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Appraisal of a Domestic Aviation Project Sudan

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Eastern Africa Regional Office
Highways Division

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CURRENCY EQUIVALENTS

Currency Unit	=	Sudanese Pound (S£)
US\$2.87	=	S£ 1.00 (official rate)
US\$1.00	=	S£ 0.34 (official rate)
US\$2.50	=	S£ 1.00 (effective rate)
US\$1.00	=	S£ 0.40 (effective rate)

WEIGHTS AND MEASURES

1 meter (m)	=	3.28 feet (ft)
1 kilometer (km)	=	0.62 miles (mi)
1 square kilometer (km ²)	=	0.386 square mile (sq mi)
1 kilogram (kg)	=	2.2 pounds (lbs)
1 metric ton (m ton)	=	2,204 pounds (lbs)

GLOSSARY OF ABBREVIATIONS

CAD	-	Civil Aviation Department
DME	-	Distance Measuring Equipment
HF	-	High Frequency
ISB	-	Individual Side Band
MOD	-	Ministry of Defense
MTC	-	Ministry of Transport and Communications
NDB	-	Non-Directional Beacon
ODM	-	Overseas Development Ministry
OPAS	-	Operational Assistance
p.a.	-	per annum
P&T	-	Ministry of Posts and Telegraphs
SSB	-	Single Side Band
UK	-	United Kingdom
UNDP	-	United Nations Development Program
VHF	-	Very High Frequency
VOR	-	Very High Frequency Omnidirectional Radio Range

REPUBLIC OF THE SUDAN FISCAL YEAR

July 1 - June 30

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This report was prepared by W.B.R. Zetterstrom (Aviation Engineer),
B. Bostrom (Aviation Economist), S.B. Rollins (Financial Analyst) and
M. Garcia-Zamor (Technical Editor).

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MAP Aviation Project (IBRD 11871)

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

SUMMARY AND CONCLUSIONS

- i. This report appraises a project comprising:
 - (i) the construction of two regional airports, at Wau and Port Sudan, and upgrading of Juba and Malakal Airports;
 - (ii) supervision of the construction/reconstruction in (i);
 - (iii) the provision of maintenance and navigational and communications equipment to the project airports; and
 - (iv) technical assistance and staff training for the Civil Aviation Department (CAD).

- ii. The Sudanese Government is attempting to integrate its widely dispersed southern communities into the economic and social life of the country by developing a dependable air transport system capable of meeting domestic transport demands. The Government also wishes to improve the inadequate airport facilities at Port Sudan, the country's second largest city. With the exception of Juba, the airports in question have short, dry weather runways with aeronautical obstructions which limit aircraft size and takeoff weights and require excessive airport and aircraft maintenance.

- iii. The project will enable the domestic airline to use its larger, more efficient and productive aircraft at a higher daily utilization rate, with correspondingly lower unit costs, and to improve schedule reliability. It will also provide the equipment required to maintain the project airports. The technical assistance and staff training element is designed to strengthen CAD's newly organized airport engineering design and construction unit.

- iv. The proposed US\$20 million Bank loan and US\$9 million IDA credit represents about 34% of total project costs (US\$86.1 million) or 45% of the foreign exchange element (US\$65 million). The Government will exempt project items from taxes and duties. **The Saudi Fund is expected to finance the airport at Port Sudan and the Government has undertaken to finance the airport at Juba** as part of its Six-Year Plan for the period commencing July 1, 1977, and may seek additional foreign exchange from external agencies to help finance this part of the project. The Government will also meet the cost of the risk contingency, should it be required, and the local costs of the project.

- v. During negotiations, agreement was reached on CAD financial objectives. For this purpose, CAD was treated as a separate corporation, although it is a Government department. The financial analysis contained herein reflects these objectives and this assumption. The Government will make available to CAD, which will execute the project, US\$35 million at 8-1/2% interest and about US\$38 million as Government equity; US\$7.2 million will be internally generated by CAD. The balance of project costs comprises the risk contingency, which Government has agreed to provide, if required.

vi. The main project benefits are cost savings to Sudan Airways from better utilized, more efficient and productive aircraft. Additional benefits include passenger time savings and foreign exchange income earned by more reliable communications and navigational aids to foreign aircraft overflying Sudan. Additional unquantified benefits comprise increased flight reliability, improved air safety, better inter-regional integration of the country and increased development potential by facilitating the movement of essential expertise to previously isolated areas and by helping make possible production increases of high value perishable commodities through provision of access to markets. The economic return for the individual project airports, exclusive of passenger time savings, ranges from 12% to 24%, using either market or shadow prices. However, the individual returns for the southern airports have limited meaning because the upgrading of any single airport allows economical use of jet aircraft only if other airports are also upgraded. The economic return for the project as a whole is 19%.

vii. Contracts financed under the loan and credit will be awarded through international competitive bidding in accordance with Bank Group "Guidelines for Procurement" after a prequalification screening. Qualified domestic civil works contractors will be given a 7-1/2% preference on their bids.

viii. This report is based on economic and engineering studies made by Brian Colquhoun and Partners (U.K.). It will be the fifth Bank Group transportation project in Sudan, and the first in aviation.

ix. Having reached agreement during negotiations with the Government on the points set out in Chapter 7, the proposed project is suitable for Bank Group loan in the amount of US\$20 million, on intermediate terms at 4.85% interest, which includes a 4% interest subsidy, for 25 years with a 7-year grace period, and an IDA credit of US\$9 million, on the usual terms.

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

1. INTRODUCTION

1.01 The Democratic Republic of the Sudan has requested Bank Group financial assistance in upgrading its air transport system to meet domestic transport demands more adequately. A suitable project comprises the construction of two regional airports, at Wau and Port Sudan; the upgrading of Juba and Malakal Airports; supervision of construction/reconstruction at the project airports; the provision of maintenance equipment and navigational and communications equipment to the project airports, and technical assistance and training to the Civil Aviation Department (CAD).

1.02 This will be the first Bank Group aviation project in Sudan. Annex 1 gives details of previous Bank Group loans and credits for Sudanese transportation projects (highways and railways). Implementation of Credits 331-SU (highways) and 457-SU (railways) is proceeding reasonably well, although we continue to be concerned by the low level of operational efficiency of Sudan railways. The 1973 railway Credit included funds for the aviation feasibility study on which this project is based.

1.03 Project cost is estimated at US\$86.1 million (net of taxes and duties), with a US\$65 million, or 76%, foreign exchange component. The project financing plan incorporates a 10% risk contingency due to the absence of contracting experience in southern Sudan. The proposed Bank Group loan of US\$20 million and IDA credit of US\$9 million will cover 45% of the foreign exchange element. The Saudi Fund is expected to finance the cost of the Port Sudan airport. The Government will finance the airport at Juba, the local project costs and the risk contingency, should it be required.

1.04 This report is based on the technical and economic studies prepared by Brian Colquhoun and Partners (UK) and on the findings of a Bank appraisal mission comprising W.B.R. Zetterstrom (Aviation Engineer), B. Bostrom (Aviation Economist), and S.B. Rollins (Financial Analyst) which visited Sudan in April/May 1975. The report has been edited by M. Garcia-Zamor (Technical Editor).

2. THE TRANSPORT SECTOR

A. Effects of Geography and Economic Growth on Transport

2.01 Sudan is the largest country in Africa, stretching over more than 2.5 million km². This huge area consists of largely uninhabited desert in the northern third of the country and tropical forests and savannas in the south. It is traversed from north to south by the Nile River (see Map)

close to which lives much of the country's 17 million population, which is growing at a rate of 2% p.a. Per capita income in Sudan is about US\$130, over 50% of which is generated by the public sector. Agriculture dominates the economy, accounting for over 40% of the gross domestic product and almost all export earnings. Although economic activity is largely concentrated within the fertile and well-irrigated 400 km stretch south and east of Khartoum, the population is widely scattered over the country. Where water is available, the potential for agricultural production is substantial. However, the great distances between potential areas of production and consumption and the sparse and poorly connected transport network hinder Sudanese development.

2.02 The harsh climate and long distances make provision of inexpensive, efficient and reliable surface transport particularly difficult. While superficially ideal for transportation, the Nile to the north is repeatedly interrupted by unnavigable rapids while to the south the White Nile disappears into the Sudd, a vast swamp with continually shifting channels. The sparse rail and road systems, which must cross hot, arid deserts in the north, northeast and central zones and skirt the Sudd in the south, are oriented for exports through Port Sudan. In view of the enormous size of the country, its need for economic integration and development, and the physical and financial constraints on the development of adequate surface transport, the development of air transport facilities is especially important. Air transport offers not only the lowest costs on many routes for passengers and some commodities, but is frequently also the only practical means of transport.

B. The Transport Modes

Railways

2.03 The railway is the primary transport mode, with road and river transport serving as feeders to it. It consists of 4,757 km of 1.067 m gauge, single track line. It is skeletal in nature, emanating from Port Sudan with connecting points at Khartoum and Sennar and reaching west and south to Nyala and Wau. The most heavily travelled section is the desert route between Port Sudan and Khartoum via Atbara (787 km) which represents only about 17% of the network but accounts for about 60% of total freight traffic carried. There is a secondary route up-country from the port via Kassala, and branch lines north to Karima and Wadi Halfa, west to El Obeid and Nyala, and south to Wau. Revenue-earning freight amounted to 2.8 million tons in 1970/71 but declined to 2.2 million tons in 1974/75. The railway has for some time been failing to meet demand, and there was a backlog of some 300,000 tons of goods in Port Sudan waiting for transport in January 1976. However, there are good grounds for expecting early improvements as a result of much new investment and intensive efforts to improve operational efficiency.

Highways

2.04 The lack of effective railway capacity has encouraged increased emphasis on road construction. However, compared with almost any other country in the world, road density in Sudan is extremely low. Of the 19,000 km of roads and tracks, only about 400 km are paved, mostly near Khartoum. The 6,000 km of gravel roads are located mainly in the three southern provinces where laterite material is available, but since construction some 30 to 50 years ago, they have been inadequately maintained and are now in poor condition. Much of the road network passes over heavy dry soils which are generally impassable during the rainy season (June-September). Current investment in roads will add over 1,000 km of paved roads to the network by 1979.

Inland Waterways

2.05 River services, provided by the semi-autonomous River Transport Corporation under the Ministry of Transport and Communications (MTC), operate on two stretches of the Nile River system: on the 1,400 km Kosti-Malakal-Juba section linking central and southern Sudan and the 290 km Karima-Dongola section in northern Sudan. Three-fourths of the river traffic is on the former section and nearly all freight moves southward. Kosti is the freight transfer point between rail and river modes because of navigational difficulties between Khartoum and Kosti. Due to operational problems and to the directional imbalance of traffic flows, the services operate at high cost and in deficit.

Ports

2.06 Port Sudan, on the Red Sea, is Sudan's only important deep-water seaport. Poor railway service in the port area considerably delays freight movements, resulting in congestion in the sheds and the open storage areas. The Government plans to construct a new port at Suakin, some 40 km south, but it will be some time before facilities are available.

Pipeline

2.07 A pipeline to carry white oils from the refinery at Port Sudan to Khartoum and to expand refinery capacity is under construction. When it is completed in 1976, the railway will lose some of its bulk petroleum traffic, estimated at 600,000 tons in 1977, or 15% of total rail freight (including an estimated 100,000 tons of aviation fuel). While this will provide the railway with additional freight capacity between Port Sudan and Khartoum, it will still have to move substantial volumes of oil, about 300,000 tons in 1977, from Khartoum to the rest of the country.

C. Transport Planning and Coordination

2.08 The 1970-75 Development Plan was an uncoordinated listing of projects proposed by individual ministries and was not based on economic priorities. Subsequent to its publication, the Government decided to review and revise the plan annually, but the review mechanism was handicapped by inadequate planning efforts at the sector level. For transport, this resulted until late 1973 in a low level of investment in relation to needs, and this sector became a major bottleneck to economic activity, especially to plans to increase agricultural production. Since 1973, investment in transportation has expanded rapidly in all modes and transportation investment has become the largest component in development expenditures.

2.09 A recent study developed a master plan for Sudanese transport development, but much work remains to be done to convert this into a coherent investment program and to build up the institutional capacity to carry out an integrated transport investment program (paras. 3.22-.23). Transportation is certain to figure prominently in the Six-Year Plan (1977-83) under preparation.

2.10 Transport coordination is not likely to pose an immediate problem. Except for aviation, which provides an entirely different level of service from that of surface transportation, most transport services in Sudan are complementary. The only duplication at present is between Khartoum and Wad Medani (185 km) where a bitumen road parallels the railway. In future, however, the need for proper planning and coordination of investments will increase along with increased demand for transport services.

3. SUDAN AVIATION

A. Aviation Policy

3.01 The Government's aviation policy is aimed at creating a dependable air transport system with much increased capacity, which will at the same time allow reduced unit costs. The aim is to draw the nation's widely dispersed communities into the economic and social life of the country, facilitate the movement of essential expertise to relatively isolated areas, encourage the growth of perishable freight traffic and allow rapid distribution of high value goods. Domestic aviation has been one of the fastest growing transport modes in Sudan.

B. Aeronautical Administration

3.02 Aviation administration is divided between two ministries. Sudan Airways comes under the MTC while all other aspects of aviation, including CAD, are governed by the Ministry of Defense (MOD).

Sudan Airways

3.03 The Government-owned Sudan Airways Corporation was founded in 1947 primarily to supplement railway services to distant and inaccessible parts of the country. The airline started operations with four eight-seat de Havilland Dove aircraft. In its first year of operation, the fleet carried 1,243 kilos of cargo and 726 passengers, mainly Government officials. The airline's carrying capacity was considerably increased shortly thereafter when it acquired a 28-seat Douglas DC-3. External operations began in 1954 with extensions to Cairo, Entebbe and Asmara.

3.04 The airline, which has a monopoly in domestic service, is operated as a commercial enterprise, although the Government can direct it to provide services regardless of profitability. Until recent years, the airline operated at a substantial loss but it is now financially viable as a result of using better aircraft on international flights and increasing domestic tariffs in 1974. Compared to other countries at similar developmental levels, Sudan Airways' tariffs are high, almost twice as high in some cases (Table 1). While long range international services presently account for more than two-thirds of total revenue, it is the domestic and regional routes which offer a more promising basis for the corporation's future. Domestic air transport is expected to be used increasingly in place of first and second-class passenger service by rail and river, particularly over long distances.

3.05 Sudan Airways aircraft fleet planning is well advanced. By mid-1975 the airline had two Boeing B-707-320C aircraft with wide-body interiors, five Fokker F-27 and two de Havilland DHC-6 aircraft, all maintained to required airline operational standards. Two new Boeing B-737 aircraft were acquired for introduction in late 1975. This appears to be the optimum choice to serve the total domestic and international system even though these new aircraft are not ideal to serve some of the small airports (Annex 2).

3.06 Although utilization of the F-27 aircraft has increased from 4.5 hours per day in 1973 to 5.6 hours in 1975, it is still low, primarily due to the lack of night landing facilities and the length of the route segments. (Initially, the B-737 will be in service 6.5 hours per day.) On the other hand, load factors are high, such as between 69% and 82% on routes to the south. However, since these load factors

do not take into account restricted take-off weights imposed by airport conditions, they do not truly reflect the unsatisfied demand in these areas, evidenced by long delays in obtaining confirmed flight reservations. If larger aircraft could be introduced at these airports, this presently unsatisfied demand would immediately cause a rapid traffic increase.

