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Problems and prospects in utilising international water resources: the case of the Nile

Term paper in the framework of the interdisciplinary course of the doctoral programme at the Centre for Development Research (ZEF) of the University of Bonn

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November 2003

Abstract

Fresh water is a scarce resource in many regions of this world. It is nevertheless vital for human existence and for economic development. The already limited supply of fresh water is going to be confronted with a growing demand for this resource in the future. As countries will also increasingly exploit international water resources, tensions and threats of violent conflicts rise. By example of the Nile Basin, the prospects and probabilities for peace are analysed by means of the "Kantian Triangle": democracy, economic interdependence and shared membership in international organisations are the elements that increase the likelihood of peace. On most accounts Egypt, the Sudan and Ethiopia – the major players in the Nile Basin – perform rather poorly, but realist constraints on the likelihood of war as well as recent signs of the will to co-operate on the management of the Nile waters are more encouraging.

Keywords: international water resources, conflict, Kantian peace, democracy, economic interdependence, international organisations, Nile Basin, Egypt, Sudan, Ethiopia.

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Abbreviations and acronyms

NBI - Nile Basin Initiative

FDI - foreign direct investment

IGO - intergovernmental organisation

MW - mega watts

1 Introduction – from water to war

"The next war in our region will be over the waters of the Nile."
(Boutros Boutros-Ghali, then Egypt's Minister of State for Foreign Affairs, 1988.[1])

Planet Earth is known to be the only planet of the solar system to harbour life – because on its surface water exists in liquid form, thanks to an optimal combination of both average temperatures and air pressure. However, of this water that covers about three quarters of the Earth's surface only about one percent is fit for consumption by human beings, animals and plants (Hillel, 1994). And this small portion is, moreover, subject to inequitable spatial repartition, thus making it a precious resource for the majority of people on Earth.

In addition, over the last years, greenhouse gas effects within the atmosphere have induced climatic changes that also affect the hydrological cycle, exacerbating existing inequalities of water distribution around the globe: rainfed countries get flooded while arid regions get dryer and dryer. Increasing pollution of fresh water further limits the amount of water that can be utilised. In this situation water is bound to become a main cause of international tensions in this century (Waterbury and Whittington, 1998). This is particularly true for countries where water scarcity is a constraint for development and where international water resources can be utilised to ease this constraint. In this case competing demands of the countries sharing such a resource are going to open up new conflicts and to intensify existing ones.

The river Nile is a case in point, as its basin encompasses ten states, and as it passes through one of the driest areas on earth and through countries that are classified as water-scarce or even water-stressed (Nasr 1999) not only providing the very basis for life in this otherwise hostile region but also offering the opportunity to utilise its waters for the economic development of its riparian states. Therefore – given the vital and simultaneously limited character of this resource, and given an ever increasing demand because of population growth, industrialisation, urbanisation, and increasing agricultural production (Webb and Iskandarani 1998) – tensions are bound to arise between the states sharing this transboundary resource.

[1] Quoted in Hillel (1994, p. 266), Klare (2001, p. 59), Gleick (1994, p. 14) and Morrow (2002 online).

It is this "case of the Nile" this paper is going to analyse with regard to the "problems and prospects in utilising international water resources". While many authors have written a lot about the Nile, this work often focused on aspects of the natural sciences or otherwise the authors frequently confined themselves to detail facts about the Nile and its basin, to describe past, current and planned projects to manage its waters, to list approaches undertaken so far to solve existing or foreseeable problems, and to illustrate offhand future scenarios for consequences of and solutions for these problems. After making a synthesis of this existing information and after presenting the connected problems, the present paper intends to improve on the analysis of the outlook, i.e. it intends to analyse the prospects for the Nile Basin by means of a coherent framework. In doing so, this paper limits its focus on the question of the probabilities of war and peace amongst the major players in the region and, thus, test the hypothesis of the introductory quote of Boutros Boutros-Ghali.

The structure of this paper is as follows: in the first chapter the above mentioned synthesis of the facts will be given, providing a general introduction to the topic and highlighting the problems of water politics in the Nile Basin. In the second chapter the findings of a quantitative study on the probabilities of armed conflict on the basis of the "Kantian Peace" (Russett and Oneal 2001) will be applied to the relationship between Egypt, the Sudan and Ethiopia in order to analyse and deduce the likelihood of a military dispute between these states. Finally some conclusions will be drawn and tentative policy recommendations will be given.

2 Problems – the Nile, a mysterious god in the ancient Egypt, a strained economic resource today

2.1 Presentation of the Nile

According to the Center for National Resources, Energy and Transport (CNRET), the Nile river basin is one of 57 international river and lake basins in Africa, from the total of 214 listed in the world. A river basin defined by this UN institution is "an area where natural resources of water (rain, general water flow, melting snow, etc.) feed a river which flows to the oceans, closed inlands, seas or lakes" (Chatterji 2002, p. 4).

The Nile river basin is located along the Mediterranean Sea in the north and the Red Sea and Indian Sea in the east. It is a prestigious river, namely linked to pharaoh's country: Egypt, with its antic and fabulous civilisation. As known from the past, the people of Egypt

though that the Nile was a holy river and revered it as god “Hapi”, and Egypt itself as a gift of the Nile (Swain 1997). Since immemorial times, Egyptians made most use of Nile waters by irrigating vast arid lands in the desert and attracting many peoples.

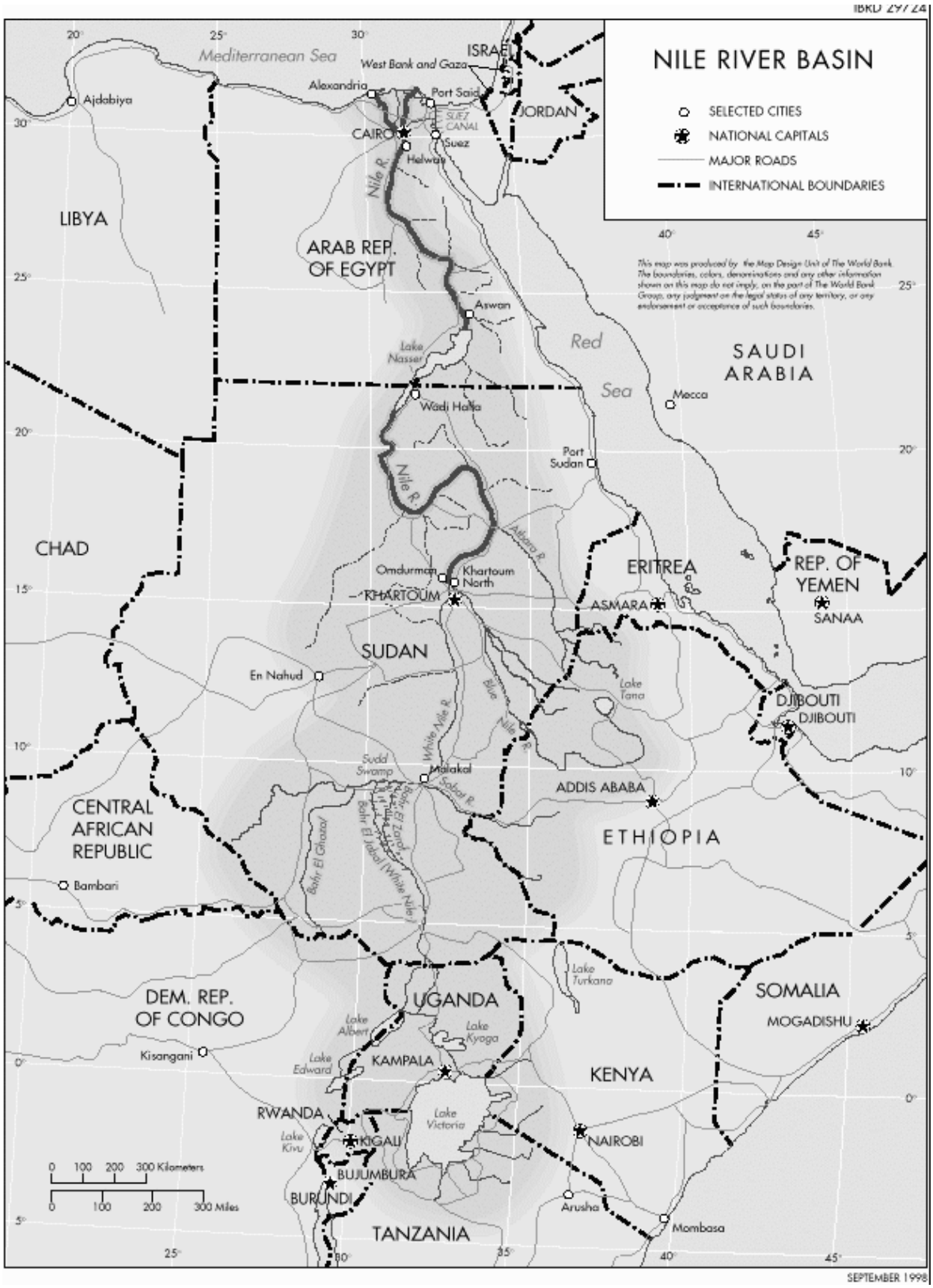
The Nile River is also known as the longest international river in the world (Swain 2002), with a length of 6,671 km and a watershed area of about 2,850 million km^2. But at historical times the river Nile was not as big as it is now (Said 1993). Its actual length is a result of long and complex geological and hydrological processes in which different independent lake basins in the central east and north of Africa became connected through overflows during wet periods’ rainfalls.

