



Post-Jonglei planning in southern Sudan: combining environment with development

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ABSTRACT In 2008, the Sudanese and Egyptian governments decided to resume work on the Jonglei Canal project, which had been abandoned for 24 years. This project in southern Sudan plans to by-pass, and thus drain, part of the wetlands of the Bahr al-Jabal and Bahr az-Zaraf rivers into the White Nile. While this would increase the Nile waters flowing northwards, it would almost inevitably have negative side-effects on the local, and maybe the regional, environment. The canal's benefits would be shared by Egypt and the Sudan, but with the expected damage falling on southern Sudan. The canal project, launched in 1978, was brought to a halt by rebels in 1984, and the moves to revive it began after the peace agreement of January 2005. This paper argues against the implementation of the project until it is justified by reliable scientific evidence. It outlines the nature of the project, the disputes around its implementation and the advantages and probable hazards of the project. It also argues for regional development in southern Sudan that recognizes the wetlands as a valuable resource and protects the ecosystem.

KEYWORDS Jonglei Canal / planning in southern Sudan / Sudanese-Egyptian relations / wetland development

I. INTRODUCTION

In the Sudan, three distinct major regions confront the physical planner with very particular challenges relating to a sustainable human–environment–resource interaction. The first is the Jonglei wetlands in the south; the second is the advancing desert belt now embracing the national capital, Khartoum; and the third is Lake Nubia, on the northern border, created by the construction of the High Dam in Egypt, with its wealth of water, silt, fish, location as a port, archaeological sites and dramatic scenery, all neglected for more than 40 years.

This paper focuses on the first region and considers the Jonglei Canal project, as interfering with the wetlands ecosystem could trigger abrupt and far-reaching ecological changes. This project has fairly influential foreign parties pressing for action for their own benefit, regardless of possible harmful local or regional effects. Numerous interrelated issues are involved and, although many experts have dealt with them individually, each has moved within the confines of his or her specialization and none has explored the many interlinkages between them.

II. THE REGION

The Jonglei wetlands lie between latitudes 6° 30' and 9° 30' north, and longitudes 30° 10' and 31° 45' east. As the waters flowing northwards from the equatorial lakes reach a certain point in the Jonglei area, their course branches out into two rivers, the Bahr al-Jabal and the Bahr az-Zaraf (Map 1). These rivers then overflow their banks and flood the adjacent low, almost flat plains (sloping at about 10 centimetres/kilometre), creating a vast marshland. This is augmented by annual rainfall of 600–700 millimetres in the northern parts of the marshland and 800–1,000 millimetres in the south. The inundated area covers more than 8,000 square kilometres, and often extends to several times this area depending on the seasonal and annual variations in the river discharge and the intensity of the rainfall. At the height of the flood, the water rises two metres above the plain.⁽¹⁾

The rainfall, the evaporation from the extensive water surface and the transpiration from the thick layer of floating vegetation (thick enough to hamper navigation, hence the name "Sudd", or dam, given to the area) all join to create the unique ecology of the region. Since the nineteenth century, writings have reported on the rich biodiversity of the place – an outcome of the proximity to the equatorial forests that extend southwards.⁽²⁾

Various mammals, reptiles, fish and birds are reported. Moghraby reports that "...it probably harbours the largest population of crocodiles in the world."⁽³⁾ The flora include papyrus, reeds, acacia and water hyacinths. The Jonglei marshland is one of three in southern Sudan, the other two being the Mashar and the Bahr al-Ghazal. The Bahr al-Jabal feeds the Nile with an average of 65 billion cubic metres of freshwater annually.⁽⁴⁾

In this region – isolated, inaccessible and for long plagued by surrounding wars – estimates in the 1980s suggested a population of between 500,000 and 800,000, partly settled in villages on the higher land and partly following a semi-nomadic pattern over land and marshes. These people are herders of cattle, the ownership of which establishes the status of the individual and the tribe. The harsh lives and vulnerable livelihoods characterizing their existence apply, to a greater or lesser extent, to the entire south.

