

On the Environmental and Socio-economic Impact of the Jonglei Canal Project, Southern Sudan

by

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INTRODUCTION

The Jonglei Canal Project has received wide publicity, especially after the United Nations Conference on Desertification, which was held in Nairobi, Kenya, in 1977. From the massive amount of literature that has been published on it during the past few years, by 'supporters of' and 'opposers to' the Project, emerges one important fact: that writers on both ends of the controversy have based their arguments on general indicators. Apart from the difficulty of quantifying the impacts that might ensue from the Canal Project, a difficulty that obscures the situation could be that of predicting with precision the future behaviour of the ecosystems involved, while another could be due to the many parameters involved and the complexity of their interrelationships.

Furthermore, opposers do not discuss the idea of the canal in the light of its multifold role in development, and do not take much interest in examining the basic economic and social goals which it is anticipated to serve. Instead, they resort directly to condemnation, on the assumption that the final excavation** of the canal would cause irreversible and mostly adverse effects, rendering the involved ecosystems incapable of sustaining the current Man-natural resources relationships.

The primary aim of the present paper is to project the brighter side of the Jonglei Canal Project and to encourage responsibility on the part of Sudanese scientists and policy-makers towards the environment. Our goal is to maximize the rational use of the environment while preserving as much as possible of it for continuing use. We realize that it would be impossible to alter the flow-pattern of the White Nile without interfering with the existing processes in the 'Sudd'. The questions are: to what extent can we do that safely, and what are the limits to which we can go?

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** In answer to our question as to the current situation, Dr Moghraby replied (*in litt.* 7 November 1984) '260 km of the canal have already been excavated. Work is now at a complete standstill due to an armed strife in the Southern Region.'—Ed.

THE ECOSYSTEMS

The 'Sudd' swamps have been a subject of curiosity and interest since the dawn of history, and have played a significant role in the cultural history of Africa south of the Sahara. Literature on the 'Sudd' is extremely large and varied, and ranges from accounts by explorers, travellers, hunters, naturalists, and adventurers, to contemporary multidisciplinary investigations, carried out with the sophisticated tools of modern scientific knowledge.

The physical background of the river-swamp system, as well as details of the history, development, and progress, of the Jonglei Canal Project, have been outlined in detail by Moghraby (1982); only a brief background will be given here.

Hydrologically, the Nile is probably the best-known river in the world. 'Records on river level extend almost as far back as A.D. 660 and, with gaps, to much earlier periods' (Hammerton, 1972). The Nile has been studied more intensively in the present century with the view to controlling its flow—e.g. Hurst & Phillips (1938), Hurst (1952), and Sutcliffe (1974). Literature on the hydrobiology of the various tributaries of the Nile is ample. The Hydrobiological Research Unit, of the University of Khartoum, alone made a total of twenty-three cruises to the 'Sudd', and published twenty-three annual reports—thus adding to the long list of publications on the area, which include several books. There is no place in this paper for a comprehensive list of the subjects investigated and the literature published, although the following sampling of them may come in useful.

Plankton and Limnology

Floral and faunal lists of plankton, as well as their distribution in time and space, have been published. Diurnal and seasonal rhythms have been outlined, in addition to the ecology of the swamps. The physico-chemical characteristics of the water have also been dealt with in detail (e.g. Brook, 1954; Talling, 1957; Bishai, 1962; Kurdin, 1968; Monakov, 1969; Green, 1971; Moghraby, 1975b; Rzóška, 1974, 1976). In addition, concentrations and distribution of natural radioactivity and trace elements have been recorded (unpublished reports, Hydrobiological Research Unit, University of Khartoum).

Aquatic Macrophytes

The sequence of colonization and succession of plant communities on islands, river-banks, and the Sudd swamps, and factors limiting their distribution and the rates of evapotranspiration, are fairly well understood (e.g. Migahid, 1947; Jonglei Investigation Team, 1954; Rzóska 1974, 1976). The biology and ecology of *Eichhornia crassipes* (Mart.) Solms, have been studied in order to apply integrated control procedures. Cycles of germination and reproduction have been described, in addition to the effects of the weed on the productivity of the White Nile system (e.g. Bebawi, 1972; Seed, 1972; Kock, 1974; Obeid, 1975; Moghraby, 1975b; Freidel, 1978).

