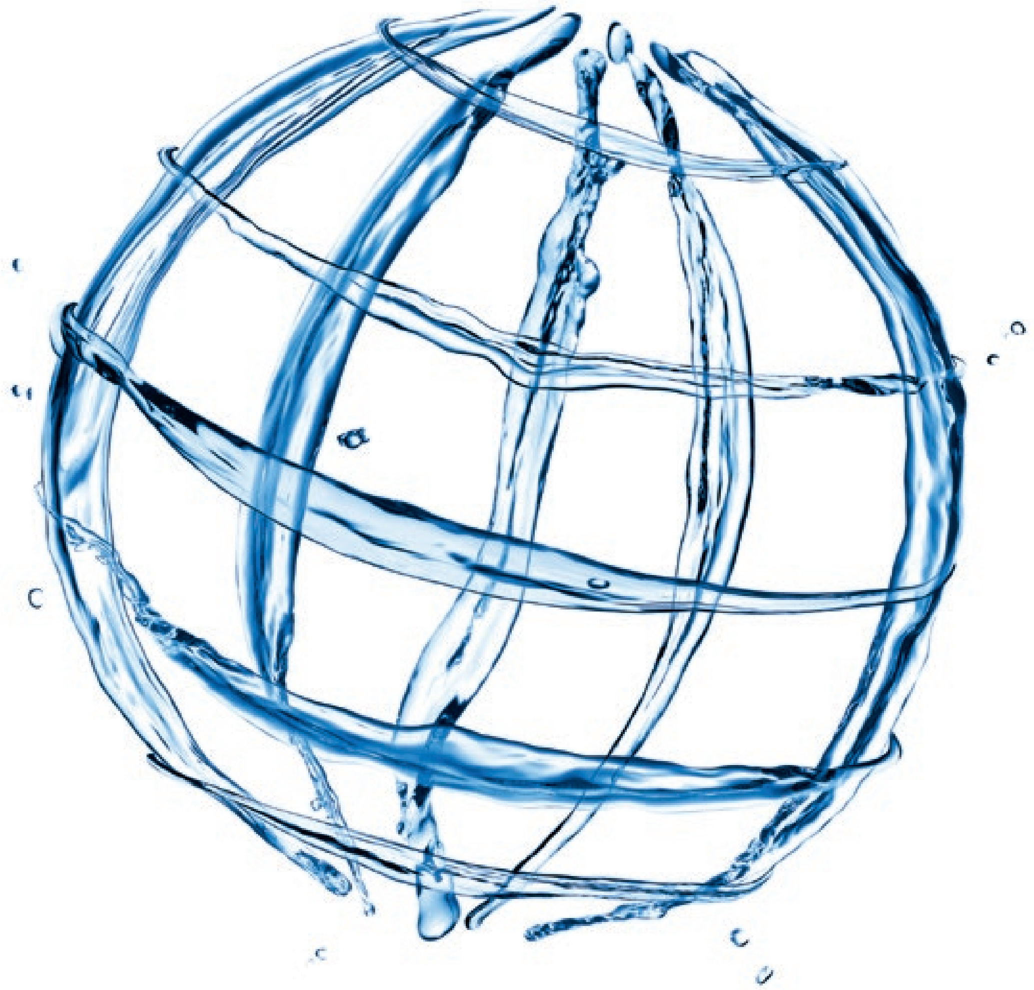
Climate Diplomacy

REPORT



WATER CONNECTS

A Short Guide to Preventive Water Diplomacy

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Climate Diplomacy

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The initiative and this publication by adelphi research gemeinnützige GmbH are supported by a grant from the German Federal Foreign Office.

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See page 54

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Acknowledgements

The author wishes to thank Hinrich Thölken for his great overall support during the development of the guide, and for his helpful suggestions. Needless to say, this does not imply that he necessarily endorses all of the analyses and recommendations. Special thanks go to Benjamin Pohl for his substantive suggestions and diligent support during the editing process. Thanks also to Jenniver Sehring for commenting on the paper, to Anya Malhotra, Helen Rebecca Sharp and Kara Canlas for their editorial support, as well as to a number of German diplomatic envoys for valuable insights and instructive information about their host countries and regions.

Place and Date of Publication

Berlin, December 2016

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EXECUTIVE SUMMARY

Water diplomacy, in the sense of third-party engagement on transboundary water issues, is increasingly being employed by European and other western governments. The main driver is the perception of looming water scarcity, fear of conflicts and even "water wars" in some regions of the world. Studies of global water-related risks back this perception. Currently, however, water diplomacy is still a nascent field of diplomacy; its necessity and instruments are neither broadly known nor employed to their full potential.

The present guide is based on the analysis of water-related economic and political inter-linkages in large shared river basins. It identifies common patterns of focal problems, drivers, sets of instruments and processes, and takes a closer look at conflicts between water utilization objectives. It outlines a general framework for an innovative water diplomacy, provides relevant background information and facilitates formulating promising narratives to promote transboundary water cooperation.

The state of global freshwaters

Per-capita water availability has decreased in many regions of the world as a result of population growth. It is likely that climate change will aggravate this situation or already does so, especially in the earth's dry regions, where social and economic resilience is commonly low. With or without climate change, unpredictable climatic fluctuations have recently triggered or are currently causing disastrous regional droughts or inundations. For vulnerable regions, it is not a question of whether significant enhancements in water management and cooperation will become a matter of survival but only when.

The good news is that solutions are known and proven. It is widely accepted that "the water crisis is essentially a crisis of governance and societies" and that, from a global perspective, sufficient water is available for the present-day population and will be so for some decades.

An estimated 90 % of wastewater in developing countries is released untreated to rivers, lakes and the sea. A worldwide average of 60 % of irrigation water is lost unproductively on its way to the crop roots. Both facts have international implications in transboundary basins. They also strongly suggest that the most significant future source of water availability will be use efficiency and appropriate wastewater treatment.

Conflicts between utilization objectives are much rarer than is commonly assumed. If water is treated appropriately, it can be used several times in succession for most uses. In transboundary basins, which host some 42 % of the global population, there is additional potential for enhanced water management based on cross-boundary cooperation that could be initiated and guided by water diplomacy.

The role and potential of water diplomacy

Water diplomacy aims at initiating and supporting processes at different political scales and levels in order to enhance basin-wide water governance and cooperation, regional integration, development, security and stability. Water-diplomacy is based on the premise that it is the finite and transboundary nature of water resources that offers the potential for basin-wide cooperation. Although the role of diplomacy in transboundary water issues has frequently proven to be successful and beneficial, it is still conceptually and operatively underrated. Transboundary water cooperation has the potential to achieve an even greater overall benefit than the sum of all national benefits. Supplementing the policy fields of development assistance and environmental cooperation with diplomatic competence can create substantial added value at reasonable additional cost. The more difficult the framework conditions, the greater the necessity for using all political resources available.

A fundamental prerequisite: sustainable national water management

Progress in international water cooperation rests on the two pillars of national water management and international water cooperation. Transboundary cooperation can only succeed if national water management is effective and sustainable, and national water man-agement performs better if it is embedded in well-conceived international water governance.

Technical, organizational and political solutions to water problems do exist and are required by many developing and emerging economies. Their implementation rests on a balanced inter-linking of political determination and commitment, sufficient funding, sound implementation and operation, capacity development, integrity and transparency at all levels, water awareness and acceptance by the population. Progress will probably proceed only in small steps. In view of the importance of water issues, international development assistance and environmental cooperation have been right to focus on water issues in bilateral cooperation. International and national NGOs as well as the media can and should also play an important role in increasing water awareness and promoting water education.

Instruments and processes

The development agenda of the UN is a remarkable step towards a common global mind-set and roadmap for water and other related resource issues, e.g. soils. The Sustainable Development Goal (SDG) No. 6 is explicitly dedicated to water issues, and more than a dozen other sub-goals are partially or indirectly related to water. The development agenda is thus a valuable reference point to base international water cooperation and diplomacy on. The mainstreaming of water diplomatic issues in international communication could follow along the lines set out in the development agenda. It is important to create broad awareness of the significance of water for development and for cooperation on international waters. Besides, water diplomacy overlaps with climate diplomacy and is well advised to actively deploy this momentum.

It is strongly recommended that proven state-of-the-art instruments, such as Integrated Water Resources Management (IWRM) be employed. The same applies for the diplomatic support to existing river basin commissions and, on the multi-national scale, for the promotion and implementation of the two major conventions, the UN Watercourses Convention and the UNECE Water Convention *(UN 1997, UNECE 1992)*, the latter now being open to parties outside the UNECE region. The conventions are global standards of legislation for shared waters and still need promotion and implementation.

The wide and diverse spectrum of water utilization makes a cross-sectoral perspective – known as the nexus of water, energy, food and ecosystems – mandatory. Food production and security are inextricably linked to questions of soils and land. Almost all processes of energy production, not just hydropower, work with water. Besides, many water-scarce countries suffer from a shortage of energy even more than from water scarcity.

Particularly in shared river basins, a cross-sectoral perspective has significant potential for improving human well-being and deserves to be promoted. Transboundary and trans-sectoral management of resources will enlarge the pie to be distributed and thus presents a significant alternative to the traditional bargaining among riparian states where a gain in water allocation for one is a loss for the others.

Fields of forces for water diplomacy

There is no silver bullet for water negotiations and processes in transboundary basins; it requires a diversified spectrum of activities and persistent engagement. Key elements and innovations should permanently be advocated for, even if at low intensity, since they need time to be absorbed by the stakeholders in the target regions.

If focused and direct water diplomacy is hampered or blocked, more general and indirect activities, e.g. Track II diplomacy, can take a leading role. Scientific discussions and results can support and pioneer awareness of the significance, potential and solutions of transboundary and trans-sectoral cooperation and to advise policy makers with scientific inputs. Science is freer to exchange views and ponder objective-oriented solutions and less restricted by representative obligations than is diplomacy. Science can recognize negative trends, launch innovative considerations and point the way towards desirable developments. Even in the absence of progress, water diplomacy should stay involved and continue to promote global standards of good water governance and cooperation.

Dominant riparians, whether situated upstream or downstream, tend to have a reluctant attitude towards international water commitments or even open talks because they deem control of transboundary water resources to be primarily their sovereign right. The arguments differ from case to case, the result is the same: any initiative to address the international repercussions of nationally oriented water strategies may be rejected as interference in internal affairs. But these internal affairs will sooner or later predictably evolve into international environmental and sometimes even security problems once unilateral strategic decisions are implemented and come into effect.

Irrigation agriculture is by far the greatest consumer of freshwater worldwide, with claims to water use based on deeply ingrained images of its role in "nourishing peoples". Countries traditionally depending on irrigation which have or claim water-scarcity commonly face the dilemma that agriculture still plays an important role for both national food security and employment, but that this significance is decreasing and will continue to do so. Indeed, several countries in shared river basins have already irreversibly lost their former food self-sufficiency because populations have grown beyond the limits of water-related carrying capacity and import agricultural products at a large scale. However, many simultaneously continue to subsidize irrigation agriculture politically and financially, although this practice withdraws funds for higher-value investments and comes at the expense of other riparians.

But water is more than irrigated food production. Water is development. It generates more employment and income in the industrial and service sectors. Since water resources are limited and water losses in irrigation are tremendous, sooner or later the strategic decision will have to be taken as to how much water should be left for the more productive economic sectors. An increase in agriculture comes up against hard limits because water resources in river basins are capped and cannot be augmented. Sticking to the traditional strategies of resource allocation was feasible as long as apparently unlimited water was available for free. Water-scarce countries already import agricultural products, which is a reasonable way to fill the supply gap. The resulting demand could be a driver for regional trade.

In some tense river basins, riparian governments receive considerable external military support. However, more and better weapons are unlikely to increase riparians' willingness to adopt a cooperative attitude. It would be a great success for water diplomacy if at least a part of these external funds were reallocated to water cooperation-related efforts. The security and economic dividends would eventually turn out to be higher and more sustainable.

Outlook

Within a complex field of forces there are many possible paths for water diplomacy. A se-lection of important and promising ones is set out in the present guide. The individual path will depend on the interests and capacities of involved actors, on the specific requirements and circumstances in the target regions and on actual developments. Although the main responsibility rests with the stakeholders and governments in transboundary basins, the scale of the challenges and their potential repercussions for regional and even global security and prosperity imply a strong justification for external involvement and support. An involvement of water diplomacy can reasonably be expected to support regional development and security, and indeed, it is mandatory in light of deteriorating environmental and demographic conditions. There is an increasing need to pull out all stops, the earlier the better.

ABOUT THIS REPORT

Water is a substance with many surprising characteristics, not just in a scientific but also in a political and diplomatic sense. Conventional diplomatic mechanisms often have their limitations with regard to transboundary water issues, particularly in regions where they are most needed, either because parties refuse talks or because compromise remains elusive. As this paper demonstrates, it is often the unique nature of water that lies behind these deadlocks. But at the same time, its immanent nature also suggests solutions. To develop these solutions and the supporting narratives in water diplomacy requires some background in water sciences that is not common currency in political discussions.

This report is an attempt to bridge the gap between water-related sciences and policy making and to contribute to setting the scene for integrated, preventive water diplomacy. It is the distillate of several years of experience in water diplomacy at the German Federal Foreign Office, with a view to sharing the lessons learned with actors in and related to water diplomacy and cooperation. The report addresses diplomats, technical staff at the interface between governance and policy issues, non-governmental organizations as well as think tanks and scientists, who are or become involved in international water issues. It aims to give insights into different sectoral perspectives in order to facilitate a case-specific development of diplomatic narratives and solutions in tense situations.

The report gives special weight to trans-sectoral perspectives on transboundary water cooperation because these have special potential in contributing to overcoming existing negotiation deadlocks and to designing promising and sustainable solutions for transboundary cooperation.

The report evaluates and reflects on situations in selected transboundary river basins from an empirical perspective, presenting results in a synthetic fashion. Any appearance of taking sides in a dispute is unintended and, in case it occurs, it is the result of scientific consideration. It does not, in any way whatsoever represent official German positions.

