VI. ECONOMY

6.1 National Economy

The Sudan is the largest country in the African Continent having a total area of about 2.5 million km^2. The population is 16,536,000 as of 1977.[1]

6.1.1 Basic Economic Statistics

Agricultural sector is dominating among all the sectors of the economy of the Sudan. Its share is GDP is about 40 % and more than 70 % of the people are engaged in agriculture. Its share in export is over 95 % and about 50 % of government revenues is derived from this sector directly and indirectly.[2]

GDP per capita in the Sudan in 1973 and 1974 were £s.83 and £s.98.5 respectively. GDP increased from £s.575.0 million in 1966 to £s.1,510.8 million in 1974.[2] Population in the Sudan increased from about 13.6 million in 1970 to about 16.5 million in 1977.[1] The population trend and the trends of GDP growth are shown in Fig. 6.1 and Fig. 6.2, respectively.

According to the 1973 population census, economically active population[3] among males was 88.9 % and 21.2 % among females i.e., 54.6 % of the total population was economically active in the Sudan.

6.1.2 Transport and Communication[4]

The distance between the production areas and the consumption or export centers are very long. Consequently, an efficient marketing system depends largely on the function of the transport system and communication system.

/1 Demographic and Population Section, Department of Statistics, Ministry of Finance, Planning and National Economy, 1977.

/2 Economic Survey 1975-76, Economic Research Section, Ministry of Finance, Planning and National Economy.

/3 The economically active population includes those who are employed or participate in or desire to produce goods and services.

/4 The information in this section is obtained through the Ministry of National Planning.

Existing and planned transport network is given in Fig. 6.3. As can be seen in the figure, busiest routes are Nyala-El Obeid-Kosti-Kassala-Port Sudan and Juba-Malakal-Kosti-Khartoum-Atbara-Port Sudan.

In 1976/77, railways carried 2,800 million ton-km of freight or 41.9 % of total freight and 1,150 million pass-km of passengers or 14.7 % of the total passengers. In the same year, about 3,790 million ton-km of freight or 56.7 % of the total freight and 6,000 million pass-km of passengers or 76.8 % of total passengers were transported by road transport. These two transportation means are playing major roles in transportation in the Sudan and the other means are playing rather minor roles.

The capacity of the existing transport network falls far short of the required capacity which causes severe transport bottleneck. The development of the country depends on the elimination of such a neck and on meeting specific transport requirements likely to be generated by the various sectors of the economy of the Sudan.

Aiming at the development of transport network in the Sudan, the Six-Year Plan starts in the 1977/78 fiscal year. The amount of the investments on transport sector totals to £s.462.2 million. The biggest portion will be appropriated for the improvement and the construction of road network. Next comes the investments on railway development. The shares of the railway, road, river, aviation, sea port and mechanical transport sub-sectors are 16.95 %, 53.99 %, 2.92 %, 6.44 %, 19.47 % and 0.22 %, respectively. The growth rate of each sub-sector in the 1976/77 over the 1982/83 is as follows.

	Railways	Roads	River	Air
Ton-km	61 %	31 %	134 %	300 %
Pass-km	30 %	78 %	25 %	98 %

The physical targets of the Six-Year Plan for the transport sector is shown in Fig. 6.4 together with the traffic data from the 1974/75 through the 1976/77.

In the 1982/83, railways are expected to carry about 4,500 million ton-km of freight or 44.4 % of the total freight and 1,500 million pass-km or about 11.2 % of the total passengers. In the same year, about 4,980 million ton-km of freight or 49.2 % of the total freight and 10,700 million pass-km of passengers or 79.6 % of the total passengers are planned to be carried by road transportation. These two transportation means are expected to remain the leading transport in the Sudan.

Port Sudan is the only major port of the Sudan and is owned and operated by the Sea Ports Corporation (SPC). The port is located on the western coast of the Red Sea some 260 km south-west of Jeddah of Saudi Arabia and 650 km north-east of Khartourm, the capital of Sudan. The distance from Khartoum to Port Sudan is approximately 840 km by rail and by road. The volume of imports handled by the Port annually during 1970/71-1974/75 period was almost constant with around two million tons. The volume of exports handled by the Port annually during the same period was around one million tons. The total annual import and export traffic through the Port during the period was, thus, around 3 million tons with small fluctuations.

The Six-Year Plan envisages the expansion of the handling capacity of Port Sudan as well as the construction of the new international port. The new port, Port Suakin will be located about 60 km south of Port Sudan. After the completion, Port Suakin will be specialized in handling bulky cargoes such as grain, sugar, oil seeds and fertilizers. At the first stage, the handling capacity of Port Suakin will be 2 million tons. At the second stage, the capacity will be expanded further. Port Sudan will be handling petroleum and general cargoes.

In a vast and sparsely populated country like the Sudan, communication media can play a crucial role in the development of the country. An effficient posts and telegraph system and the telecommunication system can serve for quicker and cheaper communication between the regions in the Sudan and with foreign countries. During the Amended Five Year Plan, 53 new telegraph, post offices and 218 postal agencies were opened. Improvements were made in the areas of telex exchange, telephone automation and micro-wave network. The communication facilities did expand.

The coverage of the communication facilities, however, is not very significant yet in terms of geographical area and population.

Expansion of the communication facilities and the modernization of the techniques of rendering services to the consumers will be given high priority in the Six-Year Plan. For attaining the objective, about £s.188 million will be invested in communication sub-sector. The actual data and the physical targets of the Six-Year Plan in communication sub-sector are shown in Table 6.1.

6.1.3 Health and Education

The education system in the Sudan consists of the elementary education, secondary education and the higher education. The period of the elementary education is 6 years. The secondary education consists of Junior high schools and high schools which consist of high schools, technical high schools and teacher training high schools. The period of the secondary education is 6 years. The higher education includes universities, higher teacher training schools and higher professional schools.

The numbers of students and teachers at different education levels in 1973 and the projected figures for 1980 are given in Table 6.2. The ratio of enrolled students to those at school ages is very low and become lower as the academic level goes up. The chances of receiving higher education and technical education are very limited.

It is analyzed that/1 there exists some weak points in the existing education system in the Sudan. They may be summarized as follows.

i) The system is geared to the needs of a relatively few students who pass from one level of education to a higher level of education despite the fact that the majority of the students at every level leave school to start work.

ii) There exist the inter-regional and urban-rural imbalances in the provision of educational facilities.

iii) The educational policy has paid insufficient attention to the relevance of the present system to the needs of rapid economic development.

/1 "Perspective Study of Agricultural Development for the Democratic Republic of the Sudan", FAO, April 1973.

Various kinds of contagious and endemic diseases are found in the Sudan. Recently, however, much progress has been made the elimination of these diseases particularly in the urban areas. The number of hospitals increased to 133 in 1974 i.e., about 2.8 times as many as in 1956. The number of doctors increased to 1,395 i.e., about 6.8 times as many. The number of beds increased to 15,670 i.e., 1.5 times as many as in 1956.[1] However, health and medical level of the Sudan remains still low particularly in the South. About 92 % of the total population of the Sudan is still living in Malarious areas with no specific anti-Malaria measure.[2]

6.1.4 Price Indices[3]

Consumers' prices in the Sudan have been increasing rapidly since 1970 because of the following reasons.

i) Rise in the price of imported goods

ii) Rise in wages

iii) A drastic increase in currency supply i.e., 138 % increase within 5 years.

Consumers' price index for the 1970-1975 period is shown below.

Year	Consumers' Price Index
1970	106.1
1971	107.5
1972	118.2
1973	137.6
1974	172.2
1975	211.1

(Base Year 1969 = 100)

The consumers' price index was about doubled from 1970 to 1975. In particular, price index was raised sharply during 1973-75 period.

/1 "Statistical Year Book 1974", Department of Statistics, Ministry of National Planning.

/2 "Weekly Epidemological Record", WHO, Jan. 1977.

/3 The information given in this section is obtained through the Department of Statistics, Ministry of Finance, Planning and National Economy.

The general index of the wholesale prices was raised during 1970-1974 period by about 59 %. The wholesale prices of industrial raw material and kerosine was increased sharply with more than 100 % increment during the period. The wholesale price of food and drinks remained relatively stable with only 18 % increase during the period.

Seasonal fluctuation of price can be observed. It is attributable to the occurrence of rainfall and floods, the shortage of supply due to transport bottlenecks, the existence of black market and the illegal piling up of stocks by the distributors as well as consumers.

6.1.5 Trade and Balance of Payments

The Sudan is one of the countries which export primary commodities and are affected adversely by the world inflation, particularly by the escalation of the prices of petroleum and manufactured products and the price descent of export commodities.

The Sudan's export has been increasing since 1971 as shown in Fig. 6.5. Main export items consist of agricultural products i.e., cotton, groundnuts, sesame, gum Arabic, hides and skins and sorghum. The export values of these commodities in 1975 were £s.70.193 million, £s.34.382 million, £s.11.939 million, £s.7.548 million, £s.3.187 million and £s.2.233 million, respectively. Their shares in the total export value were 46.0 %, 22.6 %, 7.8 %, 5.0 %, 2.1 % and 1.5 %, respectively. Total value of export in 1975 amounted to £s.152.5 million. The detailed figures are given in Table 6.3.

Sudan's import has been increasing more rapidly than her export as shown in Fig. 6.5. After 1975, as the investment increased, the import of capital material and intermediate products has increased. The details of imports are shown in Table 6.4. The table shows that the country imported a great deal of agricultural products (food stuff, drinks and tobacco) in recent years despite her huge agricultural potential. The value of the agricultural products imports in 1975 amounted to about £s.64.71 million or about 18 % the value of total imports. The details of food grains imported into the Sudan from 1964 through 1975 are shown in Table 6.5. In 1974, the value of rice imported exceeded £s. 1 million.

After 1974, the value of imports largely exceeded that of exports by a big margin, resulting in the deficit of trade balance. Service account also has been in deficit. Consequently, current account has been in deficit. Capital account has been in surplus but has not been able compensate for the deficit of current account resulting in deficit of the balance of payments. The accounts and the balance of payments during 1970/71-1974/75 are given in Fig. 6.6. The values of current account, capital account and balance of payment in 1974 were -£s.163.7 million, £S.134.1 million and -£s.41.3 million, respectively.

The net foreign exchange reserve deteriorated from about £s.33.9 million deficit to about £s.174.2 million deficit during 1971/72-1975/76 period.

According to the Six-Year Plan projection, import substitution will be attained for wheat and textiles during the Plan period. Self-sufficiency will be achieved for sugar and cement. The details of import volume projections are shown in Table 6.6.

Diversification of export commodities will be attained during the Plan period. Sugar and cement will be listed in export commodities instead of in import commodities in 1982/83. Some other commodities will enter into the group of export commodities which are listed as "others" in Table 6.7.

The export and import volume projected for 1982/83 are given in Fig. 6.7 together with the data in the past years.

The trade balance, thus, can be expected to be improved which in turn will remedy the balance of payments.

6.1.6 Taxes, Subsidy and Government Revenue/1

Central Government taxes are divided into direct taxes and indicrect taxes. Direct taxes include business profits tax. personal imcoem tax, real estate tax, capital gains tax and stamp tax. Indirect taxes include import, export, comsumption and excise duties, royalties and exhanges taxes.

/1 Data given in this section is obtained through the Department of Statistics, Ministry of Finance, Planning and National Economy.

Subsidy is applied to wheat price. Wheat is bought up by the Government at higher price and is sold to flour mills at constant price which is lower than the farm gate price. The balance is subsidized by the Government. In fiscal year 1976/77, the Government bought up wheat from the farmers at £s.75 per ton and sold them to flour mills at £s.55 per ton. The difference of £s.20 per ton was subsidized by the Government.

The revenue of the Central Government consists of direct taxes, indirect taxes, duties, sugar profits, revenue from Gezira Scheme and corporation profits. For the period 1969/70-1975/76, the total revenue increased persistently, except 1971/72 from £s.149.4 million in 1969/70 to £s.337.3 million in 1975/76 as shown in Fig. 6.8.

During this period, direct taxes, indirect taxes and duties have been increasing persistently except in 1975/76. Other components have fluctuated.

The share of the indirect taxes is the biggest among all about 50% of the total revenue. Among the components of the indirect taxes, import duties are the highest revenue yielding tax followed by excise duties. Import duties have increased constantly except in 1972/73 and 1975/76. Excise duties have been increasing persistently.

The ratio of tax revenue to the total revenue has shown a steadly growth, from 55.2% in 1969/70 to 79.5% in 1975/76. On the contrary, non-tax revenues have dropped from 44.8% to 20.5% during the same period.

The ratio of direct taxes to total tax revenue remained almost constant with about 80% share. The ratio of direct taxes were with about 15%.

Import tax rates on agricultural inputs and agricultural products are given in Table 6.8. Export tax rates on major agricultural products are shown in Table 6.9. Import taxes rates for agricultural inputs are set low to promote domestic agricultural production. Tax rates on the cereals for export are set lower than these on the cereals for import because of the same reason.

6.1.7 Basic Concept of the Six-Year Plan /1

The Six-Year Development Plan has been started in the 1977/78 fiscal year and will be completed in 1982/83 fiscal year for the purpose of strengthening the economic activities and at improving the living standard of the peopole in the Sudan. The total budget amount to about £s.2.7 billion of which £s.1.6 billion will be expended in the public sector and £s.1.1 billion in the private sector. Foreign currency component will be 50% of the total amount of the budget. Percentage share and the projected growth rate of each sector are shown in Table 6.10.

Basic objectives of the Six-Year Development Plan at national level are as follows.

a) Significant increase in per capita income, paying special attention to the removal of regional inequalities.

b) Utilization of existing capacities in all sectors.

c) The development of manpower and creation of employment opportunities.

d) Removal of bottlenecks and constraints, both physical and financial, including fiscal reforms for increasing public savings.

e) Improvement of project preparation and implementation capabilities, including reform of the information and statistical system.

f) The encouragement and support of cooperative movements, particularly in the production sphere.

Population growth in the Sudan has been around 2.5% per annum in recent years. /2 According to the Plan, it is projected that the rate of growth of total population in the Sudan during the Six-Year Plan period will be nearly 2.8% per annum.

(1) Agricultural Sector

The biggest portion of the Six-Year Plan budget will be allocated for the agricultural sector aiming at exploiting the huge agricultural potential of the Sudan. The principal targets in this sector are as follows.

/1 Data given in this section are based on "Six-Year Development Plan", Ministry of National Planning.

/2 Department of Statistics, Ministry of Finance, Planning and National Economy.

a) Achievement of self-sufficiency in food products for which local conditions are suitable for production.

b) Increased production of irrigated crops by vertical expansion.

c) Expansion of mechanized farming.

d) Development and modernization of traditional farming.

e) Intergration of livestock industry with crop production projects and improvement of conditions for the nomads.

(2) Industrial Sector

The basic objective of the development plan in the industrial sector is to promote import substitution and to increase the added value of agricultural exports. To attain this objective, the following targets are formulated.

a) To achieve an annual growth rate of 9.3% in the whole industrial sector and the following rates for the sub-sectors:

i)	Manufacturing industries and mining	9.5 %
ii)	Construction	9 %
iii)	Electricity and water	8 %

b) To achieve an increase in the amount of contribution of the industrial sector to GDP from 14 % in the base year to 16 % at the end of the Plan period.

c) To achieve an increase in the contribution of manufacturing industries and mining to GDP to be £s.281 million i.e., 10 % at the end of the Plan period compared with the £s.163 million or 9 % of the base year 1976/77.

d) To increase the production of sugar, leather, textiles, cement and edible oil.

e) To develop agro-industries based on local agricultural projection.

f) To produce agricultural inputs such as fertilizers, insecticides, farm machinery and spare parts.

g) To pay attention to industrial production which is directed export.

h) To explore and exploit mineral resources for broadening the economic base of the national economy through developing intermediate and basic industries such as steel industry, etc.

i) To support basic services necessary for the provision of pertroleum materials and their storage and marketing.

j) To achieve self-sufficiency in the basic consumer goods.

k) To give priority to vertical expansion to achieve high level of production efficiency.

l) To develop basic infrastructure such as power, especially hidro-electric power, building and construction industries.

m) To encourage participation of both foreign and national private sector in the industrial development of the country.

(3) *Transport and Communications Sector*

The basic objectives of the development of the transport and communications network are to eliminate severe transport and communications bottlenecks and to strengthen the supporting facilities needed for the expansion of agricultural and industrial programmes. The strategy will be to widen the transport and communications network in order to encourage dispersal of the economic activity to less developed areas, and to achieve a more equitable and balanced pattern of economic and social growth. The specific aims of the strategy are:

a) To attain a higher utilization of the existing physical capacities.

b) To promote competitive operational activity between the various modes of transport.

c) To create commercially viable enterprises.

d) To minimize costs for the movement of traffic.

6.2 Regional Economy

6.2.1 Administrative Structure

The White Nile Province is located in the eastern part of the Sudan as shown in Location Map. There are 6 districts in the Province. They are Northeastern District, Central District, Dueim District (Northwestern District), Southwestern District, East Nile District and Kosti District (Western Nile District). A commissioner is assigned by the Central Government. Under the Commissioner, an executive manager and 12 assistant commissioners are assigned. The Executive Manager assists the Commissioner. Six of the 12 assistant commissioners are responsible for finance, construction, education, culture and information, health and labour affairs, respectively. Each of the other 6 assistant commissioners is responsible for administrative affairs in each of the 6 districts. In each district, town and rural concils are established. They are responsible for the administration of the town and areas in the district. Administrative organization chart of the White Nile Province is shown in Fig. 6.9.

6.2.2 Regional Economic Structure

According to the 1973 population cencus, the population of the Blue Nile Province which was divided into Blue Nile Province, White Nile Province and Gezira Province after 1974, was about 3.8 million. There are tow towns in the vicinity of the project area i.e., Ed Dueim and Kosti. The Population of Kosti is about 25,000 and about 99,000 including suburbs in 1977.[1] The population of Ed Dueim is about 28,000 in 1977.[2]

According to the farm survey,[3] there are 50 villages around the project area. The total population amounts to about 110,000.

/1 Local government office, Kosti.

/2 Provincial Headquarter of the While Nile Province in Ed Dueim.

/3 Farm survey in and around the project area was done by the JICA Survey Team during July 1977.

About 50,000 villagers are living on the western bank of the While Nile River, about 40,000 in the Um Jerr and about 20,000 on the eastern bank of the White Nile River. About three fourth of the labor force of the whole population in the 50 villages are engaged in agriculture. Average number of family members is about 8.5. Percnetage of those people eged from 16 to 63 in the whole population is about 43 %. In a typical family, 3.66 people are of the ages between 16 and 63.

According to the 1973 population census, economically active population in percent in the Blue Nile Province was 89.3 % for males and 9.3 % for females. Employment rates in urban and rural areas of the Blue Nile Province for males and females in 1973 were given in Table 6.11. As of July 1977, 3,900 unskilled, 102 semi-skilled and 1,800 skilled unemployed labourers were registered in the Duiem Labor Office. Total number of registered workers amounted to 5,802. The composition of specialized laborers registered in the office is given in Table 6.12. In the Kosti Labor Office, 15,000 unemployed laborers were registered as of July 1977. They were consisting of 4,000 unskilled, 6,000 semiskilled and 5,000 skilled workers. The composition of these workers are given in Table 6.13. Most of the unemployed laborers registered in these offices have experience in agriculture.

Agricultural sector is dominating around the project area. Most of the farmers are also engaged in animal production which is mainly for meat and milk. In Rabak, a cement plant is in operation. In Kenana which is located near Kosti, a sugar factory will be in operation before 1983. In the vicinity of the project area, however, there is actually no industrial activities. Only some sorghum mills are in existence.

According to the information obtained through Kosti Labor Office, prevailing wage rates in private sector as of July 1977 were £S. 0.63 per day for a manual laborer, £S. 1.20 per day for semi-skilled labor and £S. 1.82 per day for skilled laborer. In the public sector, minimum wage for a temporary laborer is fixed at £S. 0.38 per day. Wage rates

for a permanent manual laborer, semi-skilled laborer and skilled laborer are £S. 0.62 per day, £S. 0.68 per day and £S. 0.83 per day, respectively. Labor unions have been formed in both private and public sectors. They are under the control of regional labor unions. Workers are free to choose whether or not to participate in unions. Strikes are legal for laborers in private sector.

Local government taxes consist of land tax, animal tax, sales taxes on crops, animals royalities for forest products and fishes and fish products and weighing fees on crops. Provincial governments collect these taxes. These taxes become local government revenue. Land tax is levied annually only on irrigated land. In the White Nile Province, £S. 1.79 per ha for wheat production, £S. 1.19 per ha for water melon and £S. 0.60 per ha for legumes. Annual animal tax rates per head for cattle, sheep, goat, camel, donkey, horse and mule are £S. 0.65, £S. 0.15, £S. 0.1, £S. 1.0, £S. 0.25, £S. 0.5 and £S. 0.5, respectively. Sales taxes on animals (alive and slaughered) are given in Table 6.14. Sales tax on crops is 12 %. Royalities for forest products and fish and fish products are shown in Table 6.15. Weighing fees per kantar/1 of various crops are given in Table 6.16. The estimated and actual amounts of taxes collected in the White Nile Province in 1976/77 fiscal year are shown in Table 6.17./2

6.2.3 Infrastructure

Ed Dueim is located to the north of the project area, about 40 km from the northern boundary of the project area. Kosti is located about 60 km south from the southern boundary of the project area. Ed Dueim is located 224 km south to the Khartoum, the capital of the Sudan. Though land transportation is available between them, road condition is very poor. It can be used only for cross-country vehicles during dry season. It takes about 4 hours between the towns. The distance between Ed Dueim and Kosti is 118 km. The road condition is about the same. It is also closed during rainy season. Though the White Nile

---

/1 Equivalent to 50.8 kg.