Benthos and Insect Fauna

Nilotic Mollusca were mainly investigated for the presence of potential vectors of schistosomiasis and as indicators of palaeoecological conditions. Benthic biomass was determined, and species lists were provided, from Juba to Jebel Aulia* reservoir (e.g. Monakov, 1969; Adam, 1978; Martin & Williams, 1982). The seasonal cycles and longitudinal distribution† of emergent fauna were outlined, in addition to specific studies of microhabitats and the ecology of insects in the 'Sudd' region (e.g. Thornton, 1954; Lewis, 1955, 1956; Allam, 1979).

Fish and Fisheries Studies

The taxonomy and distribution of fishes have been outlined in detail and knowledge on fish potential and ecology is steadily increasing. Current research includes population dynamics, breeding migrations††, the effect of pesticides, and socio-economic aspects of fisheries (e.g. Boulanger, 1915; Girgis, 1948; Sandon, 1950; Scudder, 1978; Khogali & Moghraby, 1979; Nyang & Guma'a, 1980; Guma'a, 1982; Tombe, 1982).

Geographical and Geological Studies

These include investigations of morphology of the Nile valley, physical features, palaeoecology, palaeolimnology, and zoogeography, of the Nile and the Gezira (e.g. Berry, 1961; Whiteman, 1971; Rzóska, 1976; Martin & Williams, 1982). The mechanism and pattern of transported sediment beds have been outlined for the whole Nile in the Sudan (e.g. Hurst, 1952; Badri, 1972; Khalil & Badri, 1973).

Animal Wildlife

The distribution of birds has been outlined in detail, including the nesting behaviour and population dynamics of some species, e.g. the Shoebill Stork (*Balaeniceps rex*)—an endangered species. Accounts on large mammals are also available. Less information, however, is found on cro-

codiles and other reptiles (e.g. Cave & MacDonald, 1955; MacLeay, 1959; Guillet, 1978; Moghraby, 1975a; Euroconsult, 1977; Green, 1977; Meffit Italian Company, 1982).

It must be emphasized, however, that owing to the complexity of the river-swamp system and the inaccessibility of the area, it has not been feasible, for example, to outline nutrient budgets and energy-flow.

SOCIO-ECONOMIC BACKGROUND

Literature on socio-economic aspects of the area is far more extensive than that on the physical environment. Interested readers are referred, for example, to the works of Evans-Pritchard (1940), Cunnison (1962), Hennin (1963), Deng (1972), Platenkamp (1978), and Sammani (1980), and to the substantial number of reports in the various Ministries in the Sudan.

The 500,000 human inhabitants of the 'Sudd' area belong mainly to the three nilotic tribes: Dinka, Nuer, and Shilluk. The major villages of the Nuer and Dinka that would be affected by the Jonglei canal lie along the Duk Ridge* and part of Zeraf Island (Fig. 2) that are thinly populated by branches of the Nuer tribe. The almost sedentary Shilluk build their villages on higher ground along the White Nile near Malakal (Fig. 1).

The way-of-life of the tribesmen is adjusted to (or rather governed by) the nature of the area and the regime of the river; it is centred around the needs of their extensive herds of cattle, namely to follow pastures over a yearly cycle. The cattle are kept more for aesthetic and prestige motivations than for economic ones.

Permanent settlements, on the highlands, are used by the people and their livestock during the rainy season (lasting from June until November–December). During that time cattle usually overgraze the highlands. Subsistence cultivation of dura (*Sorghum* spp.) is mainly a wet-season occupation. Other crops grown include maize, tobacco, pumpkins, gourds, and various beans.

As the dry-season progresses, cattle graze farther and farther away from the villages, towards the permanent swamps. Older people and children do not follow the cattle camps and remain in the villages. At that time of year, fishing and hunting become important activities and yield essential supplements to the diet.