Today’s Nile River flows from the Democratic Republic of Congo (ex-Zaire), Uganda, Rwanda, Burundi, Tanzania, Kenya, Ethiopia, Eritrea and Sudan to Egypt, and finally into the Mediterranean Sea. Thus from upstream to downstream, the Nile passes through ten countries. It has two main tributaries called the Blue Nile and the White Nile (Figure 2-1).

The White Nile is a modest tributary, contributing only 14 percent of the Nile’s flow, with water flowing steadily from Lake Victoria and other lakes (Albert, Kioga and Edward) in the central east of Africa through Uganda into the Sudd in the Sudan, and then on to Khartoum. The Blue Nile, coming from Ethiopia’s highlands (Lake Tana and flows of the eternal snows of the Ruwenzori Mountains), is the most important tributary of the Nile. Its contribution to Nile River is about 86 percent, which has high seasonal fluctuations due to local climatic conditions in the region. The two tributaries have their confluence in the Sudan at Khartoum; then, further north, they meet another tributary, the Atbara River. The Nile continues to flow into Lake Nasser, which is the man-made lake behind the Aswan High Dam in Egypt, and finally into the Mediterranean Sea (Belyazid et al. 2000).

The Nile is not only the world’s longest river, it is also the world’s best monitored river (Said 1993). Because Egyptians already benefited from Nile waters in ancient times through the floods occurring on their lands, they have tried early on to monitor Nile water fluctuations. Many “nilometers” (gauges on the Nile), were already installed in the ancient Egypt, and after the source of the Nile was discovered at the village Rutana in Burundi (Said 1993), a total of 300 observation points were installed along the entire course of the river and its tributaries. These analyses made it possible to measure the discharge of the Nile River across time (Table 2-1).

Figure 2-1: The Nile River Basin – tributaries and riparian states



Source: Taken from http://www.thewaterpage.com/images/nilebasin.gif.

Table 2-1: Variations of annual discharge of the Nile at Aswan

Period	Annual average discharge at Aswan (billion cubic metres)
1870 – 1899	1,100
1899 – 1954	84
1954 – 1996	81
*1913**	*45*
*1946**	*104*

* = Years of exceptional discharge value. Source: Swain 2002.

However, the discharge of the Nile is still modest when considering its length and when compared to other big rivers in Africa (Table 2-2). This discharge, even though it is already modest, is still decreasing proportionally to the general declination in rainfalls in the region (Table 2-1) that can be observed in connection with the El Niño phenomenon (Said 1993).

Table 2-2: Comparing the Nile with other major river systems in Africa

Name of basin	Number of riparian countries	Catchment area (million square km)	Average annual discharge (billion cubic metres)
Nile	10	2.85	84
Congo/Zaire	9	3.69	1,250
Niger	9	2.23	180
Zambezi	7	1.29	230
Volta	6	0.39	390

Source: Swain 2002.

Considering the characteristics of the Nile River, it is easy to gauge the role it plays in the region for the ten countries, which are economically depending on exploiting its water resources. Yet this economic dependence on the Nile waters, without concrete arrangements between riparian states, will lead to failure or even conflicts in the long term. According to Said (2002, p. 145), the Canadian security analyst Homer-Dixon predicted that the "Nile is one of the few international rivers which has the potential to ignite an armed conflict among riparians."

2.2 Problems with the utilisation of the water resources of the Nile

Since historical times (6,500 to 10,000 years ago), where rainfalls were abundant, Egypt was the unique exploiter of the Nile River for agriculture. The annual overflow of the Nile

in Egypt flooded vast plains, generally from August or September to December or January, and then ebbed away again. This flooding happened just in time to let plants grow to maturity before cropping. The profitability of the Nile floods in Egypt was thus favoured by the characteristics of these floods, which came regularly and with stately precision, occurring at a suitable period for the fecundity of the lands. The Nile's floods were rarely destructive in Egypt, and for years Egypt has profitably made use of its water. Starting from agriculture based on natural flooding, Egyptians introduced land management with basin irrigation systems and, lately more elaborate irrigation systems of dykes delimiting artificial basins with take-off canals (Said 1993).

Sustained by a favourable political situation, Egypt developed many projects to utilise the resources of the Nile to increase the welfare of its population. Some of these projects are the Aswan High Dam and many others, like the Jonglei Canal and the Sheik Zahed Canal (Collins, no year), which were executed without the consent of the other riparian countries except the Sudan. Apart from agricultural use, Egypt is now utilising Nile waters for hydropower production and industrial and domestic supplies (Table 2-3).

Table 2-3: The balance of Nile water utilisation in Egypt

Items	Input (billion m^3)	Output (billion m^3)
Released from Aswan	55.5	
Evapotranspiration		35
Net drainage to the sea		11
Domestic and industrial non consumptive use		2.2
Navigation and hydropower requirements		1.8 - 3.8
Evaporation losses		2
Surplus for use in reclaiming new lands		1.5 - 3.5

Source: Said 1993.

Through a British arrangement in 1929, while Great Britain was representing Kenya, Tanzania, the Sudan and Uganda, Egypt became the unique user of the Nile's waters. This agreement stated that "no works or other measures likely to reduce the amount of water reaching Egypt were to be constructed or taken in Sudan or in territories under British administration without prior Egyptian consent" (Belyazid et al. 2000). After the independence of the Sudan in 1956, it asked Egypt for negotiations to revise the 1929 agreement. During two years Egypt and the Sudan witnessed a serious dispute about the distribution of Nile waters and, when the Sudan declared its non-adherence to the 1929 agreement, Egypt

even moved troops to their common border. In 1958 a military coup took place in the Sudan. The new regime was more favourable to Egypt and they revised the 1929 agreement in 1959 in order to redistribute the total of the Nile waters between them (Swain 1997). Referring to a total amount of water of 84 billions cubic metres at Aswan, 55.5 billions cubic metres were reserved for Egypt and 18.5 billions cubic metres for the Sudan. The remaining 10 billions cubic metres of water were left for different losses through the dam and due to climatic conditions. Before the agreement between the Sudan and Egypt in 1959, Britain's colonial administration had already concluded other agreements with European countries, which had colonised other riparian regions of the Nile. Britain's aim was to assure the total exploitation of Nile waters by its two colonies, Egypt and the Sudan. In 1891, Britain signed an agreement with Italy to prevent Ethiopia (Italy's colony) from realising irrigation projects schemes on the Atbara River on the Blue Nile. Directly after Ethiopia regained its independence, Britain signed an agreement with it in 1902 that precluded building dykes across the Blue Nile, Lake Tana or Lake Sobat. In 1906 Britain arranged another agreement with the state of Congo, prohibiting constructions on the White Nile to divert waters before reaching Sudan. With France and Italy Britain agreed on protecting the Nile's flows from any upstream diversion (Swain 1997).