/2 Provincial Headquarter of the White Nile Province, Ed Dueim.

River is flowing through Kosti, Ed Dueim and Khartoum from south to north, no regular waterway service is available between Ed Dueim and Khartoum so far. Between Ed Dueim and Kosti, 2 steamers are in service, though the service is not regular and not throughout the year. One of the steamers is mainly for development goods and the other is for petrol.[1] Waterway transport plays key role from Kosti till Juba through Karima and Dongola. Main goods transported through this line consist of sugar, edible oil, salt, dura, petrol and development equipment for the South. Transportation charge from Kosti to Juba is £S. 5,375 for 500 tons of dura and £S. 1,252 for 80 tons of petrol. In Kosti, waterway and railway is directly connected through shunting tracks and rail-mounted cranes. The loading and unloading facilities consist of a 7 ton rail-mounted crane and three 4 ton rail-mounted cranes. Approximate capacity is 500 tons per day for loading and 300 tons for unloading.[2]

Through Kosti, railway line is extending to the east and west. To the west, it is extending to Nyala and Wau. To the east, it extends to Sennar where it branches off into two lines, one for Khartoum and the other for Port Sudan. Nine passenger trains are in service per week through Kosti Station. Thirty goods trains are in service per week. It takes about 40 hours from Kosti to Port Sudan by passenger train and about 52 hours by cargo train. Transportation costs for various agricultural products by railway from Kosti to Port Sudan are given in Table 6.18. Total rail freight traffic in the 1974/75 fiscal year was 639,000 tons.[3]

According to the Six-Year Plan, construction of a road which will connect Jebel Aulia and Rabak will start in 1978 and will be completed in 1983. Jebel Aulia is located about 50 km south from Khartoum. Rabak is located on the opposite side of the White Nile River to Kosti. Kosti bridge is under construction and will be completed by February 1979. After the completion of the road and the bridge, land transportation between Ed Dueim, Kosti and Khartoum will be much easier.

/1 River Transport Corporation, Kosti.

/2 River Transport Corporation, Kosti.

/3 Sudan Railway Corporation, Kosti.

In Ed Dueim, electricity is generated by only three small diesel engines generators with a total capacity of 900 kW. In Kosti, electricity is supplied from Sennar through Rabak. Approximately 15,000 kVA is supplied at the present and will be increased to 30,000 kVA in 1978 to meet the growing demand in Kosti. Two units of supplemental generators are installed for emergency./1

At present, telephone service in Ed Dueim is not in good condition. The rehabilitation of telephone system, however, is progressing and the service can be expected to be improved in the near future. The wireless system is in better condition. Telex units also will be introduced in the near future./2 In Kosti, telephone system with 830 circuits and wireless system are in operation. A micro-wave relay station is located in Kosti. International communication as well as domestic communication is available in Kosti.

6.2.4 Marketing /3

Around the project area, cotton, sorghum, wheat and vegetables are mainly produced. Cotton is cultivated in irrigated areas which consist of public and private pumping schemes. It is mainly for export. Public Corporation of Agricultural Production is responsible for the public pumping schemes. The Corporation ginns the seed cotton produced in the public schemes and transport the ginned cotton to Port Sudan. The Cotton Marketing Corporation takes this cotton from the Corporation at Port Sudan and market it to foreign countries. Agricultural Bank is responsible for ginning and transportation of the cotton grown in the private pumping schemes. The Bank carries the ginned cotton to Port Sudan and hands it to the Cotton Marketing Corporation. The Corporation markets it to abroad. Some portion of ginned cotton is carried to textile factories where it is transformed into textile products. They are consumed domestically.

/1 Local government office, Kosti.

/2 Provincial Headquarter of the White Nile Province, Ed Dueim.

/3 The information given in this section in collected from the Public Corporation for Agricultural Production, the Agricultural Service Administration and through the farm survey.

Sorghum is cultivated in the public schemes and on the private schemes as well as in the rainfed land around the project area. Some portion of it is for family consumption of the producers. The other portion is marketed mainly in Ed Dueim.

Wheat has been introduced recently in the irrigated area around the project area. The main markets of this crop are mainly Ed Dueim and Kosti.

Vegetables are produced in the public schemes and the private pumping schemes. During dry season, vegetables are also grown in the flood area. The main markets for these vegetables are Ed Dueim, Kosti and Khartoum.

Local markets and auction markets are available for trading between local merchants and producers. In case of auction market, merchants bid the price and the producer may accept or reject the highest bid. Auction markets are operated by local authorities. They provide places for dealing together with required facilities such as balances and collect weighing fees. In Kosti District, there are four auction markets. They are located in Kosti, Guli and Tendalti.

Local markets are opened in towns and villages either regularly or irregularly. Producers and local merchants gather together and make deal. The produce are collected by local merchants and are carried to stores where retailers get their requirements. During summer, cattle merchants reach nomads in their camps to exchange their animals for daily necessities.

6.2.5 Processing Facilities /1

In the Ed Dueim, there are 27 processing facilities for the milling of sorghum. The average capacity of them is about 5 sacks or 0.45 ton per hour. The working hour per day is approximately 10 hours. The total capacity of the 27 mills is estimated to be about 121 tons per day.

/1 The data in this section are obtained through the Provincial Headquarters in Ed Dueim and the local government office in Kosti.

There are 49 mills for the milling of sorghum in Kosti and its suburbs. Fourty-four of them are diesel driven and five of them are electric powered. The average capacity of them is about 4 sacks or 0.36 ton per hour. The working hour per day is about 10 hours. The total capacity of the 49 mills is estimated to be about 176 tons per day.

The average milling cost of the mills is £S. 0.45 per sack or £S. 5 per ton.

6.2.6 Health and Diseases

The Ministry of Public Health is responsible for improving health condition and for eliminating contagious and endemic diseases in the Sudan. Around the project area, there are two branch offices of the Ministry of Public Health, one in Ed Dueim and the other in Kosti. They supervise health facilities including those located around the project area. Hospitals, dispenceries, health centres and dressing stations around the project area are listed in Table 6.19 together with the numbers of the staffs and the number of beds as of July 1977. The number of the doctors of these health facilities amounts to 31 and the total number of other staffs of these health facilities amounts to 305. The total number of beds amounts to 467. There are about 23,000 people living in Ed Dueim and about 99,000 people in Kosti. According to the farm survey, there are about 50 villages with about 110,000 villagers around the project area. Comparing the figures, it is clear that the capacity of the health facilities around the project area falls far short of desirable level.

The number of Malaria cases recorded in Kosti Hospital and Ed Dueim Hospital in 1976 amounts to 13,451.[1] There are other malaria cases recorded in the rest of the health facilities.

---

[1] Statistical Section of Dueim Hospital and Statistical Section of Kosti Hospital.

Table 6.1 Existing and Projected Communication Facilities

FACILITIES	BASE YEARS		SIX YEAR PLAN PHYSICAL TARGETS
	1974-75 (Actual)	1976-77 (Expected)	1982-83
Posts & Telegraph Offices	212	230	280
Postal Agencies	369	445	695
Number of Radio Channels	95	130	500
Number of Exchanges	146	150	160
Earth Satellite Station Channels	12	24	36

Source: "Six-Year Development Plan", Ministry of National Planning.

Table 6.2 School Attendance and the Number of Teachers

(Existing and Projected)

	1973			1980		
	School Attendance (10^3)	Teacher/Student Ratio	Number of Teachers (10^3)	School Attendance (10^3)	Teacher/Student Ratio	Number of Teachers (10^3)
Elementary School	1,082.00	1 : 45	24.00	1,587.00	1 : 43	36.90
School Attendance Ratio (%)	38.00			45.00		
Junior High School	135.00	1 : 21	6.40	221.80	1 : 35	6.34
School Attendance Ratio (%)	11.00			15.00		
High School	56.00	1 : 19	2.90	71.50	1 : 19	3.76
1. Regular course	43.00	1 : 22	1.70	47.00	1 : 22	2.13
2. Technical course	5.00	1 : 13	0.40	15.50	1 : 15	1.03
3. Teacher Training course	8.00	1 : 10	0.80	9.00	1 : 15	0.60
School Attendance Ratio (%)	5.00			5.80		
Above High School	9.96	1 : 8	1.28	12.45	1 : 12	1.00
1. Khartoum University	6.00	1 : 10	0.60	6.00	1 : 12	0.50
2. Agricultural School	0.36	1 : 9	0.04	0.96	1 : 12	0.08
3. Professional School	0.50	1 : 7	0.07	1.20	1 : 12	0.10
4. Higher Teacher Training School	0.50	1 : 6	0.08	0.90	1 : 12	0.08
5. Junior Teacher Training School	0.60	1 : 8	0.08	1.50	1 : 15	0.10
6. Nurse Training School	0.10	1 : 5	0.02	0.10	1 : 5	0.02
7. Resources Professional School	-	-	-	0.24	1 : 12	0.02
8. Others	1.90	1 : 5	0.39	1.55	1 : 15	0.10
School Attendance	1,282.96			1,891.75		

Source: "Six-Year Development Plan". Ministry of National Planning

Table 6.3 Value of Main Exports during 1971 - 1975
(Value in Thousand £S.)

	1971	1972	1973	1974	1975
Cotton	69,906	73,088	84,311	43,262	70,193
Gum Arabic	8,030	8,729	7,403	14,157	7,548
Sesame	7,997	8,810	10,706	16,511	11,939
Groundnuts	9,327	9,637	12,993	18,163	34,382
Cotton Seeds	1,408	611	530	253	-
Sorghum	1,085	1,646	2,922	3,401	2,233
Hides and Skins	1,938	3,011	6,072	3,777	3,187
Others	14,683	17,702	27,235	21,486	22,986
T o t a l	114,374	123,234	152,172	122,000	152,486

Source: Bank of Sudan

Table 6.4 Imports by Commodity
(Value in Million £S.)

	1971	1972	1973	1974	1975
Food Stuffs	21.65	27.75	33.93	56.47	60.45
Drinks and Tobacco	3.00	3.95	2.32	3.20	4.26
Crude Materials	3.37	1.55	1.52	33.98	28.20
Chemicals	12.88	14.33	18.95	27.21	40.16
Manufactured Goods	24.57	24.12	33.61	38.73	60.15
Machinery and Equipments	14.19	15.93	20.00	30.09	59.14
Transport Equipments	11.45	13.40	25.29	33.68	64.47
Textiles	25.33	16.91	16.23	24.15	43.06
T o t a l	116.44	117.91	151.85	247.51	359.89

Source: Bank of Sudan

Table 6.5 Imports of Food Grains into the Sudan

YEAR	WHEAT		WHEAT FLOOR		RICE	
	Quantity ('000' Tons)	Value ('000' £S)	Quantity ('000' Tons)	Value ('000' £S)	Quantity ('000' Tons)	Value ('000' £S)
1964	55	1,620	52	1,898	6	264
1965	55	1,677	50	1,527	4	208
1966	81	820	88	2,830	5	270
1967	49	1,355	123	3,506	7	485
1968	66	1,427	79	2,138	7	485
1969	32	716	51	1,125	10	706
1970	195	4,601	25	657	11	677
1971	176	4,731	7	226	9	486
1972	225	4,925	5	164	9	514
1973	190	8,305	-	-	13	819
1974	94	7,095	16	859	9	1,164
1975	119	7,880	4	185	-	-

Source: Department of Agricultural Economics, Ministry of Agriculture, Food and Natural Resources.

Table 6.6 Import Volume Projections for 1982 - 1983

(10^3 tons)

Import Items	1975	1982 - 1983
Wheat	130	50
Sugar	132	Nil
Coffee, Tea	27	30
Food Stuff	17	18
Lumber/Wood	30	89
Fertilizers	276	496
Insecticides	14	17
Crude Oil	1,140	1,900
Petroleum Products	100	150
Paper	25	30
Textiles	25	5
Jute Sacks	36	40
Glass & Glass-ware	10	14
Other Chemicals	45	90
Vehicles	40	60
Iron and Steel	40	138
Cement	100	Nil
Machinery	60	80
Miscellaneous	70	90
T o t a l	2,367	3,297

Source: "Six-year Development Plan", Ministry of National Planning.

Table 6.7 Export Volume Production for 1982 - 1983

(10^3 tons)

Export Item	1974	1975	1982 - 1983 (Projected)
Cotton	103	144	257
Groundnuts	130	206	50
Gum Arabic	31	15	60
Sesame	108	57	20
Sorghum	98	48	500
Meat	11	10	45
Animal Feed	97	160	220
Vegetable Oils	Nil	Nil	240
Hides and Skins	7	6	12
Sugar	Nil	Nil	470
Cement	Nil	Nil	250
Petroleum Products	370	360	100
Ores	20	30	60
Others	Nil	Nil	110
T o t a l	975	1,036	2,394

Source: "Six-year Development Plan", Ministry of National Planning.

Table 6.8 Import Tax Rates on Agricultural Inputs and Cereals

Items	Tax Rate (%)
Fertilizers	5
Pesticides	Nil
Herbicides	Nil
Fungicides	Nil
Agricultural Machinery	Nil
Seeds	Nil
Wheat	Nil
Rye	70
Barley	70
Oats	70
Maize	70
Rice	Nil

Source: Ministry of Finance, Planning and National Economy

Table 6.9 Export Tax Rates on Major Agricultural Products

Item	Tax Rate (%)
Vegetables	15
Millet	15
Sorghum	15
Sesame	5
Ground Nut (Decorticated)	5
" (Undecorticated)	8
Cotton Seed	6
Gum	5
Cotton (Long Staple)	10
" (Medium Staple)	8
" (Short Staple)	5
Livestock (Slaughtered)	5
Hides and Skins	15

Source: Ministry of Finance, Planning and National Economy.

Table 6.10 Percentage Share and Projected Growth Rate of Each Sectors of the Sudan Economy during Six-Year Development Plan

Sector	Budget Allocated	Percentage Share in Total Budget	Projected Annual Growth Rate
	(Billion £S.)	(%)	(%)
Agriculture	0.86	32.0	6.5
Industry	0.68	25.0	9.3
Transport and Communication	0.65	24.0	7.5
Service	0.51	19.0	7.5

Source: Ministry of National Planning.

Table 6.11 Employment rates in the Blue Nile Province/1 (1973)

Province	Area	Sex	Employed	Un-Employed
			(%)	(%)
Blue Nile	Urban	M	94.64	5.36
		F	98.91	1.09
	Rural	M	94.23	5.77
		F	99.15	0.85

/1: Blue Nile Province become Blue Nile Province, White Nile Province and Gezira Province after 1974.

Source: "Statistical Year Book 1975", Department of Statistics, Ministry of National Planning.

Table 6.12 Agricultural Labourers (Unemployed) Registered in Dueim Labour Office

Kind	No.
Tractor Drivers	210
Creazers maintenance worker	961
Heavy machine drivers	22
Agricultural machinery mechanics	–
Water pumps drivers	5
Total	1,198

Source: Dueim Labor Office.

Table 6.13 Agricultural Labourers (Unemployed) Registered in Kosti Labour Office

Kind	No.
Tractor Drivers	297
Greazers	288
Heavy machine dirvers	286
Agric-Machinary mechanics	535
Agric (semi-skilled) lab.	397
Total	1,803

Source: Kosti Labor Office.

Table 6.14 Sales Taxes on Animals

Kind	Rate Per Head (Alive)	Rate Per Head (Slaughtered)
Cattle	500 mms	300 mms
Beef	500 mms	300 mms
Goat	100 mms	100 mms
Sheep	150 mms	300 mms
Camel	700 mms	500 mms
Horse and mule	1,000 mms	-
Donkey	500 mms	-

Note: £S 1 = 1,000 mms

Source: Provincial Headquarter of the White Nile Province, Ed Dueim

Table 6.15 Royalties for Forest Products, Fish and Fish Products

Kind	Rate (£s)
Fire Wood	0.500/m^3
Charcoal	0.123/sack
Acacia Fruits	0.054/sack
Wood	0.050/piece
Fish (Dry)	1,000/Kantar
Fish Products (Salted)	0.250/tin

Source: Provincial Headquater of the White Nile Province, Ed Dueim

Table 6.16 Weighing Fees

Crops	Weighing Fees Per Kantar
Dura	40 mms/1
Gin	50 mms
Millet	40 mms
Wheat	40 mms
Water melon	40 mms
Sesame	80 mms
Legumes	40 mms
Gum	200 mms
Okra	70 mms

/1: £S1 = 1,000 mms

Source: Provincial Headquarters, Ed Dueim

Table 6.17 Taxes Estimated and Collected in the White Nile Province (1976/77)

Kind	Estimates	Actual
	(£S)	(£S)
Land Tax	22,600	232,150
Animal Tax	172,000	113,487
Sales Tax (Crops)	139,000	420,758
Royalities (Forest Products)	50,000	31,011
Weighing Fees	61,650	92,211

Source: Provincial Headquarters, Ed Dueim

Table 6.18 Cost of Transportation of Agricultural Crops by Railway.

Kind	Cost/30 tons	Cost/ton	From - to
	(£S)	(£S)	
Rice	366.300	12.210	Kosti to Port Sudan
Sorghum	240.300	8.010	"
G/N (Shelled)	279.300	9.310	"
Sesame	417.300	13.910	"

Note:- Loading and unloading by owners.

Source: Sudan Railway Corporation, Kosti.

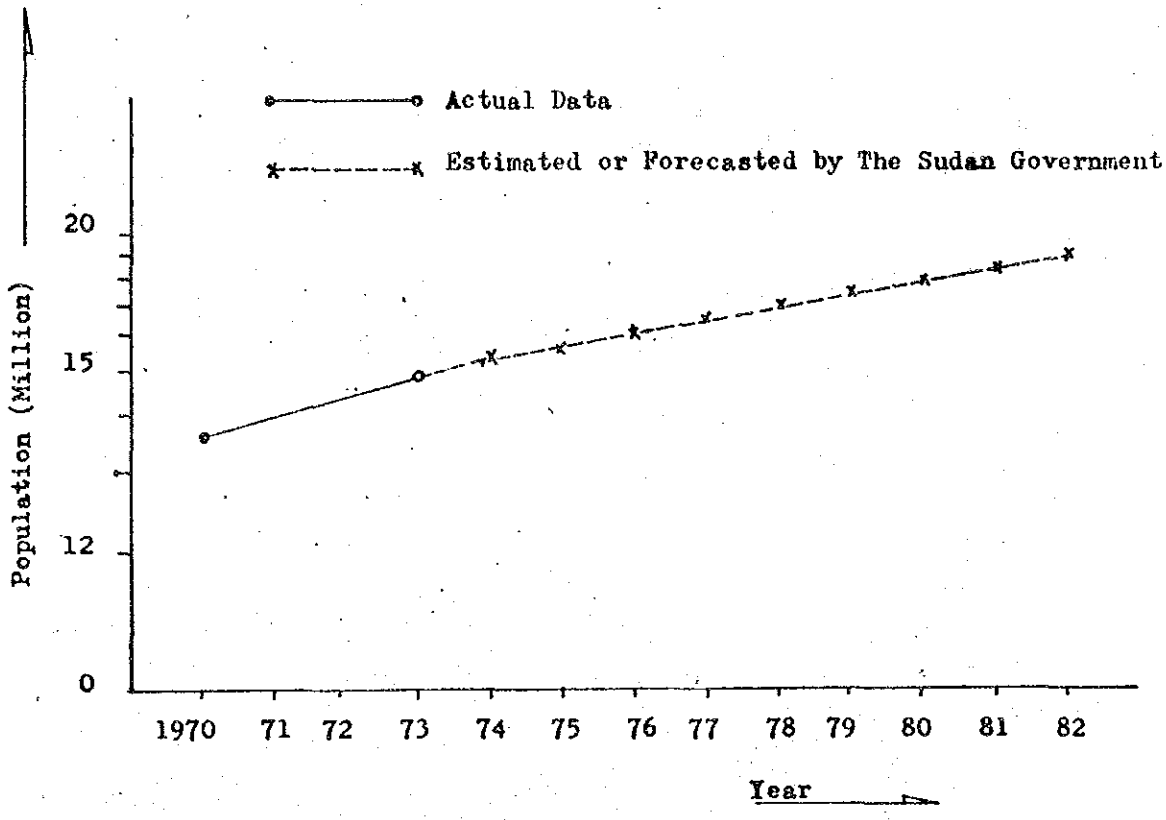
Table 6.19 Hospitals Dispensaries, Health Centres and Dressing Station in the Project Area and in the Surrounding Areas:-

Name	Doctor	Medial Assis-tant	Techni-cians	Health Assis-tant	Nurses	Beds
Un Takal Dressing Station					2	
El Minaidrieb Dressing Station					2	
El Mekaifi Dressing Station					2	
Munna Dressing Station					2	
El Gardud Dressing Station					2	
El Guaiz Dressing Station					2	
Wakara Dressing Station					-	
Kelair Balla Dressing Station					2	
Argud Faig Dressing Station					2	
Iwaiwa Dressing Station					2	
El Dinaigila Dressing Station					2	
El Shur Dispensary	-	1			2	
El Kunuz "	-	1			2	
Umjur Health Centre	-	1		-	1	
El Kiraidah Health Centre	-	1		1	4	
El Kawa Hospital	1	2	1		18	
Duiem Hospital	13	4	5		59	232
Kosti Hospital	17	6	9		167	235
Total	31	16	15	1	273	467

Note: Health Vistor: A trained woman who gives advice, supervision and care to pregnant women, children and general family health.

