

## Water Cooperation between Sudan, Egypt and South Sudan (Jonglei Canal as a model)

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### المخلص

استهدفت هذه الورقة دراسة موضوع التعاون المائي وأهميته بالنسبة لدول "مصر، السودان وجنوب السودان" التي تقع ضمن دول تتقاسم أحواض أنهار، فالمياه العابرة للحدود تشكل تحدياً كبيراً أمام تحقيق الأمن الغذائي والأمن القومي. ومن ثم تحاول الورقة إبراز أهمية تنفيذ قناة جونقلي كمشروع تنموي يمكن أن يساهم تنفيذه في دعم مشروعات التنمية الزراعية وتحقيق الأمن الغذائي ومحاربة الفقر بالدول الثلاث (مصر والسودان وجنوب السودان)، والتي تستورد لتستهلك كميات كبيرة من الحبوب والسلع الغذائية، رغم وفرة الأراضي الزراعية وإمكانية توفير المياه. وبذلك تصبح المحافظة على الموارد المائية الحالية والمتوقعة وتطويرها وتنميتها واستغلالها ضرورة يفرضها الواقع الاقتصادي بتلك الدول. وتفترض الورقة أن التعاون بين الدول الثلاث في إقامة قناة جونقلي يساهم في بناء شراكة تكاملية بين الدول الثلاث، تقلل فواقد المياه وتزيد من إمكانية استغلالها في التنمية الاقتصادية. بناءً على ذلك نستنتج أن مياه نهر النيل تعتبر مورد مشترك يمكن أن يكون مصدراً للتعاون المائي بين دوله، خاصةً وأن بها من الموارد الثروات ما يشكل حلاً للمشكلات الاقتصادية التي تعانيها دون الحاجة للصراع والمحاصصة. ومن المتوقع أن يكون حفر قناة جونقلي مفيداً بزيادة الإيراد المائي للدول الثلاث وتغيير في حياة السكان بمنطقة القناة نحو الأفضل، وإلى استصلاح المزيد من الأراضي بالدول الثلاث لزراعة محاصيل إحلال الواردات "القمح والسكر"، وتحسين المرعى النيلي لتنمية الثروة الحيوانية. وتوصي الورقة بضرورة إقامة التعاون في حفر قناة جونقلي لأجل ضبط وتطوير جريان مياه السدود وتقليل فاقد المياه، وأن إدارة الموارد المائية بشكل ضمانة اقتصادية لتنمية القطاع الزراعي بالدول الثلاث باعتبار أن المياه يشكل عنصر حيوياً للأمن الغذائي والأمن القومي.

**Abstract:**

This paper aimed to examine the significance of cooperation on water resources between Egypt, Sudan and South Sudan – three of the principal Nile Basin countries. The Nile water passing through the three countries is confronted by many challenges in terms of achieving food security and national security. Thus, the paper attempts to highlight the importance of implementing Jonglei Canal as a major developmental project which could contribute to supporting agricultural development, achieving food security, and combating poverty in the three countries – which in fact import a lot of their food products from outside. This state of affairs is so unfortunate because these three countries abound in fertile lands, human resources and the possibility of providing sufficient irrigation water from the Nile and its tributaries. Therefore, preserving the available water resources, developing them, and using them wisely becomes a necessity dictated by the current economic conditions of the three countries. This paper hypothesizes that mutual cooperation between the three countries on digging the canal will contribute in constructing an integrated partnership that is expected to reduce water loss and enhance the possibility of sustainable economic development. Therefore, the River Nile water is a shared resource which could be a basis for water cooperation between the Nile Basin states, given the fact that they have other resources (animal resources, human resources, fertile lands, etc.) which may provide solutions to the economic crises in these countries without disputation over apportionment. Digging Jonglei Canal is expected to be very beneficial in increasing the water shares of the three countries, and hence raising the living standards of the populations. Furthermore, it will assist in reclaiming more lands and growing consumption crops (like wheat, sugar cane, cotton, etc) and improving grazing lands. This paper recommends establishing cooperation and common understanding between the three countries on digging Jonglei Canal and controlling the Nile water in a way which ensures economic security and agricultural development.