III. THE PROJECT

A canal cut between Jonglei and the mouth of the Sobat River (Map 1) would by-pass, and thus ultimately reduce, the marshlands, and channel part of the excess water directly into the White Nile. The idea of such a canal to increase water volumes dates back to the early years of the Anglo-Egyptian Condominium era (1899–1955).⁽⁵⁾ First submitted in 1938 by the British irrigation inspector, and subsequently modified more than once, the study in its final version proposed a canal 280 kilometres long, four metres deep, 52 metres wide, with a 7–9 centimetres/kilometre slope and calculated to deliver an average of 20 million cubic metres of water per day.⁽⁶⁾ It has been estimated that this would shrink the permanent marshes by 34–43 per cent.⁽⁷⁾ In the second phase of the project, the discharge would be raised to 43 million cubic metres per day, either through an increase in the canal's cross section or through digging an additional canal. This would dry up the marshes entirely. An irrigation canal of 5 million cubic metres daily capacity would run along the canal's west side.⁽⁸⁾

1. Democratic Republic of the Sudan (1975), *The Jonglei Canal Project (Phase I)*, Ministry of Irrigation and Hydroelectric Power, Khartoum, January (in Arabic).

2. Moorehead, Alan (1960), *The White Nile*, Hamish Hamilton, London, 385 pages.

3. Moghraby, Asim (1982), "The Jonglei canal – needed development or potential eco-disaster?", *Environmental Conservation* Vol 9, No 2, Summer, pages 141–148.

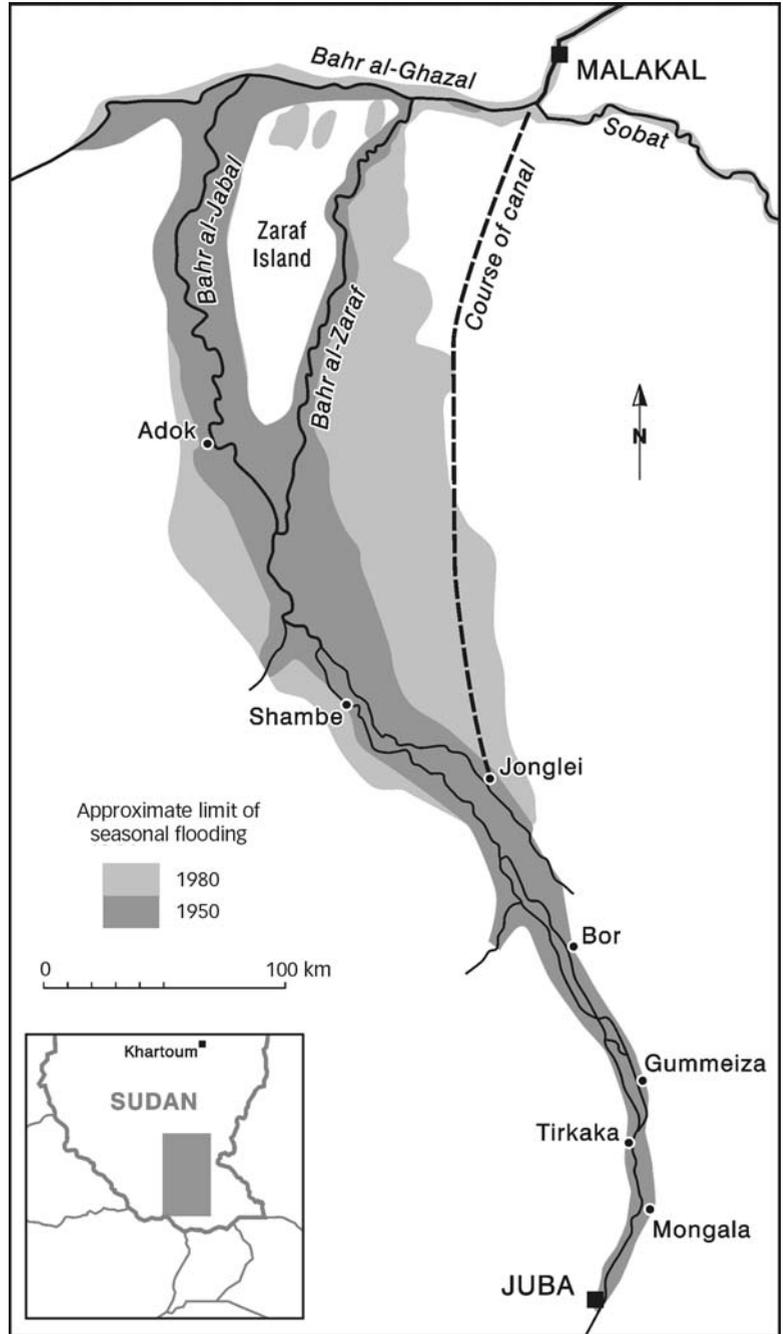
4. See reference 3.

