Nile flow over a longer period of time – 88 km<sup>3</sup>/year between 1871-1999 – is higher than the average of 84 km<sup>3</sup>/year that the agreement is based, an increase in the Egyptian or Sudanese quotas seems unlikely, even if the agreement would foresee this. Egypt's main interest seems to be to consolidate the 55.5 km<sup>3</sup>/year amount as its acquired right. If a change in the quota would be discussed, a debate could be ignited that would be hard to control. Even if this does not mean an automatic renegotiation of the 1959 Agreement, the concern would probably be that one would be heading in that direction. From Sudan's point of view, the issue is not of such great importance, as it has so far not managed to use its 18.5 km<sup>3</sup>/year quota.

Scenario e was a long-term option during the planning and initial implementation of the Jonglei Canal that found its end in the troubles in Sudan in 1983. Egyptian water development plans are no longer based on gains made by the Jonglei Canal (Egypt 1999). The troubles in Sudan have to be settled first, thus Egypt's interest in a peacefully unified Sudan (see section above). More recent plans that fit scenario e are located in the tributaries of the Baro-Akob/Sobat on Ethiopian territory in the Gambela region. Potentially this could be a win-win-win situation for the three countries in the framework of the Nile Basin Initiative if local needs and environmental sustainability are taken into consideration (section 5.1.5).

*Egyptian perceptions:* In Egypt, the Agreement of 1959 is seen as a very successful agreement (Egyptian technocrat 2000). The 32 km<sup>3</sup>/year that were lost to the sea prior to the agreement and the Aswan High Dam were finally made useable. In the years subsequent to the agreement and the Aswan High Dam, upstream countries were plagued by both floods and droughts, something that Egypt avoided through over-year storage. In Egypt there is therefore no debate about the 1959 Agreement; it is seen as a consolidation of its acquired rights and vital for the survival of the country. More than any other country of the Nile basin, Egypt is dependent on the Nile flow, and has been for thousands of years; the agreement merely holds this fast in a legal document (Egyptian academic 2000). It seems that during the negotiations leading up to the agreement of 1959, much time was spent by Egypt pushing for the principle of acquired rights. In order to have this principle accepted, Egypt was ready to give a large proportion of the additional water to Sudan (Egyptian academic).

The agreement is seen as being generous towards Sudan, as the increased amount was shared between Egypt and Sudan in a ratio of 1/3 for Egypt and to 2/3 for Sudan. The Permanent Joint Technical Commission (PJTC) includes Egyptian and Sudanese representatives, and although it did not realize its aim of the Jonglei Canal, it is seen as a success, as it was effective in exchanging information between the two countries over water issues. Despite other tensions between the two countries, the relations over water have remained good due to the PJTC and the Agreement of 1959. According to an

Egyptian technocrat, Egypt makes sure that it does not become dependent on using water above the 55.5 km<sup>3</sup>/year quota of the 1959 Agreement; an indication that it does not use the 5 km<sup>3</sup>/year that are not used by Sudan (Egyptian academics 2000). An academic in Sudan doubted this, and thought that Egypt would have had troubles filling the Nasser Lake after dry years if Sudan actually used up its quota (Sudanese academic 2001).

Besides legally fixing acquired rights, the main advantage of the 1959 Agreement from Egypt's point of view is the clause (Fifth, 5, Agreement 1959) that states that any demand for more water from another upstream country would be *jointly* dealt with by Sudan and Egypt. Any comments from an unofficial Sudanese side that Sudan may be moving into a post 1959 phase with more bilateral cooperation with Ethiopia that questions the 1959 Agreement with Egypt are viewed very critically, as it would be seen as a threat to the stability between Egypt and Sudan and as going against international law.

“It is the general opinion in Egypt that Egypt needs its quota from the 1959 Agreement and any additional water from efficiency gains for population growth, which is now at one million people every ten months.” Egyptian academic 2000.

“The idea is not to increase Egypt's share of the water but to find alternative water resources.” Abu Zaid, Egyptian Minister of Water Resources (1999).

“With the exception of Egypt and Sudan, none of the other Nile basin countries heavily depends on the Nile Water.” Ayman (2001).

*Sudanese perceptions:* In Sudan the perception of the 1959 Agreement is more ambiguous than in Egypt, but the agreement is viewed as officially binding by all. Some Sudanese see it positively, stabilizing relations between the two countries. Since Sudan has never used its quota fully, the main problem is to use the quota rather than to find faults in the agreement (Sudanese technocrat and academic 2001).

“Sudan is happy with the 1959 Agreement. Even if our quota is small, we have not managed to use it. Our problem is not the agreement, but the utilization of our quota.” Sudanese academic (2001).

On the unofficial tracks 2 and 3 there are more critical voices: some people feel that the agreement was negotiated with a weak Sudanese regime. They perceive that Egypt supported the bloodless military coup in 1958 led by General El-Ferik Ibrahim Abboud to have a government in Khartoum that was friendly towards Egypt (Sudanese academic 2001). Ibrahim Abboud had made his career in the ranks of the Sudanese branch of the Egyptian army, indicating his closeness to Egypt (Biography, Abboud 2002).

“Egypt likes to work with a weak regime in Sudan. Nasser muscled out people in the 1950s for that reason.” Sudanese academic (2001).

The Sudanese who are critical of the 1959 Agreement point out that it could be a future hurdle to Sudanese development when Sudan might need more water. They think there is now a shift to a post 1959 situation, which would include more cooperation with Ethiopia,

rather than focusing so much on Egypt. As the water arrives from upstream Ethiopia, this is seen to make sense from a resource management point of view.

“All basin states are in a transition to a post 1959 phase, except Egypt.” Sudanese academic (2001).

The majority of people and their parties in the National Democratic Alliance, the largest grouping of opposition parties in Sudan, are of the opinion to review the 1959 Agreement in a manner that will maintain the acquired rights of the downstream riparian countries and satisfy the emerging needs of upstream countries (Khalid 2003)<sup>2</sup>. There is a wide consensus in Sudan that Egypt is further developed in its water policy, and that Sudan and the other upstream countries are lagging behind in recognizing the importance of the Nile waters for development. This respect for Egypt’s development achievements are mixed with resentments towards Egypt for blocking development banks from investing in the building of dams upstream. Another indication that is understood by some to support this view is the predominance of Egyptians in International Water organizations (e.g. Ismail Serageldin, Chairman of the Global Water Partnership, former vice president of the World Bank; Abu Zaid, President of the World Water Council; Aly Shady, co-founder of the World Water Council).

“Egypt cannot wait for us. It is our problem that we are slow in developing our water resources. They cannot just look at the water idly flowing by and being lost to the sea. If we do not use the water, it is our problem, not Egypt’s fault. Some people say Egypt is playing political games to stop dams being built upstream. If so, they do it for their country; it is part of the game. I would do the same if I were an Egyptian.” Sudanese academic (2001).

“Maybe one day one will say you have no right to that water because you don’t use it.” Sudanese academic (2001).

*Ethiopian perceptions:* While it seems that everyone in Egypt is for the 1959 Agreement, and some people in Sudan are for and some against it, everyone in Ethiopia is against it. Ethiopia was not part of the agreement, was not invited to the negotiations that led to it, and is not bound by it. Ethiopia does not appreciate the title: “...Agreement for the Full Utilization of the Nile Waters” and further, the declared aim in the agreement to create an agreement for the “complete control” of the river. The view is that as Ethiopia is the source of 85% of the water arriving in Egypt, it is hardly possible to make an agreement for the complete control of the river without consulting Ethiopia. The 1959 Agreement is therefore viewed by many as an insult to Ethiopian national pride. Ethiopia wants to negotiate a Nile agreement that includes all countries involved. Without an internationally accepted agreement it is difficult for Ethiopia to access money from international

2 Mansour Khalid is the political advisor of the SPLA/SPLM, Sudanese People’s Liberation Army/ Sudanese People’s Liberation Movement. Former Foreign Affairs Minister under President Numeiry. All participants in the NDA workshop, 15-16 Feb. 2003 agreed on this issue.

development banks. It can, however, seek bilateral funds – a form of power leverage in relation to downstream countries (Arsano 2004). The question is how well Egypt, with its international alliances, can prevent this strategy.

“Many, including Ethiopia, refused to be associated with such endeavors (cooperative initiatives such as HYDROMET, UNDUGU and TECCONILE) for the obvious reason that they were considered to have the sinister motive of institutionalizing the unjust status quo in the Nile Waters, as evidenced by the 1959 Agreement (brackets added)” Seifeselassie Lemma, Director for legal affairs of the Ministry of Foreign Affairs of Ethiopia (Lemma 2001).

In conclusion, the following points can be made:

- The Agreement of 1959 must be understood in the context of the Cold War, with Egypt and Ethiopia on different sides of the East-West conflict. Part of today's Nile conflict can be viewed as a legacy of the Cold War.
- If an upstream country would claim a share of the runoff, it is likely that Egypt and Sudan would negotiate, as foreseen by the agreement. It is unlikely that such a claim will be placed, however, as the agreement is not accepted by the upstream countries.
- The agreement of 1959 allocates water according to a ratio. This makes it basically compatible with developments upstream.
- The agreement, however, also consolidates the principle of acquired rights. This is the frictional issue from an upstream point of view.
- If an upstream country goes ahead unilaterally, it is likely that Egypt and Sudan would react politically. The clause of readapting ratios was foreseen for natural fluctuations, and not for unilateral development upstream.
- “Full utilization” refers to the flow at Aswan, and not to the Nile Basin as a whole.
- Ethiopia was against the agreement not least of all because it was against the Aswan High Dam project and interested in storing water upstream, where the evaporation rates are lower.
- Should the supply of water be increased through projects like the Jonglei Canal, one way forward would be to allocate the additional amount over proportionally to the upstream countries.

## 7.6 International Water Law

Besides the Agreement of 1959, what does international law have to say in regards to the Nile question? Two aspects of international law concerning international river basins will be discussed: the convention on the Law of the Non-Navigation Uses of International Watercourses and the draft of the Nile River Basin Cooperative Framework.

### 7.6.1 Convention on the Law of the Non-Navigation Uses of International Watercourses

The “Convention on the Law of the Non-navigation Uses of International Watercourses” was adopted by the UN General Assembly in May 1997 with 103 countries in favor, 3 against and 27 abstentions (Press release 1997). There are few international river basins where all the countries of the same basin have agreed to this convention; it is therefore unlikely to bring these countries closer to an agreement. In the Nile Basin, only Kenya and Sudan were in favor of it (table 7.1).

Table 7.1:

Burundi	D.R. Congo	Egypt	Eritrea	Ethiopia	Kenya	Rwanda	Sudan	Tanzania	Uganda
Against	Absent	Abstained	Absent	Abstained	In favor	Abstained	In favor	Abstained	Absent

*Low acceptance of convention in the Nile Basin (Press release 1997)*

The convention can help in pointing out issues that need to be discussed. The following aspects were of concern to Ethiopia and Egypt:

- a. The definition of “International Watercourse”
- b. The obligation not to cause significant harm, and the principle of equitable and reasonable utilization
- c. The modalities of notification and information exchange
- d. The question of harmonizing existing agreements

These terms will be defined briefly according to the agreement, and the different perceptions of Egypt and Ethiopia will be examined.

*A. An international watercourse is defined in the following way by the convention:*

“Watercourse” means a system of surface waters and groundwater constituting, by virtue of their physical relationship, a unitary whole and normally flowing into a common terminus (...) “International watercourse” means a watercourse, parts of which are situated in different states (Part 1, Article 2).

*Egyptian Perception:* Egypt’s argument in sharing the water of the Nile is that all water resources of the basin should be included, e.g., rainfall as well as run-off. The term “international river basin” would be preferred to the term “international watercourse”. Watercourse is a more narrow term and only encompasses a system of surface waters and groundwater with a physical relationship to each other. This view is also held by

Falkenmark (2000), as there are few options for issue linkages unless more water resources in a basin are included in the negotiations.

*B. The obligation not to cause significant harm, and the principle of equitable and reasonable utilization and participation:*

Watercourse states shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse states.

Where significant harm nevertheless is caused to another watercourse state, the states whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures, (...), to eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation (Part II, Article 7).

Watercourse states shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. (...) Watercourse states shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. (Part II, Article 5).

*Ethiopian perceptions:* Ethiopia is concerned that the “no significant harm” principle will hinder the development of water resources upstream. Equitable use is seen as an encompassing phrase, as it means an equitable use for both upstream and downstream users, and there is therefore no need for the “no significant harm” article (Ethiopian academic 2001).

*Egyptian perceptions:* According to Egypt, the obligation not to cause significant harm is not strong enough. What does “significant” mean, for instance? The convention is seen as giving favor to the principle of “equitable use” over the obligation not to cause significant harm (Egyptian academic 2001).

*C. The Modalities of Notification and Information Exchange*

Watercourse states shall exchange information (...). Before a watercourse state implements or permits the implementation of planned measures which may have a significant adverse effect upon other watercourse states, it shall provide those states with timely notification thereof. (Part III; articles 11 and 12).

*Ethiopian perceptions:* Ethiopia is worried that this could put too much of a burden on upstream countries (Nega 1997). As long as Egypt is seen as trying to block development in Ethiopia, it does not make sense from an Ethiopian point of view to notify Egypt about any development plans. Furthermore, one asks why Ethiopia was not informed about water development projects in Egypt. Such projects could influence Egypt’s future negotiation strategy, by creating “faits accomplis”, facts on the ground.

*Egyptian perceptions:* The principle of notification is important for Egypt so that it can react to any developments in the upstream countries. For flood and drought forecasting,

it is also dependent on exchange of metrological information. If Ethiopia starts to hide information, this is viewed with suspicion; Egypt is not bad willed, so why does Ethiopia hide its information, what are they afraid of?

“Ethiopia is against prior notification, they are scared that we always say no. But that is not true. We just want to know what is going on.” Egyptian academic (2000).

Egypt does not see a need to notify upstream countries about any development projects in Egypt, as any water that is not used is lost to the sea and upstream countries are not affected by this. Development projects, such as Toshka or in N. Sinai, however, were publicly posted on the State Information Service website; Egypt does not have anything to hide. Egypt also welcomes upstream hydrologists to its National Water Research Center for courses and visits.

#### *D. The question of harmonizing existing agreements*

(...) parties to agreements referred to in Paragraph 1 may, where necessary, consider harmonizing such agreements with the basic principles of the present convention.

Watercourse states may enter into one or more agreements, hereinafter referred to as “watercourse agreements”, which apply and adjust the provisions of the present convention to the characteristics and uses of a particular international watercourse or part thereof. (Article 3)

*Ethiopian perceptions:* Ethiopia criticises adjusting the convention to the characteristics and uses of a particular watercourse as this would undermine the convention. Specific watercourse arrangements (i.e., agreements that already exist, such as the Agreement of 1959) should be adjusted to the convention, and not the other way around (Nega 1997).

*Egyptian perception:* Egypt is against harmonizing existing laws to the convention, as proposed by Article 3. It sees this as going contrary to international customary law. The International Court of Justice decision concerning the original dam agreement between Slovakia and Hungary upheld the validity of the historical agreement between the countries, even if the government changed since the agreement was made. Historical agreements may not be harmonized to new ones, but new laws must take existing ones into account.

#### *7.6.2 Nile River Basin Cooperative Framework*

The Nile River Basin Cooperative Framework is still in draft form. Legal advisors have partially clarified differences in the D3 project, a forum for developing the “Nile Basin Cooperative Framework” for management of the Nile. UNDP supported the D3 project since 1995 and in 1999 it was integrated into the Nile Basin Initiative (NBI site). Greater political will is needed to push an agreement through (Egyptian academic 2000). An option is to leave the tricky issues for the moment and to work on confidence-building

measures and projects on the ground, within a minimal institutional framework. Once more trust has grown, one can continue to work on the legal issues (Egyptian academic 2000). Frictional points are similar to those mentioned above:

- Modalities of information exchange
- Relationship of the framework with existing agreements; which conforms to which?
- Is there a need to review the status of present water utilization?
- How strong shall the principle of prevention of causing significant harm be phrased? What is the balance of equitable use and the principle not to cause significant harm?
- Should the word “watercourse” or “basin” be used?

There seems to be a consensus to use the word “basin”, a step forward from Egypt’s and Ethiopia’s notes concerning the convention on the Law of the Non-navigation Use of Watercourses. Ethiopia, however, prefers the word “watercourse” when referring to the protection and conservation of the Nile. Using the word “basin” here would include a far greater area to be protected in the Ethiopian highlands.

If accepted, the Nile Basin Cooperative Framework could stabilize relations in the Nile Basin. Ethiopia could gain easier access to funds when using water according to the agreement. Egypt could have a share of the Nile that is accepted by upstream countries, a legal basis protecting the water security of the country. There are uncertainties and considerations hindering an agreement, however. The agreement may be accepted but not implemented. Non-legal problems hindering development may prove to be more important than legal ones, or the development of Egypt, Ethiopia or another Nile country may be hindered by an unbalanced agreement. Balancing these possible gains and losses, it seems unlikely that any agreement will be reached soon. This need not impede development, however. Possibly a minimal legal consensus can be found establishing an institutional framework to enhance cooperative projects.

## 7.7 Forms of Sharing Water

Sharing any resource raises the question of the supply of the resource and the demand for the resource (how many parties use a resource for what purpose and with which technology?). The Law of the Non-Navigation Use of International Watercourses lists issues to be considered when answering these two questions<sup>3</sup>. All countries agree that water needs to be shared, the debate is upon which basis to do it. On the question of supply (which amount is to be divided), Ethiopia generally speaks about sharing the Nile River flow measured at Aswan according to the old average (84 km<sup>3</sup>/year). This amount was the basis of the Agreement of 1959 between Egypt and Sudan. Starting from this as the “cake” to be shared, there is nothing left to share, as Egypt and Sudan use about 88%, and 12% is lost to evaporation. Egypt, however, points out that all water resources available to a country need to be included in an assessment, “blue” (rain, river run-off, lakes, groundwater) and “green” (water in vegetation and soil) resources. Upstream countries benefit from rain, and downstream countries are dependent on run-off. The total precipitation over the Nile Basin is estimated at 1680 km<sup>3</sup>/year. Taking this amount as a base, Egypt and Sudan get about 4.5% of the total “cake” (Egypt 2000: 6).

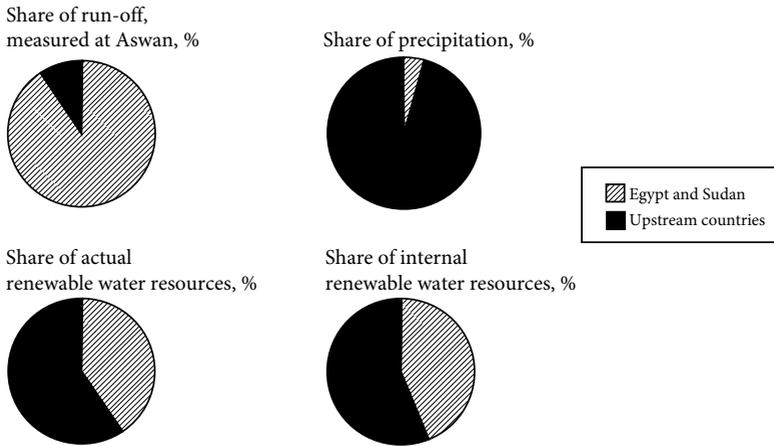
The reply from an Ethiopian academic is that Ethiopia is also entitled to using river runoff, and that Egyptians do not take the water lost through evaporation into account. Thus, a calculation should focus on all *useable* resources, including all inputs, uses and losses (Ethiopian academic 2001).

“We understand we have rainfall, but we are also entitled to a fair share of run-off.”  
Ethiopian academic (2001).

Egypt and Sudan (55.5 plus 18.5 = 74 km<sup>3</sup> water/year) use different shares of the total amount of water, depending if one uses run-off measured at Aswan (84–88 km<sup>3</sup>/year), precipitation (1680 km<sup>3</sup>/year), total internal renewable water resources (125.7–267.4 km<sup>3</sup>/year) or actual renewable water resources (127.2–354.4 km<sup>3</sup>/year)<sup>4</sup> as the starting point (diagram 7.3, table 5.3, calculation in appendix I). The last two figures are rough, as they are based on calculations that use national databases. A more precise calculation of the actual renewable water resources of the Nile Basin would be a question for further research.

- 3 Utilization of an international watercourse in an equitable and reasonable manner within the scope of Article 5 requires taking into account all relevant factors and circumstances, including: geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character; the social and economic needs of the watercourse states concerned; the population dependent on the watercourse in each watercourse state; the effects of the use or uses of the watercourses in one watercourse state on other watercourse states; existing and potential uses of the watercourse; conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; the availability of alternatives of comparable value to a particular planned or existing use. (Article 6, 1, Convention 1997)
- 4 Internal renewable water resources (IRWR) is that part of the water resources generated from endogenous precipitation. It is computed by adding up surface runoff and groundwater recharge occurring

Diagram 7.3



*Different ways of seeing the available water and "shares" of water used between Egypt, Sudan and the upstream countries based on figures 2002. Calculations in the appendix. Data: Aquastat 2002.*

Further ideas are to share water made available from supply-side projects (e.g. Jonglei, Gambela, section 5.1.5) or from efficiency increase. Most Egyptians would agree that sharing the water from supply-side projects is the best approach to take. If a project that aims at increasing the supply is successful, a part of the water gained could be allocated to Ethiopia, and a part to Egypt and Sudan. In Egypt increased efficiency, e.g. technological improvements, changes in the crops and water recycling, could make about 20 km<sup>3</sup> water/year available (El Quosy, Tarek 1999). An international funding agency could pay for rehabilitating the irrigation system in Egypt and the saved water could be allocated to upstream countries (interview with international water expert 2000). Egypt's economy is dependent on the water it is already using, however, and it will need more (efficiency increase) for its population growth (El Quosy, Tarek 1999).

We have highlighted some of the different ways of perceiving how much water there is. Further studies that would answer with greater accuracy the amount of actual internal renewable water resources and the amount made available from supply- and demand-side management (a rough estimate is given in chapter five) could provide a more solid foun-

inside the countries' borders. Special care is taken to avoid double counting of their common part. Total renewable water resources refers to the sum of IRWR and incoming flow originating outside the countries' borders. A distinction is made between natural flow (NRWR), computed by assessing the long-term yearly average of flow without any human-induced abstraction, and actual flow (ARWR), which is the maximum theoretical amount of water actually available for a country. Actual flow takes into account abstraction in upstream countries and the volumes allocated through formal or informal agreements or treaties between countries. The IRWR figures are the only water resources figures that can be added up for regional assessment and they have been used for this purpose (Aquastat 2002).

dation for these perceptions. Finding out how much water there actually is only answers half of the challenge, however. The other half concerns finding “objective” principles in order to decide which of the various “amounts” should be taken as a basis. In answering this challenge, there is a tendency to fall into positional “right” and “wrong” bargaining, rather than seeking to satisfy the interests explored at the start of this chapter.

Due to the need for flexibility in order to satisfy multiple interests, international river management agreements have generally moved away from fixed shares to more flexible and proportional forms of sharing, focusing on the optimal use. This also goes in line with sharing the cost and benefit of individual projects, rather than the drops of water.

“We do not want to speak about shares. This brings us nowhere, no, we say to Ethiopia: “Use your water”. If you want to use it, use it, lets sit together to talk about management to prevent harmful effects.” Sudanese technocrat (2001).

The present steps towards cooperation in the Nile Basin, discussed in the next section, seem to be following this interest-based approach rather than a fixed amount approach. A working relationship based on trust is a prerequisite to a more flexible approach. The management efforts are therefore directed to increasing the mutual confidence between the different stakeholders, while addressing the institutional set-up in the basin more slowly.

## 7.8 Present-Day Efforts at Cooperation In the Nile Basin

This section first looks at a possible framework for cooperation in the Nile Basin, based on the interests analyzed in the previous sections (diagram 7.4). We then describe the initiatives to foster bilateral and multilateral cooperation in the Nile Basin. Egyptian, Sudanese and Ethiopian perceptions of these initiatives are examined, as well as their perceptions of what is hindering cooperation, and how these obstacles can be overcome. The section ends with lessons learned from the Nile Basin Initiative Process, and compares it to the framework described below (diagram 7.4). The framework is then further developed in the final synthesis section of our study, combining it with the HEIT model.

A framework for cooperation in the Eastern Nile Basin would seek to satisfy the basic interests of the involved countries. The different interests of the upstream and downstream countries can lead to potential trade-offs, where Egypt supports development upstream, and Sudan and Ethiopia commit to securing Egypt’s water resources. The international community could foster this “win-win” trade-off with financial and communicative support. Sudan is generally considered as a downstream country due to its alliance with Egypt in the agreement of 1959. The development interests of Sudan, however, are closer to those of Ethiopia, the reason why both countries are situated in the box interested in “development” in diagram 7.4, while Egypt is situated in the box interested in “security”.