### 1-1 Introduction

The River Nile is a highly important geographical feature in north eastern Africa, and a political feature around which many civilizations flourished and left their evidence on the pages of human history. Although the River Nile region is very rich in natural, mineral and agricultural resources, it is still one of the most underdeveloped regions in the world. This economic backwardness is caused by a myriad of historical and political factors, which contributed in merging the economies of the Nile Basin states into a globalized capitalist system as a marginal region. On leaving their colonies, the colonial powers left behind them politically disturbed and economically impoverished states. Besides, the economic relations between them were very weak and marginal. In spite of the exerted efforts, these countries have not succeeded in promoting their economies or making noticeable changes in order to strengthen the trade exchanges between them, in spite of the aforementioned abundant resources, they still depend for their food consumption on imports from other countries, given this state of affairs, cooperation between the

countries of the region becomes a necessity, in order to distribute water resources justly, and in a way which ensures benefit for all the peoples of the Niles Basin.

During the period from 1974 to 1978, Egypt-Sudan Joint Technical Commission for the Nile Waters conducted studies in Jonglei area with the aim of facilitating the flow of the River Nile water and reducing water loss through digging Jonglei Canal, evaluated the pros and cons of the project. Different aspects of the project, such as needs, obstacles, and costs were estimated according to the capabilities of Egypt and Sudan at that time. The Committee considered the increasing cost of food production, scarcity of support from outside, and the increasing competition over capital in all economic sectors. Thus, investment capital is scarce but the potential benefits are high. However, with the absence of balance and adjustment in budgets which may realize those high long-term benefits, fast and sustainable development becomes more and more difficult.

### **1-2 The concept of the "International River"**

The massive developments in trade exchanges, the need for means of transportation and the need to reduce conflicts over using waters of shared rivers in Europe for navigation – all these reasons together necessitated the adoption of the geopolitical concept of "the international river" in the 19<sup>th</sup> century. The concept was first introduced in the Treaty of Paris on May 30<sup>th</sup> 1814, and was defined as "the river which separates between or cross the territories of two or more countries". Later, international rivers were defined in the final charter of Vienna Congress in 1815 as "the navigable rivers which cross, in their flow, the lands of two or more countries with defined geopolitical borders". However, unfortunately there is no satisfactory uniform law for organizing the use of international rivers for non-navigational purposes; yet many countries prefer to act according to the Helsinki Rules on the Uses of the Waters of International Rivers adopted by the International Law Association (ILA) in its 52<sup>nd</sup> conference in 1969, which included non-navigational uses. The rules were adopted by the UN in 1997 after adding a chapter on the prevention of waterways pollution. (Saeed, 2001).

### **1-3 The Helsinki Rules on the Uses of the Waters of International Rivers adopted by ILA**

The most important rules of ILA adopted in its 52<sup>nd</sup> conference in Helsinki included the following:

1. Equitable sharing.

2. What is equitable share within the meaning of the above article is to be determined in the light of the relevant factors in each particular case. Such relevant factors include:
  - The geography of the basin, including in particular the extent of the drainage area in the territory of each basin state.
  - The climate affecting the basin.
  - The past utilization of the waters of the basin, including in particular the existing utilization.
  - The economic and social needs of the population of each basin state.
  - The availability of other water resources.
  - The avoidance of unnecessary waste in the utilization of the waters of the basin.
  - The comparative costs of alternative means of satisfying the economic and social needs of each basin state.
3. The prevention of any new form of water pollution in an international drainage basin.

#### **1-4 Common Rules in the international agreements on shared river basins**

There are many common rules in the international agreements on shared river basins; here are a few examples:

1. Upstream states shall recognize the rights of downstream states.
2. Each basin state is entitled to a reasonable and equitable share in the beneficial uses of waters of an international drainage basin.
3. No basin state shall cause damage to another co-basin state.
4. The natural state of the international basin shall not be changed.
5. A written agreement shall be obtained from the other basin states before starting any constructions in the international river basin.
6. The international river basin waters shall be utilized on the basis of the international agreements and conventions which organize apportionment of waters.
7. If damage is caused, the state responsible for the damage shall compensate the injured co-basin state.

#### **1-5 Water Cooperation between the Nile Basin Countries**

The area of the River Nile basin in Sudan (now Sudan and South Sudan) constitutes 67.7%, in Ethiopia 21.1%, in Egypt 9.9%, in Tanzania 3.8%, in Kenya 1.8%, in DRC 0.8% in Rwanda 0.7%, and in Burundi 0.5% of the whole area of the basin. Each one of these countries attempts to increase its share: hence, abiding by the rules of the international conventions on the utilization of water becomes an unavoidable necessity. The British government signed mutual agreements between Sudan and the neighboring Nile basin countries during the British colonization, the most important of which were signed in 1902 and 1929 with Egypt and Ethiopia, and in 1959 with Egypt. Most of these agreements gave the lion's share to Egypt.