3.07 With the introduction of the large jets, Sudan Airways has been reorganizing to make its operations more efficient. Most of this effort has been directed toward the technical departments. The airline is receiving technical assistance in the form of two expatriate experts, in commercial and engineering management, funded by the United Kingdom (UK). In addition, a financial manager started a two-year assignment in mid-1975. The UK has also been considering funding two other experts for two years (an aircraft certification officer and a flight operations officer) and a decision has probably been reached. Even so, with two types of turbo-prop aircraft plus two types of large turbo-jet aircraft, the technical staff is insufficient.

Civil Aviation Department

3.08 Although it is part of the MOD and is partly manned by military personnel, CAD functions as a civilian government department. Most senior CAD officials are military officers transferred to a civilian status while with the Department. All the airport commandants and fire fighting personnel are specially-assigned military personnel. CAD financing is detailed in paras. 6.01-.06.

3.09 To upgrade its small outlying airports, the CAD has recently organized an airport engineering design and construction unit. For large projects, consultants and contractors are to be engaged, but their work will be supervised by this new unit. To date, the unit has completed the reconstruction of Atbara Airport and is now working on New Halfa Airport, with equipment provided by a loan from the Federal Republic of Germany. However, additional strengthening is required to make this unit fully self-sufficient. This is provided for under the project (para. 4.10).

3.10 CAD is also receiving technical assistance funded by the United Nations Development Program (UNDP). In a new program just under way, the electronics section will receive four Operational Assistance (OPAS) technicians. In addition, there are three air traffic control instructors, an English instructor, an aeronautical visual aids instructor, a chief advisor and an airport engineering advisor (the latter for only one year). For training in flight safety, electronic engineering, telecommunications and air traffic control, 37 fellowships were provided in 1974 and 206 man-months of training are in the new program.

C. Aviation Infrastructure

Airports

3.11 Airports range from the all-weather, 24-hour international jet airport at Khartoum to a completely unimproved field at Dinder. In between are airports such as Juba, with a recently overlaid and lengthened asphalt runway; Malakal, with a rapidly deteriorating 20 year-old asphalt runway; Geneina, with a partially asphalt sealed sand runway; Port Sudan, with an unpaved coral runway; Wau, with a laterite and rock runway; and El Obeid, with a sand runway. All of these except Khartoum and Juba are subject to closing during seasonal rains because of soft runways.

3.12 Apart from Khartoum, none of the airports have runway edge lighting, although Port Sudan and a few others have kerosene flare pots for emergencies. Electrical equipment has been purchased with a loan from the Federal Republic of Germany for temporary installation at high priority domestic airports, but only Khartoum has electronic landing aids, which are being upgraded with new equipment provided under a UK loan.

3.13 Current conditions at the four project airports are described in detail in Annex 3.

Aeronautical Communications and Navigational Aids

3.14 There are virtually no aeronautical communications within the country. Existing equipment is old and seldom works. Most traffic information is passed by telephone, if at all. The airline has no other communication with its outlying stations. In emergencies, CAD passes information on the Meteorological Department's HF-SSB network. Most of the airports with scheduled service are equipped with VHF radios for airport control air/ground communications, but these units have a range of only 50-100 km. The proposed project provides for the necessary communications equipment for the project airports (para. 4.09).

3.15 Most of the airports have non-directional radio beacons (NDB) but the equipment is generally located within the Posts and Telegraphs (P&T) compound in the town rather than at the airport proper. This equipment is very old and P&T is no longer willing to maintain it. Under the proposed project, the appropriate navigational equipment will be provided to the project airports (para. 4.09).

D. Traffic Forecasts

3.16 Air traffic in Sudan has grown relatively rapidly over the past few years despite seriously constrained domestic services. Thus, from 1968/69 to 1973/74, the number of domestic air passengers more than doubled

from 52,000 to 107,000 and domestic air cargo increased from 774 tons to 1,296 tons. The most important individual route, Khartoum-Port Sudan, accounts for 20% of passenger movements followed by airports in the west, 32%, and south, 26%. The four project airports, Port Sudan, Wau, Malakal, and Juba account for 46% of the domestic passenger flow. Although traffic forecasts for the domestic airports have been prepared by Sudan Airways and various consultants, those of the project consultants, Brian Colquhoun and Partners, are used as the best average indication of traffic flows, assuming project implementation.

Passengers

3.17 As in other countries where a changeover to jet aircraft has led to rapid traffic growth, the recently introduced trial weekly all-jet service to Juba has produced a 20-25% passenger traffic increase compared with the same period the previous year. The passenger forecasts used in this report, however, do not depend upon this individual case. They are based on more general demand factors, on demographic factors (e.g., size and growth of population and urbanization) and on socio-economic factors (e.g., level of economic development, inter-community links and travel substitutes). Further, three groups of travelers were considered separately: Sudanese business and government travelers, by far the most numerous; foreign business travelers; and tourists.

3.18 In addition to normal passenger traffic growth, even without the project, the introduction of jet services is expected to generate new traffic and to divert traffic from rail and river modes. ^{1/} As Table 2 indicates, a 14-18% p.a. growth rate with the project, on a low base, is estimated through 1980, followed by 10% p.a. or less thereafter. These estimates are likely to prove conservative in view of other countries' experience.

Freight

3.19 Air cargo flows are severely constrained by the limited capacity of aircraft in domestic service, a factor which makes it difficult to predict future traffic under improved conditions. The freight projections take into account factors similar to those considered in forecasting passenger traffic. A distinction has also been made between normal freight traffic growth and that induced by specific development projects.

^{1/} Currently, about 2,500 passengers p.a. travel between Khartoum and Wau (1,000 km) by first or second class rail services and about 9,000 travel on these classes by river between Kostî, Malakal and Juba. (The distance between Khartoum and Port Sudan is 665 km; Khartoum-Malakal is 680 km; and Khartoum-Juba, 1,200 km.)

3.20 As shown in Table 2, the combined freight traffic at Juba, Malakal, Wau and Port Sudan is expected to increase threefold by 1980 over 1975 figures and almost double again by 1985. The average freight traffic growth p.a. through 1990 is over 10% for Port Sudan and over 15% for each of the other three airports. Potential large commodity flows include fruit, tobacco and tea from Juba, fish from Malakal, meat from Wau and a large variety of manufactured goods from Port Sudan and Khartoum to these southern airports.

Aircraft Movements

3.21 Aircraft movement forecasts are shown in Table 3. Scheduled services are estimated assuming the use of the Boeing B-737 as the primary aircraft. Other aircraft movements are assumed to follow previous growth trends.

E. Additional Aviation Investment Planned

3.22 The Government intends to carry out an investment program which includes procurement and installation of navigational aids and communications equipment along the country's major air routes and technical assistance to Sudan Airways to ease its transition to a jet fleet. Such improvements and assistance are necessary because of safety and efficiency considerations. Annex 4 details these programs.

3.23 The Italian Government has financed a study of Khartoum's airport needs over the next twenty years. Although the study concludes that a new airport should be built, it does not contain a comprehensive economic analysis. A separate study prepared by the Associates for the Development of Arab Resources, after a limited analysis, recommends only minor improvements to the existing Khartoum terminal buildings and no major airport work there for the next ten years. The Government has provided assurances that the proposed new Khartoum Airport will be subjected to appropriate economic analysis.

4. THE PROJECT

A. Objectives

4.01 The Sudanese Government is attempting to integrate its widely dispersed southern communities into the economic and social life of the country by developing a dependable air transport system capable of meeting domestic transport demands. To help meet these demands, the project aims to assist the Government in developing a system of airports which can handle larger, more efficient and productive aircraft than at present. The Government also wishes to improve the inadequate regional airport facilities at Port Sudan, the country's second largest city, and this is provided for under the project.

B. Description

4.02 The project consists of:

- (i) the construction of two new regional airports, at Port Sudan and Wau; the reconstruction of the runway at Malakal Airport and the construction of a new terminal building and related ancillary works at Juba Airport;
- (ii) supervision of construction/reconstruction in (i);
- (iii) the provision of maintenance and navigational and communications equipment to the project airports; and
- (iv) technical assistance and staff training for the CAD.

(i) Airport Construction and Improvements

4.03 Port Sudan and Wau. A detailed description of existing conditions at the four project airports and the proposed construction and improvements is given in Annex 3. The construction at Port Sudan and Wau will include earthworks, drainage, paved runway, lead-in taxiway, apron, fuel farm, terminal building, control tower, maintenance vehicle shed, electrical vault, staff housing, airfield lighting, fencing, crash-fire-rescue station, access and ancillary roads and all necessary utility systems. In addition, the terminal building at Port Sudan will be designed for international traffic and a small Haj terminal and apron will be provided for the annual pilgrimage.

4.04 Malakal. The existing paved runway, taxiway and apron at Malakal will be reconstructed; the flight trip regraded, access and ancillary roads repaved; the existing terminal building and control tower renovated; the existing fuel farm rehabilitated; a new crash-fire-rescue station, maintenance vehicle shed, electrical vault and sewerage system constructed; new airfield lighting installed; fencing provided; and all related utilities provided.

4.05 Juba. The existing terminal area at Juba will be demolished and a new area constructed consisting of an aircraft apron, international terminal building, control tower, fuel farm, crash-fire-rescue station, electrical vault, maintenance vehicle shed, paved access and ancillary roads. In addition, the flight strip will be regraded, fencing provided, airfield lighting installed and all related utilities provided.

(ii) Supervision of Construction/Reconstruction

4.06 The consulting firm which the Government engaged to do technical and economic studies related to the project, Brian Colquhoun and Partners, is to prepare the architectural and engineering final design plans and specifications. This work, which should be substantially completed by the time the credit is signed, is being partly funded under IDA Credit 457-SU. The balance of the engineering costs will be financed under the project.

4.07 Supervision of construction will be required through the first quarter of 1981. For the sake of continuity, it should be desirable that the present consultants, who are competent, be engaged, and during negotiations the Government stated that this was its intention.

(iii) Provision of Equipment

4.08 Maintenance Equipment. For the CAD to maintain the project airports properly, equipment will be required which will have to be based permanently at each airport because of the long distances between the airports and poor road conditions. A list of the minimum amount of equipment required for each airport is shown in Annex 5.

4.09 Navigational and Communications Equipment. At each of the project airports, navigational aid equipment (VOR/DME) will be installed as approach and enroute aids. New VHF air/ground and HF-LSB point-to-point voice and teletype communications between the project airports, Khartoum and other domestic Sudan airports will be installed. This will also allow communications between Port Sudan and Jeddah/Asmara; between Wau and Bangui; and between Juba and Entebbe/Nairobi.

(iv) CAD Technical Assistance and Staff Training

4.10 To strengthen the airport engineering design and construction unit in the CAD (para. 3.09), six experts will be engaged for the following positions: supervising airport engineer (chief of the unit), civil engineer (chief of the surveying section), airport engineer and architect (the design and construction supervision section), electrical/mechanical engineer (chief of the lighting, navigational aid and standby power section) and aviation economist (chief of the economic and statistical section). In addition, 10 man-years of training outside Sudan will be provided.

4.11 The CAD will engage accounting consultants to design and implement a new commercial and cost accounting system for the entire department (para. 6.05).

C. Special Requirements of the Project

Airport Access at Wau and Port Sudan

4.12 The access roads provided for under the project will connect each airport with the nearest main road. At Wau and Port Sudan, however, the respective main road requires improvement in order to accommodate airport traffic. Government plans to improve these roads. During negotiations, it was agreed that the roads will be improved to all weather standard and that the work will be completed prior to the commissioning dates of these airports.

Electric Power Supply

4.13 The standby electric power provided for the airports under the project is only for emergencies during periods of prime power failure. Prime power will be drawn from the local electrical supply. It was agreed during negotiations that the capacity of the local power supply will be sufficient to meet airport needs by the commissioning date of each airport.

Potable Water Supply

4.14 Water for the airports will be drawn from local supplies. This will be adequate except for Port Sudan airport. It was agreed during negotiations that the water supply for Port Sudan will be adequate to meet airport needs prior to its commissioning.

D. Cost Estimate and Financing

4.15 Total project cost, including contingencies, is US\$86.1 million. The foreign exchange component is US\$65 million, 76% of total project cost. Government has said that it intends to exempt project items from taxes and duties. The proposed Bank Group loan of US\$20 million and IDA credit of US\$9 million will finance 45% of the foreign exchange component of the airport construction costs, including most of the foreign exchange costs of Wau and Malakal airports, plus the foreign costs of maintenance equipment, design engineering, accounting consultants and technical assistance and training for CAD. The Saudi Fund is expected to finance the cost of Port Sudan airport. The Government has undertaken to finance the Juba airport as part of the Six-Year Plan commencing July 1, 1977, and may seek additional foreign exchange from external agencies to help finance this part of the project. The Government will also meet the cost of the risk contingency, should it be required, and the local project costs.

4.16 The cost estimate shown below (in prices expected at the end of June 1976) is categorized by type of work. A detailed itemization of the project construction contracts by airport is given on page 1 of Table 4, local and foreign components of these contracts are given on page 2 of that Table. Total costs by airport are shown on page 3 of Table 4.

Component or Item	(S£ thousand)			(US\$ thousand)			Percent of Project Cost
	Local	Foreign	Total	Local	Foreign	Total	
Pavements	3,152	7,954	11,106	7,880	19,885	27,765	34.50
Buildings	787	2,163	2,950	1,968	5,408	7,376	9.16
Roadworks	416	1,158	1,574	1,040	2,895	3,935	4.89
Electrical	287	2,807	3,094	717	7,018	7,735	9.61
Misc. Equipment	19	486	505	48	1,215	1,263	1.57
Subtotal	<u>4,661</u>	<u>14,568</u>	<u>19,229</u>	<u>11,653</u>	<u>36,421</u>	<u>48,074</u>	<u>59.73</u>
Engineering Supervision (4% of construc- tion costs)	157	611	768	393	1,527	1,920	2.38
Contingencies:							
Physical	482	1,520	2,002	1,205	3,800	5,005	6.22
Price	<u>2,200</u>	<u>6,836</u>	<u>9,036</u>	<u>5,500</u>	<u>17,090</u>	<u>22,590</u>	<u>28.07</u>
Subtotal	<u>7,500</u>	<u>23,535</u>	<u>31,035</u>	<u>18,751</u>	<u>58,838</u>	<u>77,589</u>	<u>96.40</u>
Maintenance Equipment	10	130	140	25	325	350	0.43
Design Engineering	10	280	290	25	700	725	0.90
Accounting Consultants	<u>20</u>	<u>60</u>	<u>80</u>	<u>50</u>	<u>150</u>	<u>200</u>	<u>0.25</u>
Subtotal	<u>7,540</u>	<u>24,005</u>	<u>31,545</u>	<u>18,851</u>	<u>60,013</u>	<u>78,864</u>	<u>97.98</u>
CAD Technical Assistance	<u>320</u>	<u>330</u>	<u>650</u>	<u>800</u>	<u>825</u>	<u>1,625</u>	<u>2.02</u>
Total	<u>7,860</u>	<u>24,335</u>	<u>32,195</u>	<u>19,651</u>	<u>60,838</u>	<u>80,489</u>	<u>100.00</u>
Risk Con- tingency	<u>604</u>	<u>1,648</u>	<u>2,252</u>	<u>1,510</u>	<u>4,120</u>	<u>5,630</u>	
GRAND TOTAL	<u>8,464</u>	<u>25,983</u>	<u>34,447</u>	<u>21,161</u>	<u>64,958</u>	<u>86,119</u>	

4.17 The cost estimates were developed by the consultants based on recent construction contracts awarded in Sudan and in the general geographical area; they are considered reasonable. Land required for this project belongs to the Government and will be transferred to CAD at no cost.