These agreements put Egypt and the Sudan in a privileged position to exclusively utilise the Nile's waters; it also created a customary claim to this resource. However, after independence, other countries have not recognised this claim and they maintain that they have sovereignty over the waters within their boundaries. The claim of the latter for their share in the Nile waters seems to come natural, as the upstream riparian states are the main providers of all the water that flows downstream. Beyond such considerations, given population growth, rainfall scarcity and many economic constraints in the countries of the Nile Basin, it becomes obvious for these states to look for all possible resources of water, also transboundary ones, to satisfy their current and future requirements for development (Table 2-4). Tensions between riparian states of the Nile, for shares in its water resources, are now ready to arise. The Nile water, so far only shared by Egypt and the Sudan, is even insufficient to fit all of Egypt's projects; so how could they accept claims of other countries?

For some upstream countries like Congo, Tanzania, Burundi, Rwanda, Uganda and Kenya, where precipitations are still sufficient, agriculture is possible without irrigation (Table 2-5). Some of these countries have also other rivers to provide them with water. But for other riparian states of the Nile, as Ethiopia, Eritrea, the Sudan and Egypt, the river Nile

Table 2-4: Illustrative data for Nile Basin countries

Country	Population in 1995 (million)	Population in 2025 (million)	GNP per capita in 1996 (US$)	Population below poverty line* (percent)	Per capita water availability in 1990 (m^3)	Per capita water availability in 2025 (m^3)
Burundi	6.4	13.5	170	-	655	269
Congo	43.9	104.6	160	-	359,803	139,309
Egypt	62.9	97.3	1,090	7.6	1,123	630
Eritrea	3.5	7.0	-	-	-	-
Ethiopia	55.1	126.9	100	33.8	2,207	842
Kenya	28.3	63.4	320	50.2	636	235
Rwanda	8.0	15.8	190	45.7	897	306
Sudan	28.1	58.4	-	-	4,792	1,993
Tanzania	29.7	62.9	170	16.4	2,924	1,025
Uganda	21.3	48.1	300	50	3,759	1,437

* = 1 US$/day. Source: Swain 2002.

and its tributaries remain the one and only recourse for water. These states are known to be dependent on water for irrigation if they want to utilise the lands within their territories for agriculture. However, colonial agreements, that were relevant to those countries, are not adapted to today's situation and the states concerned maintain that they are to be revised or dissolved. Conflicts on Nile resource management are most likely to arise between these countries, which rely on the Nile's resources.

Table 2-5: Rainfall average in the Nile Basin

Country	Minimum average rainfall in the basin (mm/y)	Maximum average rainfall in the basin (mm/y)
Burundi	895	1,570
DR Congo	875	1,915
Egypt	0	120
Eritrea	540	665
Ethiopia	205	2,010
Kenya	505	1,790
Rwanda	840	1,935
Sudan	0	1,610
Tanzania	625	1,630
Uganda	395	2,060

Source: Karyabwite 2000.

Prior to the independence of the other riparian countries, Egypt made a plan called *Master Plan*. In this plan, hydraulic structures were to be constructed in Uganda, Congo, Ethiopia and the Sudan. The realisation of such structures in these countries was also expected to affect favourably the Nile water regime in Kenya, Tanzania, Rwanda and Burundi (Said 1993). However, after independence the new states rejected the plan because it was not conceived by them and they intended to manage resources for development themselves. Egypt could, therefore, not execute the Master Plan and continued to utilise the waters of the Nile for satisfying the needs of its population. This included also the construction of the Aswan High Dam, which was previously involved in the Master Plan. During the construction of the Aswan Dam and over the following years most of the other riparian states were shaken by internal political troubles and could not execute any development plans. Thus Egypt, based on its 1959 agreement with the Sudan, could profitably exploit the Nile resources (Said 1993).

By now the internal strife in many of the riparian states has been subdued and these states start to think about rebuilding and developing their nations. Moreover, despite of unrest and wars, the populations in these countries was still growing fast and it is expected to do so in the future, too (Table 2-4). How can these states afford economic development without resorting to the resources of the Nile?

In 1995 more than half of the 287 million people in the riparian states of the Nile relied on the Nile's waters (also c.f. Table 2-6). Assuming a medium annual population growth rate per country of three percent, the number of people relying on Nile waters is expected to double by 2025, while water availability will highly decrease due to low annual runoff levels of the watershed (Swain 2002). In addition to the increasing population in the three main competing states (Egypt, the Sudan and Ethiopia) for the Nile's water resources, the decreasing water availability in the Nile River (Table 2-1), and Egypt's and Sudan's claim on virtually all of the Nile's waters, are increasing tensions between these states.

Based on ILC (International Law Commission of the United Nations) rules on transboundary resources, in upstream states Egypt is only willing to accept hydropower dams or small dams for domestic water supply, like those currently built in Ethiopia, which are not harmful to its own irrigation schemes (Collins, no year). For this reason and complementary to the favourable topographic conditions, the Nile Basin has a high hydropower capacity (Table 2-7).

Table 2-6: Population in the Nile Basin

Country	Population density in the basin (hab./km²)	Basin population in 1990 (million)	Total population in 1990 (million)	Population within the Nile Basin (percent)
Burundi	250	3.2	5.5	58
DR Congo	88	1.8	43.1	4
Egypt	163	47.6	56.3	85
Eritrea	36	0.9	3.1	30
Ethiopia	53	19.5	55.1	35
Kenya	178	9.1	28.3	32
Rwanda	276	5.7	8.0	72
Sudan	11	20.9	28.1	74
Tanzania	40	4.9	29.7	16
Uganda	67	16.0	21.3	75
Total	-	129.6	279.1	46

Source: Karyabwite 2000.

In addition to increasing populations, the states in the Nile Basin are also faced with competing and independent plans for future water management projects by individual states. Egypt as well as Ethiopia are pursuing their own strategies to create "facts on the ground" that put them into a better bargaining position for any eventual future negotiation. Egypt is doing so by an ambitious scheme of land reclamation and settlement, the New Valley

Table 2-7: Irrigation and hydropower potential of the states in the Nile Basin in 1990

Country	Area ('000 km²)	Arable land ('000 ha)	Irrigated area ('000 ha)	Irrigation potential ('000 ha)	Hydropower installed (MW)	Hydropower potential (MW)
Burundi	26	770	14	185	36	1,366
Congo	2,345	6,930	11	-	2,829	530,000
Egypt	1,001	2,800	3,266	4,434	2,825	3,210
Eritrea	118	-	28	-	-	-
Ethiopia	1,104	11,300	190	3,637	378	162,000
Kenya	583	4,000	67	352	611	30,000
Rwanda	26	850	4	160	59	3,000
Sudan	2,506	12,920	1,946	4,843	225	1,900
Tanzania	945	3,100	190	828	339	20,000
Uganda	236	5,060	9	202	155	10,200

Source: Swain 2002.