Diagram 7.4



*Trade-off options between the countries could involve the upstream countries offering security in exchange of development, the downstream countries offering development in exchange of security. In discussion with Günther Baechler 2003.*

### 7.8.1 Bilateral Cooperation

Bilateral cooperation in the Nile Basin is older than multilateral cooperation. Sudan and Egypt have had good working relations over water resources since 1959 in the “Permanent Joint Technical Commission” (Ghany 2000). This cooperation also survived political tensions between the two countries. Cooperation between the other Nile countries is younger. Ethiopia and Sudan, for example, signed a statement of principle in 1991 over the equitable use of the Blue Nile and Atbara (El Zain 2000: 17). Two years later, Egypt and Ethiopia signed a framework of understanding that was intended to smooth the way for cooperation between the two countries. Questions relevant to the Nile were also addressed (Sellasie 2000: 12, full text see Arsano 2004). Uganda and Egypt have cooperated over various projects for many years, e.g. over the Owen Falls Dam in Uganda or over weed control in Lake Victoria (water weeds are to be destroyed, as they lead to increased loss of water through evapotranspiration). Both countries also cooperate together in a project that aims to get rid of floating islands in Lake Kyoga. These islands block the outflow of the lake, which causes flooding in Uganda and means that less water flows down the Nile. This is a good example of a “win-win” solution, as both parties gain from the project. Waterbury (2002) examines the Ugandan position towards Egypt, concluding that Uganda benefits from cooperation, even if this sometimes happens against the will of a sovereign “upstream” country. Egypt and Kenya are working together on a groundwater well project in Kenya, and a similar project is planned between Egypt and Tanzania. For Egypt it is advantageous if upstream countries use groundwater rather than river water. Egypt will also support Tanzania in building up a national water research center (Ghany 2000). In Egypt there also exist different training courses for capacity building in which the participation of students from upstream countries is supported.

These examples demonstrate how Egypt supplies know-how and financial support, and in exchange gains either concrete benefits (e.g. water flow control due to Owen Falls Dam) and/or improved relationships with the upstream countries. On the bilateral level, therefore, the framework of cooperation (diagram 7.4) seems to fit the situation on the ground, with Egypt offering development for security. Security is not granted in the form of a legally binding agreement, however.

### 7.8.2 Multilateral cooperation

Earlier attempts at multilateral cooperation ultimately failed because countries such as Ethiopia or Kenya only had an observer status. A review of these earlier attempts at multilateral cooperation such as Hydromet (1967–1992), Undugu (1983–1993), and Tecconile (1992–1999) is given in Peichert (1999) and Arsano (2004). The observer status of Ethiopia and Kenya was partly due to their perception that the fora were dominated by Egypt, and partly because of the lack of importance given to the issue. Nevertheless, these earlier initiatives were important in gathering data and preparing the way for future cooperation. In 1991 the Nile countries could barely decide on meeting on a yearly basis.

The situation has changed dramatically since, and there is now talk of a new spirit of cooperation (Hamad 2000). Since February 1999 Ethiopia is an active member of the “Nile Basin Initiative”, in which 9 of the 10 Nile countries are active members (Ghany 2000). There are yearly meetings at the ministerial level, in the “Nile Council of Ministers” (Nile COM). The “Technical Advisory Committee” (Nile TAC), in which suggestions for the Nile COM are prepared, meets 4–5 times a year. Both COM and TAC are supported by the Permanent Secretariat (Nile SEC) based in Entebbe. Chairmanship of COM and TAC rotates between the countries on a yearly basis. Another element of the Nile Basin Initiative is the D3 project that was discussed above. The Nile Basin Initiative is mainly supported by the “Nile Team” (the “third-party”), comprising the World Bank, UNDP and CIDA (Canadian International Development Agency) (NBI web).

The NBI is more complex than the “group mediation/negotiation” process as described in section 2.2.2. Yet similar to group mediations, the NBI architecture shows elements of *filtration* of actors and issues (conferences, choice of governmental representatives, Shared Vision), *negotiation* in a small circle (D3, Negotiating Committee, Nile-COM) and *rebinding* of the results into the larger socio-political context (press releases, Nile Discourse) (diagram 2.7). Filtration and rebinding are important to link the public to the steps taken towards cooperation. An example are the “Nile 2002 Conferences” held each year in one of the Nile countries, beginning in 1992, ending in 2002 (therefore the name; the conferences are described in Hefny, Amer, forthcoming). Another format is the “Nile Discourse” that involves NGOs from the different Nile countries. The first meeting was hosted by the IUCN, WWF and the World Bank in Geneva in 2001. The Nile Discourse has the objective of promoting a broad-based dialogue on issues concerning the development of the Nile Basin (Nile Discourse web).

What makes the NBI more complex than a conflict management process in a smaller

arena is that besides negotiations, projects on the ground are being developed. In this way, an integrative, holistic approach is combined with a more pragmatic step-by-step approach on a lower management level. While the "Shared Vision" is basin-wide in order to find a common language and common goals, the "Subsidiary Action Program" works on the regional, national or even local level. Here concrete needs can be met. The Nile countries have worked out common projects, e.g. a hydroelectric power project with shared costs and benefits, and soft projects such as training courses. The projects were presented to the international funding community in 2001 in the framework of the International Consortium for Cooperation on the Nile (ICCON), and 14 million US\$ were granted (ICCON 2001).

The NBI strategy is to cooperate where cooperation is possible despite differences in other areas, such as over legal issues. There is a focus on interests, rather than only on legal positions. At the same time these positions and the tricky legal questions are not ignored, as they were in past multilateral initiatives. To understand the NBI in greater depth, the perceptions from different countries will be looked at.

*Egyptian perceptions:* All the Egyptians interviewed were very enthusiastic about the Nile Basin Initiative. In the press, however, there are some very skeptical views, for example, the fear that the NBI is "selling" out to the upstream countries (Rushdie 2001). One can thus discern two schools in Egypt, an "old" school that continues in the path of the water war threats expressed by President Sadat and does not see a need to cooperate with the upstream countries. This school relies more on force and the lack of development in the upstream countries. A "new" school of thought aims at cooperation with the upstream countries. The Egyptian Minister of Water Resources, Abu Zaid, is an example of this new school of thought and is thus also someone who is respected in the upstream countries.

The political troubles in the upstream countries, in Sudan, between Ethiopia and Eritrea, and around the great lakes are seen as the main *obstacles* for cooperation in the Nile Basin. The mistrust between the countries is seen as an obstacle that will take a long time to surmount. The last regime in Ethiopia was not considered to be as cooperative as the present regime (Egyptian academic 2000). There is some mystification in Egypt as to why Ethiopia is not more cooperative. One technocrat who was interviewed thought that cultural factors also play a role:

"Maybe it lies in their character. Egyptians see Egyptian and Ethiopian civilizations as equal, but the Ethiopians don't, maybe they feel Egypt is dominant, superior. One Canadian person at a conference said Abu Zeid has more than 100 Ph.D personnel in his ministry. Ethiopia has 2-3 of them, the other upstream countries also have about 2-3 in their water ministries. Maybe they are aggressive because of this. Some people say Ethiopians should be careful, because Egyptians are clever and tricky. This is nonsense. The Ethiopian Church used to be a follower of the Egyptian Coptic Church, then they broke away, that was fine. They are a civilization on the same footing." (Egyptian technocrat 2000).

Asked about the perceived defensive attitude that some people in upstream countries complain about when talking about Egyptians, one Egyptian NGO worker thought it may have something to do with their geographically weaker position:

“If you are last in the line you may not get a ticket or the train may have left, you are in a weak position, so this may explain Egypt’s defensive attitude.” Egyptian NGO worker (2000).

The way Egypt seeks to motivate cooperation with the upstream countries is through know-how, experience, land, manpower, and financial and technical support. Examples of *options* suggested by Egyptians interviewed to enhance cooperation in the Nile Basin, included:

1. Share the increase in water from a project such as Jonglei
2. Reforestation and watershed management that would decrease erosion and sedimentation, and may stabilize run-off and local rainfall
3. Increase the efficiency to ease pressure on resources
4. Work on the comparative advantages of the different countries: HEP in Ethiopia, irrigation in Egypt and Sudan
5. Projects to use groundwater
6. Develop models to see how different projects would effect the flow
7. Share the costs and benefits of different projects
8. Work on joint projects and look at the legal questions later

\* \* \*

*Sudanese perceptions:* People interviewed in Sudan were generally very optimistic about the NBI.

“There are many lessons to be learned from the NBI, and there is still a lot to do. The most important thing is confidence-building. Then the next step is projects to be managed together, that do not have negative effects, and then later the legal issues. Thus the most important thing now is to allow for time for people to sit together, to enable friendship.” Sudanese technocrat (2001).

While the “old” and “new” schools of thought in Egypt deal with unilateralism or cooperation, the two schools of thought in Sudan are more concerned with being passive or active in relation to water issues. The “new” school of thought is realizing and pushing for a more proactive stance for Sudan; it is formulating and implementing a national water policy and making sure that Sudan does not just react to Egyptian initiatives. The main *obstacle* to water development is seen in Sudan as being the “troubles” in the South. According to one Sudanese businessman interviewed, the political stability is of greatest importance, this alone creates predictability, which then attracts foreign investment.

Most Sudanese who were interviewed were very much in favor of the idea of using comparative advantages, thus Ethiopia could specialize in HEP. Dams in Ethiopia would also stop sediments from being transported to Sudan. Sudan could specialize

in agriculture, and Egypt could deliver know-how, management and workers, e.g., for harvesting. *Options* to enhance cooperation were seen as follows:

1. Politicians need to learn and shift their focus from national management to common utilization and management
2. Increased contact between people, politicians and legal advisors
3. Third-party actors such as the World Bank, CIDA and UNDP give the financial support and are important in getting people to sit together
4. Long-term projects involving different countries are needed. To increase security, these projects must be part of a treaty or an official agreement.

\* \* \*

*Ethiopian perceptions:* People interviewed in Ethiopia were less enthusiastic about the Nile Basin Initiative than in Egypt and Sudan, but they were increasingly more open to the basic idea of the initiative. Similar to Egypt, there are two schools. The “old” school is worried about selling out to Egypt and is mistrustful of international involvement. This mistrust in the international community comes partly from a history of having repeatedly been cheated and abandoned by the international community (e.g., Heile Selassie’s appeal to the League of Nations 1936 in Geneva that was not listened to). The “old” school of thought could also be called the “silent” school, as the basic stance is to not talk to downstream countries. This comes from an attitude that nothing can be gained from communication. When asked about obstacles to cooperation, one Ethiopian academic answered:

“If we knew the obstacles, we could solve the problem. The Egyptians think that all the water is theirs. There is a process of cooperation now, but politics in Africa are unstable, I am not too confident.”

Ethiopians are skeptical of the Egyptian offer to provide Ethiopia with know-how. Ethiopians perceive that any information exchange with the Egyptians could be used against them, rather than for the benefit of water development in Ethiopia (Ethiopian academic 2001). The “new” or “talking” school in Ethiopia sees the opportunity of international cooperation. There is hope that financial resources can be tapped, projects developed, and that a legal framework can be established. Ethiopia joined the multilateral NBI, motivated by the incentive to deal with legal affairs in the D3 project and not only to talk about technical issues, as in older multilateral forums (Arsano 2004). Like Sudan, the “new” school pushes for a more active stance of Ethiopia to develop its water resources, both on the international and national level. If the NBI fails, then Ethiopia will look for financial support elsewhere (probably in the East). *Options* to enhance international cooperation are seen:

1. Negotiating a Nile agreement acceptable to all
2. Developing HEP and irrigation
3. Watershed management to hinder soil degradation and erosion
4. Coordination of national water policies and developing master plans

*Comparison of perceptions:* While there is disagreement over historical agreements and large-scale irrigation upstream that could harm downstream countries, there is consensus on many other points, such as concerning HEP, small scale irrigation and other projects that do not harm any of the countries. Many of the options suggested in the interviews for enhancing cooperation are being implemented in the Nile Basin Initiative (table 7.2). The perceptions of the NBI are sufficiently compatible to enable cooperation. Where perceptions concerning the legal issues are incompatible, the process, not surprisingly, is developing at a slower pace. Egypt has agreed to discuss legal issues in the D3 project, even if it does not wish to negotiate a new Nile water agreement that would supersede the Agreement of 1959.

Perceptions of reality lead to different negotiation strategies. There is an apparent paradox between diagram 7.4, suggesting a trade-off between development and security, and the strategies that Ethiopia and Egypt are pursuing in the cooperative steps since 1999. According to diagram 7.4, based on the analysis of the different interests, Ethiopia is expected to seek development and offer security, and Egypt is expected to seek security and offer development. According to the reality on the ground, however, it seems that Ethiopia is seeking to negotiate a new Nile Basin agreement, a security issue, and Egypt is pushing for the project-by-project approach, a development issue.

The apparent paradox is partly clarified by considering that a legal agreement is not necessarily the only, or best, way to achieve security. From Egypt's point of view, negotiating a new Nile agreement is perceived as increasing Egypt's insecurity, rather than guaranteeing security. Thus Egypt is offering development while seeking to gain security through improved relations, a flexible institutional set-up and acceptance of the Agreement of 1959. The apparent paradox from Ethiopia's point of view is harder to clarify (at least from this study's downstream perspective, see Arsano (2004) for the upstream perspective). A new Nile agreement is seen as a means to access international investment for *independent* development on a long-term basis. A project by project development strategy is perceived as being too dependent on the good will of the downstream countries.

\* \* \*

*Comparison of BATNAs:* Cooperative behavior is also influenced by the alternatives a conflict party may have to cooperation. Egypt's best alternative to a negotiated agreement (BATNA) is to block development upstream through the conditions set by development banks or through undercover operations, or alternatively to create facts on the ground (*faits accomplis*) through large water development projects. Facts on the ground are a powerful card for future negotiations, one possible reason for Egypt's mega development projects. Nevertheless, these BATNAs are not very promising in the long term. In contrast a negotiated approach promises to enable Egypt to influence development upstream in such a way as to minimize the negative impacts downstream.

Ethiopia's BATNA consists in seeking bilateral funding for development which is not hindered by the conditions set by development banks, or to use its own economic

resources. With the USA protecting the interests of Egypt, the first BATNA is not very promising, and the second BATNA is only possible in the future with a stronger economy. The balance between accessing international development funds through cooperation without losing too much control over its national development will decide in the long term if Ethiopia will cooperate or not.

## 7.9 Conclusions

Cooperation in the late 1990s resulted from a shift from a “this before that” to a “this as well as that” approach. Egyptians accepted to discuss legal issues in the D3 project – a strong wish of the Ethiopians. Ethiopia accepted a project by project approach to cooperation which was propagated by the Egyptians. Ethiopia had long argued that it would only cooperate if Egypt first agreed to renegotiate the 1959 Agreement; and Egypt had long refused to discuss legal issues. When both countries accepted to work simultaneously on the two different issues (legal framework and projects), the door to cooperation was opened (Tamrat forthcoming).

Further “Lessons learned” from the Nile Basin Initiative process related to how countries can enhance cooperation for sustainable development are summarized below. Examples for each point are given in brackets.

1. *Multi-track communication*: Bring people together to discuss and exchange views at different levels: ministerial, technical assistance, official and non-official (official: Nile COM, Nile TAC, unofficial: Nile 2002 Conferences, Nile Discourse).
2. *Integrated and functionalist approach*: Use the complementary principles of an integrated approach as well as a step by step (project-by-project) approach (Shared Vision and Subsidiary Action Programs).
3. *Strategy of cooperation*: Cooperate where cooperation is possible despite differences in other areas. These “sticky” issues should not be ignored. A forum where they are discussed should be created to make sure work continues in these areas. Advances and breakthroughs in easy areas should not be linked to advances in difficult areas (e.g. sticky issues: Nile River Basin Cooperative Framework, dealt with in the D3 forum).
4. *Win-win “packages”*: Not each project has to be similarly beneficial to each country. Rather, all projects together form a win-win “package” where countries benefit from the overall win-win situation (Multiple projects in one NBI framework).
5. *Third-party coordination*: The international third party has to be coordinated to have a positive effect, both when it comes to financing and when it comes to doing different tasks by the different organizations (the Nile team includes the World Bank, UNDP and CIDA).
6. *Financial incentives*: Having cooperation as a condition for accessing international financial resources can act as an incentive to cooperate (ICCON meetings).

Table 7.2

	<b>Egyptian</b>	<b>Sudanese</b>	<b>Ethiopia</b>
HEP in Ethiopia?	yes	yes	yes
Small-scale irrigation in Ethiopia?	yes	yes	yes
Large-scale irrigation in Ethiopia?	<ul style="list-style-type: none"> <li>• yes, if it does not reduce the amount of 55.5 arriving in Egypt</li> <li>• Is terrain in Ethiopia suitable?</li> </ul>	<ul style="list-style-type: none"> <li>• yes</li> <li>• Is terrain in Ethiopia suitable?</li> </ul>	<ul style="list-style-type: none"> <li>• yes</li> </ul>
Diversion of Nile outside natural basin?	no	no	no
Acceptance of Agreement of 1959?	<ul style="list-style-type: none"> <li>• yes on Track 1</li> <li>• yes on Track 2</li> </ul>	<ul style="list-style-type: none"> <li>• yes on Track 1</li> <li>• yes &amp; no on Track 2</li> </ul>	<ul style="list-style-type: none"> <li>• no on Track 1</li> <li>• no on Track 2</li> </ul>
Discuss legal issues in D3 project?	yes	yes	yes
Negotiate a new Nile agreement	yes, if principle of “acquired rights” is accepted	yes, if principle of “acquired rights” is accepted	yes
Convention on the Non-navigation use of international watercourses	abstained	agreed	abstained
Win-win projects that benefit all and harm no one (NBI, Subsidiary action)?	yes	yes	yes
Obstacles to cooperation as viewed by the different countries	<ul style="list-style-type: none"> <li>• internal troubles in the upstream countries</li> </ul>	<ul style="list-style-type: none"> <li>• civil war in Sudan</li> <li>• economic and political instability</li> </ul>	<ul style="list-style-type: none"> <li>• downstream holding on to “status quo” of 1959 Agreement</li> <li>• economic and political instability</li> </ul>
Options to enhance cooperation as suggested by people interviewed in the different countries	<ul style="list-style-type: none"> <li>• share costs and benefits of different projects</li> <li>• share the increase in water from projects such as the Jonglei Canal</li> <li>• projects to use groundwater</li> <li>• models to preview impact of projects upstream</li> <li>• increase efficiency in irrigation, share increased amount of water</li> <li>• upstream reforestation and watershed management</li> <li>• upstream HEP</li> <li>• increase contact between politicians and legal advisors in the different countries</li> <li>• negotiate Nile agreement acceptable to all</li> <li>• coordination of national policies and master plans</li> <li>• third-party financial support from international organizations that also help bring different people together</li> <li>• long-term international projects within the framework of an agreement</li> <li>• look at all useable water resources when thinking about new shares</li> <li>• regional development and economic integration</li> </ul>		

*Similarities and differences in the Egyptian, Sudanese and Ethiopian perceptions*

7. *Balance of support and ownership*: Third-party support is important to assist communication and set financial resources free. On the other hand, the ownership of the process must remain in the hands of the involved parties. The right balance of external support and ownership by the involved parties is therefore essential (Balance between Nile COM and Nile Team).
8. *Comparative advantages*: Base development plans on the comparative advantages of the different countries involved (Ethiopia: HEP, Egypt: know-how, financial resources, Sudan: land for irrigation).
9. *Economic integration*: Aim at economic integration. Agreements over water issues alone do not guarantee peace; economic interdependence is more likely to ensure peace (ENSAP plan to have an international electricity grid).
10. *Patience and perseverance*: Cooperation needs time and perseverance. Don't expect fast results. Politicians who are cooperative and who persevere should be supported (media coverage of the NBI).

Chapter eight focuses in more detail on the first point, the Multi-track approach, as it was implemented in the Nile Dialogue Workshop. In order to place the above ten lessons learned from cooperation in the Nile Basin in a global context, the management efforts in the Nile are compared with those in the Rhine and Euphrates/Tigris in chapter 9. In chapter 10, the lessons learned are discussed in the context of the HEIT framework.



## 8 Nile Dialogue Workshop

One of the main goals of ECONILE was to support the ongoing cooperative efforts in the Nile Basin with an action research component, the Nile Dialogue Workshop. The methodological aim of the action research was to develop the Interactive Problem-Solving Workshop method by adapting and applying it in the context of an environmental conflict. Chapter three described the theoretical background and first planning phase (1<sup>st</sup> action research phase), evaluating the suitability of such a conflict management method to this conflict. Chronologically the workshop took place toward the end of the two PhD studies that served as preparation and reconnaissance for such a workshop. The explorative expert-interviews established a network of water experts, from which participants to the workshop could be invited. This chapter describes the workshop (2<sup>nd</sup> action research phase) and evaluates it (3<sup>rd</sup> action research phase) according to the criteria set up in chapter three.

Based on our contacts, we invited a water expert from Egypt, Ethiopia and Sudan, and asked this person to find a second water expert that could complement his/her background (invitation letter in appendix IV). The rationale for this was to have a team from each country that was put together by themselves, as it was important that they could work together. The criteria by which people were invited were their expertise, experience, their influence, closeness to the academic and official world, and openness to such a Dialogue Workshop. The six participants were: Atta El-Battahani, University of Khartoum; Imeru Tamrat, Consultant, Addis Ababa; Magdy Abd El-Moenim Hefny, University of Cairo; Osman Eltom Hamad, Ministry of Irrigation, Khartoum; Salah El-Din Mhmoud Fawzy Amer, University of Cairo; and Yacob Arsano, University of Addis Ababa. The two participants from each country were asked to jointly write an academic paper, answering the questions developed in chapter three<sup>5</sup>. These papers served as a starting point for the workshop, with the aim of thus exchanging knowledge and experience, clarifying issues and contributing to the ongoing cooperative efforts in the Nile Basin. The outcome of the experts' contribution and participation at the workshop was to be a joint academic publication. The participants' participation and contribution was made solely in their personal capacities and did not represent the views of any government or institution (see also the workshop program outline appendix V).

- 5 What are the interests and needs of your country concerning the use and management of water resources in the Nile Basin (minimum and maximum options)?
2. What does your country expect from international cooperation, and what is it prepared to offer in order to enhance cooperation?
3. Over which issues is there, from your point of view, a consensus between the three countries concerning the use and management of water resources in the Nile Basin?
4. What questions are still open?
5. What are the options to deal with these open questions?

The workshop was organized by the Swiss Federal Institute of Environmental Science (EAWAG) and the Center for International Studies (CIS-ETH Zurich). It was funded by the Swiss National Science Foundation and the Swiss Agency for Development and Cooperation in the framework of NCCR North-South, Research Partnerships for Mitigating Syndromes of Global Change, IP7 Environmental Change and Conflict Management<sup>6</sup>. The workshop was moderated by Günther Baechler, COPRET-SDC (Conflict Prevention and Transformation, Swiss Agency for Development and Cooperation), and Hansueli Müller-Yersin, OECONSULT. It was organized by Alexander J. B. Zehnder, EAWAG, and Kurt R. Spillmann, CIS. Simon Mason, CIS/EAWAG, coordinated and evaluated the workshop, Marwa Gouda, CIS, did the organization assistance.

The workshop on “Sustainable Development and International Cooperation in the Eastern Nile Basin” took place from the 27–30 August 2002 in Kastanienbaum, Switzerland. The workshop was located in EAWAG Kastanienbaum, on the shores of Lake Lucerne. The participants and moderators stayed in a hotel, on the opposite shore of Lake Lucerne, the participants met on the eve of the workshop in the hotel. At the initial dinner Kurt Spillmann welcomed the participants to the workshop and introduced all the participants. The after dinner hours were spent making personal contacts and renewing former acquaintances amongst the participants. Both in the mornings and in the evenings all the workshop participants and moderators were brought across the lake by boat to the EAWAG at Kastanienbaum.

## 8.1 Workshop Process

Alexander Zehnder introduced the participants and moderators to the EAWAG during the first morning. This was followed by the core interactive part of the workshop, initiated by the two moderators, Günther Baechler and Hansueli Müller-Yersin. Each morning and afternoon, sessions were separated by coffee breaks. Kurt Spillmann and Alexander Zehnder left the workshop after the first morning; Kurt Spillmann joined the participants for the excursion to a dam and a Swiss mountainous region on the third day.

As the aim of the workshop was interactive problem-solving, the program was interactively developed by the moderators with the participants, rather than imposed by the organizers or moderators (box 8.1). The moderators alternated the responsibility for different sessions of the workshop, the second moderator serving as a back-up when needed. A clear delineation of responsibilities clarified for the participants who was in charge of which process. The program roughly followed the phases: 1) introduction (1<sup>st</sup> morning), 2) presentation of country papers (1<sup>st</sup> afternoon, 2<sup>nd</sup> morning), 3) clarification of opportunities and challenges (1<sup>st</sup> afternoon, 2<sup>nd</sup> morning), 4) discussion of next steps (2<sup>nd</sup> afternoon).

<sup>6</sup> For more information see NCCR North-South, Research Partnerships for Mitigating Syndromes of Global Change, <<http://www.nccr-north-south.unibe.ch>> (02.02.2003).