5. The Sudan was under Anglo-Egyptian administration from 1899 (Kitchener's invasion) until 1 January 1956 (Independence).

6. Moghraby, A and M O Sammani (1985), "On the environmental and socioeconomic impact of the Jonglei canal", *Environmental Conservation* Vol 12, No 1, Spring, pages 41–48.

7. Sutcliffe, J V and Y P Parks (1982), "A hydrological estimate of the effect of the Jonglei canal on areas of flooding", Institute of Hydrology, Wallingford, UK (cited by Moghraby and Sammani (1985), see reference 6).

8. El Zein, Soghayroon (no date), "Jonglei canal", Proceedings of the Fifth Erkowit Conference, January 1971, Juba, the Sudan.



MAP 1
The Sudd and the Jonglei Canal

SOURCE: Based on Sudan Ministry of Irrigation and Water Resources Archives.

In 1975, the Sudanese government's Ministry of Irrigation and Hydro-electric Power issued a 70-page report dealing in considerable detail with the hydrological aspects of the project, and touching on historical and socioeconomic issues.⁽⁹⁾ The central objective was to increase the Nile revenue by 4.7 billion cubic metres annually, measured at Malakal (equivalent to 3.8 billion measured at Aswan), to be shared equally by the Sudan and Egypt. This would be raised to 7 billion cubic metres if Phase II of the project was executed.

The report mentions other benefits: providing a water source for livestock and wildlife; providing a road along one bank of the canal that could be used most of the year; reducing the flooded area by 10–20 per cent during the flood season; shortening the river route from Juba to Malakal (two provincial capitals) by about 300 kilometres (this figure seems exaggerated when checked against the map); reducing the prevalence of disease vectors; and supporting comprehensive national development plans. The report makes no mention of possible side-effects. Admittedly, the protection of biodiversity was not as prominent an issue three decades ago as it is at present. But a description of the probable impacts of the project on the climate, especially on rainfall, on the depletion of the flora and fauna and on increasing desert creep was needed. The southerners had additional worries, namely that tribes would be pushed closer together and conflicts over pasture would increase. In addition, the canal would cut across the routes of their livestock and game, and drying out the wetlands would facilitate the infiltration of government troops into their homelands. (The wetlands have protected the district from potential damage wrought by the military – most notably from landmines, which have proved such a problem in other parts of the south.)

The controversy is compounded by Egypt's subtle but persistent pressure for the project's implementation. The Egyptian government would welcome the extra share of water and, in return, is prepared to meet half the project's costs. Egypt would be the primary beneficiary of the project since the Sudan is not even utilizing all the water it is allocated under the current agreement. Increasing the revenue from the river is less of a priority in Sudanese development plans than fighting droughts, desertification and the unrest resulting from these trends (as demonstrated, for example, by the instability and other problems in Darfur).

With such a variety of issues at stake, the Jonglei project was bound to trigger more controversy and accusations than the approval it gained. The Nimeiri military regime (1969–1985), in one of its rare acts of cooperation with as-Sadat's Egypt, imposed the project on the Sudan. Excavation by the French *Compagnie de Construction Internationale* began in 1978, but was forced to a halt in 1984 by southern rebels, led by Dr John Garang, after most of the excavation work had been completed.

IV. EGYPT'S ROLE

Egypt faces some serious problems, created and exacerbated by four factors: the dictates of geography; the dictates of history; the Egyptian people's use of land; and the Egyptian state's attitude when dealing with other nations. The problems that concern our present debate can be summed up in a few points. The country has a population of more than 70 million.⁽¹⁰⁾

9. See reference 1.

10. United Nations (2006), *World Urbanization Prospects: the 2005 Revision*, United Nations Population Division, Department of Economic and Social Affairs, CD-ROM Edition – Data in digital form (POP/DB/WUP/Rev.2005), United Nations, New York.

At present, the population is growing by 1.8 million annually and the total population is estimated to reach 92 million by 2017; this instead of the 86 million previously estimated, despite the drop in fertility from 5.3 children per family in the period 1980–90 to 3.2 children in the period 1997–2003. It had been hoped that fertility would drop to 2.1 children per family by 2017, but this figure has now been discarded.⁽¹¹⁾

The dictates of geography have squeezed this population into a small liveable strip along the Nile. Only 4 per cent of Egypt's land area is arable, and although the government has succeeded in regularly increasing the cultivable area, the per capita area has continued to shrink. This very small agricultural land base relative to the population has been further depleted by urban sprawl and other non-agricultural developments over agricultural land. Egypt is heavily reliant on the Nile for all freshwater needs; only a small proportion of the water need is provided by rains and a slightly higher proportion by underground water sources. Water demand has also been much increased by the demands of Egypt's fast expanding middle- and high-income groups and by inefficient water resource management (as discussed in more detail later).