At the beginning of the flood, around May, people and cattle return from the 'toich'† pastures. Smaller cattle-camps are then established in the intermediate land—until, in July, the people and herds move back to their villages. They are then pestered by mosquitoes, tabanids, and other biting insects, limited grazing-range, and diseases. The carrying capacity of the wet-season pastures limits the number of cattle that can be kept by the tribesmen.

The Jonglei canal area is sparsely populated, and the economy is basically of a subsistence nature. The life which the people lead is extremely harsh, and falls below the economic level of many regions of the country. The tribes-

* Jebel Aulia Dam is 46 km south of Khartoum, on the White Nile.

† Namely along the length of the river (e.g. from upstream to downstream) as opposed to horizontal distribution (as a cross-section from one bank to the other.—Ed.

†† Migrations influenced by the breeding cycles of various species of fishes, either upstream in the river or laterally, into the swamp system.—Ed.

* The Ridge along which Duk Fadiat and Duk Faiwil lie (cf. Fig. 2, p. 44).

† As outlined by Dr Moghraby in his paper which we published in 1982, 'toich' is a Dinka word meaning temporary swamps.—Ed.

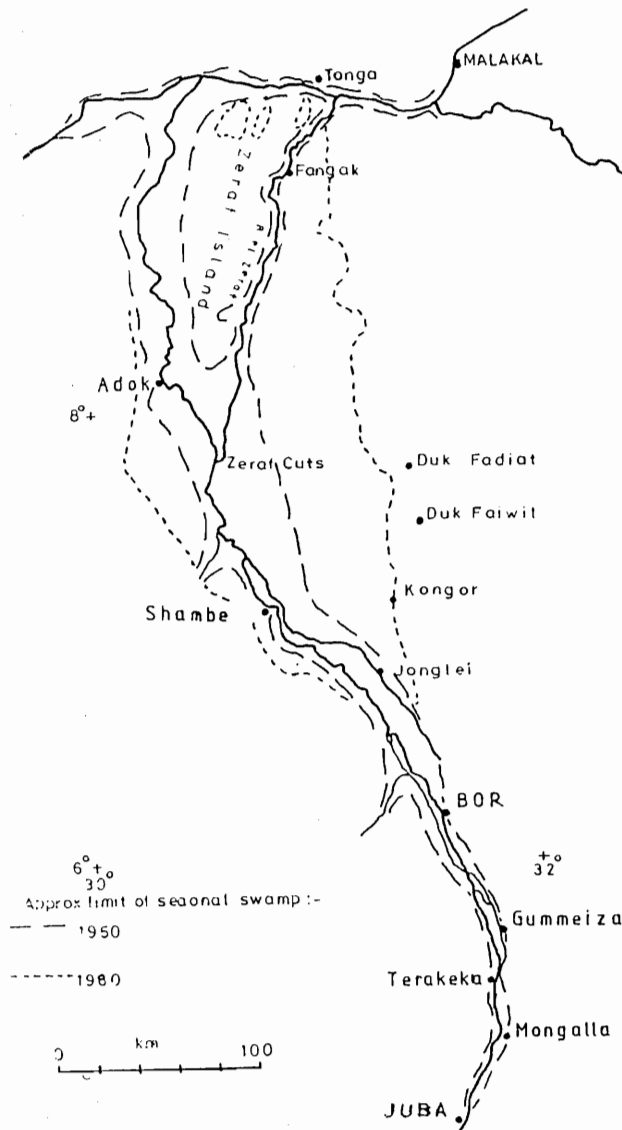


FIG. 1. Location map of the 'Sudd' area (after Sutcliffe & Parks, 1982). Jebel Aulia Dam is 46 km south of Khartoum, on the White Nile. — See also Fig. 2.

people even lack basic utility commodities such as cooking utensils, blankets, mosquito nets, etc. Nudity is not uncommon or unusual.

DISCUSSION OF PROS AND CONS

The benefits accruing from excavating the canal, as outlined in a Government publication in 1975, can be summarized as follows:

- To save 4.7×10^9 m³ of water per year which will* be shared equally by Sudan and Egypt.