The report
- summarizes relevant fundamentals of water and environmental sciences relating to international water cooperation for readers who are not familiar with the former but involved in the latter;
- clarifies common misconceptions on international water issues, which often undermine objective perceptions, and complements the discussion by drawing attention to facts and relationships that are rarely discussed, underrated and often misperceived;
- points out the interlinkages and political implications of water and political processes; and
- is intended to support the development of new water diplomacy instruments and narratives.

The report is designed for a varied audience, with different parts addressing varying interests. After setting the scene in Chapter 1 and 2 addresses the scientific and political aspects of water cooperation respectively. Chapter 3 summarizes the political inferences and recommendations and can also be read as an extended summary. Separate text boxes elaborate technical terms to provide additional background information for those who are interested or need greater detail.

INTRODUCTION

Water is increasingly receiving global attention as a social and political issue. Climate change, water scarcity, inter-state tensions and even armed conflict between countries are frequently mentioned in the context of water. It is likely that climate change will impact negatively on water availability, especially in the earth's drier regions, which are generally also poorer. Pressure on water resources is already high in these areas, while at the same time social and economic resilience is low. Demographic growth, economic development and water pollution further widen the gap between the supply of and demand for water.

Typically, countries in the planetary dry belts are also affected by rapid population growth, low education levels, high dependence on agriculture, and, consequently, poverty. In vast regions, drinking water has to be fetched from more or less remote wells or water holes, which is traditionally a women's task.

What is less widely known is that sufficient water is available for the present-day global population, that this will continue to be the case in the near future, that used water is potentially recyclable several times in succession, and that huge amounts of water are being wasted. Ever since it was originally mentioned in the United Nation's first Water Development Report *(UNESCO 2003),* it is widely accepted that "the water crisis is essentially a crisis of governance and societies".

Why does water, of all things, play such a crucial role? Water is more complex than any other resource. Water is not only vital from a biological perspective, is also indispensable for many other aspects of life and the economy. Water is an irreplaceable resource for food production and for almost all economic sectors, including industry (notably most energy-related processes) and the service sector. Climate adaptation is primarily water-related. Water crosses political borders, and human capacity to control water and its flow is and will remain limited.

However, an estimated 90% of the wastewater in developing countries is released untreated to rivers, lakes and the sea *(UNEP 2010).* A worldwide average of 60% of irrigation water is lost on its way to the crop, which is to say unproductively *(Jägermeyr et. al 2015).*

National water sectors in water-scarce countries by and large require urgent improvement. There are technical, organizational and political solutions to existing water problems. These solutions need to interact sensibly to produce sustainable improvements. Moreover, they require sustainable funding and time. This is why much of international development aid already focuses on the water sector. But what is often lacking is enhanced transboundary cooperation in affected river basins.

THE ROLE OF FOREIGN POLICY

The role of foreign policy within the scope of transboundary water policy has been conceptually and operatively underrated so far. Water-diplomacy is based on the premise that it is precisely the finite and transboundary nature of water resources that offers the potential for basin-wide cooperation. This is evidenced by successful examples, such as the multilateral Sava Treaty *(International Sava River Basin Commission 2002)* following the civil war in former Yugoslavia, the first post-war agreement between former enemies. In contrast to foreign policy, development assistance and environmental policy are traditional fields of political action in the water sector. But supplementing these policy fields with diplomatic competence can create substantial added value at reasonable additional cost by tapping the potential that arises from transboundary cooperation. The more difficult the framework conditions, the greater the necessity for using all political resources available.

As soon as questions of national sovereignty are perceived to be impinged on, which is frequently the case in transboundary water issues, the involvement of the highest political levels becomes inevitable. Foreign policy needs to get involved for transboundary water issues to be addressed internationally. The bundling of international communication and negotiating internally balanced positions is a classic task of ministries of foreign affairs (MFAs). In conflictive basins, there will hardly be substantial progress in water cooperation without the involvement of the MFAs.

In nearly all large water-scarce river basins, the potential for cooperation is not yet fully recognized and taken into account in the national politics of the riparian states. This is despite mostly unfavourable framework conditions that, given global population growth and economic development, continue to deteriorate. The outbreak of crises, and possibly even catastrophes, is merely a matter of time. Unpredictable climatic fluctuations can trigger disastrous regional droughts or inundations any time and have done so recently. During the final editing of the paper *(May 2016),* the drought situation in Ethiopia *(Jeffrey 2016)* and India *(Vyas 2016)* is worsening, in Brazil continuing *(Poindexter 2016).* It is not a question of whether significant enhancements in water management and cooperation will become a matter of survival but only when. Yet reacting to disasters or to the emergence of violent situations can just mitigate the worst.

Water diplomacy needs to be anticipatory and cross-sectoral. It aims to preventively initiate and support sustainable supply security, development, regional integration and stability in transboundary river basins. National and international experiences and lessons learned in this field offer a valuable and solid foundation. In the past, successful broader cooperation in riverine catchments resulted from cooperation on the water issue.

Germany could contribute significantly to water diplomacy because it has many years of wide-ranging experience in water technology, institutions and water-related education. This includes the outstanding work of its national Water Boards, experience with transformational processes from subsidized to cost-covering water management, and the conversion of post-mining landscapes into unpolluted and maintenance-free landscapes. Moreover, Germany is also a member of seven international water commissions[1], including for the Danube, which is the most international of all rivers worldwide with 18 riparian states. Germany is part of a community of like-minded and dedicated nations which share the same attitude and engagement. For many years, the United States have assigned a coordinator for international water policy. The EU has also been actively shaping and developing this policy field by adopting the Council conclusions on EU water diplomacy (22 July 2013) *(EU 2013)*.

Coalitions and resolutions of like-minded actors to successfully promote the objectives of preventive and sustainable water diplomacy are promising.

[1] Rhine, Danube, Elbe, Oder, Maas, Moselle/Saar, Lake Constance

I. THE SETTING

There are 263 transboundary river basins (catchments) worldwide. Only 40 % of these are managed in a coordinated or even collective way *(UNESCO 2003).* Many of these catchments are experiencing a critical development, i.e. their national economic and demographic parameters are on a downward trend, starting from an already low baseline. Critical river basins are characterized by major demographic growth, a high level of dependence on irrigation water, low education levels of much of the population, weak civil societies and/or autocratic governments generally lacking innovative power.

In arid regions, the water supply of many countries depends in part or entirely on inflows from upstream riparian states, often provided by allochthonous rivers (see Note 1). In many of these countries, irrigated farming is a major employer and food producer, and is also vital for GDP and national export earnings. The convergence of rising demand for water due to growing populations, increasing industrialization and changing dietary habits on the one hand with decreasing availability due to unproductive water losses, expansion of irrigated lands, pollution and climate change on the other hand leads to increasing aggravation of the situation in numerous major transboundary river basins and dry regions. Open conflicts over water resources have not yet erupted, but even if they do not, low-threshold conflicts with a potential for future escalation are imminent and could, in a worst case scenario, trigger humanitarian and ecological disasters.

Water makes the difference: The floodplain of the Nile with fertile soils, water availability and favorable climate conditions formed the traditional basis of its economy and nourished the Egyptian people for millennia. Recent population growth has overstressed the carrying capacity of the natural resources.

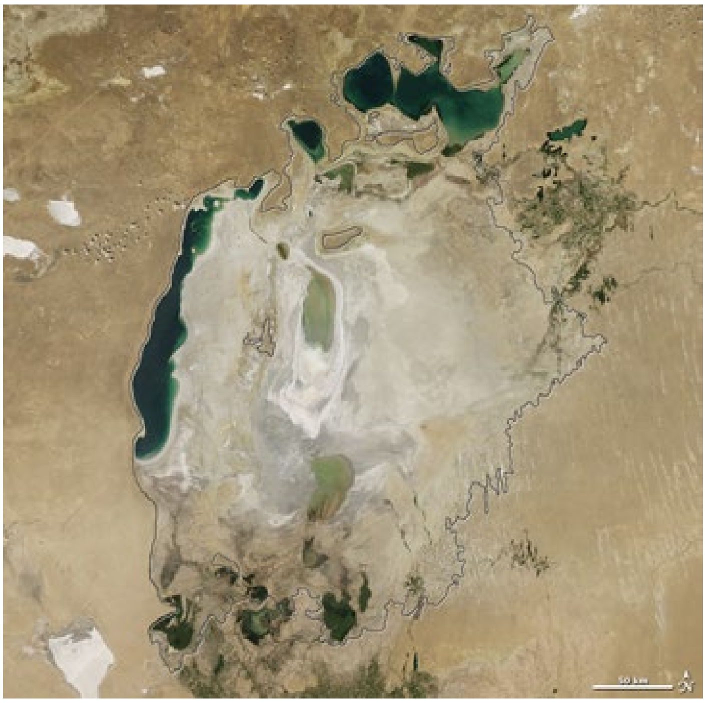
Note 1 ARID REGIONS AND ALLOCHTHONOUS RIVERS

Dry regions may benefit from large rivers which originate in moist regions somewhere else and cross both deserts and national boundaries. These broader conditions have implications for water management and water diplomacy, e.g. an aggravated upstream-downstream dichotomy.

In humid latitudes, rivers become larger as they flow downstream, fed by tributaries. In arid regions, evaporation exceeds rainfall by far, due to which few or no rivers originate there. Streams arising from humid, often mountainous areas that cross arid regions and are not fed by tributaries along their courses are called allochthonous rivers. Their discharge volume decreases in arid regions due to evaporation and seepage. Some of the most famous examples are the Nile in Sudan and in Egypt, the Tigris and Euphrates in Syria and Iraq, the Amu Darya and Syr Darya in Central Asia, the Jordan River in Israel and Jordan, the Niger River in Mali, Niger and Nigeria, and the Colorado River on the Colorado Plateau.

Allochthonous rivers harbour a special potential for conflict, as the discharge downstream is usually further reduced by water abstraction upstream in addition to natural losses. The riparian states worldwide that are most reliant on inflows are located in the basins of allochthonous rivers. Often, they depend on just one major inflow. 100 % of agricultural areas in Egypt depend on irrigation, 88 % in Pakistan (the Indus River from Jammu and Kashmir), 57 % in Bangladesh (the Brahmaputra River from Tibet) and 33 % in India.

The reduction in discharge along the courses of allochthonous rivers causes degradation of water quality as the dissolved load and pollutants become more concentrated downstream due to loss of water by evaporation and mobilization of dissolved matter during soil passage in irrigation areas. The river water is repeatedly reutilized, i.e. the water recurrently passes new cycles of irrigation, soil passage and/or drainage, where additional mineral salts, fertilizers and agrochemicals are dissolved and henceforth remain in solution. Along allochthonous rivers, it is essential to maintain water quality as good as possible.



The Aral Sea (shore line 1960 solid black, satellite image 2015) shares the same fate as several other dryland inland lakes, e.g. Lake Chad, the Dead Sea, Lake Urmia (Iran): heavily increased water withdrawals along their inflows for irrigation reduce water levels and let lakes shrink and fishery die *(Forschungsstelle Osteuropa 2012).* They can be restored to the extent that withdrawals along the tributaries are reduced.

To note a few examples of these issues: The water level of the **Aral Sea** has sunk by 28 meters, and the remaining expanse of the lake is just 10 % of its original size *(UNDP 2006).* Wind-blown salt from the former lake bed is causing large-scale environmental damage in Central Asia *(Forschungsstelle Osteuropa 2012).* Lake Chad has shrunk to a tenth of its size and will turn into a seasonal lake unless the underlying conditions are changed. While the original lake reached up to Nigeria, Niger, Cameroon and Chad, the remaining lake is confined to Chad. Just a small fraction, if any, of the discharge of the **Colorado River** and the **Rio Grande** reaches Mexico.

Death of the Colorado River. Overexploitation of water resources may lead to the complete disappearance even of large allochthonous rivers downstream.

The three major rivers of the Indian subcontinent originate in the Tibetan highlands. The Indus River, source of life for the 180 million inhabitants of Pakistan, first crosses Indian territory. Bangladesh (approximately 140 million inhabitants), which occupies large parts of the shared delta of the Ganges and the Brahmaputra (see Note 2), is not known for drought and water shortage. Yet its pre-monsoon period, a vital stage of the growing season, is dry. During that period, agriculture is highly dependent on the water of the Brahmaputra, called Yarlung Tsangpo in Tibet, and the Ganges. India is planning to withdraw water for irrigation on a large scale. China is implementing plans to divert large amounts of water from rivers originating on the Tibetan plateau to its dry northeastern regions. The infrastructure required is huge, the costs likewise, and the ecological and international impacts are unpredictable. The mere increase of supply in the dry parts of China is unlikely to solve the structural problem *(Barnet et al. 2015).* Yet once these mega-projects are implemented, they are expected to pay off. At that point, the leeway for strategy changes and international negotiations is significantly reduced.

Note 2 **DELTA REGIONS**

Deltas are accumulations of solid river load that expand as land surface into the sea or into lakes. On maps or satellite imagery they can easily be identified and they often constitute traditional and densely populated areas of settlement. This is due to natural favourable factors such as fertile soils, flat terrain, availability of freshwater (near-surface groundwater), prevailingly favourable climate conditions and the absence of tides. Risk factors such as flood hazards emanating from the river or the sea, or caused by sea level rise or tsunamis, high groundwater tables (waterlogging, salinization) and medium-term subsidence due to the natural compaction of delta deposits were outweighed in significance by the favourable factors.

Delta regions are generally densely populated but particularly vulnerable to changes in environmental conditions, such as sea level rise and poor water quality from upstream water users, among others.

Inland deltas are located onshore rather than along coastlines. Among the best known ones are the Sudd in Sudan, a vast swamp region, the Okavango Delta and the internal delta of the Niger River in Mali. They develop in low-sloping flat parts of river basins and are either periodically flooded or constitute large, wetlands. Their diversity of flora and fauna can be a tourist attraction, but they also evaporate much water.