New threats are expected in Egypt as a result of global warming. Rises in sea levels will cause flooding, saltwater intrusion into fertile land and population displacement, hence further congestion in the Nile Valley. The UN *Human Development Report 2007–2008* lists as one of the consequences of a one-metre rise in sea levels in Lower Egypt "...the possible displacement of 6 million people and the flooding of 4,500 square kilometres of farmland. This is a region already marked by high levels of deprivation in many rural areas, with 17 per cent of the population (some 4 million people) having incomes below the poverty line."⁽¹²⁾ Shortages in food and water supplies will be expected, in addition to desertification as a result of farmers being displaced to marginal, infertile lands where farming causes further degradation. Expansion outside the Nile strip is not without its hazards. Egypt is one of the regions of the world most contaminated by landmines and explosive remnants of war. The explosives in the western desert, dating back to World War II, were planted by the British army on the one side and the German and Italian armies on the other, in their struggle to dominate the region. Those in Sinai, the Red Sea and the provinces adjacent to the Suez Canal were planted in the successive wars with Israel. More recently, they were used by Islamist militants to mine approaches to their hideouts, as well as by the Egyptian government itself to secure the national borders against infiltration by terrorists and drugs and arms traffickers. Estimates suggest more than 20 million landmines and explosive remnants of war, covering in excess of 3,000 square kilometres, including a strip 30 kilometres wide along the Mediterranean coastline.⁽¹³⁾ This combination of seawater intrusion and the presence of landmines has resulted in further squeezing the Egyptian population into the Nile Valley by impeding possible expansion elsewhere, and in further depleting the valley's water and land resources.

The extent of Egypt's reliance on the Nile for its water means that intensive water use by the nations to its south is not in its interests – for instance, irrigation, agricultural, industrial or urban use in the Sudan or Ethiopia, drawing on the Nile waters. Egypt's interests are not served by dams constructed in Ethiopia that would reduce the flow of water into Egypt. In the Sudan, the prospect of the separation of the southern provinces, which will be decided in 2011, may lead to the creation of a new

11. Anon (2007), "Stopping the population explosion ... the job of every Egyptian", *Al-Musawwar*, Cairo, 16 November, pages 38–39. Figures by Dr Hatim Al-Jabaly, Egyptian Minister of Health and Population.

12. United Nations Development Programme (2007), *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World: Human Development and Climate Change*, Palgrave Macmillan, London, 480 pages.

13. Anon (2005), "Egypt seeks to resolve landmine legacy", *Agence France Presse*, Cairo, 27 December.

state in the Nile Basin and this too will have implications for Egypt's share of the Nile waters.

In 1929, when the entire region was under foreign domination, the *Nile Waters Agreement* was ratified; this distributed the Nile waters between the Sudan and Egypt in a ratio of 1:12, giving 4 billion cubic metres annually to the Sudan and 48 billion to Egypt. The agreement was revised in 1959 and the shares were raised to 18.5 billion cubic metres to the Sudan and 55.5 billion to Egypt (a ratio of 1:3). The needs and rights of other countries, where the river's tributaries originate or through which it flows, were overlooked. Subsequently, the government in Egypt sought to claim that the terms of this agreement were inviolable, and even threatened to resort to arms if its share of the water was reduced – irrespective of changes within the region. When former President Anwar as-Sadat signed the peace agreement with Israel in 1979, he declared that Egypt would never go to war again except to protect her water resources; this was later repeated by other Egyptian officials, notably Dr Boutros Ghali.⁽¹⁴⁾ The debate continues as to whether it is geography or history that should be the predominant influence in setting the water shares, i.e. whether it is the party that possesses the source of the river or the party that has for a longer period utilized its water that should get priority.