4.18 An item for physical contingencies amounting to 10% has been included in the cost estimate to allow for minor changes in design and scope of work. An additional item for price contingencies, amounting to 12% through 1977 and 10% for 1978 and 1979, has been included to allow for

anticipated increases in labor and material costs. An additional 10% risk contingency has been included for the three southern airports, in view of the lack of contracting experience in southern Sudan.

E. Execution

4.19 The project will be executed by CAD. The civil works contracts for Wau, Port Sudan and Juba are expected to be awarded first, followed by Malakal. The other contracts will be timed to allow for completion of all contracts at any one airport at the same time. Annex 6 shows the expected schedule of project implementation. The airport at Juba is expected to be completed in March 1979 and the other three airports in March 1980. During the construction phase, approximately 500 persons, ranging from laborers to highly skilled artisans, will be employed at Wau, and another 500 at Port Sudan. A smaller number, about 300 each, will be employed at Juba, since there is no runway to be built, and at Malakal, since only minor work is required on the terminal buildings.

4.20 CAD will handle all electronic equipment procurement and installation through contractors, with provision for on-the-job training for CAD personnel.

4.21 As recorded in the Agreed Minutes of Negotiations, the Government and the Association agreed upon a project implementation schedule, as a reasonable current estimate of project execution (Annex 6).

F. Procurement

4.22 Contracts for civil works (earthworks, paving, drainage, buildings, fuel systems, etc.), visual aids, navigational aids, communications equipment and installation will be awarded through international competitive bidding in accordance with Bank Group "Guidelines for Procurement" after a prequalification screening of interested contractors, with particular attention to the logistics, timing and coordination involved in these contracts. Qualified local civil works contractors will be allowed a 7-1/2% preference in the evaluation of their bids.

G. Disbursement

4.23 The IDA credit will be disbursed before the loan, and disbursements will be made against 100% of the foreign exchange cost of items to be financed, except for the civil works component. For this latter category, disbursement will be made against 90% of the foreign exchange cost. Disbursements are

expected to take place from the second quarter of 1977 through the third quarter of 1981. A schedule of quarterly disbursements is shown in Table 5. Any surplus funds remaining in the loan after project completion will be cancelled.

H. Ecology

4.24 The ecological and environmental effects of the development of these airports were taken into account during their siting and design. The existing airports at Wau and Port Sudan are being discarded because of their proximity to populated areas. Approaching and departing aircraft now pass over these areas with attendant noise, fumes and safety problems. The new locations, and those of the other two airports, place the approach and departure paths away from the population centers. In Wau, the land that will become available is worth as much to agriculture as that to be taken, while in Port Sudan, the land at either site is non-productive. However, at both towns, it is possible that the existing sites might be used for future town development because of their proximity to the town centers. At each of the four airports, drainage of the area will be improved, the possibility of stagnant pools will be eliminated and the existing open sewerage will be replaced with modern sanitary systems.

5. ECONOMIC EVALUATION

A. Major Benefits

5.01 In Sudan the need for air transport is reinforced by the extremely low density of the road network and the physical constraints on rail and river transport. For many years to come, air transport can offer not only the lowest costs on many routes for passengers and selected freight commodities, but also the only practical means of travel. In time the other modes will improve, but air transport will remain essential, especially for long distance passenger movements. In particular, the integration of the southern Sudan with the rest of the country, and the area's economic development, demands better and faster links with the north that only air transport can offer. Further, the air service between the country's two largest cities, Khartoum and Port Sudan, will continue to be the only practical link for passengers for some time. The economic background of each project airport is detailed in Annex 7.

5.02 The major source of quantifiable benefits for the project airports is the much lower operating cost of Sudan Airways' more efficient jet aircraft compared with the propeller-driven fleet now in service at these airports. In addition, present aircraft utilization is low, due partly to the absence of night landing aids, the provision of which under the project will further reduce the jet operating costs. Present load factors are so high (para. 3.06) that services do not meet current demand, and it is not possible to satisfy this demand at reasonable cost by adding more propeller aircraft.

After the introduction of faster, larger and better utilized jet aircraft, passengers will not only gain time from a faster flight but, more importantly, will be able to travel without excessive waiting for available space. This is also important for perishable or otherwise valuable air cargo. Despite the lower load factors involved in making this service improvement possible, the better utilization of more economical aircraft will lead to lower costs per passenger-mile and per ton-mile and will much improve the financial position of Sudan Airways.

5.03 The unquantified benefits of the project include increased flight reliability, improved air safety, better inter-regional integration of the country and increased development potential. The two last-mentioned benefits will accrue to the areas of influence of the three southern airports (Juba, Malakal and Wau) more than to Port Sudan because the isolation of the three southern cities has constrained their development. Substantially decreased air transport costs and improved availability will facilitate the movement of essential expertise to previously isolated areas and help make possible potential production increases of high value commodities by providing access to markets for perishable foods. For example, in Bahr el Ghazal Province (Wau), cattle raising is a dominant activity. There is a good potential for meat export from the region in view of a growing demand from the Middle East and rising world market prices, but the potential cannot presently be exploited because of transport's restricted availability and high cost. The Upper Nile Province (Malakal) also produces livestock but has similar transport problems. Another important commodity in this area is fish, which is now transported dry. Airlifting, combined with a relatively limited investment in refrigeration facilities, would allow the sale of high value frozen, rather than low value dry fish. Also, Equatoria Province (Juba) grows fruits and has good prospects for tobacco and tea export. Tobacco shipments, using trial jet flights, have already begun. With big game reserves, national parks and abundant game, the area also has tourist potential. All these developments depend on the provision of adequate, reliable and rapid long distance transport.

B. Economic Analysis

5.04 Given that air transport is clearly essential to country-wide development in Sudan, the economic case for the project depends on its ability to provide increased transport capacity more efficiently and at lower cost than the existing constrained air services, which constitute the "base case" (i.e., use of F-27 services with high load factors). In making this comparison, the quantified benefits are:

- (i) reduction of transport costs from the use of more efficient aircraft;
- (ii) time savings from faster air service; and

- (iii) increased aircraft utilization and overflight fees from improved airport lighting and navigational aids.

The construction costs, including a physical contingency, have been included as an economic cost of the project. From this amount about S£ 0.5 million has been excluded for each of the three airports in the south for necessary safety items and some deferred maintenance required for continued operation of existing aircraft. (There have been about 70 serious accidents in Sudan over the last 15 years, including 43 during takeoff or landing.)

(i) Reduction of Transport Costs

5.05 The most important of the quantified benefits is the savings in aircraft operating costs per passenger or per ton carried (Tables 6 and 7). This has been estimated by comparing the direct operating cost for existing aircraft under current operating conditions at the existing airports with the costs of Sudan Airways' new, more efficient jet aircraft that will be accommodated at the project airports. The comparison was made for each airport separately, as well as for the three southern airports as a subsystem.

5.06 Transport cost savings over each route were calculated based on the unit cost differential, including aircraft depreciation, between B-737 services and the current F-27. This differential was about S£ 0.025 per passenger mile, amounting to a cost reduction of about S£ 1.96 million in 1980. About 80% of this is foreign exchange (Tables 7 and 8).

(ii) Time Savings

5.07 Since long waiting times for available airline seats cannot be quantified with any accuracy, only the actual gain in scheduled flight time, comparing the base case with the use of the new aircraft, has been calculated. Of the passenger traffic shown in Table 2, over 80% is Sudanese business travel, more than half of which is for government travel. A salary rate of S£ 1.00 per hour of working time, at 1975 prices (growing at 2% p.a. in real terms), has been assumed. The substantial time savings are shown in Tables 7 and 9 for the years 1979-98. Estimated passenger time savings from improved air travel will be about S£ 190,000 in 1980.

5.08 Personal time savings are underestimated since time savings for air travel compared to surface travel for traffic diverted from other modes is not taken into account. Analysis of present aircraft payload constraints and other limitations indicates that this traffic will be equivalent to one year's normal air traffic growth at current rates, or about 10% of the total. (The alternative to air transport from Khartoum to Malakal takes

four days, ten days to Juba by train and river steamer and at least three days to Wau by train. In practice, actual passenger travel times are considerably longer because of frequent delays.)

(iii) Increased Aircraft Utilization and Overflight Fees

5.09 Without considering the effects of improved airport lighting and navigational aids, the other airport improvements under the project result in improved aircraft utilization, increasing from 2,000 to 2,500 hours per year, due to more flexible aircraft operations. However, the improved airport lighting and navigational aids will also permit operations under difficult weather conditions and at night. The addition of lighting will increase aircraft utilization to meet current demands, from 2,500 to about 3,000 hours per year (Tables 6 and 10), which will postpone the need for further aircraft accordingly.

5.10 New navigational aids will benefit overflying foreign aircraft as well as Sudanese aircraft and will earn foreign exchange revenue for CAD. The use of Port Sudan as an alternate for Khartoum Airport for some international flights will also earn foreign exchange revenue from foreign airlines. The incremental effect of these benefits is estimated at S£ 238,000 p.a. by 1980 (Table 10).

C. Total Return

5.11 Excluding passenger time savings, the estimated economic return for the total project is almost 18%. For the three southern airports, the return is 15%, and 22% for Port Sudan. The corresponding return for airport lighting and navigational aids is 16%. If passenger time savings are included, the economic return for the total project is 19%; 17% for the southern airports and 24% for Port Sudan (Table 11). All these estimates are based on shadow pricing of foreign exchange. However, since this is reflected in both the costs and benefits, the overall effect is negligible compared to use of market prices.

5.12 The results of a sensitivity analysis undertaken for all the project airports, both individually and as a group, are shown in Table 11. Cost increases are considered the major risk. However, even if costs increase by 15%, the economic return for the project is still a satisfactory 17%.

6. FINANCIAL EVALUATION

A. General

6.01 CAD operates under a budgetary control system whereby a comprehensive budget of anticipated revenues and operating expenses is prepared each year. The Department must stay within this budget unless given Government approval to exceed the projected expenditures.

6.02 CAD maintains control over revenues and operating expenses. Fees are collected and deposited in the Treasury and checks for payments are drawn against the Treasury. Any excess of revenues over expenditures remains with the Central Government.

6.03 Accounting records of revenue and expenditure items are kept at CAD headquarters. Inter-departmental charges not involving cash transactions are billed to CAD at rather erratic intervals making the preparation of current operating statements difficult. The records are not maintained on an individual airport basis but for the system in total. However, the mission was able to obtain a breakdown of revenues and expenses for the project airports and Khartoum for FY1974.

6.04 Capital items are supplied directly by the Central Government so they are not included in the accounts of CAD. Hence, no provision for depreciation and no charge for interest is included in the accounts. As the capital assets are not recorded, CAD does not prepare an annual balance sheet. The mission prepared a balance sheet as of June 30, 1975, by having a physical inventory compiled of all existing assets, together with the date they entered service. No value was assigned to assets whose age was beyond that normally considered the economic life for such items. A high percentage of the assets are in this category and should be replaced in the immediate future. Provision for these replacements has been made in an orderly and realistic manner in the projections.

6.05 The accounting system is inadequate and during negotiations it was agreed to replace it with one designed to supply information by airport and by classifications necessary to formulate and review user charges. It will also include provision for the acquisition and disposal of capital assets. This was discussed with CAD management and the Central Government. Consultant services to design and implement a new accounting system for CAD no later than July 1, 1977, were agreed to during negotiations and are provided for under the project. An outline of the terms of reference for the accounting consultants was also agreed to during negotiations and is recorded in a Memorandum of Understanding.

6.06 The accounts are currently subject to annual audit by the Auditor General. During negotiations, it was agreed that certified copies of the audited annual accounts be furnished to the Bank Group not later than four months after the end of each fiscal year of CAD.

B. Financial Objectives

6.07 Government policy has been that CAD's tariffs are to be maintained in real terms so that earned revenues cover at least cash operating expenses and contribute towards depreciation. This excess of revenues over cash operating expenses has been retained by the Government and could be considered a contribution towards the acquisition of capital assets. During negotiations, understandings were reached with the Government on more specific

financial objectives for CAD, resembling those of prudently managed, independent public corporations. The financial projections contained in the following paragraphs reflect these objectives.

6.08 CAD revised its tariff schedule effective July 1, 1975, and these rates have been used in all projections in this report. In addition, higher overflight, navigation and landing fees have been assumed for FY1981 when the project is completed. The increases used in these projections are 45% for overflight, 20% for navigational fees and 30% for local B-737 landing fees and 10% for all other landing fees. During negotiations, it was agreed that, depending on conditions prevailing at that time, such adjustments to tariffs as are necessary will be applied in order to produce, from 1983 onward, sufficient revenues for CAD to cover all operating expenses plus debt service or depreciation, whichever is the greater.

C. Financing Plan for CAD

6.09 The total cost of the project (excluding the risk contingency) is estimated to be S£ 32.195 million (para. 4.16). In the Agreed Minutes of Negotiations, the Government considered as reasonable a debt/equity ratio on the average of 50:50 for all investment funds. Accordingly approximately 50% of the financing will be made available at 8-1/2 interest from the Government to CAD for a term of 25 years with a grace period of four years. The balance will be equity and internally generated funds as follows:

	<u>S£'000</u>	<u>US\$'000</u>
(i) Government Interest-bearing Funds	14,000	35,000
(ii) Government Equity	15,330	38,325
(iii) Internally generated	<u>2,865</u>	<u>7,164</u>
Total	<u>32,195</u>	<u>80,489</u>

If a risk contingency of 10% is applied to the three southern airports of Juba, Malakal and Wau, the project costs would be increased by S£ 2.25 million (US\$5.63 million). These additional funds will have to be provided by the Government either in the form of additional equity, or by loan in which case tariffs will have to be raised accordingly.

D. Financial Projections

Operating Results

6.10 CAD operating revenues by category are set out in Table 12 and the projected operating statements are given in Table 13. Financial assumptions are detailed in Annex 8. Summarized forecast results for 1976, 1980, 1985 and 1990 are:

	<u>1976</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
	----- S£ thousand -----			
Revenue	1,855	2,496	5,019	8,216
Expenses	<u>1,135</u>	<u>1,277</u>	<u>1,589</u>	<u>1,664</u>
Operating surplus	720	1,219	3,430	6,552
Depreciation	<u>424</u>	<u>1,037</u>	<u>2,626</u>	<u>2,648</u>
Operating income	296	182	804	3,904
Interest	<u>-</u>	<u>-</u>	<u>1,276</u>	<u>1,062</u>
Net profit (loss)	<u>296</u>	<u>182</u>	<u>(472)</u>	<u>2,842</u>

Throughout the projection period, revenues cover all working expenses, including depreciation, with the exception of 1981-83. This is because three of the four project airports are completed by 1981 and the increase in the depreciation provision is not immediately compensated by a comparable traffic increase. For FY1983, the suggested tariffs used in these projections fall short by S£ 51,000 of covering the greater of debt service or depreciation but for all other years the financial objectives are met (para. 6.08).