The Nile River and delta form the mainland of historical Egypt. Delta and floodplain formation results from solid river load accumulation, the delta encroaches upon the Mediterranean. Characteristically for allochthonous rivers in dry regions, a clear-cut boundary without transition fringe separates desert and floodplain.

Despite the adverse framework conditions for sustainable change to be achieved, technical, organizational and political solutions do exist. However, these solutions are not yet receiving sufficient support, and follow-up is inadequate, especially in critical regions. And yet the resource of water in all its manifold facets of utilizations could serve as a basis for peaceful cooperation in which riparian states, apart from gaining peace and security, could collaboratively benefit more than they can achieve on their own. Thus far, little attention has been paid to these considerations. They have not been implemented and are often subordinated to other interests.

Although water allegedly causes conflict, a number of historical examples reveal its potential to initiate regional cooperation and integration. Water has been a gateway to peaceful cooperation, as in the case of the Danube River, where talks and agreements went on even during the Cold War era, or in case of the agreement on the Sava River (International Sava River Basin Commission 2002), a tributary of the Danube River, which was the first treaty concluded after the end of the civil war in former Yugoslavia in recognition of the vital importance of transboundary cooperation for the nations in the river basin.

Target-oriented concepts, administrative development, assertiveness and the political will necessary for improvement through efficient action is often weak in the riparian states concerned. Water, whether for drinking or irrigation purposes, remains a subsidized resource in most countries and the root causes of water problems are preferably externalized.

The issue of water cooperation differs from the issues of climate change and security in that water – apart from the oceans – is a regionally confined resource. Issues of water scarcity, water security and water cooperation do not receive the same political attention that is devoted to climate diplomacy. Yet many climate change impacts exacerbate already tense situations in the water sector, and water-related changes embody climate change for many societies.

WATER AS A RESOURCE

Water is a unique resource in comparison with all others. It is not only the fundamental substance for life on earth, but also hardly substitutable in numerous industrial and economic processes. Physically and as a resource, water has several distinguishing characteristics with implications for its management. Water is

- vital, being required for existence only in small volumes (5 litres per person per day), but necessary on a daily basis and in hygienic quality;
- ubiquitous, existing everywhere on earth, even in the driest deserts, but in highly varying quantities both temporally and spatially;
- mobile and volatile, circulating between atmosphere, land and oceans, naturally renewable, crossing political borders, removed by evaporation and thus withdrawn from local availability;
- versatile but not or hardly substitutable in most industrial processes, especially energy-related ones;
- vulnerable to pollution, with the downstream riparians empirically being affected more;
- reusable, even repeatedly, and able to be recycled through appropriate management that requires administrative and financial effort and is energy consuming.

Water is **essential** for life on earth. Humans require only small amounts of water to survive, but the supply needs to be regular and the water quality hygienic and safe. Among the human rights, the one to drinking water and sanitation has been established and developed since 2008 *(UN 2015b),* but poor-quality drinking water still causes various diseases, often resulting in death. Annually, 1.8 million people die from diarrhoeal diseases (including cholera); 90 % (approx. 4,400 per day) of these are children under the age of 5, mainly in developing countries *(UNESCO 2012).*

Two boys fetch dirty water of unknown origin from a trickle directly by the street in a slum.
Water education is an imperative for all affected target groups.

Water is **ubiquitous,** it exists even in the driest deserts of the earth. Man has tapped water resources for food and energy production since time immemorial.

Water is **renewable,** it runs in global cycles. On a catchment scale, it is constantly being removed from land surfaces by evaporation and discharge. After evaporation it is no longer available for economic processes in the source basin, but may precipitate somewhere else. At the global level, the economic process that removes most freshwater from land surfaces is irrigation farming.

Water is **mobile.** Rivers flow within natural areas, "river basins" or "catchments", bounded by watershed divides – following the topographic inclination of the landscape. It sometimes forms political borders and may also cross them. The same is true for groundwater flows. Rainfall reduces dependence on inflowing surface waters. It is not transboundary, however, and thus is not an immediate issue of water diplomacy (see Note 3 on virtual, green and blue water).

Water is **limited.** Due to increasing mechanization and cheap energy, water extraction from surface and groundwater bodies has today reached quantities that approach the renewability rates of even large hydrological systems. Many freshwater ecosystems worldwide are qualitatively degraded to the limits or in excess of their self-cleaning capacity.

Agricultural fields in the floodplain of the Euphrates River in Syria. It originates in Anatolia and flows into Iraq.

The **diversity** of water uses comprises drinking water, sanitation, food production, fishing, energy production, industrial process applications, cooling, transportation and tourism. Water is an integral factor in the protection of nature and the environment, in biodiversity and in the water-related recreational and tourism sector. The variety of uses bears potential for conflicts, but users' interests also overlap in some cases. Some are mutually indifferent.

Water is **vulnerable.** Contaminations are commonly emitted to water even from unpolluted environments. As an opportune means to wash away all kinds of unwanted substances and waste, its contamination usually increases further downstream, unless managed sustainably. As a consequence, downstream riparians and dry regions are more affected by water pollution.

Water can be **recycled** and **reused.** Polluted water can be purified, but the more complex the contamination, the costlier, more difficult and time-consuming the treatment becomes. Efficient treatment requires a hydraulic and institutional infrastructure, technical and organizational know-how and economically viable operations, legislation and administrative enforcement capacity. However, standard treatment does not remove all contaminations. The remaining purification is provided by ecosystem services.

German industry has an average reuse factor of 5.8, i.e. it uses water almost six times *(BMU 2011).* Conventional sewage plants are designed for municipal and small-trade sewage. They consume plenty of energy (approx. 1 kWh/m³ in Germany *(Rosenwinkel and Hinken 2006),* i.e. approx. 160 GWh/year in Berlin versus approx. 920 GWh in Beijing), and entail costs and CO_2 emissions. The extensive purification of water in terms of bacteriology, chemistry and physics is a service provided by the near-surface bedrock and aquatic ecosystems. Industrial wastewater can contain other, highly toxic substances (heavy metals, halogenated hydrocarbons) requiring special purification processes. Drug residues and hormones (micro pollutants) are increasingly impairing drinking water quality in Europe, as they are quite persistent to conventional purification and natural self-cleaning processes. They have become ubiquitous in groundwater and pose a challenge to water management as their emission is hardly containable and their removal requires new, expensive processes.

Avoiding contamination is preferable to follow-up treatment. In the vast arid environments of the world, centralized supply and disposal infrastructure is hardly economical or viable, semi-centralized or decentralized solutions are a better choice.

The vicinity of rivers is favourable for industrial and power plants since rivers and floodplains usually provide transportation facilities, be it by ship or train, as well as cooling and process water.

Note 3 VIRTUAL, GREEN AND BLUE WATER

The water equivalent for the production of goods, denominated as virtual water, particularly for food and other crops, has proven a useful instrument in linking food production to water management aspects. It is the amount of water that has to be provided at the place of production somehow. On national or lower levels, it allows for water efficiency evaluations, on the transboundary level for import/export flows in terms of consumed water. The categories green and blue water classify the origin of the virtual water used and allow assessment of the value and implications of the consumed water with reference to sustainability, economic terms and good water management.

The water that is consumed, polluted or evaporated during the production process of a product is called virtual water. The virtual water concept allows quantifying the use of water during the manufacture of goods by individuals, companies and nations. The production of one kilogramme of wheat or bread consumes 1,300 l of virtual water, while one kilogramme of rice consumes 3,400 l, and one kilogramme of beef consumes 15,000 l *(UNESCO 2012)*. As for cereals, most of the water is needed for growing the crop, while in the case of beef it is mostly used in the production of animal feed. The amount of virtual water for a certain product has to be provided somewhere and somehow, be it by ecosystem services, irrigation or neighbour riparians. Based on the equivalence of goods and their virtual water "content", water footprints for individuals, nations and companies, it becomes possible to determine water exchange balances and trade among nations in terms of water. Additionally, water use efficiency can be quantified and compared.

In Germany, domestic daily water consumption is around 120 l per person, only 5 l of which are directly consumed through drinking and cooking. However, virtual water consumption, including imports, is assessed at 5,400 l *(WWF 2009)*. The per capita renewable water resources in Germany amount to 3,900 l/day (1,430 m³/year) *(WWF 2009)*. Virtual water imports over compensate the shortfall, but Germany also exports virtual water.

Large quantities of virtual water are lost through wasted and spoiled food; in less developed countries predominantly at the beginning of the supply chain, in industrialized countries more at the end of the supply chain.

Green water denotes soil moisture recharged by precipitation. It is a fundamental source for plant growth. In temperate climate zones, green water sustains extensive vegetation and rainfed agriculture. Another characteristic is that it can be utilized without causing opportunity costs. Green water cannot be withdrawn as ground and surface water and does not cross borders.

Blue water includes rivers, lakes and groundwater bodies. These bodies flow according to gradients and can cross political boundaries. The use of blue water entails additional effort and opportunity costs, such as drilling, pumping, and the establishment of irrigation schemes.

Rating the use of virtual water depends largely on its origin. Apart from certain exceptions, the consumption of green water is generally more environmentally adapted than the use of blue water. The export of blue water extracted from transboundary basins with water distribution conflicts (e.g. oranges from Israel, cotton from Uzbekistan, rice from Egypt *(Egyptian Ministry of Water Resources and Irrigation 2013)* and from areas where the extraction has environmental and/or social impacts *(e.g. sugar from Ethiopia, see Avery 2013)* or does not contribute to food security should be critically questioned. A shift to more water-efficient products, for example wheat instead of rice, and the avoidance of beef production in unsuitable regions would help to save significant amounts of water. Prioritizing national food security over growing cash-crops for export could also contribute to reducing national water demand and subsidies for imported food.

PERCEPTION OF WATER AND WATER RESOURCES

For thousands of years, water has influenced human awareness, economy and culture. Agriculture, individual subsistence and the power of states, particularly in the planetary dry zones, depended on the availability of water. The population explosion and the industrial revolution sharply increased water extraction from natural water cycles and the emission of water-polluting substances. For this reason, water is beginning to approach the limits of its per capita availability in significant regions of the world and has already exceeded them in some. Humans also affect water quality on a global scale through biologically active contamination like drug residues, hormones and plastic particles. However, people still cling to their traditional mental images of water and water resources. Water is broadly perceived and treated as

- infinitely available: it comes down from heaven or from upstream and is continuously available without own efforts;
- disposable and to be polluted arbitrarily: severe contamination is often invisible, whereas visible pollution is washed away;
- free of charge, a gift from God;
- a national acquis at the political level and an object of national sovereignty, not suitable for sharing on the basis of international commitments, and something that can and should be used for national economic benefits to the fullest extent possible;
- a provider of food security for the population;
- a reason for externalizing claims and problems, often towards the upstream riparian(s), which is quite common in transboundary river basins;
- something to be provided to the population by the state at low or no cost;
- fully manageable and controllable. Water problems, e.g. flood assessment or water supply are felt – and suggested – to be resolvable by technical engineering. Whatever is feasible is perceived to be mandatory.

Moreover,

- the existence, reduction and pollution of groundwater is beyond direct sensory perception;
- on a national scale of recipient nations and regions, ownership of externally aided good water governance and management policies lags behind.

The most common perception of water as a resource in regions along large rivers is the one of permanent, unlimited and free availability. The perception is fed by the historical experience of apparently unlimited replenishment from upstream because for population numbers of the past the resource was indeed abundant. This has significantly shaped cultures and still determines their strategic orientation today. Today, the subsidized availability of water resources encourages ecological and economic malpractice, creates misleading incentives and therefore prevents the development of sustainable water management and economical practices. Irrigation infrastructure is set up even in cases where the hard upper limit of water resources is well known and competing riparians' demands are foreseeable.

In most parts of the world, rivers are misused as dumps for liquid and solid waste. Waste contains or emits hazardous substances and bacteria to water bodies, eventually to the oceans. Contaminants inevitably enter the food chain of man.

The **quality** and **vulnerability** of water are rarely recognized to their full extent, if at all, because few serious contaminants are visible. Broader awareness of, for example, hygiene or quality nexuses could reduce water-borne diseases among the population and increase pressure on poor water management practices. Decision makers need to know that omitted investments for sound water management cause costs in the long run that are in excess of what was apparently saved.

Water itself is indeed free of charge, but that does not necessarily apply to water services, i.e. the tapping of new sources, purification, transportation, distribution and expenses for wastewater treatment. These costs need to be covered in order to permanently guarantee the quality of water services, ideally in accordance with integrated water resources management. Sound journalism could and should contribute to spread this knowledge and raise broad awareness.

The water of the Dead Sea appears clear and clean, although it contains 25% of dissolved salts rendering it unsuitable for any utilization except limited wellness activities and the extraction of salts. In general, dissolved substances or bacteriological contamination are usually invisible, even if hazardous or in high concentrations. Transfer of contaminants or salinized waters to downstream riparians is a basic problem in transboundary water management.

The existence and profitability of agricultural production using irrigation is dependent, among other factors, on the availability and price of irrigation water. That price should include the costs for construction, maintenance and operation of the irrigation infrastructure (handling costs). Providing irrigation water below the cost of water services is a de facto subsidization of agriculture. Irrigated agriculture, like all subsidized sectors, tends to be conservative, has a strong interest in a low water price and the continuation of the economically favourable status quo, with little interest in investments for enhancing water efficiency. Empirically, agricultural lobbies have a strong influence on national politics.

Dominant riparians tend to consider water to be their **national property** and also claim national sovereignty for upstream transboundary water resources. Turkey needs the water resources of the Euphrates and Tigris rivers for hydropower but has committed that it will release a fixed rate of 500 m^3/s (16 billion m^3/year) water from the Tigris to Iraq. Complaints by Iraq to receive a "fair share" (see Note 7, Fair Share) are countered with the argument that Iraq would not discuss common use of its oil reserves, although this would be precisely what was demanded for the water resources of the Tigris and Euphrates rivers. Egypt opposes Ethiopia's plans to build and to fill the reservoir behind the Grand Ethiopian Renaissance Dam (GERD) at the Blue Nile as severe threat to its water supply. Although the filling phase would be temporary and the storage volume of the Aswan Dam reservoir could compensate the shortfall, Egypt insists on the application of legal agreements, in this case the colonial-era Nile Water Treaties of 1929 and 1959, to which Ethiopia is no party. As a matter of fact, the GERD project adds additional buffer capacity to the fluctuating hydrological system of the Nile river, which is one of the purposes the Aswan High Dam in Egypt was built for.