Not surprisingly, there is considerable tension between Egypt and other Nile Basin countries. This is not helped by the fact that a review of the work of Egyptian scientists found no mention of the possible damage to the Sudan's ecosystems, or of changes in the hydrological regime, when they discuss drying out the "swamps" to increase the Nile discharge. In addition, no reference is made to the fact that this increase would be dependent in large part on the heavy rainfall that itself would be threatened if the drying out actually took place. There are frequent references to "swamps" and to "evaporated, lost waters", terms that serve to dismiss or diminish the importance of this unique ecology and the processes that create it.⁽¹⁵⁾ Egyptian scientists are concerned about the loss of biodiversity in their own national territory (the small lakes of Manzala and Mariout in northern Egypt⁽¹⁶⁾) but tend not to discuss this concern in relation to the Sudd. The head of the Cairo sector in the Ministry of the Environment warns that Cairo province loses 1.5 billion cubic metres of drinking water each year "...through leaking water networks and the Egyptian citizens' lack of environmental awareness relating to the use of water."⁽¹⁷⁾ This claim makes it difficult to justify increased Nile water for Egypt's needs, as does Egypt's offer to pipe Nile water to the Negev Desert in Israel through the Peace Canal (an offer made by Egyptian former President Anwar as-Sadat to Israeli former Prime Minister Menachem Begin in 1979).⁽¹⁸⁾

V. WINDS OF CHANGE

Only recently has some sign of reform emerged. The Nile flows through 10 independent countries, home to more than 300 million people, and all their governments, except Egypt's, show evidence of wanting to work out more reasonable agreements. First among these is Ethiopia (source of the Blue Nile, which offers Egypt 84 per cent of her freshwater), which faces serious problems with poverty, droughts, famines and wars. Agreements concluded during colonial times should not automatically continue to be binding. Similarly, agreements concluded by dictatorial regimes after

14. See, for example, Darwish, Adil (1994), "Water wars", Conference on Environment and Quality of Life, Geneva, accessible at <http://www.mideastnews.com/waterwars.htm>.

15. Saeed, R (2004), *Egypt of the Future*, Kitab al-Hilal, Cairo (in Arabic).

16. Hinnawi, I (2001), "The future of the Egyptian environment in five scenarios", *Al-Bee'a wa-Tanmiya (Environment and Development)* Vol 6, No 44, November, pages 18–23, Beirut (in Arabic).

17. Anon (2004), "Egypt: waste of 1.5 billion cubic metres of water annually", *Bada-il (Arabic edition of The Ecologist)* Vol 1, No 2, Autumn, page 10.

18. See, for example, Bleier, Ronald (1997), "Will Nile water go to Israel? North Sinai pipelines and the politics of scarcity", *Middle East Policy* Vol 5, No 3, September, pages 113–124.

independence, which went against national interests, should not continue to be honoured without change. These agreements need to be regularly re-examined in the light of new circumstances and new developments. It is unfortunate that the world's longest river carries by far the least amount of water in comparison to other great African rivers (Table 1). Given the rising regional needs, rational action is critical.

The required reform involves two new considerations; first, that none of the Nile Basin countries be excluded from the talks or agreements on the Nile issues; and second, that it is not only the sharing of the waters that is at issue but also the comprehensive development and utilization of all the river's resources in a way that will benefit all parties. In response to the first of these considerations, the Nile Basin Council of Ministers was created, and meetings of the Equatorial countries were held in December 2004 to discuss matters of mutual interest and to resolve conflicts. On the issue of sharing the river's resources, the most prominent step was the World Bank's *Nile Basin Initiative* of 2001,⁽¹⁹⁾ which for the first time looked comprehensively at the problem and proposed seven projects: the Nile Trans-boundary Environmental Action project; the Nile Basin Regional Power Trade project; the Efficient Water Use for Agricultural Production project; the Water Resources Planning and Management project; the Confidence Building and Stakeholder Involvement project; the Applied Training project; and the Socioeconomic Development and Benefit Sharing project. Egyptian reactions to these initiatives have, on the whole, been distinctly negative.⁽²⁰⁾

As for the Sudan, suddenly the country has found itself one of the main foci of world attention. This is due, in part, to the struggle for control over the natural resources, and also the ongoing resources wars – to borrow Suleiman's term⁽²¹⁾ – over oil, water, gold, uranium and livestock, to name but a few.⁽²²⁾ Using various pretexts, high-income countries keep seeking to establish an early foothold in this emerging oil state. While their interest presents obvious drawbacks, it might help address some of the nation's domestic problems (of marginality, totalitarianism, instability and vulnerability to crises). It draws world attention to local and regional affairs, offers partnerships and expertise, enforces surveillance and introduces powerful parties (great powers, multilateral organizations) into relationships that were hitherto bilateral, with the Sudan usually the weaker party.

19. World Bank and Nile Basin Initiative Secretariat (2001), "Nile basin initiative strategic action programme: an overview", The World Bank, Washington DC, May.