In 1967 cooperation between Sudan, Egypt and the countries of the Equatorial Lakes was initiated with support from the United Nations Development Program (UNDP) in the form of Project HYDROMET which continued until 1992, when another project "TECCONILE" was started (Ndayizeye 2006). In 1995 the ministers of irrigation in the Nile basin countries issued an agreement to resolve most of the points of differences except for the articles concerning the consensus on taking decisions and the article concerning the prior notification when intending to start a construction on the waterway. Later, the Nile Basin Initiative was launched with the aim of strengthening cooperation and playing a pioneering role in the economic development in the area.

The integration of the nations of the Nile Basin Region through time was confronted by many obstacles, such as, the difficulty of permanent navigation (due to the thick bushes, Nile grasses around the river and the numerous cataracts), irregular flow of seasonal tributaries. Furthermore, the conflicts and differences between the Nile basin states were (and still are) aggravated by the ideological and linguistic differences, illiteracy, and sanctions imposed by the colonial superpowers.

Before the industrial revolution and population explosion in urban areas, 90% of freshwater in the world was used for agriculture. In the few past decades, the competition between agriculture, industry and urban expansion over freshwater increased the conflicts over waters resources.

Research centers, in their intellectual debates, scientific and strategic research, focus on the necessity of collaborative work between the international river basin states and equity of apportionment of water revenues, in order to prevent any possible conflicts. This could be accomplished through mutual cooperation between the basin states in carrying out shared projects and information exchange. These shared developmental projects will help eradicate poverty diseases, droughts, and chaos in the region. The most optimistic researchers, when looking at the issue of water from all perspectives, could now see that the problem has grown big into a nightmare. The political, economic and environmental indicators and the consequent issues of poverty famines disasters have become major issues in forming life on our planet in the present age. The need of every state contradicts with the needs of another co-basin state. This state of affairs is interpreted within a number of other factors. Thus, water can be a major cause of conflict (in this area) for the following reasons :

1. Water is a shared resource which is directly linked to the human life, it is the common ground for achieving development and combating poverty,

illiteracy, and disease. The economic, social, and environmental value is irreplaceable.

2. Differences in power between the basin countries.
3. Water is not only an economic feature, but also has a cultural dimension which makes it an important factor for ideological and political conflicts.
4. The scarcity of freshwater resources (rivers and ground water).
5. The huge loss of water caused by evaporation, absorption and transpiration in the Equatorial Lakes region and the sudds (swamps) region, in addition to the fluctuation in rainfall rates.
6. The huge population growth in the region.
7. About 40% countries in the world suffer from water crises; 20 of them are African countries.
8. The poorest 4 countries in the world are in the Nile Basin region.

### **1-6 Impediments of Optimal Water Utilization in the Nile Basin Region**

Improving the efficiency of water utilization is a useful option in terms of cost to compensate for the water loss in some areas. It is necessary to build dams to preserve water during the short abundance period to be used during the long shortage period when it is badly needed. In spite of the seemingly ongoing cooperation between the Nile Basin states, there is no efficient utilization of the Nile water in these countries, due to the following reasons:

- Shortage of water resources funding.
- Water waste.
- Lack of water use awareness.
- Temporal variation; about 75% of the annual water comes during autumn.
- The limited storage capacity of dams.
- Floods and other natural disasters and their grave consequences.
- Sedimentation.
- Shortage in qualified water professionals.
- Negligence of governments.
- The absence of specialized departments for managing surface and ground water at the ministries of irrigation in the different districts and countries of the Nile Basin region.

We may add that the real problem which impedes cooperation between the Nile Basin states consists in dealing with the following issues:

1. The economized use of water and distributing it properly to the competing needs of agriculture, energy, industry and drinking.
2. The possibility of regional cooperation, especially when there is water shortage in a specific country.
3. The possibility of integrated management of water resources.
4. The flexibility of water policies in the co-basin states and the possibility of linking these policies to the objectives of the NBI.