* In answer to our question regarding the wisdom of using this definitive word in these and some following lines, Dr Moghraby, wrote (*in litt.* 7 November 1984) 'I suggest leave "will" although I agree completion of the canal seems, at the moment, far from being definite. "Will" expresses the determination of the two governments. I should point out that, with the present drop in volume of discharge of the whole of the Nile system, the Jonglei Canal Project, in addition to other conservation works, seems to be inevitable'. —Ed.

- To prevent excessive flooding of land neighbouring the Nile and the canal, and thus increase the availability of land for agriculture and natural pasture.
- To provide employment for local people.
- To provide a new source of fisheries.
- Provision of a year-round water source for nomads' cattle.
- To reduce disease vectors that at present breed in the swamps.
- Shortening the river route between Malakal and Juba by more than 300 km.
- A dry-season road will be provided along one bank of the canal.
- Expedite the agricultural, livestock, and industrial economic, development in this part of the country which helps in achieving the promotion of comprehensive integrated socio-economic development on a national scale.

On the other hand critics of the Jonglei Canal Project, such as Mann (1977), Tato (1977), Bugler (1978), Muller (1978), Platenkamp (1978), and others, talk of:

- Lack of sufficient data to estimate the consequences of the canal: 'side-effects' is a favourite phrase with them;
- The canal will* adversely affect the way-of-life of the local inhabitants;
- Decrease the area of the 'toich' pastures and cut across the seasonal migration-routes of domestic livestock and wildlife;
- Affect the local climate;
- Alter the hydrology of the river-swamp system;
- Affect water quality and the sediment transported; and
- Reduce fisheries in the area.

We have attempted to demonstrate that there is no dearth of information, and that the system is sufficiently understood to justify the execution of the project. In addition to available information, a hydrological model has recently been completed (Sutcliffe & Parks, 1982). The Executive Organ of the National Council for the Development Projects in the Jonglei Canal Area has also commissioned several national and international agencies to carry out research on the possible effects of the canal, and to design and/or implement development projects in the area (Moghraby, 1982). It should be emphasized, however, that ecology is neither infallible nor is it a highly precise discipline. Moreover, we do not claim that there is 'complete knowledge' of the ecosystems of the 'Sudd' and the processes within the system.

The present Jonglei canal project, unlike the two old proposed projects, will not alter the flooding regime of the White Nile. The volume of discharge of Bahr el Jebel† would remain the same after the completion of the canal (i.e. 65×10^6 m³ per day; Moghraby, 1982). Consequently the seasonal cycles of abundance of fauna and flora may be expected to remain as they are now.

* See footnote in preceding column. —Ed.

† See first footnote on the following page. —Ed.

The most recent study on the hydrology of the 'Sudd' (Sutcliffe & Parks, 1982), revealed that the operation of the canal would bring about a total decrease in the area of the permanent swamp by from 34 to 43%. The 'toich' swamps^{††} would move closer to the midstream of the river, though even then the total area of the Bahr el Jebel wetlands would remain greater than it had been before 1961.

Fluctuations in the area of the 'Sudd' are continuous, reflecting cyclic changes in both long and short terms. Increases in the area of the swamps were experienced from 1916 to 1918, and decreases during 1928. The most recent increases, in the early 1960s, nearly doubled the area of the swamps, and the effects of these floods are still lasting. The increases were due to a rise in the level of Lake Victoria and the consequent increase in its discharge, with drastically adverse repercussions to Man, domestic animals, and wildlife (Fig. 1). A classical example is Zeraf Island, which used to be a wildlife reserve, rich in game and livestock. As mentioned above, it is now very thinly populated. Roads to such towns as Fangak have been completely submerged. People born and brought up in Fangak after 1961 have never seen a motor-car. By exposing some of the inundated 'toich' and part of Zeraf Island, by retreat of the water towards the main channel of the river, the area of available pasture will increase enormously.

Other Foreseeable or Claimed Changes

Another example of natural phenomena, which could not be predicted precisely, might be widespread invasion of the White Nile system by Water-hyacinth, *Eichhornia crassipes* (Gay, 1958). Open-water lagoons are now nearly completely covered with this attractive pest, in addition to vast coverage of the running watercourses. Chemical control through the use of the herbicide 2,4-D (2,4-dichlorophenoxy acetic acid) has introduced chemical pollution to the area*.