Project, while Ethiopia is proceeding with the construction of microdams in the Tigray province, as these can be built economically and without foreign technical assistance, and as Ethiopia has hardly tipped into the irrigation potential of its land (Table 2-7). The New Valley Project is expected to require an additional five to ten billion cubic metres per year to be available at the Aswan High Dietary availability of micronutrients Reservoir, while the microdams can increase water use within Ethiopia also by five billion cubic metres per year (Waterbury and Whittington 1998, Dallmer 2002). These additional requirements have to be contrasted with the projected future requirements only under the conditions of 1995, when already around the year 2028 serious water shortages are expected to occur, with the corresponding risk of armed conflict about this vital resource (Belyazid 2000).

Given Egypt's current vision and plans for the utilisation of Nile waters, it will not tolerate any riparian state, except the Sudan for the latter's co-signature of the 1959 agreement, to practice irrigated agriculture with Nile waters. Egypt is the dominant economic and military power in the Nile Basin (Hillel 1994) and the other states, although they want to develop irrigation projects on Nile, have to overcome their weak financial resources and their situation of indebtedness, which are less conducive for such projects. With this background, the following chapter will look in more detail into the prospects for the states in the Nile Basin.

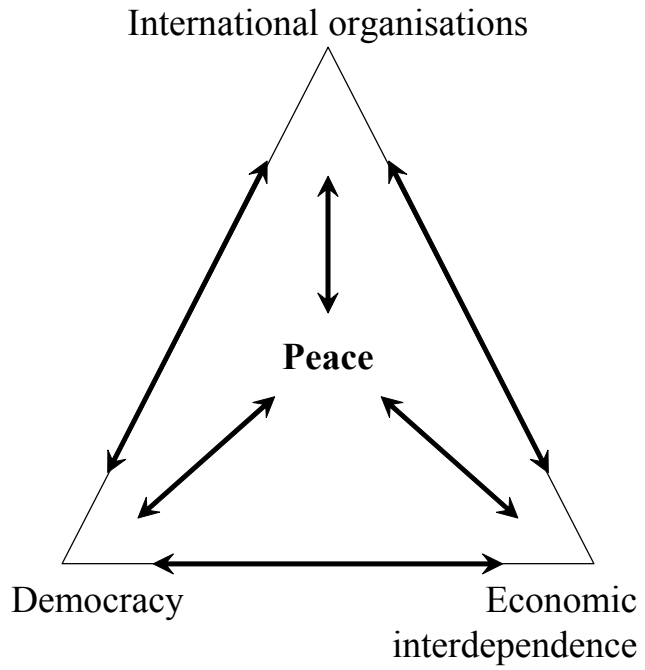
3 Prospects – is war the future for the riparian states of the Nile?

3.1 Methodology – how to assess the likelihood of war?

As was seen in the preceding chapter, the states in the Nile Basin face the problem of an increasing and competing demand for a limited resource: the waters of the Nile. In this chapter we will look at the probability that the governments of these states might resort to violence as a means to solve this problem in the future.

According to Russett and Oneal (2001) and Weede (2003), peace is the more likely the more democratic the states concerned are, the more they are economically interdependent and the more they are involved in common international organisations. In their book "Triangulating peace" Russett and Oneal trace these three elements back to Immanuel Kant's 1795 essay "Perpetual Peace" and visualise them in a simple diagram (see Figure 3-1) as virtuous circles that can help to perpetuate peace. They also establish the statistical

Figure 3-1: The Kantian Triangle



Source: Russett and Oneal (2001).

relevance of realist factors of peace, while they cannot find significant results for other factors that are proposed in the literature like, for instance, economic growth.

The scope of this paper does not allow analysing the prospects of peace in the Nile Basin in the quantitative fashion of Russett and Oneal (2001), but in the following we will take a look at each of the factors for which they established a statistically significant impact on peace. We will relate the findings of their study to the situation in the Nile Basin to be able to deduce the likelihood of peace in this region prior to drawing some conclusions.[2] In doing so it has to be kept in mind however, that Russett and Oneal take a probabilistic approach, which means that absolute statements are elusive.

For states to go to war with each other there must be a rational reason why they should do so in the first place. In the case of the states in the Nile Basin the preceding chapter showed that such a reason might arise from uncoordinated and competing use of the water of the Nile as well as (or anyway) in the face of increasing demands within the different states. And almost all the countries in the Nile Basin have known armed conflict and political violence in the last decades, as the Nile Basin encompasses countries in the hot spots of the

[2] The general structure and the theoretical background of the following paragraphs as well as some definitions, therefore, draw heavily on the first five chapters of Russett and Oneal (2001).

Middle East, the Horn of Africa and the African Great Lakes Region. Only with regard to specific conflicts that involved water issues, over the last 50 years there have been two armed conflicts in the region: In 1958 there has been a military dispute between Egypt and Sudan amidst pending negotiations over the Nile waters and in 1963/64 there have been border skirmishes between Ethiopia and Somalia over disputed territory where critical water resources were located (Gleick 2000).

From the preceding chapter it has become obvious that there are three states that are either dependent on the Nile and utilise virtually all its waters or that have the potential to utilise a substantial share of the Nile's waters in future. These "key players" are Egypt, the Sudan and Ethiopia and it is these states whose governments could have tangible reasons to engage in an armed conflict – respectively upstream states are probably not the ones that would initiate an armed conflict because they can already control and utilise the water they need. However, such an undertaking might be the very reason that provokes downstream states to resort to military action. With this background we will only focus on Egypt, the Sudan and Ethiopia when we proceed with our analysis. These three states, especially the pair Egypt-Ethiopia, have also been singled out in the general literature on the Nile and on water conflict as those states amongst which a conflict is most likely (Belyazid et al. 2000, Gleick 2000, Waterbury and Whittington 1998, Postel 2000, Hillel 1994, Chou et al. 1997, Ameri 1997, Hamilton 1997, Allison online, Dallmer 2002, Swain 1997 and 2002). And indeed, according to Russett and Oneal (2001) the threat to use military force, like Egypt's threat to use force against any state that undertakes to divert waters of the Nile, should already be counted as a dispute that might precede concrete military action.

3.2 "Realist" factors – geographic and military obstacles to war

One first pertinent "realist" factor stated by Russett and Oneal (2001) that is limiting the probability of an armed conflict between a dyad, i.e. between a pair of two states, is geography: attacking one's direct neighbour is quite straight forward, but projecting military force over hundreds or thousands of kilometres to fight a more distant country is much more difficult. Thus it can be considered to be quite unlikely that Egypt and Tanzania get involved in an armed conflict over a distance of thousands of kilometres, while such a conflict might well occur between Ethiopia and the Sudan or between the Sudan and Egypt who share long borders (Figure 2-1). In the case of the dyad Egypt-Ethiopia the prerequisite of contiguity, i.e. of a shared boundary on land or a separation of less than 150 miles

by water, is not fulfilled.[3] Thus the probability of war between Egypt and Ethiopia is already greatly diminished because of their geographic distance from each other. And Waterbury and Whittington (1998, p. 155) find moreover that "one can hardly imagine a worse place for Egypt to conduct a military campaign than the heavily-populated Ethiopian highlands."

Another limiting factor on the probability of war is power, respectively preponderant power: if two states have about equal military capabilities, one government might overestimate its chances in an armed conflict and start a war because it believes that the real balance of power tilts in its favour and expects to win. If one state is predominant, however, the weaker side will not go to war but rather concede what the more powerful state demands in order to avoid at least the predictable costs of losing a war.