**1-7 Jonglei Canal: A Basis for Achieving Cooperation and Food Security**

The issue of water resources and their utilization preoccupies is the strategic thinking of all countries around the world, since their scarcity constitutes persistent threat to the overall national security (water security, food security, political security and social security). Therefore, protecting, preserving, and wisely using the available water resources become an inevitable necessity, in order to reduce water shortage to a minimum. When a lot of surface drainage water is lost due to factors like evaporation, absorption, transpiration, etc, states request their planners and engineers to find treatments to reduce the loss, even if the treatments require diverting the path of the waterway. The more the need for water presses, the more treatment projects are required to reduce water loss. Thus, the digging of Jonglei Canal is a necessity dictated by the need to achieve food security, combat poverty, provide work opportunities, and support economic sectors such as industry and transportation.

The three countries (Sudan, Egypt and South Sudan) consume a lot of cereals (especially wheat), and import a lot of food consumption products – in spite of the abundance of fertile cultivatable lands and the possibility of providing sufficient irrigation water . The average water quota per capita in these countries is now around 500 cubic meters per year – meaning that these three countries are all below the water poverty line (set by the UN as 1000 cubic meters of water per capita per year) and within the domain of high water stress. With the forecasts of more population growth, the ownership of agricultural lands will decrease gradually. Increasing chemical fertilizers to increase productivity will be of no use under such circumstances. With the expectations of increase, on the long term, in the actual cost of oil and natural gas used in producing fertilizers, it becomes more and more obvious that it is very difficult to keep up the increasing rate of productivity, the feasibility of horizontal expansion strategies, improving irrigation methods, etc. (Brown 1983). This trend was prevalent during the period from 1950 to 1973.

The legal status of digging the Canal conforms to the international laws and conventions. Article 5 (equitable , reasonable utilization and participation), Part II (General Principles), of the Convention on the Law of Non-navigational Uses of International Watercourses adopted by the General Assembly of the UN on 21<sup>st</sup> May 1997 states that:

"Watercourse States shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse states with a view to attaining optimal , sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse states concerned, consistent with adequate protection of the



watercourse. Watercourse States shall participate in the use, development , protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse , the duty to cooperate in the protection and development thereof, as provided in the present convention."

It is worth mentioning that the issue of River Nile waters was not negotiated by the government of Sudan and the Sudan's People's Liberation Movement (SPLA) of South Sudan neither in the Machakos Agreement in July 2002 nor in the Comprehensive Peace Agreement of Naivasha signed in September 2003. In both agreements the prevalent issue was the division of oil revenues. For both parties, resuming the work on Jonglei Canal project, which was terminated in 1983 due to the civil war, was not a priority. Looking at the Naivasha Agreement, which was accredited for stopping the longest civil war in the modern age, from this perspective, we find that it did not give much of an attention to the Jonglei Canal Project or to any of the other water resource issues. The issue of shared water resources was merely put under the responsibility of the National Unity Government in Khartoum without delving into details, until the secession of South Sudan in January 2011.

Acceptance to continue the work on the canal as a principal means for increasing water revenues , reducing the loss in the swamps area and the Upper Nile caused by evaporation, absorption and transposition, in addition to the pollution caused by the grasses was one of main topics discussed by the delegations of the Ministry of Irrigation and Water Resources of Sudan and South Sudan in their visit to Egypt in 2007. A memorandum of understanding was signed by the government of Egypt and the Sudanese delegations, the most important articles of this memorandum were:

- 1) The government of Sudan shall accept the resumption of work on Junglie Canal as a principal means for increasing the Nile water.
- 2) Reclamation of the upper Nile Sudds area and storing a good reserve for irrigation in the Sudan.
- 3) Updating environmental studies of Jonglei Canal in preparation to complete the project which is expected to save about 4 billion cubic meters of water annually, which can be utilized properly to meet the needs of the three countries.
- 4) The government of Egypt agrees to work on expanding the objectives of the project to include developmental projects in South Sudan.
- 5) The government of Egypt agrees to contribute in constructing drinking water stations in the big cities in South Sudan.
- 6) Conducting studies and making plans for the optimal utilization of ground water.
- 7) Establishing economic cooperation in all other sectors.

Implementing Jonglei Canal Project requires:

1. Negotiation with the concerned parties.
2. Rereading the previous studies concerning the economic ramifications and reviewing the results – some of which has to do with the environmental effects for digging the canal.
3. Facilitating the tasks of the companies which are to dig the canal, especially after the withdrawal of the international consortium led by the French Technip S. A. Engineering Company.
4. Collaboration of the efforts of the official authorities, civil society organizations, NGOs, and public organization.
5. Stockholding.
6. Conducting demographic studies to determine the number of population, their residence, movements, birth and mortality rates, internal and external migration.
7. Rereading the map of the region.
8. Consulting specialized experts.