It is estimated that, during the floods of the early 1960s, come 120,000 head of cattle were lost in the Zeraf Island area alone. Of the livestock in the District of Bor, in the past decade or so, some 20% have been grazing in the surroundings of Juba, because of the permanent inundation of large areas of the 'toich' in the District. Although loss of human life due to drowning has not been estimated, many children die every year because of bilharzia and malaria, which are two scourges associated with the floods (Alier, 1974).

[†] Dr Moghraby explains (in litt. 7 November 1984) that 'Bahr el Jebel is the White Nile before it is joined by Bahr el Ghazal at Lake No. Above Nimuli, it is called the Albert Nile.'—Ed.

^{††} Widely dominated by *Typha domingensis* and various emergent grasses—see Moghraby (1982), whose illustrations indicate the general character of the region.—Ed.

* In answer to our queries Dr Moghraby replied (in litt. 7 November 1984): 'About one thousand tonnes of 2,4-D are sprayed on Water-hyacinth every year. Khoghali & Moghraby (1979) have demonstrated that the application of 2,4-D at the rate of 1.8 kg active ingredient per surface feddan (rate applied in Sudan) does not cause acute toxicity to some chlidid fishes from the Nile. Studies on bio-accumulation are being carried out in the University of Khartoum.'—Ed.