To measure the military capabilities of states Russett and Oneal (2001) use a composite capabilities index of the Correlates of War project (COW online) which is composed of military manpower, military expenditures, the states' total population, their urban population, their energy consumption and their iron and steel production. The first two dimensions – manpower and expenditures – are obvious and can immediately be utilised for military purposes. The other dimensions indicate rather long-term military potential: "In a protracted conflict, a state can mobilize substantial parts of its total population, particularly if many people live in cities, and divert its industrial base (indicated by energy consumption and iron and steel production) to the war effort" (Russet and Oneal 2001, p. 103). According to the COW web site the level of urbanisation also reflects power through its correlation with the level of modernisation. In Table 3-1 we replaced some of the COW data with newer data from other sources. In doing so we also used the value added in the industrial sector instead of iron and steel production as a proxy for the potential contribution of the industrial base to an armed conflict.

Looking at the table we can confirm what Daniel Hillel already stated in his book "Rivers or Eden" (1994, p. 136): "Egypt is the dominant economic and military power in the Nile basin". It is obvious that Egypt is the preponderant power and, therefore, an armed conflict that would involve Egypt is less probable. With regard to the Sudan and Ethiopia the situa-

[3] This is the definition used by Russett and Oneal (2001).

Table 3-1: Military capabilities of Egypt, the Sudan and Ethiopia

	Egypt	Sudan	Ethiopia
Military personnel ('000, 1992) [c]	440	83	110
Military expenditure (million US$, 1999/2000) [a]	4,000	580	800
Electricity consumption (billion kWh, 2001) [a]	70.0	2.2	1.6
Oil consumption ('000 bbl/day, 2001) [a]	562	50	23
Value added in industry (billion current US$, 2002) [b]	31.5	2.5	0.7
Urban population (million in cities >100,000; 1992) [c]	18.1	3.8	2.5
Total population (million, 2003) [a]	74.7	38.1	66.6

Sources: a) CIA 2003, b) World Bank 2003, c) COW online (national material capabilities, version 2.1).

tion is less clear. In the short run Ethiopia's direct military capabilities are clearly superior to those of the Sudan, and with more time Ethiopia has a bigger population it can mobilise. But the Sudan has a stronger industrial base and a bigger urban population. The balance of power between the Sudan and Ethiopia is therefore less clear, which increases the probability of an armed conflict within this dyad.

So far we have seen that war between either of the dyads Egypt-Sudan and Egypt-Ethiopia is not likely because Egypt is always preponderant, and in the case of the dyad Egypt-Ethiopia mere geographic distance makes war less likely. However, Russett and Oneal (2001) give another realist constraint on waging war, namely military alliances. Yet, none of the three states considered is in a military alliance with another state of the group and therefore this factor cannot (further) increase the probability of peace. But the idea of an alliance could become important from another perspective: two of the three states might enter an alliance that is directed against the third party and thereby turn our prior analysis possibly upside down. Any dyad consisting of Egypt-Sudan vs. Ethiopia, Egypt-Ethiopia vs. Sudan or Sudan-Ethiopia vs. Egypt is directly contiguous and therefore each of these constellations increases the probability of war. Yet, if we look at the balances of power (Table 3-2) it becomes clear that even if the two smaller powers enter an alliance against Egypt, the latter will still be preponderant, which again decreases the probability of an armed conflict. Still, in the future increased population growth in Ethiopia[4] and the Sudan could – for the sake of argument – encourage them to pit the sheer numbers of their combined populations against an otherwise superior Egypt.

[4] "[B]y 2025 Ethiopia's population may well exceed Egypt's by 20 percent or more." (Hillel 1994, p. 135.)

Table 3-2: Military capabilities of potential alliances

	Egypt-Sudan	Ethiopia	Egypt-Ethiopia	Sudan	Sudan-Ethiopia	Egypt
Military personnel ('000, 1992)	523	110	550	83	193	440
Military expenditure (million US$, 1999/2000)	4.580	800	4,800	580	1,380	4,000
Electricity consumption (billion kWh, 2001)	72.2	1.6	71.6	2.2	3.8	70.0
Oil consumption ('000 bbl/day, 2001)	612	23	585	50	73	562
Value added in industry (billion current US$, 2002)	34.0	0.7	32.2	2.5	3.2	31.5
Urban population (million in cities >100,000; 1992)	21.9	2.5	20.6	3.8	6.3	18.1
Total population (million, 2003)	112.8	66.6	141.3	38.1	104.7	74.7

Source: Based on Table 3-1.

The analysis so far leaves us with only one pair of states and one constellation of alliances where realist factors let an armed conflict appear probable: the dyad Sudan-Ethiopia and, in future, possibly an alliance of the Sudan and Ethiopia against Egypt. However, which rational reasons are conceivable for an armed conflict between in these cases? We pointed already out that such a conflict is most likely to be initiated by a downstream state to ensure the continued flow of the river – an upstream state has already control over the water. From this background, for the first case, it is conceivable that the Sudan takes military action against Ethiopia if the latter obstructs the flow of the Nile. However, in this case Egypt is going to be equally concerned and, becoming a natural ally, might support the Sudan against Ethiopia, which would produce again a situation where there is preponderance and where, consequently, the probability of war decreases. And to undertake any international military intervention the Sudan first has to stabilise internally so that, currently, the probability of war between the Sudan and Ethiopia does not seem to be very pronounced. In the second case the fact that the Sudan – for the time being – is a state torn apart by civil war (Perras 2003) makes it not a reliable ally; and it is also some kind of an outcast within the international community (Hamilton 1997, Swain 1997), which is still

important for Ethiopia in its role as a donor. Under these circumstances it does not seem very plausible for Ethiopia to enter an alliance with the Sudan.[5]

Concluding this realist analysis of the likelihood of war in the Nile Basin one can state that a war between any of the three major players is not very likely. On the other hand a war between an offensive alliance of two states against the third one is also rather unlikely because the alliances do not eliminate preponderance. Nevertheless, in the following sections we will also take a closer look at the "Kantian" factors influencing the probability of war.

3.3 Democracy – voting or gun toting

In the framework of the "Kantian Triangle" used by Russett and Oneal (2001) the basic assumption is that democracies rarely fight each other. Following Robert Dahl, Russett and Oneal (2001, p. 44) define a democracy as "a country where (1) most citizens can vote, (2) the government comes to power in a free and fair election contested by two or more parties, and (3) the executive is either popularly elected (a presidential system) or is held responsible to an elected legislature (a parliamentary system)", underlining the fact that in such systems citizens have control over the executive branch and can vote a leader out of office who does not serve the interest of most of the people. This latter characteristic is the basis of structural explanations for the empirical relationship between democracy and peace: in a democracy the executive not only depends on the legislative for approval and funding of a decision to go to war, democratic leaders can and will also be made responsible for bad decisions. Therefore political leaders in democracies are more reluctant to go to war as this decision can bring high political domestic costs in the form of lower chances of being re-elected. In the same vein goes the argument that democratic leaders have to provide collective goods in order to be re-elected, while autocrats depend on smaller groups of cronies and the military elite who might suffer less from war or actually benefit from it. An additional reason for the "democratic peace" can be found in cultural explanations: in democracies people are used to solve their internal problems peacefully and therefore they are also more likely to resort to peaceful means to solve international disputes.

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[5] Moreover one could add non-realist reasons against such an alliance as cultural differences between the Sudan (which is dominated by Arab Muslims) and Ethiopia (which is dominated by black Christians), which might raise the hurdle for entering such an alliance.

When analysing their data, Russett and Oneal (2001) find strong evidence for this "democratic peace proposition", i.e. they find that the more democratic two states are, the less likely they are to become involved in an armed conflict with one another. On the other hand they could **not** confirm the existence of a corresponding "autocratic peace", which is based on the idea that armed conflict principally arises between democracies and autocracies because they mistrust each other (what Russett and Oneal call the "cats-and-dogs effect"), while pairs of autocracies as well as pairs of democracies generally maintain peaceful relations. This finding can easily be explained by the lack of the kind of above described norms and institutions that keep democracies from easily waging wars. Even more so it can be explained by the general lack of a unifying set of values amongst autocracies, which form a checkered group of states of different political orientations, reaching from the far left to the far right. To summarise: The more democratic the states in a dyad are, the more probable is peace amongst them, the more autocratic one or both states in a dyad are, the less probable is peace.