6.11 The projected operating results of the four project airports are set out in Tables 14, 15, 16, 17. Only Port Sudan and Malakal develop sufficient traffic to generate revenue greater than operating expenses, before depreciation, but not until 1990 and 1989, respectively. The remaining two airports do not cover cash operating expenses at any time. However, non-project airports receive increased revenues in the form of increased landing and navigation fees, as a result of the project.

6.12 To show the total domestic aviation situation, the combined operating statements of CAD and Sudan Airways are given in Table 18. For this presentation, transfer payments between the two entities have been eliminated. Thus, CAD revenue includes only fees earned from foreign carriers and from passenger tax. A summary for 1976, 1980, 1985 and 1990 is given below:

	<u>1976</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
	----- S£ thousand -----			
Combined revenues	6,239	8,879	13,801	20,711
Combined expenses	<u>4,334</u>	<u>5,218</u>	<u>6,954</u>	<u>8,966</u>
Operating surplus	1,905	3,661	6,847	11,745
Depreciation	<u>718</u>	<u>1,271</u>	<u>3,094</u>	<u>3,350</u>
Operating income	<u>1,187</u>	<u>2,390</u>	<u>3,753</u>	<u>8,395</u>

6.13 To assess the impact of the proposed project on Sudan's domestic aviation, a base case, without the project, is presented in Table 19 for CAD. It includes only minimal improvements to Wau and Malakal airports in the amounts of S£ 690,000 and S£ 499,000, respectively. The base case for Juba requires S£ 1.793 million, mainly for earthworks, to accommodate the jet aircraft Sudan Airways is now using. Table 20 sets out the combined base case of CAD and Sudan Airways.

6.14 A comparison of the operating results of the base case and the proposed project is shown in Table 21. The incremental profits earned by the project are shown both before and after providing for depreciation. In total the project will earn an additional S£ 35,831 million over the base case before depreciation for the projection period and S£ 17,472 million after depreciation.

6.15 The overall financial internal rate of return is about 10%. Details of the calculation are contained in Table 22. The capital costs used are the financial costs which include a price contingency of 27%. The financial benefits, on the other hand, are calculated using a constant 1975 monetary unit. If the price contingency were excluded from the capital costs, the rate of return would be 16%.

Cash Flow

6.16 A projected cash flow for CAD, based on the assumptions contained in para. 6.09, is shown in Table 23. Provision has been made for the replacement of assets included in the project, when required, and for the addition of other necessary items (para. 6.04). A summary of the cash flow for the construction period is set out below:

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
	----- \$ thousand -----					
<u>Sources of Funds</u>						
From operations	605	824	978	1,092	1,204	1,913
Loans	-	766	4,541	8,693	-	-
Equity	<u>436</u>	<u>-</u>	<u>983</u>	<u>3,059</u>	<u>8,423</u>	<u>2,429</u>
Total	<u>1,041</u>	<u>1,590</u>	<u>6,502</u>	<u>12,844</u>	<u>9,627</u>	<u>4,342</u>
<u>Use of Funds</u>						
Capital investments /1	1,041	1,525	6,567	12,844	9,627	2,641
Loans - Principal	-	-	-	-	-	307
Interest	-	-	-	-	-	<u>1,394</u>
Total	<u>1,041</u>	<u>1,525</u>	<u>6,567</u>	<u>12,844</u>	<u>9,627</u>	<u>4,342</u>
Cash surplus (deficit)	-	65	(65)	-	-	-
Opening balance	-	-	65	-	-	-
Closing balance	<u>-</u>	<u>65</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>

/1 Includes items in addition to the proposed project.

6.17 The projected balance sheets are shown in Table 24 for the years 1976 to 1990. The balance sheet as of June 30, 1975, is set out below, subject to the limitations in para. 6.04.

<u>Assets</u>	<u>\$ thousand</u>
Runways and buildings	3,801
Electrical equipment	449
Airport equipment	<u>1,054</u>
	5,304
Less accumulated depreciation	<u>502</u>
Total Assets	<u>4,802</u>
<u>Capital</u>	
Invested	4,185
Retained earnings	<u>617</u>
Total Capital	<u>4,802</u>

The retained earnings are for the fiscal years 1974 and 1975 only. The annual rate of return on net fixed assets in use after completion of construction does not become positive until 1984 (about 1%) but then improves rapidly to 1990, the end of the projection period (about 21%). A schedule of selected financial indicators is set out in Table 25.

7. AGREEMENTS REACHED AND RECOMMENDATION

7.01 During negotiations, agreement was reached with the Government on the following matters:

- (i) consultants for supervision (para. 4.07);
- (ii) improving the main roads from Wau and Port Sudan leading to the airport access roads up to all weather standard (para. 4.12);
- (iii) improving the electricity services provided for the four airports before each is commissioned (para. 4.13);
- (iv) insuring an adequate water supply to the Port Sudan airport (para. 4.14);
- (v) outline terms of reference for accounting consultants (para. 6.05);
- (vi) annual auditing of CAD (para. 6.06);
- (vii) financial objectives for the CAD (paras. 6.07-.08).

7.02 Assurances have also been received concerning proposed investment in Khartoum Airport (para. 3.23).

7.03 The proposed project constitutes a suitable basis for a Bank loan of US\$20 million, on intermediate terms at 4.85% interest, which includes a 4% interest subsidy, for a term of 25 years including a 7-year grace period, and an IDA credit of US\$9 million.

June 3, 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTComparative Air Fares, 1975

<u>Route</u>	<u>Distance</u>	<u>US\$</u>	<u>US\$ Per Mile</u>
<u>Sudan</u>			
Juba - Khartoum	745	145.36	.195
Malakal - Khartoum	423	85.81	.203
Wau - Khartoum	626	122.98	.196
Port Sudan - Khartoum	413	85.53	.207
<u>Kenya</u>			
Nairobi - Mombasa	263	40.6	.154
<u>Algeria</u>			
Algiers - Bechar	469	38.92	.083
Algiers - Ghardaia	301	24.85	.083
<u>Egypt</u>			
Cairo - Luxor	317	36.53	.115
<u>India</u>			
Bombay - Delhi	708	60.5	.085
Bombay - Calcutta	1,035	82.5	.080
Bombay - Madras	644	57.1	.089
<u>Iran</u>			
Teheran - Isfahan	213	24.84	.117
Teheran - Mashad	467	39.22	.084
Teheran - Shiraz	432	44.44	.103
<u>Zaire</u>			
Kinshasa - Kisangani	753	106.44	.141
Kinshasa - Lubumbashi	965	124.16	.129
<u>Ethiopia</u>			
Addis Ababa - Asmara	437	62.10	.142
Addis Ababa - Diredawa	214	33.00	.154

Source: Official Airline Guide, November 1975.

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECTForecast Passengers (Embarking and Disembarking) and Freight
at Project Airports 1/

<u>Airport</u>	<u>Passengers</u>				Percent Average Annual Growth <u>1975-1990</u>
	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	
Juba	22,550	51,000	77,500	123,000	12
Malakal	11,375	22,575	34,000	51,500	11
Port Sudan ^{2/}	47,700	90,550	140,600	220,000	11
Wau	10,375	20,725	31,000	47,500	11

<u>Airport</u>	<u>Freight (tons)</u>				Percent Average Annual Growth <u>1975-1990</u>
	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	
Juba	219.0	750	1,600	2,900	19
Malakal	110.2	350	700	1,200	17
Port Sudan	328.8	750	1,150	1,650	11
Wau	106.7	350	650	1,100	17
Total	<u>764.7</u>	<u>2,200</u>	<u>4,100</u>	<u>6,850</u>	

1/ Includes total scheduled Sudan Airways and foreign airline flights.

2/ Includes Haj traffic.

Source: Brian Colquhoun and Partners Report and IBRD Mission

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Forecast Aircraft Traffic

	Annual Landings			
	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
<u>Juba</u>				
Scheduled Domestic ^{1/}	312	416	624	936
Scheduled International	52	52	52	52
Other	463	616	819	1,089
<u>Malakal</u>				
Scheduled Domestic ^{1/}	416	572	1,092	1,716
Other	366	395	427	461
<u>Port Sudan</u>				
Scheduled Domestic ^{1/}	520	468 ^{2/}	780	1,196
Scheduled International	208	156	156	260
Other	782	931	1,108	1,319
<u>Wau</u>				
Scheduled Domestic ^{1/}	312	208 ^{2/}	260	416
Other	179	254	361	513

^{1/} Based on passenger and cargo growth and on changes from F-27 to B-737 aircraft.

^{2/} B-737 replacing the smaller F-27.

Source: Brian Colquhoun and Partners Report and IBRD Mission

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Airport Construction Cost Estimates
(S£ thousand at June 30, 1976 Prices)

<u>Description</u>	<u>Juba</u>	<u>Malakal</u>	<u>Port Sudan</u>	<u>Wau</u>
Pavements				
Earthworks	362.43	223.58	185.00	749.39
Runway and Shoulders	579.39	2,674.20	1,471.08	1,751.11
Taxiway and Shoulders	233.27	286.56	172.24	145.61
Apron and Shoulders	580.65	681.82	417.21	400.44
Runway daylight markings	2.51	6.18	5.11	5.01
Drainage	22.57	43.23	44.65	62.77
Subtotal	<u>1,780.82</u>	<u>3,915.57</u>	<u>2,295.29</u>	<u>3,114.33</u>
Buildings and Ancillary Works				
Terminal building	739.12	51.56	651.84	259.73
Cargo building	36.12	-	30.14	36.39
Fire crash and rescue building	44.54	46.53	40.20	47.67
Generator building	10.83	9.43	10.04	8.78
Motor transport building	25.27	21.38	21.35	18.82
Water supply	65.00	54.08	216.02	114.18
Sewerage	43.33	84.27	33.92	43.91
Pilgrim terminal	-	-	145.69	-
Demolition				
Veterinary building ^{1/}	36.12	-	-	-
Terminal and other buildings	3.61	-	-	-
Subtotal	<u>1,003.94</u>	<u>267.25</u>	<u>1,149.20</u>	<u>529.48</u>
Roadworks and Fencing				
Main access road	158.94	22.48	286.89	65.57
Internal roads and car parks	178.96	104.89	112.00	92.07
Fencing	57.57	139.87	222.72	132.42
Subtotal	<u>395.47</u>	<u>267.24</u>	<u>621.61</u>	<u>290.06</u>
Electrical Services				
Airfield lighting	317.59	230.05	246.99	209.52
Power generation & distribution	198.02	120.81	219.97	131.11
Navigation aids	137.59	140.08	231.55	70.70
Telecommunications	159.44	183.78	100.34	154.26
Air conditioning	-	-	241.84	-
Subtotal	<u>812.64</u>	<u>674.72</u>	<u>1,040.69</u>	<u>565.59</u>
Equipment				
Fire crash and rescue	104.96	104.86	103.72	104.95
Motor transport	20.74	18.12	28.52	16.84
Meteorological	1.30	-	-	1.30
Subtotal	<u>127.00</u>	<u>122.98</u>	<u>132.24</u>	<u>123.09</u>
Total	<u>4,119.87</u>	<u>5,247.76</u>	<u>5,239.03</u>	<u>4,622.55</u>

^{1/} Includes replacement.

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Airport Construction Cost Estimates
(S£ thousand at June 30, 1976 Prices)

<u>Description</u>	<u>Material</u>	<u>Labor</u>	<u>Plant</u>	<u>Total</u>	<u>Local Element</u>	<u>Foreign Element</u>
<u>Juba</u>						
Pavements	377.31	339.37	1,064.14	1,780.82	484.55	1,296.27
Buildings and ancillary works	543.27	259.54	201.13	1,003.94	277.41	726.53
Roadworks and fencing	142.16	73.82	179.49	395.47	113.65	281.82
Electrical services	586.82	130.72	95.10	812.64	75.29	737.35
Equipment	125.86	1.14	-	127.00	4.79	122.21
<u>Total - Juba</u>	<u>1,775.42</u>	<u>804.59</u>	<u>1,539.86</u>	<u>4,119.87</u>	<u>955.69</u>	<u>3,164.18</u>
<u>Malakal</u>						
Pavements	1,265.82	632.91	2,016.84	3,915.57	1,501.18	2,414.39
Buildings and ancillary works	143.99	61.86	61.40	267.25	67.19	200.06
Roadworks and fencing	139.89	49.59	77.76	267.24	81.02	186.22
Electrical services	481.87	111.31	81.54	674.72	64.88	609.84
Equipment	122.98	-	-	122.98	5.48	117.50
<u>Total - Malakal</u>	<u>2,154.55</u>	<u>855.67</u>	<u>2,237.54</u>	<u>5,247.76</u>	<u>1,719.75</u>	<u>3,528.01</u>
<u>Port Sudan</u>						
Pavements	336.71	490.35	1,468.23	2,295.29	339.62	1,955.67
Buildings and ancillary works	605.14	288.43	255.63	1,149.20	300.31	848.89
Roadworks and fencing	270.26	125.21	226.14	621.61	154.03	467.58
Electrical services	748.33	185.73	106.63	1,040.69	93.15	947.54
Equipment	132.24	-	-	132.24	4.53	127.71
<u>Total-Port Sudan</u>	<u>2,092.68</u>	<u>1,089.72</u>	<u>2,056.63</u>	<u>5,239.03</u>	<u>891.64</u>	<u>4,347.39</u>
<u>Wau</u>						
Pavements	777.04	603.19	1,734.10	3,114.33	826.16	2,288.17
Buildings and ancillary works	293.94	129.09	106.45	529.48	142.20	387.28
Roadworks and fencing	130.13	79.31	80.62	290.06	67.18	222.88
Electrical services	408.36	90.70	66.53	565.59	53.63	511.96
Equipment	121.41	1.68	-	123.09	4.80	118.29
<u>Total - Wau</u>	<u>1,730.88</u>	<u>903.97</u>	<u>1,987.70</u>	<u>4,622.55</u>	<u>1,093.97</u>	<u>3,528.58</u>
<u>Total Project</u>	<u>7,753.53</u>	<u>3,653.95</u>	<u>7,821.73</u>	<u>19,229.21</u>	<u>4,661.05</u>	<u>14,568.16</u>

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Airport Construction Cost Estimates
(S£ thousand at June 30, 1976 Prices)