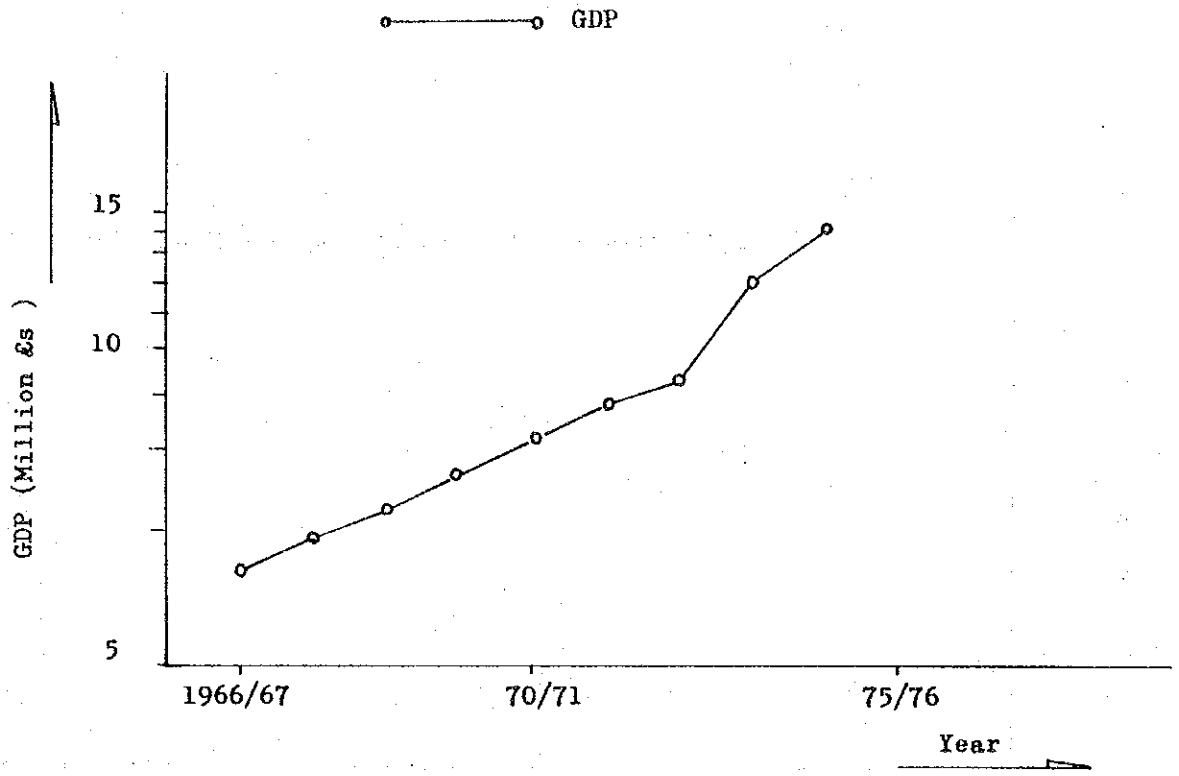
Source: Statistical Section, Duiem Hospital July 1977.

Fig.6.1 Population Trend in The Sudan



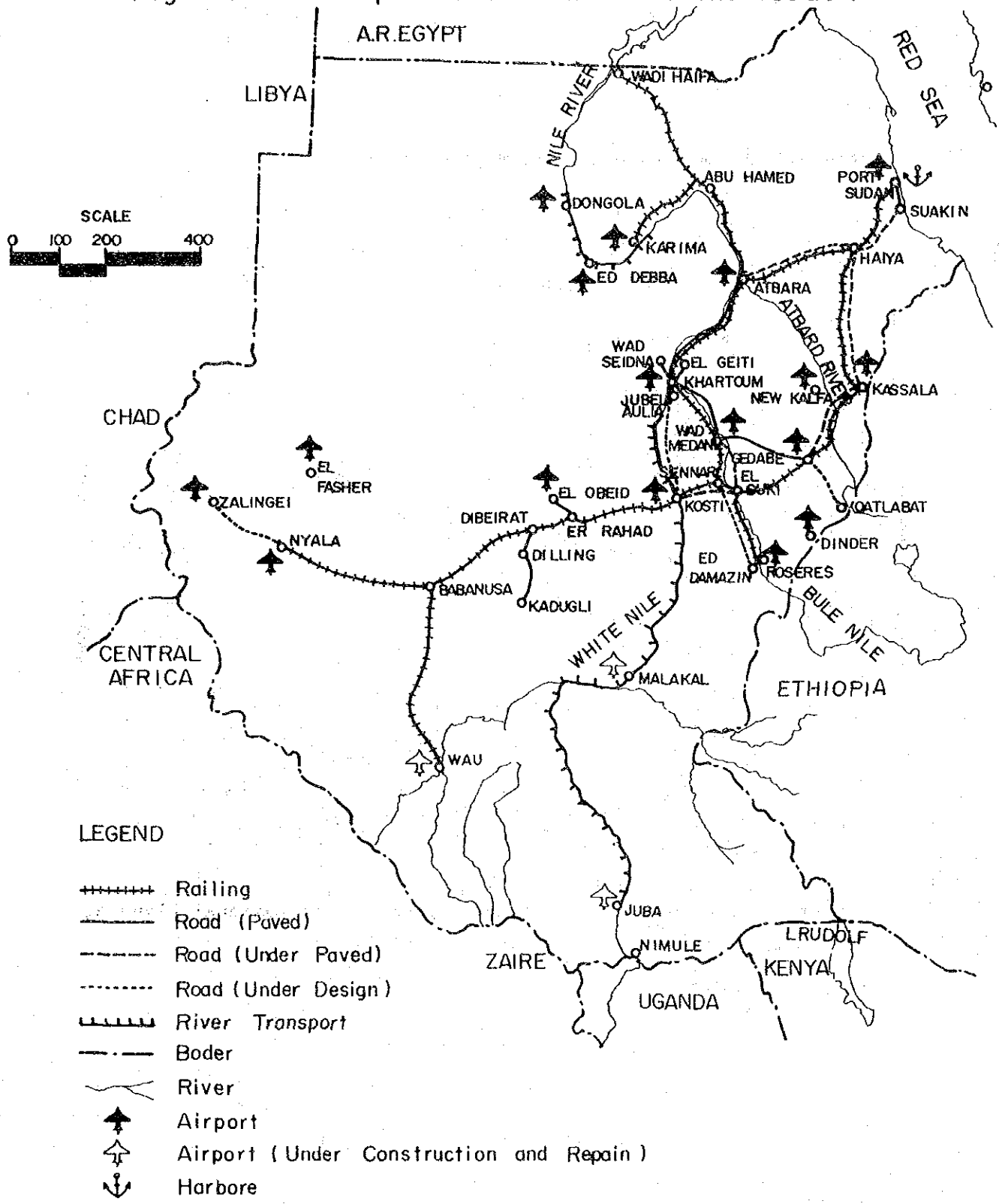
Source : Department of Statistics, Ministry of Finance, Planning and National Economy

Fig.6.2 Growth Trends of GDP



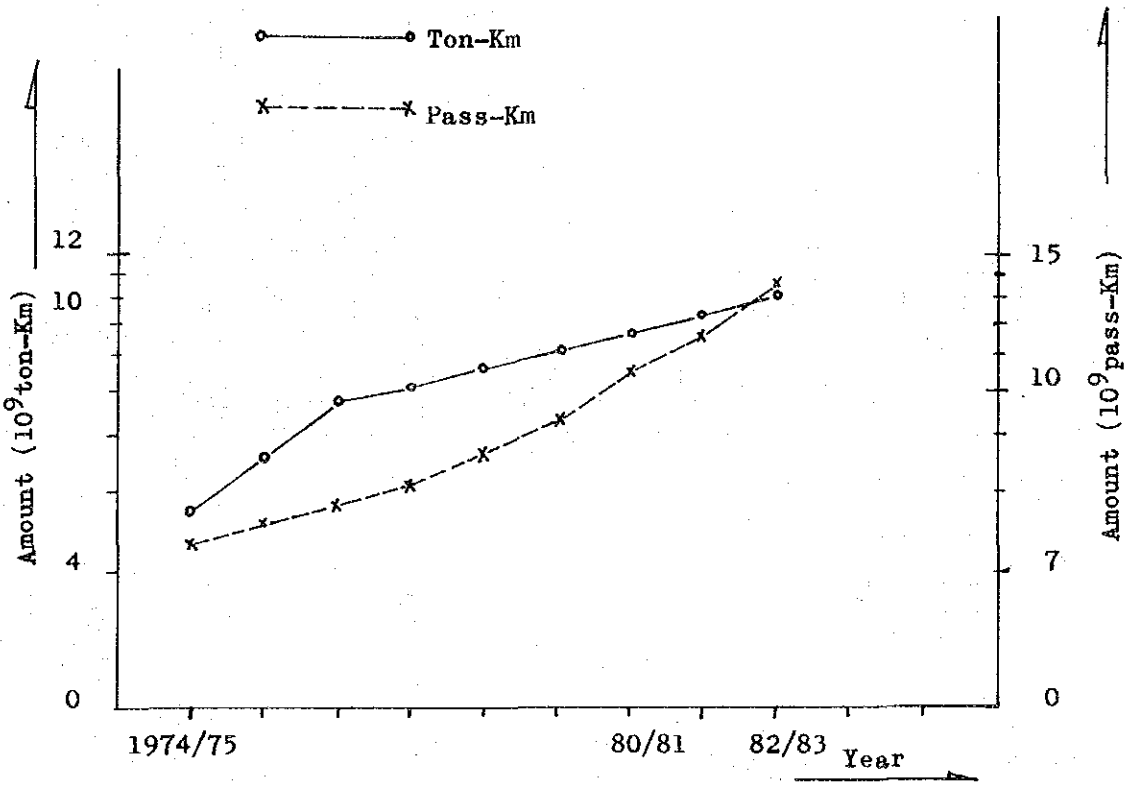
Source : Department of Statistics,Ministry of Finance, Planning and National Economy

Fig. 6.3 Transportation Network in the Sudan



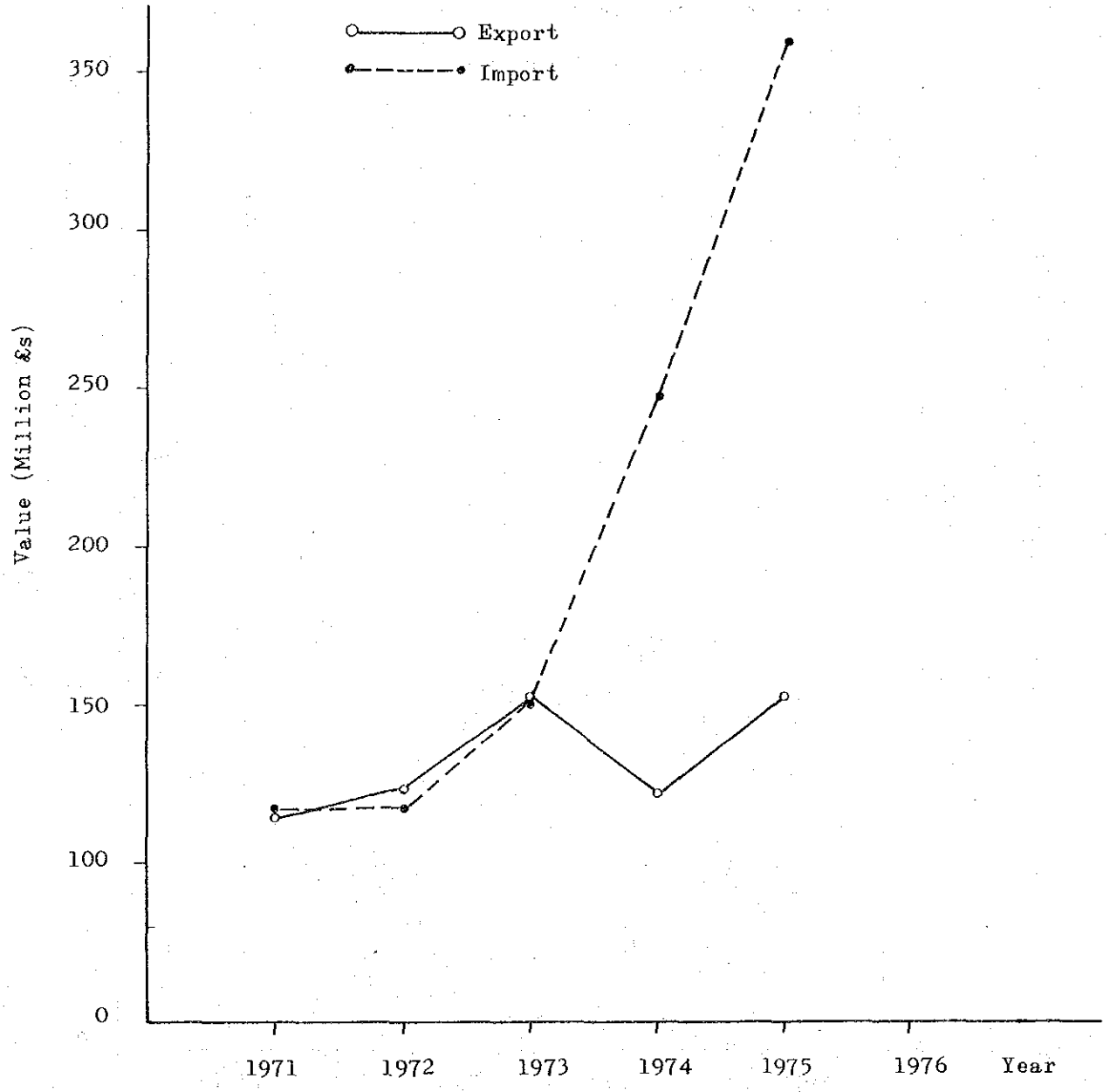
Source : Transport and Communication Section, Ministry of Finance, Planning and National Economy

Fig.6.4 Actual and Projected Traffic Flow



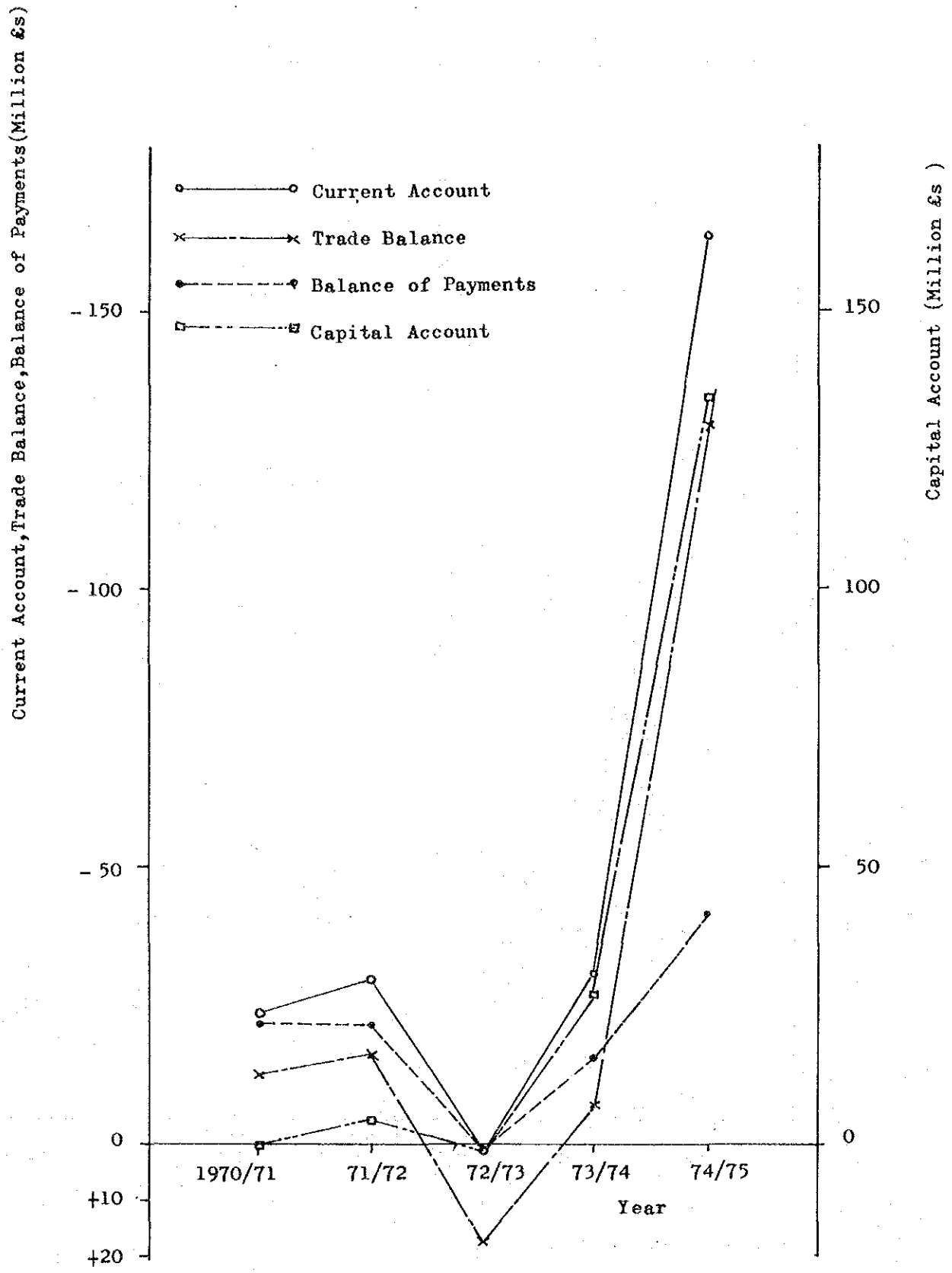
Source ;"Six-Year Development Plan",Ministry of National Planning