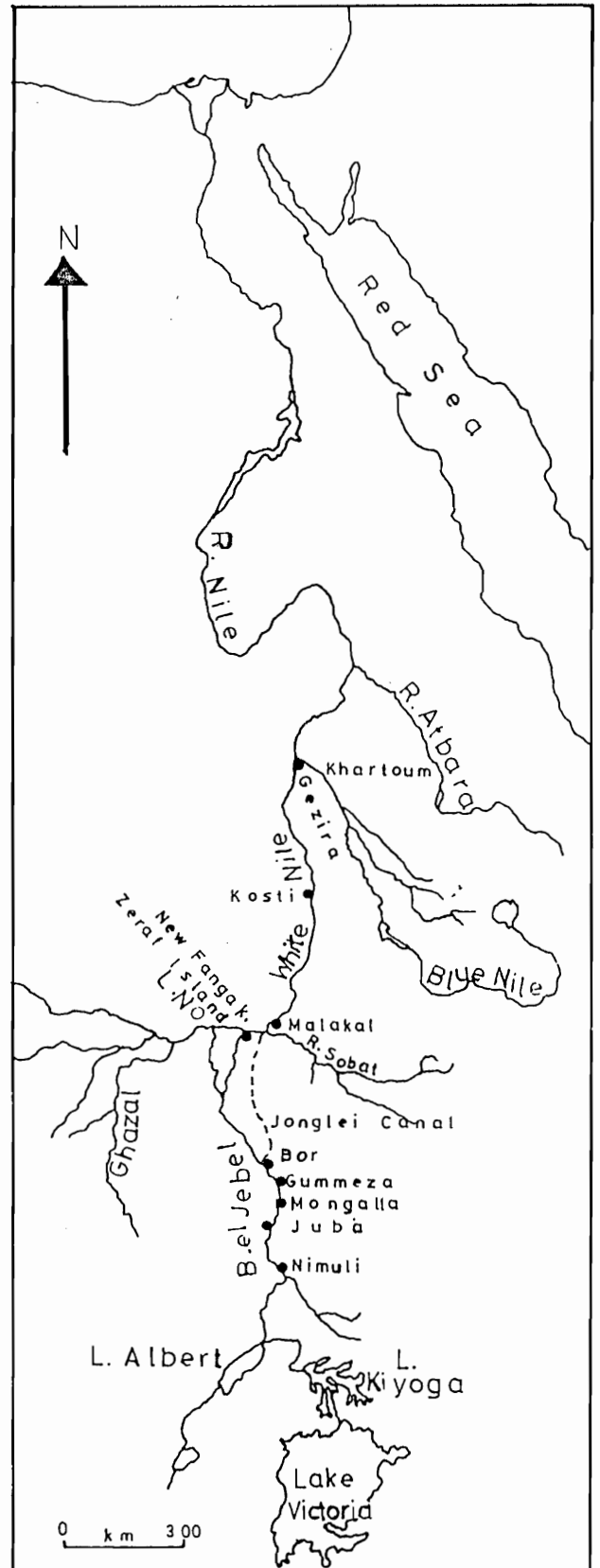


FIG. 2. Sketch-map of the Nile basin. See also Fig. 1 caption.

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It must be emphasized that the ecosystems of the 'Sudd' have some intrinsic disadvantages from the human point of view, being not as ideal as has been portrayed by many. Apart from the direct effects of flooding, other cyclic changes alter the Man/natural resources relationships. Accordingly in such a system which is open to natural climatic and cyclic changes, local tribes have to become adapted to the changes. Grazing cycles are good indicators in this connection, and Sammani (1980) has outlined the shift in the types of land grazed and the duration spent on each, showing that the present grazing cycle is substantially different from that found before 1961.

The main source of precipitation on the area is the southern Atlantic Ocean, so fears that the decreased area of the 'Sudd' will bring about a reduction in the amount of rainfall are quite unjustified. Best (1978) furnishes a good argument in this connection, casting doubt on the suggested changes in climate at the local or regional levels. He states that '... the latter argument [the effect of the canal on climate] is purely based on ignorance. The overall effect of a reduced marsh area can be predicted by comparing the pre-1960 conditions, when rainfall in the equatorial zone was less, and the water flowing in the upper Bahr el Jebel was about half its present volume. Accordingly the "Sudd" was much smaller and the total evaporation was considerably less. Rainfall in the Sahel, in that period, was on the average higher than at present'. It should be emphasized that the reservoir behind the Aswan High Dam has caused the evaporation of thousands of millions of cubic metres of water, in recent years, without affecting the amount of rainfall in that region.

Depletion of underground water-sources, in the area of the proposed canal and farther north, is advanced by critics as a factor that would aid the process of desertification. Our counter-argument is that, on the one hand, the canal would provide an alternative supply of water close to the permanent settlements. On the other hand the argument that the excavation of the canal, and the decrease in the area of the 'Sudd', would eventually lead to a drop in the water-level of the aquifers to the north, due to reduced recharge, is based on wrong information on the behaviour of the 'Sudd' aquifer and of the aquifers to the north. The 'Sudd' aquifer is not inclined to the north, thus feeding the tube-wells occurring in that direction; rather is the reverse true (Salama, 1975). Furthermore, the water-tables of the aquifers to the north did not show any fluctuations in relation to the floods of the early 1960s, before and after the rise in level and extent of the 'Sudd'.

Water Quality and Fisheries

The oft-repeated argument that the canal would affect the water quality and amount of sediment transported (Kassas, 1971; Cloudsley-Thompson, 1977; Mann, 1977; etc.) seems to us unfounded. We must emphasize here that conditions in the 'Sudd' are different from those in estuarine swamps such as, for example, Lake Albert. Bahr el Jebel flows through the 'Sudd' and feeds the swamps through overspillage only when its discharge exceeds $65 \times 10^6 \text{ m}^3$ per day, so that there is only a minimal degree of mixing with the swamp waters (Moghraby, 1982). Data published

by Talling (1957), Bishai (1962), Khalil & Badri (1973), and Moghraby (1975b), showed that the influence of the swamps was local. To be sure, sediments are filtered off during the passage of water through the 'Sudd'; but the amounts of transported sediments are very small, and the 'Sudd' does not improve the water-quality of Bahr el Jebel. The discharge of the River Sobat is far more important in modifying the water characteristics of the White Nile than is any influence of the swamps. These effects include decrease in ionic conductivity, alkalinity, and transparency, and also in phosphate, chloride, and silicon, contents.