Given these findings we now want to look at the likelihood of war between Egypt, Sudan and Ethiopia, based on their democratic status (Table 3-3). Russett and Oneal (2001) used the old Polity III data set of Jaggers and Gurr of 1995; here we use the more recent information available in the Polity IV data set and, as additional information, include the country rating of Freedom House. Both are rather complex and widely used composite indicators that measure a broad variety of pertinent issues, which, therefore, we will take as granted as a more detailed discussion would go beyond the scope of the present paper.

Both scores of "democracy" rate Egypt and Sudan as unfree and autocratic, while Ethiopia is rated as partly free and slightly democratic. Consequently either dyad considered gives a

Table 3-3: Rating of democracy for Egypt, the Sudan and Ethiopia

	Egypt	**Sudan**	**Ethiopia**
Polity IV country report for 2001 (score: -10 = autocracy, 10 = democracy) [a]	-6	-7	1
democracy score (0 = low, 10 = high)	*0*	*0*	*3*
autocracy score (0 = low, 10 = high)	*6*	*7*	*2*
Freedom House country rating for 2003 (score: free, partly free, not free) [b]	not free	not free	partly free
political rights (1 = ideal, 7 = absent)	*6*	*7*	*5*
civil liberties (1 = ideal, 7 = absent)	*6*	*7*	*5*

Sources: a) Marshall and Jaggers 2002, b) Freedom House 2003.

pair in which at least one state is autocratic and, thus, the current political constellation amongst the three states is not likely to improve the perspective of peace in the region.

3.4 Economic interdependence – trade fair or warfare

The next "Kantian" factor forwarded by Russett and Oneal (2001) is economic interdependence; economic interdependence has two components: bilateral trade within a dyad and general openness of a state's economy. The rationale for a "liberal peace" is that commerce is mutually beneficial (even if the distribution of benefits might be asymmetric), it creates common interests and transnational ties among the trading states, and it benefits those members within a society who are peaceful and productive, thus increasing their political power. Accordingly Russett and Oneal find that both components of economic interdependence have a significant, positive impact on the likelihood of peace within a dyad – independently of the positive effect of democracy. As might have been expected, they also find that the intensity of dyadic trade has a bigger positive effect than the general openness of an economy.

Even though rationality is not always attributable to all fields of human action, it generally is taken for granted that people act rationally in accordance with their economic interests. Therefore states whose citizens trade amongst each other and who have financial investments in the other country have little interest in destroying this material basis by engaging in an armed conflict with each other. However, in states where there is less bilateral trade with another state, there is also less domestic economic interest linked to the maintenance of good relations with this other state and, thus, conflict is more probable. Generally the more a state benefits from trade and foreign investment, the more national prosperity and growth depend on peaceful international relations and the less likely this state is to resort to military means.

Apart from generating mutual economic benefits, trade also creates shared values between the people who engage in it: trade can be considered a means of communication that exposes the citizens of a state to the ideas and values of the people of its trading partners. Thus international commerce produces a common basis and mutual interests which discourage the use of force. Moreover the more intense communication between two societies that is resulting from trade can also serve to solve disputes early on by peaceful means. This mechanism is reinforced though democracy as in this case economic powerful groups are more likely to be able to express their interests within the political framework.

For this reason democracies are also more likely to comply with their obligations that arise from international trade agreements, which in turn reinforce the peaceful effect of economic interdependence.

With regard to the general openness of states to the global economy, more trade relative to the size of an economy also indicates less self-sufficiency of the state. Therefore states with more open economies have more to lose from involvement in armed conflicts than more self-sufficient states: if a state is involved in an armed conflict, this not only interrupts trade with the adversary, it also increases the risk and costs of doing business in and with this state in general. A rather self-sufficient state has less to lose from such a disturbance of the international trade, but an open economy has any incentive to solve international disputes peacefully.

Unlike the democracy ratings in the preceding subchapter, similar data is not available in such a condensed form for economic interdependence, which makes a more qualitative analysis of the economic interdependence in the Nile Basin necessary. In Table 3-4 we give the extent of bilateral trade between Egypt, the Sudan and Ethiopia and we put the numbers in relation to the importance of the main bilateral trading partners of each state, and for the purpose of comparison we provide data on the bilateral trade of a rather arbitrary selection of other states from different regions, of different sizes, and of different levels of development.

Looking at these numbers, it becomes quite obvious that bilateral trade between either pair of the three countries analysed in this paper is very small if not virtually nonexistent. The most important trade is the one between Egypt and the Sudan, where Egypt provides, however, only a market for about three percent of Sudanese exports, and where the Sudan imports about three percent of all its imports from Egypt. On the other hand trade with Ethiopia, its other neighbour, is close to zero for the Sudan. But even the trade flows between the Sudan and Egypt are very small if compared to the trade of other (befriended) neighbours, where the share of bilateral trade amounts to 10 to 30 percent. This result is not very encouraging for the prospects of peace in the region as bilateral trade, the cornerstone of the “liberal peace”, amongst the three states does not play any major role.

To consider the second aspect of economic interdependence, general openness of the economy of a state, we want to look at Table 3-5. The picture conveyed by this information is more ambivalent than the one given by the data on bilateral trade. The export and import of

Table 3-4: Trade amongst Egypt, the Sudan and Ethiopia in an international context

Trade in percent	1.	2.	3.	... [a]	... [a]
Egypt					
Export to (2002)	USA (20)	Italy (14)	UK (9)	**Sudan** (0.7)	Ethiopia (0.1)
Import from (2002)	USA (18)	Germany (8)	Italy (7)	**Sudan** (0.2)	Ethiopia (0.0)
Sudan					
Export to (2000)	China (42)	Japan (14)	**S. Arabia** (7)	**Egypt** (3.2)	**Ethiopia** (0.0)
Import from (2000)	China (9)	**S. Arabia** (8)	Germany (7)	**Egypt** (2.6)	**Ethiopia** (0.0)
Ethiopia					
Export to (2002)	**Djibouti** (13)	Italy (9)	Japan (9)	Egypt (1.2)	**Sudan** (0.5)
Import from (2002)	S. Arabia (29)	Italy (7)	India (6)	Egypt (1.2)	**Sudan** (0.1)
USA					
Export to (2001)	**Canada** (22)	**Mexico** (14)	Japan (8)		
Import from (2001)	**Canada** (19)	**Mexico** (12)	Japan (11)		
Germany					
Export to (2001)	**France** (11)	USA (8)	UK (8)		
Import from (2001)	**France** (9)	**Netherl.** (8)	USA (8)		
Poland					
Export to (1999)	**Germany** (34)	Italy (5)	France (5)		
Import from (1998)	**Germany** (24)	Russia (9)	Italy (8)		
Kenya					
Export to (2001)	UK (14)	**Tanzania** (13)	**Uganda** (12)		
Import from (2001)	UK (12)	UAE (10)	Japan (7)		
Argentina					
Export to (2000)	**Brazil** (27)	USA (12)	**Chile** (11)		
Import from (2000)	**Brazil** (25)	USA (19)	Germany (5)		

Contiguous states are marked in bold. Sources: CIA 2003, a) UN Comtrade online.

goods and services is not as big a share of GDP as in other countries, but international commerce is still a factor, especially for Ethiopia, but less so for the Sudan. At the same time Ethiopia and Egypt seem to favour self-sufficiency, if the height of tariffs and the performance of attracting foreign direct investment can be taken as an indicator for the importance the governments' attach towards their countries economic openness.