#### **1-8 The proposal of Digging the Canal**

Jonglei was initially proposed as a canal assisting to Bahr Al-Jebel with a length of 360 kilometers, starting from an area near the small village of Jonglei on Bahr Al-Jebel. The canal extends from that point up to the confluence of Sobat River with Bahr Al-Jebel to the south of Malakal. (Janzouri & Samaha 1983). The idea of digging the canal began to crystallize since 1904 when Sir William Jarsten published his ideas concerning the construction of projects to manage the River Nile waters through permanent and seasonal storage. To do so, he suggested the construction of dams at the Lake Albert area and dams at the swamps region. In the same year, detailed studies of the Nile Basin were conducted (Riyad, 1984). In 1920, Sir Murdach MacDonald presented a plan for building Sinnar Dam, Jebel Auliya Dam and a diversion canal in the swamps area to carry the water which would be stored at the Great Lakes area and to reduce the amount of water loss through evaporation. The plan was presented by Egypt to Sudan in 1938 (Riyad, 1984).

In 1946, Egypt's Ministry of Works published a study under the title "the Future Conservation of the Nile" co-authored by Hurst, Black and Simaika, which included the proposal of digging Jonglei Canal (Saeed, 2001). In 1945, a research team was formed by the Government of Sudan to study the available plans of the project. The team made some modifications, like keeping the natural fluctuations of the river. The Egypt-Sudan Joint Technical Commission for the Nile Waters was established in 1969 as a more advanced step towards implementing the Canal. The Commission conducted a detailed study and presented its suggestions to the governments of Egypt and Sudan on December 11<sup>th</sup> 1971, after the approval of the second reading; the suggestions included

constructing projects for decreasing the water loss in the swamps region. In 1974, the third (and last) reading was approved, and it included the implementation of the first stage of digging the Canal. Sudan's Ministry of Irrigation and water resources formed a special authority for following up the managing the funding and implementation of the project. However, the work was terminated in 1984 due to the civil war in South Sudan. By that time, about 260 kilometers of the Canal had already been dug.

Since planning the digging of Jonglei Canal, the project had not entered into the actual implementation phase until 1974. The project was confronted by a lot of criticism and which amounted to disapproval on the ground that digging the Canal would result in changing the environment and would thus negatively affect the lives of the inhabitants of the region. Those objections were considered by the Government of Sudan, which, in response, changed the route of the Canal. This change increased the length of the Canal to 360 kilometers instead of the initially proposed 260 kilometers, meaning increasing the costs of construction. Digging Jonglei Canal is expected to save great amounts of waters , cultivatable lands, lead to development, and surmounts the negative consequences of the project. Furthermore, the three countries can hire their experts to help in avoiding and reducing the negative consequences.

### **1-9 The main objectives of the project**

The construction of Jonglei Canal is one of the major complementary irrigation projects in Equatoria which aims at saving the huge amounts of Nile waters wasted by evaporation in the swamps (sudds) region in South Sudan. It is one of the projects which adopt the concept of Integrated River Basin Development – meaning the coordination/combination of the uses of the basin water in irrigation, sewerage, hydropower, navigation, flood control and industry – taking into account the needs of each basin state. The project aims to achieve the following set of objectives:

- 1- To benefit from the topography and geomorphology of the area in digging a canal that gathers the waters of the heavy rains.
- 2- To reduce the huge water loss in the suddes and Upper Nile regions which encompass the basins of Bahr Al-Jebel, Bahr Al-Zaraf, Bahr Al-Ghazal and its estuaries, and Machar swamps.
- 3- To accommodate the drainage, which exceeds the capacity of Bahr Al-Jebel, without being wasted in the neighboring swamps.
- 4- To increase the waters of the main (greater) Nile through diverting the amounts of water spread in the low swamps along Bahr Al-Zaraf basin and Bahr Al-Jebel basin to the White Nile – the major tributary of the greater Nile.

- 5- To strengthen cooperation between the three countries in order to achieve food security, combat poverty, provide more work opportunities, and develop the other economic sectors, like food industries and transportation.