## Box 8.1

<b>Nile Dialogue Workshop Program: Aiming at Interactive Problem-Solving.</b>			
<b>Arrival</b>	<b>First day</b>	<b>Second Day</b>	<b>Third day</b>
<i>Evening:</i> Opening supper, welcome speech by Kurt Spillmann	<p><i>Morning:</i></p> <ul style="list-style-type: none"> <li>• Introduction to EAWAG by Alexander J. B. Zehnder</li> </ul> <p><b>Phase 1, introduction:</b></p> <ul style="list-style-type: none"> <li>• Introduction to workshop by moderators: Günther Baechler, Hansueli Müller-Yersin</li> <li>• Discussion of program and workshop guidelines</li> </ul> <p><b>Phase 2, presentation:</b></p> <ul style="list-style-type: none"> <li>• Presentation of first paper</li> <li>• Discussion</li> </ul> <p><i>Afternoon:</i></p> <ul style="list-style-type: none"> <li>• Presentation of second paper</li> <li>• Discussion</li> </ul> <p><b>Phase 3, joint clarification</b></p> <ul style="list-style-type: none"> <li>• Collecting challenges and opportunities</li> </ul>	<p><i>Morning:</i></p> <p><b>Phase 2, presentation:</b></p> <ul style="list-style-type: none"> <li>• Presentation of third paper</li> <li>• Discussion</li> </ul> <p><b>Phase 3, joint clarification:</b></p> <ul style="list-style-type: none"> <li>• Discussion of mind-map based on collected challenges and potentials</li> </ul> <p><i>Afternoon:</i></p> <p><b>Phase 4, next steps:</b></p> <ul style="list-style-type: none"> <li>• Discussion of publication format</li> <li>• Discussion of next steps</li> <li>• Wrap-up by moderators, Günther Baechler, Hansueli Müller-Yersin</li> </ul>	<p><i>Whole day:</i></p> <p>Excursion to Rigi and Sihlsee Dam</p> <p><i>Evening:</i></p> <p><b>Farewell supper</b></p>

*Outline of the Nile Workshop program. The first morning was prepared by the moderators, the rest of the workshop program was developed together with the participants.*

While problem-solving phases are described in a linear fashion in the literature, they are often mixed in the real world; the process loops back, e.g. the presentation and clarification phases looped during the workshop (box 8.1).

A Dialogue Workshop is not a mediation, yet the Nile Dialogue Workshop indicates that there are certain similarities in any interactive problem-solving exercise, be this moderation, mediation or any other form of facilitation. The first three phases of the Nile Dialogue Workshop were similar to the first three phases of a mediation (section 3.2.1). The workshop reached a certain degree of clarification, but not sufficiently to jointly brainstorm new management options, as foreseen in the fourth phase of a mediation. The workshop involved non-polemical conflict analysis, more than the development of new ideas for conflict resolution. This is an indication that further workshops are needed, to deepen the clarification and perspective change between the parties. The similarity in phases between different problem-solving methods indicates that a problem cannot be solved consensually by any method before the parties experience a change in perspective, i.e. walk some miles in the other person's shoes.

During the first phase, the workshop guideline was proposed by the moderators, and adapted, agreed and adhered to by the participants (box 8.2). The framework helped create a space to discuss issues freely. The introduction and guidelines also recapitulated the aim of the workshop, a joint publication. Having a clear aim avoids the dialogue drifting without focus, while also setting the atmosphere. The atmosphere of the workshop was very relaxed and friendly.

*Box 8.2*

Nile Workshop Guidelines

1. Focus on the future. Understand the past and present to learn lessons for the future.
2. Chattam house rules, nothing said during the workshop will be quoted in public.
3. Any paper developed by the participants for the workshop or in the workshop is only published with consent of all the participants.
4. Focus on a joint product: a publication.
5. The workshop is evaluated in the framework of a Ph.D.

*The guidelines of the Nile Dialogue Workshop, proposed by moderators, and adapted and agreed to by the participants.*

During the second phase, the presentations of the participants were longer than originally planned, following the wish of the participants. Two of the participants also wished to have some extra time to prepare their presentation, the program was therefore adapted accordingly, resulting in the second phase looping with the third phase. The second phase allowed the participants to bring themselves into the process and state their countries' perceptions, positions, interests, needs and proposed management options. During the discussion of the presentations, the first interactions between the participants developed.

During the third phase, the interaction was more intensive. There was a creative brainstorming atmosphere while challenges and opportunities were collected. The moderators listed the issues mentioned, and the participants rated which issues they wanted to focus on. Based on this, a mind-map was developed and discussed in the second part of the third clarification phase (diagram 8.1). The mind-map proved to be a very valuable tool to visualize and integrate what the group had jointly produced. It allowed an overview of the opportunities and challenges, bringing both the issues as well as the participants closer together.

While perceptions of a conflict may be over-simplified, they may on the other extreme also become over-complicated and become lost in details. Visualizing issues on one image/mind-map can support a differentiated but not over-complicated perception of the situation. The second part of the third phase also raised some frictional issues. The group agreed that it did not want to be limited by the unresolved controversy of the legal issues. Participants felt that it was more productive to discuss opportunities and

points of consensus. Participants felt that the legal issues needed to be dealt with at a higher political level. Viewed negatively, this could be seen as avoiding the conflict, a manifestation of a “cold” conflict. Viewed positively, this can be viewed as the participants realizing that nothing is to be gained by going over the same positional debates again and again; more can be gained by focusing on solutions, on the future.

During the fourth phase, on the afternoon of the second day, the positive, solution-oriented outlook proved to be fruitful, as the discussion was lively and new ideas were developed on how to go about the publication. There was a discussion about the introduction to the joint publication and it was finally agreed that the participants would revise and correct the draft of the joint introduction and only agree to it at the end if they felt comfortable with it.

Diagram 8.1



Eastern Nile Mind- Map, challenges (left) and opportunities (right). Issues brainstormed and rated by the workshop participants, visualized by the moderators (on four flip-charts, therefore the small scale here).

## 8.2 Participants' Interaction

One of the main benefits of the workshop was that personal contacts were established and/or refreshed. Many of the participants had already met each other at past meetings and conferences, which formed an ideal basis for relationships during the workshop. Participants came from different disciplines: law, hydrology, economics, and political science. We invited participants from Track 2, as water experts in their personal capacity. Some of the participants were more involved with the Nile Basin Initiative process than others. The Interaction between participants of one country as well as between participants of different countries was very cordial. Cross-track diffusion of knowledge occurred during discussion when participants who were closer to the official NBI process interacted with those who were less involved and who viewed the process from a different angle. The tone of the participants was very friendly, even when points raised in the presentations were questioned. The spoken language seemed to be able to express more nuances than the written language, i.e. the oral presentations often had a more cooperative tone than some of the written excerpts in the country papers. Debates were carried out in a friendly bantering style. The entire workshop benefited from a very relaxed atmosphere, during which the small informal setting was helpful.

There were moments of recognition of different viewpoints, but never moments of changing one's position. Thus, the workshop helped to go into each other's territory of thought, but not to change the other person's thoughts. The differentiation of positions, interest and needs was not always explicit, but they were expressed, both in the draft publication as well as in the oral presentations and discussions. The participants were able to disagree about different issues, but not to make the disagreement a point of personal conflict. Thus the dictum: "be hard on the issues and soft on the people" was followed. Some stereotypical ways of seeing the other country were expressed. These were not addressed to the participants of the other countries, however, but to the country in general. Such statements were also corrected by the other participants.

One of the participant evaluations differed from the observer and moderator evaluation regarding the role of positional debates. The observer felt there were positional debates between the participants, whereas one of the participants felt the discussion was reflective and evaluative, rather than positional. One of the participants also wrote that:

"The participants were too careful about touching sensitive issues, to such an extent that the whole exercise sometimes made it appear that there were no problematic issues. It would have been good if some of the known problems and positions had been revisited with the help of the moderators."

This concerns how far the moderators should only facilitate dialogue, and how far they should also challenge participants to revisit sticky issues. The moderators clearly kept to the workshop aim and mandate by only facilitating. For future workshops, however, one could ask the participants what role they would like to give to the moderators.

### 8.3 Moderators Influence of the Process

The two moderators, Günther Baechler and Hansueli Müller-Yersin, took turns in moderating different program sections, and coordinated very well with each other. The moderators initiated certain subjects by posing them to the group in the form of program or content suggestions at the beginning of a session. The moderators did not stick to their suggestions if the group opted for a different approach. An important changing point that actively integrated the participants was the adaptation of the program according to their wishes. This enabled the ownership of the process to remain in the hands of the participants, supporting their empowerment. The moderators also supported empowerment and recognition by summarizing and visualizing points raised. The rated issue list and mind-map proved to be useful tools to structure and clarify the process. The moderators took participants' input into account, both during the session as well as during the breaks. The session moderator summarized the main points of the previous session at the beginning and end of a session, thus pointing to where the discussion was standing and clarifying issues. From an observer's point of view, the moderators seemed to be all-inclusive and even-handed with all the parties.

### 8.4 Comparison with HEIT Propositions

To what extent did the Dialogue Workshop follow, support or question the HEIT propositions (section 2.3)?

HEIT proposition 1: Some of the participants were, or had been, active participants in the official NBI process, others came from a purely academic field. Thus the multi-track approach was followed

HEIT proposition 2: The participants proposed a systems approach already in their papers, thus the moderators could enhance the systemic approach without introducing it as a new approach during the workshop. Participants agreed that many issues in the Nile Basin needed to be dealt with simultaneously rather than in a linear fashion. The systemic approach was not stuck to throughout, however, as arguments in the line of "first negotiation, then cooperation" or "first cooperation, and then renegotiation" did arise.

HEIT proposition 3: The approach of sharing the costs and benefits of joint projects, rather than sharing the resources, was raised mainly by the downstream countries. The Ethiopians seemed to agree that this approach may be an option in the short run, yet concerns were expressed that the approach would not guarantee their rights in the long run. The Ethiopian concern therefore seems to question the applicability of this HEIT proposition, rather than to support it.

HEIT proposition 4: Positions, interests and needs were stated by the participants. When more frictional issues arose, participants often fell back to more positional debating. The participants recognized the interests and needs of the other countries; the difficulty is to find acceptable principles on *how* to satisfy these interests when their satisfaction

could harm another country. The challenge of focusing on interests rather than positions is how to create a relaxed atmosphere while at the same time preventing parties from avoiding difficult issues.

HEIT proposition 5: There is no water agreement accepted by all countries in the Nile Basin, yet all the parties agreed that an acceptable legal framework would ease tensions. They also seemed to agree that the realization of this aim is still far off, yet this need not necessarily hinder cooperation.

HEIT proposition 6: Power symmetry between the Nile countries was not discussed in the workshop. The expertise and communication skills of the different participants created a power symmetry between the participants, allowing for constructive communication. All participants spoke excellent English and so language was not a problem.

HEIT proposition 7: Alternatives to negotiations were not discussed, this could be an interesting issue to follow up in a second workshop.

HEIT proposition 8 was followed by the workshop, as perceptions were the heart of the Dialogue Workshop approach. There were few instances of agreement with the other parties' perceptions of tricky issues, but there was acceptance of the different perceptions.

HEIT proposition 9: Even if the aim of sustainability was agreed on, the limits of dealing with the Nile in a long-term horizon were pointed out by the immense time pressure present in order to satisfy the needs of the growing populations. The need for basin-wide management was agreed to without reservations. The environment was specifically considered during a discussion on the environmental implications of water development projects in the wetlands of Sudan and Ethiopia. The potential impacts of such projects pointed to the need for further knowledge about the limited adaptive capacity of the environmental systems.

HEIT 10: Demand- and supply-side management was not explicitly mentioned. The need and difficulties of supply-side management were focused on more than those of demand-side management.

## 8.5 Conclusions and Outlook

The Nile Dialogue Workshop was evaluated with a triangulation approach, by the workshop observer (the author), one of the moderators (Hansueli Müller-Yersin, see Appendix II) and the participants (see appendix III). The three independent evaluations agree that the main benefit of the workshop was in the clarification of Nile water issues, exchange of knowledge and enhancement of relationships between water experts in the Nile Basin. The benefit of the workshop was expressed by two participants as follows:

“The benefit of the workshop was in bringing together people with long experience, different perceptions and who already knew of each other from their writing or from conferences. The main benefit is to enable the exchange of tacit knowledge

based on experience – that cannot be gained from books. The systems approach and mind map could be a leverage for next steps together. The mind map we developed created an image we could take home.”

“Participants had the opportunity to get to know the views of other researchers on the issues. This is a very useful feedback for future research.”

Somewhat different priority was given by the three different evaluations to the various factors influencing the success of the workshop, yet all three evaluations agree that the choice of participants, the informal setting and the facilitation by the moderators were key factors. Based on oral feedback at the end of the workshop, the success of the workshop was seen by the participants in: 1) The small number of participants; 2) The choice of participants and the fact that many of them had already met each other beforehand; 3) The informal atmosphere and helpful moderation; there was a focus on personal perspectives, rather than articulating national positions. It was helpful that there was no pressure to agree; 4) The facilitative venue and organization; and 5) The progress and good atmosphere in the workshop reflected the achievements on the ground in the Nile Basin in the recent years.

Participants clearly viewed the workshop as only one piece of the larger dialogue process occurring in the Nile Basin, and felt it was helpful because it was not isolated from this process. As part of the larger “dialogue accumulation” a follow up workshop was viewed as a good idea.

Ideas for a follow-up workshop included: 1) Meeting experts from other river basins, e.g. the Rhine River Commission. 2) Including further participants in such a workshop, depending on specific issues to be addressed. 3) The use of methods that enable in-depth work on specific questions. 4) Developing an exchange of academics and students between the Nile Basin countries, where a group of students and academics visit another country and are then visited in turn in their own country. This last idea could very well support the link between such academic exercise and the larger Nile Basin Initiative activities.

The main tangible outcome of the workshop was the joint publication, which will support the transfer and linkage of insights developed by the group to the larger context, making them available to academics and practitioners in the Nile Basin and other international river basins. The papers still have to be published, the extent of their impact cannot therefore be assessed yet.

The Nile workshop evaluation confirms the following lessons learned on workshop effectiveness (Roberts 2000). Dialogue projects require: 1) a long-term focus, 2) the correct choice of participants, 3) a long-term organizational input, 4) a stable institutional anchorage, 5) an ethically responsible third-party, 6) a broad and flexible theoretical and methodological basis, and 7) the transfer of workshop results to the meso-social level.

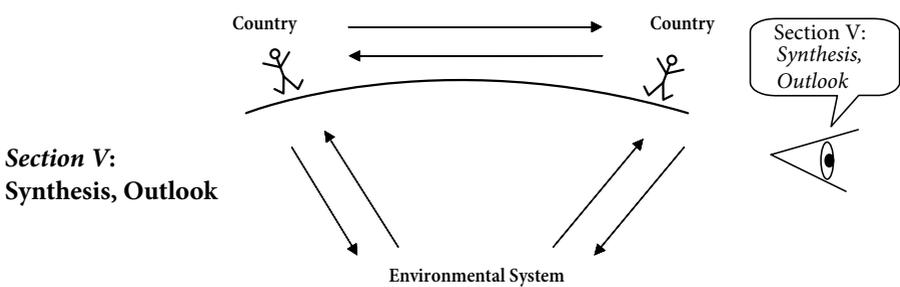
The approach of a joint conflict analysis by experts from different sides of the same conflict holds enormous potential to enhance an all-inclusive understanding of a conflict. Dialogue Workshops can create a setting for multi-track *and* cross-track conflict transformation to support a dialogue dispute culture between, as well as within, parties.



# Generalization, Synthesis and Outlook

In the last three sections we have explored the environmental, national and international aspects of water conflict management in the Nile Basin. The applied focus of this study was to support cooperation in the Nile Basin, the general knowledge gathered was to shed light on how large groups use scarce resources in a sustainable and peaceful way. In order to generalize, one can compare a specific case to a theory and/or to other cases. Chapter nine compares the lessons learned from the Nile case to other international river basins. Chapter ten attempts to synthesize our study, to grasp some of the interactions between the factors of the previous sections.

*Diagram V.I*



*Synthesis of our study, after having examined the Nile HEIT from different view points.*



## 9 Comparison of Nile, Rhine, Mekong, and Euphrates/Tigris

The Rhine, Mekong, and Euphrates/Tigris Basins are shortly compared in order to place the Nile in the wider global context of international river management. We do this by first evaluating the success of river management in these basins, we then attempt to explain success/failure using the criteria developed in the thesis.

### 9.1 Evaluation of Success

The following section evaluates the success of an international river basin management on three levels: the international, intra-national and ecological level. The questions evaluating success are:

1. Does the river management have a positive effect on easing tensions on the international level?
2. Does the management effort take the intra-national mitigation of conflicts into account, i.e., by not shifting the problem to the national or local level?
3. Does it enhance ecological sustainability?

Full success is assumed when a river management effort has positive impacts on all three levels. Partial success is given when one or two levels have been successfully addressed, and unsuccessful management is considered when none of the three levels experienced an improvement (table 9.1).

*Table 9.1: Measuring Success of an International River Management Effort*

Effect of management effort on:	Easing international tensions	Avoiding shifting the problem to the intra-national level	Enhancing ecological sustainability
Full success	+	+	+
Partial success	+	+/-	-
Unsuccessful	-	-	-

*Full success is given when the international, intra-national and ecology are taken into consideration. Key: - = dimension is not effectively dealt with in the management effort, + = dimension is effectively dealt with in the management effort.*

The following examples serve as an illustration. If we take these three levels to measure the success of different environmental conflict management efforts, the planned Jonglei Canal can be seen as partially successful, as it eased the international conflict between Egypt and Sudan by promising more water. According to the Egyptian perception, the canal was a preventive strategy seeking to mitigate the negative impacts of increased

water scarcity. The project did not take the intra-national level sufficiently into account, however. The “troubles” in Sudan have actually been the death-blow to this project so far, and the canal is viewed by some Sudanese as partly causing the troubles in Sudan (Suliman 1999). The effects on environmental sustainability have also been debated (Howell 1988).

Different bilateral initiatives between Egypt and other upstream countries can be seen as being partially or fully successful, as the projects seem to have a beneficial effect in all three dimensions. The smaller the water development project, the more manageable the impacts on the international, local and ecological dimension seem to be. For the Nile Basin Initiative, it is too soon to judge, but many people are optimistic that it will foster ecologically sustainable development on the international and local levels (Hamad 2000). On the international level it has been a success so far, as it has eased international tensions. The challenge will be to take intra-national conflicts sufficiently into account, especially in the case of projects to build canals through the wetlands, such as in the Gambela region in Ethiopia. A further challenge will also be to adequately take the long-term ecological sustainability dimension into account.

*Table 9.2: Success of Rhine, Nile, Mekong and Euphrates/Tigris compared*

Effect of management effort on:	Easing international tensions	Avoiding shifting the problem to the intra-national level	Enhancing ecological sustainability
Rhine <sup>4</sup> : full success	+	+	+
Nile <sup>2</sup> : partial success	+	-	?
Mekong <sup>3</sup> : partial success	+	-	?
Euphrates/Tigris <sup>1</sup> : unsuccessful	-	-	-

*Sources of assessment of rivers: 1) Ayeb 1998, Barandat (1997), Baradat, Mason, Ratsch (2001); 2) Mason, this study; 3) Mynt (2002b), Tun Mynt, email to the author August 2002; 4) Mynt (2002a), Marty (2000). Key: - = dimension is not effectively dealt with in the management effort, + = dimension is effectively dealt with in the management effort.*

Using the three dimensions above, one can argue that international cooperation in the Rhine Basin was fully successful, as international tensions were eased, intra-national “sacrifices” were taken care of, and the water quality of the river has improved (Mynt, 2002a). In absolute terms, of course, the pollution of the Rhine from non-point sources of pollution, such as fertilizers used in agriculture, means that the water quality of the Rhine is probably worse than that of the Nile, where industrial agriculture is not developed to a similar degree. Measuring success of management efforts, however, does not make sense in absolute terms, rather the change over a certain time period should be examined. In this relative sense, the management efforts in the Rhine have been more successful than in the Nile. Similar to the Nile, the Mekong River Commission can be viewed as partially successful, as international tensions have been eased. It is, however, less clear how far intra-national conflicts have been avoided and ecological sustainability has been taken into account. In the case of the Euphrates/Tigris, international cooperation is rudimentary, international tensions are still high. In addition, intra-national problems

related to water use have not been dealt with. Management is therefore seen as being unsuccessful (Ayeb 1998, Barandat 1997) (table 9.2.).

## 9.2 Explaining Success and Failure

Different factors are used to try and explain the success or failure of the Euphrates, Tigris, Nile, Mekong and Rhine Basin (table 9.3). Some of the factors are derived from this thesis (table 7.2), the others stem from river management and environmental conflict literature.

A basic differentiation can be made between context factors that are difficult to influence and proximate factors that are easier to influence. Context and proximate factors are explained and discussed in relation to the Rhine, Euphrates/Tigris, Mekong and Nile, and for comparison the factors are summarized in table 9.3.

The number of riparian states, the level of economic integration or the power balance between the riparian states are examples of context factors. The high level of economic integration in the Rhine Basin is one of the main factors why the river is managed successfully (Holtrup 1999, Shulte-Wülmer-Leidig, Wieriks 1997). Technological solutions can often be found to deal with pollution problems; it is harder to find technological solutions to solve the effect of irrigation, as water is consumed (Libiszewski 1999). The Rhine is mainly faced by a pollution flood and problem. This maybe another reason for its success, compared to the Euphrates, Tigris, Nile or Mekong, that all deal with irrigation challenges, and thus with potential scarcity (table 9.3). In theory, the number of riparian countries in a river basin has an influence on management success. Fewer riparian countries would seem to facilitate successful management as the dynamics between the riparian countries would be more transparent and straightforward – the more states involved, the more complex the situation. According to our four examples, however, this factor does not seem to be too relevant, as the Euphrates/Tigris basin has the least members, but is the least successfully managed. The type of relations seem more important than the number. The relations between countries of a shared river basin are characterized by the power symmetry between the countries, the rules and laws governing the relations, and by negotiations and other forms of communication. The power symmetry is considered as a context factor, as the geographical position (upstream or downstream) cannot be changed, and the economic capacity (GDP) can only be influenced slowly. Negotiations and rules, conversely, are considered as proximate factors, as they are malleable to management efforts.

Unlike context factors, proximate factors can be directly influenced by how an international river management initiative is designed and implemented. Marty (2001) argues that a functionalist, issue-specific approach to river management is more successful than an integrated, holistic river management. Biswas et al. (1997) and Falkenmark (2000) argue more for an integrative approach that takes issue linkages into account. This thesis argues for combining the strengths of both approaches. The issues-specific approach is

pragmatic and easy to implement. The integrated approach can prevent problems from being shifted to another field, different activities can be coordinated, the overall goal can be clarified, and a “shared vision” can motivate the participants to cooperate. All the river basins examined, except the Euphrates and Tigris, use a combination of an issue-specific and an integrated approach (table 9.3).

The coordination of third-party activities is given, or partially given, in all the basins. Until recently the Aral Sea Basin, in contrast, demonstrated a lack of coordination of the third party, one reason why management efforts were not more effective (Bosnjakovic 2000). Both in the Nile and the Mekong Basin, the members of the river management forum seem to have a high degree of ownership over the process. The Rhine River Commission’s ownership of process and activities increased over time and went hand in hand with an increased impact of the commission (Spillmann 2000, Marty 2001). Water conflicts are influenced by non-water conflicts in the area. In contrast to the Nile, Mekong or Rhine, the differences in the Euphrates, Tigris basin over water and non-water issues (e.g. the Kurdish question) appear to make cooperation over water much more difficult.

Using the comparative advantages of different countries in a river basin makes best use of the water from an economic point of view. A mountain country, for example, is better suited for HEP, while a country with large plains is more suited for irrigation. To some extent, all river basins follow this approach due to economic necessities, but national security considerations influence the degree to which comparative advantages of the different countries are actually used.

Patience, perseverance and taking perceptions into account are soft factors that are hard to measure. The Euphrates, Tigris Basin has had various attempts at a tripartite cooperative settlement between Turkey, Syria and Iraq; so far these have never lasted (Ayeb 1998, Barandat 1997, Sahan, Zogg, Gilli, Mason 2001). In the other river basins, initiatives accumulated and finally led to management forums. In the Nile Basin the perseverance of the people involved has greatly benefited the initiation of the Nile Basin Initiative. The high level of public involvement and the inclusion of stakeholders from official and unofficial sides seem to be one factor supporting the Rhine Commission (Holtrup 1999, Marty 2001). Civil society and public participation is not as developed in the other river basins.

The focus on demand-side management seems to be growing as water scarcity increases in all the river basins mentioned (table 9.3). In the Rhine, pollution is still often dealt with in an end-of-pipe manner in the form of sewage treatment facilities, rather than by minimizing the source of pollution, however.