Overall the second aspect of economic interdependence, general openness of their economies, does not drastically change the result for the probability of an armed conflict between Egypt, the Sudan and Ethiopia that was derived from their bilateral trade relations. It seems as if economic interdependence cannot serve as an inhibiting factor to decrease the likelihood of an armed conflict between these states. Thus also the second factor of the Kantian Triangle fails to improve the prospects of peace in the Nile Basin.

Table 3-5: Openness of the economies of Egypt, the Sudan and Ethiopia

Exports of goods and services (% of GDP, 2002) [a]	Hong Kong	152.4	Imports of goods and services (% of GDP, 2002) [a]	Hong Kong	142.5
	Germany (2001)	35.0		**Ethiopia**	**33.5**
	Spain (2001)	29.9		Germany (2001)	33.1
	Poland	19.4		Spain (2001)	31.4
	Egypt	**18.2**		Poland	25.6
	Ethiopia	**15.2**		**Egypt**	**23.4**
	India	15.2		**Sudan** (2001)	**16.2**
	Sudan (2001)	**13.2**		India	16.1
	USA (1998)	11.1		USA (1998)	12.8
	Japan (2001)	10.4		Japan (2001)	9.8
	Myanmar (1998)	0.5		Myanmar (1998)	1.1
Unweighted average tariff rates (percent, 2001) [b]	Hong Kong	0.0	Country ranking of 140 economies of the UNCTAD Inward FDI Performance Index (1999-2001) [c]	Angola	2
	EU	3.9		Hong Kong	3
	USA	4.0		Germany	39
	Myanmar	4.8		Spain	41
	Japan	5.1		Poland	47
	Sudan (1996)	**5.3**		**Sudan**	**57**
	Indonesia	6.2		USA	79
	Poland	10.0		Myanmar	85
	World*	12.3		**Ethiopia**	**106**
	Ethiopia	**17.2**		**Egypt**	**110**
	Romania	18.1		Japan	128
	Egypt (1999)	**20.5**		Indonesia	138
	India	30.9		Suriname	140

* Average of 137 countries for last data available.

Sources: a) World Bank 2003, b) World Bank 2003a, c) UNCTAD 2003.

3.5 International organisations – talk shops or bomb drops

The last in row of the Kantian elements of peace is shared membership of states in inter-governmental organisations (IGOs). Like for the other elements of the Kantian peace before, Russett and Oneal (2001) find a statistically significant, positive impact of this factor. That is, in the more IGOs two states have a shared membership, the more it is likely that they settle their disputes peacefully.

Russett and Oneal (2001) list six functions that IGOs can have in preventing armed conflicts between their members. Those are the coercion of norm-breakers, mediation amongst conflicting parties, conveyance of information and reduction of uncertainty, establishment of common long-term perspectives, development of norms and safeguarding adherence to the rules, and creating of a sense of community and common identity.

Compared to the other two Kantian factors, Russett and Oneal (2001) find that shared membership in IGOs has the smallest impact, but it is still statistically significant and positive. This result might also be a consequence of the difficulty to weight the importance of shared membership in different IGOs: in how far is shared membership in a military

alliance like the NATO or in the WTO, with its dispute settlement mechanism, comparable with shared membership in the International Bureau of Weights and Measures? Russett and Oneal avoid any weighting, as this would also be arbitrary, and assign each membership equal importance, assuming that each IGO provides a potential forum for the peaceful resolution of conflicts.

Given the more limited scope of this paper we will only look at 1) those international organisations that deal directly with the Nile or that, in the past, have been involved in corresponding projects and initiatives, 2) those international organisations that have a more general scope and, thus, provide a general forum to deal with potential disputes, and 3) those international organisations that are of relevance to the other two elements of the Kantian peace – democracy and international commerce. In doing so we also include those international organisations that are not a hundred percent intergovernmental organisations but that in general experience official recognition and that are listed in the directories we used.[6] Furthermore, in order to gauge the states' attitudes towards the peaceful resolution of conflicts, we look at multilateral arms regulations and disarmament agreements of relevance to the three countries.

The directories we used to establish a tentative list of pertinent international organisations (Table 3-1) include the International Documents Collection (NUL online), the Documents Center (UMich online) and the Government Documents Library (MSU online). For the table on arms regulations agreements (Table 3-7) we used the listing of the Department for Disarmament Affairs of the United Nations (UN DDA online), and with regard to the Nile-specific organisations we referred to the literature (Table 3-8).

Looking at Table 3-6 the "odd man out" is Ethiopia, which has the least organisational ties with either of the other two states, while Egypt and the Sudan can find a common platform in practically all organisations considered. This is true even if this result can basically be reduced to the common denominators of (Arab) ethnicity and (Muslim) religion of Egypt and the Sudan. Altogether, membership of general international organisations seems to reduce the probability of war between Egypt and the Sudan, while failing to do so for any constellation involving Ethiopia. It is also interesting to note that none of the three states has ratified the Statute of the International Criminal Court, which has a role to play in

[6] This applies in particular to the International Federation of Red Cross and Red Crescent Societies.

Table 3-6: Membership in internat. organisations by Egypt, the Sudan and Ethiopia

	Egypt	Sudan	Ethiopia
African Development Bank			
African Union			
African, Caribbean and Pacific Group of States			
Food and Agricultural Organization			
International Criminal Court			
Int. Federation of Red Cross and Red Crescent Societies			
International Monetary Fund			
Inter-Parliamentary Union			
Islamic Development Bank Group			
League of Arab States			
Multilateral Investment Guarantee Agency			
Organization of the Islamic Conference			
South Centre			
The Common Market for Eastern and Southern Africa			
The Group of 77			
The Non-Aligned Movement			
United Nations (incl. International Court of Justice)			
United Nations Conference on Trade and Development			
World Bank Group			*
World Customs Organization			
World Trade Organization		observer	observer

* Ethiopia is not a member of the International Centre for Settlement of Investment Disputes.
Sources: Web sites of the individual organisations.

avenging war crimes. In this context in the following table (Table 3-7) we want to look at the priority the three states place on their freedom of manoeuvre with regard to warfare.

With regard to their commitment to arms regulation, none of the three states has signed all relevant international agreements, thus shedding some doubt on the resolve or the confidence of these states to settle disputes peacefully or at least within the framework of internationally acknowledged rules. Therefore, in the Table 3-8, we are looking into the resolution of Egypt, the Sudan and Ethiopia to settle the more specific issues surrounding the utilisation of the waters of the Nile within the framework of international organisations and agreements. There were and still are several agreement and platforms that deal with the Nile, which are listed chronologically.

As with Table 3-6 it is again Ethiopia that was least involved in multilateral undertakings. In this case, however, a gradual change can be observed: since the early 1990s Ethiopia started to co-operate within the framework of Nile-specific international agreements and

Table 3-7: Signing of arms regulations agreements by Egypt, the Sudan and Ethiopia

	Egypt	Sudan	Ethiopia
1925 Geneva Protocol			
African Nuclear-Weapon-Free-Zone (Pelindaba) Treaty			
Biological Weapons Convention			
Comprehensive Nuclear Test-Ban Treaty			
Inhumane Weapons Convention			
Environmental Modification Convention (ENMOD)			
Chemical Weapons Convention			
Mine-Ban (APM) Convention			
Non-Proliferation Treaty			
Partial or Nuclear Test-Ban Treaty			
Treaty on Open Skies			

Source: UN DDA online.

organisations. Thus it seems as if all three states are willing to solve the problems of the utilisation of the waters of the Nile on a co-operative and peaceful basis. Therefore, concluding this subchapter on the probability of a peaceful impact of international organisations, the result is somewhat ambivalent: within the last years a common forum developed to deal with Nile-specific issues, thus increasing the probability of peaceful resolution of conflicts. However, in general the three states are not overly committed