	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
<u>Juba</u>			
Construction	955.69	3,164.18	4,119.87
Engineering Supervision	38.23	126.56	164.79
Contingencies:			
Physical - 10%	99.39	329.07	428.46
Price - 12% and 10%	<u>363.64</u>	<u>1,213.60</u>	<u>1,577.24</u>
Total - Juba S£	<u>1,456.95</u>	<u>4,833.41</u>	<u>6,290.36</u>
	US\$		
	<u>3,642.38</u>	<u>12,083.52</u>	<u>15,725.90</u>
<u>Malakal</u>			
Construction	1,719.75	3,528.01	5,247.76
Engineering Supervision	42.18	167.58	209.76
Contingencies:			
Physical - 10%	176.70	371.64	548.34
Price - 12% and 10%	<u>889.20</u>	<u>1,863.90</u>	<u>2,753.10</u>
Total - Malakal S£	<u>2,827.83</u>	<u>5,931.13</u>	<u>8,758.96</u>
	US\$		
	<u>7,069.58</u>	<u>14,827.82</u>	<u>21,897.40</u>
<u>Port Sudan</u>			
Construction	891.64	4,347.39	5,239.03
Engineering Supervision	41.04	167.58	208.62
Contingencies:			
Physical - 10%	93.48	451.44	544.92
Price - 12% and 10%	<u>437.76</u>	<u>2,093.04</u>	<u>2,530.80</u>
Total - Port Sudan S£	<u>1,463.92</u>	<u>7,059.45</u>	<u>8,523.37</u>
	US\$		
	<u>3,659.80</u>	<u>17,648.63</u>	<u>21,308.43</u>
<u>Wau</u>			
Construction	1,093.97	3,528.58	4,622.55
Engineering Supervision	35.34	149.34	184.68
Contingencies:			
Physical - 10%	112.93	367.79	480.72
Price - 12% and 10%	<u>509.58</u>	<u>1,665.54</u>	<u>2,175.12</u>
Total - Wau S£	<u>1,751.82</u>	<u>5,711.25</u>	<u>7,463.07</u>
	US\$		
	<u>4,379.55</u>	<u>14,278.13</u>	<u>18,657.68</u>
<u>Total Project</u>	S£		
	<u>7,500.52</u>	<u>23,535.24</u>	<u>31,035.76</u>
	US\$		
	<u>18,751.31</u>	<u>58,838.10</u>	<u>77,589.41</u>

Source: Brian Colquhoun and Partners' Report and IBRD mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTEstimated Schedule of Disbursements

<u>IBRD Fiscal Year and Quarter</u>	<u>Cumulative Disbursement at end of Quarter (US\$ thousand)</u>
<u>1976/77</u>	
June 30, 1977	650
<u>1977/78</u>	
September 30, 1977	1,400
December 31, 1977	1,700
March 31, 1978	2,250
June 30, 1978	2,950
<u>1978/79</u>	
September 30, 1978	5,000
December 31, 1978	6,600
March 31, 1979	9,000
June 30, 1979	11,900
<u>1979/80</u>	
September 30, 1979	15,500
December 31, 1979	19,100
March 31, 1980	22,300
June 30, 1980	25,800
<u>1980/81</u>	
September 30, 1980	25,800
December 31, 1980	25,800
March 31, 1981	25,800
June 30, 1981	25,800
<u>1981/82</u>	
September 30, 1981	29,000

Source: IBRD Mission

June 1976

TABLE 6

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTAircraft Operating Costs and Performance Data

<u>Direct Operating Costs</u>	<u>Boeing 737-200</u>	<u>Fokker F27</u>	<u>Twin Otter</u>
	(SL, using a rate of SL 1.00 = US\$2.05)		
Per block hour (including aircraft depreciation)	600.0	215.0	110.0
Per seat mile	0.0211	0.0434	0.0524
Per passenger mile	0.0351	0.0603	0.0728
Per ton mile available	0.1770	0.3525	0.4622
Per ton mile used (60% load factor)	0.2950	0.5875	0.7703
<u>Performance Data</u>			
Block speed (miles per hour)	300	165	140
Passenger seats	95	30	15
Seat miles per block hour	28,500	4,950	2,100
Passenger load factor	60%	72%	72%
Maximum ton payload	11.3	3.7	1.7
Ton miles per block hour	3,390	610	238
Hours used per year (before provision of night flying facilities)	2,500	2,000	1,200

Source: Brian Colquhoun and Partners, CAB Aircraft Operating Cost and Performance Report, Vol. IX July 1975, Sudan Airways Operations Manual.

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTQuantified Project Benefits, 1979-98
(S£ thousand)

<u>Year</u>	<u>Aircraft Cost Reduction</u>	<u>Passenger Time Savings</u>	<u>Net Benefits from Nav aids</u>	<u>TOTAL</u>
1979	984	140	189	1,313
1980	1,962	190	238	2,390
1981	2,182	211	272	2,665
1982	2,429	234	310	2,973
1983	2,702	259	350	3,311
1984	3,010	287	395	3,692
1985	3,351	318	444	4,113
1986	3,704	452	490	4,646
1987	4,098	390	541	5,029
1988	4,528	432	596	5,556
1989	5,006	478	655	6,139
1990	5,535	530	718	6,783
1991	6,088	587	787	7,462
1992	6,697	650	1/	7,347
1993	7,366	720		8,086
1994	8,104	798		8,902
1995	8,913	884		9,797
1996	9,804	979		10,783
1997	10,787	1,085		11,872
1998	11,869	1,202		13,071

1/ Nav aids have a lifetime of 13 years

Source: IBRD Mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTEstimated Aircraft Cost Savings in 1980

<u>Route</u>	<u>Passengers Both Ways</u>	<u>Distance (miles)</u>	<u>Saving Per Passenger 1/ (S£)</u>	<u>Cost Saving (S£)</u>
<u>Passenger/Cargo Flights</u>				
Juba - Khartoum	40,000	745	18.77	750,800
Malakal - Khartoum	15,700	423	10.66	167,362
Malakal - Juba	4,700	324	8.16	38,352
Port Sudan - Khartoum	57,800	413	10.41	601,698
Port Sudan - Cairo	3,700	815	20.54	75,998
Port Sudan - Jeddah	9,350	185	4.66	43,571
Wau - Khartoum	14,950	626	15.77	235,761
Wau - Juba	3,600	318	8.01	28,836
Wau - Malakal	1,850	281	7.08	13,098
<hr/>				
<u>Route</u>	<u>Tons</u>	<u>Distance (miles)</u>	<u>Saving Per Mile (S£)</u>	<u>Cost Saving (S£)</u>
<u>Cargo Flights</u>				
Wau - Khartoum	36.7	626	.2925	6,719
<u>Total Cost Saving</u>				<u>1,962,195</u>

1/ S£ 0.0252 per passenger mile, i.e., 0.0603 less 0.0351 (Table 6).

Source: Brian Colquhoun and Partners Report and IBRD Mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTEstimated Passenger Time Savings in 1980

<u>Route</u>	<u>Passengers both Ways</u>	<u>Distance (miles)</u>	<u>Time Saving per Passenger (hours)</u>	<u>Hours Saved</u>
<u>Passenger/Cargo Flights</u>				
Juba - Khartoum	40,000	745	2.032	81,280
Malakal - Khartoum	15,700	423	1.154	18,118
Malakal - Juba	4,700	324	0.884	4,155
Port Sudan - Khartoum	57,800	413	1.126	65,083
Port Sudan - Cairo	3,700	815	2.222	8,221
Port Sudan - Jeddah	9,350	185	0.504	4,712
Wau - Khartoum	14,950	626	1.707	25,520
Wau - Juba	3,600	318	0.867	3,121
Wau - Malakal	1,850	281	0.766	<u>1,417</u>
Total:				<u><u>211,627</u></u>
	<u>Hours Saved</u>	<u>Working Time Saved (hours)</u>	<u>Value of Time Savings (SE)</u>	
	211,627 x 0.8	= 169,302 x 1.125	= 190,465	

Source: IBRD Mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTBenefits of Navigational Aids and Lighting
(S£ thousand)

<u>Year</u>	<u>Increased Aircraft Utilization</u>	<u>Increased Overflight Fees</u>	<u>Operating Cost</u>	<u>Net Benefit</u>
1979	261	82	154	189
1980	306	86	154	238
1981	336	90	154	272
1982	369	95	154	310
1983	404	100	154	350
1984	444	105	154	395
1985	488	110	154	444
1986	528	116	154	490
1987	573	122	154	541
1988	622	128	154	596
1989	675	134	154	655
1990	731	141	154	718
1991	793	148	154	787

Sample Calculation of Increased Aircraft Utilization, 1980S£

<u>Revenue:</u>	The revenue per passenger-mile is S£ 0.0603, which converts to revenue per block hour (28,500 seat miles = 17,000 passenger-miles per block hour; Table 6). Thus, revenue per 500 block hours =	515,500
less		
<u>Costs:</u>	500 hours times (direct operating costs, S£ 600, minus aircraft depreciation and insurance, S£ 180) =	<u>-210,000</u>
<u>Net Revenue:</u>		305,500

Source: IBRD Mission

June 1976

SUDAN
APPRAISAL OF A DOMESTIC AVIATION PROJECT

Economic Rates of Return

	<u>Best Estimate</u>	<u>Construction Costs</u>		<u>Benefits</u>		<u>First Year Return</u>
		<u>-15%</u>	<u>+15%</u>	<u>-25%</u>	<u>+25%</u>	
Port Sudan	24	26	21	19	27	16
South Sudan Airports	17	19	15	13	20	12
Lighting & Nav aids	16	20	13	10	22	9
Total Project	19	21	17	15	22	13

Source: IBRD Mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTCivil Aviation DepartmentStatement of Revenue
(S£ thousand)

<u>Year Ended June 30</u>	<u>Landing Fees</u>	<u>Overflight Fees</u>	<u>Navigation Fees</u>	<u>Other</u>	<u>Total Revenue</u>
1974 ^{1/}					1,313
1975 ^{2/}					1,640
1976	805	676	194	180	1,855
1977	843	757	204	199	2,003
1978	884	855	215	220	2,174
1979	928	917	227	241	2,313
1980	1,008	984	239	265	2,496
1981	1,405	1,531	295	293	3,524
1982	1,544	1,641	313	328	3,826
1983	1,700	1,762	332	364	4,158
1984	1,905	1,894	358	400	4,557
1985	2,160	2,037	388	434	5,019
1986	2,443	2,192	417	470	5,522
1987	2,747	2,358	448	507	6,060
1988	3,106	2,536	481	547	6,670
1989	3,545	2,728	517	587	7,377
1990	4,090	2,933	557	636	<u>8,216</u>
					<u>68,723</u>

1/ Unaudited - detailed classification not available

2/ Estimated - detailed classification not available

Source: Feasibility Study, Director of CAD accounts and IBRD Mission.
June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Civil Aviation Department

Projected Operating Statements
(S£ thousand)

Year Ended June 30	Operating Revenue	Working Expenses				Operating Surplus	Depreciation	Operating Income	Interest	Net Profit
		Maintenance	Wages	Other	Total					
<u>1/</u>										
1974	1,313	58	526	304	888	425	188	237	-	237
1975 <u>2/</u>	1,640	90	591	298	979	661	281	380	-	380
1976	1,855	122	650	363	1,135	720	424	296	-	296
1977	2,003	115	670	384	1,169	834	493	341	-	341
1978	2,174	110	690	381	1,181	993	556	437	-	437
1979	2,313	118	711	381	1,210	1,103	614	489	-	489
1980	2,496	116	770	391	1,277	1,219	1,037	182	-	182
1981	3,524	135	894	508	1,537	1,987	2,622	(635)	1,394	(2,029)
1982	3,826	134	906	508	1,548	2,278	2,623	(345)	1,368	(1,713)
1983	4,158	158	919	508	1,585	2,573	2,624	(51)	1,340	(1,391)
1984	4,557	149	932	508	1,589	2,968	2,626	342	1,309	(967)
1985	5,019	136	945	508	1,589	3,430	2,626	804	1,276	(472)
1986	5,522	139	959	509	1,607	3,915	2,624	1,291	1,240	51
1987	6,060	181	973	509	1,663	4,397	2,625	1,772	1,201	571
1988	6,670	168	987	509	1,664	5,006	2,648	2,358	1,158	1,200
1989	7,377	138	1,001	509	1,648	5,729	2,648	3,081	1,112	1,969
1990	8,216	138	1,016	510	1,664	6,552	2,648	3,904	1,062	2,842
<u>3/</u>	<u>68,723</u>	<u>2,205</u>	<u>14,140</u>	<u>7,588</u>	<u>23,933</u>	<u>44,790</u>	<u>29,907</u>	<u>14,883</u>	<u>12,460</u>	<u>2,423</u>

1/ Unaudited

2/ Estimated

3/ From Table 12

Source: Feasibility Study and IBRD Mission

June 1976

TABLE 13

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Juba Airport

Projected Operating Statements
(S£ thousand)

<u>Year Ended</u> <u>June 30</u>	<u>Operating</u> <u>Revenue</u>	<u>Operating Expenses</u>				<u>Operating</u> <u>Deficit</u>	<u>Depreciation</u>	<u>Operating</u> <u>Loss</u>
		<u>Maintenance</u>	<u>Wages</u>	<u>Other</u>	<u>Total</u>			
1974	7	6	18	16	40	33	161	194
1975	7	10	18	15	43	36	161	197
1976	24	5	20	44	69	45	197	242
1977	27	4	21	46	71	44	197	241
1978	30	4	24	55	83	53	198	251
1979	34	4	26	55	85	51	198	249
1980	38	10	65	65	140	102	587	689
1981	50	10	65	65	140	90	588	678
1982	54	10	65	65	140	86	588	674
1983	59	19	65	65	149	90	588	678
1984	63	10	65	65	140	77	588	665
1985	74	12	65	65	142	68	588	656
1986	80	12	65	66	143	63	588	651
1987	86	30	65	66	161	75	588	663
1988	93	9	65	66	140	47	606	653
1989	100	10	65	66	141	41	606	647
1990	108	10	65	66	141	33	606	639

Source: Feasibility Study and IBRD Mission

June 1976

TABLE 14

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Malakal Airport

Projected Operating Statements
(S£ thousand)

<u>Year Ended</u> <u>June 30</u>	<u>Operating</u> <u>Revenue</u>	<u>Operating Expenses</u>				<u>Operating</u> <u>Deficit</u>	<u>Depreciation</u>	<u>Operating</u> <u>Loss</u>
		<u>Maintenance</u>	<u>Wages</u>	<u>Other</u>	<u>Total</u>			
1974	8	1	16	10	27	(19)	-	19
1975	8	-	18	11	29	(21)	-	21
1976	15	1	20	12	33	(18)	-	18
1977	16	-	21	13	34	(18)	-	18
1978	17	-	24	12	36	(19)	-	19
1979	18	-	26	12	38	(20)	-	20
1980	20	-	29	12	41	(21)	-	21
1981	51	9	65	54	128	(77)	508	585
1982	58	9	65	54	128	(70)	508	578
1983	66	9	65	54	128	(62)	508	570
1984	75	13	65	54	132	(57)	508	565
1985	86	9	65	54	128	(42)	508	550
1986	105	10	65	54	129	(24)	508	532
1987	115	11	65	54	130	(15)	508	523
1988	126	19	65	54	138	(12)	508	520
1989	138	11	65	54	130	8	508	500
1990	151	11	65	54	130	21	508	487

Source: Feasibility Study and IBRD Mission

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Port Sudan Airport

Projected Operating Statements
(S£ thousand)

<u>Year Ended</u> <u>June 30</u>	<u>Operating</u> <u>Revenue</u>	<u>Operating Expenses</u>				<u>Operating</u> <u>Surplus</u>	<u>Depreciation</u>	<u>Operating</u> <u>Loss</u>
		<u>Maintenance</u>	<u>Wages</u>	<u>Other</u>	<u>Total</u>			
1974	19	10	23	19	52	(33)	1	34
1975	19	16	30	17	63	(44)	1	45
1976	49	17	33	18	68	(19)	9	28
1977	52	17	36	44	97	(45)	9	54
1978	56	17	39	44	100	(44)	9	53
1979	59	17	43	44	104	(45)	10	55
1980	65	17	48	44	109	(44)	10	54
1981	82	18	68	80	166	(84)	535	619
1982	89	18	68	80	166	(77)	535	612
1983	97	18	68	80	166	(69)	535	604
1984	105	25	68	80	173	(68)	535	603
1985	115	18	68	80	166	(51)	535	586
1986	125	19	68	80	167	(42)	535	577
1987	136	19	68	80	167	(31)	535	566
1988	148	34	68	80	182	(34)	540	574
1989	159	19	68	80	167	(8)	540	548
1990	176	19	68	81	168	8	540	532