Poverty of parts of the population, the importance of water for the production of staple food, vested interests, but also cultural reasons and resistance from national lobbies inhibit the political tendency to reduce the de-facto subsidization of drinking and irrigation water. As a result, the water sector is underfinanced and water services are usually insufficient, which in turn makes cost-covering water management difficult to implement. The poverty argument against selling water is strong, but it veils the fact that in poor urban areas bottled drinking water is actually sold at top global prices in the absence of an appropriate supply and wastewater infrastructure (slums). The supply of irrigation water through capital-intensive infrastructure often benefits industrial agriculture and agricultural investors rather than subsistence and small-scale farmers. In this context, the causes for national water shortages are commonly politically externalized. The arguments are rarely fair, no consideration is given to fellow riparians' needs or to own efforts for more efficient national water management.

Mistrust towards upstream riparians is widespread. The upstream riparian is perceived as an opponent who does not release enough water or who would be willing and able to cut river flow completely. The media can play a constructive role here by contradicting the propagation of such stereotypes and speculations and contribute to triggering and supporting a more objective, fact-based discussion. The facts behind such statements are seldom as simple as they appear and deserve detailed analysis. For instance, the oft-cited and most feared situation of river water supply being completely cut off is usually unrealistic or feasible only for short periods. Artificial reservoirs can usually stop river discharge only for quite limited periods, no matter how big the reservoir is, and energy production at the reservoir would have to be halted for that period. Under peaceful circumstances, upstream riparians are hardly interested in taking such drastic measures in their own interest. However, an exception would be the redirection of rivers, which has been considered in the former Soviet Union and is being considered in China, but has so far not been implemented. This paper does not consider scenarios where large volumes of stored water are withheld or released to generate floods as a means of warfare.

Engineering solutions only suggest general feasibility, but frequently, they result in a perceived necessity to implement what is feasible. Two examples: Instead of building and raising flood protection dykes in Germany, the development of flood-prone areas could be restricted. Administrative strategy change in this direction is difficult but underway. Chinese strategic water resources management has a reputation of being dominated by engineers who prefer the construction and operation of a large and costly supply infrastructure for the water-deficient northeast of the country instead of implementing sustainable water resources management there. So far no transboundary rivers are affected, but hydraulic structures along the Yarlung Tsangpo (Upper Brahmaputra), which could serve this purpose, are being implemented *(Ramachandran 2015).*

Groundwater is often perceived as a hidden treasure that simply needs to be raised, and the need to manage aquifers cautiously and monitor them systematically is ignored. Groundwater bodies, particularly in dry regions, have low recharge rates. Beyond this, groundwater extraction is capital-intensive and energy consuming.

The man-made river project in Libya is based on the tapping of groundwater resources of the Nubian sandstone aquifer in the Sahara, which is a limited and internationally shared water resource with very low recharge rates, and conveying it hundreds of kilometres to the north. The agricultural returns of the project put a question mark over the financial investments and energy consumption. Besides, overuse of the aquifer is foreseeable, rendering the project as temporally limited.

USES OF WATER

Water is indispensable for life and food production; it is used for a multitude of economic purposes in most of which it is not substitutable. It is essential to distinguish between water use, where water quantity remains unchanged but water quality is altered either through contamination or heating, and water consumption, where water is permanently withdrawn and not returned to its original source, mainly through evaporation to the atmosphere.[2]

In general, most utilizations have both effects, but the extent of the impact differs. As for contaminated substances, they are removable through appropriate treatment. These aspects are important for waters that are shared across sectors and countries because they determine whether and how water can be used repeatedly as well as by several and different types of utilizations in sequence.

- Drinking water and domestic use (globally about 8 % of freshwater use) has the highest requirements for quality (hygiene) and supply continuity; appropriate treatment may almost completely remove bacteriological and chemical pollution caused by domestic use.
- Irrigated agriculture is the biggest consumer, using 70 % on a global average and 90 % or more in irrigation regions. This renders most of the used water unavailable for further use, increases the salinity of seepage and drainage water, emits macro nutrients (fertilizer) and agrochemicals (e.g. pesticides). A significant share of allocated water is lost on the way to the plant roots. Irrigated agriculture is the primary source of food production in arid regions (see Note 4: The nexus approach).

[2] It may then be transported to other global regions and precipitate after unknown periods of time.

- The freshwater fishing industry makes important contributions to food security (proteins) without increased consumption of water, substitutes for or relieves pressure on livestock farming; however industrial aquaculture can cause heavy pollution that impairs biological productivity.
- Industries use a share of about 22 % of the freshwater globally and cause the largest share of pollution, mostly with toxic and very toxic contaminants or a mixture of these. Purification is possible but is often politically difficult to enforce.
- Cooling water for thermal power plants may cause evaporation losses depending on the technique installed. Water is heated by the process, which constitutes a degradation in quality.
- Hydropower: evaporation from storage reservoirs is basically small compared to their storage volumes. Dam projects often serve irrigation schemes downstream. Hydropower has no process-inherent[3] negative effects on water quality, it has low quality but high supply consistency demands. Dam projects change the downstream discharge regime and curtail or interrupt the biological continuity of rivers.
- Nature protection and biodiversity do not represent utilization in a narrower sense, but guarantee the functioning of ecosystem services (including self-purification, fish production, biodiversity).
- The shipping industry demands regulated flows, has low quality demands and causes little process-inherent impairment of the water quality.
- Recreation and tourism have very high quality standards for reasons of hygiene, cause low system-inherent degradation of water quality and are responsible for little water removal.[4]

Although wheat production requires 1,300 l water per kg (virtual water) on average, it is a water-efficient crop. The export of agricultural goods is equivalent to the export of water at the expense of dry countries, many of them with shared water resources.

[3] System and process-inherent means to be bound to the system or process inextricably and excludes practices that may occur but are unnecessary for the process. For instance, it refers to the operation of turbines or navigational traffic, not to leakage of lubricants from power plants or waste and wastewater dumping from ships.

[4] Refers to recreational activities in a narrower sense and not to accommodation needs, which may be significant in regions with limited freshwater supply, e.g. arid regions or islands.

Drinking and domestic water has the highest quality demands, also with regard to supply security; low to very low consumption (in Germany, 5 litres per person per day excluding other domestic uses, 120 l including other domestic uses), is a considerable source of bacteriological and chemical contamination through macronutrients in untreated wastewater. Domestic pollution can be removed almost completely through common wastewater treatment. Traditional wastewater treatment consumes large amounts of energy. Per capita water demand comprises individual household consumption in addition to direct human consumption that varies from country to country: 120 litres per person per day in Germany, 340 litres in Egypt, almost 300 litres in the United States and 450 litres in Iraq) *(UNESCO 2012).* Quality standards for some domestic uses are lower, but for economical and hygienic reasons, drinking water quality is provided. The little direct consumption demand underscores that freshwater scarcity is usually not a question of quantity but of insufficient water services and/or poor water quality. In Germany, 7 % of drinking water is lost in the distribution network, while the highest loss levels in Europe are above 50 % *(Deutsche Bank 2010).*

In the vast arid regions of the earth, centralized solutions are uneconomical or even unfeasible; decentralized, e.g. improved traditional water supply and wastewater treatment systems offer alternatives.

Water for human consumption is the most essential and vulnerable use. Water consumption is low compared to industrial and agricultural use, but the quality demands are the highest. Every day 4,400 children below the age of 5 years die from diarrheal diseases, almost 90% of them can be traced back to a lack of clean water.

Irrigated agriculture has moderate quality demands, a very high consumption of 70 % globally and 90 % or more of total freshwater in irrigation cultures due to evaporation; it causes considerable withdrawal of water from natural systems, often from allochthonous rivers (see Note 1). The water consumed, polluted and incorporated for the production of agricultural and industrial goods is referred to as "virtual water" (see Note 3). In Germany, the daily consumption of virtual water per person amounts to 5,400 litres *(WWF 2009).*

Irrigation is a highly consumptive water use. Beyond that, a global average of approx. 60% of the withdrawn water is lost before reaching the plant roots, mainly by transfer losses, inefficient irrigation technology and management.

Water pollution by irrigated agriculture is moderate and diffuse; it returns to natural systems by underground passage on a multitude of paths and can therefore not be handled at the source. Concentration of pollutants, e.g. agrochemicals, macronutrients and mineral salts is low, making treatment more difficult. Mineral salts resist standard treatment. In dry regions, constituents are subject to residual accumulation when water evaporates and dissolved matter remains at the evaporation front. Waterlogging due to excess irrigation or insufficient drainage are widespread drivers of soil salinization. Drainage waters in arid regions also lack dilution through tributaries.

Globally, water losses in irrigated agriculture are significant, not only because of plant growth as such (productive losses), but through losses during the water supply chain to plant roots (evaporation from storage, loss from supply channels, irrigation practice). Moderate seepage loss is needed to prevent salinization. Global overall losses are estimated at greater than 60 % of allocated water. On the fields, which constitute only the last step in the supply chain, an efficiency level of about 50 % is reached through surface irrigation, whereas drip irrigation has an efficiency level of 90 % *(Jägermeyr et al. 2015).* Globally, irrigated agriculture has the greatest water-saving potential of all sectors.

In many irrigation dependent countries, agriculture is still a significant economic sector, although its significance is often overrated given the cost and effort necessary to sustain it and its likely future significance. In industrial countries, the share of the primary sector in GDP (GDP share in Germany is 0.8 % versus 15 % in Egypt) as well as in the employment rate (Germany 1.5 %, Egypt 29 %) *(Berié et al. 2014)* is marginal. Put into perspective, agricultural sectors have or will have no major effect on employment or on GDP in developed economies.

In irrigated agriculture, large quantities of energy are needed for the extraction and pumping of groundwater and surface water. The energy demand for the desalinization of 1 m³ of seawater equals the energy required to lift the same quantity of water for a flow distance of 350 km. The establishment of new irrigation areas requires technical and financial efforts, and their maintenance is likewise more elaborate than that of rain-fed areas.

The fishing industry has high quality demands. Within certain limits it is tolerant of contamination, except for substances toxic to fish (e.g. pesticides). However, it is important to stress that harmful substances accumulate in food chains. The negative effects of industrial aquaculture are as harmful on the aquatic environment as those of industrial agriculture in terrestrial environments. Inland fishing provides local populations with affordable proteins, the terrestrial production of which would require much more virtual water.

Industries' quality demands may be quite different depending on the prevailing processes. During industrial processes, heavy pollution may occur through toxic and very toxic contaminants or mixtures, which are not or hardly degradable. Globally, industries use 22 % of the freshwater but are responsible for the majority of its pollution *(UNESCO 2012).* In developed national economies, industry contributes a considerably larger share of GDP and employment than agriculture (Germany 2013: 30.2 % of GDP, 24.7 % of employment). Discharging untreated wastewater into water bodies is banned in the EU and the polluter-pays principle is implemented. In Germany, water in industries is used 5.8 times on average *(BMU 2011).*

Application of chemical substances and fertilizers in agriculture contaminates drainage water and may pose a problem for drinking water withdrawals and downstream riparians. Monocultures cause heavy stress on biodiversity.

Hydropower has low quality demands; there are minor evaporation losses from reservoirs, which are higher in arid climate zones. About 6.5% of the water evaporates annually from the Aswan Reservoir, located in one of the hottest and driest deserts on earth. This is not a high percentage but works out to approx. 10.5 km^3 per year in absolute figures.

Reservoirs constitute sediment sinks where the solid river load is deposited. Although it may take centuries to fill up completely, this eventually results in sites with tremendous demand for rehabilitation at the expense of future generations.

Large reservoirs in crisis or earthquake regions are exposed to damage and destruction, are an obstacle to navigation and are generally in conflict with nature conservation interests, due mainly to their interfering with biological continuity and equalizing natural discharge fluctuations. They contribute to preventive flood protection and carbon neutral hydropower. Although experience shows that large reservoir projects often serve irrigation schemes downstream, this dual use is not mandatory. Large dam projects have had and still do have unpredictable collateral environmental, social and cultural impacts and promote negative political dynamics.

Hydropower is clean energy in terms of carbon production with very low water consumption due to evaporation from the reservoirs, but it has strong impacts on biological and sediment continuity.

Cooling for thermal power plants requires a sufficient minimum quantity of water and regulated water flows for constant and reliable supply. Shortage of cooling water during droughts can lead to reduced performance or to the temporary halting of thermal power plants (e.g. in summer and autumn 2003 along the Rhine River) *(Bundesanstalt für Gewässerkunde)*. The warming of cooling water is a form of ecological degradation that impairs the ecosystem service of "self-purification of water bodies".

Power generation by thermal power plants is inextricably linked to the availability of cooling water. In the majority of cases, cooling water is returned to the environment unpolluted but warmed up, which constitutes ecological degradation. Consumptive water use, as shown by evaporating cooling towers, is applied in only approx. 25 % of the plants.

Environmental protection/biodiversity has high quality demands and may have a high level of water consumption, e.g. wetlands, particularly in hot regions where water resources are coveted at the expense of ecosystems. Ecosystem services such as the purification of water in water bodies or in soils and geological strata have been functioning since time immemorial without being noticed or maintained. They are fundamentally operational, provide added economic value and will constantly be needed in the future. Their functional capability depends on intact geosystems and ecosystems.

Natural waters and wetlands provide best quality water if undisturbed, and have a strong although limited capability of self-purification.

Shipping industry and transport have low quality demands but cause no considerable pollution if practised soundly. Infrastructure for navigation and for preventive flood protection collide with environmental protection interests: Navigation favours constant medium water levels and thus the absence of natural discharge fluctuations. Watercourses serve as a cheap and convenient medium for transporting waste-water and solid waste in many regions of the world.