*Table 9.3: Factors Explaining Success/Failure of the Euphrates/Tigris, Nile and Rhine Management.*

<i>Context (difficult to influence):</i>	Euphrates, Tigris Unsuccessful <sup>1</sup>	Nile, partial success <sup>2</sup>	Mekong, partial success <sup>3</sup>	Rhine Full success <sup>4</sup>
Level of economic integration: the higher, the better <sup>f</sup>	low	low	medium	high
Level of economic development: the higher, the better <sup>f</sup>	low	low	lower medium	high
Power balance (geographic, economic, political): the more balance, the better <sup>a</sup>	not given	partially given	not very balanced	given
Non-environmental conflicts: the less, the better <sup>b</sup>	<ul style="list-style-type: none"> <li>• Kurdish problem</li> <li>• regional hegemony</li> </ul>	<ul style="list-style-type: none"> <li>• foreign support of internal opposition</li> <li>• regional hegemony</li> </ul>	<ul style="list-style-type: none"> <li>• regional hegemony</li> </ul>	none
Hydroelectric power (HEP) and pollution effects are easier to manage than water quantity (irrigation) effects <sup>b, a</sup>	HEP, pollution and irrigation effects	HEP, pollution and irrigation effects	HEP, irrigation effects, fishing, (seasonal requirements), pollution	pollution
Number of Riparian countries: the lower, the better <sup>e</sup>	4	10	6	9
<b><i>Proximate Factors (possibility of influencing):</i></b>				
Integrated and / or issue specific management: Integrated is better, issue specific is easier <sup>a, e</sup>	none	integrated and issue specific	integrated and issue specific	integrated and issue specific
Coordination of third-party funding, financial incentives to cooperate <sup>a</sup>	no	yes	yes	partially, from EU
Balance of third-party support and ownership of process by the involved parties <sup>a</sup>	partially	arranged by choice of member states, funding incentives	arranged by choice of member states, funding incentives	partially applicable
Cooperation despite differences <sup>a</sup>	no	yes	yes	yes
Use comparative advantages of the countries <sup>a</sup>	partially given	partially given	partially given	partially given
Patience, perseverance and fair media coverage <sup>a</sup>	not given	partially given	partially given, of member states	yes
<b>Multi-track diplomacy</b> <sup>g, a</sup>	<b>not given</b>	<b>given</b>	<b>partial</b>	<b>given</b>
Public involvement <sup>e</sup>	not given	minimal	medium	given
Focus on interests rather than positions <sup>c</sup>	not given	yes, e.g. Nile Basin Initiative	partially, e.g. Mekong Action Plan	yes, e.g. Rhine Action Plan
Share cost and benefits of resource use, rather than resource itself <sup>d</sup>	no	partial	partial	yes
Demand-side management (efficiency increase) <sup>a</sup>	not given	not given	minimal	minimal
Functioning river commission	no	transitional mechanism	yes	yes
<b>Legal framework exists</b> <sup>a</sup>	<b>no</b>	<b>no</b>	<b>yes</b>	<b>yes</b>
<b>Strong ecological sustainability (time, space, carrying capacity)</b> <sup>a</sup>	<b>not given</b>	<b>aimed at</b>	<b>aimed at</b>	<b>aimed at and in good progress</b>

*Sources of criteria: a: chapter seven, section on lessons learned from NBI, and four HEIT indicators (marked bold) b: Mason & Spillmann 2003, c: Fisher, Ury, Patton 1991, d: Wolf 2000, e: Marty 2001, f: Durth 1996, g: Trondalen 1997, h: Libiszewski 1999. Sources of assessment of rivers: 1: Ayebe 1998, Barandat 1997, Baradat, Mason, Ratsch 2001, Sahan, Zogg, Gill, Mason 2001, 2: Mason, this study, 3: Mynt 2002b, Tun Mynt, email to the author August 2002, 4: Mynt 2002a, Marty 2000, Holtrup 1999, Shulte-Wülmer-Leidig, Wieriks 1997.*

Sharing the cost and benefit of resource use is often more flexible than sharing the water itself, not least of all because the natural flow fluctuates. A cost and benefit approach also goes hand in hand with a focus on interests, rather than on incompatible positions. Only when at least some of the interests are taken into consideration and satisfied, will countries participating in an international river management effort speak of success, such as in the Rhine, Nile and Mekong Basins. The Mekong Commission seems more successful than the Nile concerning the legal status, as it has a legally binding agreement. Not all countries of the basin are active members, however, China and Burma have an observer status only (Mynt 2002b). Where there is a functioning international river commission, strong ecological sustainability is often given as an aim. In the case of the Rhine the aim has partially been reached, as shown by the return of the salmon (Holtrup 1999, Shulte-Wülmer-Leidig, Wieriks 1997, Mynt 2002a).

### 9.3 Conclusions

According to the criteria developed in section 9.1, the environmental conflict management efforts in the Euphrates/Tigris river are unsuccessful, in the Nile and Mekong they are partially successful and in the Rhine they are fully successful. The four HEIT indicators (power symmetry, multi-track conflict management, existence of a legal framework and the human-environmental fit) are used as a simple test of how far the HEIT hypothesis can explain the success/failure assessed in table 9.2:

- In the Euphrates/Tigris basin there is no power symmetry, minimal multi-track conflict management, the human-environmental fit is not given, and there is no legal framework (0/4 indicators fulfilled).
- In the Nile basin, power symmetry is given, multi-track conflict management is given, there is a partial human-environment fit (all countries represented in the NBI), but there is no legal framework (3/4 indicators fulfilled).
- In the Mekong basin, power symmetry is not given (China is relatively more powerful), multi-track conflict management is given, there is a partial human-environment fit (all countries are represented as active members or observers (China and Burma have observer status) in the Mekong River Commission), and there is a legal framework (3/4 criteria fulfilled).
- In the Rhine basin, power symmetry is given through regional economic integration, multi-track conflict management is given through participation of civil society, there is a partial human-environment fit (all countries of the river basin are involved in the Rhine River Commission as active members or observers), and there is a legal agreement (soft and hard laws) (4/4 criteria fulfilled).

The explanatory scope of the HEIT indicators should not be overestimated, yet these four examples support the HEIT hypothesis. Using a larger sample of river basins and making the HEIT hypothesis more operational is a task of further research. The role of

in-depth case studies is to have an applied problem-solving value, to point out important variables, to generate hypotheses, and only to a minimal degree to test these hypotheses. The role of larger comparative studies is then to test these hypotheses in order to increase the generality of the research findings.



## 10 Synthesis and Outlook

The first section of this chapter examines the strengths and limitations of our methodology in order to clarify its implications for conflict research. A synthesis of the core issues of this study is then carried out, focusing on the interaction between national and international water management, and the implications of this on cooperation over the waters of the Nile. The synthesis leads up to the outlook, which concerns a framework of cooperation in the Nile Basin (diagram 10.1).

### 10.1 Strengths, Limits and Implications of the ECONILE Methodology

The ECONILE approach was suited to dealing with the ECONILE goals (supporting cooperation and researching environmental conflict management) because it: 1) combined conflict management with science, 2) used a joint upstream/downstream approach, 3) had an action research component, and 4) used a participatory research method.

Combining the strengths of conflict management that deal with a specific real-world problem and take perceptions seriously, with the strengths of science to produce objective knowledge, makes use of synergies. Objectivity gains a new flavor in this context; it does not exclude the subjectivity of human perceptions, but rather seeks to portray the different perceptions in an even-handed way, not favoring one viewpoint above another. Conflict research concerned with a specific case can: 1) produce knowledge applicable to the management of a specific conflict, 2) develop conflict-sensitive research methods, 3) trace causal mechanisms, and 4) point out variables to be examined in comparative studies. Its weakness is its limited generality. In contrast, conflict research that compares few variables between a large number of cases can lead to greater generality and test causal effects, yet it has fewer real world implications for the management of a specific conflict. The HEIT model proved to be a useful tool for our study, as it combined the systemic nature of conflict management, with the needed structure and focus of conflict research.

An independent but coordinated upstream/downstream study design is a way of carrying out conflict-sensitive research in an international river basin. Two researchers working on one case study from different angles can contribute to understanding different positions, interests and perceptions, and thus encourage communication and cooperation. A constructive working relationship between the two researchers is a prerequisite for success. Based on the ECONILE experience, the following reiterative process for conflict-sensitive research is suggested:

- 1) Two researchers independently seek to understand the interests and perceptions of the different parties involved in the conflict, each researcher focusing on one of the conflict parties.
- 2) The two researchers meet and confront each other in endless (but very enjoyable!) discussions, where the interests and perceptions they have learned to understand are compared with each other; differences and similarities are clarified.
- 3) The researchers go back to the field, rechecking open questions with the people directly involved. Differences can be fine-tuned, and arguments on one side of the conflict can be balanced with arguments on the other side of the conflict.

The action research component of ECONILE contributed to dialogue accumulation in the Nile Basin and showed that the Dialogue Workshop Method can be applied to an environmental conflict. The strength of developing a joint publication in a Dialogue Workshop is: 1) to combine both “soft” (e.g. perceptions) and “hard” (e.g. figures of water availability) factors. The nuances and flexibility of oral communication complement the factual clarity of a written academic document; 2) A publication can enhance the transfer of workshop results to the larger academic and political audience; and 3) A conflict assessment developed jointly by representatives from different sides of a conflict creates an all-inclusive view, an invaluable base document for practitioners and scientists dealing with a specific conflict. The cross-track aspect of Dialogue Workshops can play an important role in supporting the development of networking, knowledge diffusion, an increase in questions and options raised, and enhance long-term acceptability of solutions. The effectiveness of multi-track conflict management could be enhanced by focusing more on the cross-track dimension, i.e. the dynamics within each conflict party. Dialogue Projects require a lot of coordination and time, which is one of their limiting factors. Another limiting factor concerns the power asymmetry between the parties. The depth a workshop can reach is influenced by the level of escalation, the choice of participants and/or the number of workshops. A shift from positioning to clarification to brainstorming management options can happen with a few workshops in a low escalated conflict, or with many workshops in a highly escalated conflict.

The strength of conflict-sensitive, explorative expert-interviews lies in: 1) their participatory nature, 2) their focus on perceptions, and 3) their applicability to real world problems with relevance for conflict management. This kind of interview enables people directly involved in a conflict to participate in conflict analysis. Any outcome that is developed through such a participatory approach is more applicable and acceptable, as the outcome is implemented by the same people who will be affected by it. The method is not suitable for generalizing reality. Besides the three main principles of conflict-sensitive research methods (1. transparency, accountability, 2. working with researchers on the other side, 3. ensuring the safety of those involved), any further development of conflict-sensitive methods needs to focus on how to strengthen the participatory approach. This holds both for conflict analysis and conflict management, as the subjective reality affects the objective reality, and because a solution to a conflict cannot be

successfully and sustainably imposed by outside actors. The strengths and limits of the participatory approach<sup>1</sup>, e.g. in relation to the level of escalation of a conflict, need to be explored in greater depth.

## 10.2 Interaction between National and International Water Management

The national water management approaches in Egypt, Ethiopia and Sudan are characterized by similarities as well as by differences, both affecting international relations in the basin. In all three countries, water resource management results from a balance between a food self-sufficiency policy and an export-orientated policy (e.g. cotton, coffee), linked with a relatively high degree of state intervention in the economy. All three countries of the Eastern Nile Basin aim at, and have partly implemented, a market-oriented economy. Water resource management in these three countries is as much influenced by social, political and cultural aspects, as it is by economic considerations. International cooperation can make better use of the comparative advantages of the three countries (e.g. large-scale irrigation in the low lands, small-scale irrigation and HEP in the highlands), but water cannot be allocated between the three countries purely according to the highest economic return rate, as this would cause social and cultural disruption.

The greatest difference between the three countries concerns Egypt's present shift to demand-side management, while Ethiopia is only just beginning to implement supply-side management. The different management practices involve making better use of existing water withdrawal downstream, and withdrawing water upstream to make use of it. Both approaches need to maximize benefit per unit of water consumed. Differentiating between water consumption and withdrawal can decrease international tensions. Egypt is not concerned about Ethiopia withdrawing more water, rather it is concerned about the amount of water consumed.

Water development in the Eastern Nile Basin is as much, or even more, affected by the limited success of the respective national water management practices as it is by international tensions. The limited success of mega development projects in Egypt results from internal economic constraints, rather than from international pressure from the upstream countries. The limited formulation and implementation of Sudan's and Ethiopia's water policy is primarily caused by internal economic and political constraints, and only secondly by the limited access to international development money, that can be blocked by Egypt. The failure on the national level to unilaterally implement projects consuming vast amounts of water has prevented the international conflict from escalating, but has not solved the conflict. Alarmist literature of the 1980s and 1990s, that forecast conflicts in the Nile based on what the countries said they would do, did not

1 Hirsch (2003) points to the "participatory fallacy" (the exaggerated belief in stakeholders' capacity to solve problems), a tendency of applied social sciences; and the "optimization fallacy" (the exaggerated belief in efficiency and economy, irrespective of other human needs), a tendency amongst engineers and economists.

give enough consideration to what the countries actually could do due to the difficulties faced by national development. The slow unilateral national progress seems to have been an incentive to encourage international cooperation. It is hoped that the internationally coordinated development of water resources – using international financial support – will support national water development, especially in the upstream countries. Success in international cooperation is not primarily important to avoid violent international conflict, but rather to ease long-standing international tensions and support national development. International cooperation can thereby help mitigate poverty, unemployment and internal conflicts on the national level (with international spill-over effects) resulting from the present state of economic under-development. The transformation from conflict to cooperation entails a movement from unsuccessful unilateral development to internationally coordinated development.

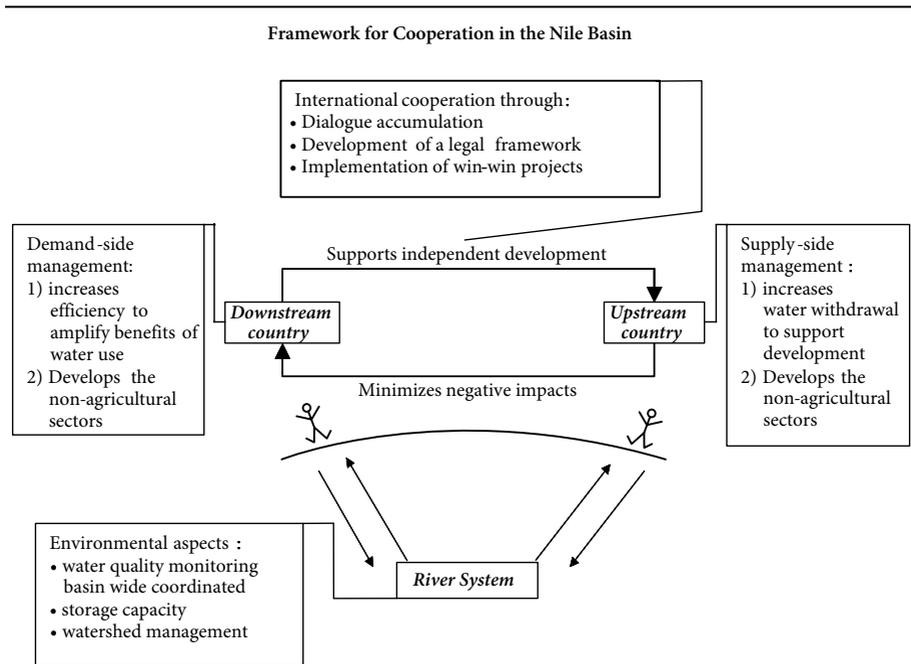
Ethiopia and Sudan seek to formulate and implement a national water policy and benefit from international cooperation in order to gain access to financial support to make use of their water resources. Egypt seeks to increase efficiency on the national level and benefit from international cooperation to implement supply-side projects upstream (in Sudan and Ethiopia) and secure its present use of water. The Nile riparian countries seek both physical and legal/institutional benefits from cooperation. Physical benefits include hydroelectric power production, irrigation, flood control, supply-side projects and watershed management projects. Institutional/legal benefits for the upstream countries involve more control over their development, for the downstream countries it consists of securing their present supply of water.

Since 1999, within the framework of the Nile Basin Initiative, the chances that the Nile riparian countries can benefit from international cooperation have increased. This transformation from conflict to cooperation in the Nile Basin is, amongst other factors, a result of multi-track dialogue accumulation, coordinated third-party assistance, projects to satisfy the interests of development, ongoing discussion of legal issues to satisfy the interests of security, win-win potential of using the comparative advantages of the three countries, and the combination of an integrated (holistic) and functionalist (step-by-step) approach to river management. Context factors enabling this cooperative process include a certain degree of power symmetry (economic, political and environmental) between the three countries, and the end of the Cold War, which enabled the countries of the Nile Basin to no longer be aligned in different ideological camps. The Nile Basin is an example of how communication can lead to cooperation if there is a certain degree of power symmetry, and the BATNAs are low and the WATNAs high. The dialogue process takes time, perseverance is needed as insights accumulate and lead to breakthroughs. An environmental factor supporting this process was the downstream realization that upstream water development projects do not have as detrimental of an impact downstream as was long believed.

### 10.3 Outlook: A Framework for Cooperation in the Nile Basin

The following possible framework for cooperation in the Nile Basin is based on the above synthesis, combining aspects of the HEIT model with the trade-off aspect of diagram 7.4. The difference between water withdrawn, consumed and efficiently used is the key to national water management (diagram 10.1). Water withdrawn is not equal to water consumed. Neither is water efficiently used equal to water withdrawn. In other words, Ethiopia withdraws more water, minimizing consumption, and Egypt uses water more efficiently, minimizing the amount of water it needs to withdraw. The development of the industrial and service sectors in the long term eases the pressure on the finite resources of the Nile. Agriculture remains important, but the economies diversify, and off-farm opportunities are created. On the international level, increased confidence resulting from communication and concrete win-win projects on the ground (e.g. HEP, irrigation, watershed management) are institutionalized in a flexible legal framework.

Diagram 10.1



*Outlook on a possible framework for international cooperation and sustainable development in the Eastern Nile Basin.*

The linkages between the international, national and local levels are taken into consideration by the legal framework and project implementation, so that conflicts and problems are not shifted from one level to another. The Nile Basin Commission monitors the water quality and coordinates water storage. Upstream countries are committed by the legal framework to minimizing the negative impacts of water development on the downstream countries, and the downstream countries are committed to maximizing the independent development of the upstream countries (diagram 10.1). Downstream development is not hindered, and the upstream countries' options to develop in the way they wish are increased.

#### **10.4 Global Significance**

In the year of water, 2003, there are many research reports and much media coverage on the topic of the dramatic challenge facing humanity over scarce water resources. These research findings support the severity of the challenge. Our research findings contradict one aspect of many of these reports, however, and this concerns the human adaptive capacity to deal with these challenges. The glass is half full, not half empty. The challenge is enormous, yet the potential of human beings to deal with these challenges is even greater. Interactive cooperation is one of the keys to sustainable development.

# Bibliography

- Abbas, Mohamed Mustafa, 2000. Environmental Aspects and Social Impacts of Nile Water Management. VIII Nile 2002 Conference, Addis Ababa June 26-29, 2000.
- Abdella, Hassan Abdella Achmed, 2001. Speech at a conference on "Peace Through Development Along the Nile Valley in the Framework of a New Just World Economic Order" of the Center for Strategic Studies in Collaboration with the Ministry of Culture and Information and the International Schiller Institute, Hotel Palace, Khartoum, Jan. 16, 2001.
- Abrams, Len, 2000. Water Resource Management Reform Process, Water Policy International, <[http://www.thewaterpage.com/water\\_sector\\_reform.htm](http://www.thewaterpage.com/water_sector_reform.htm)> (17.06.2003).
- Abrams, Len, 2001. Water Resource Management Policy, Guidelines for the Preparation of a Water Policy Document, Water Policy International, <[http://www.thewaterpage.com/policy\\_doc\\_prep.htm](http://www.thewaterpage.com/policy_doc_prep.htm)> (17.06.2003).
- Abu Zaid, Mahmoud (Minister of Irrigation and Water Resources), 1999. Future stakes, interviewed by Maye Ostowani, Al Ahram Weekly, <<http://www.ahram.org.eg/weekly/1999/415/bfair4a.htm>> (11.07.2002).
- Abu Zeid, Ahmed, 2001. Food, Rural and Agricultural Policies in Egypt, Mediterranean Agronomic Institute of Bari, Italy, <<http://www.iamb.it/ciheam/report/egitto.html>> (17.06.2003).
- Abu Zeid, Mahmoud A. & F. Z. El-Shibini, 1997. Egypt's High Aswan Dam. In: Water Resources Development, Carfax, Vol. 13, No. 2, pp 209-217.
- Abu Zeid, Mahmoud, 1987. Environmental Impact Assessment for the Aswan High Dam. Water Research Center, Ministry of Irrigation. In: Asit K. Biswas & Qu Geping (eds.). Environmental Impact Assessment for Developing Countries. London, pp 168-190.
- Abu Zeid, Mahmoud, 1991. Planning for Groundwater Development in Arid & Semi-Arid Regions, Research Institute for Groundwater (RIGW), Dutch Consultants for Water and Environment (IWACO), Roundtable Meeting, Cairo, Rotterdam October 5-9, 1991.
- Agreement, 1959. Agreement between the Republic of the Sudan and the United Arab Republic for the Full Utilization of the Nile Waters Signed at Cairo Egypt, 8 November 1959 [Law]. Food and Agriculture Organization, Available from <<http://www.fao.org/docrep/W7414B/w7414b13.htm>> (17.06.2003).

- Ahmed, Faki El Mahdi, 1994. A Comparative Study of the Water Quality of the Blue and White Niles at Khartoum State, Institute of Environmental Studies, University of Khartoum, B.Sc. Thesis.
- Ahmed, Medani Mohamed M., 1993, Development of Agriculture in the Sudan: an annotated bibliography with an introductory essay. Institute of African and Asian Studies, University of Khartoum, P.O. Box 321, Khartoum, Sudan.
- Ahram Weekly, Mahmoud Bakr & Sherine Nasr, 1999. Awakening to the Environment, Cairo 3-9 June 1999, <<http://www.ahram.org.eg/weekly/1999/432/intview.htm>> (02.07.2001).
- Ali, Osman Mirghani, 2003. Lecturer at the Institute for Environmental Studies, University of Khartoum, in an email to the author, June 25.
- Allan, J.A., 1997. "Virtual Water": A Long-term Solution for Water Short Middle Eastern Economies? Paper presented at the 1997 British Association Festival of Science, University of Leeds, UK, 9. September 1997.
- Allan, Tony & Alan Nicol, 1998. Water Resources, Prevention of Violent Conflict and the Coherence of EU Policies in the Horn of Africa. London: School of Oriental and African Studies (SOAS).
- American Heritage Dictionary of the English Language, 2000. Fourth Edition, Houghton Mifflin <<http://www.dictionary.com>> (10/12/2002).
- Anderson, Mary & Lara Olson, with Kristin Doughty, 2003, Confronting War, Critical Lessons for Peace Practitioners, The Collaborative for Development Action, Inc. Cambridge, MA. <<http://www.cdainc.com/rpp/publications/confrontingwar/ConfrontingWar.pdf>> (12.01.2004).
- Aquastat database, FAO's Information System on Water and Agriculture, <<http://www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm>> definitions: <<http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/regions/neast/index3.stm>> (17.06.2003).
- Aquastat, 1995. Country Profile Ethiopia, FAO's Information System on Water and Agriculture, <<http://www.fao.org/ag/AGL/aglw/aquastat/countries/ethiopia/index.stm>> (12.12.2002).
- Aquasat, 1997a. Country Profile Egypt, FAO's Information System on Water and Agriculture, <<http://www.fao.org/ag/AGL/aglw/aquastat/countries/egypt/index.stm>> (10.11.2001).
- Aquastat, 1997b. Country Profile Sudan, FAO's Information System on Water and Agriculture, <<http://www.fao.org/ag/agl/aglw/aquastat/countries/sudan/>> (12.12.2002).
- Arabic News, 1997. Khartoum Might Seek Arab League Intervention in Differences with Egypt, 10.13.1997, <<http://www.arabicnews.com/ansub/Daily/Day/971013/1997101301.html>> (10.07.2002).
- Arabic News, 1998. Egypt Seeks Self-sufficiency in Wheat to Lessen Dependence on US <<http://www.arabicnews.com/ansub/Daily/Day/981102/1998110235.html>> (10.01.2002).