Table 3-8: Membership in specific internat. organisations, signing of agreements and participation in projects dealing with Nile issues by Egypt, Sudan and Ethiopia*

	Egypt	Sudan	Ethiopia
Treaty about the full Utilization of the Nile waters (1959)			
Permanent Joint Technical Committee protocol (1960)			
Hydromet project (1967)			
Jonglei Canal project (1976)			
Undugu (Swahili for "brotherhood", 1983)			
Agreement about future use of Nile waters (1991)			
TECCONILE committee (1992)			observer
Series of Nile 2002 Conferences (1993)			observer
Agreement on the Nile River (1993)			
Nile Basin Initiative (1999)			
Internat. Consortium for Co-operation on the Nile (2001)			

* Only the post-independence period is considered. Sources: Hillel 1994, Posthumus 2000, Hamilton 1997, Alavian 1999, Swain 2002, Collins no year, Allan 1999, Dallmer 2002, Swain 1997, Ameri 1997, Waterbury and Whittington 1998, UN 1999, UN 2001, NBI 2003.

within the framework of international arms agreements, and with regard to general regional or international organisations there is a tendency of Ethiopia to remain apart, thus widening the gap to Egypt and the Sudan and increasing the likelihood of a military dispute between Ethiopia on the one side and Egypt and the Sudan on the other.

3.6 Technical and co-operative solutions – some propositions from the literature

At the very heart of this paper is the problem of an increasing and competing demand of several states that faces a limited supply, the international water resources of the Nile. While our preceding analysis dealt with a situation in which it comes to a conflict between the competing interests, and in which the question was whether this conflict is more likely to be solved peacefully or by means of war, a rather obvious solution is to avoid or delay the worsening of the situation in the first place. As the supply of Nile waters cannot be increased the only alternatives are to use the existing supply more efficiently, to slow down the increasing demand, and to develop new water resources.

To increase the efficiency of current water use appropriate measures include the purification and the reuse of water, the implementation of pollution control mechanisms, the introduction of modern irrigation techniques like drip-irrigation and more efficient and integrated basin-wide water management (including the relocation of reservoirs to the most suitable sites, irrespective of national territories, including the undertaking of large-scale projects like the completion of the Jonglei Canal, and including the abandonment of narrow national projects). Measures to slow down demand would include a shift in agricultural production towards less water-intensive crops or, in the driest regions, a shift from an agricultural to an industrial development strategy, and the initiation of policies to reduce population growth. Finally the development of new water resources could imply the abandonment of strategies of self-sufficiency in agriculture and to increase the import of "virtual water" (food crops), and it could even imply the desalination of sea water (Chou et al. 1997, Belyazid et al. 2000, Dallmer 2002, and Waterbury and Whittington 1998). However, some of these measures and strategies are associated with considerable costs and there is a problem of free-riding.

In order to co-ordinate and implement the strategies that were just outlined, co-operation amongst the riparian states is paramount, especially as "in the field of international water the position is one of anarchy" (Allan 1999, p. 7) where there are two contentious principles, sovereignty and prior use, of which the one favours upstream states while the other

favours downstream states. As was seen in the preceding chapter, with the Nile Basin Initiative there have been some positive developments over the last years in respect to co-operation in the basin. This is generally seen as the most promising way ahead that should, if necessary, focus first on co-operation amongst the major players and on the least contentious issues to pave the way for more comprehensive and far-reaching agreements (Swain 2002, Allan 1999, Waterbury and Whittington 1998, Dallmer 2002, Chou et al. 1997, Posthumus 2000, and Belyazid et al. 2000).

4 Conclusion – geography and co-operation decrease the likelihood of war

In the preceding subchapter we have seen that there are technical and political solutions to the problems of water scarcity in the states of the Nile Basin. However, most solutions impose considerable costs, which, in the end, have to be outweighed by the costs of war if the latter is not to happen. Therefore our prior analysis of the probability of armed conflict between the major players in the Nile Basin becomes relevant again. Table 4-1 provides an overview of the results of the analysis of the individual factors influencing the probability of peace in the previous chapter.

Table 4-1: Factors of peace and factors of war

	Egypt vs. Sudan	**Egypt vs. Ethiopia**	**Sudan vs. Ethiopia**	**Egypt-Sudan vs. Ethiopia**	**Egypt-Ethiopia vs. Sudan**	**Sudan-Ethiopia vs. Egypt**
Geographical constraints	–	+	–	–	–	–
Preponderance & alliances	+	+	+	+	+	+
Democracy	–	–	–	–	–	–
Economic interdependence	–	–	–	–	–	–
International organisations	+	–	–	–	+	+

Factor generally increases the prospects of peace: +
Factor does not have an inhibiting impact on the likelihood of a military conflict: –
Source: own compilation.

For realist factors it could be shown that the risk of war between the two main potential adversaries, Egypt and Ethiopia, is somewhat reduced because those two states are not contiguous. Yet, an armed conflict involving either of these two states and the Sudan is perceivable as they share long borders with the Sudan, which facilitates the deployment of military means. In these cases, however, the preponderance of Egypt has either directly or indirectly an inhibiting impact on the likelihood of a military conflict.

Turning to the Kantian factors of peace the picture gets somewhat gloomier. As none of the three states is a true democracy, the pacifying effect of the "democratic peace" does not hold. Bilateral trade between either pair of the three countries is also very low, if not virtually non existent; the only inhibiting aspect in this case is the general importance of international trade for the economies of the three states, which is relevant but not extreme. Finally there is the role of international organisations. On the one hand Egypt and the Sudan share not only membership in most international organisations considered, they also have a long history of co-operation on Nile-specific issues, indicating a decreased probability of war within this dyad. Ethiopia, on the other hand, remains aloof of some of the common international platforms of Egypt and the Sudan, and it only recently started to co-operate in organisations and frameworks dealing with the management of the Nile waters. This latter development at least is a factor that works to decrease the probability of an armed conflict between Ethiopia and either or both of the other two states.

The prospects for peace in the Nile Basin are therefore mixed. It seems however that Egypt's preponderance and Ethiopia's growing commitment to co-operate within an international institutional framework are both increasing the probability of peace, with the mere geographical distance between these two states having an additional limiting effect on the likelihood of a military dispute. In this constellation the Sudan takes the role of a minor actor as it is clearly inferior with respect to a direct confrontation with Egypt, while Egypt dominates any potential conflict with Ethiopia as it would be as concerned by Ethiopian action as the Sudan.

Given this analysis, the most promising way to ensure peace amongst the major players in the Nile Basin is to promote and encourage further multilateral co-operation between Egypt, the Sudan and Ethiopia on Nile issues. Loans, grants and development aid from industrialised countries or international organisations can have a role to play in giving the corresponding incentives. Likewise, the international community can make clear that any military dispute in the region will have serious consequences for the international trade with the states responsible and, finally, it can provide financial support to implement technical solutions to improve the efficiency of current water use and to develop new water resources. Apart from having merits in its own right, democratisation of the states in the region would also have a positive effect on the probability of peace, but this is certainly a difficult and challenging task that can only be approached with a long-term view.

As was described in the first chapter, water issues are less likely to lead to conflicts amongst the other riparian countries of the Nile. In any case, however, the most recent initiative (the Nile Basin Initiative) encompasses all ten countries of the Nile Basin. Therefore, it promotes peaceful resolution of conflicts that might arise outside the relationship of the states analysed in this paper.

To conclude, it seems as if the outlook for peace in the Nile Basin is brighter than the introductory quote, the starting point of this paper, made believe. Peace can by no means be guaranteed – the framework used for the analysis builds only on probabilities and the present paper only analysed the situation with regard to the management of the Nile – but there is reason for optimism and hope.

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