Tourism/recreation has very high demands on the hygienic condition and cleanliness of water; very little if any water consumption and little system-inherent pollution. A visually appealing – not necessarily natural – landscape is also an important factor.

Clean natural waters and attractive landscapes attract various kinds of activities and tourism. Tourism is one of the global top employers.

Note 4 **THE WATER-ENERGY-FOOD-ECOSYSTEMS NEXUS**

The nexus is an approach for a cross-sectoral and transboundary analysis of trans-sectoral water resource allocation. It is based on the close links between water and energy, water and food, water and ecosystems. Water is directly needed for hydropower production, indirectly as cooling agent, for the cleaning of photovoltaic panels, to bind coal dust in open mining pits etc. On the other hand, all kinds of water handling and treatment require energy, e.g. pumping, wastewater treatment, desalination. Because of the transboundary implications, it is an appropriate instrument for the formulation of cross-sectoral and transboundary water management strategies in order to realize greater benefits for the riparians within the river basin (benefit sharing, positive sum game) than can be achieved by the sum of discrete national gains. In a simplified model, riparians with best conditions for food crop production generate a surplus of food, other riparians generate a surplus of hydropower, needs are then balanced by exchange. An approach like this first of all requires mutual confidence. Egypt for instance imports food and forage crops in large quantities, but not from the upstream riparians of the Nile river, and could, in turn, export industrial goods to them. Ideally, other relevant sectors become an integral part of the approach. Ultimately, implementation according to the nexus perspective would have a positive effect on the exchange of goods, the transportation network, power grids, custom barriers, currency exchange and passenger transport.

The Rhine River and its water are used for multiple non-competing demands: transportation, hydropower, cooling water for thermal power plants, industrial process water, withdrawal of bank filtrate for drinking water supply, tourism.

II. CONFLICTING AND CONVERGING INTERESTS

Water-related strategies and claims with a political motivation often have transboundary implications. In the past, claims addressed to other riparian states frequently led to international tensions and gave rise to the fear of water conflicts and wars. A closer look at demands of sectoral water uses reveals that they do not necessarily inhibit each other and are less competitive than is commonly assumed. This applies also for riparian states in river basins, which feel they have to compete for water share although upstream riparians' uses and interests do not necessarily have to collide with those of downstream riparians. Claims, compatibilities and their factual background therefore deserve examination, both from sectoral and the national perspectives.

SECTORAL CONFLICTS AND CONVERGENCES OF INTERESTS

For a closer examination of sectoral compatibilities and incompatibilities, a distinction needs to be drawn between quality and quantity aspects, whereby conflicts concerning the flow regime (see Note 5: Discharge and flow regime), such as shifted or regulated flow regimes, are understood as quantity-related conflicts. The mutual relationships between different sectors are often asymmetrical or indifferent. Asymmetrical means that one sector serves the other but the other impairs the first, e.g. domestic water supply and environmental protection. Ecosystems provide good to best raw water for drinking and domestic needs, but untreated domestic wastewaters impair surface and ground water bodies. Indifferent means that two sectors do not harm each other as is the case with the shipping industry and hydropower, provided that dams do not interrupt navigability. Most sectors benefit from natural water supply but release polluted wastewater, unless treated.

The **treatment of waters after pollution and the extent of pollution make a critical difference** to conflict potential. Polluting sectors impair others if their wastewaters are released untreated (conflict situation). Proper treatment may change a conflict situation into an indifferent one.

There are proven technical solutions for treating wastewater. Their implementation and control requires appropriate legal regulations (water management law, wastewater regulation, polluter pays principle), financial resources for investment and maintenance, and an up-to-date, trained organizational and technical staff. Since polluting sectors emit specific groups of substances and the groups and mixtures require specific treatment, it is preferable to treat polluted waters at the source of pollution and not after the contaminant mixture has become even more heterogeneous. General good practice in water management is manifested by the broadly accepted guidelines of Integrated Water Resources Management *(IWRM, see Note 6).*

Sewage from point sources, such as urban or industrial wastewater, is generally stored and moved in more or less closed systems (sewers, drains) and is thus collected for further centralized treatment. Contaminated waters from diffuse (non-point) sources, such as drainage or seepage waters from agriculture as well as from leaks in sewers, are not accessible for treatment. Consequently, while agriculture releases waters with low pollutant concentrations, they are hard to manage and treat.

Note 5 DISCHARGE AND FLOW REGIME

Most water conflicts are perceived as conflicts over the distribution of water quantities, i.e. actual or feared reductions in water flows. But river systems have characteristics that go beyond this and are relevant for water cooperation and diplomacy.

Usually, river discharge changes from month to month. Particularly when rivers originate in mountainous regions and monsoon areas (e.g. Ethiopia, India, etc.), significant seasonal variability is common. The typical (average) annual pattern river discharge, the flow regime, is a statistical product of many years of flow monitoring or hydrographs. However, every annual hydrograph deviates to a greater or lesser extent from the average flow regime. In addition, perennial deviations from the mean values, such as dry or wet years/periods, are rather the rule than the exception. This fact raises the fundamental question of how much water should be talked about in negotiations. But shifts of the flow peaks from the summer season to the winter due to hydropower installations are also a matter of dispute among riparians. The question then reads, how much water at which time of the year negotiations are about. And this does not yet include the question of water quality, namely salinity, hazardous substances, solid and liquid waste.

At major rivers it is almost impossible to store the discharge during wet periods for dry periods because of the tremendous storage volumes that would be required. According to climate projections, most river basins will face decreasing water availability and/or modified discharge regimes due to climate change.

Annual, inter-annual and periodic fluctuations as well as those due to climate change make water distribution in transboundary river basins more complicated than they are anyway. Precise hydrometric monitoring demands a high level of technical effort. Data release to other riparians requires good relationships and confidence among the riparians, and similarly mutual trust in external data. This is why a great deal of communication and diplomacy is behind something apparently as simple as exchange of data for international waters. The prevalent practice by now is that discharge data from transboundary rivers are handled as secret national information.

There is also a strong contrast between environmental protection and other sectors. Most sectors benefit from ecosystem services but all sectors impair ecosystems more or less. The demands of **environmental protection** collide with all uses that deteriorate, pollute, withdraw or otherwise alter natural conditions of water bodies or water-related ecosystems. On the other hand, a clean and intact environment provides all other sectors with good quality water in large quantities and has done so for millennia. Shipping industries and hydropower are to a certain extent impaired by unregulated, natural flow regimes. In hot regions, wetlands (delta of the Shatt el Arab in Iraq), inland deltas (Sudd in Sudan) and lakes (Lake Turkana, Lake Chad, Aral Sea) are hotspots of biodiversity, but have a high water consumptionthat appears unproductive and thus regularly gives rise to plans to use the waters or the water of tributaries for irrigation (Jordan River, Amu and Syr Darya Rivers, Omo river).

Note 6 **INTEGRATED WATER RESOURCES MANAGEMENT**

IWRM is the widely accepted guideline of sustainable water resources management. It is defined as water resource utilization that takes into consideration the regenerative capacity of the resource and ensures its reusability *(Global Water Partnership 2000)*. Integrated water resources management is a process that aims to "maximize economic and social welfare without compromising the sustainability of vital ecosystems" *(Global Water Partnership 2010)*. IWRM is laid down as a basic principle in the UNECE Water Convention *(UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Helsinki 1992)* and UN Watercourse Convention *(United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses, New York 1997)* and the EU Water Framework Directive *(EU 2000)*, the latter being the most advanced legal framework for national and international water governance.

IWRM principles are broadly reflected in Sustainable Development Goal (SDG) No. 6 (water, sanitation and water management) and in various sub goals of other SDGs. SDG 6.5 is explicitly dedicated to the implementation of IWRM at all levels including transboundary cooperation *(UN 2015a)*.

IWRM takes environmental, economic, social and political factors into account. A river-basin-based perspective on water resources that cross political borders as surface water or groundwater is an integral part of IWRM. The member states of the UNECE Water Convention have committed to implementing IWRM, while several river basin commissions orient their strategic and action plans to it. According to IWRM, not only do upstream states have obligations towards downstream states, but downstream states also have obligations towards upstream states. The upstream states, for example, have a right to be informed about the downstream states' water use, and under the international conventions they also have a certain limited say in these decisions.

Domestic water supply has the highest quality demands and the highest level of vulnerability but relatively low quantity demands (8% of global freshwater use). The abstraction of drinking water is not a quantitative problem if implemented according to good practices. The essential per capita water demand is relatively low, as figures from well-managed countries show. Insufficient supply is a problem of poor water governance regardless of the climate zone.

In megacities and urban agglomerations, demand may be high in absolute figures, resulting in high withdrawals, which often are not sustainable for the respective source region. Such situations can be alleviated by reduced per capita water demands, or, more generally, by enhanced water management *(e.g. Rio de Janeiro 2015)*. Domestic water supply demands reliable amounts of good raw water and benefits much from ecosystems services, but usually does not actively support good overall environmental conditions in the source regions, e.g. natural structures in fluvial systems and floodplains. The rule rather is that water withdrawals from source regions affect water bodies and ecosystems negatively.

The release of untreated urban wastewater is a significant quality-related problem that threatens drinking water supply. Even treated wastewater requires ecosystem purification before it can be re-used by sensitive sectors. There is no conflict with navigation and hydropower. Along the Rhine river, plenty of cities use Rhine water for their supply, though not directly but as bank filtrate after underground passage (ecosystem service). Drainage and seepage waters from agriculture affect water quality.

Depending on the industrial sector, quality demands for process water can be very high, particularly in the food industry. A general rating would fail. Industrial wastewaters may be extremely contaminated, for instance by toxic substances and heterogeneous mixtures of these. German industry's wastewaters are recycled an average 5.8 times *(BMU 2011),* which shows that industrial water consumptions can be reduced significantly.

Water for cooling in thermal power plants may be lost through evaporation or discharged to rivers, depending on the cooling technique installed. Returned waters are heated or "thermally polluted", which reduces their self-purifying capability. Cooling of nuclear power plants in arid regions is a serious security issue because of insecure water supply. The Fukushima disaster has shown the consequences of cooling failures. During the 2003 drought in the Rhine basin, thermal power plants including nuclear plants along the Rhine river had to reduce their output because of a cooling water shortage *(Bundesanstalt für Gewässerkunde).*

Water-related **tourism** and recreation is not a consumer and only a minor polluter of water - accommodation and domestic water supply needs excluded. The water quality demands are as high as those of domestic water supply and environmental protection for hygienic reasons. Tourism has an interest in the attractiveness and suitability of river and lake landscapes for recreational activities. The environment is expected to be neat and to appear natural regardless of whether it is natural in ecological terms. From the perspective of pleasant surroundings, all kinds of economic uses are compatible with water-related recreation and tourism to a limited extent; navigation and hydropower installations may constitute a safety risk.

Quality standards in **irrigated agriculture** are moderate because crops are more robust with regard to water quality. Limited pollution by domestic wastewater and industries do not seriously affect agriculture. Irrigation of food crops with treated or untreated wastewater bears the risk of bacteriological contamination and faces cultural inhibitions. Soils have a purification function (ecosystem service), which is, however, relative, i.e. it depends on the grade of pollution, kind of pollutants and is limited in capacity. Toxic substances contained in irrigation water are not necessarily harmful to plants but may remain in the food chain. Highly mineralized or saline irrigation water impairs plant growth, which is an issue in dry regions.

Irrigated agriculture consumes quantities of water that have the potential to reduce river flow substantially, with potential downstream impacts on navigation, hydropower, cooling of thermal power plants and terminal lakes (e. g. Aral Sea, Lake Chad, Dead Sea). Rivers like the Colorado River and the Rio Grande have fallen dry due to irrigation water withdrawals. On the other hand, about two thirds of the allocated water evaporates unproductively, i.e. before reaching the plant roots. A part of it percolates to groundwater bodies, a desired effect for salt removal, and returns to water bodies, commonly downgraded by mineral salt and agrochemicals (pesticides) accumulation.

The **shipping industry** and **hydropower generation** share an interest in regulated flow regimes with constantly average flows. They may conflict with one another if dam installations interrupt waterways. Both are almost completely resistant to degraded water quality but do not intrinsically cause pollution. Regulated flow regimes are a field of conflict between navigation and hydropower on the one hand and environmental protection on the other because hydraulic structures have negative effects on biological continuity and diversity. The shipping industry and hydropower do not interfere with drinking water production.

Natural river flow peaks in the growing season may be shifted to the winter season by water management for hydropower generation, but this may be counterproductive for irrigated agriculture downstream. Tajikistan's Rogun dam, planned for power production mainly to reduce winter power shortages, led to tensions with Uzbekistan, which needs much irrigation water during the summer vegetation period. This is an example of a trans-sectoral, international conflict based on the fear of an altered flow regime.

This paper assumes that **freshwater fisheries** are managed in a sustainable way, although in some cases this is not so, mainly for aquaculture and also with regard to fishing techniques. Medication and surplus food in fish farms deteriorate water quality and impair ecosystems. Freshwater fishery is an underestimated source of protein, which is produced onshore with lots of virtual water.

The sectors and sub sectors are listed in the table below, giving an overview of their main characteristics and mutual compatibilities. Because of their high and increasing significance, some sectors are divided into their supply and release segments; energy production is separated from industries and the cooling segment is separated from the production segment.

The explicit indication of indifferent sector relationships has been omitted. Only the main disruptive (column 4) and supporting factors (last column) are mentioned. In order not to go into confusing details, sectors are evaluated in their intrinsic function without taking into account potentially linked, unnecessary side effects. In other words, water-related tourism refers to the recreational aspect and excludes the accommodation and water infrastructure aspect. Shipping is assumed to use the water body only for navigation and not to pollute water bodies by the avoidable dumping of bilge and wastewater, fuels and lubricants.