- Arabic News, 1999. Mubarak Says Israel Will Not Get Nile Water. Egypt-Israel, Politics 1/23/1999, <<http://www.arabicnews.com/ansub/Daily/Day/990223/1999022312.html>> (10.07.2002).
- Arabic News, 2002: First Stage of Toshki to be Inaugurated, Egypt, Economics, 1.2.2002 <<http://www.arabicnews.com/ansub/Daily/Day/020102/20020102235.htm>> (10.01.2002).
- Arabic News.Com, 2002. Egypt Makes Final Push on Desert Reclamation 'Megaproject' January 13, 2002 <<http://www.arabia.com/egypt/business/article/english/0,5127,20221,00.html>> (10.12.2002).
- Arsano, Yacob, 2004. Ethiopia and the Nile, Dilemma of National and Regional Hydropolitics, Ph.D. thesis, University of Zurich.
- Atteslander, Peter, 1995. Methoden der empirischen Sozialforschung. Berlin.
- Attia, Fatma Abdel Rahman, 1999. Water and Development in Greater Cairo (Egypt). Research Institute for Groundwater, The National Water Research Center, Ministry of Public Works and Water Resources, Kanater, Egypt, <<http://www.cidob.org/Ingles/Publicaciones/Afers/45-46abdel.html>> (17.06.2003).
- Austin, Alexander; Martina Fisher & Norbert Ropers, 2001. The Berghof Handbook for Conflict Transformation, Berghof Research Center for Constructive Conflict Management, Berlin, <<http://www.berghof-center.org/handbook/>> (19.08.2002).
- Awad, Omar M. El Awad & Sidding E. Ahmed, 1999. Economic Reforms of Sudan Irrigation Sub-Sector & Impact on Water Use. Irrigation Cooperation and Ministry of Irrigation and Water Resources. In: Proceedings, 7th. Nile 2002 Conference, Cairo March 15-19, 1999 P1a.2.
- Ayeb, Habib, 1998. *Leau au Proche-Orient, La guerre n'aura pas lieu*. Karthala-CEDEJ (Centre d'études et de documentation économique, juridique et sociale).
- Ayman, El-Sayed Abd El-Wahab, 2001. River Nile Water and Egyptian Sudanese Ties. In: African Perspective, Fifth Issue, <<http://www.sis.gov.eg/public/africanmag/issue05/html/enafr02.htm>> (28.07.2002).
- Azar, Eduard, 1990. The Management of Protracted Social Conflict: Theory and Cases, Dartmouth Publishing, United Kingdom.
- Baechler, Günther; Volker Böge; Stefan Klötzli; Stephan Libiszewski & Kurt R. Spillmann, (eds.), 1996a. *Ökologische Konflikte in der Dritten Welt und Wege ihrer friedlichen Bearbeitung*. 1 ed. 3 vols. Vol. 1, Environmental Degradation as a Cause of War. Ruediger, Zürich.
- Baechler, Günther & Kurt R. Spillman, (eds.), 1996b. *Regional and Country Studies of Research Fellows*. 1 ed. 3 vols. Vol. 2, Environmental Degradation as a Cause of War. Ruediger, Zürich.
- Baechler, Günther & Kurt R. Spillmann (eds.), 1996c. *Country Studies of External Experts*. 1 ed. 3 vols. Vol. 3, Environmental Degradation as a Cause of War. Ruediger, Zürich.

- Baechler, Günther (ed.), 2002. Promoting Peace, The Role of Civilian Conflict Resolution, Staempfli Publishers, Bern.
- Baechler, Günther, 1999. Violence Through Environmental Discrimination: Causes, Rwanda Arena, and Conflict Model, Kluwer Academic Publishers, Dordrecht.
- Baechler, Günther, 2000. Environmental Degradation and Acute Conflicts as Problems of Developing Countries. Paper Presented at the International Workshop Within the Framework of the ‚Forum Globale Fragen‘, Berlin 15-16 June, 2000.
- Baechler, Günther, 2001. Conflict Transformation Through State Reform. In: Austin, A., Fisher M., Ropers, N. (ed.), The Berghof Handbook for Conflict Transformation, Berlin <<http://www.berghof-center.org/handbook/baechler/final.pdf>> (27.09.2002).
- Baechler, Günther, 2002. Lecture at the Modular Training in Mediation, Mediation in der internationalen Zusammenarbeit und humanitären Hilfe. Norbert Ropers & Günther Baechler, 17-21 June 2002, Schloss Hünigen.
- Baechler, Günther; Kurt R. Spillmann & Mohamed Suliman (eds.), 2002. Transformation of Resource Conflicts, Approaches and Instruments, Peter Lang, Bern.
- Baechler, Günther; Stefane Bellwald & Mohamed Suliman, 1996. Environmental Conflict Management, Approaches and Implications in the Horn of Africa. ECOMAN Working Paper, Swiss Priority Program Environment (SPPE), Bern, Zurich, 1996.
- Barandat Jörg; Simon Mason & Ulrich Ratsch, 2001. Jordan, Euphrat, Nil: Konflikt oder Kooperation? In: Reinhard Mutz; Bruno Schoch & Ulrich Ratsch (eds.). Friedensgutachten 2001, Lit Verlag, Münster, Hamburg, London pp. 85-94.
- Barandat, Jörg (ed.) 1997. Wasser - Konfrontation oder Kooperation, ökologische Aspekte von Sicherheit am Beispiel eines weltweit begehrten Rohstoffs. Nomos Verlagsgesellschaft, Baden-Baden.
- Barnett, Jon, 2001. The Meaning of Environmental Security: Ecological Politics and Policy in the New Security Era, Zed Books, London.
- Behery, Al, Nihal, 1997. Pussycat on the Nile. Egypt Adjusts its Hopes for Tiger Status in the Global Economy, Cairo Times, 25. December 1997 <<http://www.cairotimes.com/content/issues/ecref/pussy22.html>> (10.12.2002).
- Belay Tegene, 1992. Erosion: Its Effects on Properties and Productivity of Eutric Nitosols in Gununo Area, Southern Ethiopia, and some Techniques of its Control, Geographica Bernensia, Berne. African Studies Series 9. 176 pp.
- Bercovitch, Jacob (ed.), 1996. Resolving International Conflicts, Colorado.
- Berman, M. & J. Johnson (ed.), 1977. Unofficial Diplomats. New York: Columbia University Press.
- Bernard, Russel, 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches, Sage publications, London, New Delhi.
- Bingham, Gail; Aaron Wolf & Tom Wohlgenant, 1994. Resolving Water Disputes. Conflict and Cooperation in the United States, the Near East and Asia, USAID, <<http://www.colorado.edu/conflict/peace/example/bing7515.htm>> (17.06.2003).

- Biography, El-Ferik Ibrahim Abboud, <<http://www.sudan.net/government/biography/about.html>> (29.07.2002).
- Biswas, Asit K. (ed.), 1997. *Water Resources, Environmental Planning, Management, and Development*. McGraw-Hill, New York.
- Biswas, Asit, K.; John Kolars; Masahiro Murakami; John Waterbury & Aaron Wolf, 1997. *Core and Periphery: A Comprehensive Approach to Middle Eastern Water*, Oxford University Press, Delhi.
- Bleier, Ronald, 1997. Will Nile Water Go to Israel? North Sinai Pipelines and The Politics of Scarcity. In: *Middle East Policy*, September, Volume V, Number 3, pp. 113-124 <<http://desip.igc.org/WillNile1.html>> (10.07.2002).
- Bosnjakovic, Branko, 2000. New Challenges for Resource Management in the Aral Sea Region. In: *Environment and Security, Crisis Prevention Through Cooperation*, German Federal Foreign Office, June 15-16, 2000. <<http://www.auswaertigesamt.de/www/en/infoservice/download/pdf/workshop.pdf>> (12.03.2003).
- Briggs, C., 1986. *Learning How To Ask. A Sociolinguistic Appraisal of the Role of the Interviewer in Social Science Research*. Cambridge University Press, Cambridge. Quoted in Holstein, James & Jaber Gubrium, *Active Interviewing*, 1997. In Silverman, David (ed.). *Qualitative Research, Theory, Method and Practice*. London, pp. 113-129.
- Burgess, Heidi & Guy Burgess, 1997. Conflict Transformation, A Comparison of Lederach's "Conflict Transformation" with Bush and Folgers' Transformative Mediation, University of Colorado, Conflict Research Consortium <<http://www.colorado.edu/conflict/transform/jplall.htm#Comparison>> (10.03.2003).
- Burton, John W. & Frank Dukes, 1990. *Conflict: Readings in Management & Resolution*. Houndsmill, London.
- Burton, John W. (ed.), 1990. *Conflict: Human Needs Theory*, St. Martin's Press, New York.
- Burton, John W. 1969. *Conflict and Communication: The Use of Controlled Communication in International Relations*. Macmillan, London.
- Bush Ray, 2001. Time To Go. *Al-Ahram Weekly*, Cairo, <<http://www.ahram.org.eg/weekly/2001/539/fo72.htm>> (10.01.2002).
- Bush, Baruch Robert A. & Joseph P. Folger, 1994. *The Promise of Mediation: Responding to Conflict Through Empowerment and Recognition*, The Jossey-Bass Conflict Resolution Series. Jossey-Bass, San Francisco.
- BUWAL, Swiss Agency for the Environment, Forests and Landscape, 1995. *Tolerance Thresholds and Limits for Drinking Water*, <<http://www.buwal.ch/e/themen/umwelt/wasser/ek11u01.pdf>> (01.08.2001).
- Carius, Alexander; Günther Baechler; Stefanie Pfahl & Andreas March, 1999. *Umwelt und Sicherheit: Forschungserfordernisse und Forschungsprioritäten*, Center for International and European Environmental Research (ECOLOGIC), Berlin, <[http://www.ieep.de/download/1999/872\\_bmbf\\_envsec\\_001231.pdf](http://www.ieep.de/download/1999/872_bmbf_envsec_001231.pdf)> (17.06.2003).

- Carucci, Volli; Nedessa Betru & Yirga Arega, 1999. Guidelines for the Preparation of a Community-Based and Integrated Land Rehabilitation Plan, World Food Program (WFP), Ethiopian Ministry of Agriculture.
- CEDARE, 2001. Nubian Sandstone Aquifer System Programme, Centre for Environment and Development for the Arab Region and Europe (CEDARE) <<http://isu2.cedare.org.eg/nubian/>> (24.03.2003).
- Charmaz, Kathy, 1995. Grounded theory. In: Jonathan A. Smith, Rom Harré, & Luk Van Langenhove (eds.), *Rethinking methods in psychology*. Sage, London, pp. 27-49.
- Cohen, Raymond, 2001. Negotiating Across Cultures. In: Crocker, Chester A.; Fen O. Hampson & Pamela Aall (eds.), 2001. *Turbulent Peace, The Challenges of Managing International Conflict*, United States Institute of Peace Press, Washington D.C..
- Collins, Robert O., 1990. *The Waters of the Nile, Hydropolitics and the Jonglei Canal 1900-1988*. Clarendon Press, Oxford.
- Convention, 1997. Convention on the Law of the Non-navigation Use of International Watercourses, Adopted by the UN General Assembly, May 1997, <[http://www.thewaterpage.com/UN\\_Convention\\_97.html](http://www.thewaterpage.com/UN_Convention_97.html)> (10.07.2002).
- Converse, J. M. & H. Schuman, 1974. *Conversations At Random: Survey Research As Interviewers See It*. Wiley, New York. Quoted in Silverman, David (ed.), 1997. *Qualitative Research, Theory, Method and Practice*. Sage, London.
- Conway, Declan, 2000. The Climate and Hydrology of the Upper Blue Nile River. *The Geographical Journal*, no. 166, pp. 49-62.
- Coser, Lewis, 1956. *The Functions of Social Conflict*. The Free Press. New York.
- CRC, 1998. Conflict Research Consortium (CRC), International Online Training Program on Intractable Conflict, Glossary, University of Colorado, <<http://www.colorado.edu/conflict/peace/glossary.htm>> (28.02.2003).
- Dawoud, Khaled, 2001. Taming the Nile's Serpents, correspondent for Al-Ahram, UNESCO Courier, October. <[http://www.unesco.org/courier/2001\\_10/uk/dosso1.htm](http://www.unesco.org/courier/2001_10/uk/dosso1.htm)> (09.05.2003).
- Delli Priscoli, Jerome, 1992. Collaboration, Participation and Alternative Dispute Resolution; Process Concepts for the (World) Bank's Role in Water Resources.
- Delli Priscoli, Jerome, 1996. Conflict Resolution, Collaboration and Management in International Water Resource Issues. US Army Corps of Engineers. Working paper No. 6, Alternative Dispute Resolution Series. Alexandria.
- Diamond, L. & J. McDonald, 1991. *Multi-track Diplomacy: A Systems Guide and Analysis*. Iowa Peace Institute, Iowa.
- Dick, Bob, 1998. Convergent Interviewing: A Technique for Qualitative Data Collection. Resource Papers in Action Research, Action Research Resources, <<http://www.scu.edu.au/schools/gcm/ar/arp/iview.html>> (27.09.2002).
- Dick, Bob, 2002. Grounded Theory, a Thumbnail Sketch. Resource Papers in Action Research, Action Research Resources, <<http://www.scu.edu.au/schools/gcm/ar/arp/grounded.html>> (11.06.2003).

- Diehl, Paul F., & Nils Petter Gleditsch, 2001. *Environmental Conflict*, Westview Press, Boulder.
- Directive 2000/60/EC of 23 October 2000. Establishing a Framework for Community Action in the Field of Water Policy (Water Framework Directive). In: EEA multilingual environmental glossary, [http://glossary.eea.eu.int/EEAGlossary/R/river\\_basin](http://glossary.eea.eu.int/EEAGlossary/R/river_basin) (01.01.2003).
- Douglas, J.D., 1985. *Creative Interviewing*. Beverly Hills. Quoted in Silverman, David (ed.), 1997. *Qualitative Research, Theory, Method and Practice*. Sage, London.
- Durth, R., 1996. *Grenzüberschreitende Umweltprobleme und regionale Integration*. Nomos, Baden-Baden.
- EAAE, 2000. *Patterns of Changes in the Economic Value of Irrigation Water During the Era of Agricultural Policies Reform 1986-1996*, Egyptian Association of Agricultural Economics (EAAE), Cairo.
- Easton, David, 1965. *A Systems Analysis of Political Life*. Wiley, New York.
- Ebeid, Nadia M. & Ahmed A. Hamza, 1999. *Prevention of Industrial Pollution to the Nile: A Success Story*. Ministry of State for Environmental Affairs. In: *Proceedings, VII Nile 2002 Conference*, Cairo March 15-19, 1999.
- EC, 1999. *Compilation of Environmental Information on Egypt*, June, Framework Contract for the Mainstreaming of Environment into EC Development and Economic Co-operation, European Commission (EC), Brussels, Namur 1999, <<http://a4.grp.yahoofs.com/v1/oBDvPir1l8Eu2J7ybEkEWJ1PALXH-rQmBxBfGjmdueGIV4NLWYkn4DjMnThDRAbq5iWzYZylbWDF5-1G/Egypt%20EC.pdf>> (17.06.2003).
- ECOSOC, 2001. *Statistical Profiles of LDCs, 2001*. Economic and Social Council (ECOSOC), United Nations Conference on Trade and Development UNCTAD, <<http://www.unctad.org/en/pub/ldcprofiles2001.en.htm>> (01.10.2002).
- EEA, 2001. *EEA Multilingual Environmental Glossary*. Source of definition of "demand-side management": Sustainable water use in Europe. Part 2. Demand management, European Environment Agency (EEA), Copenhagen, <[http://glossary.eea.eu.int/EEAGlossary/D/demand-side\\_management](http://glossary.eea.eu.int/EEAGlossary/D/demand-side_management)> (10.12.2002).
- EEA, 2002. *Information for Improving Europe's Environment, Water Guidelines*, European Environment Agency (EEA), <<http://star.eea.eu.int/thematic.asp?themeID=2&class=inst&instr=Guidelines>> (13.02.2003).
- Egypt, 1999. *Country Paper of the Arab Republic of Egypt*. Country Paper: Egypt's Water Policy for the 21st Century. VII Nile 2002 Conference, March 15-16, Cairo.
- Egypt, 2000. *Country Paper of the Arab Republic of Egypt*. VIII Nile 2002 Conference, Addis Ababa, June 26-30.
- Egypt, 2002. *Country Paper of the Arab Republic of Egypt*. IX Nile 2002 Conference, October 7-9, Nairobi.
- Egyptian academic, 2000. Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.

- Egyptian NGO worker, 2000. Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- Egyptian technocrat, 2000. Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- El Battahani, Atta, 2003. Lecturer at the Department of Political Science, University of Khartoum Sudan, in an email to the author, June 22.
- El Kady, Monal & Jacques Millette, 2002. Towards improved national water quality understanding and management in Egypt, The 18th Congress and the 53 Rd International Executive Council Meeting International Commission on Irrigation and Drainage, Montreal, Canada, July 21-28.
- El Khalifa El, M. D. & H.O. Abdel Nour (eds.), 1991. National Report of Sudan, United Nations Conference on Environment and Development, Brazil, June 1992, Khartoum.
- El Khalifa, M. D. (ed.), 1985. Blue Nile River, from the Ethiopian Border to Khartoum, Institute of Environmental Studies, University of Khartoum.
- El Quosy, Dia El Din & Ahmed, A. Tarek, 1999. Water Saving Techniques – Lessons Learned From Irrigation of Agricultural Land in Egypt. In: Proceedings of the VII Nile 2002 Conference, Cairo March 15-19, EGY-18.1-18.10.
- El Swaify S. A., & H. Hurni, 1996. Transboundary Effects of Soil Erosion and Conservation in the Nile Basin. Land Husbandry, International Journal of Soil and Water Conservation. Vol. 1, No 1 and 2, New Delhi, pp 7-21.
- El Zain, Mahmoud, forthcoming, Regimes of Structural Inequality and Environmental Scarcity and the Changing Formula of the Nile Hydropolitics: Disputes Between the Enriched Riverain Zone and Marginalized Landscape in the Sudan (1820-2002), Ph.D thesis, Institute for Social Sciences (ISS), the Hague.
- Elarabawy Mohsen M., 2002. Water Supply-Demand Management for Egypt: A Forthcoming Challenge, IX Nile 2002 Conference, Nairobi.
- Elgadir, Mohamed Yassir, 1982. Study of the Water Quality for Blue Nile and White Nile, M.Sc. Thesis, University of Khartoum.
- Enien, Abdoul; Abdel Shafi; Abdel Monem; A. Kamel; M. Solh; M. Bedier & H. Khalifa, 2000. A New Research Paradigm for Sustainability Research in Egypt. Cambridge.
- ERF, Economic Research Forum: Some Demographic Issues in Egypt, ongoing research project, Resubmit Research Proposals, <<http://www.erf.org.eg/html/resubmit.asp>> (01.01.2002).
- Erlich, Haggai, 2002. The Cross and the River: Ethiopia, Egypt and the Nile, Lynne Rienner Publishers, Boulder.
- Essam El-Din, Gamal, 2000. Toshka in the Crossfire. In: Al-Ahram Weekly, Cairo Jan. 27-Feb. 2, 2000/466, <<http://www.ahram.org.eg/weekly/2000/466/eg7.htm>> (10.12.2000).

- Ethiopia, 2000. Country Paper of the Federal Democratic Republic of Ethiopia. VIII Nile 2002 Conference, Addis Ababa, June 26-30.
- Ethiopian academic, 2001. Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- Ethiopian NGO worker, 2001. Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- Ethiopian technocrat, 2001. Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- Euroconsult, 1992. Executive Summary of the World Bank/Arab Republic of Egypt. Northern Sinai Agricultural Development Project Environmental Impact Assessment, prepared by Euroconsult, Arnhem, the Netherlands, in association with Pacer and Darwish Engineers, Cairo, Egypt, January 1992, <<http://www.cedar.at/unep/eia/docs/sinai.html>> (14.12.2002).
- Fackler, Norbert & Thomas Flucher, 2002. INMEDIO/DEZA/COPRET mediation course in Moosegg, November.
- Falkenmark, Malin, 1993. Quoted in: Engelman, Robert & Pamela LeRoy. Sustaining Water: Population and the Future of Renewable Water Supplies, Population Action International, Washington, D.C., <<http://www.cnie.org/pop/pai/water-12.html>> (01.12.2000).
- Falkenmark, Malin, 2000. No Freshwater Security Without Major Shift in Thinking. Ten-year Message from the Stockholm Freshwater Symposia, Stockholm <[http://www.siwi.org/pdf/10\\_year\\_water.pdf](http://www.siwi.org/pdf/10_year_water.pdf)> (17.06.2003).
- FAO, 1997a. Irrigation Potential in Africa, A Basin Approach, Food and Agriculture Organization of the United Nations (FAO), Rome, <<http://www.fao.org/docrep/w4347e/w4347e00.htm>> (01.12.2000).
- FAO, 1997b. Irrigation in the Near-east Region in Figures, Food and Agriculture Organization of the United Nations (FAO), Rome, <<http://www.fao.org/docrep/w4356e/w4356e00.htm#Contents>> (01.12.2000).
- FAO, 2000a. Food Supply Situation and Crop Prospects in Sub-Saharan Africa. Food and Agriculture Organization of the United Nations (FAO); Global Information and Early Warning System on Food and Agriculture (GIEWS), Africa Report No.1, Rome, <<http://www.fao.org/WAICENT/faoinfo/economic/giews/english/eaf/eafo004/AF00041.htm#TopOfPage>> (01.12.2000).
- FAO, 2000b. SOFI The State of Food Insecurity in the World, 2000, Food and Agriculture Organization of the United Nations (FAO), Italy, <<http://www.fao.org/news/2000/001002-e.htm>> (01.12.2000).
- FAO, 2000c. FAOSTAT Agriculture Data Food and Agriculture Organization of the United Nations (FAO), Rome. <<http://apps.fao.org/page/collections?subset=agriculture>> (01.12.2000).

- FAOSTAT, 2000. Agriculture Data, Food and Agriculture Organization of the United Nations (FAO), Rome, <<http://apps.fao.org/page/collections?subset=agriculture>> (01.12.2000).
- FAOSTAT, 2002. Agriculture Data, Food and Agriculture Organization of the United Nations (FAO), Rome, <<http://apps.fao.org/page/collections?subset=agriculture>> (12.12.2002).
- Farag, Fatemah, 1999. Managing Turbulent Waters. Interview with Abu Zied, Minister of Irrigation and Water Resources. *Al-Ahram Weekly*, 16-22 September, Issue No. 447, Cairo, <<http://www.ahram.org.eg/weekly/1999/447/spec3.htm>> (01.12.2000).
- Farag, Fatemah, 2000. Watering the Future, *Al-Ahram Weekly*, 6-12 April, Issue No 476, Cairo, <<http://weekly.ahram.org.eg/2000/476/foc1.htm>> (10.12.2002).
- Farag, Fatemah, 2003. Green Desert – At What Cost? *Al-Ahram Weekly*, 23-29 January. Issue No 622, Cairo, <<http://weekly.ahram.org.eg/2003/622/fe1.htm>> (28.02.2003).
- FAS, 2000. Egypt: Rice Increased as Area Rises, Foreign Agriculture Service (FAS), United States Department of Agriculture, <<http://www.fas.usda.gov/WAP/circular/2000/00-02/wap1.htm>> (28.02.2003).
- Filippini, Massimo; Silvia Banfi & Cornelia Luchsinger, 2002. Deregulation of the Swiss Electricity: Implication for the Hydroelectric Power Sector. CEPE Working paper Nr. 13, <<http://www.cepe.ethz.ch>> (10.12.2002).
- Financial Times, 2000. Mega-Projects: Draining Away Resources. Egypt, Energy & Resources <<http://specials.ft.com/In/ftsurveys/country/scdd22.htm>> (20.09.2002).
- Fisher, Ronald J. & Loreleigh Keashly, 1991. The Potential Complementarity of Mediation and Consultation within a Contingency Model of Third Party Intervention, *Journal of Peace Research*, 28, 29-42.
- Fisher, Ronald J., 1997. *Interactive Conflict Resolution*, Syracuse University Press, New York.
- Fisher, Roger; Ury William & Bruce Patton, 1991 (2nd edition). *Getting to Yes: Negotiating Agreement Without Giving In*, Penguin, New York, London, Victoria, Ontario.
- Freud, Sigmund, 1915. Instincts and Their Vicissitudes, *Standard Edition XIV*, 109 –140.
- Frey, Frederick W., 1984. Middle East Water: The Potential for Conflict or Cooperation. In: Naff T. & R.C. Matson, (ed.). *Water in the Middle East: Conflict or Cooperation*, pp. 180-198. Westview Press, Boulder. Cited in: Frey, Frederick W., 1993. The Political Context of Conflict and Cooperation Over International River Basins. *Water International: Water in the Middle East Vol. 18, no. No. 1*, pp. 54-58.
- Frey, Frederick W., 1993. The Political Context of Conflict and Cooperation Over International River Basins. *Water International: Water in the Middle East Vol. 18, no. No. 1*, pp. 54-58.
- Galtung, Johan & Tord Hoivik, 1971. Structural and Direct Violence: A Note on Operationalization. In: *Journal of Peace Research*, Vol. 14:1, pp 73-76.
- Gandhi, Mohandas, 1920. *Young India*, May 12, India. Quoted in Iyer R. (ed.), 1986. *Moral and Political Writings of Mahatma Gandhi*, Oxford University Press, New York. Vol. I, p.47.