20. For a typical Egyptian reaction, see Saeed, Rushdi (2001), "The World Bank prescription for the development of the Nile Basin", *Wijhat Nathar* No 32, September, The Egyptian Company for Arabic and International Publishing, Cairo (in Arabic).

21. Suleiman, M (2000), *The Sudan: Resources and Identity Wars*, Academic Press, Cambridge, UK (in Arabic).

22. Badal, Rafael Koba (no date), "Development potential of southern Sudan: strategies and constraints", Mohamed Omer Beshir Centre for Sudanese Studies, Omdurman Ahliyya University.

TABLE 1
Average annual discharge of major African rivers
(in billion cubic metres)

The Congo	1,200
The Volta	390
The Zambezi	230
The Niger	180
The Nile	84
The Amazon (for comparison)	6,900

SOURCE: Hamad, S (2008), "Agreements on the Nile waters", Workshop on Dams on the Nile: Lessons Learnt and Future Perspectives, Sudan National Discourse Forum (SNDF), 19–21 January, Khartoum; also Amazon basin facts, accessible at <http://nationalzoo.si.edu/Animals/Amazonia/Facts/basinfacts.cfm>.

Moreover, federalism, officially adopted in the Sudan in 1971, imposes further conditions on development. Environmental issues, the development and management of animal and water resources and road networks are now handled mainly by the provincial governments, not the central government. And although the main distinction in the federal state is that between central government and the provincial governments, the Sudan has its peculiarities: the provinces themselves have never had equal weight. The imbalance between north and south is the predominant issue here. The injustice inflicted on the south, and the neglect it suffered for half a century, remains a serious consideration. This history introduces new obligations, and particular emphasis must be laid, when planning the utilization of resources, on placing the interests of the southern Sudanese before those of the northerners and foreign interests. This concern is highlighted by the fact that one of the vital national resources, oil, is now being pumped from the southern region. The peace agreement signed in Naivasha (Kenya) on 9 January 2005 between the government and the "rebels" has allowed the south a more equal status within the federal state.

The peace agreement suffered a severe setback after Dr John Garang's untimely death in a mysterious plane crash, and the anger and disillusionment this sparked in the southerners has strengthened the stand of the separatists. This is likely to complicate the development issue further, but could equally facilitate the abandonment of the Jonglei Canal project for good. Egypt is responding by exerting pressure and by entering into many agreements to take part in rebuilding the south – a branch of Alexandria University, for example, has already been approved in Juba, in addition to a secondary vocational school, health centres, several thermal power stations and electricity supply lines serving Juba, Wau, Rumbeik and Bor.⁽²³⁾

The present Sudanese government is not taking environmental degradation seriously, nor is it striving to devise a workable link between environment and development. A 2007 report by the National Forests Corporation states that the area affected by oil exploration and production activities all over the country is estimated at 544,234 hectares (more than 1.3 million acres), necessitating the removal of more than 579 million trees. Forest areas are cleared for the purposes of exploration, drilling, piping and the construction of roads, camps and settlements; they are also cleared by the military for security purposes. The report considers this excessive and directs attention to cases of unnecessary deforestation.⁽²⁴⁾

VI. A SUGGESTED WAY FORWARD

At present, the Jonglei Canal project is too riven with complexity and controversy to be approved. Particularly in view of the approaching Nubian desert front, drying up the wetlands partially or totally is almost certain to bring undesirable long-term environmental changes. This is not just a local issue. The world has finally come to recognize the threats posed by global warming and desertification and is beginning to understand the scale of effort required to combat and overcome these. Awarding the Nobel Peace Prize to Kenyan environmental activist Wangari Maathai in 2004 has strengthened this awareness and has highlighted the link between peace and the environment or, to put it more directly, between

23. Interview with Mr El-Tahir Eidam, Director of Bilateral Aid, Ministry of International Cooperation, Khartoum, 28 May 2007.

24. Republic of the Sudan, Ministry of Agriculture and Forests (2007), "Deforestation as a result of petrol explorations and building the pipelines", Forests National Corporation, June, 22 pages (in Arabic).

environmental degradation and the rise in conflicts. In the Sudan, where the Sahara and the Nubian deserts are advancing southwards, drying up the wetlands would exacerbate this advance.