Fig.6.5 Total Value of Export-Import During 1971-75



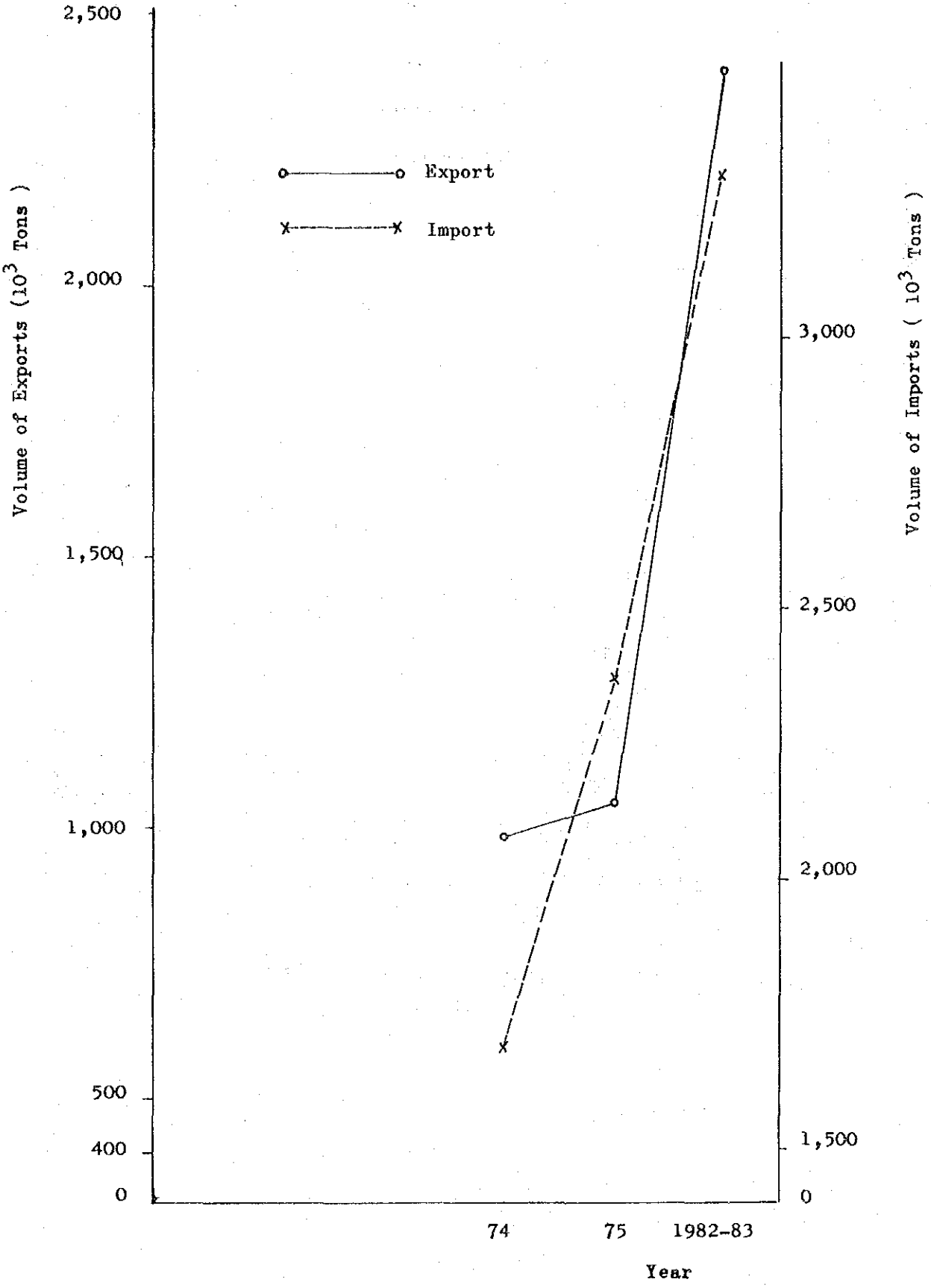
Source : Bank of Sudan

Fig.6.6 Accounts and Balance of Payments



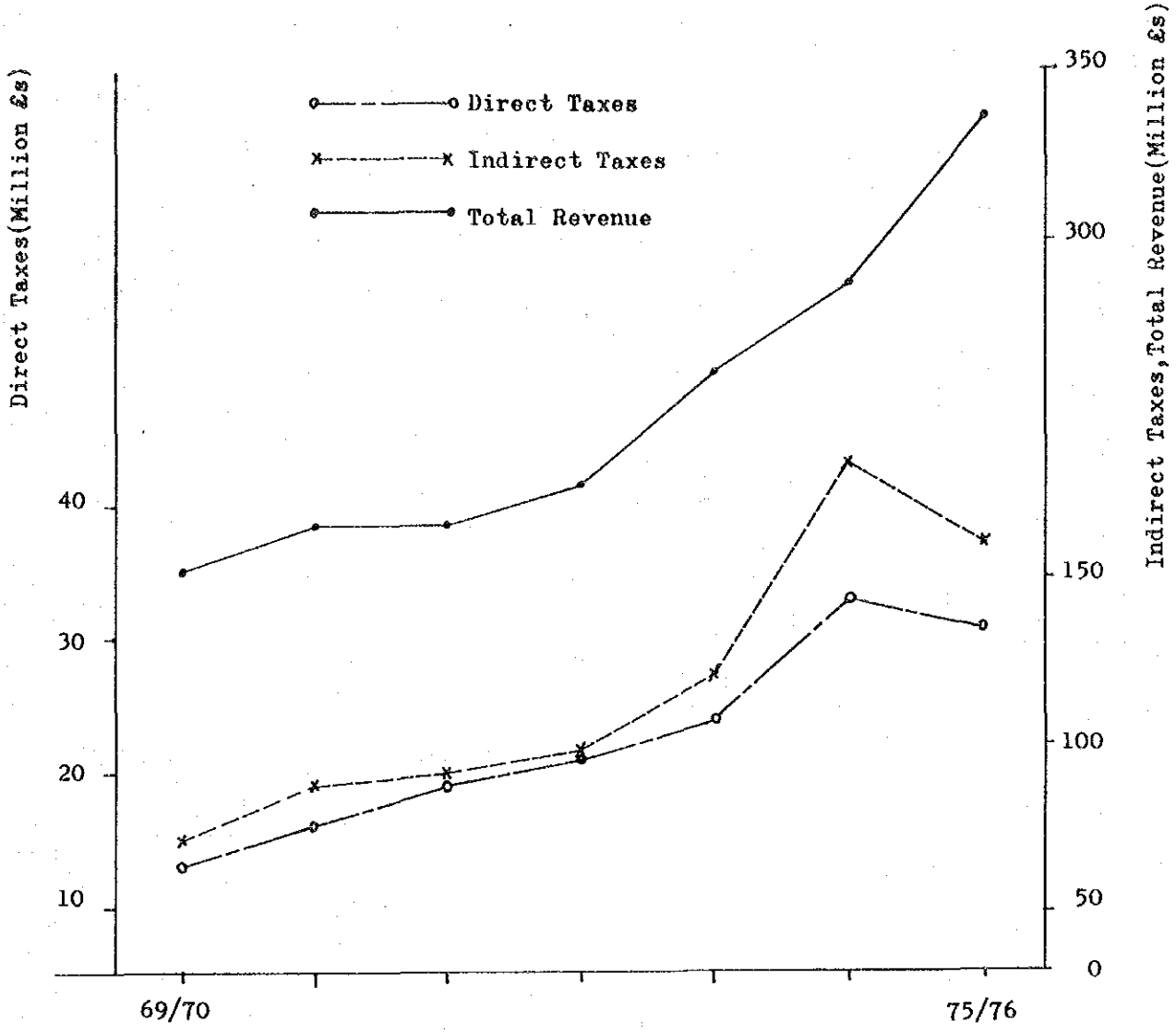
Source : Bank of Sudan

Fig.6.7 Export-Import Volume(Actual and Projected)



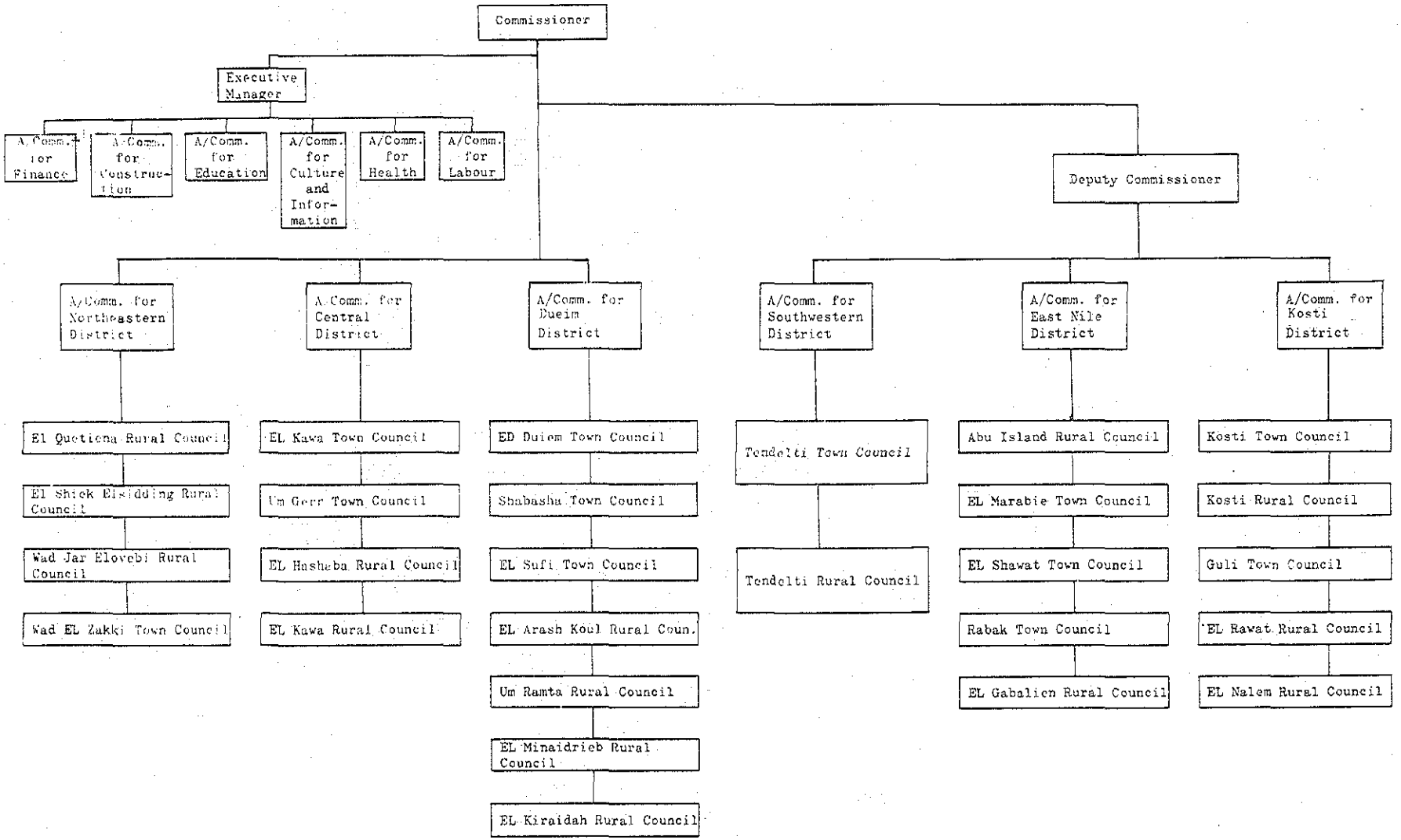
Sourse : Bank of Sudan and the Ministry of National Planning

Fig.6.8 Revenue According to the Main Sourses



Source : Department of Statistics,Ministry of Finance, Planning and National Economy

Fig. 6.9 Administrative Organization Chart of the White Nile Province



[1]: Assistant Commissioner

Source: Head Quarter of the White Nile Province (Ed Dueim)

ANNEX VII

AGRICULTURE SUPPORT SERVICES

ANNEX VII

AGRICULTURE

		Page
7.1	National Agriculture	VII-1
7.1.1	Basic Statistics and Characteristics	VII-1
7.1.2	Rice Production	VII-3
7.1.3	Roles of Irrigation and Mechanized Farming	VII-4
7.1.4	Six-Year Development Plan	VII-5
7.2	Agriculture in and around the Project Area	VII-11
7.2.1	Present Land Use	VII-11
7.2.2	Agriculture in the Existing Pump Scheme	VII-12
7.2.3	Irrigation and Farming Practices	VII-13
7.2.4	Yield and Productions	VII-15
7.2.5	Livestock	VII-15
7.2.6	Land Ownership and Land Tenure System	VII-16
7.2.7	Farm Economy	VII-17

Tables

7.1	Area, Yield and Output of Major Crops	VII-18
7.2	Total Area of Main Crops by Type of Irrigation	VII-19
7.3	Production Costs, Gross Returns and Net Returns per Ha for Various Crops in the Sudan Gezira Board	VII-20
7.4	Share of Different Production Sectors in Area and Production of Major Crops	VII-21
7.5	Production Targets of Major Crops	VII-22
7.6	Sub-Sectoral Allocations of Six-Year Plan Investments	VII-23
7.7	Present Condition of Land Use	VII-25
7.8	Existing Pump Schemes and Land Use Conditions	VII-24

Tables | Page

7.9 Farming Practices on Rice Cultivation in Gasaba Plain VII-25

7.10 Vegetables and Fruits in Gasaba VII-26

7.11 Crop Season and Farm Management on Major Crops VII-26

7.12 Crop Production Cost VII-28

7.13 Crop Seasons in Gasaba and Gezira Area VII-29

7.14 Average Yield of Major Crops in Gasaba and Gezira Areas VII-30

7.15 Land Holding Size and Its Distribution (Project Area) .. VII-30

7.16 Land Distribution by Size VII-31

7.17 Land-holding Size of Tenant VII-32

7.18 Income from Agricultural Products VII-31

7.19 Income from Animal Products VII-31

7.20 Expenditure on Farm Products VII-33

7.21 Expenditure on Animal Products VII-33

7.22 Net Income VII-33

7.23 Revenue from Outside Works VII-33

Figures

7.1 Production Levels of the Grains VII-34

7.2 Production Levels of Crops VII-35

7.3 Area and Production of Rice VII-36

7.4 Projected Per Capita of Rice Consumption VII-37

VII. AGRICULTURE

7.1 National Agriculture

7.1.1 Basic Statistics and Characteristics

Agricultural sector is a dominating sector in the Sudan. Its share in the total GDP is more than 40% and more than 70% of workers have its occupation in this sector. Domestic market for agricultural products is relatively small.

Main crops are sorghum, millet, wheat, rice, ground nuts, sesame, cotton and sugar cane. Production levels of the major crops during 1970-1976 are given in Fig. 7.1 and Fig. 7.2. Cropping area, yield and output of these crops in 1974/75 and 1976/77 are given in Table 7.1.

The types of agriculture in the Sudan can be classified, according to the way of water supply, into pump irrigation, rainfed and flood irrigation farming. The area cultivated under each type is given in Table 7.2.

The Sudan possesses vast area of underutilized, fertile land with adequate rainfall during parts of the year. Some portion of the area is already developed. Irrigation farming and mechanized rainfed farming is practiced in the area. The average income earned in the area is relatively high. This part of agricultural sector is usually called modernized sector. About 90% of the irrigated and the mechanized area is located in Kassala and the former Nile Provinces. The remaining part or the bigger portion of cropped land is cultivated through manual labor under rainfed condition. The productivity and average income in this portion is low. This portion is called traditional sector. This marked dualism not only causes inequality among farmers but also causes regional inequality between the North and the South and West.

Production costs of crops vary according to the kind of the crops and the type of farming. In the mechanized rainfed area, they make use of farm machinery. In the irrigated area, they utilize pump irrigation water, and fertilizers together with agro-chemicals. In these areas, production costs are relatively high with relatively high productivity.

In the traditional sector, farmers depend on the rain for watering their crops and use only manual labor. The production costs in this sector are relatively low. The productivity is relatively low in this sector.

Production costs of various crops of the Sudan Gezira Board which belongs to the modernized sector in the 1976/77 fiscal year are shown in Table 7.3 together with gross returns and net returns of them.

A large number of Sudananese population depends on livestock production as a source of income. The livestock production contributes about 7 % to the total annual revenue from foreign trade. The official estimates of the livestock resources for the fiscal year 1973/74[/1] show that the animal resources amounted to about 40.7 million heads subdivided into 14 million cattle, 10.5 million goats, 2.7 million camels and 13.5 million sheep. In 1975/76 fiscal year, following numbers of the animals are estimated to be slaughtered for local consumption in the main slaughter houses[/1].

cattle	220,398
sheep	437,561
goats	102,803
camels	-

Big portion of the livestock is owned by nomads. They hold about one fourth of the total labor force in the agricultural sector. They depend on natural grass for feeding their livestock. Animal production by monads, therefore, is always subject to wide annual fluctuations as a result of changes in grazing conditions due to variations in rainfall.

Transportation network in the Sudan is not fully developed and the level of the available transportation service is not adequate. The flow of commodities including agricultural inputs and outputs is not smooth nor timely. Most of the transport means are operated by public organization and the freight and the passenger charges are not high. The passenger charges, however, are expensive for seasonal laborers

/1: Ministry of Agriculture, Food and Natural Resources.

whose income level is quite low. They can not earn enough wages which can justify transportation cost resulting seasonal labor shortage during peaking period of labor requirement.

7.1.2 Rice Production

Rice is relatively newly introduced crop in the Sudan. It is now cultivated in Gezira, Bahr El Ghazal and Equatoria. Area and production of rice in the past years in the Sudan are given in Fig. 7.3. The average yield of rice in the 1974/75 year in Gezira, Bahr El Ghazal and Equatoria are 1.55 ton per ha, 0.169 ton per ha and 0.567 t per ha, respectively. The corresponding figures in 1975/76 year in these areas are 1.19 ton per ha, 0.317 ton per ha and 0.571 ton per ha, respectively.

Only single cropping has been adopted in the Sudan. The average yield of rice production in the Sudan is low with the maximum figure of 1.55 ton per ha in Gezira in the 1974/75 year compared with other rice producing countries.

The domestic demand for rice in the Sudan has been exceeding domestic production of rice. The balance has been compensated by importing rice from abroad. The amounts of rice imported in the 1971/72, 1972/73 and 1973/74 are about 9,000 tons, 9,000 tons and 13,000 tons, respectively. According to the Six-Year Plan projection, per capita consumption of rice in the Sudan will increase constantly as shown in Fig. 7.4.

According to the Plan projection, rice production in the Sudan will be expanded both vertically and horizontally. Average yield is planned to increase from 1.19 ton per ha (0.5 ton per feddan) in 1976/77 to 1.36 ton per ha (0.57 ton per feddan) in 1982/83 i.e., 14 % increase. Area for rice production is planned to increase from 10,080 ha (24,000 fedds) to 42,000 ha (100,000 fedds) in 1982/83 i.e., about 400 % increases. Consequently, rice production will be increased from 12,000 tons in 1976/77 to 57,000 tons in 1982/83. Self-sufficiency in rice will be attained in 1981/82. Afterwards, production will exceed demand and surplus will be exported abroad.

7.1.3 Roles of Irrigation and Mechanized Farming

This country is endowed rich water resources i.e., the Blue and the White Nile Rivers with adequate rainfall. According to the Nile Waters Agreement concluded between the Sudan and Egypt in 1959, the Sudan is entitled to the use of 18.5 milliard m^3 out of 84 milliard m^3 of Nile water annually.

The population density in the Sudan is low with about 16.5 million people in 1977 living in the area of about 2.5 million km^2. Transport network in the country is not yet fully developed. It is not easy for seasonal laborers to migrate to answer job offers. Labor shortage occurs frequently during peak labor demand period.

Irrigation and mechanized farming, thus, in the Sudan are of vital importance for the development of agriculture.

Irrigation and mechanized farming together form the modernized sector of the agriculture in the Sudan. The productivity of the modernized sector is relatively high as shown in Table 7.4. Though the area of irrigated land holds only 18.5 % of the total farm land on the average during 1973/74-1975/76 period, more than 50 % of the total production was derived from the irrigated land. Though the area of mechanized farm land holds less than 50 % of the total farm land, more than 70 % of the total production was derived from mechanized farm land on the average during the same period./1

As of 1975, the Sudan possessed about 1.68 million ha (4 million fedds) of farm land under irrigation of which about one million ha (2.3 million fedds) were cropped in the year./2 Most of the irrigated land were managed by public corporation type organizations such as the Sudan Gezira Board and the Public Corporation for Agricultural Production.

/1 : Some portion of the farm land is both irrigated and mechanized.

/2 : "A Summary of Growth, Employment and Equity", IBRD, 1975.

During the last seven years, 1,381 new mechanized crop production schemes were started in rainfed areas. Thus the mechanized crop area increased from about 690,000 ha (about 1.63 million fedds) in 1969/70 to about 1.42 million ha (3.38 million fedds) in 1975/76.

7.1.4 Six-Year Development Plan/1

(1) Introduction

The agricultural sector has been playing the leading role for the development of the economy of the Sudan and is expected to continue the role. In the Six-Year Plan, the first priority is put on the development of the agriculture and the biggest portion of the development budget will be spent on this sector/2.

(2) Objectives of the Six-Year Development Plan

The objectives of the Six-Year Plan for agriculture are given below.

i) Development of the crops and non-crops subsectors as a base for the development of the national economy and coordination of development of the other sectors with that of agriculture.

ii) Increase in production of irrigated crops by vertical expansion.

iii) Expansion of mechanized farming and review of crop sharing relations in existing projects.

iv) Integration of livestock with crop production projects.

v) Improvement and strengthening of mechanized crop production schemes.

vi) Improvement of agricultural services to support and protect crop production on flooded lands.

vii) Development and modernization of traditional, farming, improvement of conditions for nomads, and modernization of the pastoral activities.

/1: The information given in this section is based on "The Six-Year Development Plan", Ministry of National Planning.
/2: See Section 6.1.7.

viii) Development of animal wealth, control of diseases and improvement of production and marketing facilities.

ix) Tree plantation, soil conservation, preservation of forests, checking desert creep, and increase in production of forest products and gum arabic.

x) Development of wildlife and fisheries resources and improvement of fishermen's condition.

xi) Increasing storage facilities in keeping with the need for buffer stocks as well as export trade.

xii) Intensifying hydrological research and development of underground water resources in regions suffering from lack of drinking water.

xiii) Electrification of irrigation pumping sets to save petrol and increase pumping efficiency.

xiv) Strive for self-sufficiency in tea and coffer and any other product for which local conditions are suitable for production.

xv) Organization of an adequate and efficient primary marketing system for agricultural produce and control over activities of middlemen to ensure fair returns to small producers.

(3) Strategy and Policies

The strategy for the development of agriculture is twofold; vertical expansion and horizontal expansion.

Vertical expansion aims at optimizing resource utilization so as to increase the productivity of the land through:-

a) The optimal utilization of irrigated lands.

b) Consolidation, grouping and electrification of pumping schemes on the White and Blue Nile.

c) Integrating livestock in crop production schemes.

d) Adequate provision of fertilizers, insecticides, agricultural machinery, modern equipment and other inputs essential for raising productivity in existing projects.

e) Raising effectiveness of agricultural extension and research services.

f) Developing an efficient primary marketing system for all agricultural products.

g) Introduction of high yielding drought resistent varieties of crops in rainfed regions.

Horizontal expansion aims at the increase of agricultural production through the horizontal expansion of farm land mainly through mechanized farming and modernization of traditional farming.

(A) General Strategy:

i) Improving and increasing the supply of both surface and underground water so as to facilitate irrigation of new lands and to increase drinking water supply.

ii) Reclamation of arable lands with heavy machinery.

iii) Making available agricultural machinery to small farmers in rainfed areas to enable them to cultivate more lands.

(B) Mechanized Farming:

i) Supporting and improving the existing state farms by replacement of old machinery and provision of other imports.

ii) Diversification of crops through introduction of new crops such as sunflower, soybeans, maize and castor.

iii) Taking flood protection measures.

iv) Improving and developing transport and storage facilities.

v) Reactivation of private sector projects that are deteriorating in productivity.

vi) Establishing closer relations between the Mechanized Farming Corporation and the private sector so as to facilitate the provision of adequate facilities, guidance and services to the private farmers.

vii) Revising and rationalizing the basis of land rent and reclamation charges.

viii) Taking policy decisions to solve the problem of unauthorized utilization of land.

ix) To start massive semi-private sector projects for rainfed mechanized cultivation in Blue Nile, South Kordofan and South Darfur Provinces as well as in Northern parts of Bahr El Ghazal.

(C) Modernizing Traditional Sector:

i) Consolidating the studies and researches already done or under way to determine suitable project for mechanization of traditional agriculture.

ii) Establishing agriculture complexes and a network of research stations in all rainfed crop areas.

iii) Establishing modern ranches in savanah region.

iv) Encouraging and assisting the establishment of large agricultural cooperatives.

v) Encouraging the development of close relations between modern agricultural schemes (like Rahad) and the neighbouring traditional agriculture areas so that the latter would benefit from the production systems used in these schemes.

(4) Targets

Through vertical and horizontal expansion, crop production will be raised by big margin. Crop production targets for the fiscal year 1982/83 are shown in Table 7.5.

(5) Irrigation and Mechanization

In the irrigation sub-sector, rehabilitation and remodeling of the existing irrigation canals will be carried out aiming at removing all deficiencies in the existing system.