### **1-10 Project Management**

A national council was formed in 1974 to supervise the implementation of the developmental projects based on Jonglei Canal project. The council was to set integrated plans for socioeconomic development in Jonglei region. The council's tasks also include improving the environment , evaluating the negative impacts of digging the Canal, and making plans for reducing and/or avoiding them. The council was subordinated by an executive authority chaired by a general commissioner.

### **1-11 Location and Environment**

Jonglei Canal Project is located in Bahr Al-Gazal State (Greater Upper Nile region) between coordinates 6.30° - 9.30° N and 30.10° - 31.45° E. the region in which the canal is located is called the sudd (swamps) region, which is itself located in a vast plain extending over 1767 kilometers between Khartoum and Juba (called Central Sudan by geographers). The area lies within the Great Depression. The southern part of the Depression extends from Juba to Malakal over a distance of 809 kilometers, and is called the sudd (swamps) region (Saeed, 2001). Jonglei Canal project lies in an area at the centre of a floodplain with the lowest gradient of Bahr Al-Jebel (only one meter per 15 kilometers). The heavy rainfall and the abundant water coming from the Equatorial Lakes make a lot of swamps which extend over an area of 20 thousands sq kilometers according to aerial maps. The region is characterized by thick vegetation and tall floating grasses. The heavy rainfall and rainstorms in the region lead to the expansion of the river, but huge amounts of water are lost due to evaporation, absorption and transposition.

Terry Evans of Mot MacDonald Firm mentioned that the alterations of floods and droughts in the region are not a random phenomenon but rather a regular and systematic phenomenon. The White Nile waters come from the Equatorial Lakes and the heavy rains during two wet seasons. This system is different from the one-season rainfall of the Ethiopian Highlands where the Blue Nile and River Atbara originate. In the early 1960's of the 20<sup>th</sup> century, the amount of water coming to Sudan and Egypt from the Equatorial Lakes Plateau was very large due to the heavy rainfall. Since the 1980's the water rates of the Equatorial Lakes had declines severely, and continued declining until the heavy rainfall of 1998 which caused devastating floods in the swamps (Jonglei) region. Michael Holm thinks that the most optimistic contemporary expectations indicated the possibility of a continuous decline of the Blue Nile rates and a

minor increase of the Equatorial Lakes rates on the long run, meaning that there is a pressing necessity for the digging of Jonglei Canal and the construction of storage and control projects. (*The Pharaohs*, 1998).

### **1-12 Components of the Project**

Jonglei Canal was designed to accommodate 25 million cubic meters per day at its first phase, expandable to 55 million cubic meters per day at the second phase. The canal is expected to receive 9.1 billion cubic meters at the first phase out of the 32.2 billion cubic meters of water which arrives to the sudd (swamps) area at Mangala. 1 billion cubic meters will be wasted during the diversion, while what will be lost due to evaporation and transposition amounts to 10.7 billion cubic meters. The amount of water coming out of Jonglei Canal at Malakal is expected to be 21.2 billion cubic meters. The gain after digging the Canal would be 4.7 billion cubic meters, 19% of which would be lost by evaporation, absorption and transposition. Consequently, the net increase would be about 3.8 billion cubic meters (Saeed, 2001). Implementing the second phase, which involves increasing the width of the canal, would result in increasing the gain up to 9 billion cubic meters. However, implementing the second phase depends on the construction of Lake Albert's storage dams to ensure the increase of the amount of water coming from the Equatorial Lakes Plateau. Initially, the canal was designed to have a width of 52 meters and a depth of 4 meters; now, the new studies propose a width of 120 meters and a depth of 5 meters, in addition to constructing arch bridges at the beginning and at the end of the Canal to allow for the passage of steamers and ferries. At the first phase, the canal consists of the following components:

1. Digging a canal of 280 kilometers length that assists in draining 20 billion cubic meters per day with a gradient of 7-9 cm per kilometer. The route of the canal was changed in response to the objections of the local inhabitants to be 360 kilometers instead of 250 kilometers.
2. Constructing three arch bridges.
3. Digging an artificial river (parallel to Bahr Al-Jebel) near Jonglei Canal and building water control constructions on it.
4. Digging a supplementary canal parallel to Jonglei Canal that assists in draining 5 million cubic meters per day to irrigate about 200 thousand acres for agricultural development in South Sudan.