Physical planning is a challenge in southern Sudan. No population census has ever been conducted here and the last 21 years of civil war and the resultant population displacements have all but invalidated old estimates. The patterns and conditions of settlements, except for the larger towns, must have changed considerably. But it is no longer appropriate (if it ever was) to have ambitious physical plans with no consideration of their ecological impacts. The Jonglei region should be developed as a **wetland**. Wetlands should be regarded as valuable assets and preserved and developed as such. Their potential as social, economic, environmental, scientific and entertainment resources needs rigorous assessment; much international attention has focused on them lately.⁽²⁵⁾ Shrinking the permanent flooded area by up to 43 per cent, as the Sutcliffe and Parks study predicts will happen, is certainly too high a loss of wetland area to give the desired results.⁽²⁶⁾

In light of the new resources available to the Sudan from oil, of the end of the civil war in the south and of the incoming funds from various sources that are dedicated to the south (now reaching several billion dollars in addition to half the oil revenue), upgrading the entire wetland to a healthy, productive, sustainable state no longer seems as daunting a proposal as it once did, provided the political will is there to help the south catch up. Due to the clashes in the region, no environmental impact assessment has been conducted. The Jonglei Canal project has also long been discussed as if it were a single initiative, in isolation, while what was needed was to see it in the context of an integrated, long-term, regional plan covering the entire southern region. It is also important to recognize what has been learnt from studies of similar experiences abroad, the most dramatic and relevant of which being the drying up of the Ahwar wetlands in southern Iraq.⁽²⁷⁾

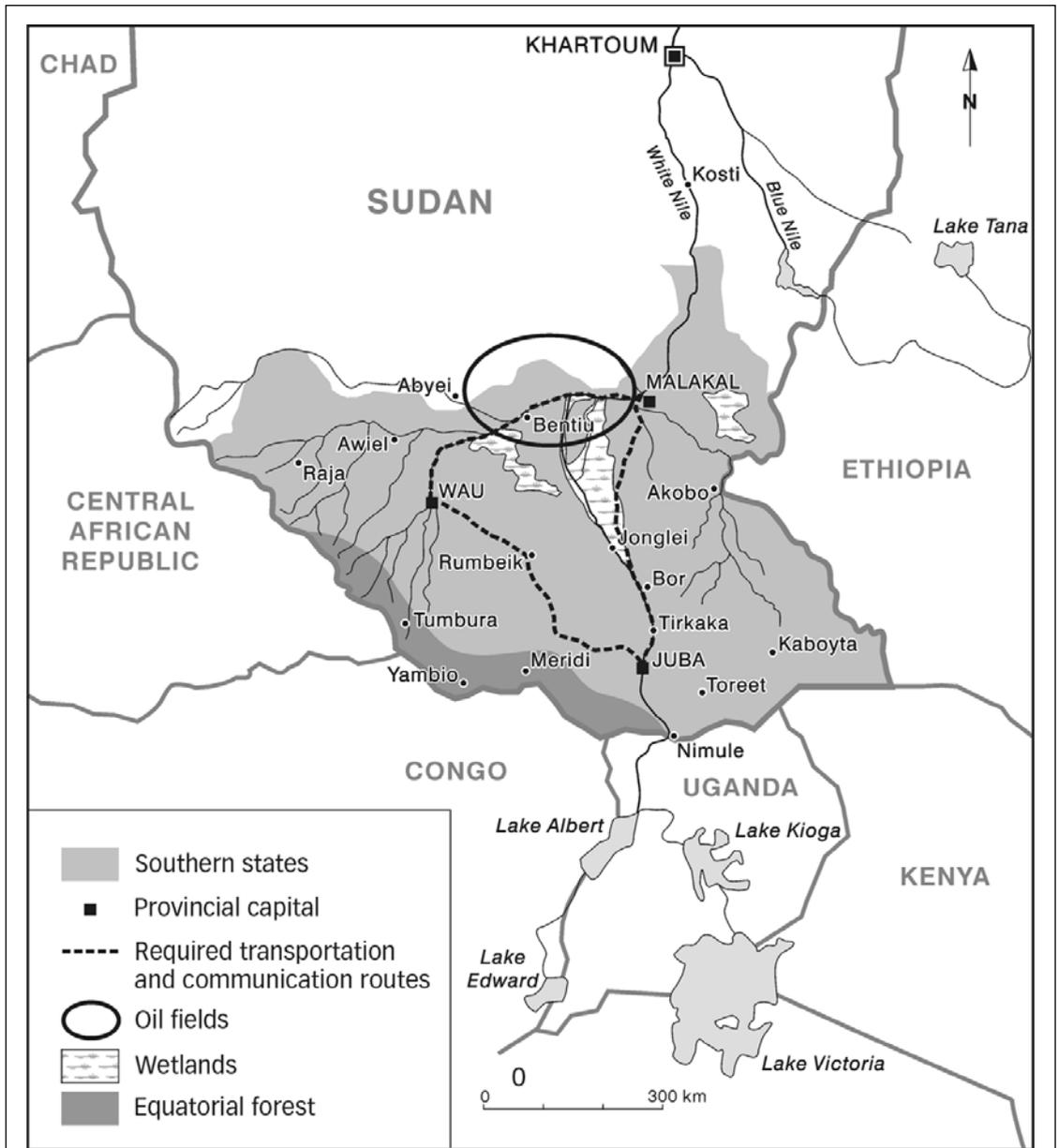
We should also consider the development potential of the south. It constitutes one-quarter of the Sudan and covers 646,000 square kilometres – equivalent to almost two-thirds of Egypt's total area. More significantly, its **habitable** area may be more than 10 times that of Egypt's. And if we estimate the southern population at, say, 40 per cent of the nation, it would number around 13 million, with a higher natural growth rate than in the north. The desired development of the south must link its three isolated regional capitals (Juba, Malakal and Wau) by reliable communication and infrastructure lines. But no proper planning of land uses (human settlements; transportation, communication and power lines; pastures and grazing lands; farmlands; forests and green belts; natural reserves and sanctuaries; wetlands; drinking spots for humans, domestic herds and wildlife, etc.) will be feasible unless we first succeed in managing the water flows, by demarcating all land uses and protecting those threatened by floods.