Implementation of both on-going and new irrigation projects are encompassed in the Six-Year Plan as well. The important projects included in the programme of the irrigation sub-sector are as follows.

i) Construction of Jonglei Canal which will increase available water both for the Sudan and the Egypt through the White Nile River.

ii) Construction of a dam and irrigation facilities at Upper Atbara which will stabilize water supply to New Halfa Project.

iii) Execution of Part II of Rahad Project which will add another 63,000 ha (150,000 fedds) of farm land for the production of cotton, ground nuts, fruits and vegetables.

iv) Continuation of Northern Area Pumps Project which will provide assured water supply to a highly productive area that was previously depending on flooding.

v) Continuation of "Electrification of White and Blue Nile Schemes" Project which has the dual purpose of saving petrol by electrifying the pumping sets and of increasing the pumping efficiency.

In the mechanized agriculture sub-sector, public funds will be invested to strengthen the state mechanized farms as well as to assist in rehabilitation of some private mechanized schemes which have been deteriorated in their productivity. Major developments in this subsector would, however, derived from the semi-private investments which will be made through the Arab Authority Programme in the Sudan. The new projects include the development of about 2.5 million ha (6 million fedds) under mechanized farming in the South Darfur, Blue Nile and Bahr El Ghazal provinces. The areas developed through these projects would produce over one million tons of sorghum and would also contribute to increase of the

production of ground nuts, sesame and cotton. Additional 210,000 ha (half a million fedds) would be brought under mechanized farming in the Southern Region.

(6) Investments on the Agriculture

The total planned investments in agriculture during the Six-Year Plan amount £s. 860 million i.e., about 32 per cent of the total investments of the Plan. The on-going projects are given priority for completion followed by needs of the completed projects for consolidation and improvement. Sub-sectoral allocations of the investments are shown in Table 7.6.

7.2 Agriculture in and around the Project Area

7.2.1 Present Land Use

Before implementation of the Jebel Aulia Dam, the lands in the project area had been extensively cultivated by the local inhabitant. According to the information obtained from the Agricultural Service office, Ed Dueim, out of about 20,000 ha (47,600 Feddans) of gross area, about 12,000 ha (28,600 Feddans) or 60 % of the gross area had been cultivated with the summer crop of sorghum (Dura) under rainfed conditions. Remaining 8,000 ha (19,000 Feddans) corresponding to 40 % of gross area had been left fallow due to waterlogging during the rainy season. The production of sorghum varied from 0.8 ton/ha to 1.5 tons/ha on an average, depending on the rainfall distribution. No ploughing and fertilizing had been practised. After the harvesting of sorghum, straws were used for feeding the livestock seasonally migrating from the outside area. No crops other than sorghum were harvested in the dry season.

After the Jebel Aulia dam was operated in 1937, all of the Project area was inundated consecutively from August to March. Thus, no farming was compelled to operate except grazing livestock by nomads in the dry season. The local people were compensated by the Government for the land and most of these people were moved to the adjacent area where the land was developed under irrigation schemes.

At present, most of the land in the plain lie waste and are covered with such wild grasses as lawn,reed-mace, reed, sedge, water-hyacinth and acacia scrub. In most of the high elevated lands along the western bank of the Gasaba plain and old remnant levees scattered in the plain, acacia trees were planted by the Government for producing the gum-arabic.

In some exceptional cases, some of the farmers grow vegetables and fruits, such as okra, water-melon, sweet-melon, cantaloupe on the limited land where the soils have sufficient moisture for their vegetation in the dry season. Rice is also cultivated in the flooding season, but very rare, at present. A semi-floating rice cultivation method was the dominant practice. The yield was as low as about 0.6 ton/ha (250 kg/Feddan) to 1.0 ton/ha (620 kg/Feddan).

According to the informations obtained from the local people and data from the Agricultural Services Office, Ed Dueim, the present conditions of the land use in the project area are shown in Table 7.7.

7.2.2 Agriculture in the Existing Pump Schemes

Before 1937, most of the lands surrounding the project area lay waste and the agricultural production was found only in a small part. In 1937 when Jebel Aulia dam was constructed, the Government had implemented pumping scheme in the Um Jerr area and started the irrigation farming. The first implementation of the private irrigation scheme was started with the use of primitive water-wheels (Persian type) operated by animal power, in 1950. Water-wheels were replaced by the motor-driven pump, in 1956. Both Governmental and private pump schemes rapidly extended all over the area along the White Nile under the rural development programme of the White Nile province. So far 89,700 ha (213,500 Feddans) of irrigated land has been developed over, of which about 25,480 ha (60,700 Feddans) or about 28.4 % of the total irrigated lands is in the area adjacent to the project area. The total acreage of 25,490 ha is divided into 18,540 ha (44,100 Feddans) of the State farm and 6,940 ha (16,600 Feddans) of the divisible farms. These farms are respectively provided with 28 Governmental pump schemes and 218 private pump schemes belonged to the individual farmers or groups of land owners as shown in Table 7.8.

In the above irrigation pump schemes, the crop production is usually operated with the three-year rotation system, namely, growing cotton in the first year, sorghum in the second year and followed by fallow in the third year. Following sorghum, such winter crops as wheat, onion, pea and beans etc, are also grown to some extent. Recently groundnut has been introduced into the rotation, namely cotton in the first year and then groundnut in the second year and thereafter left fallow, in the State farm.

The cropping takes place mostly under two types of farming system or management systems: (a) one is the State farm under the Governmental irrigation pump schemes and (b) the other is the individual farm under

the private irrigation pump scheme. In case of the State farms, the lands belong to the Government and the farmers cultivate these lands as tenants. Generally, tenants fully enjoy farming under sufficient security of the temure arrangement and share the profit from the farm products. At present, overall coordination and management of the State farm in the Gasaba area are being played by the Agricultural Corporation Offices in Ed Dueim and Kosti.

On the contrary, the individual farms are generally operated by the labourers, who are regularly and/or seasonally employed for daily wages, under direct management of the pump owner or land owner. These farm operations and management, particularly on the cotton cultivation are fully supported by the Government through the agricultural credit programme.

7.2.3 Irrigation and Farming Practices

In the project area, the rice cultivation is practiced in very limited area during in the flood summer season and some vegetables and fruits in the non-flood season. The farming practices are primitive and the cultivated lands are shifted year by year. The land for rice cultivation is selected in the low lying area where the flood water stands sufficiently long. Generally, seeding starts in mid-June to August when the field is still dry and harvesting in mid-November to December when the land is still flooded. The major work items in rice cultivation are shown in Table 7.9 .

As for the cultivation of vegetables and fruits, the lands are also selected in the low lying area where the soils retain enough moisture for vegetation for a sufficient period say longer than 90 days consecutively, even in the dry season. Generally, no regular field preparation except burning of grasses is practiced. In April to mid-May, the seeds are spottedly sown using wooden sticks. Harvesting of the products is in mid-June to mid-July, in general. During the crop season, no other practices except some thinning of melon nurseries are operated. Detailed descriptions of each product are summarized in Table 7.10.

In the area adjacent to the project area, semi-mechanized and irrigated farming is operated under the production programme of the State and the individual pump schemes. Cotton is grown under full security of irrigated conditions. While the sorghum, staple crop, is basically cultivated under rainfed conditions, and irrigation water is supplemented only during drought. The winter crops of wheat and onion and other vegetables as the second crops are mainly grown in the State farm.

The farm mechanization is made for field preparation such as ploughing and harrowing, ridging, ditching of water courses, etc. and transportation of the products after harvesting. The mechanization of harvesting work is being promoted to a small extent on the wheat cultivation. In the State farm, all the above works are conducted under direct management of the Agricultural Corporation Offices. In case of the divisual farms, these field preparations are made mostly by rented machinery. All of the other works, such as seeding, thinning of cotton nurseries, weeding, fertilizing, harvesting, etc. are played by the tenants and labourers themselves using hand tools.

Fertilizers are applied only for cotton and wheat at present. Dosage is 80 kg/Feddan (190 kg/ha) of urea for both cotton and wheat and it is properly applied by split drassing method. The plant protection is directly managed and operated by the Plant Protection Office under the overall plant protection programme prepared by the Directorate of Plant Protection, Ministry of Agriculture, Food and Natural Resources. Cotton is being taken up under this programme. The insecticides are also applied to wheat and groundmut by the use of handy sprayer but only a small extent so far.

In case of cotton production in the State farm, all of the farming expenditures are provided by the Corporation Office and these expenditures are subtracted from the gross value of the output after the harvesting. As for the cotton production by the individual farmers, most part of the farming expenditures are generally supported by the Government through the agricultural credit programme.

The detailed farming practices for the major crops are summarized in Table 7.11 and the average crop production cost is shown in Table 7.12.

7.2.4 Yield and Productions

No statistical data is available with regard to the agricultural production in the Project area. Agricultural production in this area is, at present, for small and is limited to the cultivation of semi-floating rice in the flood summer season and okra, water-melon, sweet-melon and cantaloupe in the non-flood spring season. The rice yield is estimated to be 0.6 ton/ha to 1.0 ton/ha and the average production of vegetables and fruits is 3.5 tons/ha for okra, 1,000 fruits/ha for water-melon and 1,500 fruits/ha for sweet-melon and cantaloupe, according to the data obtained by the interview with the farmers in Gasaba.

According to the annual statistics, in the existing pump scheme area adjacent to the project area the unit production of seed cotton per hectar varies from 0.5 ton to 1.2 tons. Generally, cotton production in the State farms is always higher than that of the individual farms. The yield of the other crops are, 1.1 tons/ha for sorghum; 0.8 ton/ha for groundnut; 0.4 ton/ha for wheat; 0.4 ton/ha for sesame and 5.1 tons/ha for onion which are rather low as compared with those in the Gezira Scheme, in spite of the similarity in soil and ecoclimatic conditions. It is considered that these lower production may be attributable to poor farm management and inadequate crop season which is one month or so behind that of the Gezira area due to availability of water. The crop season and yield of major crops in the Gasaba and Gezira areas are shown in Tables 7.13. and 7.14.

7.2.5 Livestock

Animal products form another important cash source in the Gasaba area. The following Table shows the livestock population in and around the project area.

Population of Livestock
(as of June, 1977)

Kind of Animals	Population (head)
Cattle	42,758
Sheeps	54,770
Goats	34,238
Camels	148
Donkies	5,159
Horses	158
Total	137,229

Note: Figures are obtained at the farm survey which covered 50 villages related to the project.

Among the above animals, cattle, sheeps and goats are mainly intended for sale. Annual yield is about 5,600 head of cows, 600 tons of milk, 17,800 head of sheep and 12,000 head of goats, respectively. Camels, donkies and horses are mainly used for transportation works. An animal power for farm operation is not expected owing to the farm mechanization which has become prevalent.

For the grazing of the animals, some improved pasture and feeder crops have been introduced into the farm land, but still very rare, at present. Most of the animals are, therefore, raised by the wild grasses and those are supplemented by the by-products and/or waste of sorghum, cotton, wheat, etc. The sedentary livestock and further migrating animals from outside area are being grazed in the project area during the nonflood season from April to July.

7.2.6 Land Ownership and Land Tenure System

The land in the Project area was traditionally owned by the local inhabitants and it is the same even after the Government compensation for the flooding caused by the construction of the Jebel Aulia Dam. The present land holding size is about 7.5 ha per household on an average. The land holding size and its distribution are summarized in Table 7.15.

The area adjacent to the project area are owned either privately or by the Government. An average size of land holding in the existing small pump schemes is about 33 ha per housefold. The maximum holding

size is 83.5 ha, while the minimum size is 3.34 ha. The land distribution by size is as shown in Table 7.16. In the Governmental pump schemes, the farmers as the tenants are allocated the land of 12 to 15 Feddans (eqv. 5.04 ha to 6.3 ha) per household on an average as shown in Table 7.17.

7.2.7 Farm Economy

On the basis of the results of the farm survey, the farm economy inclusive of income from agricultural products and animal products and revenue from outside works, farming cost, cost on animal raising and net income is estimated on the household basis as shown in Tables 7.18 to 7.23.

The farm income is mainly from the production of cotton and sorghum exclusive of home-consumption. The income from the production of fruits, vegetables, wheat, legumes, etc. is small in general. An average value of the gross income is £s 182 per household.

The income from animal products is obtained mainly from the cows, sheeps, goats and milk and/or cheese, yoghurt. The gross annual income per household is £s 121 on an average.

The expenditure on the farm products is £s 63 per household annually on an average. This expenditure is mainly for the cultivation of sorghum. The cost of cotton production is excluded from this expenditure, because it is directly controled by the Agricultural Bank.

The expenditure on animal product per household is £s 32 annually on an average. It is mainly for up-keeping of the animals such as vaccination, purchasing of fodders and salts, etc.

Based on both income and production expenditure, net annually income from agriculture and livestock is estimated at £s 208 per household on an average. Under rather low income condition, a standard livelihood is sustained by additional revenue obtained from outside works and some borrowing from relatives and/or local marchants. An annual income from outside works borrowing per household is £s 163 on an average.

Table 7.1 Area, Yield and Output of Major Crops

Product	1974/75			1975/76		
	Area ($x10^3$Feddans)	Yield (kgs/Feddans)	Output ($x10^3$MT)	Area ($x10^3$Feddans)	Yield (kgs/Feddans)	Output ($x10^3$MT)
1. Cotton	1,219	531	647	1,125	540	607
2. Sorghum	5,577	306	1,702	6,000	316	1,900
3. Wheat	591	461	269	622	500	311
4. Millet	2,576	156	402	2,500	160	400
5. Rice	15	492	7	24	500	12
6. Maize	197	231	46	210	250	53
7. Sesame	2,173	107	233	2,200	110	242
8. Ground nut	1,792	519	930	1,840	456	839
9. Sugar cane	40	32,250	1,290	40	30,230	1,200
Total	14,180	-	5,526	14,561	-	5,564

Source: Ministry of National Planning

Table 7.2 Total Area of Main Crops by Type of Irrigation 1970/71-1974/75

(10^3 fedds)

Season	Pump Irrigation		Flood Irrigation		Rainfed		Total	
	Area	%	Area	%	Area	%	Area	%
1970/71	2,029.4	18.2	212.7	1.9	8,887.6	79.9	11,129.7	100
1971/72	1,993.3	16.9	126.5	1.1	9,662.1	82.0	11,781.9	100
1972/73	2,036.0	16.0	148.4	1.2	10,531.9	82.8	12,716.4	100
1973/74	1,165.6	10.4	66.0	0.6	10,629.0	89.6	11,860.6	100

Source: Ministry of Agriculture, Food and Natural Resources

N.B.: Main Crops are Cotton, Sorghum (Dura), Millet (Dukhn), Wheat, Ground nuts, Sesame, Haricot Beans (Fasulia), Horse Beans, Castor, Chickpeas, Rice, Onion, Barley, Sugar cane, Maize and Elusine.

Table 7.3 Production Costs, Gross Returns and Net Returns per Ha for Various Crops in the Sudan Gezira Board/1

(£S/ha/year)

	Cotton	Sorghum	Ground nuts	Wheat	Rice	Vegetables/2
Cross Return	NG /3	41.5	102.6	82.9	247.6	399.3
Production Cost	59.6	27.9	53.8	64.6	234.0	194.7
Net Return	NG /3	13.6	48.8	18.3	13.6	204.6

/1 "Annual Report on Economic Surveys of Crop Production in the Gezira/Managil Scheme for Season 1976/77", Sudan Gezira Board, May 1977.

/2 Vegetables include tomato, pepper, egg-plant, sweet potato and onion. The cost and the returns are obtained by calculating weighted average of the vegetables.

/3 Not given in the report.

Table 7.4 Share of Different Production Sectors in Area and Production of Major Crops

Production Sector	3 years average 1966/67 - 1968/69		3 years average 1973/74 - 1975/76	
	Area (%)	Production (%)	Area (%)	Production (%)
Irrigated	22.4	53.8	18.5	50.3
Unirrigated	77.6	46.2	81.5	49.7
Public	27.6	54.9	22.3	51.6
Private	72.4	45.1	77.7	48.4
Mechanized	47.2	69.2	45.6	71.2
Traditional	52.8	30.8	54.4	28.8

Source: Ministry of National Planning.

Table 7.5 Production Targets of Major Crops

Product	Base Year 1976/77 (Provisional)			Target 1982/83			Annual increase in output
	Area	Yield	Output	Area	Yield	Output	
	$x10^3$ Feddans	kgs/Feddans	$x10^3$ MT	$x10^3$ Feddans	kgs/Feddan	$x10^3$ MT	%
1. Cotton	1,125	540	607	1,490	621	926	7.3
2. Sorghum	6,000	316	1,900	9,100	411	3,740	12.0
3. Wheat	622	500	311	890	750	668	12.6
4. Millet	2,500	160	400	2,800	185	518	4.4
5. Rice	24	500	12	100	570	57	29.7
6. Maize	210	250	53	315	380	120	14.6
7. Sesame	2,200	110	242	2,700	140	378	7.7
8. Ground Nut	1,840	456	839	2,900	541	1,568	11.0
9. Sugar Cane	40	30,230	1,200	288	30,210	8,700	39.1
Total	14,561	-	5,564	20,583	-	16,675	138.4

Source: Ministry of National Planning

Table 7.6 Sub-Sectoral Allocations of Six-Year Plan Investments

(10^3 £S)

Sub-Sector	Public Sector	Private Sector	Total	%
Services	71,274	-	71,274	10.0
Crops	143,380	181,770	325,150	45.4
Irrigation	155,177	-	155,177	21.7
Livestock	55,169	108,230	163,399	22.9
Total	425,000	290,000	715,000	100.0

Source: Ministry of National Planning.

Table 7.8 Existing Pump Schemes and Land Use Conditions

Region or Blocks	No. of Scheme	Gross Area (ha)	Cropping Area by Crop (ha)				Total Cropped Area(ha)	Fallow Area(ha)	Cropping Intensity
			Cotton	Sorghum	Wheat	Vegetable			
A. Government pump schemes:									
a) Ed Dueim region:									
(1) Western bank of Gasaba plain	12	11,940	4,370	3,580	600	-	8,550	3,990	0.72
(2) Um Jerr island	4	2,210	640	660	150	220	1,670	910	0.75
Sub-total	16	14,150	5,010	4,240	750	220	10,220	4,900	0.72
b) Kosti region:	12	4,390	1,470	1,540	850	70	3,930	1,380	0.89
Total	28	18,540	6,480	5,780	1,600	290	14,150	6,280	0.76
B. Private pump schemes:									
a) Ed Dueim region:									
(1) Western bank of Gasaba plain	33	1,220	260	120	-	30	410	830	0.34
(2) Abu Araki island	30	980	280	80	-	50	410	600	0.37
(3) Um Jerr island	52	2,070	310	130	-	30	470	1,650	0.22
Sub-total	115	4,270	850	330	-	110	1,290	3,080	0.30
b) Kosti region:	96	2,670	730	730	-	230	1,690	980	0.63
Total	211	6,940	1,580	1,060	-	340	2,980	4,060	0.43
Grant total	239	25,480	8,060	6,840	1,600	630	17,130	10,340	0.67

Note: (1) Vegetables are predominantly of leguminous crops and onion in winter cropping.
(2) Recently, ground nut is also introduced in this area but still now a small extent.
(3) Data source: a) Figures on the Governmental Pump Schemes are provided by the Agricultural Corporation Offices in Ed Dueim and Kosti
b) Figures on the Private Schemes are provided by the Agricultural Service Office in Ed Dueim and Kosti.

Table 7.7 Present Conditions of Land Use

Land Categories	Area	Proportional extent (%)
1. Forest lands (acacia trees & scrub);	2,950	14.8
2. Wild grass lands:		
- lawn and others	8,950	45.0
- reed-mace	4,000	20.1
- other swampy grasses	3,850	18.8
3. Cultivated land:		
- Vegetables	210	1.1
- Rice	40	0.2
Total	20,000	100.0

Note: (1) Uncultivated lands, such as forest land, wild grass land are delineated by interpreting the aerial photograph (1/40,000) provided by the Government.

(2) Cultivated lands are estimated on the basis of the information obtained at the interview with the farmers and by the data provided by the Agricultural Service Office, Ed Dueim.

Table 7.9 Farming Practices on Rice Cultivation in Gasaba Plain

Work items	Practices	Remarks
1. Field preparation;	- Weeding by hoe	- 15 man-day/ha
2. Seeding;	- broadcasting followed by ploughing by hoe	- seeding rate, 35 to 40 kg/ha - 15 man-day/ha - germination & nursery under rainfed, normally mid-July
3. Weeding;	- hand weeding by knife	- 2 times before flooding - 20 man-day/ha time
4. Harvesting;	- hand-cutting the panicles by knife	- use a small boat - 40 man-day/ha
5. Threshing	- hand beating	- 5 man-day/ton grains

Note: Data collected at the interviews with the farmers in Gasaba.

Table 7.10 Vegetables and Fruits in Gasaba

	Description	Okra	Water-Melon	Sweet-Melon
1.	Crop season;	- Apr. to Jul.	- Apr. to mid-Jul.	- Apr. to mid-Jul.
2.	Field preparation;	- weeding & hand-ploughing (15 M/D)	- weed burning (3 M/D)	- weed burning (3 M/D)
3.	Seeding rate;	- 3.0 kg/ha	- 3.5 kg/ha	- 2.5 kg/ha
4.	Thinning;	- 5 man/day/ha	- 5 man/day/ha	- 5 man/day/ha
5.	Weeding;	- 3 times (20 M/D)	- none	- none
6.	Farm inouts	- none	- none	- none
7.	Harvesting;	- 15 man/day/ha	- 10 man/day/ha	- 15 man/day/ha
8.	Average yield;	- 3.5 tons/ha	- 1,000 fruits	- 1,500 fruits

Note: Data are collected at the interviews with the farmers in Gasaba.