A great deal of guess-work has been put forward on the subject of fisheries. The general belief is that the 'Sudd' swamps act as breeding grounds and support rich fisheries, but present knowledge is not enough to substantiate or disprove this belief. The large catches landed do not necessarily reflect the productivity of the 'Sudd', but could simply be a reflection of under-exploitation. Theoretically speaking, limitation of conditions inside the swamps could be inimical to the propagation of benthos, plankton, and fish, and already mass mortality of fish due to deoxygenation has been reported by Talling (1954) from near Shambe. Conditions at the fringes of permanent swamps are more favourable to fish and invertebrate fauna than in their interior, and the area of these fringes will not be affected by the first phase of the Jonglei canal. On the contrary, sustainable yields could become larger after new projects are implemented—for example, fish farming and restocking of the main channel of Bahr el Jebel.

Critics also contend that the water-current velocity in the canal will be too swift to sustain any aquatic life, and that 'it will sweep all the fish to Lake Nasser'. The counter-argument is that the speed of flow in the Jonglei canal would be at the rate of 0.95 m per sec. The rate of flow of Bahr el Jebel near Bor is 0.83 m per sec, between Nimuli and Juba it varies between 2 and 3 m per sec, in Bahr el Zeraf it is 1.5 m per sec and, at $30 \times 10^6 \text{ m}^3$ per day, the Gezira Canal flow-rate is from 0.8 to 0.9 m per sec. In all of these, fishes, of varied quantities and species, are found (Ibrahim, 1974).

Animal Wildlife

The data available so far on animal wildlife is not accurate. Some species are resident in the canal area, e.g. Elephant (*Loxodonta africana*), Cape Buffalo (*Syncerus caffer*), Oribi (*Ourebia ourebi*), Sittunga (*Limnotragus spekei*), and the Mrs Gray's Nile Lechwe (*Onotragus megaceros*). The major migratory species, however, is the Tiang (*Damaliscus korrigum tiang*), which crosses the canal line towards the Boma Plateau near the Sudanese-Ethiopian borders. Boma was declared a National Park in 1980, and thus better management and conservation measures are to be expected in the newly-established Park and its surroundings.

Designs have already been planned to establish crossing-points on the migration routes of wildlife and domestic livestock, and to establish game reserves and sanctuaries, as well as to restrict hunting and poaching, in the canal area.

Social and economic conditions in southern Sudan, in general and in the Jonglei area in particular, fall below those in comparable areas in the northern parts of the country. Local monthly *per caput* income in the Jonglei area is only about 20 US dollars, but even that rate is not maintained steadily, being generated from primary activities and through occasional transactions such as sale of cattle or small amounts of tobacco, the products of hunting and gathering the yields of forestry, and casual employment. Cash surpluses are seldom available, and capital accumulation is almost nil.

Problems of Southern Sudan

The project will foster national, political, and economic, integration of the various populations of the modern Sudan. The country, emerging from the era of British administration, found itself in a disintegrated state. This originated from the politics of the period and the gaps in the degree of development attained between the various communities. The British applied what was called the 'closed district law' to southern Sudan. A large number of tribes and subtribal units were thus deprived of the benefits of the process of 'spontaneous development', which opened up the rest of the country both socially and economically.

The lack of integration of the country as a whole is a major factor undermining its development of the area is that it is particularly widely underpopulated. The seasonal dispersion of the population over the vast areas that are used for traditional grazing, retards economic and human development, branding the Jonglei area and the Southern Region as a 'Plighted region' (Alier, 1974).

It is accordingly only logical to accept that development ensuing from the Project would improve conditions in the Jonglei area, consolidate its dispersed populations, open up the intermediate and 'toich' lands for more effective and rational use, and put an end to the remoteness of this part of the country. Sustained inputs of modern development will in the long run weaken the forces of tribalism—one of the factors responsible for the disintegration of national unity. The South is still one of the few remaining strongholds of tribalism in Sudan.

The way out of this impoverished situation is through more effective utilization of the available potential resources. One of the long-term objectives of development is to break the subsistence cycle through introducing new elements of economic progress and creating a cash-economy basis for generating viable economies to meet rising expectations—and, in the process, erase regional disparities. By so doing, it should prepare the Nilotic tribes economically to assume a more positive role in fulfilling their currently deferred citizenship obligations—at the local, regional, and national, levels.