- Gelaw, Abebe, 1998. Interview with Marawan Badr – Egyptian Ambassador to Ethiopia, [www.geocities.com/~dagmawi/News\\_July23\\_Egypt.html](http://www.geocities.com/~dagmawi/News_July23_Egypt.html) (01.01.1999).
- Genena, Tarek M., 1996. From Environmental Planning to Enforcement: A Case Study From Egypt. Fourth International Conference on Environmental Compliance and Enforcement, International Network for Environmental Compliance and Enforcement, <http://www.inece.org/4thvol2/genena.pdf> (12.12.2002).
- Ghany, Hesham A., 2000. Technical Secretary Permanent Joint Technical Commission for Nile Water, Cairo, in discussion with the author, May 9, 2000.
- Glaser, Barney G., 1998. *Doing Grounded Theory: Issues and Discussions*. Sociology Press, Mill Valley, Ca.
- Glasl, Friedrich, 1982. The Process of Conflict Escalation and Roles of Third Parties. In: Bomers G. B. J. & R. B. Peterson, (eds.), *Conflict Management and Industrial Relations*, Kluwer Nijhoff Publishing, The Hague, pp. 119-140.
- Glasl, Friedrich, 2002. *Konfliktmanagement. Ein Handbuch für Führungskräfte, Beraterinnen und Berater [Conflict Management. A Handbook for Executives and Counselors]* (7th supplemented and revised ed.). Verlag Freies Geistesleben, Stuttgart.
- Gleditsch, Nils Petter, 2001. Armed Conflict and the Environment. In: Diehl, P.F. & Gleditsch, N.P. (eds.) *Environmental Conflict*, Westview Press Boulder, pp. 251-272.
- Gleick, Peter H., 1998. *The World's Water 1998-1999: The Biennial Report on Freshwater Resources*, Washington, D.C. <<http://www.worldwater.org/table2.html>> (01.12.2000).
- Gulf Business, 1999. *Water World Egypt*. Vol. 4, Issue 5, Sept. 4, <<http://www.gulfbusiness.com/articles/260.shtml>> (01.12.2000).
- Gupta, Gian, 2001. Sample probe taken in May 2001 in Cairo, email sent to the author, July 2001.
- Hagos, Mohamed A., 2000. The Role of Proper Nile Water Resources Development for Poverty Alleviation. Paper presented at the VIII Nile 2002 Conference, Addis Ababa, June 26-30.
- Hamad, Osman El-Tom (Nile-TAC), 2000. Speech at the Ethiopian VIII Nile 2002 Conference, Addis Ababa, June 26-30.
- Hamad, Osman El-Tom, 2002. Email to the author, 21.12. 2002. Osman El-Tom Hamad is Chairman, Water Resources Technical Organ, Ministry of Irrigation and Water Resources, Khartoum, Sudan.
- Hammad, Abdel-Azim, 2000. Water, Water Everywhere. In: *Al-Ahram Weekly*, Cairo, February 10-16, Issue No. 468, <<http://www.ahram.org.eg/weekly/2000/468/op5.htm>> (01.12.2000).
- Hammersley, M. & R. Gomm, 1997. 'Bias in Social Research' *Sociological Research Online*, Vol. 2, No. 1, <<http://www.socresonline.org.uk/socresonline/2/1/2.html>> (01.01.1999).

- Hamza, Waleed, 1999. Economic Development and Compensatory Measures Related to the Management of the Egyptian Freshwater Resources. In: *Water Security in the Third Millennium, Mediterranean Countries as a Case*, Como, April 12-15.
- Harik, Iliya, 1998. *Economic Policy Reform in Egypt*, The American University in Cairo Press, Cairo.
- Hassan, A.A.; M. M. Soliman & N. A. Hassan, 1998. A Simplified BOD\_DO Model With an Application to the Nile River, Egypt.
- Haumersen, Petra; Helmolt Rademacher & Norbert Ropers, 2002. *Konfliktbearbeitung in der Zivilgesellschaft. Die Workshop-Methode im rumänisch-ungarischen Konflikt*, Reihe: *Konflikttransformation*, Münster.
- Hauser, Christine (Reuter) 1997. U.S. Agriculture Official, Dan Glickman, Urges Open Egypt Market, *News on Genetic Engineering*, <<http://www.netlink.de/gen/Zeitung/970920.htm>> (02.01.2002).
- Hederman, Mark Patrick, 2002. *Anchoring the Altar, Christianity and the Work of Art*, Veritas, Dublin.
- Hefny Magdy, 2002. Former Egyptian ambassador to Ethiopia, in discussion with the author, August, Kastanienbaum.
- Hefny, Kamal; Samir Farid & Mohamed Hussein, 1991. *Groundwater Assessment in Egypt*. In: *Research Institute for Groundwater (RIGW); Dutch Consultants for Water and Environment (IWACO): Planning for Groundwater Development in Arid & Semi-Arid Regions*, Roundtable Meeting, Cairo, Rotterdam October 5-9, pp. 93-104.
- Hefny, Magdy & Amer Salah El Din, forthcoming. *Egypt and the Nile River*. Paper presented at the EAWAG-CIS Workshop on Sustainable Development and International Cooperation in the Eastern Nile Basin, August 2002.
- Helmy, Omneia, 2001. *Managing Cotton Price Volatility in Egypt*, Policy Viewpoint, Egyptian Center for Economic Studies, Cairo.
- Herweg, K. & E. Ludi, 1999. *The Performance of Selected Soil and Water Conservation Measures – Case Studies from Ethiopia and Eritrea*. *Catena* Vol. 36, pp. 99-114.
- Herweg, Karl & Kurt Steiner, 2002. *Impact Monitoring & Assessment. Instruments for Use in Rural Development Projects with a Focus on Sustainable Land Management. Volume 2: Toolbox*. Center for Development and Environment (CDE) & Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ).
- Hill, Michael, 1997. *The Policy Process in the Modern State*, Prentice Hall.
- Hillig, Alex, 1996. *Schüler-Duden, Psychologie*. Meyers Lexikonredaktion, Mannheim, Leipzig, Wien, Zürich, Dudenverlag.
- Hirsch, Gertrude, 2003. *Lectures at the Department for Environmental Sciences, Swiss Federal Institute of Technology, ETH Zurich*. Presentation on Sustainability Research at the NCCR North South Symposium on Generality and Applied Research, June 12-14, Hotel Seepark, Thun, Switzerland.

- Holstein, J.A., 1994. Phenomenology, Ethnomethodology, and Interpretive Practice. In: Denzin & Lincoln Y. (ed.). *Handbook of Qualitative Research*. Newbury park, CA. pp. 262-272.
- Holstein, James, & J. Gubrium, 1997. Active Interviewing. In: David Silverman (ed.), *Qualitative Research: Theory, Method, and Practice*. Sage, London, pp. 113-129.
- Holtrup, Petra, 1999. *Der Schutz grenzüberschreitender Flüsse in Europa: zur Effektivität internationaler Umweltregime*, Berichte des Forschungszentrums Jülich, JÜL-3642, Ph.D thesis University of Bonn, Jülich.
- Homer-Dixon, Thomas & Jessica Blitt, (eds.), 1998. *Ecoviolence: Links Among Environment, Population and Security*. Lanham: Rowman and Littlefield.
- Homer-Dixon, Thomas, 1991. On the Threshold: Environmental Changes as Causes of Acute Conflict. *International Security*, Vol. 16, No. 2, pp. 76 -116. <<http://www.library.utoronto.ca/pcs/thresh/thresh1.htm>> (19.08.2002).
- Homer-Dixon, Thomas, 1999. *Environment, Scarcity, and Violence*. Chichester, Princeton UP.
- Howell, Paul; Michael Lock & Stephen Cobb (eds.), 1988. *The Jonglei Canal: Impact and Opportunity*. Cambridge University Press, Cambridge.
- HRW, 2001. State Control and Liberalization of Cotton Production, Human Rights Watch (HRW), <<http://www/hrw.org/reports/2001/egypt/Egypt01-02.htm>> (01.01.2002).
- Hussein M. N., 1991. Food Security and Adjustment Programs, the Case of the Sudan. In Suliman M. (ed.) *Environment and Women*, Institute for African Alternatives, London.
- ICCON, 2001. Nile Basin Initiative, Strategic Action Program, Overview, International Consortium for Cooperation on the Nile (ICCON), May 2001, Geneva.
- ICRC, 1998. Forum: War and Water, International Committee of the Red Cross (ICRC), Geneva.
- IFAD, 2001. Twenty-fourth Session of IFAD's Governing Council: Keynote Address by His Excellency Mohamed Hosni Mubarak, President of the Arab Republic of Egypt, International Fund for Agricultural Development (IFAD), <<http://www.ifad.org/events/gc/mubark.htm>> (01.01.2002).
- IGAD, 2002. Machakos Protocol, Secretariat on Peace in the Sudan July 20, <[http://www.woek.de/pdf/sudan\\_machakos-protocol.pdf](http://www.woek.de/pdf/sudan_machakos-protocol.pdf)> (17.06.2003).
- ILEC, 1999. World Lakes Database, Aswan High Dam Reservoir, International Lake Environment Committee (ILEC), (sediment flowing into reservoir, average between 1965-1978), <<http://www.ilec.or.jp/database/afr/afr-19.html>> (12.03.2003).
- Inmedio, 2003. Handout at the INMEDIO/DEZA/COPRET Modular Training in Mediation 2002-2003.
- INMEDIO/DEZA/COPRET, 2002-2003. Modular Training in Mediation, Eight Weeks of Training Between 2002-2003, organized by Conflict Prevention and Transformation (COPRET) of the Swiss Development and Cooperation Agency (SDC) and Inmedio, <<http://www.inmedio.ch/>> (17.06.2003).

- IRIN, 2001. Egyptian-Libyan Peace Initiative, unofficial, translated copy received by Integrated Regional Information Networks (IRIN), part of the UN Office for the Coordination of Humanitarian Affairs (OCHA), July 11. <<http://allafrica.com/stories/200107110485.html>> (17.07.2003).
- IRIN, 2002. Sudan: Direct Talks Due Between Government and Rebels, Integrated Regional Information Networks (IRIN), part of the UN Office for the Coordination of Humanitarian Affairs (OCHA), Aug. 26, <<http://www.irinnews.org/report.asp?ReportID=29519>> (26.09.2002).
- ITF, 2001. Country Report: Egypt – Cotton, Desk Review, International Task Force (ITF), Commodity Risk Management in Developing Countries, <<http://www.itf-commrisk.org/DisplayContent.asp?ID=14>> (01.01.2002).
- Iyer Raghavan (ed.), 1986. Moral and Political Writings of Mahatma Gandhi, Vol. I/III, Oxford University Press New York.
- Jägerskog, Anders, 2003. Why State Cooperate Over Shared Water: The Water Negotiations in the Jordan River Basin. Department of Water and Environmental Studies, Linköping University.
- Jervis, Robert, 1976. Perception and Misperception in International Politics. Princeton University Press.
- Jervis, Robert, 1997. System Effects: Complexity in Political and Social Life. Princeton University Press.
- Kalebbo, Geoffrey Denye, 2002. 6.3 Million in Need of Emergency Food, Reliefweb, World Vision, Dec. 10. <<http://www.reliefweb.int/w/rwb.nsf/6686f45896f15dbc852567ae00530132/bb077a4024f7234ec1256c8b00314f33?OpenDocument>> (12.12.2002).
- Kalkur, Mamta (design), Smita Premchander, Sampark, 2001. Empowering People or Empowering Institutions, March issue <[http:// http://www.sampark.org/](http://http://www.sampark.org/)> (27.09.2002).
- Kamal, Ali Mohamed (Sudanese Minister of Irrigation and Water Resources), 2001. Water Potential of the Nile Achieving Peace Among the Nile Riparian Countries Through the Development of the Water Resources of the Nile. Paper presented at the conference: “Peace Through Development along the Nile Valley in the Framework of a New Just World Economic Order”, Center for Strategic Studies in Collaboration with Ministry of Culture and Information and the International Schiller Institute, Hotel Palace, Khartoum, Jan. 16.
- Keddy, Paul, 2000. The World’s Largest Wetlands. In: Wetland Ecology: Principles and Conservation, Cambridge University Press, <<http://www.selu.edu/Academics/Faculty/pkeddy/world2.htm>> (13.03.2003).
- Kelman, Herbert, 1993. Interactive Problem-Solving: A Social-Psychological Approach to Conflict Resolution. In: John Burton & Frank Duke (eds.). Conflict: Reading in Management and Resolution, pp. 199-215. Macmillan, Hampshire.
- Kelman, Herbert, 1999. Experiences From 30 Years of Action Research on the Israeli-Palestinian Conflict. In: Spillmann, Kurt R. & Andreas Wenger (eds.).

- Zeitgeschichtliche Hintergründe aktueller Konflikte VII. Zürich, <[http://www.fsk.ethz.ch/documents/beitraege/zu\\_54/zu54\\_Kelman.htm](http://www.fsk.ethz.ch/documents/beitraege/zu_54/zu54_Kelman.htm)> (27.09.2002).
- Keohane, Robert O., 1994. International Institutions: Two Approaches. In Friedrich Kratochwil and Edward D. Mansfield (eds.), *International Organizations: A Reader*. HarperCollins, New York.
- Kerntke, Wilfried, 2004. *Mediation als Organisationsentwicklung. Mit Konflikten Arbeiten – ein Leitfaden für Führungskräfte*. Paul Haupt, Bern.
- Khalid, Mansour, 2003. Sudan: Post-Conflict Foreign Policy and Diplomacy. Issues and Challenges. National Democratic Alliance (NDA) Workshop on Global Issues, Asmara, Eritrea, Feb. 15-16.
- Khater, Ahmed, Samir Atta & Ruud Platenburg, 1991. Impact of Desert Reclamation on Groundwater Quality. In: Research Institute for Groundwater (RIGW), Dutch Consultants for Water and Environment (IWACO): *Planning for Groundwater Development in Arid & Semi-Arid Regions, Roundtable Meeting, Cairo, Rotterdam, October 5-9*, pp. 93-104.
- Klitzsch E., 1991. Die Grundwassersituation Nordostafrikas. *Naturwissenschaften*, No. 78: pp. 59-63. Cited in: WBGU, 1997. German Advisory Council on Global Change: *World in Transition: Ways Towards Sustainable Management of Freshwater Resources*, Springer Verlag, Berlin, p 74.
- Knoepfel, Peter; Corinne Larrue & Frédéric Varone, 2001. *Analyse et pilotage des politiques publiques*, Helbing & Lichtenhahn, Politikanalyse Band. 2.
- Korayem, Kaima, 1997. *Egypt's Economic Reform and Structural adjustment; The Egyptian Center for Economic Studies (ECCS)*, Cairo.
- Kuru, Ahmet, 2002. The Rentier State Model and Central and Central Asian Studies: The Turkmen Case. In: *Alternatives, The Turkish Journal of International Relations*, Vol. 1, No. 1. <<http://alternativesjournal.com/akuru.htm>> (24.06.2003).
- Lapiere, R.T., 1934-1935. Attitudes and Actions, *Social Forces* 13, 230-237.
- Latour, Bruno, 1997. The Trouble With Actor-Network Theory, *Danish Philosophy Journal*, <<http://www.ensmp.fr/~latour/astpop/p67.html>> (19.08.2002).
- Lederach, John Paul, 1995. *Preparing for Peace: Conflict Transformation Across Cultures*. Syracuse University Press.
- Lederach, John Paul, 1997. *Building Peace: Sustainable Reconciliation in Divided Societies*, United States Institute of Peace, Washington, D.C.
- Lemma, Seifeselessie (Director for legal affairs of the Ministry of Foreign Affairs of Ethiopia), 2001. Cooperating on the Nile: Not a Zero-sum Game, *UN Chronicle*, <<http://www.un.org/Pubs/chronicle/2001/issue3/0103p65.html>> (10.07.2002).
- Lewin, Kurt, 1948. *Resolving social conflicts; selected papers on group dynamics*. Gertrude W. Lewin (ed.). Harper & Row, New York.
- Libiszewski, Stephan, 1992. What Is An Environmental Conflict? Environment and Conflicts Project (ENCOP) Occasional Paper No. 1. Center for Security Policy and Conflict Research, ETH Zurich, Swiss Peace Foundation Bern. Zurich, Bern, <<http://www.fsk.ethz.ch/encop/1/libisz92.htm>> (12.12.2002).

- Libiszewski, Stephan, 1999. International Conflicts Over Freshwater Resources. In: Mohamed Suliman (ed.), *Ecology, Politics & Violent Conflict*, pp. 115-138. Zed Books, London.
- Ludi, Eva, 2004. *Economic Analysis of Soil Conservation: Case Studies from the Highlands of Amhara Region, Ethiopia*. African Studies Series A18. Berne: Geographica Bernensia.
- Maclaran, Pauline, 1999. *The Role of Theory in Research Methods*. The Queen's University of Belfast <<http://www.qub.ac.uk/mgt/pauline/mbarm2b/index.htm>> (19.08.2002).
- Mahmoud, Fatima Babiker, 1984. *The Sudanese Bourgeoisie: Vanguard of Development?* Khartoum University Press, Khartoum.
- Martinez-Alier, Joan, 2001. *Ecological Conflicts and Valuation, Mangroves Vs. Shrimps in the Late 1990s*, <<http://www.h-economica.uab.es/unitat/papers/4-2001.pdf>> (19.08.2002).
- Marty, Frank, 1997. *International River Management, The Political Determinants of Success and Failure*, Universität Zurich, Studien zur Politikwissenschaft, Nr. 305, Zurich.
- Marty, Frank, 2001. *Managing International Rivers, Problems, Politics, Institutions*, Peter Lang, European Academic Publishers, Bern.
- Mason, Simon A. & Kurt R. Spillman, 2003, *Environmental Conflicts and Regional Conflict Management*, in *Encyclopedia of Development and Economic Sciences*, edited by Yew-Kwang Ng and Ian Wills, in *Encyclopedia of Life Support Systems (EOLSS)*, Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford, UK, [<http://www.eolss.net>] (23.03.2004).
- Mason, Simon A., 2001. *Die Nil-Anreinerstaaten auf dem Weg zu einer kooperativen Ressourcennutzung*. In: Mader G.; W. Eberwein & W. Vogt (eds), Günther Baechler (coordination). *Die Umwelt, Konfliktbearbeitung und Kooperation*, Agenda Verlag.
- Mason, Simon, Christine Bichsel & Tobias Hagmann, 2003, *Trickling Down or Spilling Over, Exploring the Links Between International and Sub-national Water Conflicts in the Eastern Nile and Syr Daria Basin*, paper presented at the ECPR Joint Session of Workshops, Edinburgh, <<http://www.nccr-north-south.unibe.ch>> (12.06.2003).
- Mason, Simon, 1999. *Gandhi's Spirituality in Today's Ecological Crisis*. In: Grey Mary (ed.), 1999. *Ecotheology 5 (1998)/6(1999)* Sheffield academic press, Sheffield.
- Mayer, B.; Christopher Moore; Susan Wildau; Suzanne Ghais; R. Marada; Norbert Ropers; A. Weiss & R. Volker, 1999. *Reaching for Peace - Lessons Learned from Mott Foundation's Conflict Resolution Grant-making 1989-1998*. Charles Stewart Mott Foundation, Flint, Michigan.
- McDonald, John W. & Diane B. Bendahmane, (eds.), 1987. *Conflict Resolution: Track Two Diplomacy*, Foreign Service Institute, Department of State, Washington, D.C.
- Mehyar, Rasha, 1999. *Price Taking Hurts Egypt's Cotton Industry*. Middle East Times, Cairo, <[http://metimes.com/issue99-40/bus/price\\_taking\\_hurts.htm](http://metimes.com/issue99-40/bus/price_taking_hurts.htm)> (01.01.2002).

- Mekay, Emad, 1999. Sugar Cane Growers Call For Protection, Middle East Times, issue 99-20. [http://metimes.com/issue99-20/bus/sugar\\_cane\\_growers.htm](http://metimes.com/issue99-20/bus/sugar_cane_growers.htm) 1999 (01.01.2002).
- Merton, Thomas (ed.), 1964. Ghandi on Non-violence: Selected Texts From Ghandi's "Non-violence in Peace and War", New Directions, New York.
- Miall, Hugh, Oliver Ramsbotham & Tom Woodhouse, 1999. Contemporary Conflict Resolution: The Prevention, Management and Transformations of Deadly Conflict, Polity Press, Blackwell Publishers, Cambridge, Oxford, Maden.
- Michigan State University, Wellhead Protection Program, Glossary, <[http://www.orcbs.msu.edu/environmental/programs/wellhead\\_protection/glossary/glossary.htm](http://www.orcbs.msu.edu/environmental/programs/wellhead_protection/glossary/glossary.htm)> (24.02.2003).
- Middle East Times, 2001. Nile Soon to be Unable to Sustain Egypt Cairo, September 7, <[http://www.metimes.com/2K1/issue2001-36/eg/nile\\_soon\\_to.htm](http://www.metimes.com/2K1/issue2001-36/eg/nile_soon_to.htm)> (10.12.2002).
- Mitchell Christopher, 1993. Problem Solving Exercises and Theories of Conflict Resolution. In: Sandole Dennis & Hugo Van Der Merwe (eds.). Conflict Resolution: Theory and Practice, Manchester University Press, Manchester, New York, pp. 78-94.
- Minsch J.; A. Eberle; B. Meier & U. Scheidewind, 1996. Mut zum ökologischen Umbau: Innovationsstrategien für Unternehmen, Politik und Akteurnetze. Birkhäuser, Basel.
- Minsch, J.; P. Baur; P. Giannini & L. Rigendinger, 1995. Schritte zur Ökologisierung des Welthandels. SGU Schriften, Diskussionsbeitrag Nr.1, Fachausschuss Ökonomie. Zürich.
- MOA, 2000. Agricultural Development in Egypt, Challenges and Achievements, Ministry of Agriculture (MOA), Cairo, <<http://www.agri.gov.eg/develop.htm>> (01.01.2002).
- Moattassem, El M.; S.K.A.G. Hassan; A. Z. Makary & Amal El Sherbini, 1993a. River Nile Water Quality Status (July 1991/April 1992). In: International Commission on Large Dams (ICOLD), High Aswan Dam Vital Achievement Fully Controlled, Cairo.
- Moattassem, El M; M. Rafik; A. Makary; M. Hikal & A. Ramadan 1993b. Review of Aswan High Dam Lake Water Quality. In: International Commission on Large Dams (ICOLD), High Aswan Dam Vital Achievement Fully Controlled, Cairo.
- MOE, 2000a. Quarterly Economic Digest, Sectoral Analysis Agriculture, Ministry of Economy (MOE), Cairo, <[http://www.economy.gov.eg/English/quarterly/Ve\\_42.htm](http://www.economy.gov.eg/English/quarterly/Ve_42.htm)> (02.01.2002).
- MOE, 2000b. Quarterly Economic Digest, Macroeconomic Overview, Ministry of Economy (MOE), Cairo, <[http://www.economy.gov.eg/English/quarterly/II\\_7.htm](http://www.economy.gov.eg/English/quarterly/II_7.htm)> (02.01.2001).
- MOFA, Sudan: Water in Sudan, Ministry of Foreign Affairs (MOFA), <<http://www.sudmer.com/Water%20in%20Sudan.htm>> (12.12.2002).
- Mohamed, M.A.M.; M.A. Osman; T.L. Potter & R.E. Levin, 1998. Lead and Cadmium in the Nile River Water and Finished Drinking Water in Greater Cairo, Egypt. Environment International, Vol. 24, No 7, pp 767-772.

- Moneim, Assan Abdel, 2000. Request to Establish Arabic Food Self-Sufficiency Projects. In: Al-Ahram (in Arabic), November 8, Cairo, <<http://www.ahram.org.eg/arab/ahram/2000/11/8/EGYP5.HTM>> (01.12.2000).
- Montville, J.V., 1987. The Arrow and the Olive Branch, The Case for Track Two Diplomacy. In: McDonald, John W & Diane B. Bendahmane (eds.), Conflict Resolution: Track Two Diplomacy, Washington D.C.: Foreign Service Institute, U.S. Department of State. pp. 5-20.
- Morrison, James, 1995. The First Interview, Revised for DSM-IV. New York.
- Mougrabi, A. 1995. Ecological Problems of the Sudan, Hydrobiology Unit, Khartoum: University of Khartoum (unpublished paper). In Suliman, Mohamed, 1999. The Sudan: A Continent of Conflicts – A Report on the State of War and Peace in the Sudan. Institute for African Alternatives, London, Country Risk Profile, Swiss Peace Foundation, FAST, Bern,
- Mynt, Tun, 2002a. Harnessing Governance for Democracy and Sustainability: Empirical Evidences from the Rhine. In: Walter Leal Filho (ed.), International Experiences on Sustainability, Volume 12 of the Series: “Environmental Education, Communication and Sustainability”, Peter Lang Scientific Publishers, Bern, Frankfurt, New York, Vienna. pp. 133-158.
- Mynt, Tun, 2002b. Managing Complexities in Global Environmental Governance: Issues-Interests-Actors Network Model for Transnational Environmental Governance in Mekong River Commission and the International Commission for the Protection of the Rhine. In: Biermann, Frank; Rainer Brohm & Klaus Dingwerth (eds.), Global Environmental Change and Nation State: Proceedings of the 2001 Berlin Conference on the Human Dimensions of Global Environmental Change, Potsdam Institute for Climate Impact Research, Potsdam, <<http://www.glogov.de/publications/bc2001/index.html>> (17.06.2003).
- NATO, 1999. Environment & Security in an International Context, North Atlantic Treaty Organization (NATO), Report No. 232, March.
- NBI, 2001. Transboundary Environmental Analysis, Shared Vision Program, Nile Basin Initiative (NBI), GEF, UNDP & World Bank, Washington.
- NBI, Update Nov. 2002. Nile Basin Initiative website, about the Nile, History of the Nile, <<http://www.nilebasin.org>> (26.02.2003).
- NCCR North-South IP7, Research Partnerships for Mitigating Syndromes of Global Change, Individual Project 7 “Environmental Change and Conflict Transformation” <<http://www.nccr-north-south.unibe.ch/Objectives.asp?contextID=7&refTitle=Conflict%20Transformation&Context=IP>> (26.09.2002).
- NCCR North-South, Research Partnerships for Mitigating Syndromes of Global Change, <<http://www.nccr-north-south.unibe.ch>> (26.09.2002).
- Nega, Berhanemeskel, 1997. Cited in: United Nations General Assembly Press Release, GA/9248, concerning the convention on the Law of the Non-navigation Use of International Watercourses, <<http://www.thewaterpage.com/UNPressWater.htm>> (17.06.2003).