Source: Feasibility Study and IBRD Mission

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Wau Airport

Projected Operating Statements
(S£ thousand)

<u>Year Ended</u> <u>June 30</u>	<u>Operating</u> <u>Revenue</u>	<u>Operating Expenses</u>				<u>Operating</u> <u>Deficit</u>	<u>Depreciation</u>	<u>Operating</u> <u>Loss</u>
		<u>Maintenance</u>	<u>Wages</u>	<u>Other</u>	<u>Total</u>			
1974	5	-	6	2	8	3	-	3
1975	5	-	6	3	9	4	-	4
1976	10	1	7	3	11	1	-	1
1977	11	1	7	4	12	1	-	1
1978	12	1	8	3	12	-	-	-
1979	13	1	9	3	13	-	-	-
1980	14	1	10	3	14	-	-	-
1981	21	9	64	42	115	94	432	526
1982	22	9	64	42	115	93	432	525
1983	23	9	64	42	115	92	432	524
1984	24	13	64	42	119	95	432	527
1985	26	9	64	42	115	89	432	521
1986	28	10	64	42	116	88	432	520
1987	31	10	64	42	116	85	432	517
1988	34	18	64	42	124	90	432	522
1989	38	10	64	42	116	78	432	510
1990	41	10	64	42	116	75	432	507

Source: Feasibility Study and IBRD Mission

June 1976

TABLE 17

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Civil Aviation Department and Sudan Airways

Combined Projected Operating Statements
(S£ thousand)

Year Ended June 30	Revenue			Operating Expenses			Operating Surplus	Provision for Depreciation			Operating Income
	C.A.D.	Sudan Airways	Total	C.A.D.	Sudan Airways	Total		C.A.D.	Sudan Airways	Total	
1976	1,626	4,613	6,239	1,127	3,207	4,334	1,905	424	294	718	1,187
1977	1,758	5,063	6,821	1,161	3,379	4,540	2,281	493	294	787	1,494
1978	1,909	5,556	7,465	1,173	3,559	4,732	2,733	556	294	850	1,883
1979	2,025	6,098	8,123	1,202	3,748	4,950	3,173	614	234	848	2,325
1980	2,186	6,693	8,879	1,269	3,949	5,218	3,661	1,037	234	1,271	2,390
1981	2,961	7,198	10,159	1,529	4,200	5,729	4,430	2,622	468	3,090	1,340
1982	3,206	7,741	10,947	1,540	4,467	6,007	4,940	2,623	468	3,091	1,849
1983	3,473	8,326	11,799	1,578	4,750	6,328	5,471	2,624	468	3,092	2,379
1984	3,801	8,955	12,756	1,581	5,052	6,633	6,123	2,626	468	3,094	3,029
1985	4,170	9,631	13,801	1,581	5,373	6,954	6,847	2,626	468	3,094	3,753
1986	4,560	10,358	14,918	1,599	5,714	7,313	7,605	2,624	468	3,092	4,513
1987	5,010	11,140	16,150	1,655	6,076	7,731	8,419	2,625	468	3,093	5,326
1988	5,524	11,981	17,505	1,656	6,463	8,119	9,386	2,648	702	3,350	6,036
1989	6,126	12,885	19,011	1,640	6,873	8,513	10,498	2,648	702	3,350	7,148
1990	6,853	13,858	20,711	1,656	7,310	8,966	11,745	2,648	702	3,350	8,395
Total	55,188	130,096	185,284	21,947	74,120	96,067	89,217	29,438	6,732	36,170	53,047

Source: Feasibility Study and IBRD Mission

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Civil Aviation Department

Base Case 1/

Projected Operating Statements
(S£ thousand)

<u>Year Ended</u> <u>June 30</u>	<u>Operating</u> <u>Revenue</u>	<u>Working Expenses</u>				<u>Surplus</u>	<u>Depreciation</u>	<u>Operating</u> <u>Income</u>
		<u>Maintenance</u>	<u>Wages</u>	<u>Other</u>	<u>Total</u>			
1976	1,828	231	650	363	1,244	584	483	101
1977	1,981	273	668	427	1,368	613	577	36
1978	2,153	268	686	424	1,378	775	649	126
1979	2,296	279	745	434	1,458	838	809	29
1980	2,501	271	779	507	1,557	944	874	70
1981	2,710	271	796	507	1,574	1,136	876	260
1982	2,940	279	815	507	1,601	1,339	897	442
1983	3,191	294	833	507	1,634	1,557	898	659
1984	3,498	281	894	507	1,682	1,816	899	917
1985	3,843	257	908	508	1,673	2,170	901	1,269
1986	4,208	246	921	508	1,675	2,533	898	1,635
1987	4,630	266	935	508	1,709	2,921	925	1,996
1988	5,113	139	949	535	1,623	3,490	925	2,565
1989	5,676	162	964	537	1,663	4,013	925	3,088
1990	<u>6,356</u>	<u>139</u>	<u>979</u>	<u>537</u>	<u>1,655</u>	<u>4,701</u>	<u>947</u>	<u>3,754</u>
	<u>52,924</u>	<u>3,656</u>	<u>12,522</u>	<u>7,316</u>	<u>23,494</u>	<u>29,430</u>	<u>12,483</u>	<u>16,947</u>

1/ The base case constitutes use of F-27 services with high load factors.

Source: Feasibility Study and IBRD Mission.

June 1976

TABLE 19

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Civil Aviation Department and Sudan Airways
Combined Operating Statements

Base Case 1/
(S£ thousand)

Year Ended June 30	Revenue			Operating Expenses			Operating Surplus	Provision for Depreciation			Operating Income
	CAD	Sudan Airways	Total	CAD	Sudan Airways	Total		CAD	Sudan Airways	Total	
1976	1,625	4,613	6,238	1,240	3,207	4,447	1,791	483	294	777	1,014
1977	1,757	5,063	6,820	1,363	3,651	5,014	1,806	577	294	871	935
1978	1,910	5,556	7,466	1,374	4,155	5,529	1,937	649	294	943	994
1979	2,025	6,098	8,123	1,453	4,728	6,181	1,942	809	234	1,043	899
1980	2,183	6,693	8,876	1,552	5,383	6,935	1,941	874	234	1,108	833
1981	2,361	7,130	9,491	1,569	5,673	7,242	2,249	876	234	1,110	1,139
1982	2,559	7,596	10,155	1,595	5,980	7,575	2,580	897	234	1,131	1,449
1983	2,775	8,092	10,867	1,630	6,303	7,933	2,934	898	234	1,132	1,802
1984	3,044	8,620	11,664	1,677	6,643	8,320	3,344	899	468	1,367	1,977
1985	3,348	9,101	12,532	1,668	7,000	8,668	3,864	901	468	1,369	2,495
1986	3,666	9,845	13,511	1,671	7,444	9,115	4,396	898	468	1,366	3,030
1987	4,037	10,554	14,591	1,704	7,917	9,621	4,970	925	468	1,393	3,577
1988	4,464	11,314	15,778	1,619	8,420	10,039	5,739	925	468	1,393	4,346
1989	4,967	12,129	17,096	1,658	8,955	10,613	6,483	925	468	1,393	5,090
1990	5,581	13,002	18,583	1,650	9,523	11,173	7,410	947	468	1,415	5,995
	<u>46,302</u>	<u>125,489</u>	<u>171,791</u>	<u>23,423</u>	<u>94,982</u>	<u>118,405</u>	<u>53,386</u>	<u>12,483</u>	<u>5,328</u>	<u>17,811</u>	<u>35,575</u>

TABLE 20

1/ The base case constitutes use of F-27 services with high load factors.

Source: Feasibility Study and IBRD Mission
June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECTCivil Aviation Department and Sudan AirwaysComparison of Base Case and Project ^{1/}
(S£ thousand)

<u>Year Ended</u> <u>June 30</u>	<u>Profit Before Depreciation</u>			<u>Profit After Depreciation</u>		
	<u>Project</u> ^{2/}	<u>Base Case</u> ^{3/}	<u>Increment</u>	<u>Project</u> ^{2/}	<u>Base Case</u> ^{3/}	<u>Increment</u>
1976	1,905	1,791	114	1,187	1,014	173
1977	2,281	1,806	475	1,494	935	559
1978	2,733	1,937	796	1,883	994	889
1979	3,173	1,942	1,231	2,325	889	1,426
1980	3,661	1,941	1,720	2,390	833	1,557
1981	4,430	2,249	2,181	1,340	1,139	201
1982	4,940	2,580	2,360	1,849	1,449	400
1983	5,471	2,934	2,537	2,379	1,802	577
1984	6,123	3,344	2,779	3,029	1,977	1,052
1985	6,847	3,864	2,983	3,753	2,495	1,258
1986	7,605	4,396	3,209	4,513	3,030	1,483
1987	8,419	4,970	3,449	5,326	3,577	1,749
1988	9,386	5,739	3,647	6,036	4,346	1,690
1989	10,498	6,483	4,015	7,148	5,090	2,058
1990	<u>11,745</u>	<u>7,410</u>	<u>4,335</u>	<u>8,395</u>	<u>5,995</u>	<u>2,400</u>
Total	<u>89,217</u>	<u>53,386</u>	<u>35,831</u>	<u>53,047</u>	<u>35,575</u>	<u>17,472</u>

^{1/} The base case constitutes use of F-27 services with high load factors.

^{2/} Table 18.

^{3/} Table 20.

Source: Feasibility Study and IBRD Mission

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Civil Aviation Department and Sudan Airways

Financial Internal Rate of Return
(S£ thousand)

Year Ended June 30	Capital Cost			Operating Surplus ^{3/}			Net Cash Flow
	Project	Base Case	Net	Project	Base Case	Net	
1976	-	2,086	(2,086)	1,905	1,791	114	2,200
1977	841	896	(55)	2,281	1,806	475	530
1978	5,937	-	5,937	2,733	1,937	796	(5,141)
1979	12,226	-	12,226	3,173	1,942	1,231	(10,995)
1980	12,914	-	12,914	3,661	1,941	1,720	(11,194)
1981	2,629	-	2,629	4,430	2,249	2,181	(448)
1982	-	-	-	4,940	2,580	2,360	2,360
1983	-	-	-	5,471	2,934	2,537	2,537
1984	-	3,512	(3,512)	6,123	3,344	2,779	6,291
1985	-	-	-	6,847	3,864	2,983	2,983
1986	-	-	-	7,605	4,396	3,209	3,209
1987	3,512	-	3,512	8,419	4,970	3,449	(63)
1988	-	-	-	9,386	5,739	3,647	3,647
1989	-	-	-	10,498	6,483	4,015	4,015
1990	-	-	-	11,745	7,410	4,335	4,335
1991 ^{1/}	-	-	-	11,745	7,410	4,335	4,335
1992	-	-	-	11,745	7,410	4,335	4,335
1993	-	-	-	11,745	7,410	4,335	4,335
1994	-	-	-	11,745	7,410	4,335	4,335
1995	3,512	-	3,512	11,745	7,410	4,335	823
1996	-	-	-	11,745	7,410	4,335	4,335
1997	-	-	-	11,745	7,410	4,335	4,335
1998	-	-	-	11,745	7,410	4,335	4,335
1999	-	-	-	11,745	7,410	4,335	4,335
2000 ^{2/}	(2,341)	-	(2,341)	11,745	7,410	4,335	6,676
	<u>39,230</u>	<u>6,494</u>	<u>32,736</u>	<u>206,667</u>	<u>127,486</u>	<u>79,181</u>	<u>46,445</u>

1/ No growth is shown for years 1991-2000

2/ Residual value of aircraft

3/ Table 21

Financial I.R.R. = 10%

Source: IBRD Mission

June 1976

SUDAN

Appraisal of a Domestic Aviation Project

Civil Aviation Department

Projected Cash Flow
(SE thousand)

Year Ended June 30	Source of Funds						Application of Funds				Annual Cash Surplus	Cumulative Cash Balance
	Operating Surplus ^{1/}	Debtors Less Creditors	Cash from		New Equity	Total Cash Available	Capital Invest- ments	Loan Repayment		Total Cash Required		
			Operations	Loan				Principal	Interest			
1976	720	115	605	-	436	1,041	1,041	-	-	1,041	-	-
1977	834	10	824	766	-	1,590	1,525	-	-	1,525	65	65
1978	993	15	978	4,541	983	6,502	6,567	-	-	6,567	(65)	-
1979	1,103	11	1,092	8,693	3,059	12,844	12,844	-	-	12,844	-	-
1980	1,219	15	1,204	-	8,423	9,627	9,627	-	-	9,627	-	-
1981	1,987	74	1,913	-	2,429	4,342	2,641	307	1,394	4,342	-	-
1982	2,278	25	2,253	-	-	2,253	12	333	1,368	1,713	540	540
1983	2,573	26	2,547	-	-	2,547	18	361	1,340	1,719	828	1,368
1984	2,968	34	2,934	-	-	2,934	179	392	1,309	1,880	1,054	2,422
1985	3,430	39	3,391	-	-	3,391	950	425	1,276	2,651	740	3,162
1986	3,915	42	3,873	-	-	3,873	956	461	1,240	2,657	1,216	4,378
1987	4,397	41	4,356	-	-	4,356	511	500	1,201	2,212	2,144	6,522
1988	5,006	53	4,953	-	-	4,953	1,145	543	1,158	2,846	2,107	8,629
1989	5,729	61	5,668	-	-	5,668	628	589	1,112	2,329	3,339	11,968
1990	6,552	70	6,482	-	-	6,482	2,064	639	1,062	3,765	2,717	14,685
	<u>43,704</u>	<u>631</u>	<u>43,073</u>	<u>14,000</u>	<u>15,330</u>	<u>72,403</u>	<u>40,708</u>	<u>4,550</u>	<u>12,460</u>	<u>57,718</u>	<u>14,685</u>	

^{1/} Table 13

Source: IBRD Mission

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Civil Aviation Department

Projected Balance Sheets
(S£ thousand)