Rather than opting for the easier task of draining the plain, efforts should focus on erecting dams, bridges and dikes with various degrees of elaboration to control water flow through them, and on banking rivers and seasonal streams where needed to protect against floods. The task is not easy but the know-how is not lacking. The experience of building retaining walls on Bahr al-Jabal has demonstrated that "*...they could be done with no difficulty and without taking any special precautions ... they*

25. See, for example, The Ramsar Convention on Wetlands (1972).

26. See reference 7.

27. For details, see, for example, Human Rights Watch (2003), "The Iraqi government's assault on the Marsh Arabs", January, accessible at <http://www.hrw/backgrounder/mena/marsharabs1.htm>].



MAP 2
Southern states of the Sudan envisioning possible regional links

were found resistant enough for all practical purposes ... their ability to retain water increased with time ... and they could resist the pressure of three metres high tides."⁽²⁸⁾

Once this stage has been reached, the Sudan's strategic partner will be Uganda rather than Egypt, since realizing a qualitative step forward will necessitate close collaboration with Uganda in storing the water in

28. See reference 1.

Lakes Victoria and Albert, monitoring their levels and controlling their discharge all year round, as required.

Increasing the Nile waters revenue is at present a lower priority than developing the marshland (and the whole southern region). In relation to Egypt's water needs, what is required is more attention within Egypt to positive, practical measures to make better use of existing water flows – for instance, a reduction in water lost in piped systems, recycling of used water, modernization of irrigation systems, and the utilization of sea-water and desalination where appropriate. It is time to start listening to critics such as Saeed, the respected Egyptian geologist, who argued for decades that the whole romantic idea of “greening the desert”, and in particular its related Toshki project in southern Egypt, is basically wrong headed, and must give way to realistic alternatives.⁽²⁹⁾

Reorganizing and upgrading key settlements in the south into a functional hierarchy, probably starting with the Upper Nile regional capital, Malakal, is vital to all regional development. This would be helped greatly by the establishment of specialized institutions for development and wetland studies, to build reliable databases and serve at different levels, from the local to the African Equatorial region. Environmental impact assessments for any initiative have to be conducted not only at the start, to justify the project, as has been the rule, but also on a regular basis after the project has started to operate, for follow-up, assessment and feedback purposes. The development plans for each province of the region also need to be guided by the province's potential human and natural resources, to ensure diversity and complementarity and to enhance cooperation without violating the rights of others.

There are many areas in southern Sudan that potentially would be well served by the application of intermediate technologies (at home, neighbourhood, city and regional levels), the tapping of renewable resources (water, solar, wind and geothermal) and the realization of healthful “eco-tecture” and “eco-cities”. Potentially, the Sudanese are suited to demonstrating how to respect the environment and how to live in harmony with it.

29. See reference 15; also Darweesh, Nabeel (2004), “Egyptian scientist: the Toshki project is a big mistake and the Egyptian desert is not suitable for agriculture”, *Ad-Dustour*, 7 March, Amman, page 13 (in Arabic).

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