The post-Addis Ababa Agreement* times have witnessed vast improvements in this direction. Yet they fall short of the expectations of the local communities. Modest though they are, these changes have produced new generations and an educated elite, who have grown up with new

ways of life and new demands. The result is that the tribal communities of the 1980s are not the same as were those of the 1950s, when the Jonglei Investigation Team studied the tribes that would be affected by the old canal project.

The Jonglei Canal Project, with a 59.4 million US dollars allocation for development at the local level, earmarks a sizeable capital input for a specific area. That will lead to the creation of cash-economy bases, and make it feasible to respond to many of the people's expectations, which could not otherwise be secured.

Some authorities advocate a theory of leaving people alone to the 'forces of evolutionary change' (e.g. Platenkamp, 1978), on the assumption that communities in the South are living under semi-closed systems. We have tried to emphasize the need for more effective social and economic contributions from the side of the Nilotes. The merely evolutionary approach is not feasible. Even if local communities contemplate being left alone (which is not the case), and if the central Government adopts such a strategy, the educated elite in the South will adamantly stand in sharp opposition to such a policy. The educated elite sees its future, and the future of its people, in modern economic contexts and not in the continuity of the traditional subsistence systems.

The findings of the Socio-economic Survey Team (under the auspices of the Executive Organ for the Development Project in the Jonglei Canal Area) provide many indicators that the Jonglei Area has already entered an era of quick changes. Among these are signs that the social importance of cattle has started to weaken. Cattle are now sold for cash to purchase *Sorghum* and other necessities, and to pay for taxes and school fees. Migrations, during seventeen years of civil strife and also at present, have introduced the tribesmen to new horizons in the way of animal husbandry and vaccination, formal education, and modern health-care. Consequently the forces of change are encroaching faster than ever over their semi-closed systems. It is only logical that the Nilotes be guided through the process by planned change rather than being left to 'evolutionary' change.

It is unfortunate that the Jonglei Canal Project has been linked with local, national, and even outside, politics. Otherwise, the project could have been received on more rational grounds, as part of the development package for the Southern Region, in the manner of many others.

SUMMARY

The Jonglei Canal Project should be weighed against its socio-economic impacts as well as environmental considerations. If taken in a short- or long-term cost-benefit perspective, the Project we think is a justified undertaking.

One might argue: 'let everything well alone; change is another word for disaster'. We are not contending that the Jonglei Canal Project, if duly completed, would not bring about a new mode of life for both Man and domestic and other animals. We are contending that the new mode will be a more satisfactory one than that which exists at present. Sudan aims at the transformation of traditional communities to better social and economic horizons, and not the intentional destruction of the traditional way of life. Many overlook the fact that the Nilotes are already changing, and

* The Sudan went through a civil war (1955-72) between its North and South, but an agreement was reached at Addis Ababa in 1972 whereby the South was given regional autonomy.

that it is beyond the powers of the political and social systems to confine them to the past.

Nevertheless there are indications that ecologists and environmentalists are far from agreed among themselves as to whether the Jonglei canal is, on balance, a good or a bad idea. But in any case we would like to stress in conclusion that the Jonglei Canal Project is being executed at a relatively fortunate time in Man's history of awareness of the way in which he should be using his natural resources*.

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* This paper having been drafted in 1983, we asked Dr Moghraby late in 1984 about the current situation and possible need for caution, to which he replied (*in litt.* 7 November 1984). The contracted Italian Company Mellit-Babtie Sr has already concluded their studies on range and swamp ecology of the area. They published (in 1984) a 10-volumes' report on the range; and four on the swamps. The funds came from the EEC. The idea of diversion of swamp waters should of course be taken with caution; there are many alternatives, e.g. better water management and recycling, but Sudan is faced with drought and famine in addition to decrease in the volume of discharge of the Nile. I really have my doubts [as] to whether policy-makers would see the need for caution. Short-term solutions are almost always preferred by them.—Ed.

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