- NFI, 1998, National Forest Inventory (NFI) for the Sudan, Forests National Corporation, Ministry of Agriculture and Forestry, Khartoum, and the Food and Agriculture Organization of the United Nations (FAO), Khartoum.
- Nile Basin Initiative (NBI) homepage, <<http://www.nilebasin.org>> (12.07.2002).
- Nile Discourse homepage, <<http://www.nilediscourse.org/>> (12.07.2002).
- Nile-Sec, 2001. Strategic Action Program. Nile Basin Initiative Secretariat (Nile-Sec) in Cooperation With The World Bank.
- Noeman, Rachel, 1999. Millers Face Hard Grind As Profits Dip. Middle East Times, Cairo, <[http://metimes.com/issue99-16/bus/millers\\_face\\_hard.htm](http://metimes.com/issue99-16/bus/millers_face_hard.htm)> (02.01.2002).
- Nohlen, Dieter, 1998. Lexikon der Politik, Band 7 Politische Begriffe. Beck, München.
- O'Brien, 1978. How traditional is traditional agriculture. Sudan Journal of Economic and Social Studies, Vol. 2, No. 2, Khartoum.
- Ohlsson, Leif, 1999. Environment Scarcity and Conflict, A Study of Malthusian Concerns, Department of Peace and Development Research Göteborg University, Göteborg.
- Peck, Scott, 1998. The Different Drum, Community Making and Peace, Touchstone Books.
- Peichert, Henrike, 1999. Hydropolitik im Nilbecken. Diplomarbeit, Freie Universität Berlin, Berlin.
- Perry, C.J.; Michael Rock & D. Seckler, 1997. Water as an Economic Good: A Solution, or a Problem? Research Report Series, International Water Management Institute (IWMI), <<http://www.cgiar.org/iwmi/pubs/PUB014/RR014.htm>> (10.12.2002).
- Pomeory, Thomas; Ahmed Hassan & Sherif Ibrahim, 2000. Egypt, Sugar, Annual 2000. Global Agriculture Information Network, Cairo.
- Press release 1997. United Nations General Assembly Press Release, GA/9248, Concerning the Convention on the Law of the Non-navigation Use of International Watercourses, <<http://www.thewaterpage.com/UNPressWater.htm>> (10.07.2002).
- Raimann, Cordula, 2001. Assessing the State of the Art in Conflict Transformation. In Austin, A.; M. Fisher & N. Ropers (eds.), 2001. The Berghof Handbook for Conflict Transformation, Berlin, <<http://www.berghof-center.org/handbook/>> (19.08.2002).
- Reliefweb, 1998. Rain-fed Nile Swamps Egypt's Dam and Villages, United Nations Office for the Coordination of Humanitarian Affairs, <<http://www.reliefweb.int/w/rwb.nsf/s/60758026DD43D650C125668A0053A623>> (01.12.2001).
- Reliefweb, 2000. Drought in the Greater Horn of Africa – Millions Still Face Hunger As Drought Continues: Update Sep. 16. World Food Program (WFP), United Nations Office for the Coordination of Humanitarian Affairs, <<http://www.reliefweb.int/w/rwb.nsf/s/3F193168D2F1AA8EC125695E005806FC>> (01.12.2001).
- Reliefweb, 2001. Sudan: Floods Appeal No. 24/2001 Operations, update No. 1, United Nations Office for the Coordination of Humanitarian Affairs, <<http://www.reliefweb.int/w/Rwb.nsf/48ofa8736b88bbc3c12564f6004c8ad5/5d540fbb3a5bb9d685256afbo05f9d26?OpenDocument>> (01.12.2001).

- Ropers, Norbert, 2000. From Resolution to Transformation: Assessing the Role and Impact of Dialogue Projects, Contribution to ZEF (Center for Development Research) Conference "Facing Ethnic Conflicts", Dec. 14-16, [http://www.zef.de/download/ethnic\\_conflict/ropers.pdf](http://www.zef.de/download/ethnic_conflict/ropers.pdf) (16.09.2002).
- Ropers, Norbert, 2002. Discussions and Lectures at the Modular Training in Mediation, Mediation in der internationalen Zusammenarbeit und Humanitären Hilfe, Ropers, Norbert & Günther Baechler, INMEDIO/DEZA/COPRET, June 17-21, Schloss Hünigen.
- Rosenberg, Marshall B. 1999. Nonviolent Communication, A Language of Compassion, Del Mar, CA. <<http://www.nonviolentcommunication.com/>> (17.06.2003).
- Rushdie, Said, 2001. Cold water wars, Al-Ahram Weekly, Cairo: <<http://web1.ahram.org.eg/weekly/2001/531/special.htm>> (10.07.2002).
- Sahan, Emel; Andreas Zogg; Simon Mason & Adi Gill, 2001. Case Study: South-Eastern Anatolia Project in Turkey - GAP. In: Seminar: Sustainable Management of International Rivers for Doctoral Students of the Swiss Federal Institute of Technology, Zurich, <[http://www.eawag.ch/research\\_e/apec/Scripts/GAPo7febo1.pdf](http://www.eawag.ch/research_e/apec/Scripts/GAPo7febo1.pdf)> (01.01.2002).
- Sandole, Dennis & Hugo van der Merwe, (eds.), 1993. Conflict Resolution in Theory and Practice, Manchester University Press, Manchester, New York
- Schellenberg, James A., 1996. Conflict Resolution, Theory, Research and Practice, State University of New York Press, New York.
- Schemm Paul, 1999. Middle East Times Staff, Building The Next Great Pyramid, Middle East Times, Cairo, <[http://www.metimes.com/issue99-8/eg/building\\_the\\_next.htm](http://www.metimes.com/issue99-8/eg/building_the_next.htm)> (12.12.2002).
- Scholz, R.W. & O. Tietje, 2002. Embedded Case Study Methods, Integrating Quantitative and Qualitative Knowledge, Sage Publication, London.
- Schwartz, Daniel, Tom Deligiannis & Thomas Homer-Dixon, 2001, The Environment and Violent Conflict. In: Diehl, P.F. & Gleditsch, N.P. (eds.) Environmental Conflict, Westview Press Boulder, pp. 273-294.
- Scialabba, Nadia, 2000. Factors Influencing Organic Agriculture Policies, With A Focus on Developing Countries. Food and Agriculture Organization of the United Nations Rome (FAO), Italy, <<http://www.fao.org/organicag/doc/BaselSum-final.doc>> (01.01.2002).
- Scimecca J. 1993. Theory and Alternative Dispute Resolution: A Contradiction in Terms?. In: Sandole Dennis & Hugo Van Der Merwe, (eds.). Conflict Resolution: Theory and Practice, Manchester University Press, Manchester, New York, pp. 211-221.
- Seckler, David, 1999. Growing Population Faces Shrinking Water Supply. Environment News Service <<http://ens.lycos.com/ens/jul99/1999L-07-20-01.html>> (01.11.1999).
- Seckler, David; Upali Amarasinghe; David Molden; Radhika de Silva & Randolph Barker, 1998. World Water Demand and Supply, 1990 to 2025: Scenarios and Issues. International Water Management Institute, <<http://www.cgiar.org/iwmi/pubs/PUB019/RR019.htm>> (19.08.2002).

- SEI, 1997. Comprehensive Assessment of the Freshwater Resources of the World. Stockholm Environment Institute, Stockholm.
- Sellasie, Dedjazmatch Zewde G. 2000. The Nile River Questions in a New Era of Cooperation Among Riparian States. Paper presented at the VIII Nile 2002 Conference, June 26-29, Addis Ababa.
- Serageldin, Ismail, 2000. World's Rivers in Crisis: Some Are Dying; Others Could Die, World Water Council Press Release, Hague, <<http://www.worldwatercouncil.org/Vision/6902B03438178538C125683A004BE974.htm>> (12.05.2003).
- Sherif Saad M. & M. Ashraf Elewa, 1999. Effects of Floating Aquatic Weeds on Watercourses, and a Proposed Technique for Weeds' Control. In: Proceedings, VII Nile 2002 Conference, March 15-19, Cairo, EGY-40.4.
- SHI, 1999. World Water Resources and Their Use, State Hydrological Institute (SHI), Russia and UNESCO, <[http://espejo.unesco.org.uy/part%604/1\\_africa/index.htm](http://espejo.unesco.org.uy/part%604/1_africa/index.htm)> (01.01.2002).
- Shulte-Wülmer-Leidig, Anne & Koos Wieriks, 1997. Grenzüberschreitender Gewässerschutz am Rhein. In Barandat, Jörg (ed.), Wasser – Konfrontation oder Kooperation, ökologische Aspekte von Sicherheit am Beispiel eines weltweit begehrten Rohstoffs. Nomos Verlagsgesellschaft, Baden-Baden.
- Silverman, David (ed.), 1997. Qualitative Research, Theory, Method and Practice. Sage, London.
- Sipri, 2001. Stockholm International Peace Research Institute (SIPRI), Yearbook 2001, Armaments, Disarmament and International Security, <<http://editors.sipri.se/pubs/pro1.html>> (10.10.2003).
- SIS, 1997. Speech by President Hosni Mubarak on the Launching of Upper Egypt New Delta Project, Egypt State Information Service (SIS), <<http://www.sis.gov.eg/egyptinf/economy/html/e21cent/html/cho1.htm>> (03.12.2000).
- SIS, 1999. Abu Zaid (Minister of Irrigation and Water Resources) in an interview with the Editor-in-Chief of "Al-Musowwar Weekly": Toshka Project Facts and Figures, Feb. 3. Egypt State Information Service (SIS), <<http://www.sis.gov.eg/online/html/0020299a.htm>> (12.12.2002).
- SIS, 2001a. Yearbook 2001, Mega National Projects, Egypt State Information Service (SIS), <<http://www.sis.gov.eg/yb2001f/ehtml/ch11.htm>> (17.06.2003).
- SIS, 2001b. Egyptian State Information Service: Agriculture Goes International, <<http://www.sis.gov.eg/egyptinf/economy/html/eep/html/text25.htm>> (04.01.2002).
- SIS, 2002. L.E. 2405 Billion for Toshka Project Under Current Five-year Plan, Egypt State Information Service (SIS), <<http://www.sis.gov.eg/online/html8/00312220.htm>> (12.12.2002).
- SIS, Mega Projects, Egypt State Information Service (SIS), <<http://www.sis.gov.eg/mprojects/html/proj01.htm>> (04.12.2000).
- SIS, Sinai, National Development for the Development of Sinai, Egypt State Information Service (SIS), <<http://www.sis.gov.eg/public/sinai/html>> (02.12.2000).

- Smyth, Marie & Gillian Robinson, 2001. *Researching Violently Divided Societies*, United Nations University Press, Tokyo, New York.
- Snyder, Jack, 2000. Robert Jervis: Illuminating the Dilemmas of International Politics, Columbia University, <<http://www.apsanet.org/PS/septoo/snyder.cfm>> (10.07.2002).
- Sobhy M., 1993. Effect of the High Dam on Malaria. In: International Commission on Large Dams (ICOLD), High Aswan Dam Vital Achievement Fully Controlled, Cairo.
- Spencer, Tanya, 1998. *A Synthesis of Evaluations of Peace-building Activities Undertaken by Humanitarian Agencies and Conflict Resolution Organizations*, Overseas Development Institute, London.
- Spillmann, Kurt R. & Kati Spillmann, 1997. Some Sociobiological and Psychological Aspects of "Images of The Enemy". In: Ragnhild Fiebig-von Hase & Ursula Lehmkuhl (eds.): *Enemy Images in American History*, Berghahn books, Oxford.
- Spillmann, Kurt R., 2000. Wasser als Thema der Weltpolitik. In: Kaiser, Karl, & Hans-Peter Schwarz (eds.), *Weltpolitik im neuen Jahrhundert*, Bundeszentrale für politische Bildung, Bonn.
- Spillmann, Kurt R., 2002. Of War and Peace, Zürcher Beiträge zur Sicherheitspolitik und Konfliktforschung Nr. 66, Farewell Address, ETH Zurich, July 3, Zurich, <[http://www.fsk.ethz.ch/documents/Beitraege/zu\\_66/zu\\_66\\_content.htm](http://www.fsk.ethz.ch/documents/Beitraege/zu_66/zu_66_content.htm)> (17.06.2003).
- SSI, update June 2003. *Industrial Ecology and Systems Thinking*, Indigo Development, Sustainable Development Division of Sustainable Systems, Inc (SSI), <<http://www.indigodev.com/Systems.html>> (17.06.2003).
- Stumm, Werner, & James J. Morgan, 1996. *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*, Wiley, New York.
- Sudan, 1999. Country Paper of the Republic of the Sudan, presented at the VII Nile 2002 Conference, March 15-19, Cairo,
- Sudan, 2000. Country Paper of the Republic of the Sudan, presented at the VIII Nile 2002 Conference, June 26-30, Addis Ababa.
- Sudanese academic, 2001, Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- Sudanese Ministry of Irrigation and Water Resources, 1998. *Irrigation and Water Resources of the Sudan, Past, Present and Future*, Sudan.
- Sudanese NGO worker, 2001, Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.
- Sudanese technocrat, 2001, Interviews carried out by the author with representatives of this group of stakeholders, experts. The name is omitted for reasons of confidentiality.

- Suliman, Mohamed, 1997. Ethnicity From Perception to Cause of Violent Conflicts: The Case of the Fur and Nuba Conflicts in Western Sudan. A Contribution to: CONTICI International Workshop Bern, July 8-11, Institute For African Alternatives (IFAA), London, <<http://www.ifaanet.org/The%20Inversion%20of%20Ethnicity.htm>> (10.06.2003).
- Suliman, Mohamed, 1999. The Sudan: A Continent of Conflicts – A Report on the State of War and Peace in the Sudan. Institute for African Alternatives, London, Country Risk Profile, Swiss Peace Foundation, FAST, Bern, <[http://www.isn.ethz.ch/publihouse/fast/crp/suliman\\_99.htm](http://www.isn.ethz.ch/publihouse/fast/crp/suliman_99.htm)> (12.12.2002).
- Sutcliffe J.V. & Y.P. Parks, 1999. The Hydrology of the Nile, International Association of Hydrological Sciences, Wallingford, England.
- Taban, Alfred, 2001. New Sudan Dam Seen Boosting electricity, Economy, Sudan.net Sept. 1, <<http://www.sudan.net/news/posted/5763.html>> (12.12.2002)
- Tamrat, Imeru, forthcoming. A Viable Cooperation in the Nile Basin, A Personal Perspective. Background Paper to the EAWAG-CIS Workshop on Sustainable Development and International Cooperation in the Nile Basin, August 2002.
- Taylor, Steven J., & Robert Bogdan, 1998. Introduction to Qualitative Research Methods: The Search For Meanings. Wiley, New York.
- Trochim, William M., 2002. The Research Methods Knowledge Base, 2nd Edition, <<http://trochim.human.cornell.edu/kb/index.htm>> (25.09.2002).
- Trolldalen, Jon Martin, 1992. International Environmental Conflict Resolution, The Role of the United Nations, World Foundation for Environment and Development, Washington, D. C.
- Trondalen, Jon Martin, 1997. Troubled Water in the Middle East: the Process Towards the First Regional Water Declaration between Jordan, Palestinian Authority, and Israel. In: Natural Resources Forum, Vol. 21, No.2, pp. 101-108, Elsevier Science.
- UN, 1997. United Nations Comprehensive Assessment of the Freshwater Resources of the World, Report of the Secretary-General. United Nations Commission on Sustainable Development, April 5-25, <<http://www.un.org/esa/sustdev/freshwat.htm>> (10.12.2002).
- UNCCD, 1999. Egyptian National Program to Combat Desertification, United Nations Convention to Combat Desertification (UNCCD), <<http://www.unccd.int/cop/reports/africa/national/1999/egypt-eng.pdf>> (01.06.2001).
- UNDP, 2000. Human Development Report 2000, United Nations Development Program (UNDP), New York, <<http://www.undp.org/hdro/Backmatter1.pdf>> (01.12.2000).
- UNECO-EOLSS, 2003, Encyclopedia of Life Support Systems <<http://www.eolss.net/>> (19.08.2002).
- UNEP, 2002. Africa Environment Outlook, Past Present and Future Perspectives, United Nations Environment Programme (UNEP), Earthprint, <<http://www.unep.org/aeo/153.htm>> (24.03.2003).

- UNFPA, 1999. *The State of the World Population 1999, Demographic, Social and Economic Indicators*, United Nations Population Fund (UNFPA): New York, <<http://www.unfpa.org/swp/1999>> (01.08.2001).
- UNFPA, 2000. *The State of the World Population 2000, Demographic, Social and Economic Indicators*, United Nations Population Fund (UNFPA), New York, <<http://web.unfpa.org/swp/2000/english/indicators/indicators2.html>> (01.12.2000).
- UNFPA, 2002. *The State of the World Population 2002, Demographic, Social and Economic Indicators*, United Nations Population Fund (UNFPA), New York, <<http://web.unfpa.org/swp/2002/pdf/english/swp2002eng.pdf>> (17.06.2003).
- Ury, William. L.; Jeanne M. Brett & Stephen B. Goldberg, 1988. *Getting Disputes Resolved: Designing Systems to Cut the Costs of Conflict*. San Francisco, Jossey Bass.
- US Environmental Protection Agency <<http://www.epa.gov/safewater/mcl.html#8>> (04.10.2001).
- USAID Sudan Disaster History: Office of Foreign Disaster Assistance, The United States Agency for International Development (USAID), <<http://www.hydrosult.com/niledata/usaiddisas.htm>> (01.01.2002).
- USAID, 1992. *Policy Determination, Definition of Food Security*, The United States Agency for International Development (USAID), <<http://www.usaid.gov/pubs/ads/200/pd19.pdf>> (02.12.2000).
- USAID, 1996. *Performance Monitoring and Evaluation, TIPS, Conducting Key Informant Interviews*, <[http://www.usaid.gov/pubs/usaid\\_eval/pdf\\_docs/pnabs541.pdf](http://www.usaid.gov/pubs/usaid_eval/pdf_docs/pnabs541.pdf)> (27.09.02).
- Väyrynen, Raimon (ed.), 1991. *New Directions in Conflict Theory, Conflict Resolution and Conflict Transformation*, International Social Science Council.
- Vesilind, Priit J., 1993. *Middle East Water - Critical Resource*. In: *National Geographic*, Vol. 183 (5) May.
- Walker, Robert, 1985. *Applied Qualitative Research*. Aldershot.
- Waterbury John, 2002. *The Nile Basin: National Determinants of Collective Action*. Yale University Press.
- Waterbury, John & Whittington Dale, 1998. *Playing Chicken on the Nile? The Implications of Microdam Development in the Ethiopian Highlands and Egypt's New Valley Project*. *Natural Resources Forum*, Vol. 22 No 3, pp 155-163, Elsevier.
- Waterbury, John, 1979. *Hydropolitics of the Nile Valley*, Syracuse.
- Watson, Robert T.; Marufu C. Zinyowera & Richard H. Moss, 1997. *The Regional Impacts of Climate Change: An Assessment of Vulnerability*, International Panel on Climate Change (IPCC), <<http://www.usgcrp.gov/ipcc/html/specprep.html>> (01.12.2000).
- WBGU, 1999. *German Advisory Council on Global Change: World in Transition: Ways Towards Sustainable Management of Freshwater Resources*, Springer Verlag, Berlin.
- Wehr, Paul & John Paul Lederach, 1996. *Mediating Conflict in Central America*. In: *Bercovitch, Jacob (ed.) Resolving International Conflicts*, Colorado. pp. 55-74.

- Weidner, Helmut (ed.), 1998. *Alternative Dispute Resolution in Environmental Conflicts, Experiences in 12 Countries*, Berlin.
- WFP, 2002, Ethiopia 2002, World Food Program of the United Nations (WFP), <[http://www.wfp.org/country\\_brief/index.asp?continent=1](http://www.wfp.org/country_brief/index.asp?continent=1)> (10.12.2002).
- Whittington, Dale & Elizabeth McClelland, 1992. Opportunities for Regional and International Cooperation in the Nile Basin, *Water International*, Vol. 17, No 3, pp 144-154.
- Whittington, Dale; John Waterbury & Elizabeth McClelland, 1995. Toward a New Nile Waters Agreement. In: Dinar, Ariel, & Tusakloehman Edna (eds.). *Water Quantity / Quality Management and Conflict Resolution*, Westport, Connecticut, London, pp. 167-178.
- WHO, 1997. *Guidelines for Drinking Water Quality, Volume 3*, World Health Organization (WHO), <[http://www.who.int/water\\_sanitation\\_health/Documents/GDWQtraining/S10.pdf](http://www.who.int/water_sanitation_health/Documents/GDWQtraining/S10.pdf)> (05.08.2001).
- WHO, 2000. Africa, Water Supply and Sanitation Coverage by Country in 1990 and 2000, World Health Organization (WHO), <[http://www.who.int/water\\_sanitation\\_health/Globassessment/Global6-2.htm](http://www.who.int/water_sanitation_health/Globassessment/Global6-2.htm)> (06.08.2001).
- Wolf, Aaron T., 2000. Indigenous Approaches to Water Conflict Negotiations and Implications for International Waters. *International Negotiation: A Journal of Theory and Practice* Vol. 5, No. 2, <<http://www.transboundarywaters.orst.edu/publications/indigenous/>> (15.12.2002).
- Wolf, Aaron T., 1998. Conflict and Cooperation Along International Waterways. *Water Policy*, Vol. 1, No 2, pp 251-265.
- Wolf, Aaron T. & Jesse H. Hamner, 1998. Trends in Transboundary Water Disputes and Dispute Resolution, Green Cross International, <<http://www.gci.ch/GreenCrossPrograms/waterres/middleeast/wolf.html>> (15.12.2002).
- Wolf, Aaron T., 1997. International Water Conflict Resolution: Lessons From Comparative Analysis. *International Journal of Water Resource Development*, Vol. 13, No.3, pp. 333-365.
- Wolf, Aaron T.; J.A. Natharius; J.J. Danielson; B.S. Ward, & J.K. Pender, 1999. *International River Basins of the World*. *Water Resources Development*. Vol. 15, No. 4, pp. 387-427.
- Wolleh, Oliver, 2000. *Möglichkeiten und Grenzen interner Akteure bei der Friedensbildung in geteilten Gesellschaften*, Die Conflict Resolution Trainer Group in Zypern (1993-1997). Unpublished Ph.D. thesis, Berghof Research Center for Constructive Conflict Management, Berlin.
- World Bank, 1994. *World Bank Operational Policies: Projects on International Waterways*. Operational Policy 7.50, <<http://wbln0018.worldbank.org/institutional/manuals/opmanual.nsf/opolw/5f511c57e7f3a3dd8525672c007d07a2?opendocument>> (01.12.2000).
- World Bank, 1998. *World Development Indicators*, CD-Rom.
- World Bank, 2001. *World Development Indicators*, CD-Rom.

- World Bank, 2002. Outreach, Egypt, World Bank Group: Towards a Poverty Reduction Strategy, Sept. 2002.
- World Water Council, The International Water Policy Think Tank, established in Marseille, 1999. <<http://www.worldwatercouncil.org/>> (17.06.2003).
- Woube, Mengistu, 1995. Resource Use and Conflicts Along the Blue Nile River Basin: The Need for New Conservation Sustainability Measures, Uppsala, Sweden.
- WRI, 1999. World Resources 1998-99, Freshwater Resources and Withdrawals 1970-98, Data Table 12.1, 1998, World Resources Institute (WRI), <[http://www.wri.org/wri/wr-98-99/pdf/wr98\\_wa1.pdf](http://www.wri.org/wri/wr-98-99/pdf/wr98_wa1.pdf)> (01.12.2000).
- Wüsthube, Ljubjana & Günther Baechler, 2002. Intercultural Aspects of Mediation, INMEDIO/DEZA/COPRET Modular Training in Mediation, Solothurn.
- Wüsthube, Ljubjana, 1999. Konflikte nicht unter den Teppich kehren. In: Siga Diepold (ed.): Die Fundgrube für Klassenlehrer. Cornelsen Scriptor, pp. 104-135, <<http://www.inmedio.ch>> (02.02.2003).
- Wyoming Department of Agriculture: A Collection of Water Quality Mathematical Expressions and Relationships, <<http://wyagric.state.wy.us/aslab/wmterms.htm>> (03.08.2001).
- Yang, Hong & Alexander J.B. Zehnder, 2002. Water Scarcity and Food Import – A Case Study for Southern Mediterranean Countries. In: World Development, Vol. 30, No. 8.
- Zehnder, Alexander J.B., 1997. Wasser ein knappes Gut? EAWAG News 43 Dübendorf, June.
- Zehnder, Alexander J.B., 1999. Wassernutzung und Nahrungsmittelproduktion – eine internationale Arbeitsteilung. EAWAG news, 46 D. Dübendorf, Januar.