The second phase includes expanding the canal to accommodate the drainage of 43 million cubic meters per day. Some studies even go to the extent of suggesting digging another canal at this phase. However, this phase cannot be commenced without the completion of the first phase.

### **1-13 Costs and Funding**

The project cost was US \$200 million (Janzouri and Samaha, 1983) (In 1974, it was estimated as US \$70 million to be paid as 50% by each country (Sudan and

Egypt at the time). After the estimations were made, a loan on easy term was given to the governments of Sudan and Egypt. The funding was determined as 30% in local currency and 70% in foreign currency. The cost of the first phase was US \$170 million, and in the second phase it will increase to US \$300 million according to the estimations of 1977.

The Canal was to be implemented by an international consortium led by the French Technip S. A. Engineering Company. The company brought a giant German digger which looks like a mobile factory, with a length of 24 meters and a weight of 2000 tons. It was one of the largest diggers in the world, and has a digging power of 30 thousand tons per day. About 70% of the digging processes of first phase were completed, before the termination of work due to the outbreak of the civil war in the south. The following table shows some details of the estimations made by the Egypt-Sudan Permanent Joint Technical Commission for the Nile Waters for the first phase.

**Table (1): Initial cost of the first phase of the canal according to 1974 estimations**

Type of work	Percentage cost
Earthworks for digging the canal to allow the passing of 20 billion cubic meters of water per day.	25.71%
Building an arch bridge at the beginning of the canal to allow the passing of 20 billion cubic meters of water per day.	7.86%
Building an arch bridge at the end of the canal to allow the passing of 20 billion cubic meters of water per day.	7.14%
Building an arch bridge on the lower artificial river to allow the passing of 60 billion cubic meters of water.	13.57%
Building bridges on the artificial river to drain the flood waters.	7.14%
Agricultural and animal development and community development projects. (e.g. agricultural reclamation, irrigation and sewerage networks, housing, etc)	25.71%
Gross total	87.14
Reserve amounts, drying works, and other unforeseen works.	12.86%
Local currency estimations	29.69%
Foreign currency estimations	70.31%

Source: Henry Riyadh *etal*, Joint Technical Commission for the Nile Waters Beirut, 1984.

**Funding:** Local currency: SDG 20780000 (1974 estimations) ,Foreign currency: SDG 49220000 (1974 estimations) = Total: SDG 700000000 (1974 estimations)

### **1-14 The economic benefits of Utilizing Jonglei Canal waters**

The total amount of lost water exceed 40 billion cubic meter per year, and increasing the input of the Nile waters requires the construction of control and storage projects in order to utilize the lost water by investing it in agriculture and generating hydropower. A 1982 study by the US Ministry of Agriculture revealed that 80% of the water allocated for agricultural reclamation was priced at US \$12 for each 1000 cubic meters. Producing a ton of cotton requires 5000 cubic meters of water, and a ton of wheat requires 1800 cubic meters. Therefore, the economic benefits of the project in agriculture (growing wheat as an example) can be calculated as follows:

- Total water gains of Jonglei Canal = 9 billion cubic meters.
- The amount of water required for producing a ton of wheat = 1800 cubic meters
- Supposing the productivity of one acres is one ton of wheat, the total amount of water gained from the project would allow the cultivation of 5000000 (5 million) acres with productivity of 5000000 tons of wheat per annually.
- Given that the world price of wheat is now US \$800 (SDG 4720), the total income would be US \$ 4 billion.
- The price of 1000 cubic meters of water = US \$12.
- The price of 9 billion cubic meters of water = US \$1080 million. (i.e. the cost of irrigating 5 million acres of wheat).
- Therefore, the net profits gained from using 9 billion cubic meters in growing wheat would be US \$2920 million annually.

Moreover, Sudan can follow the example of Brazil in developing an industrial economy based on the resources of renewed energy like hydropower, and alcohol fuel (esp. ethanol which is produced from sugar cane).

What is of much concern here is that Sudan can utilize its share in cultivating its fertile lands and investing in agricultural projects which could generate a lot of income with the least cost. South Sudan can depend on Jonglei Canal in building strategic projects which could help in solving many of the problems related to humans like providing food and clean drinking water and developing livestock and wildlife in the area of the Canal.

Digging Jonglei Canal could also help in utilizing the river basin positively in river navigation, which provides slow but cheap means of transport for people and goods. River transport has always been an indispensable means of travel in the south, due to the absence of railways and scarcity of tarmac roads. However, many of them are seasonal because of the swamps and the floating grasses; the canal would solve this problem. The following table shows some of the main permanent and seasonal river navigation routes.