Table 7.11 Crop Season and Farm Management on Major Crops

	Description	Cotton	Sorghum	Wheat
1.	Crop season;	- Aug. to Feb.-Apr.	- Aug. to mid-Dec.	- Nov. to mid-May
2.	Major farm operation;			
	a) Maintenance of irrigation facilities	- Jul.	- nd operation	- Oct.
		- hand work on big canals (10 M/D)		- dicher (0.5 hr)
		- ditcher (0.5 hr)		
	b) Field preparation,	- mid-Jun. to Jul.	- mid Jun.	- Oct.
	- ploughing	- disc plough (2.5 hr)		- disc plough (2.5 hr)
		- some weeding	- disc plough (2.5 hr)	

-to be continued-

Description	Cotton	Sorghum	Wheat
- harrowing	- disc harrow	- no practice	- no practice
- farrow arrangement	- ridger (1.0 hr)	- ridger (1.0 hr)	- ridger (1.0 hr)
c) Seeding	- end-Jul. - Aug.	- mid-Jul. - Aug.	- end-Oct. - Nov.
	- seeds (30 kg)	- seeds (8.5kg)	- seeds (95 kg)
	- hand work (2 M/D)	- hand work (1 M/D)	- hand work (1 M/D)
d) Thinning	- mid-Aug.	- no practice	- no practice
	- hand work (3 M/D)		
e) Weeding	- 3 to 4 times	- 2 times	- 2 times
	- hand work (15 M/D)	- hand work (10 M/D)	- hand work (10 M/D)
f) Fertilizing	- 3 times by top dressing method	- no application	- 3 times by top dressing method
	- urea; (190 kg)		- urea (95 kg)
	- hand work (1 M/D)		- hand work (1 M/D)
g) Watering	- 12 times	- no practice	- 6 times
	- hand work (5 M/D)		- hand work (2 M/D)
h) Plant protection	- 3 times	- no application	- some
	- by air craft		- hand work (1 M/D)
i) Harvesting	- Feb. to Mar.	- mid Nov. to Dec.	- mid-April to mid-May
	- 3 to 4 times of picking	- hand work (15 M/D)	- hand work (15 M/D)
	- hand work (20 M/D)		
j) Control of product	- hand work (3 M/D)	- hand beating (5 M/D)	- hand beating (5 M/D)
	- 8 sacks	- 11 sacks	- 4 sacks

Note: - Information was collected at the interview with the farmers and data on the farm inputs were provided by the Agricultural Service Offices in Ed Dueim and Kosti.

- Figures show the requirement per ha.

Table 7.12 Crop Production Cost

(Unit: £s/ha)

Descriptions	Cotton	Sorghum	Wheat	Regumes	Vegetables
1. Field Preparation;					
- maintenance of irrigation facilities	7.9	0	0	0	2.4
- ploughing	4.8	4.8	4.8	4.8	4.8
- harrowing & ridging	2.4	2.4	2.4	2.4	2.4
(sub-total)	(15.1)	(7.2)	(7.2)	(7.2)	(7.2)
2. Farm inputs;					
- seeds	3.2	0.9	7.1	6.7	10.4
- fertilizers	22.8	0	13.6	0	some
- chemicals	4.8	0	0.8	0.8	some
- sacks for products	4.3	0.6	0.3	0.5	-
(sub-total)	(35.1)	(1.5)	(21.8)	(8.0)	(10.4)
3. Labour charges;					
- crop management	11.6	1.5	2.3	6.7	7.5
- water management	2.8	0	1.1	1.5	1.5
- harvesting & others	12.7	11.7	7.8	12.3	15.1
(sub-total)	(27.1)	(13.2)	(11.2)	(20.5)	(24.1)
Total	77.3	21.9	40.2	35.7	41.7

Note: - Cost on field preparation and Farm inputs is provided by the Agricultural Service office, Ed Dueim.

- Labour charges are estimated on the basis of the information obtained from farmers.

- These figures are to be refered by the farmers in irrigated land.

Table 7.13 Crop Seasons in Gasaba and Gezira Area

Crops	Gasaba area		Gezira area	
	Sowing	Harvesting	Sowing	Harvesting
Cotton	Aug.	Feb. to Apr.	mid-July	Feb. to Apr.
Sorghum	Aug.	mid-Nov. to mid-Dec.	Jun. to Jul.	Oct. to Nov.
Ground-nut	Jul.	mid-Dec.	Jun. to Jul.	Oct. to Nov.
Wheat	Nov.	mid-Apr. to Mid-May	mid-Dec. to Apr.	
Legumes	Nov.	Mar.	*	*

Table 7.14 Average Yield of Major Crops in Gasaba and Gezira Areas

Crops	Gasaba Area						Gezira Area
	Government Scheme			Private Scheme			
	Area (ha)	Product (tons)	Yield (ton/ha)	Area (ha)	Product (tons)	Yield (ton/ha)	Yield (ton/ha)
Cotton	6,480	5,084	0.78	1,580	762	0.48	1.23
Sorghum	5,780	5,890	1.02	1,060	1,439	1.35	1.33
Wheat	1,600	704	0.44	-	-	-	1.26
Legumes	290	167	0.57	-	-	-	0.84
Onion	-	-	-	340	1,746	5.13	6.05

Note: Figures on the Gasaba area are provided by the Agricultural Service Offices and the Agricultural Corporation Offices in Ed Ducim and Kosti.

Figures on the Gezira area are according to the Annual Report on Economic Surveys, season 1976/77.

Table 7.15 Land Holding Size and Its Distribution

(Project area)

Area (ha)	Less than 10	10.1 - 20	20.1 - 30	30.1 - 45	45.1 - 60	More than 60	Total
Proportion (%)	78.7	7.2	8.1	6.0	-	-	100

Note: Data were collected at the farm survey made on 245 households.

Table 7.16 Land Distribution by Size
(existing pump scheme in Gasaba)

Region or block	Less than 10 ha.	10.1 - 20 ha.	20.1 - 30 ha.	30.1 - 45 ha.	45.1 - 60 ha.	More than 60 ha.	Total
A. Ed Dueim:	3.5	0.9	34.5	37.2	8.9	15.0	100.0
- Western	0	3.0	48.5	27.3	9.1	12.1	100.0
- Abu Araki	13.3	0	20.0	53.3	6.7	6.7	100.0
- Um Jerr	0	0	34.0	34.0	10.0	22.0	100.0
B. Kosti:	8.3	11.5	56.2	21.9	2.0	0	100.0
Total	5.7	5.8	44.5	30.1	5.8	8.1	100.0

Note: Land Registration in 1976 provided by the Agricultural Service Offices in Ed Dueim and Kosti

Table 7.18 Income from Agricultural Products (Unit: £s)

	Less than 100	101 - 200	201 - 300	301 - 400	401 - 500	501 - 600	More than 600
Proportion of household (%)	9.7	75.5	7.7	2.1	1.3	2.5	1.2

Note: Data were obtained by interview with 245 farm families in Gasaba

Table 7.19 Income from Aninal Products (Unit: £s)

	Less than 100	101 - 200	201 - 300	301 - 400	401 - 500	501 - 600	More than 600
Proportion of household (%)	14.9	69.4	3.8	3.0	2.1	1.3	5.5

Note: Date were obtained by interview with 245 farm families in Gasaba

Table 7.17 Land-holding size of Tenant

Name of Schemes	Gross area	Annual cropping Area	No. of Tenants	Average holding size	Annual cropping area by tenant	Average cropping intensity
	(ha)	(ha)	(house-hold)	(ha)		
a) West bank of Gasaba:						
Um Takal	1,386	781	90	5.04	8.68	1.72
EL Magamu	1,330	828	204	6.30	4.06	0.64
Abu Gimri	407	278	80	5.04	3.47	0.69
EL Mineidrib	1,638	1,050	140	5.04	7.50	1.49
EL Mahala	605	353	82	6.30	4.30	0.68
EL Atstan	588	290	93	5.04	3.12	0.62
EL Firdous	319	195	47	6.30	4.15	0.66
EL Hilal	343	270	68	5.04	3.97	0.79
EL Rama	2,346	2,463	340	5.04	7.24	1.43
Gamar EL Gerdoud	1,134	1,170	290	6.30	4.03	0.64
Hayafa (North)	874	432	101	5.04	4.27	0.85
EL Fitouh	970	440	135	5.04	3.26	0.65
(Sub-total)	(11,940)	(8,550)	(1,670)	(5.64)	(5.12)	(0.94)
b) Um Jerr island:						
EL Salam	456	390	99	5.04	3.94	0.78
Mana	442	344	62	5.04	5.55	1.10
Falah Bogo	442	332	67	5.04	4.95	0.98
EL Tayef	870	604	154	5.04	3.92	0.78
(Sub-total)	(2,210)	(1,670)	(382)	(5.04)	(4.37)	(0.87)
(Total)	(14,150)	(10,220)	(2,052)	(5.88)	(4.89)	(0.83)

Note: Figures are modified from data provided by the Agricultural corporation office, Ed Dueim

Table 7.20 Expenditure on Farm Products (Unit: £s)

	Less than 100	101 - 200	201 - 300	301 - 400	401 - 500	501 - 600	More than 600
Proportion of household (%)	95.8	1.7	1.3	0.4	0	0.4	0.4

Note: More than £s 200 of farm expenditure is inclusive of the cost on cultivation of vegetables and/or fruits.
Data were obtained by interview with 245 farm families in Gasaba

Table 7.21 Expenditure on Animal Products (Unit: £s)

	Less than 100	101 - 200	201 - 300	301 - 400	401 - 500	501 - 600	More than 600
Proportion of household (%)	89.4	5.5	3.8	0.9	0.2	0.1	0.1

Note: Data were obtained by interview with 245 farm families in Gasaba

Table 7.22 Net income (Unit: £s)

	Less than 100	101 - 200	201 - 300	301 - 400	401 - 500	501 - 600	More than 600
Proportion of household (%)	2.5	8.7	83.5	3.5	1.5	0.6	0.2

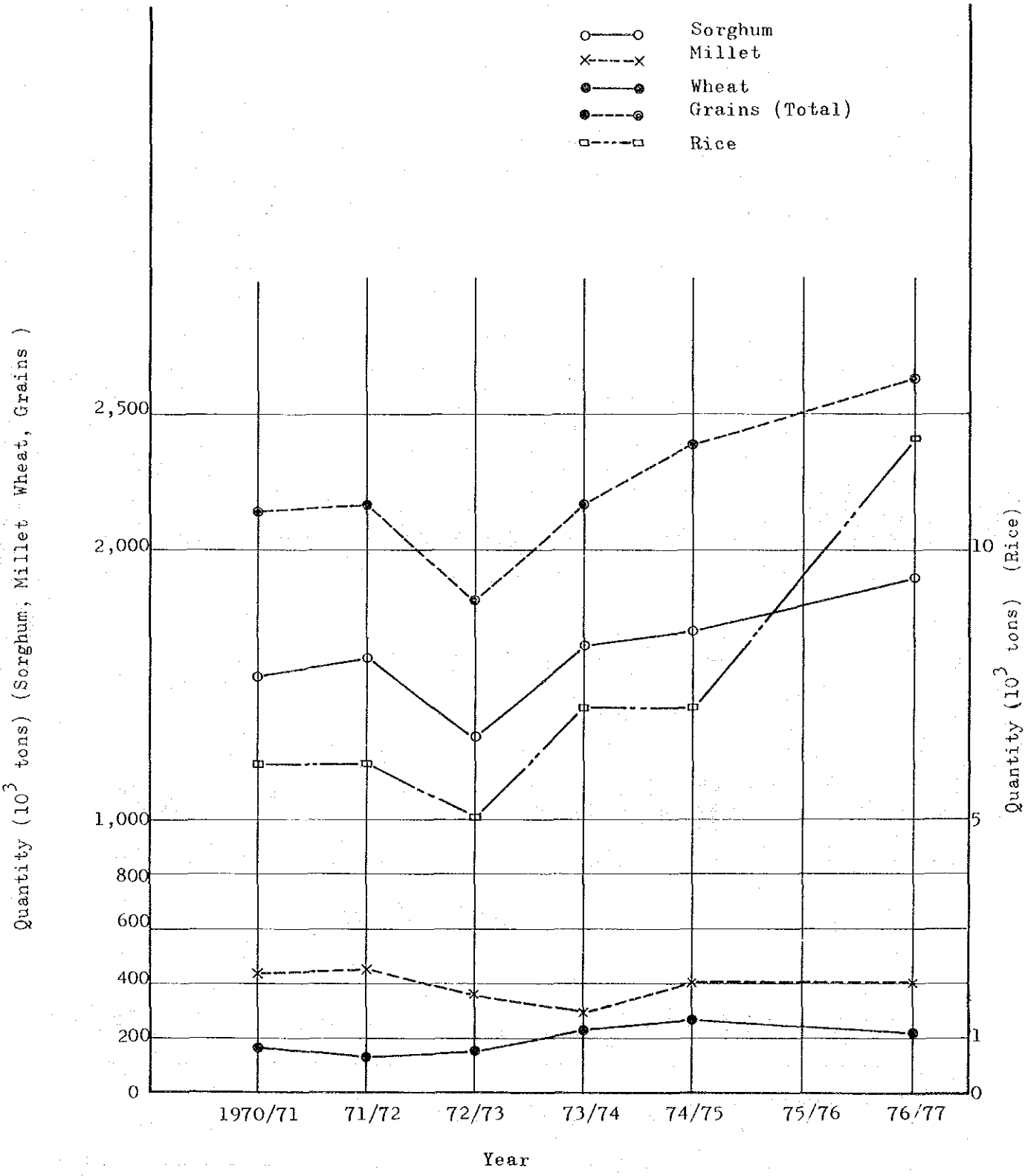
Note: Data were obtained by interview with 245 farm families in Gasaba

Table 7.23 Revenue from outside works (Unit: £s)

	Less than 100	101 - 200	201 - 300	301 - 400	401 - 500	501 - 600	More than 600
Proportion of household (%)	9.8	80.8	4.3	1.7	0.9	1.3	1.2

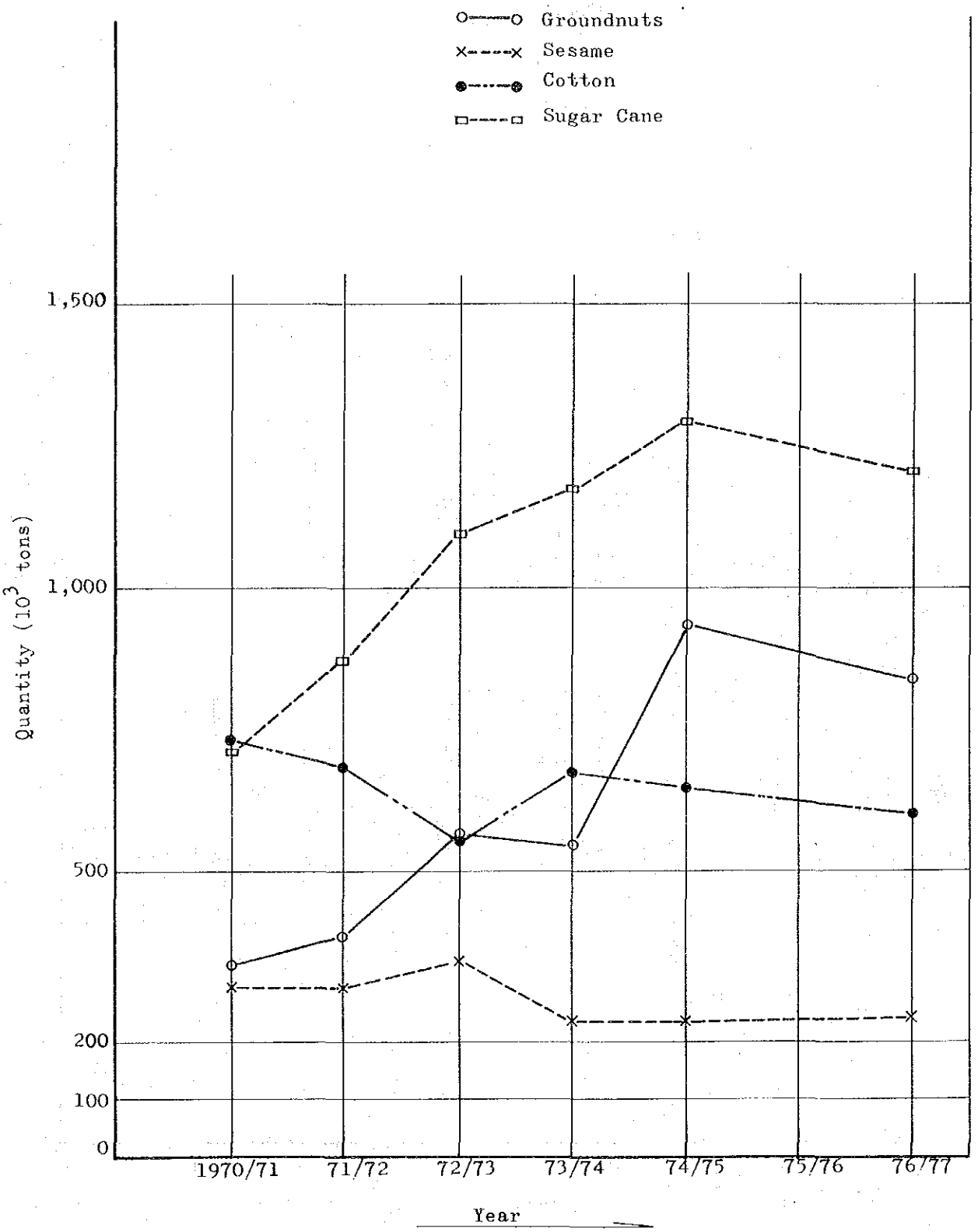
Note: Date were obtained by interview with 245 farm families in Gasaba