SECTORS OF WATER DEMAND AND WATER USE AND THEIR MUTUAL COMPATIBILITIES

Sector	Impact on water, special characteristics	Water quality requirements	Potentially disruptive factors	Supportive factors/ reasons
Domestic water supply (extraction)	Qualitatively unproblematic, quantitatively ambivalent, 8 % of global freshwater use; losses in supply networks	Highest quality requirements (hygiene)	Raw urban or industrial wastewater, drainage water	Env. protection/ good water quality
Domestic water supply (wastewater disposal)	Raw wastewater hazardous for human consumption, still unsafe after treatment, high content of plant macro-nutrients			
Industrial use (process water)	22 % of global use, raw wastewater highly problematic, generally point sources**	High quality requirements	Raw urban and industrial wastewater, highly mineralized drainage water; irrigation water removal	Env. protection/ good water quality
Industrial use (cooling)	Thermal pollution* of water bodies, water losses depend on kind of cooling process	Depending on kind of cooling process	Polluted intake water	Env. protection/ good water quality
Irrigation (water abstraction)	Largest global consumer of water, 70 % (+/++), ⅓ productive and ⅔ unproductive evaporation	Limited quality requirements	Highly polluted urban and industrial wastewater, excessively mineralized intake water	Env. protection/ good water quality and quantity

Sector	Impact on water, special characteristics	Water quality requirements	Potentially disruptive factors	Supportive factors/ reasons
Irrigation (drainage water, return flow)	Decrease in the quality of drainage water by agro-chemicals, non-point source**			
Hydropower (operation)	No/negligible water quality and quantity changes***	Very low quality requirements	Potential water removal by upstream irrigation	Navigation/regu-lated flow regimes
Hydropower (water storage)	Damming structures disrupt biological continuity, evaporation losses from reservoirs low, larger in desert regions	Very low quality requirements		Navigation/regu-lated flow regimes
Navigation	No/negligible water quality and quantity changes***, engineering structures impair ecosystems	Very low quality requirements, prefers regulat-ed flow regimes	Potential water removal by upstream irrigation	Hydropower/regu-lated flow regimes
Freshwater fisheries	Productive, unproblematic if practised in an environ-mentally responsible way (including aquaculture)	High quality requirements	Raw urban and industrial wastewater, drainage water; disturbance of biological continuity	Env. protection/ water quality, intact environment
Tourism/ recreation	Diffuse low-level contamina-tion, no water consumption by recreation activities***	Very high quality re-quirements (hygiene)	Raw urban and industrial wastewater, drainage water; excessive navigation	Env. protection/ water quality, clean environment
Environmental protection, biodiversity	Self-purification of water bodies, natural structures absorb flow extremes, bio-logical productivity, high water consumption in hot regions (marshlands, inland deltas)	Limited or no pollution of inflowing waters, little or no impact of hydraulic engineering	Untreated urban and industrial wastewater, drainage water; regulated flow regimes, engineering structures (e.g. dams), thermal stress*	No supporting sectors

Green: Environmentally compatible sectors (Col. 1) and benefitting sectors (Col. 5)

Pink: Quality degrading factors (Col. 1) and potentially affected sectors (Col. 4)

Red: Consumptive uses (Col. 1), impair all other sectors more or less

* Thermal pollution reduces the self-purifying ability of aquatic ecosystems

** Point sources release water at discrete places (e.g. wastewater pipe outlets), non-point (diffuse) sources are sources covering areas (fields, plantations) or a multitude of small point sources scattered over areas (e.g. household seepage pits)

*** Refers to operation in its intrinsic sense, excludes possible harmful but unnecessary side-effects

INTERNATIONAL CONFLICTS OF INTEREST

The background causes of water tensions merit particular attention because the analysis of these contextual conditions provides a basis for identifying approaches to solutions. Strong riparian states are empirically reluctant to cooperate and insist on their water allocations and sovereignty even when the water they lay claim to originates outside their territory. Recent examples show that the prospect of temporary reductions in water flow – for example during the filling phase of a new reservoir – can elicit vigorous diplomatic reactions. But it is not only the question of undiminished inflow that downstream states keep a wary eye on (e.g. Egypt). Changing the flow regime and shifting the runoff maximum from the vegetation period to the winter is also regarded as a restriction of national sovereignty (e.g. Uzbekistan). This stance can only be taken by strong states. Bridging the gaps, balancing the interests among riparians and mediating multilaterally acceptable solutions is a difficult but rewarding task for a determined, enduring and preventive water diplomacy.

In both cases, parties insist upon an unlimited supply to irrigated agriculture and implement national measures to increase water efficiency hesitantly if at all. The acceptance of partner riparian needs may be questioned. Water-intensive and crops for export are grown. This does not contribute to national food supply and is equivalent to the export of virtual water although exporting countries claim to be or are actually suffering from water scarcity. On the other hand, increases in water efficiency require effective and sustainable national water governance, which needs efforts, funds and time to build up or enhance. Commercial interests and a favourable status quo are retarding factors when it comes to changing attitudes, although at the same time the strategic positions amount to a political and economic subsidization of cash crop production. Reconsidering traditional strategies in the light of population growth, industrialization and globalization could be supported by the international scientific community, think tanks, NGOs and diplomatic communication.

Some cases with potential for international conflict do not, however, erupt into outright conflict because the affected - downstream - states do not consistently pursue what are supposed to be their own interests. The Xayaburi Dam currently under construction in Laos threatens the biological continuity of the Mekong, which is rich in biodiversity and is an important source of protein for 60 million people in six countries due to fishery. It is feared that the construction of the Xayaburi and other dams would endanger the river's biological productivity, and construction has started without prior finalization of environmental impact studies. There is, however, little opposition to the Laotian project in neighbouring countries. Overlapping priorities among the riparians are apparent, including participation in the supply of energy, participation in dam construction and own national plans for Mekong dam projects. Environmental concerns are not prioritized.

Kenya is not opposing the construction of the Gibe III dam and power plant on the transboundary Omo River in Ethiopia, despite a number of expected negative impacts on the local Kenyan population, the environment, and UNESCO World Heritage sites presumably because it will benefit from the energy produced *(Avery 2013).* A Chinese development bank is funding the power plant turbines, while the World Bank is funding the power line from the Ethiopian power plant to Kenya.

DIVERGING INTERESTS – REGIONAL EXAMPLES

Uzbekistan opposes a large hydropower project in Tajikistan, the Rogun Dam at the Vaksh River, an indirect tributary of the Amu Darya, because the generation of energy will take place mainly in winter when domestic heating demand is at its highest. Tajikistan also hopes to supply an aluminium smelter with hydropower *(World Bank 2014)*. Uzbekistan fears that the traditional summer discharge peak needed for agriculture (e.g. cotton) during the vegetation period will be shifted to winter *(Putz 2015)*. Whether and to what extent this will occur is neither known nor is it an issue in the communication between Uzbekistan and Tajikistan. More details would be needed about the hydrology of the Amu Darya and the range of feared impacts in order to develop solutions that could embrace the interests of both riparians. So far there is a diplomatic deadlock, with both countries insisting on their positions.

Ethiopia is constructing a cascade of dams on the Omo River (called Gibe River in Ethiopia), which feeds Lake Turkana in Kenya, for generating hydropower and irrigating large areas, mainly for the cultivation of sugarcane. Discharge equalization threatens the livelihoods of indigenous peoples living close to the river or the lake and also several ecosystems. Water extraction threatens the lake and UNESCO World Heritage sites in Kenya. Irrigation lands are massively cutting into Ethiopian national parks and wildlife reserves *(Avery 2013, International Rivers)*. The production of sugar for export contributes only marginally to national food security or to broader development in Ethiopia. The Ethiopian actors are the government-owned Ethiopian Sugar Corporation and large investors. A Chinese bank is financing the power plant turbines made in China, thereby filling the funding gap after the World Bank, the African Development Bank and the European Investment Bank retreated from the project due to the non-transparent manner in which the project was initiated.

Despite existentially important interests, Uzbekistan and Ethiopia, both dominant in these cases, have paid scant attention to concerns about their international and national water policy, although water use efficiency and consumption for water-intensive cash crops as well as all other impacts are questionable.

Basin and furrow irrigation, the traditional systems, may be favourable in economic terms, but are highly ineffective with respect to water consumption. There is a lot of space for improvement in irrigation technology, but it requires investments and training. In hot dry regions water-logging fosters salinization of soils.

Case study **THE EUPHRATES-TIGRIS BASIN**

For a long time, Turkey and Iraq have been discussing the distribution of water from the Tigris and Euphrates rivers. Turkey has committed to releasing 500 m^3/s (approximately 16 billion m^3/year) from the Tigris river and deems this discharge as sufficient. Turkey invokes its need for hydropower under the GAP (Güneydoğu Anadolu Projesi, Southeast Anatolian Project) strategy, a large-scale project to construct a dam cascade along the Tigris and Euphrates, and the need for flood protection through the dams, which is also beneficial for Iraq. Iraq insists on the argument of water scarcity as well as on historical although not quantified claims, and it is requesting a larger amount of water, a "fair share" (see Note 7: Fair share). National demand and the calculation of fair share are neither justified nor specified, and the claims of the other upstream riparian states of Iran (tributaries to the Tigris) and Syria (Euphrates) are unknown. As a matter of fact, the per capita water availability of renewable water resources in Iraq is greater than that in Germany and Turkey. International statistics *(UNESCO 2012)* show that the available water resources in Iraq are not scarce in per capita terms and that a great deal of water is used for domestic supply. Local per capita household consumption in Iraq is more than three times the level in Germany, most certainly because domestic water supply in Iraq is not managed with metering and a tariff system. Reducing domestic water demand could save about 2 billion m^3 of water annually.

Note 7 **FAIR SHARE**

The term "fair share" is often used to claim water from transboundary rivers without it being concretely defined. The wording has a connotation of legitimacy and equitability. In practice, a fair and equitable share is difficult to determine or to justify and is in fact rarely quantified in claims or negotiations. Because of these problems, the fair share argument is not very useful for political negotiations. Besides, a simple division of water resources in transboundary basins into national quotas does not include qualitative or discharge regime criteria and does not create further impetus for transboundary cooperation, integration, regional confidence-building or security. From the political perspective, bargaining with national water quotas is neither constructive nor promising. Every nation strives for its own stakes and every own gain is necessarily a loss for the other riparians. There are no incentives for compromises. From a water and resources management perspective, it is even counterproductive because the management of water resources remains confined by national borders and the transboundary allocation of resources is not optimized.

Water distribution among the riparians by quota is a zero-sum game. The opposite is benefit sharing (see Note 8), which is more complicated to achieve but creates incentives for compromise. The share of water is rendered as secondary.

Proportional quota arrangements, i.e. fixed percentages of inter-annually varying discharges, would be more appropriate for natural and climate-induced hydrological fluctuations than fixed quotas. Nevertheless, this type of sharing agreement is uncommon. It is complicated, requires a permanent and precise recording of water resources in river sub basins, intergovernmental communication and mutual confidence, which are usually lacking in tense basins.

Proportional quota arrangements may be better adjusted to natural conditions, but apart from that they have the same deficiencies as quantitatively fixed quotas, particularly from a political perspective.

The water efficiency of Iraqi agriculture is low due to destroyed and damaged irrigation infrastructure, conveyance losses in general, deficient irrigation management and the absence of a water price policy. Instead, an increase in the low productivity of existing irrigated areas would be more efficient and sustainable in order to achieve a higher level of water efficiency and food security.

The discharge of untreated municipal or industrial sewage water into surface water bodies is a common practice in Iraq. According to Iraqi scientists (talks with Iraqi hydrologist Oct. 2011 in Istanbul and subsequent digital communication), there is no treatment of industrial sewage in and around Baghdad. Tributaries of the Tigris, coming from the Zagros Mountains in Iran, are contaminated with sewage and otherwise untreated water. This shows that in Iraq, national efforts towards sustainable water management that could significantly ameliorate the situation are lacking, but this does not keep the government from claiming more water from upstream.

Before the civil war in Syria, Turkish, Syrian and Iraqi representatives met on a regular basis in a Joint Technical Committee (JTC) to discuss questions concerning transboundary bodies of water. In talks with Iraq, Turkey's requests for more information on Iraqi water management and consumption as well as measures to increase use efficiency remained unanswered. Iraq repeatedly expressed its willingness to cooperate and announced that it would join the UNECE Water Convention, but little of international significance has been implemented so far. This attitude led to frustration on the Turkish side and Turkey's retreat from multilateral meetings *(side talks with Turkish officials on the sixth session of the Meeting of the Parties to the Water Convention. 28–30 November 2012. Rome, Italy)* Turkey currently refuses external involvement in transboundary questions.

Note 8 BENEFIT SHARING

Benefit sharing refers to the transboundary use of advantages accruing through a common, optimized allocation of resources, including all water-related economic sectors. The approach is ambitious, but there are examples of successful implementation. In contrast to the zero-sum game focusing on fixed quotas, benefit sharing is designated as a positive-sum game. Instead of distributing only water, this approach aims at obtaining benefits from optimized transboundary resource allocation, which achieves more than national management.

Benefit sharing in the Nile basin could work as follows: Sudan and Egypt benefit from power production in Ethiopia through a transboundary energy network; Egypt improves and ensures its food security by importing agricultural goods from the southern riparian states, which are produced through rain-fed farming (green water). In return, Egypt exports industrial goods to the upstream riparian states. The issue of a fixed water quota for Egypt and Sudan would take a back seat, because water-intensive national irrigated agriculture – based on blue water – would decrease in importance. Egypt imports food and fodder, although mainly from overseas and not from the upper Nile basin. Warranties could be an international instrument to pave the way for realization.

Case study **THE NILE BASIN**

Egypt announced that it has entered the water poverty era with an annual shortage of 23 billion m³/year by March 2015 and that it would henceforth experience a supply shortage of 23 billion m³/year *(Ahram 2015)*. The announcement was linked to fears that the Ethiopian Grand Renaissance Reservoir Dam (GERD) could endanger the Egyptian share of Nile water. Ethiopia plans to become the "battery" of East Africa, being endowed with abundant monsoon rainfall and highlands. It maintains that it will use the Blue Nile waters only for hydropower and will not cause damage to any downstream riparian.