## Estimating the Useable Amount of Water

One way of trying to estimate the amount of useable waters to be divided, is by using an approximation of the precipitation, total internal renewable water resources or actual renewable water resources in the Nile Basin. The figures of internal renewable resources and actual renewable water resources are reported in international databases for countries as a whole, not for parts, nor for the Nile Basin. Nevertheless, a rough estimate is possible:

- According to Egyptian estimates, the total precipitation in the Nile Basin is (all figures in km<sup>3</sup>/year): 1680 (Egypt 2000).
- The total amount of precipitation in all the Nile countries is 7458.74 or, if one excludes the DR. Congo that only has about 1% of its territory in the Nile Basin, 3840.62 (table 5.3).
- The total amount of internal renewable water resources in the Nile countries is 1187.3, or without the Congo, 287.3, and the total actual renewable resources is 1573.7, or without the Congo, 290.7 (table 5.3).
- Thus the total amount of internal renewable water resources in the Nile is calculated as follows: Basin internal renewable resources = Basin precipitation/Nile country precipitation x Nile country internal renewable resources. Or in figures:  $1680/7458.74 \times 1187.3 = 267.4$ , or without the Congo:  $1680/3840.62 \times 287.3 = 125.7$
- The total amount of actual renewable water resources in the Nile can be calculated as follows: Basin actual renewable resources = Basin precipitation/Nile country precipitation x Nile country actual renewable resources. Or in figures:  $1680/7458.74 \times 1573.7 = 354.4$  or without the Congo:  $1680/3840.62 \times 290.7 = 127.2$
- If these figures are not too far off, and it is probable that they are somewhat inaccurate because of the difference between using figures for the countries and figures for the Nile Basin, then Egypt uses 21–44% and Sudan 8–16% of the internal renewable water resources of the Nile Basin. Egypt uses 16–44%, and Sudan 6–16% of the actual renewable resources (= 55.5 for Egypt or 20.5 for Sudan / basin internal or actual renewable water resources x 100). The lower figure includes and the higher figure excludes D. R. Congo.
- Thus Egypt and Sudan use 4.5% of the Nile precipitation, 28–60% of the internal renewable resources, and 21–60% of the actual renewable water resources in the Nile Basin and 90% of the run-off measured at Aswan (diagram 7.2).

*Diagram appendix I*

	Precipitation	Internal renewable resources	Actual renewable resources
All Nile Countries	7458.74	1187.3	1573.7
All Nile countries minus D.R.Congo	3840.62	287.3	290.7

*Basis for calculations of diagram 7.3*

The definitions of total internal renewable water resources or actual renewable water resources given in the glossary.

## Appendix II

### Moderator Evaluation of the Nile Workshop Process (Hansueli Müller-Yersin)

Hansueli Müller-Yersin, one of the two workshop moderators, wrote the following evaluation:

#### *“Organization / accommodation / logistics*

The workshop was organized by the Center for International Studies, Swiss Federal Institute of Technology, together with the Swiss Federal Institute for Environmental Science and Technology (EAWAG).

All the participants and the two moderators stayed in a hotel near Lucerne, which offered a secluded but very picturesque and quiet setting for the evenings. In this hotel the participants met on the eve of the workshop. At the initial dinner Kurt Spillmann welcomed the participants warmly to the workshop and introduced all participants. The after-dinner hours were spent making personal contacts and renewing former acquaintances amongst the participants.

Both in the mornings and in the evenings all workshop participants were brought across the lake by boat to the EAWAG at Kastanienbaum. The workshop was held in a well- equipped seminar room directly at the lakeside. The very good logistical and organizational support offered by the workshop observer Simon Mason and the workshop assistant Marwa Gouda throughout the whole workshop period was greatly appreciated by all the participants. It contributed much to the smooth running of the program.

#### *Participants*

In their preliminary documents the participants outlined their personal views on the subject of the workshop. These papers indicated that legal and political issues lie at the center of the debate between the Egyptian and Ethiopian participants, and that the participants from Sudan stressed the need for practical step-by-step cooperative solutions. The mix of participants was well chosen: Six highly competent professionals from a wide range of backgrounds (law, political science, engineering, diplomatic field), all of them with personal experience relating to the water-use issues in the Eastern Nile Basin.

*Role of moderators*

Günther Baechler, SDC, Bern, and co-moderator Hansueli Müller Yersin, OECONSULT, Amden, agreed to moderate the workshop together, aiming to facilitate the exchange of information and to strengthen mutual acceptance of personal views and – if possible – to enable a common publication of the participants' finalized papers. The main activities and interventions of the workshop moderators were:

- outlining the workshop setting
- formulating framework and rules
- structuring of work phases and intermissions / time management
- enhancing personal contacts and discussions
- helping to clarify topics by asking questions
- visualizing the interdependencies of topics
- summarizing convergent and divergent ideas
- clarifying the proceedings leading to a common publication

*Main results of the workshop*

The workshop contributed to the establishing / refreshing of personal contacts between the participants. As it proceeded the participants interacted more freely and were more at ease with each other. This was noticeable in the atmosphere of the working sessions: Overall it was more relaxed on the second day.

The mind map of the themes addressed in the workshop visualizes the interdependencies of the topics as seen by this group of experts. As a final step a procedure and timetable for the common publication of the participants' finalized papers could be established and was agreed upon.

*Excursion*

The last day was used for an excursion to the Rigi mountain and a visit to the Sihlsee (artificial lake reservoir; hydroelectric power production for the Federal Swiss Railway system). At the Sihlsee, sedimentation aspects could be discussed with a power plant operator, who afterwards guided the group through the control alleys in the 60-year old dam, explaining its stability and security measures.

At the farewell-dinner at Feusisberg Kurt Spillmann thanked all the participants for the time they had dedicated to prepare the initial documents, as well as for their valuable input and contributions to the discussions at the workshop. The mutual expressions of gratitude and heartfelt reactions of the participants reflected the personal esteem which had developed during this workshop.

*Personal appraisal and critical evaluation by co-moderator (H.U. Müller)*

The workshop aims in terms of enhancing personal contacts and relationships have been reached to a large extent. This workshop has established a good interpersonal basis for further cooperation in view of sustainable water use in the Eastern Nile Basin.

The exchange of views and information, as well as the mutually growing understanding of the participants' views, made it possible to develop a common picture of systemic interdependencies towards the end of the working sessions. This conjointly established analysis also facilitated the development of a common publication. Factors that were helpful:

- highly motivated and competent participants
- good and secluded accommodation (informal personal contacts)
- pleasant surroundings (mountains, lake, boat ride etc.)
- sound preparation, organization and logistics for the workshop

The progressive ease in personal contacts amongst the participants was noticeable also in the atmosphere of the working sessions. As the atmosphere became more relaxed, critical stages in the discussions became easier to detect as they were marked by a more formal interaction.

Such resurgent incidents of “temporary regression” in the discussion atmosphere indicated, that – in spite of improving personal contacts – there was no marked détente on the legal / political opposition of upstream / downstream views in the course of the workshop. Whenever the contested legal issues came up, a tendency towards more rigid “either/or”-logic and conditional argumentation prevailed.

Nevertheless the workshop has helped to clarify and detail the positions and views of this group of experts from Ethiopia, Sudan and Egypt. It has indicated neuralgic points and outlined aspects that might help to ease tensions. It will be for further activities to start developing concrete options and to generate evaluation criteria to help resolve the conflicts in the area over the use of the Nile waters.

*Outlook and Follow-up*

The common publication of the papers from the Kastanienbaum meeting will round up this workshop. It will be important to disseminate this publication to officials and groups of stakeholders in the Eastern Nile Basin as well as to actors in other “tracks” of watershed conflict resolution in the Nile Basin.

*Future activities*

The overall promising outcome of the Kastanienbaum workshop could lead to further activities. These should be carefully coordinated and tuned to other tracks in the conflict resolution process. Personally, I think it might be worthwhile if such activities could lead to regular and possibly more formal exchanges of relevant detailed information

within the Nile Basin. An evaluation on whether this will be done primarily on a local / pragmatic scale or in a greater, more political context will have to be carried out.

To further enhance the conflict resolution process and to facilitate the generation and evaluation of possible options, it might be helpful to compile and visualize relevant data (e.g. hydrographic, technical, environmental, ethnographic, economic data) and make this data base accessible to future stakeholders and especially to actors taking part in future conflict resolution activities.

Hansueli Müller-Yersin, Amden, 12.01.2003

## Appendix III

### Participants' Evaluation of the Nile Workshop Process

The following workshop evaluation stems from the workshop participants, who were asked about the workshop benefits and what they thought could be improved. This is followed by specific answers to the questions in box 3.4:

#### *Benefits*

Participant A: "Participants had the chance to give their independent reflections on the issues of the Nile Water. They got the opportunity to talk informally with researchers from other Nile countries. Participants did not have to represent and advance the views of their government. They had the opportunity to get to know the views of other researchers on the issues. This is a very useful feedback for future research. The organizers and moderators were able to know what issues are sticky and which ones were not. Participants got to know each other better. The research output will be helpful in contributing to the research literature on the subject."

Participant B: "The benefit of the workshop was in bringing together people with long experience, different perceptions and who already knew of each other from their writing or from conferences. The main benefit is to enable the exchange of tacit knowledge based on experience – that cannot be gained from books. The systems approach and mind map could be a leverage for next steps together. The mind map we developed created an image we could take home. Respect, the art of listening and learning is important."

#### *Room for Improvements*

Participant A: "The participants were too careful about touching sensitive issues, to such an extent that the whole exercise sometimes made it appear that there were no problematic issues. It would have been good if some of the known problems and positions had been revisited with the help of the moderators. Participants seemed to exercise caution as regards their home governments. Moderators were too cautious in not going beyond what the participants had to say or what they had written. More issues and independent analysis of the issues could have been useful to check if the participants could deliver independent views from those of their governments. In the deliberations, more comparative analysis of similar situations (e.g. water issues in the Rhine Basin) would have been helpful."

Participant B: “The knowledge café method could improve the interaction and focus. Small groups of two to three of mixed nationalities visit the different knowledge “cafés”. Different tables are set up, with different questions at each table, e.g. “What do you mean by a vision?” The small group discusses the questions and seeks to reply. Then the groups rotate and deal with the other questions. At each table there is a host, who links what has been discussed before. The results are then presented in the plenum. One could ask what are the challenges, what are the visions, and how to get from the challenges to the visions. We could reflect on stumbling blocks, for example how to operationalize the principles of “cause no significant harm” and “equitable use”. Maybe an input from other basins, such as the Danube, could help; how did they put these principles into practice?”

Answers of participant A to specific questions (box 3.4) are given below:

*Questions concerning the workshop in general:*

1. Were the aims of the workshop clearly set and reached?

“Yes, participants were to deliver the interests of the three countries on the water right and use issues. That was clear and met.”

2. Were the ground-rules set and adhered to?

“Yes, they were very clear and they were adhered to.”

3. Was there ever a creative “brainstorming” atmosphere?

“I would say not clearly and specifically.”

4. What was the balance between focus on the past vs. focus on the future? to, as the issues concerning

“Focus was more on the future. But the past was often reverted to, as the issues concerning the past have yet to be changed from static positions.”

5. What was the balance between one-way presentation and interaction?

“There was very good interaction, via questions, clarifications and dialogue over certain issues in the presentations.”

6. What was the balance between communication between the different country participants vs. communication between the participants of one country? Could any instances of “cross-track” communication be observed, i.e. a diffusion of knowledge between the tracks?

“There was no conspicuous cleavage or visible frequent consultations between participants of countries. Rather there was a lot of mixing and informal interaction across participants from different countries. There was a lot of interaction at interpersonal levels.”

7. How were specific environmental issues taken into consideration (sustainability, natural systems boundaries)?

“The question about Baro-Akobo was raised. That triggered the reflection on Jonglei between Sudanese and Ethiopian delegations.”

8. How were sticky issues dealt with? What helped to create a relaxing atmosphere?

“They were not raised too much. Mention was often made that sticky issues are handled at governmental levels. Interpersonal acquaintance at various levels helped very much to go easy and to keep within that knowledge and friendship. Also, the responsibility to be representing views was less strong. The venue, moderation and organizational tone were helpful.”

9. What went well, what went badly, what were decisive changing points, and why?

“On balance, all went well. Nothing in particular went wrong. There was no need for such a thing as “decisive change”. “

10. How were cultural aspects taken into consideration during the workshop?

“Everyone was polite, respectful to one another. That cultural element was well maintained, even after the workshop.”

*Questions concerning the participants:*

11. How was the tone of the participants during the workshop in comparison to their written work and/or their style during public conferences (impact of informality)?

“They did not move too much away from the substantive content of their papers. The papers had an academic orientation. They are not position-oriented, but reflective and evaluative.”

12. Did all participants participate actively during the workshop?

“Yes, but some of course were more active in contributing in the discussions.”

13. What was the disciplinary (social, natural and engineering science) and Track (1 and 2) mix of the participants?

“Except one, all the participants were from social sciences (law, economics, political science, engineering). That did not create any misunderstandings. The subject was jointly analyzed.”

14. Were there moments when the recognition of other perceptions and interests was expressed by the participants?

“Yes, for instance the Baro, Jonglei cases.”

15. How far did the participants differentiate between positions, interests and needs, as well as between different issues?

“This was in their respective papers. The papers gave the framework, which was well delivered by every group. At no time did the participants themselves engage in positioning. However, they reported as researchers and authors on the positions of one or another country.”

16. How well were participants from the other countries seen in a differentiated or stereotypical way?

“Yes, there were some stereotypical utterances on the questions governments disagree on.”

17. How were the participants satisfied with the organization and venue?

See answer to questions 18.

18. What was the participants’ overall satisfaction with the workshop?

“All the participants were satisfied with the organization, venue, selection of participants and knowledgeable moderators of the workshop.”

*Questions concerning the moderators:*

19. What did the moderators do to initiate certain subjects?

“The greatest contribution by the moderators was to engage participants in commonly drawing the road map of the Nile Basin Cooperation.”

20. How did the moderators deal with unforeseen occurrences?

“There were no unforeseen occurrences.”

21. How did the moderators support recognition and empowerment?

See answer to question 22.

22. What did the moderators do to structure and visualize the process?

“Conduct of the sessions was very smooth. Presentations, discussion, debate occurred without additional commitment to resolve it.”

23. Were the moderators all-inclusive and even-handed with the different parties?

“Yes, very much so.”

24. How did the participants rate the moderators?

“Moderators knew the level and tone of the workshop. They went as far as the participants went on the issues. They were unassuming. They were attentive and watchful of matters raised.”

During the oral feedback by the participants at the workshop wrap-up phase, the following points were raised:

1. The venue was agreeable and the organization was good and swift. For some of the participants too many emails were sent out.
2. The flexibility, program and spirit of the workshop were felt to be valuable as one part of the puzzle in the larger picture. The wish for a follow-up workshop was expressed.
3. The moderators' facilitating role and input in the form of structuring and visualization were greatly appreciated.
4. The group selection was seen as vital, a different choice of participants could have blocked the process.
5. The sincerity and appreciative listening spirit of all the participants and organizers were seen as a decisive reason of the workshops success.
6. The workshop was not isolated from other dialogue efforts. As part of all the communication forums in the Nile Basin it was seen as helping “dialogue accumulation” and international cooperation.
7. In summary, the success of the workshop was seen by the participants in: 1) The small number of participants. 2) The choice of participants and the fact that many of them had already met each other beforehand. 3) The informal atmosphere; there was a focus on personal perspectives, rather than on articulating national positions. There was no pressure to agree. 4) The progress and good atmosphere in the workshop reflected the achievements on the ground.

*Ideas for future workshops and follow-up activities raised by the participants were:*

8. Meet experts from another river basin, e.g. the Rhine River Commission.
9. Include further participants in such a workshop, depending on specific issues to be addressed.
10. Use methods that enable in-depth work on specific questions.
11. Develop an exchange of academics and students between the Nile Basin countries, where a group of students and academics visit another country and are then visited in turn in their own country.



## Appendix IV

### Nile Workshop Letter of Invitation

Swiss Federal Institute for Environmental Science and Technology (EAWAG)  
Ueberlandstrasse 133  
P.O. 611  
CH-8600 Duebendorf  
Switzerland  
Phone +41-1-823 55 11  
Fax +41-1-823 50 28  
www.eawag.ch  
Director  
Professor Alexander J. B. Zehnder  
Phone direct +41-1-823 50 01  
Fax direct +41-1-823 53 75  
E-Mail zehnder@eawag.ch

Zurich, July 18, 2002

Dear Sir,

We are organizing a workshop on “Sustainable Development and International Cooperation in the Eastern Nile Basin” and would be extremely honored if you could participate. It goes without saying that EAWAG will provide the academic setting and arrange for all financial and organizational matters. The workshop will take place near Lucerne from the 27<sup>th</sup> to the 31<sup>st</sup> of August 2002.

We have been researching the Nile Basin and following the Nile Basin Initiative process since 1999, with a focus on “lessons learned” for national and international river management. However, during the course of our research we have come to realize that there is very little literature on the topic that represents the various views and interests of the different countries involved. Thus, we have decided to invite leading academics dealing with the subject to participate in a workshop. Our goal is to have representatives from the various countries present their research and share and learn from their colleagues. Different to the “Nile 2002 Conferences”, this will happen in a moderated workshop setting, with two academics from each country (Egypt, Ethiopia and Sudan). As a final outcome we are aiming at a publication by the authors from the different

countries to serve as a comprehensive outlook on the water management issues involved in the Nile Basin.

The Swiss Federal Institute for Environmental Science and Technology (EAWAG) is a research institute that belongs to the domain of the Swiss Federal Institutes of Technology (ETH). Our main activities are research, teaching and consulting on the environment. One of our main concerns is to ensure that ecological, economic and social water interests are brought into line. Our acquired knowledge and know-how is transmitted nationally and internationally through publications, lectures, teaching, and consulting for the private and public sector. The earth's 260 largest rivers (representing ca. 80% of the global run-off) drain about 45% of the planet's land surface, indicating the paramount importance of one our research areas: the sustainable management of international rivers.

I would be more than pleased you could participate in this workshop, as I am sure your input will be a key factor in the success of this endeavor. For further information please refer to the enclosed program.

We thank you for your availability and are looking forward to gearing from you soon.

Very truly yours,

A handwritten signature in black ink, appearing to read 'A. Zehnder', written in a cursive style.

Alexander J. B. Zehnder

## Nile Workshop Program Sent to Participants

### Workshop Organizers

The workshop is organized by Prof. Alexander J.B. Zehnder, Director of the Swiss Federal Institute for Environmental Science and Technology (EAWAG), together with Prof. Kurt R. Spillmann, Managing Director of the Center for International Studies (CIS), Swiss Federal Institute of Technology (ETH) Zurich.

Workshop moderators will be Dr. Günther Baechler, lecturer at the University of Berne, Director of COPRET, Conflict Prevention and Transformation, Swiss Agency for Development and Cooperation (SDC) and Dr. Hansueli Müller-Yersin, seminar lecturer at the Universities of St. Gallen and Zurich, Director of OECONSULT, an environmental consulting office.

Workshop assistants are Simon Mason, general support and workshop evaluation, and Marwa Gouda, for administrative questions.

### Workshop Schedule

<i>27<sup>th</sup> August 2002:</i> Participants arrive	<i>30<sup>th</sup> August 2002:</i> Excursion
<i>28<sup>th</sup> August 2002:</i> 09.00 Workshop starts 18.00 Workshop ends	<i>31<sup>st</sup> August 2002:</i> Departure of participants
<i>29<sup>th</sup> August 2002:</i> 09.00 Workshop starts 18.00 Workshop ends	

*(Detailed schedule will follow)*

### Outline of Paper and Workshop Questions

In order to be able to proceed in a coordinated way during the workshop, we suggest that the structure of the country papers should follow the questions to be discussed during the workshop. We have kept these very general, in order to allow for flexibility. We hope the questions reflect your interests and opinion concerning points to be discussed. If

this is not the case, and if you have any suggestions for changes or additional questions, please notify us as soon as possible, so that we can inform the other participants.

1. What are the interests and needs of your country concerning the use and management of water resources in the Nile Basin?
2. What does your country expect from international cooperation (minimal as well as most optimistic expectation), and what is it prepared to offer in order to enhance cooperation?
3. On which issues is there, from your point of view, a consensus between the three countries concerning the use and management of water resources in the Nile Basin?
4. Where are still open questions?
5. What are the options to deal with these open questions?
6. Other points do be discussed

The length of the country papers will be between 8 000 and 10 000 words.

## Remuneration and Compensation

EAWAG will, as mentioned before, arrange for the workshop facilities. We will also cover all travel expenses (airfare, visa application, train tickets, taxi to and from location). We will make all the necessary airline reservations taking into consideration the participants' needs and our budget. These tickets will either be mailed directly to the participants, or left for pick-up at the local airline office. Should the participants want to extend their stay that can be arranged provided that there is no cost difference for the airplane ticket and we can also make suitable hotel accommodations upon request. Furthermore, hotel accommodation and meals during the workshop period will be arranged and covered. Please note that room charges in the hotel (mini-bar and telephone) are not covered by EAWAG.

### *Paper Remuneration:*

Paper remuneration for the country paper will be paid upon finalization.

## General Information

### *Workshop Venue:*

The workshop will be held at the *EAWAG's Training and Meeting Centre* located in Kastanienbaum. Our quiet and scenic location and building facilities on the shore of Lake Lucerne provide the right setting for courses, seminars, workshops, meetings or conferences for up to 40 persons. The participants will have plenty of space for side

discussions, general discussions and an opportunity to relax in the scenic atmosphere during lunch.

*For further information:*

Swiss Federal Institute for Environmental Science and Technology EAWAG,  
Limnological Research Center,  
CH-6047 Kastanienbaum,  
Switzerland.  
Phone +41-41-349 21 11, Fax +41-41-349 21 68  
<http://www.eawag.ch>

*Hotel Accommodation:*

Hotel accommodation is arranged at the family run Seehotel Baumgarten located on Lake Lucerne (Vierwaldstättersee) in the beautiful village of Kehrsiten only a 20-minutes drive from the city of Lucerne. The area offers beautiful scenery: mountains, forests and a beautiful lake surround the hotel. There are plenty of opportunities to take leisurely strolls in the evening after a hard-working day on the various paths surrounding the hotel. The hotel lies on the opposite side of the lake from the workshop venue, which will give the participants the pleasure of crossing the lake in the morning and in the evening by boat.

*For further information:*

Seehotel Baumgarten  
CH-6365 Kehrsiten-Dorf  
Tel. +41-1-610 77 88  
Fax +41-1-610 76 21  
<http://www.seehotel-baumgarten.com/>  
[info@seehotel-baumgarten.com](mailto:info@seehotel-baumgarten.com)

## Deadline Overview

- 25<sup>th</sup> June: Application deadline (Email or fax confirmation)
- 16<sup>th</sup> July: Visa application should have been submitted
- 24<sup>th</sup> July: Deadline for submission of first draft of country paper
- 20<sup>th</sup> August: Deadline for submission of final draft of country paper

## Contact Information

### *General Questions:*

Simon Mason  
EAWAG and CIS, Swiss Federal Institute of Technology,  
ETH Zentrum SEI  
CH-8092 Zurich  
Tel: +41 1 632 67 67  
E-mail: mason@sipo.gess.ethz.ch

### *Administrative Questions:*

Marwa Gouda  
CIS, Swiss Federal Institute of Technology,  
ETH Zentrum SEI  
CH-8092 Zurich  
Tel: +41 1 632 51 95,  
E-mail: gouda@sipo.gess.ethz.ch

### EAWAG secretary:

Tel. +41 1 823 55 11, Fax: +41 1 823 50 28

### EAWAG Kastanienbaum secretary:

Tel: +41 41 349 21 11, Fax +41 41 349 21 68

### CIS secretary:

Tel. +41 1 632 79 68, Fax: +41 1 632 19 41

## Participant's Application Form

First and Middle Names: \_\_\_\_\_

Last Name: \_\_\_\_\_

Street Address/P.O. Box: \_\_\_\_\_

Area Code: \_\_\_\_\_ State: \_\_\_\_\_

Country: \_\_\_\_\_

Business Phone: \_\_\_\_\_ Private Phone: \_\_\_\_\_

Business E-mail: \_\_\_\_\_

Private E-mail: \_\_\_\_\_

I hereby confirm my participation in the workshop

I will not be able to attend the workshop

I will fly in from my native country.

I will fly in from another location

Please specify \_\_\_\_\_

I wish to extend my stay in Switzerland

Please specify the dates: \_\_\_\_\_

I require extra accommodation and would like EAWAG to arrange for it

Please specify in which city you would like accommodation: \_\_\_\_\_

Please specify price ceiling: \_\_\_\_\_

Other specifications: \_\_\_\_\_

I have special dietary needs which means I cannot eat:

\_\_\_\_\_

Place, date and signature:

Please send this completed form by fax to the following number: +41 1 632 19 41. Application deadline is the 25<sup>th</sup> of June 2002. Should you prefer an electronic version please email Marwa Gouda at: [gouda@sipo.gess.ethz.ch](mailto:gouda@sipo.gess.ethz.ch) to make your request.

## **About the author**

Simon A. Mason, born in Zurich 1971, Dr. Sc. Swiss Federal Institute of Technology, ETH Zurich. M.Sc. Environmental Sciences, ETH Zurich. Trained Mediator (Inmedio/Copret/Deza). Project coordinator of the subproject “water conflicts” of the NCCR North South IP7, “Environmental Change and Conflict Transformation” at the Swiss Federal Institute of Technology, ETH Zurich. Married, two children.