Fig. 7.1 Production Levels of the Grains



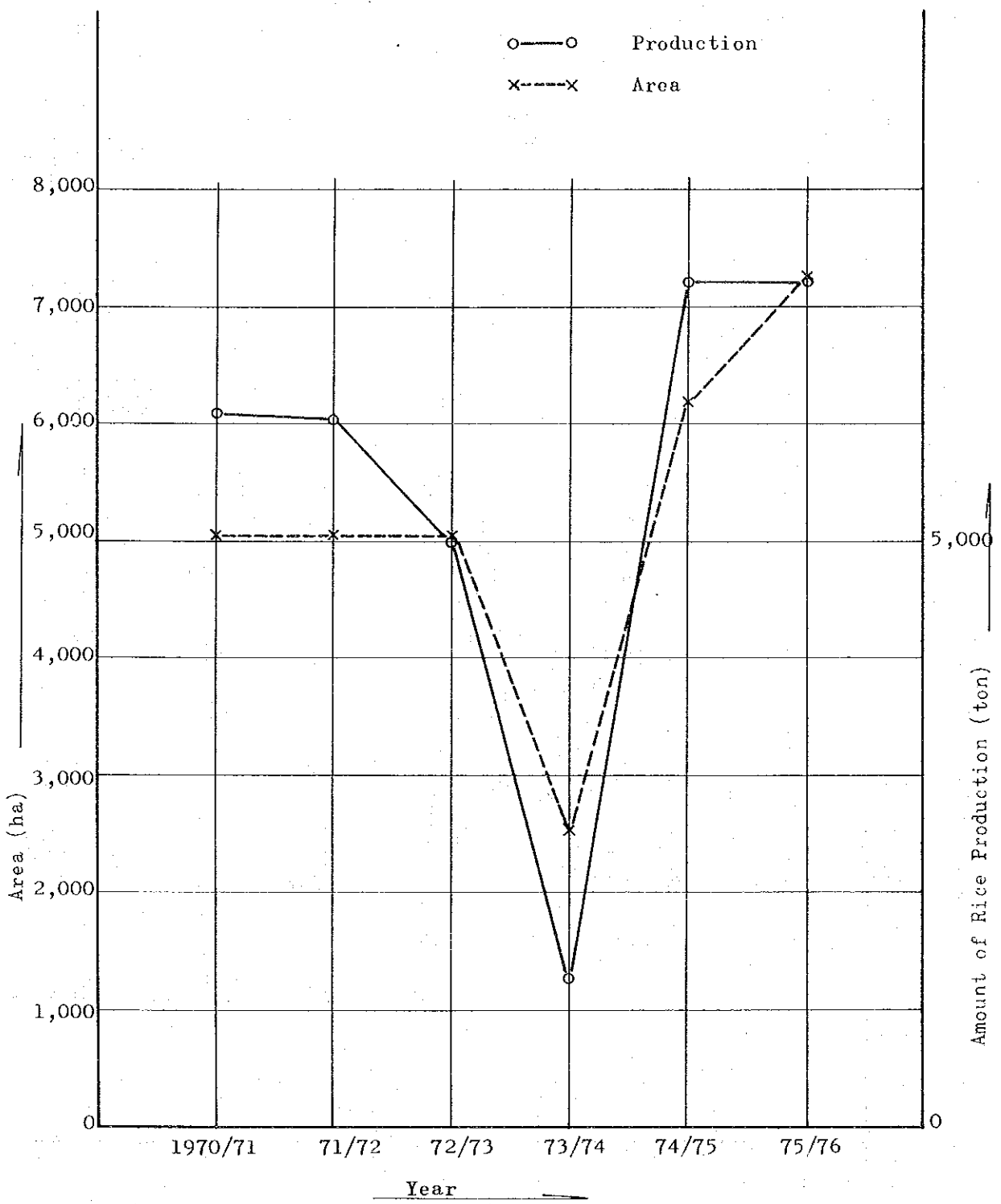
Source: Ministry of National Planning

Fig. 7. 2. Production Levels of Crops



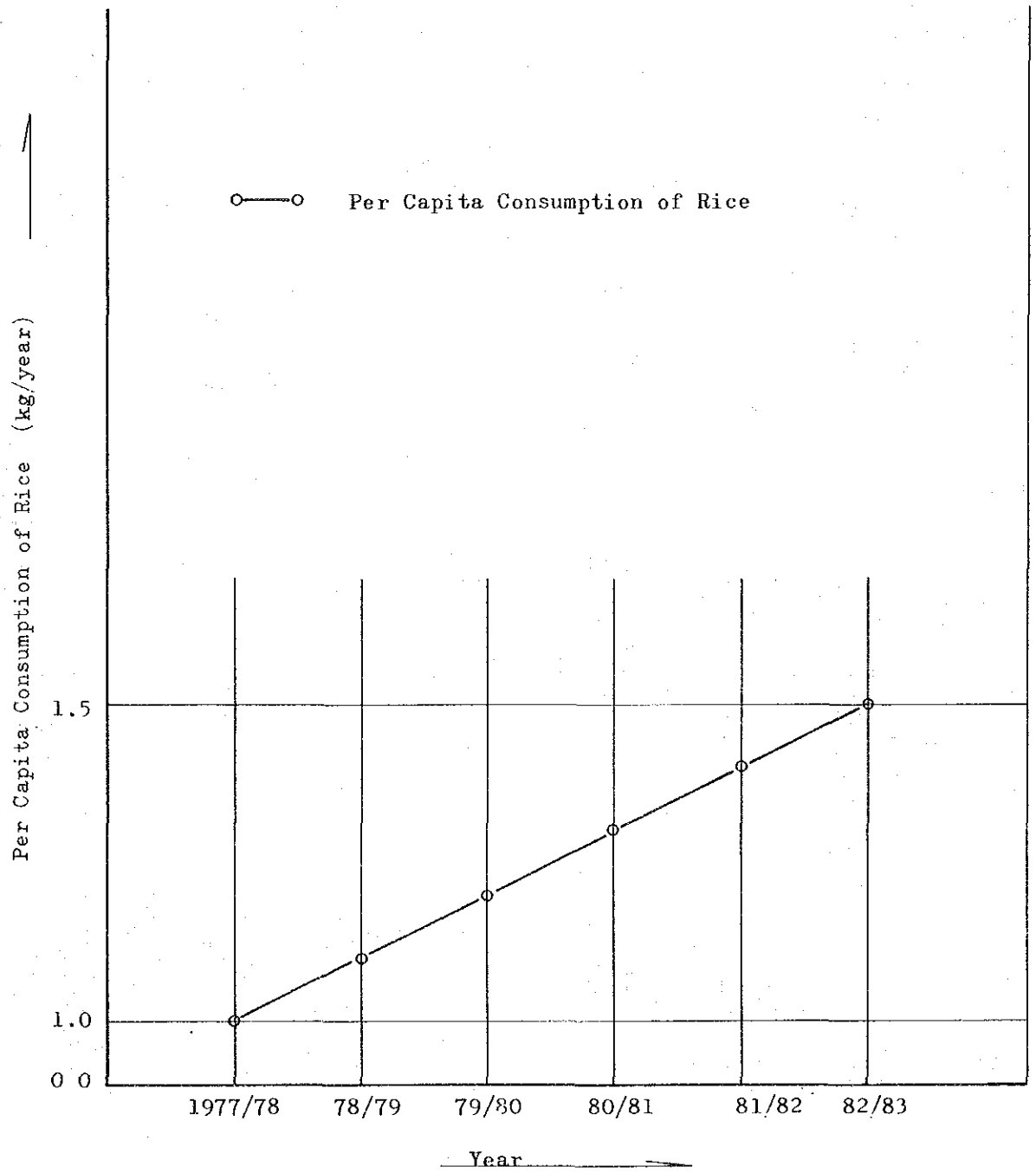
Source: Ministry of National Planning

Fig. 7. 3 Area and Production of Rice



Source: Ministry of National Planning

Fig. 7.4 Projected Per Capita of Rice Consumption



Source: "Six-Year Development Plan", Ministry of National Planning

ANNEX VIII

AGRICULTURE

ANNEX VIII

AGRICULTURAL SUPPORT SERVICES

		Page
8.1	Agricultural Services	VIII-1
8.1.1	General	VIII-1
8.1.2	Extension Services	VIII-1
8.1.3	Plant Protection	VIII-3
8.1.4	Agricultural Research	VIII-3
8.2	Cooperation with Farmers' Organization	VIII-5
8.3	Credit System	VIII-7
8.4	Agricultural Education and Training	VIII-9
8.5	Six-Year Development Plan	VIII-11

Tables

8.1	Loans by the Agricultural Bank (During the Period 1970 - 1975)	VIII-12
8.2	Public Sector Projects in Agriculture	VIII-13

Figures

8.1	Organization Chart for the Ministry of Agriculture, Food and Natural Resources	VIII-15
8.2	Organization Structure for Cooperation Unions	VIII-16

VIII. AGRICULTURAL SUPPORT SERVICES

8.1 Agricultural Services

8.1.1 General

The Ministry of Agriculture, Food and Natural Resources is responsible for rendering agricultural services for the farmers in the Sudan in cooperation with other concerned ministries and organizations including the Ministry of Irrigation and HEE, Ministry of Finance, Planning and National Economy, Agricultural Bank and Ministry of Education.

In the Ministry of Agriculture, Food and Natural Resources, three state ministers are assigned under the Minister. They are responsible for agricultural production, agricultural planning and development and research and services, respectively. There are four undersecretaries under the Minister i.e., the First Undersecretary, Undersecretary for Agricultural Services, Undersecretary for Animal Resources and Undersecretary for Natural Resources. The organization chart of the Ministry is given in Fig. 8.1.

The agricultural services for crop production are mainly rendered by the administrations supervized by the Undersecretary for agricultural services. Agricultural research activities are carried by the Agricultural Research Corporation.

There is no fertilizer factory nor agro-chemical factory in the Sudan. All the fertilizers and agro-chemicals used in this country have been imported from abroad. By 1971, fertilizers are imported through the Agricultural Bank, afterwards by the Sudan Gezira Board.

8.1.2 Extension Service

The Agricultural Extension and Education Department of the Ministry of Agriculture, Food and Natural Resources is responsible for agricultural extension service. It has regional branches which are shared by two other administrations of the same ministry i.e., the Plant Protection Administration and the Horticulture Administration in the provinces and they conduct extension services for the farmers. The objectives of their activities are as follows:

a) Giving advices to farmers about farming practices; starting from land preparation up to harvesting. This activity is of vital importance specially for the rice crops which are newly introduced in the area.

b) Encouragement and development of rural youth capabilities.

c) Teaching and giving advises to farmers and rural families about home economics. This work is mainly directed towards the improvement of the living conditions such as food making, handicrafts, childcare, sewing, etc.

To transmit the information to the farmers and the rural societies, the extension workers have been utilizing the following methods and measures.

a) Demonstration farms

b) Local leaders selected from the farmers. Extension officials instruct and train these leaders so that they become capable of conveying agricultural information and convincing other farmers to adopt the most suitable farming practices and the new technology in order to increase the productivity of agriculture.

c) Lectures, agricultural circulars, periodicals, meetings and discussion among farmers, radio, television and mobile cinema.

The regional branches under certain circumstances, do small scale research works such as experimental farms in cooperation with the Research Corporation stations. Usually the staff for extension services in the regional offices are consisting of agricultural extension inspectors agricultural extensionists, and home economists.

There are two regional Branches around the project area. One is located in Ed Dueim and the other is in Kosti. In the Dueim Branch, the Agricultural Administration possesses five staffs consisting of university graduates and senior high school graduates. In the Kosti Branch, it possesses ten staffs. The Administration is suffering the same kind of difficulties in the two offices. Number of staff is not adequate. Transportation facilities (automobiles) are not adequate. Budget appropriated is not sufficient to achieve the objectives. The officials can not find farmers during their visits quite often. Farmers sometimes do not pay attention to the information which are of vital importance for their farming activities.

The introduction of rice production into the Sudan is very recent. Farmers do not possess sufficient knowledge for rice production. Number of agricultural extensionists who are eligible as rice extensionist, however, is almost nil in the two offices.

8.1.3 Plant Protection

Plant Protection Administration of the Ministry of Agriculture, Food and Natural Resources is responsible for extermination of pests which are harmful to crops. It is responsible for eradication of national pests such as rates, desert locust, grain eating birds. It is also responsible for control of water hyacinth which is prevalent in the White Nile River and is considered as national danger. They enter in crop fields either by flood or by irrigation water and become noxious weeds. The expenses for the extermination of national pests and water hyacinth are born by the Government.

Some of the staff of the Plant Protection Administration has been transferred to the Public Corporation for Agricultural Production. They have formed a plant protection section in the Corporation and are engaged in plant protection activities including their salaries, insectivide cost and transportation cost.

If they are asked, they carry out plant protection activities for the private pump scheme owners in their schemes. In this case, the owners must bear all the expenses associated with these activities.

In the Dueim Branch, the Plant Protection Administration owns 167 staffs with 5 land-rovers, 2 lorries and one tractor. The amount of the budget is sufficient. The number of vehicles will be sufficient with one or two additional cars. The number of staffs is, however, not adequate. Moreover, all the staffs and the facilities are located in the Dueim Branch and the Kosti Branch, preventing easy access to the distant part of the area. Establishment of additional branches would be desirable.

8.1.4 Agricultural Research

Agricultural Research Corporation conducts research works for production of field and horticultural crops. The Corporation is directly

financed by a block sum of money from the Central Government budget. The Corporation's act also makes it possible to finance from proceeds from sale of crops and other products of the Corporation, grants donated by agricultural bodies and other local and international institutions or fees paid for services rendered by the Corporation.

The Technical Committee and Agricultural Research Council formulate research programmes and write out annual research report. A number of specialized committees such as pest and disease committee, crop husbandary committee whose members are from the Research Corporation and other organizations discuss research results and propose recommendations.

The Research Corporation controls four regional stations and six substations. The regional stations are:

Gezira Research Station	One director and 31 scientists
Hudeiba Research Station	Head and 9 research workers
Kenana Research Station	Head and 8 research workers
Yambio Research Station	Not functioning at this moment.

The research substations are:

Shambat Research Station	Head and 1 research worker
Kadugli Research Station	Head and 1 research worker
Sennar Research Station	Head and 2 research workers
Maatuk Research Station	One scientist
Guneid Research Station	Head and 2 research workers
Khashm Girba Research Station	Head and 3 research workers

Research activities of these stations consist of crop husbandry, phytopathology, plant selection and breeding, entomology, soil science and others.

No regional stations nor substations exist near the project area, neighter in the White Nile Province. The only research activities are carried by the Extension Department through the liaison offices in Ed Dueim and Kosti in cooperation with the nearest regional research station i.e., the Gezira Regional Research Station. No research activities for rice production are carried out around the project area and in the White Nile Province.

8.2 Cooperation with Farmers' Organization

To achieve higher efficiency in agricultural sector, cooperative unions and cooperatives have been formed. The Central Cooperative Union in Khartoum controls regional cooperative union in each province. Each regional cooperative union supervises local cooperative unions in each province. The organization chart for the above-mentioned system in the White Nile Province is shown in Fig. 8.2.

Local government assigns one assistant commissioner as shown in the chart for cooperation with farmer's organization. He also supervises the local offices of the Cooperative Department of the Ministry of Finance, Planning and National Economy.

The local offices of the Cooperative Department assumes the following responsibilities:-

a) Conducting studies on the necessity and the feasibility of formation of cooperatives.

b) Formation of cooperatives if the studies show that it is necessary and feasible.

c) Administrative and financial supervision.

d) Auditing the financial position of cooperatives every year.

The staff of the local offices are usually consisting of cooperation inspectors, cooperation officers, and cooperation controllers.

In the surrounding area of the project area lying in the Dueim District, there are 9 cooperatives in various kinds i.e., multipurpose, agricultural production, flour milling, dairy, bakery and passenger transportation. The total number of participants in these cooperatives totals 1,393 in 1977. In the surrounding area of the project area lying in the Kosti District, there are 8 multi-purpose cooperatives and one flour milling cooperative. Two agricultural production cooperatives are under construction.

These cooperatives posses common problems and constraints as follows.

i) The elected committees for running the cooperatives is not always know-how familiar with technical matters nor experience in cooperative management.

ii) Most of the rural people can hardly recognize the objectives and benefits of cooperatives.

iii) Due to the problems mentioned above, there are always personal disputes among the members of the same cooperative which in some cases result in failure of the cooperatives.

To solve these problems, adequate information about the objectives and benefits from agricultural cooperatives should be provided for the farmers concerned and training of leading farmers who are capable of the management of agricultural cooperatives is required. These activities will lead to higher participation of farmers in the agricultural cooperatives. The number of staffs of local offices in Ed Dueim and in Kosti of the Cooperative Department which is responsible for these activities is not adequate at present.

8.3 Credit System

The Agricultural Bank was established in 1959 to develop agricultural and agribusiness in the Democratic Republic of the Sudan. The paid-in capital in 1976 was L.S. 15 million which was shared by the Bank of Sudan and the Ministry of Finance, Planning and National Economy. The Bank has 20 branches in the nation including those in Kosti and in Ed Dueim.

The Bank provides three kinds of loans i.e., 1) short-term or seasonal loan, 2) medium-term loan, and 3) long-term loan. Main objectives and loan conditions of the loans are as follows:

(1) Short-term or seasonal loan:

This loan is to be used for running expenses farming, storing and marketing expenses. Crop should be put in security. Interest rate is 7 % and the maximum repayment period is 15 months. Total amount of loan lent by the Bank from 1959 through February 1976 was L.S. 14.5 million.

(2) Medium-term loan:

This loan is to be used for burchasing agricultural machinery. Estates, (land or building) should be put in security. Interest rate is 9 % per annum for indivisuals and 7 % per annum for cooperatives and the maximum repayment period is 5 years. Total amount of loan lent from 1959 through February 1976 was L.S. 7 million.

(3) Long-term loan:

This loan should be used for capital investment. Estates should be given to pledge. A letter of guarantee whose financial position is good enough is also required. Interest rate is 9 % per annum for indivisuals and 7 % per annum for cooperatives, respectively. The maximum repayment period is 10 years. Total amount of loan lent by the Bank from 1959 through February 1976 was L.S. 0.27 million.

The amount of loans lent by the Bank from 1970 through 1975 is shown in Table 8.1. Besides these loans, the Bank used to finance cotton from

1959 through 1969. The total loans granted for this purpose amounted to Ls. 61.8 million.

The activities of the Bank is not only providing loans to farmers and agribusinessmen but also engaging in storing, transportation and marketing of proceeds on behalf of lessees under certain circumstances. The Bank also imports agricultural inputs including fertilizers and agricultural machinery.

In the Dueim office of the Agricultural Bank, £.S. 185,000 is allocated annually for loans. Greater portion is usually advanced for cotton producers. In the year 1974/75 £.S. 169,000 was lent and £.S. 137,000 in the year 1975/76. Last season no cotton was grown in Dueim area. Consequently, only £.S. 22,000 was advanced through the office.

Agricultural sector is dominating sector in the Sudan. Its share in GDP is about 40 % and more than 70 % people are engaged in agriculture. Its share in export is over 95 % and about 50 % of government revenues are derived from this sector directly and indirectly. To develop the economy of the Sudan further and to improve the living standard of the Sudanese people whose GDP per capita was £.S. 98 in 1974, *strengthening of the productivity of the agricultural sector is urgent.*

The amount of loans lent by the Bank were not sufficient so far as shown in Table 8.1. Further, the biggest portion is appropriated for the short-term loans and only smaller portion is allocated for the medium and long-term loans.

8.4 Agricultural Education and Training[1]

Agricultural education and training are of vital importance for the development of the agriculture in the Sudan.

They are conducted at five levels:

i) Agricultural secondary schools (under the Ministry of Education).

ii) Agricultural training colleges and schools (under the Ministry of Agriculture).

iii) Faculty of Agriculture (University of Khartoum).

iv) Post graduate training (mainly abroad)

v) Vocational Training Centers.

The secondary schools select pupils with 9th grade passes and give them either an arts or a science-oriented training in agriculture of engineering for four years.

Shambat Agricultural College is the only agricultural training college for training people for intermediate diploma level, below university standards. The College provides a three year course in general agriculthre, oriented towards applied and practical training and leading to a Diploma in Agriculture. Its entrants are selected from students with Higher Secondary Certificate of Education i.e., after 12 years of education.

Candidates for the BS of Agriculture are selected from the high level passes in the Higher Secondary Certificate of Education after 12 years of school. The Facultyof Agriculture covers not only crop husbandry but animal husbandry, range management and forestry. Practical training is limited but arrangements are made for study and work tours during vacations to projects in the rural areas.

It is planned to increase post graduate training within Sudan rather than abroad in more general fields than is normally given abroad aiming at usefulness and relevance to the Sudan.

The vocational training centers are established with the purpose of training skilled laborers under the management of the Department of

[1] Information about agricultural education is obtained through the Ministry of Agriculture, Food and Natural Resources and the Ministry of Education. Information about training centers are based on the data given in "Basic Study of Industrial Development in the Middle East", International Development (enter of Japan, 1977.)

Labour, Ministry of Public Service and Administrative Reform. They provide the training courses of three years mainly for those who have completed junior high school level education. The courses are mainly consisting of mechanical, electrical, automobile and farm machinery engineering. The centers and their capacities are given below.

Center	No. of Trainees
Khartoum Vacational Training Center	600
Wad Medani Vocational Training Center	170
May Vocational Training Institute	150
Kosti Vocational Training Center	50
Port Sudan Vocational Training Center	200
El Obeid Vocational Training Center	200

Role of mechanized farming is of vital importance for the development of the agriculture in the Sudan. As mechanized farming develops in the Sudan, needs for farm machinery operators and mechanics will be strengthened. For meeting the needs two farm machinery centers are completed and one center is planned to be completed at the end of 1977. The centers and their capacities are given below.

Center	No. of Trainees
Tozi Farm Machinery Center	250
Nyala Farm Machinery Center	220
Malakal Farm Machinery Center/1	60

The needs for agricultural experts and farm machinery operatos and mechanics will be intensified as the agriculture in the Sudan develops further. Reinforcement of agricultural education and training is strongly recommended.

/1 Planned to be completed at the end of 1977.

8.5 Six-Year Development Plan

In the agricultural service sub-sector of the agricultural sector, 8 projects have been completed and 19 projects are under construction. According to the Six-Year Development Plan, 20 new projects will be implemented aiming at improvement of agricultural services as an essential prerequisite to the realization of the productivity targets. The names and the investment costs of these projects are shown in Table 8.2. After the Plan period, capacity of governmental institutions for agricultural development is expected to be improved. Consequently, agricultural support system will be improved. To exploit the huge agricultural potential of the Sudan, however, further intensification of the agricultural support system will be required.