According to the 1929 and 1959 colonial Nile waters treaties, 55.5 billion m³/year of the 84 billion m³/year are granted to Egypt. In fact, Egypt even receives 6 billion m³/year more than that because Sudan is not capable of using its entire entitlement of 18.3 billion m³/year due to insufficient storage capacities. In this context, a shortage of 23 billion m³/year appears hardly plausible, particularly, since the filling of the GERD has not yet begun. According to the Nile treaties, no share is granted to Ethiopia, the main exporter of Nile water resources.

The Egyptian municipal sector demand amounts to 10 billion m³/year of water *(Egyptian Ministry of Water Resources and Irrigation 2013)*, equivalent to 340 l per person per day *(UNESCO 2012)*, almost three times the per capita consumption in Germany. Most of it may be assumed to be returned to surface and groundwater, treated or not, and thus not accounted for as loss. But even so, this cannot account for a shortage of 23 billion m³/year, as maintained. Since water scarcity refers to a per capita figure, shifting to water scarcity is a matter of continuous population growth in Egypt.

The root cause of increasing Egyptian water demand is most certainly the ongoing reclamation of new irrigation lands. Egypt reclaims new irrigation areas in its deserts with large technical and financial effort, although the limits of Nile water availability are obvious and newly created irrigation areas were and continue to be only hesitantly accepted by the target groups.

Egyptian fears that an annual discharge volume of the Blue Nile, almost equalling the discharge of the Nile at Aswan, could be withheld during the filling phase of the GERD also need to be commented on. Egypt stores approximately twice the annual discharge of the Nile in the Aswan High Dam reservoir, which could compensate for a reduction of inflow. Nonetheless, based on hydrological facts and given political will, it should be feasible to develop procedures with minimum disadvantages for all nations involved.

The exclusion of Nile riparians other than Egypt and Sudan from the Nile water treaties (1929, 1959) is the reason why Ethiopia and the other riparian countries reject the treaties and support or have already signed the alternative Cooperative Framework Agreement (CFA), which is supposed to replace the colonial treaties.

Egypt suffers from permanent energy shortages. To solve this problem, plans have been considered to connect the Egyptian power grid with that of Saudi Arabia. The link would be longer and more expensive than a link to the Sudanese or Ethiopian (GERD project) grid, which would improve Egyptian energy security, suit Ethiopian plans and indirectly add momentum to regional integration dynamics. Sudan has abandoned its former alliance with Egypt in opposing the GERD project because it will receive a share of the hydropower and possibly also because the flow of the Blue Nile, after filling the GERD reservoir, will be much more continuous throughout the year and enable Sudan to make use of its complete Nile water entitlement without having to adopt additional own measures *(Pearce 2015)*.

POSITIONS AND MOTIVATIONS OF RIPARIAN STATES

International water negotiation have better chances to succeed if the drivers and interests of the partners or involved parties are known. A sound analysis allows for the development of narratives and scenarios which can help overcome deadlocks and support the negotiation progress.

The positions within riparian states are not necessarily coherent. For instance, due to different concerns and areas of action, the **scientific community** of a country may have a different, usually more fact-oriented rather than negotiation-oriented position. Track II activities are a suitable means of communicating and discussing knowledge-based solutions. They help to keep communication channels open, even if not at the representative level. Scientific cross-border communication and cooperation has been denoted as scientific diplomacy. The scientific community of a country advises the political level, thus allowing national and international expert knowledge to find its way into decision-making.

However, the influence of **national lobby groups** and national or international actors and their interests can eventually prevail in governance and in international negotiations, regardless of the objective circumstances and well-founded positions and possibly also without control by legitimate bodies or procedures. In a number of states, predominantly those with weak civil societies, water policy decisions with far-reaching consequences lack transparency. This may result in an unholy alliance between autocratic governments and external investors following their countries' resource interests.

Riparian states in shared river basins can essentially be distinguished by their political and military **strength** (dominance), their **willingness to cooperate,** and their **dependence on external waters.** Reluctance to cooperate is commonly accompanied by dominance. However, closer examination shows that the states' actual willingness to cooperate is sometimes quite different from what it appears at first glance. Turkey, for example, is perceived and reported to be reluctant to cooperate, although Turkish and Iraqi bodies in fact meet regularly. The Niger and Benue riparian states have committed themselves to cooperate under the Niger Basin Authority (NBA), but it suffers chronic underfinancing due to some parties' delays in payment contributions.

Political boundaries dominate ethnic or religious ones. Ethnic or religious commonalities do not necessarily foster tendencies towards cross-border solidarity, even if shared cross-border interests, e.g. environmental protection, are additional push factors to cooperate across political boundaries. Iran has made no known efforts to keep the tributaries of the Tigris (e.g. the Diyala) cleaner, even though the downstream Iraqi population consists of Shi'ites like the Iranians. The rift was deepened by the Iran-Iraq war.

The **upstream or downstream status** of riparian states does not grant them a priori advantages or disadvantages in the use and control of transboundary water bodies. The upstream state has independent access to the sources of water bodies, but its ability to control them completely depends on its technological, physical and financial capacities as well as its political strength. The most dominant upstream states are the United States, Turkey, China and India (Ganges and important tributaries of the Indus). In Central Asia, the Jordan and the Nile Basin, the respective downstream states (Uzbekistan, Israel, Egypt) are dominant. Egypt is completely dependent on Nile water, while its upstream neighbour Ethiopia receives monsoon rainfalls on parts of its territory (green water) that makes Ethiopia less dependent on the Nile or other surface (blue) waters for irrigation, which gives leeway for compromises.

In water-rich **upstream countries,** many of which cover significant shares of mountainous terrain, poor climatic or topographic conditions can limit or prevent intensive agricultural water use (e.g. Switzerland, Austria, Tajikistan, Kyrgyzstan). Downstream states are not necessarily at a disadvantage in actual water sharing if the necessary conditions for comprehensive water use are not present in the upstream country.

Egypt, for example, has for years received more Nile water than it is entitled to because Sudan is unable to make use of its share.

The disadvantage of a downstream state is generally mitigated if it has a certain dominance. In the Nile basin a transformation from single state dominance in favour of Ethiopia is currently taking place *(Lossow 2015).* Dominant riparian states have shown a great deal of perseverance in preserving conditions that favour them.

Historical claims can aggravate dominant downstream states' unwillingness to compromise. Egypt, for example, insists on adhering to the colonial Nile Waters treaties, even though Ethiopia was not party to the agreements. Besides, this example shows the limitations of legal instruments.

Hydropower is a very important national motivation. Turkey has committed itself clearly to hydropower generation in the Tigris-Euphrates basin for strategic reasons due to its rapidly growing energy demand and its lack of own fossil fuel resources. Ethiopia is massively expanding its hydropower capacity, not only on the Blue Nile (Grand Ethiopian Renaissance Dam, GERD), but also with a cascade of five dams along the Omo River. Harnessing energy from hydropower uses little water in itself but reduces the downstream flow during the filling phase, which is warily observed by downstream neighbours. However, irrigation projects often come up downstream of dams, making use of the regulated flow regimes. Much of the water-related conflict potential is linked to hydropower installations.

Another motivation is subsidization of water services and acceptance by benefitting populations and the economic interests of agricultural actors. International statistics confirm that water consumption is high when consumer prices are low. Poor water efficiency results in inflated demand, poor quality and delivery inconsistency. Attempts to raise water prices lack general acceptance. A paternalistic attitude towards the population, religious reasons and caring for the poor are also widespread motives. Claims vis-à-vis the upstream riparians appear to be easier than costly and unpopular national efforts to reduce consumption.

The same applies for irrigation water, although in this case for economic reasons. The beneficiaries are not only of small-scale farmers but also agribusinesses and investors, including international and crop-exporting actors. If subsidized crops are exported, subsidies are exported. Cash crops neither benefit national food security nor significantly improve the national employment situation or economic development. It may be questioned to what extent the revenues generated by export benefit populations. Autocratic states are particularly prone to the sellout of national resources, e.g. water and land, to external actors. In general, riparian states tend to favour interest groups rather than consider their riparian neighbours' interests. This attitude makes it more difficult to achieve greater regional cooperation.

An entanglement of interests can be observed in the Mekong River Basin, which is mainly characterized by energy shortage. Laos undermines the good practice of IWRM (see Note 6: Integrated Water Resources Management) and the notification and prior consultation agreements of the Mekong River Commission (MRC). The start of construction on the Xayaburi Dam, which Laos did not coordinate with others, constitutes a fait accompli. However, the other riparian states have objected only mildly, presumably because they also plan to build hydropower plants on the main river. China is indirectly involved in this and other hydropower projects. Environmental issues (biodiversity and continuity) and the use of the river as a whole in accordance with the principles of IWRM are being put on the back burner in favour of increased energy production

The Niger Basin presents a situation where regional action appears to act lag behind what is appropriate with regard to the region's vulnerability and probable future development. In the Sahel north of the Niger, the southward spread of aridity from the north (Sahara) will, according to projected aridification trends, probably soon cause pastoralists to extend their grazing range southward into the lands of settled communities along the Niger River. Pastoralists by nature act across natural and political boundaries in their search for good pasture for their herds. Conflicts could then arise among ethnic groups and Niger riparian states because of water and land conflicts. As a matter of fact, violent incidents are actually becoming more frequent (internal communication with German embassies in member states of the NBA). The Niger Basin Authority (NBA) for the common Niger and Benue basin could manage the moderation of complex interests quite well, would it not have to struggle with unreliable payment contributions from some riparians. The Niger Basin is a focus region of European water diplomacy and the NBA is being supported by various international donors. Since problems in the Mekong River Basin as well as in the Niger Basin and the adjacent Sahel have not yet reached a critical state and do not yet dictate the political and diplomatic agenda, there is still leeway for preventive action. The preconditions are quite good because in both regions river basin commissions already exist.

GUIDANCE FOR WATER RESOURCES MANAGEMENT AND GOVERNANCE

As long as transboundary coordination and cooperation is not established, water-scarce countries are well advised to strengthen their water management and governance. As a matter of fact, enhanced water efficiency is their closest source of more and better water. Better water management would in many cases solve home-made problems. Even in Jordan, one of the driest countries in the world, there is still untapped potential to increase water efficiency. Beyond that, transboundary water cooperation can only succeed if national water sectors achieve satisfactory efficiency. Besides, good national water management offers leeway for international negotiations.

General guidelines for good water management in brief are:

- Efficient water use in all sectors, priority for non-evaporating uses, efficiency should be increased before supply, water prices should tell the economic truth.
- This will help to leave more water for other uses, particularly those with several utilization cycles in sequence, which multiply the benefit derived from the water resources used. Most irrigation waters can only be used once. Irrigation is capital-intensive, even more so with modern, water-saving equipment.
- The minimizing of unproductive losses in irrigated agriculture, growing of water-efficient, adapted crops helps to save physical and virtual water and contributes to national food security. The export of cash crops (virtual water) from water-scarce basins and the cultivation of water-demanding crops deserves thorough examination.
- Ecologically and socially adapted traditional land use systems in resource-scarce environments, which are often decentralized, small-scale and labour-intensive, deserve special attention and support because they contribute to resource conservation (soils), local subsistence, employment and cultural identity,[6]

[6] Traditional small-scale farming systems contribute significantly to soil conservation, i.e. protection from erosion, which reduces sedimentation in reservoirs. SDGs 2.3, 12.2. and 13.1 refer to this objective. Stable agricultural income counteracts rural emigration

Terracing is traditional, small-scale, labour-intensive and capital-independant water and soil management. It contributes significantly to local subsistence, soil conservation, flood protection and to withholding sediment from rivers and reservoirs.

- Greatest possible avoidance of pollution or treatment of polluted waters before release into natural water bodies, polluter-pays principle,
- Large water projects, mainly dams and irrigation infrastructure, tend to have transboundary implications with negative long term impact, are economically questionable and unfold negative political dynamics; unavoidable negative impacts can be minimized through proven best practices (local population participation, environmental impact assessment), which are often omitted. Once dams are built, the temptation is to reclaim irrigation land downstream of it.
- The replacement of capital and energy-intensive solutions with management solutions, e.g. irrigation management training, increasing agricultural productivity instead of reclaiming new irrigation lands, helps to make more efficient use of financial resources and to reduce carbon emissions.
- Good water management and governance are in line with and indirectly support the implementation of the human right to drinking water and sanitation as well as the SDG goals (Goal 6 and several sub-goals) *(UN 2015a)*. Good water quality through treatment is a prerequisite to provide healthy drinking water. The right to drinking water and sanitation goes into further details concerning aspects such as accessibility, affordability etc. and appends the gender aspect. Sub goals related to water are comprised in SDG 2 (agricultural productivity of small-scale producers, sustainability of food production systems)
- A well-managed national water sector contributes to sustainable water management, ideally according to IWRM, and is of great importance if not mandatory under international obligations.
- Combined trans-sectoral (WEFE-Nexus) and transboundary approaches have an even better scope of achieving sustainable water management.

Much attention in shared critical river basins, often in traditional irrigation cultures, is given to the national entitlements of surface waters, although the negotiation of water shares has not proven to be a success story. From a climate change perspective they are not future-oriented and from a diplomatic perspective they perpetuate the disincentive in negotiations that gains for one party are losses for others and that sovereignty is given up with regard to water rights, which domestically is perceived as a sellout of national interests.

Salinization of soils (white crusts) in hot and dry regions is a permanent threat to soils and their productivity particularly if too much irrigation water is applied, here in the Oasis of Qara, Western Desert of Egypt.

INTERNATIONAL CONVERGENCE OF INTERESTS AND SYNERGIES OF USE

The broad discussion about conflicts and the mismatching interests of sectors and riparian nations distracts attention from the fact that these need not be the only determinants of national water strategies and transboundry communication. Converging and complementary interests among the riparian states of river basins are quite common although rarely communicated. They suggest alternative national positions and pave the way for constructive talks and a balancing of transboundary interests.