**Table (2): permanent and seasonal river navigation routes to South Sudan**

Route	Distance (in kilometers)	Type
Kosti – Juba	1436	Permanent
Khartoum – Kosti	319	Permanent
Kosti – Malakal	501	Permanent
Kosti – Gumbeila	1069	Seasonal
Kosti – Bantio	211	Seasonal
Kosti – Nassir	821	Seasonal

**Source: Sudan River Transport Corporation, Khartoum.**

In the field of fisheries, South Sudan can utilize the potential and reserve fish resources in the Sudds area and Jonglei Canal, which is estimated at 75000 tons per year (within an area of 6.4 million acres). Before the secession of south Sudan, this region was rated second among the domestic fisheries in terms of fish production. However, only 20% the abovementioned reserve is actually utilized. Therefore, the fisheries sector requires the cooperation and support of local, regional and international efforts, in order to be developed, through the following set of procedures:

- 1- Proper utilization and management of fisheries according to the international standards (in terms of weight, type, size and nutritional value).
- 2- Establishing new fisheries and providing infrastructure and proper training on aquaculture.
- 3- Expanding the scope of fish farming in a businesslike manner.
- 4-

**Table (3): Fish Reserve in South Sudan**

Fish Reserve (area and reserve)	Area (in acres)	Reserve
	6420	75000

**Source: Arab Org. for Agricultural Development: Khartoum, 1994.**

The 1<sup>st</sup> Conference on Agricultural Development convened at Khartoum in 1982 by the National Research Council (Jumaa, 1982) revealed that the implementing development projects in South Sudan would yield the following outcomes:

- 1- Preserving 50 billion cubic meters of irrigation water annually.
- 2- Completing the construction of pump irrigation projects with a total area of 52000 acres.
- 3- Implementing mechanized farming projects in Bahr Al-Ghazal and Upper Nile States.
- 4- Implementing the projects proposed for growing rice, tea, coffee, tobacco and sugar cane.



- 5- Developing livestock.
- 6- Investment in animal and fish resources.

**Table (4): Agricultural development projects after digging Jonglei Canal**

Project	Main Crop	Area (thousand acres)
Betjico, Jonglei	various crops	2520
Mangala	sugar cane	40.3
Southern Rank & Jelhak	sugar cane	350
Total	//////////	2910.3

Source: Jumaa, Sayyed, the 1<sup>st</sup> Conference on Agricultural Development National Research Council, Tamaddon Printing Press, Khartoum, 1982.

### **2-1 Findings**

After the completion of constructing Jonglei Canal Project, the following benefits are expected to be achieved:

1. Asserting that the River Nile is a shared international river whose water is a common resource of economic, social and environmental values.
2. Increasing the shares of the three countries and reclaiming the fertile lands in growing consumption crops to save hard currency.
3. Implementing mechanized and rain-fed agricultural projects in all of the three countries.
4. Improving grazing lands.
5. Controlling and organizing the flow of the River Nile waters, and combating Nile grasses to reduce water loss and facilitate river navigation.
6. Encouraging food industries, e.g. dairy, meat industry and fisheries.

### **2-2 Recommendations:**

On the basis of the yielded results, the following recommendations are proposed:

- 1- Paying more concern to management and control of water resources, through joint cooperative projects, as water is considered a vital factor in national security and food security.
- 2- Exploiting the construction of Owen Dam at the mouth of Lake Victoria which is part of a larger plan for the construction of Lake Albert's Dam and Jonglei Canal.
- 3- Starting serious negotiations on resuming the work on the Canal as substantial start for developmental projects that could strengthen the ties of cooperation and economic integration between the Nile Valley states.
- 4- Providing the technical, economic, social and environmental studies on Jonglei Canal and updating them.
- 5- Managing the waters of the Nile efficiently and justly to secure food for humans and animals in all of the co-basin states.

- 6- Employing diplomacy in supporting cooperation on water resources and gaining technical assistance from UN organizations and other concerned organizations.
- 7- Resolving border conflicts and eradicating tensions between neighbor countries, and exploiting water strategies in strengthening relations and achieving stability and sustainable development.
- 8- Attempting to keep a solid cooperation basis for the exchange of information and expertise, building capabilities, supporting research and development projects and raising water awareness.

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