Year Ended June 30	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Assets															
Current Assets:															
Cash ^{1/}	-	65	-	-	-	-	540	1,368	2,422	3,162	4,378	6,522	8,629	11,968	14,685
Receivables	155	167	181	193	208	294	319	347	380	418	460	505	556	615	685
	155	232	181	193	208	294	859	1,715	2,802	3,580	4,838	7,027	9,185	12,583	15,370
Fixed Assets:															
Runways	3,706	3,706	3,706	6,412	24,112	24,112	24,112	24,112	24,112	24,112	24,112	24,112	24,573	24,573	24,573
Buildings	95	95	95	1,605	4,776	4,776	4,776	4,776	4,776	4,776	4,776	4,776	4,776	4,776	4,776
Other	2,544	3,228	3,856	6,549	13,051	13,063	13,075	13,087	13,099	13,111	13,123	13,135	13,135	13,135	13,135
	6,345	7,029	7,657	14,566	41,939	41,951	41,963	41,975	41,987	41,999	42,011	42,023	42,484	42,484	42,484
Accumulated depreciation	926	1,419	1,973	2,588	3,624	6,246	8,869	11,487	13,946	15,634	17,314	19,440	21,404	23,424	24,008
Net fixed assets in use	5,419	5,610	5,684	11,978	38,315	35,705	33,094	30,488	28,041	26,365	24,697	22,583	21,080	19,060	18,476
Construction in progress	-	857	7,053	14,479	-	-	-	-	-	-	-	-	-	-	-
	5,419	6,467	12,737	26,457	38,315	35,705	33,094	30,488	28,041	26,365	24,697	22,583	21,080	19,060	18,476
Total Assets	5,574	6,699	12,918	26,650	38,523	35,999	33,953	32,203	30,843	29,945	29,535	29,610	30,265	31,643	33,846
Equities															
Current Liabilities:															
Trade creditors	40	42	41	42	42	54	54	56	55	54	54	58	56	54	54
Hold backs	-	-	-	646	2,629	-	-	-	-	-	-	-	-	-	-
Current portion - long term debt	-	-	-	-	307	333	361	392	425	461	500	543	589	639	693
	40	42	41	688	2,978	387	415	448	480	515	554	601	645	693	747
Long-term debt - 8-1/2%		782	5,582	15,119	16,097	15,764	15,403	15,011	14,586	14,125	13,625	13,082	12,493	11,854	11,161
Capital:															
Present investment	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185	4,185
Required new investment	436	436	1,419	4,478	12,901	15,330	15,330	15,330	15,330	15,330	15,330	15,330	15,330	15,330	15,330
	4,621	4,621	5,604	8,663	17,086	19,515	19,515	19,515	19,515	19,515	19,515	19,515	19,515	19,515	19,515
Retained earnings:															
Opening	617	913	1,254	1,691	2,180	2,362	333	(1,380)	(2,771)	(3,738)	(4,210)	(4,159)	(3,588)	(2,388)	(419)
Profit (loss)	296	341	437	489	182	(2,029)	(1,713)	(1,391)	(967)	(472)	51	571	1,200	1,969	2,842
Closing	913	1,254	1,691	2,180	2,362	333	(1,380)	(2,771)	(3,738)	(4,210)	(4,159)	(3,588)	(2,388)	(419)	2,423
Total Capital	5,534	5,875	7,295	10,843	19,448	19,848	18,135	16,744	15,777	15,305	15,356	15,927	17,127	19,096	21,938
Total Equities	5,574	6,699	12,918	26,650	38,523	35,999	33,953	32,203	30,843	29,945	29,535	29,610	30,265	31,643	33,846

TABLE 24

1/ Table 23

Source: IBRD Mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTCivil Aviation DepartmentSchedule of Selected Financial Indicators

	<u>Operating Ratio</u> <u>1/</u>	<u>Debt Service Coverage</u> <u>2/</u>	<u>Times Interest Earned</u> <u>3/</u>	<u>Debt/Equity Ratio</u> <u>4/</u>	<u>Percent Annual Return on Net Fixed Assets in Use</u> <u>5/</u>
1976	0.84	n/a	n/a	0/100	6.0
1977	0.83	n/a	n/a	12/88	6.2
1978	0.80	n/a	n/a	43/57	7.7
1979	0.79	n/a	n/a	58/42	5.5
1980	0.93	n/a	n/a	45/55	0.7
1981	1.18	1.17	Loss	44/56	Loss
1982	1.09	1.34	Loss	46/54	Loss
1983	1.01	1.51	Loss	47/53	Loss
1984	0.92	1.74	0.26	48/52	1.2
1985	0.84	2.02	0.63	48/52	3.0
1986	0.77	2.30	1.04	47/53	5.1
1987	0.71	2.58	1.48	45/55	7.5
1988	0.65	2.94	2.04	42/58	10.8
1989	0.58	3.37	2.77	38/62	15.4
1990	0.52	3.85	3.68	34/66	20.8

1/ Operating Ratio - Total operating expenses, including depreciation but excluding interest, divided by total operating revenue.

2/ Debt Service Coverage - Net operating income before depreciation divided by the total of interest plus principal repayments.

3/ Times Interest Earned - Net operating income after depreciation divided by the interest charges.

4/ Debt/Equity Ratio - The relative percentages of long-term debt and equity invested in the enterprise. The equity includes invested capital plus retained earnings (losses).

5/ Annual Return on Net Fixed Assets in Use - Net operating income after depreciation, but before interest, as a percentage of the average net fixed assets in use for the year.

Source: IBRD Mission

June 1976

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTBank Group Projects in the Transport Sector

<u>Loan or Credit No.</u>	<u>Effective Date</u>	<u>Amount (US \$ million)</u>	<u>Works</u>	<u>Present Status</u>
202-SU	1/06/59	39 Loan	Sudan Railways' 1959/60 development program	Completed 1964
440-SU	3/10/66	31 Loan	Sudan Railways' 1966/68 development program	Completed 1972
331-SU	12/29/72	7 Credit	Highway maintenance and transport sector technical assistance	Expected to be completed by end 1976
157-SU	7/29/74	24 Credit	Sudan Railways' 1971/75 development program	Expected to be completed by end 1976

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Effects of Existing Infrastructure on Airline Operations

1. The poor airport facilities, communications and daytime only flight restrictions have always been at the root of Sudan Airways' financial problems. For instance, the F-27's had a utilization rate per day of 4.5 hours in 1973 while the DHC-6's had only 3.0 hours. Normal utilization would be higher. The way the domestic route structure is laid out, Sudan Airways fleet could be better utilized if any one route were upgraded. The development of Port Sudan as an international alternate for Khartoum is the best example of this. From a traffic point of view, El Obeid on the near western route is probably the next most important. It is served from Khartoum in the late afternoon only after the fleet has returned from other routes. If the fleet is delayed, El Obeid must be cancelled because of lack of night landing facilities. In the far west El Geneina, El Fasher and Nyala are extremely important during the rainy season because of surface transportation limitations. However, the airports suffer from weather and poor communications and are forced to restrict operations at unpredictable times. In the south, Juba, Wau and Malakal are all limited to daylight operations. While the runway at Juba has just been lengthened and strengthened for use by B-737's on the international route to Entebbe, the F-27 at Wau and Malakal suffers weight restrictions because of runway lengths and surface conditions.
2. If any of these groups of airports were provided with night landing facilities the airline would be able to readjust its schedules and get better utilization of its aircraft. One of the major potential improvements in the south would be for the airline to schedule cargo flights at night. There is a high demand for air cargo to this area because of the reconstruction effort and the inadequate capacity of surface transportation. However, the development of air cargo traffic has not been encouraged by the airline up to the present time because of the very low cargo carrying capability of the F-27's when loaded with passengers. The passenger demand in this area has resulted in very high load factors. This condition, augmented by a poor reservation system due to lack of communications, has caused waits in excess of two weeks.
3. In addition, a country-wide aeronautical telecommunication and navigational aids improvement program is necessary for two reasons; one, to help Sudan Airways increase the utilization of its present domestic fleet through the use of night time operations; two, to enable the country to live up to its international obligation to provide navigational aids and communication services to all aircraft wishing to overfly Sudan. While some of this equipment already exists, it is becoming old, obsolete and unreliable. The provision of these services to foreign aircraft is a source

of foreign exchange. The existing charges are S£ 35-45 for each civil aircraft and S£ 60 for each military aircraft overflying Sudan.

4. Use of the B-737 on those domestic airports which can support it would allow the airline to divert two F-27 aircraft to airports now served by DHC-6 aircraft. These aircraft in turn could then be used to serve areas not now served. Such upgrading of services to the outlying areas would require some infrastructure improvements. The Civil Aviation Department is in the process of developing this capability internally by organizing a new division to design and construct its domestic airports. A recent loan from the West German Government provided almost S£ 1.0 million to purchase airport construction and maintenance equipment. However, the CAD will require outside help to develop the new design and construction unit to satisfactory standards.

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Project Airports: Current Conditions and Project Works

A. Current Conditions

JUBA

1. The existing runway is 2,400 x 45 m of flexible pavement. The 300 m wide flight strip beyond the runway edges generally is ungraded. Drainage swales and gullies and hummocks abound in this area and pose serious hazards to any aircraft which happens to swerve off the runway during landing or takeoff operations.
2. The terminal area buildings are all within the flight strip clear zones and therefore are obstructions to flight. The access roads leading to these buildings are unsurfaced and become almost impassable during the rainy season.
3. A very old radio beacon (NDB) is located in the P & T compound in the town a slight distance away from the airport. During times of poor visibility its use as an approach aid is greatly reduced.
4. An airport VHF radio is available for direct pilot-to-ground communications within a relatively short radius but point-to-point radio communications with Khartoum are not available.
5. The electrical power supply for airport use is provided by diesel engine generators located in the terminal area. This power is used for the radios and buildings. Field lighting is not available.

MALAKAL

6. The existing runway is 2,000 x 40 m of flexible pavement. The pavement was constructed over a period of about 10 years and is now in a serious condition due to vehicle overloads. The northeast half of the runway has developed a series of waves which place severe stress on aircraft nose wheels during takeoff or landing operations. The southwest part of the runway is relatively smooth, although the pavement is breaking up in small sections.

7. The airport is located close to the Nile River on black cotton soil and is relatively flat. The flight strip is clear of obstruction with the exception of a rest house located in the southwest approaches to the runway. The terminal building is large but its interior layout inhibits efficient passenger processing.

8. The sewerage system existing within the terminal area does not operate. Access roads to the terminal area are unpaved and become impassable or nearly so during the rainy season.

9. A very old radio beacon (NDB) is located in the P & T compound in the town a slight distance away from the airport. During times of poor visibility its use as an approach aid is thus greatly reduced.

10. An airport VHF radio is available for direct pilot-to-ground communications within a relatively short radius but point-to-point radio communications with Khartoum are not available.

11. The electrical power supply for airport use is provided by diesel engine generators located in the terminal area. This power is used for the radios and buildings. Field lighting is not available.

PORT SUDAN

12. The airport has two runways crossing near the terminal area at an acute angle. However, the shorter runway is no longer active. The other runway is 1,750 x 45 m with a sand surface. The 300 m wide flight strip beyond the runway edges contains dikes to divert rain water. These dikes are obstacles to flight. The runway is almost perfectly flat and during the rare times of rain cannot be used. The approaches from the south are clear but from the north they are directly over the town of Port Sudan which lies less than 100 m beyond the end of the runway. Emergency lighting kerosene lamps are provided at periodic intervals along the runway. While intended for emergency use, these are used quite often for night operations.

13. The terminal area buildings are all within the flight strip clear zones and are therefore obstructions to flight. The terminal building itself is very modest in size and becomes overloaded with any full F-27 flight. The access roads to the terminal area are unpaved.

14. A very old radio beacon (NDB) is located in the P & T compound in the town a slight distance away from the airport. During times of poor visibility its use as an approach aid is thus greatly reduced.

15. An airport VHF radio is available for direct pilot-to-ground communications within a relatively short radius but point-to-point radio communications with Khartoum are not available.

16. The electrical power supply for airport use is provided by diesel engine generators located in the terminal area. This power is used for the radios and buildings.

WAU

17. There are two runways at Wau crossing at almost a 90° angle. The main runway rises for a short distance, crosses a ridge and proceeds downhill for the major portion of its length. It is 1,500 x 45 m, constructed of laterite. The crosswind runway is 1,275 x 45 m and runs along the ridge mentioned previously. It is relatively level. Because of the slopes of the main runway, any rain causes serious erosion, moving the small laterite particles and exposing the bedrock on which the runway is constructed. Aircraft propeller blast also adds to the erosion of the fine material. The up and down profile of this runway shortens its effective length to approximately 1,200 m for landing. The eastern approaches to the crosswind runway are obstructed by the main railroad line and highway.

18. The terminal area buildings are relatively new, modest in size but are located within the flight strip clear zones and are therefore obstructions. Directly adjacent to the runway in the northeast quadrant is a military compound and to the south is the town of Wau.

19. The access roads leading to the terminal area are unsurfaced and are highly affected during the rainy season.

20. The very old radio beacon (NDB) is located in the P & T compound in the town a slight distance from the airport. During times of poor visibility its use as an approach aid is thus greatly reduced.

21. An airport VHF radio is available for direct pilot-to-ground communications within a relatively short radius but point-to-point radio communications with Khartoum are not available.

22. The electrical power supply for airport use is provided by diesel engine generators located in the terminal area. This power is used for the radios and buildings. Field lighting is not available.

B. Project Works

JUBA

23. The 300 m flight strip will be regraded to provide proper drainage and to remove all obstructions to flight.

24. The existing terminal area will be demolished (it is within the flight strip) and a new terminal area will be developed on the opposite side of the runway. It will include an international terminal building,

control tower, crash/fire/rescue station, vehicle maintenance shed, standby engine generator and electrical vault building and a mechanical services building. These buildings will be served by paved ancillary roads and the entire area will be provided with a paved access road. A fuel storage area will be constructed adjacent to this area.

25. The terminal area will be provided with an aircraft apron connected to the runway by a stub or lead-in taxiway. The buildings will be provided with suitable water, electrical and sewerage services.

26. Runway, taxiway and apron lights will be provided along with visual approach slope indicators and simple approach light systems at both ends of the runway. A standby engine generator will be provided but prime power will come from the town as will the water supply.

27. A VOR/DME (navigational aid equipment) will be installed on the airport to act as an approach as well as an enroute aid. New VHF air/ground radio equipment will be provided in the tower along with HF-ISB radios for point-to-point voice and teletype communication with Khartoum, Entebbe/Nairobi and domestic Sudan airports. An NDB (non-directional radio beacon) will also be installed on the airport property.

MALAKAL

28. The existing runway will be scarified, widened and repaved as a flexible runway, 2,000 x 45 m of strength suitable for Boeing 737 aircraft, fully loaded. The flight strip will be regraded to provide for drainage. The southwestern threshold will be displaced by paint markings to provide clearance over the rest house in the approach area. The lead-in taxiways and terminal apron will be reconstructed in flexible pavement of suitable strength. Runway edge lighting, taxiway and apron lighting will be provided as well as visual approach slope indicators and simple approach light systems at both ends of the runway.

29. The existing terminal building and control tower will remain but the ancillary buildings in the terminal area will be demolished. They will be replaced by a new crash/fire/rescue station, vehicle maintenance shed, standby engine generator and electrical vault building and a mechanical services building. The terminal building interior will be rearranged and partitions constructed to provide an efficient processing area for passengers. The interior of the control tower will be renovated. The terminal area buildings will be provided with paved ancillary roads and the entire area will be provided with a paved access road. Adjacent to the terminal area will be a fuel storage area.

30. The terminal area buildings will be provided with suitable water, electrical and sewerage services. A standby engine generator will be provided but prime power will come from the town, as well as the water supply.

31. A VOR/DME (navigational aid equipment) will be installed on the airport to act as an approach as well as an enroute aid. New VHF air/ground radio equipment will be provided in the tower along with HF-ISB radios for point-to-point voice and teletype communication with Khartoum and domestic Sudan airports. An NDB (non-directional radio beacon) will also be installed on the airport property.