Successful transboundary water cooperation requires highest-level political support. In advance to negotiations, traditional perception of water problems might have to be examined and sustainable national strategies need to be developed.

Hydropower is generated by flowing water. Withholding water means to stop power generation. This is a high price to be paid by upstream riparians to harm downstream riparians. Beyond that, it is difficult withhold flows of large rivers completely and for significant periods of time except when the reservoir is empty. Evacuating reservoirs takes a long time. There are good reasons for upstream riparians not to cut river discharge even if it should be technically feasible.

Upstream nations have an own interest in not destabilizing their water-dependent downstream neighbours by causing water shortage. Turkey has explicitly committed itself to a "zero problem" policy towards its neighbours. Apart from understanding downstream water needs and complying with them voluntarily, "turning off the water tap" would turn global public opinion vehemently against any upstream country doing so.

Dams reduce the danger of flooding downstream. There are cultures that have lived and worked with seasonal flooding, some even continuing to do so (e.g. in the Omo-Turkana region and along the Mekong River). Dams of the GAP project on the Tigris and Euphrates rivers in Anatolia in southeastern Turkey serve as flood control and protection in Iraq (see: Case Study of the Euphrates-Tigris Basin).

Solid river load is deposited in reservoirs. This needs to be evaluated from case to case, because the solid load usually contains fertile minerals that the irrigated land was supplied with during floods before dam construction. These made artificial fertilizers obsolete. In opposite cases, depositing the sediment in the reservoir can be advantageous for the downstream actors because the material is otherwise deposited in irrigation channels (Central Asia) necessitating costly maintenance.

Maintenance of good water quality reduces treatment efforts for drinking water, industrial and service facilities along rivers, both within national boundaries and internationally. If polluted, every user needs to treat raw water before using it. A multitude of cities along the Rhine river, which is Europe's most significant waterway from Basel onwards, use the bank filtrate of the Rhine water as a source of drinking water. This is possible because of sound water quality management and a disaster early warning system agreed upon in the Convention on the Protection of the Rhine and the EU Water Framework Directive, among others, and coordinated by the International Commission for the Protection of the Rhine (ICPR).

In mountainous upstream states, various natural factors may be less conducive to agriculture than in downstream states, but all the more so for hydropower generation. This complementarity of potentials encourages an exchange across borders (water-energy-food nexus).

In many water-scarce states, energy demand will soon become or is already a more pressing issue than water share for agriculture. The agricultural sector will fade into insignificance as past and ongoing developments of national economies show. In power generation and industry, water can be utilized several times in sequence, in agriculture significant amounts are evaporated and lost for further uses. Transboundary power networks can contribute to national economic development and regional integration.

Arid regions are only suitable for agriculture if sufficient water and suitable land for cultivation is available. Even then, arid soils are limited in fertility. In contrast, there is generally tremendous potential for solar and wind energy in vast deserts and steppes. Physical water shortage in water-scarce countries can be circumvented through the exchange of virtual water (food) and energy.

Egypt, for example, imports 30 billion m³ of virtual water per year in the form of food and animal feed *(Zeitoun et al. 2009)*. Its food production is in any case no longer self-sufficient because of population growth and not because of water shortage. However, only a small portion of these imports comes from the upstream riparians of the Nile. On the other hand, the volume of rice that Egypt exports each year equals 3 billion m³ of virtual water *(Egyptian Ministry of Water Resources and Irrigation 2013)*.

The global dry belts where water is typically scarce have great potentials for potentials for renewables that could provide energy for growing economies and relieve pressure on hydropower and transboundary waters.

III. PRINCIPLES, CONCEPTS AND FIELDS OF ACTION FOR WATER DIPLOMACY

There is a wide choice of instruments, attitudes and scales that are suitable for innovative water diplomacy that can and should be organised according to capacities, requirements and framework conditions. The last chapter compiles both basic principles that should serve as background considerations for concrete action and more implementation-oriented proposals. Not all of them entail a lead for diplomacy – many are complementary to existing processes and structures where environmental, development and scientific policy take the lead. The correct balance between those activities and the role of different political levels will depend on the specific situation in the basin, but they can all play a role in driving good water governance and water diplomacy.

GENERAL PRINCIPLES AND CONCEPTS

THE ROLE OF FOREIGN POLICY

Transboundary water issues touch upon **national sovereignty.** Therefore, the development of transboundary cooperation often needs to involve the highest political levels. Their participation in water policy processes can encourage and authorize sectoral ministries and technical administration agencies to go into action. In the case of sensitive dominant riparian states that are reluctant to get involved at the diplomatic level, indirect (e.g. Track II) formats are promising avenues to pave the way to improving water cooperation and fostering a rethinking towards a more cooperative attitude.

The **mainstreaming of water diplomacy issues** in international communication **at all political levels** merits continuation and strengthening. Germany has for years been promoting the human right to drinking water and sanitation, the development of a comprehensive Sustainable Development Goal dedicated to water (No. 6) and advocating for sustainable solutions in other fields together with like-minded partners. This type of engagement addressing the larger framework rather than concrete regional cooperation and measures is an important if not indispensable contribution to mainstream water diplomacy issues and objectives internationally.

Water and cross-sectoral governance

Water diplomacy does not and should not occur in a policy void, but it needs to be embedded in broader water governance processes. The implementation of **good water governance** requires decisions, institutional development and financial resources. Without good water governance, efforts at the technical level are almost destined to fail or be significantly reduced in efficiency. Good water governance, mainly manifested by the IWRM process, is an overarching goal. Water diplomacy should continuously address its significance. In diplomatic communication, uncooperative positions and poor practices (e.g. reckless investments, direct and indirect land and resource grabbing), particularly by external actors, donors and **funding institutions** in financing water-related projects, need to be addressed and reconsideration processes aiming at more cooperative and sustainable attitudes and strategies need to be triggered and supported.

Through its unique role among all resources for human existence and economic development, water is directly or indirectly related to other established fields of politics, including development policy, climate diplomacy, humanitarian aid, energy and environmental policy. Water diplomacy overlaps with **climate**

diplomacy in terms of adaptation to climate-related changes (water supply changes, flooding, drought, rainstorm frequency, intensity and seasonal distribution changes) as well as water management measures for adaptation and mitigation with intrinsic international implications in transboundary river basins. Climate change threatens to intensify already existing water problems. These interlinkages deserve more substantiated attention and communication. Diplomacy should be more water-oriented in the established fields that are related to water issues.

Considering water issues with trans-sectoral perspectives – particularly the perspectives of energy, food and environmental protection (Water-Energy-Food-Ecosystems-Nexus) – and implementing these accordingly has the potential to enhance water-related benefits in a transboundary river basin, to "enlarge the pie". Compromises by a party may then not be regarded as equivalent to losses, but allocate a share of the common benefits to it, which is not less valuable than what it strived for under sector and national perspectives. Although the approach is complex, it constitutes a great if not unique chance to pave the way for effective transboundary cooperation. The results and the explicit and implicit effects of nexus-guided implementation will surely strengthen regional integration, security and stability.

Principles for operationalizing water diplomacy

Water negotiations and processes in transboundary basins need much time, patience and persistence. **Permanent engagement in national and transboundary water issues,** if necessary at low intensities, can drive progress without overstretching the capacities of partners. In difficult basin constellations in particular, and there are hardly any easy ones, there is no silver bullet, but only a spectrum of diversified efforts and persistent engagement. The political decision-making levels in the target regions need time to absorb innovative solutions and to change awareness internally and among national groups of stakeholders. At the same time, communication and dissemination of proposed solutions should be continuous. Acceptance in target regions can also be supported through e.g. Track II activities, occasionally also referred to as "scientific" diplomacy.

Moreover, proactive acquisition and substantiation of knowledge and experience, including by sectoral ministries, science and water-related NGOs, ensures that relevant and proven knowledge is available in time for due consideration and implementation through political processes. For example, apart from demographic growth, conditions in the Niger and Benue river basin will additionally deteriorate due to climate change. Timely, effective action by the Niger Basin Authority (NBA) complemented by the involvement of water diplomacy could accelerate progress and prevent developments from reaching a critical stage.

In some tense river basins, military forces of antagonistic riparian states are supported externally by the same sponsor. However, armament will hardly increase competing riparians' willingness to cooperate and it also allocates financial resources in an unproductive way. Funding volumes are usually significant, to put it mildly, in relationship to expenses for water management and infrastructure. If only a part of the military support in these basins would be invested in water-security and cross-border cooperation, security and economic dividends would be higher and more sustainable.

Continued coordination and cooperation with external partners is a hallmark of successful water diplomacy. For Germany, this entails coordinating initiatives with the EEAS, like-minded EU members and third states with comparable agendas (Norway, Switzerland, USA), including further implementation of European Council conclusions on EU water diplomacy *(July 2013).* Technical implementation, optimal communication, coordination and cooperation among donors would help to optimize the use of resources and to address poor practices (land and resource grabbing). Joint initiatives of like-minded actors increase the political weight and momentum of the initiatives and coalitions are more likely to be perceived as neutral brokers.

POTENTIAL FIELDS OF ACTION FOR WATER DIPLOMACY

PUBLIC WATER DIPLOMACY

It is important to **raise public awareness about water and foster water education in target regions** with regard to the significance of good water quality, issues of water vulnerability, hygiene nexuses, individual ownership of water issues, the importance of the polluter-pays principle and of covering the costs of water services, limitations of water availability, support for water-related educational institutions and scholarships, and capacity development. All age and user groups are potential target groups, as are water-related professional groups from the technical to the political level. Relevant active NGOs in the target countries should be addressed, included or engaged.

Understanding and awareness of water problems, solutions and own contributions of all stakeholder groups is a cornerstone of enhanced water utilization.

Water issues and their implications are complex. Without adequate **political and scientific training for journalists,** media reporting and commentaries are frequently imprecise, if not skewed, incorrect and, as for international water affairs, nationally or otherwise biased. In order to raise public awareness, promote public discussion on national and international water policy and make the discussion more objective, training for journalists can support the mainstreaming of national and international water issues for a broader public.

INDIRECT WATER DIPLOMACY

The refusal of states to engage in negotiations and agreements may be rooted in the fear of not being able to assert their own interests sufficiently in negotiations. These fears can be allayed if the states' own negotiating capacities are strengthened through targeted training measures for negotiators **("empower to negotiate").**

There is no silver bullet in water diplomacy. Negotiations need to be open-minded, based on profound knowledge and will take much time, patience and support to succeed.

Transboundary exchange of water-related data has proven to be a decisive step for advanced international water cooperation, but the political will for inter-governmental confidence-building is an indispensable prerequisite to taking this step. The exchange comprises not only runoff and water quality data but also early warnings about flooding and industrial accidents that threaten water quality, drinking water supply and river ecosystems. Although the objective sounds easy to achieve, water data are subject to strict secrecy in many transboundary river riparians and there is much mutual distrust concerning the release and methodology of the data.

Scientific exchanges and joint scientific projects make international talks on problem areas more objective and keep Track II channels of communication open. Since national decision-makers consult their national scientific advisors and experts, international scientific exchange can help to induce political reconsideration of traditional attitudes and can function as a precursor to political talks. Scientific forums offer the opportunity of bringing objective, innovative perspectives into the discussion without putting pressure on political decision-makers.

Strengthening national water sectors in partner regions (hydrological services, water administration bodies responsible for price policy and water legislation, water supply and disposal, water resources management plans, water users' and agricultural associations, capacity development in the water sector) also makes sense in river basins with one or more cooperation-averse riparian states because international efforts without functioning national water management can hardly succeed. Comprehension of their own water efficiency reserves could significantly relieve the national water supply situation in a number of water-scarce countries and at the same time improve their international standing in water negotiations. There is a great deal of German and other donor nations' development aid that has been invested into this field for many years. However, the potential of transboundary cooperation needs to be tapped if good water governance and management are to be made ready for future challenges.

In this context, combatting corruption and **strengthening integrity and transparency** in the water sector is a multi-purpose field of action. The sector is particularly prone to corruption as significant financial resources are allocated to it. Negative impacts affect vulnerable population groups the most. The worst case scenario of Transparency International mentions a figure of 30 % losses or an increase of global costs by US$ 48 billion over the decade starting 2008 to achieve the MDG on water and sanitation *(Transparency International 2008)*. The Water Integrity Network (WIN) has gained extensive experience in this area and has developed proven, practice-oriented instruments for institutional and grassroots work.

INTERNATIONAL WATER GOVERNANCE AND DIPLOMACY

The development of a reference framework for good national and international water governance by a recognized organization with international reach and a recognized political and professional reputation could be an important step towards a shared understanding of global sustainable water governance. The water conventions (UN watercourse and UNECE water convention) *(UN 1997, UNECE 1992)* summarize many of the good practices but are not yet joined by many nations for different reasons. The water SDG (No. 6) *(UN 2015a)* and more than a dozen partially or indirectly water-related sub goals address many shortcomings and could support shaping innovative and effective international efforts.

Ideas of an institution similar to the IPCCC are being discussed in the water community. Yet there are no concrete plans or actions, and the plan is ambitious with a long way ahead. But if it succeeds, it would give more political weight to water issues in general, and to transboundary water cooperation and water governance in particular. The formation of such an institution should definitely be supported and strengthened by water diplomacy. With the UN 2030 Agenda for Sustainable Development *(UN 2015a)*, member states have already committed themselves to pursue a number of objectives that constitute significant components of good water management and cooperation, including transboundary cooperation. An intergovernmental body would significantly mainstream essential water issues, bundle views on water, monitor progress and emphasize fields of priority efforts.

In sum, there are many ways to strengthen water diplomacy. The specific path forward should and will depend on the interests and capacities of interested actors and on the specific requirements and circumstances in the target regions. Although primary responsibility rests with the stakeholders and governments in transboundary basins, the scale of the challenges and their potential repercussions for regional and even global security and prosperity imply a strong justification for external involvement. Such involvement of water diplomacy can reasonably be expected to support regional development and security, but it is mandatory in light of the deteriorating framework conditions and the resulting increased need to pull out all the stops, the earlier the better.

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