PORT SUDAN

32. An entire new airport will be constructed for Port Sudan. It will consist of a 2,200 x 45 m flexible pavement runway, a main and secondary aircraft apron and dual lead-in taxiways, an international terminal building, a Haj terminal building, a crash/fire/rescue station, a control tower, a vehicle maintenance shed, standby engine generator and electrical vault building, a mechanical services building and a fuel storage area. The runway will be provided with edge lighting with precision approach lighting system at one threshold and a simple approach lighting system at the other. It will be provided with visual approach slope indicators at both thresholds and taxiway and apron edge lighting. The terminal area buildings will be provided with paved ancillary roads and a paved access road from the main highway. The buildings will be provided with suitable water, electrical and sewerage services. A standby engine generator will be provided but the prime power will come from the town, as well as the water supply.

33. The paving of the secondary apron will be less in strength than that of the primary apron since it is to be used only during the annual Haj pilgrimage flights.

34. A VOR/DME (navigational aid equipment) will be installed on the airport to act as an approach as well as an enroute aid. New VHF air/ground radio equipment will be provided in the tower along with HF-ISB radios for point-to-point voice and teletype communication with Khartoum, Jeddah, Asmara and domestic Sudan airports. An NDB (non-directional radio beacon) will also be installed on the airport property.

35. Staff housing with suitable services will be provided adjacent to the airport.

WAU

36. An entire new airport will be constructed for Wau. It will consist of a 1,840 x 45 m flexible pavement runway, an aircraft apron, lead-in taxiway, a terminal building, a crash/fire/rescue station, a control tower, a vehicle maintenance shed, standby engine generator and electrical vault building, a mechanical services building and a fuel storage area. The runway will be provided with edge lighting with simple approach lighting systems at

both ends. It will be provided with visual approach slope indicators at both thresholds and taxiway and apron edge lighting. The terminal area buildings will be provided with paved ancillary roads and a paved access road from the main highway. The buildings will be provided with suitable water, electrical and sewerage services. A standby engine generator will be provided but the prime power will come from the town, as well as the water supply.

37. A VOR/DME (navigational aid equipment) will be installed on the airport to act as an approach as well as an enroute aid. New VHF air/ground radio equipment will be provided in the tower along with HF-ISB radios for point-to-point voice and teletype communication with Khartoum, (Bangui) and domestic Sudan airports. An NDB (non-directional radio beacon) will also be installed on the airport property.

38. Staff housing with suitable services will be provided adjacent to the airport.

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Additional Aviation Investments Planned by the Government of Sudan

A. Technical Assistance

Sudan Airways

1. In order that Sudan Airways may make an orderly transition to its larger jet operated fleet, ten management experts will be engaged in the following categories for five years each: commercial manager, engineering manager, workshops manager with two systems instructors, quality control manager with two quality control supervisors, diesel engines and ground equipment manager and catering manager. Cost for these positions is estimated to be about US\$2.1 million.

B. Airways System Development

Navigational Aids

2. In addition to the NDB's (non-directional radio beacons) and VOR/DME's (VHF omni-directional radio range/distance measuring equipment) to be installed at each of the four project airports, five other VOR/DME's would be installed at the following sites: El Obeid, Shendi, El Fasher, Kosti and Kassala. These nine units, along with the equipment at Khartoum, would provide full coverage along the major north/south, east/west and northeast/southwest air routes of the country. The cost of these units is estimated to be about US\$1.2 million.

Communications

3. The project airports will be provided with both VHF and HF-LSB radio equipment for air/ground voice and point-to-point voice and teletypewriter, respectively, but eight other sites will also be provided with HF-LSB for point-to-point voice and teletypewriter communications: Geneina, El Fasher, Nyala, El Obeid, Atbara, Kassala, Roseires and new Halfa. The addition of this equipment will allow much more efficient air traffic control and prompt passage of aeronautical information. The cost of these units is estimated to be about US\$750,000.

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECTAirport Maintenance Equipment Provided Under the Project

For the CAD airport engineering section to properly maintain the new airports they will require some equipment which will have to be based permanently at each airport because of **the long distances between airports** and poor road conditions. A list of the minimum amount of equipment required for each airport follows. Its cost is estimated to be about US\$85,000 per airport or a total of US\$340,000.

Airport Maintenance Equipment and EstimatedCost for Each Project Airport

<u>Equipment</u>	<u>Sh</u>
1. Asphalt mixing plant, 8 ton/hour	16,300
2. Bitumen boiler/sprayer, 500 gallons	6,300
3. Asphalt cauldron, 500 kg	550
4. Direct drum hand sprayer	300
5. Tandem self-propelled vibrating roller, 1140 kg	2,500
6. Compressor, breaking tools and hoses, 125 cfm, 100 psi	3,800
7. Garage compressor, 100 psi	300
8. Oxy-acetylene burning gear	300
9. Welding transformer and tools	550
10. Carpenter's tool kit	100
11. Electrician's tool kit	100
12. Diesel fitters tool kit	250
13. Vehicle mechanics tool kit	200
14. Pavement maintenance hand tools	550
Total per Project Airport	<u>32,100</u>
Total for the Four Airports	<u>128,700</u>
	<u>US\$</u>
Total for the Four Airports	321,000
Price Contingency	19,000
Total	<u>340,000</u>

SUDANAPPRAISAL OF A DOMESTIC AVIATION PROJECTProject Implementation ScheduleConstruction

Advertisement for interested contractors for Wau, Port Sudan and Juba Civil Works.	Aug 1976
Completion of draft construction working drawings for Wau, Port Sudan and Juba Civil Works.	Sept 1976
Completion of draft contract documents for Wau, Port Sudan and Juba Civil Works.	Sept 1976
Government and Bank review of draft drawings and documents	Oct 1976
Solicitation for pre-qualification information	Oct 1976
Consultant review of pre-qualification information	Nov 1976
Consultants recommendation of pre-qualified list	Jan 1977
Completion of final contract drawings and documents for Wau, Port Sudan and Juba Civil Works	Jan 1977
Government and Bank review of pre-qualified list and final civil works contract documents and drawings for Wau, Port Sudan and Juba	Jan 1977
Invitations to bid issued for Wau, Port Sudan and Juba civil works.	Feb 1977
Bids opened	May 1977
Consultants recommendation for awards	May 1977
Government and Bank review of awards	June 1977
Award and notice to proceed at Wau, Port Sudan and Juba Civil Works	June 1977
Advertisement for interested contractors for Malakal Civil Works	Aug 1977
Completion of draft construction working drawings for Malakal	Sept 1977

Completion of draft contract documents for Malakal	Sept 1977
Government and Bank review of draft drawings and documents	Oct 1977
Solicitation for pre-qualification information	Oct 1977
Review of pre-qualification information	Nov 1977
Consultants recommendation of pre-qualified list	Jan 1978
Completion of final contract drawings and documents for Malakal	Jan 1978
Government and Bank review of pre-qualified list and final civil works contract documents and drawings for Malakal	Jan 1978
Invitations to bid issued for Malakal civil works	Feb 1978
Bids opened for Malakal civil works	May 1978
Consultants recommendation for awards	May 1978
Government and Bank review of awards	June 1978
Award and notice to proceed at Malakal civil works	June 1978
Completion of Juba civil works contract	Mar 1979
Final acceptance of Juba civil works contract	Mar 1980
Completion of Wau, Port Sudan and Malakal civil works contracts	Mar 1980
Final acceptance of Wau, Port Sudan and Malakal civil works contracts	Mar 1981

Navigational and Communications Equipment

Advertisement for interested contractors for navigational aids, communication and control tower equipment manufacture and installation at Wau, Port Sudan, Malakal and Juba	Mar 1977
Completion of draft construction drawings and contract documents for nav aids and communications	May 1977
Solicitation for pre-qualification information for nav aids and communications contractor	May 1977
Government and Bank review of draft nav aids and communications drawings and contract documents	June 1977
Consultants' review of pre-qualification information for nav aids and communications contractors	June 1977
Consultants' recommendation of pre-qualified nav aids and communications contractor list	Aug 1977
Completion of final nav aids and communications contract drawings and documents	Sept 1977
Government and Bank review of pre-qualified list and final contract documents and drawings for nav aids and communications contract	Sept 1977
Invitations to bid issued for nav aids and communications contract	Oct 1977
Bids for nav aids and communications contract opened	Jan 1978
Consultants recommendation for award of nav aids and communications contract	Feb 1978
Government and Bank review of award for nav aids and communications contract	Feb 1978
Award and notice to proceed with nav aids and communications contract	Mar 1978
Completion of Juba nav aids and communications contract	Mar 1979
Acceptance of Juba nav aids and communications contract	Mar 1980
Completion of Wau, Port Sudan and Malakal nav aids and communications contract	Mar 1980
Acceptance of Wau, Port Sudan and Malakal nav aids and communications contract	Mar 1981

Maintenance Equipment

Advertisement for interested contractors for airport maintenance equipment for Wau, Port Sudan, Malakal and Juba	Oct 1977
Completion of draft contract documents for maintenance equipment	Dec 1977
Solicitation for pre-qualification information for maintenance equipment manufacturers	Dec 1977
Government and Bank review of draft contract documents for maintenance equipment	Jan 1978
Consultants' review of pre-qualification information for maintenance equipment manufacturers	Feb 1978
Consultants' recommendation of pre-qualified maintenance equipment contractor list	Mar 1978
Completion of final maintenance equipment contract documents	Mar 1978
Government and Bank review of pre-qualified list and final contract documents for maintenance equipment contract	Apr 1978
Invitations to bid issued for maintenance equipment contract	May 1978
Bids for maintenance equipment contract opened	July 1978
Consultants' recommendation for award of maintenance equipment contract	Aug 1978
Government and Bank review of award for maintenance equipment contract	Aug 1978
Award and notice to proceed with maintenance equipment contract	Sept 1978
Delivery of maintenance equipment	Mar 1979

Technical Assistance and Staff Training

Government to prepare Terms of Reference for technical assistance positions for CAD	Dec 1976
Review of Terms of Reference for TA positions by Bank	Feb 1977
Search for grant funding for TA positions and training by Government	May 1977
Search for TA experts by ICAO/Bank or others	Sept 1977
Review of candidates and selection of experts for TA positions by Government and Bank	Nov 1977
Mobilization of TA experts in Sudan	Mar 1978
Preparation of training plan by CAD and its TA experts	Dec 1978
Review of training plan by Bank	Feb 1979
Selection of trainees by CAD	May 1979
Review of training candidates by Bank	July 1979
Placement of trainees in training facilities	Sept 1979

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SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Economic Background of Individual Airports

PORT SUDAN

1. Port Sudan is the second largest city in Sudan and the major port for imports and exports. Industrial development now underway will further enhance the commercial importance of this city. The latest census in 1973 indicated an urban population of 130,000. The city is connected with the rest of the country by a narrow gauge railway but lacks a paved road connection. A road via Kassala is under construction to Khartoum as well as a pipeline which will relieve the railway of part of its traffic. Port Sudan is also the Sudanese terminal for a large part of the pilgrim traffic to Saudi Arabia. The port is reaching its capacity and a new port is planned to the south at Suakin. The lack of roads and limitations of the railway have encouraged the use of air transport despite its present constraints. Since some of the surface transport limitations will be overcome in the foreseeable future, the domestic air traffic growth is likely to be less here than for the other project airports. The international and, in particular, the non-scheduled (pilgrim) traffic will continue to grow rapidly.

JUBA

2. Juba, on the Nile, is the main center, not only for Equatoria (1.3 million inhabitants), but also, in many respects, for the two other southern provinces, Bahr El Ghazal and Upper Nile. The Regional Government for Southern Sudan is based in Juba. The town has a rapidly increasing urban population of more than 57,000. It is probably also the center in the south where current development programs will yield results the quickest. In the meantime, these programs will be greatly facilitated through jet air services both for passengers and air cargo, coming principally from the north. North-bound air cargo will develop more slowly. Nevertheless, significant quantities of tobacco are already being shipped by air. Game lodge development for tourists has also started. In the longer term, off-season tropical fruits and commodities such as tea will benefit from the improved air cargo services. The river connecting Juba with northern Sudan is navigable throughout the year but, during periods of low water, delays are frequent. Juba lacks reliable road connections to the north except for a gravel road to Wau. Many supplies are imported from Kenya and Uganda over better, but still unpaved roads.

WAU

3. Wau, in the Bahr El Ghazal province (1.4 million inhabitants), is the second largest center in the south. Its urban population is about 55,000 and is growing at 12% per year. Wau is better served by surface transport than Juba or Malakal and has a railway connecting it to the rest of the

country, a tributary of the Nile navigable for part of the year and an all weather gravel road to Juba. However, these modes are not very reliable year-round and Wau is still highly dependent upon air services for contact with the rest of Sudan. Despite attempts to encourage local projects, the province still provides seasonal labor for the more developed parts of Sudan. Bahr El Ghazal is the second largest surplus area for livestock in Sudan. Its development has been encouraged by the Bank through an experimental farm credit (476-SU). Although not yet financed, there are plans to use this cattle surplus to support a slaughter house with up to 30 tons capacity daily. This would be partly used by a local cannery but would also create a possibility in the longer term for exports to areas deficient in meat, such as Zaire. A developed airport is vital for such an undertaking.

MALAKAL

4. Malakal, on the Nile, is the center of Upper Nile province (1.3 million inhabitants) and has an urban population of about 38,000. Its access by river is better than Juba, but the town lacks road connections with the rest of Sudan, except for dry weather roads usable only part of the year. Malakal has the same requirement for urgent or valuable commodity transportation as Wau and most passengers with high time values depend on air services. The rich fish catch from the Nile now is mostly sun dried before shipment to the rest of Sudan. Given air transport, a limited investment in handling and refrigeration facilities could easily increase the value of the catch substantially. The airport is now served by most flights to the other two southern airports which increases the desirability of upgrading it to the same standard as Juba and Wau. Other major investment proposals in this region will enhance Malakal's importance.

June 1976

SUDAN

APPRAISAL OF A DOMESTIC AVIATION PROJECT

Financial Assumptions

1. Revenues, expenses and capital costs are stated in constant monetary unit (1975), but include price contingencies.
2. Tariffs used are in accordance with the revised User Charges of the CAD which became effective July 1, 1975. Commencing with FY1981, when the project is scheduled to be completed, overflight fees are increased by 45%, navigation fees by 20%, local B-737 landing fees by 30%, and all other landing fees by 10%.
3. Wages:
 - (a) wages for FY1976 were increased by 10% over actual wages paid for FY1975 as advised by the CAD;
 - (b) wages for project airports after completion of construction were determined by consultants on the basis of staff requirements at 1975 wage levels; and
 - (c) wages on non-project airports increased at 2% per year to allow for increased requirements resulting from greater traffic.
4. Provision for Depreciation:
 - (a) runways, buildings and fences - 5% commencing year following completion;
 - (b) all other - 10% commencing year of acquisition.
5. Maintenance - Pavements, Buildings, Equipment:
 - (a) in project as determined by consultants;
 - (b) in base case - minimal required to operate existing aircraft types; and
 - (c) Khartoum (non-project airport) - 2% of replacement cost per year.

SUDAN AVIATION PROJECT

-  Project airports
-  New VOR/DME (Navigational aid and communication stations)
-  Airports
-  Bituminous surfaced roads
-  Roads and tracks, all season
-  Roads and tracks, dry season
-  Railways
-  River service
-  National capitals
-  Provincial capitals
-  Towns and villages
-  Provincial boundaries
-  International boundaries

The boundaries shown on this map do not imply endorsement or agreement by the World Bank and its affiliates.