Table 8.1 Loans by The Agricultural Bank
(During the period 1970 - 1975)

(10^3 £s)

	Short-term loans	Medium term loans	Long-term loans	Total
1970	1,281	598	12	1,891
1971	814	590	65	1,469
1972	1,209	332	28	1,569
1973	1,909	479	6	2,394
1974	2,380	391	-	2,771
1975	3,087	1,289	-	4,376
	Grand total			14,470

Source: Bank of Sudan

Table 8.2 Public Sector Projects in Agriculture

Services Sub-sector: (Cost 10^3 £s)

Project Number	Project	Class	Total	Local	Foreign
1.	Jebel Marra Project	O	4010	1855	2155
2.	Expansion of Horticultural Crops	O	1000	1000	-
3.	Fruits and Vegetable Production in Red Sea Province	N	150	150	-
4.	Improvement and Export of Vegetables	N	50	30	20
5.	Tombul & Tozi Machinery Centres	N	400	261	139
6.	Sag El Naam Project	O	2100	1182	918
7.	Experimental Rice Farm, White Nile	O	404	404	-
8.	Farm Machinery Training Centre Tozi	E	110	71	39
9.	Agricultural Planning Unit	N	220	208	12
10.	Agricultural Census	N	1220	860	360
11.	Agricultural Economics & Marketing	N	1772	1406	366
12.	Agricultural Administration in Provinces	N	1095	1095	-
13.	Agricultural Laboratory, Atbara	N	168	168	-
14.	Agricultural Extension Units	E	400	250	150
15.	Training Programme (extension)	O	500	400	100
16.	Strengthening Main Seed Stations	E	801	504	297
17.	Construction Main & Subsidiary Stations for Seed Multiplication	N	1199	799	400
18.	Soil Survey Dept.	E	1081	699	382
19.	Construction Nyala & Hodaiba Stations	N	752	716	36
20.	Strengthening Section on Stored Grain Pests	N	2000	1034	966
21.	Control of Water Hyacinth	O	3000	1500	1500
22.	Plant Protection Services	E	3000	1500	1500
23.	Control of Horticultural Pests	O	1000	500	500
24.	Remodelling Existing Research Stations	E	2043	1601	442
25.	Kadugli Research Station	O	804	728	76
26.	Expansion Fisheries Research	O	304	256	48
27.	Wildlife Research	O	225	102	123
28.	Pastures Research	O	277	238	39
29.	Forestry Research	O	458	370	88

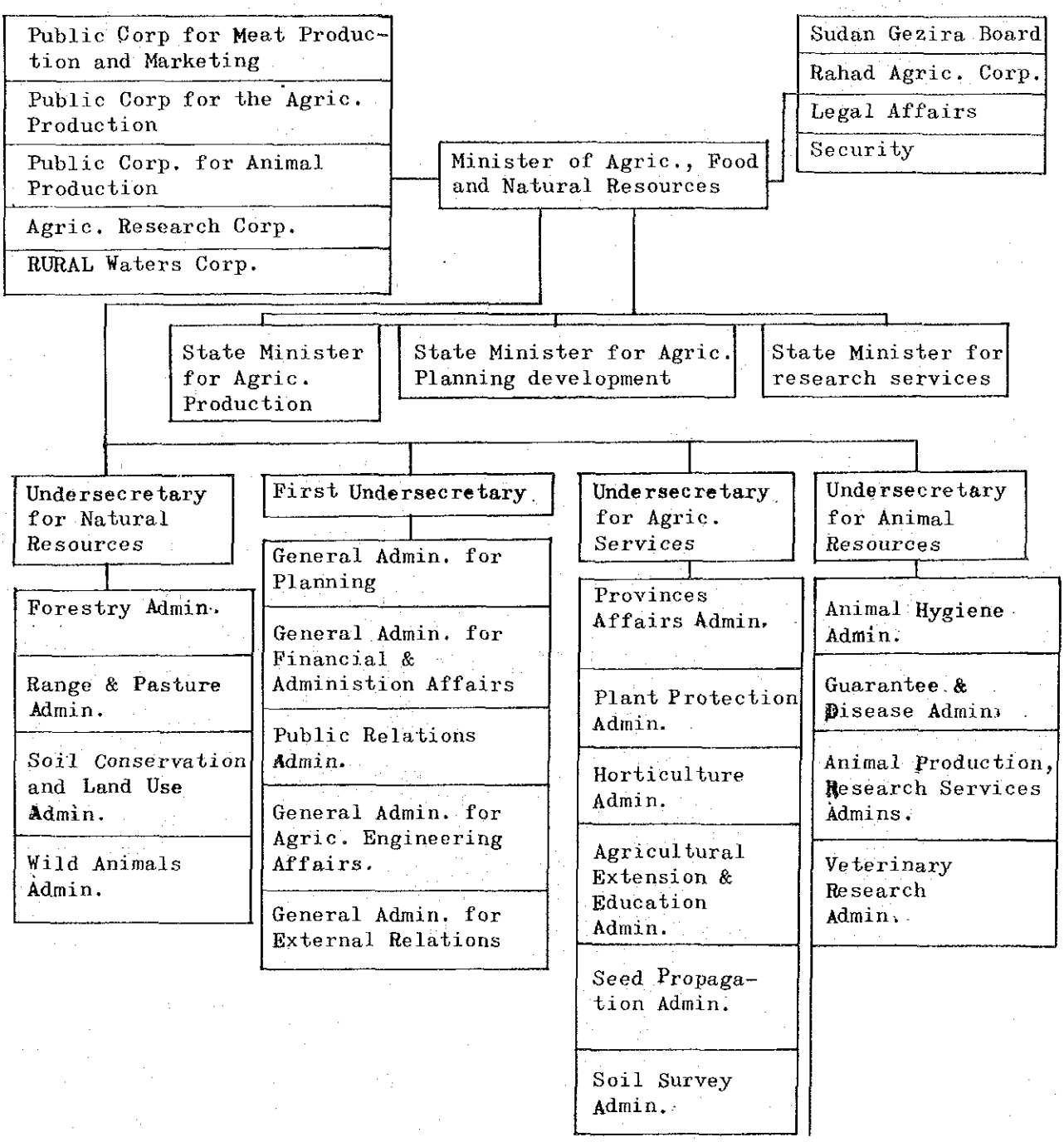
1/: "O" for on-going projects, "E" for existing completed projects and "N" for new projects.

(continued)

Project Number	Project	Class	Total	Local	Foreign
			(Cost 10^3 £s)		
30.	Agricultural Research in S. Region	N	827	702	125
31.	Northern Province Research Station	N	462	402	60
32.	Surface Water Research	O	1000	700	300
33.	Groundwater Research	O	2200	1000	1200
34.	Improvement of Hafirs & Reservoirs	E	5000	3000	2000
35.	Dutch aid for Potato Research	N	267	100	167
36.	Strengthening Watering Points	E	1640	440	1200
37.	Yugoslav aid, Maintenance Workshop	N	5000	1000	4000
38.	Savanah Development	O	6710	2673	4037
39.	South Photo Interpretation	O	3509	1509	2000
40.	Aerial Photo Interpretation	O	675	357	318
41.	Survey of Nomads for Improvement of nomadic Sector N. Sudan	N	140	104	36
42.	Land Use, Studies for Settled Communities	N	750	572	178
43.	Experimental Schemes for Soil Conservation and Improvement	N	1500	1049	451
44.	Possibility of Pumping Water from Seasonal Streams	N	250	165	85
45.	Storage Projects	N	9968	5664	4304
46.	Laboratories	O	240	115	125
47.	Improvement of Water Services	O	160	160	-
	Total		71,274	40,199	31,075
		O	28,276	14,600	13,676
		E	14,075	8,065	6,010
		N	28,923	17,534	11,389

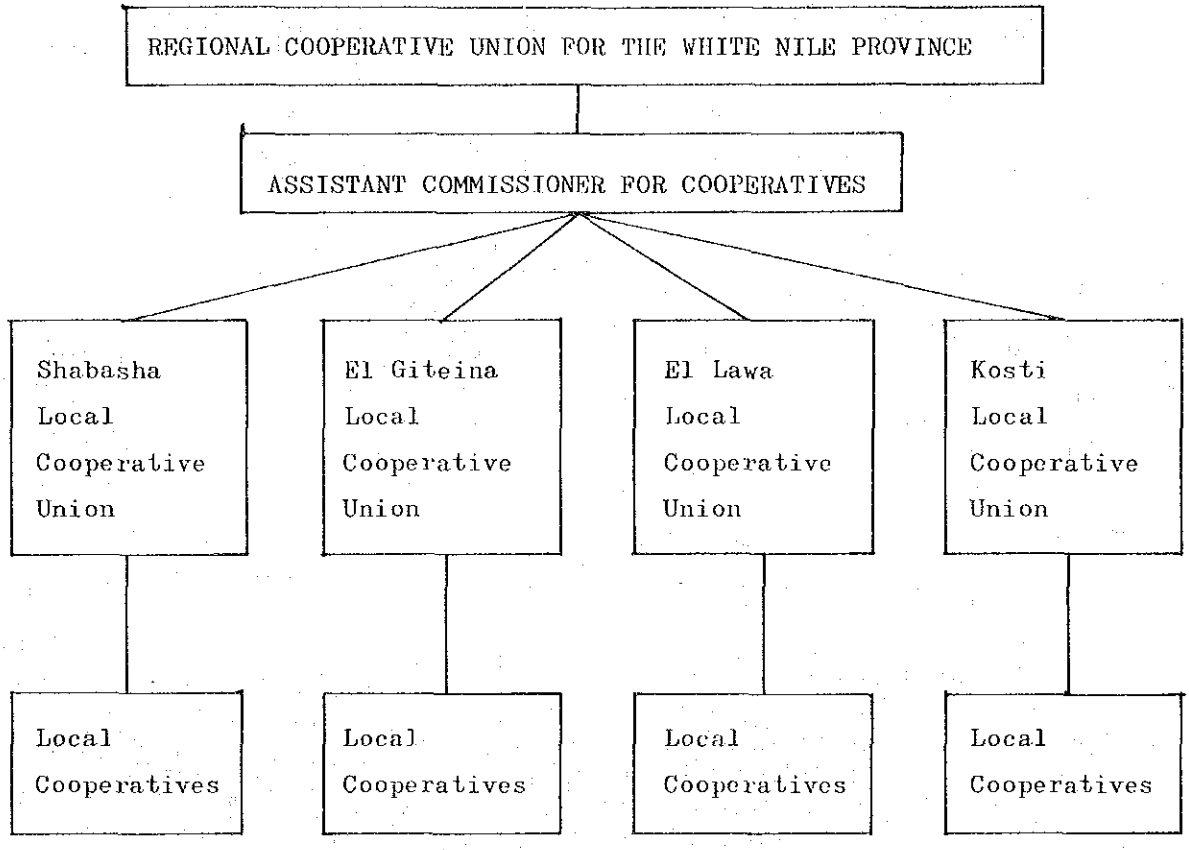
Source: "Six-Year Development Plan", Ministry of National Planning.

Fig. 8.1 Organization Chart for the Ministry of Agriculture, Food and Natural Resources



Source: Ministry of Agriculture, Food and Natural Resources.

Fig. 8.2 Organization Structure for Cooperative Unions



Source: Provincial Headquarters in Ed Dueim.

ANNEX IX

IRRIGATION DRAINAGE REQUIREMENT

ANNEX IX

IRRIGATION AND DRAINAGE REQUIREMENT

		Page
9.1	Irrigation Requirement	IX-1
9.1.1	General	IX-1
9.1.2	Potential Evapotranspiration	IX-1
9.1.3	Consumption Use of Water	IX-2
9.1.4	Pre-irrigation Requirement and Percolation Rate	IX-2
9.1.5	Effective Rainfall	IX-4
9.1.6	Diversion Irrigation Requirement	IX-4
9.2	Drainage Requirement	IX-5
9.2.1	General	IX-5
9.2.2	Daily Maximum Rainfall	IX-6
9.2.3	Drainage Requirement	IX-6
9.3	Net Consumption of Water Resourse	IX-8
9.4	Water Economy	IX-10

Tables

9.1	Effective Rainfall	IX-12
9.2(1)	Irrigation Water Requirement (1st Crop)	IX-13
9.2(2)	Irrigation Water Requirement (2nd Crop)	IX-14

Figures

9.1	Comparison of Potential Evapotranspiration	IX-15
9.2	Crop Coefficient Curve of Rice	IX-16
9.3	Probable Distribution of Effective Rainfall	IX-17
9.4	Probable Distribution of Daily Rainfall	IX-18
9.5	Frequency of Consecutive Drought Day	IX-19

IX. IRRIGATION AND DRAINAGE REQUIREMENT

9.1 Irrigation Requirement

9.1.1 General

The irrigation requirement consists of the consumptive use of water by crops, percolation, and conveyance and application losses. The appropriate method to determine the consumptive use of water by crops is that based on the actual measurement in the field over a long period. Since no data is available around the project area, the consumptive use of water is estimated from climatic data.

The irrigation requirement for the project area is estimated, using the following procedure:

- Estimation of potential evapotranspiration;
- Calculation of the consumptive use of water by crops;
- Assessment of percolation rate and pre-irrigation requirement;
- Estimation of the effective rainfall; and
- Assessment of irrigation requirement

9.1.2 Potential Evapotranspiration

In order to pick out the appropriate method to estimate the potential evapotranspiration in the project area, four methods, namely, the Radiation, the Penman, the Hargreaves and the Blaney-Criddle methods were comparatively examined from the climatic data of the Kosti station. As shown in Fig. 9.1, the Hargreaves method and the Blaney-Criddle method estimated considerably high and low values, respectively, whereas the values obtained by the Penman and the Radiation methods are comparatively similar to the tendency of Piche evaporation recorded at the said station, except for the rainy season. According to the reference/1 of F.A.O., the Radiation and the Penman methods should be more reliable than the other methods. Especially, for areas where measured data on temperature, humidity, wind and bright sunshine hours or radiation are available, the Penman method is suggested since it is likely

/1: Crop Water Requirements, Irrigation and Drainage Paper 24, Food and Agriculture Organization of the United Nation, Rome 1975.

to provide the most satisfactory results to predict the effect of climate on crop water requirements. Therefore, the average of the values estimated by both methods, Penman and Radiation, is recommended for the estimation of the potential evapotranspiration in the project area, as shown in the following table:-

Potential Evapotranspiration Estimated

(Unit: mm/day)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Penman Method	6.3	7.3	8.4	8.2	8.3	7.9	6.7	5.5	6.2	6.5	7.2	6.7
Radiation Method	7.0	7.8	8.3	9.0	7.9	6.9	5.4	5.0	5.9	5.8	7.6	7.4
Average	7.7	7.6	8.4	8.6	8.1	7.4	6.1	5.3	6.1	6.2	7.4	7.1

9.1.3 Consumptive Use of Water

The crop coefficient is determined according to the crop, growing stage of crops, etc. The coefficient of rice which is examined by Hargreaves based on the data of the direct sowing in U.S.A., was applied for the estimation of crop consumptive use, as illustrated in Fig. 9.2.

Consumptive use of water by rice is estimated by multiplying the potential evapotranspiration estimated in the foregoing subsection by the crop coefficient as shown in Table 9.2.(1) to (2).

9.1.4 Pre-irrigation Requirement and Percolation Rate

Before land preparation, pre-irrigation is required to enable the ploughing paddy fields easily. Pre-irrigation requirement is largely depend on the soil moisture content immediately before ploughing. From the results of field survey, the distribution of three phases of soil in the project area is tabulated below.

Soil Condition	Solid phase (%)	Liquid phase (%)	Vapor phase (%)
- Dry clay	52	18	30
- Clay with moisture content below its plastic limit	54	33	13
- Clay with moisture content above its plastic limit	48	50	2

The soil condition before pre-irrigation in the full operation stage of the project is considered to be medium moisture content between the dry clay and the clay with moisture content below its plastic limit. On the other hand, the soil condition after pre-irrigation is considered to be similar condition of the clay with moisture content above its plastic limit. Based on the above points, the distribution of three phases of soil before and after pre-irrigation is assumed as follows.

	Solid phase (%)	Liquid phase (%)	Vapore phase (%)
- Before pre-irrigation	50	27	23
- After pre-irrigation	50	45	5

Pre-irrigation requirement of the surface soil layer 20 cm thick is calculated as follows.

Pre-irrigation requirement = 200 x (1 - 0.5 - 0.23 - 0.05) ≒ 45 mm

The requirement was finally assumed taking the local condition during the sowing season into account as follows.

For 1st crop

- from late December to early February

  A period from draining of 2nd crop to pre-irrigation for 1st crop is about 1.5 months. Therefore, it is considered that cracks will appear on the surface of the paddy field. The pre-irrigation requirement is assessed taking the additional requirement by the cracks of more 20 cm thick into account as follows.

  Pre-irrigation requirement = 45 mm + 20 mm = 60 mm

- from early February to late March

  In this stage, water for germination of crop is required. Its amount of water assumed is 45 mm.

For 2nd crop

- from June to mid-July

  The period from draining of 1st crop to pre-irrigation for 2nd crop is about 0.5 months. Therefore, the additional requirement

by the cracks can be disregarded.

Pre-irrigation requirement = 45 mm

- from mid-July to the end of August

The about 45 mm of water is required for germination of crop similar to 1st crop.

The percolation rate assumed is 0.5 mm/day taking into account the soil structure.

9.1.5 Effective Rainfall

The effective rainfall was estimated on the following assumptions.

- Daily rainfall less than 50 mm is effective; and
- Excess beyond 50 mm is ineffective.

The daily rainfall data covering a period of 20 years from 1956 to 1975 were used. The annual total effective rainfall of each year is shown in Fig. 9.3. By frequency analysis using the Thomas method, the probable annual total effective rainfall of the probability of occuring once in ten years is estimated at 135 mm, while average annual total effective rainfall is about 225 mm. The distribution of the effective rainfall is in proportion to that of the average rainfall on 15-day basis to be complied as shown in Table 9.1.

9.1.6 Diversion Irrigation Requirement

Diversion irrigation requirement is defined as the total amount of water to be diverted from the water source to cover the loss through evapotranspiration, percolation, conveyance loss and application loss; it is estimated by dividing the net irrigation requirement by the irrigation efficiency. From the results of a sample study based on the following assumptions, the irrigation efficiency was estimated at 70 %.

- Farm Waste = 25 % of water requirement
- Leakage through gates = 5 % of the farm irrigation requirement
- Seepage rate = 0.05 m^3/m^2/day (clay soil)
- Percolation rate = 0.5 mm/day

The result of calculation is shown in Table 9.2 (1), (2). The total diversion requirement for the project is as shown below.

(Unit: m^3/s)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
TRACT-1	0.7	1.7	4.6	5.6	4.3	1.6	0.6	1.7	3.4	4.0	3.9	1.4
TRACT-2	1.4	3.7	9.8	11.8	9.1	3.5	1.4	3.7	7.2	8.5	8.2	3.1
TRACT-3	0.7	1.7	4.6	5.6	4.3	1.6	0.6	1.7	3.4	4.0	3.9	1.4
TRACT-4	0.7	1.8	4.9	5.9	4.6	1.8	0.7	1.8	3.6	4.3	4.1	1.6
Total	3.5	8.9	23.9	28.9	22.3	8.5	3.3	8.9	17.6	20.8	20.1	7.5

The unit peak diversion requirement is 1.85 ℓ/sec/ha.

On the other hand, in order to study O & M cost of the pump, the diversion irrigation requirement of the normal year is calculated using the average effective rainfall as shown below.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Ful.	Aug.	Sep.	Oct.	Nov.	Dec.
TRACT-1	0.7	1.7	4.6	5.4	4.3	1.6	0.6	1.3	3.1	3.9	3.9	1.4
TRACT-2	1.4	3.7	9.8	11.6	9.1	3.4	1.3	2.7	6.7	8.4	8.2	3.1
TRACT-3	0.7	1.7	4.6	5.4	4.3	1.6	0.6	1.3	3.1	3.9	3.9	1.4
TRACT-4	0.7	1.8	4.9	5.8	4.6	1.7	0.6	1.4	3.3	4.2	4.1	1.6
Total	3.5	8.9	23.9	28.2	22.3	8.3	3.1	6.7	16.2	20.4	20.1	7.5

9.2 Drainage Requirement

9.2.1 General

The drainage system comprises onfarm drains, draingae laterals and main drainage canals of the sizable capacity. The drainage runoff will be directly drained into onfarm drains and then collected to laterals and subsequently main drains. Generally, the water level of the White Nile during a period from August to March is higher than the ground level of the project area. The drainage runoff is gradually removed to the White Nile by the pump after once detained into the drainage canal and paddy field.

9.2.2 Daily Maximum Rainfall

According to the rainfall recorded at the Ed Dueim station during past 20 years, there exist very little care of 2-day consecutive rainfall of more than 50 mm. For drainage planning in the project area, daily maximum rainfall in 10 % chance of occurence is used. Probability analsyis on daily maximum rainfall was made by using the Thomas method, on the basis of the data obtained at Ed Dueim. The results are illustrated in Fig. 9.4 and summarized below.

Probable Daily Maximum Rainfall

Probability (%)	50	20	10	5
Daily Rainfall (mm)	52	68	79	88

On the other hand, frequency analysis of the consecutive drought days after the cease of heavy rainfall more than 40 mm/day was statistically examined as shown in Fig. 9.5. It is known from this figure that 4-day consecutive drought corresponds to 10 % chance in occurrence so that. It is desirable from this result that the runoff is removed to outside of the project area within 4 days against the coming rainfall.

9.2.3 Drainage Requirement

The total runoff based on the daily maximum rainfall was figured out, deducting the amount of evaporation during 4 days, as follows.

Total Amount of Runoff

	TRACT-1	TRACT-2	TRACT-3	TRACT-4
Catchment Area (ha)	3,450	7,770	3,600	3,800
Total Amount of Rainfall (10^3 m^3)	2,726	6,138	2,844	3,002
Evaporation (10^3 m^3)/1	731	1,647	763	806
Total (10^3 m^3)	1,995	4,491	2,081	2,196

/1: The evaporation of 5.3 mm/day x 4 days to be assumed in the rainy season.

In order to meet the above runoff, the capacity of storage between the drainage canal and paddy field are examined. In the case that paddy field will be inundated with water by the runoff, the damage rate of rice production is assumed as shown below as function of the flooding period from the experience in Japan and Nigeria.

Flooding Period (day)	Damage Rate of Rice Production (%)
1	0
2	0
3	30
4	50

Using the damage rate of rice production, the construction cost of main drainage canal and the anticipated benefit are roughly estimated as follows.

Flooding Period (day)	Damage Rate (%)	Construction Cost (£s/ha)	Benefit /1 (£s/ha)	B - C (£s/ha)
1	0	365	922	557
2	0	205	922	717
3	30	164	645	481
4	50	147	461	314

From the above result, the allowable flooding period on paddy field is decided 2 days. Therefore, the runoff is once detained as shown below dividing into the drainage canal and paddy field according to the size and length.

	TRACT-1 (10^3 m^3)	TRACT-2 (10^3 m^3)	TRACT-3 (10^3 m^3)	TRACT-4 (10^3 m^3)
Paddy Field	998	2,246	1,041	1,098
Onfarm Drain	203	432	203	216
Drainage Lateral	155	471	188	198
Main Drainage Canal	639	1,342	649	684
Total	1,995	4,491	2,081	2,196

/1: Benefit = (Yield of rice 10 t/ha) x (Milled ratio 0.7) x (Gate Price 176 £s/t) - (Production Cost 310 £s/ha)
Rfere to 10.1.1.

On the other hand, the delivery discharge of pump for drainage is assumed to be 1.2 times as much as that for irrigation as shown follows, since the maximum actural lift for drainage is 3.5 m, smaller than the maximum actural lift of 6.5 m for irrigation.

Delivery Discharge for Drainage

	TRACT-1	TRACT-2	TRACT-3	TRACT-4
Delivery Discharge (m^3/sec)	8.1	17.0	8.1	8.5

This delivery discharge is enough to meet the amount of drainage runoff which is removed within 4 days.

9.3 Net Consumption of Water Resource

Amount of water returned out of irrigation water

Some amount of water out of the irrigation water requirement returns into the drainage canal during the dry season from October to May. This amount of water is estimated by the following equation:

$$RW = (DW-NW) \times fr$$

where, RW: Amount of water returned into the drainage canal (mm)
DW: Diversion water requirement (mm)
NW: Net water requirement (mm)
fr: Coefficient (0.9)

Using 2,247 mm of DW and 1,572 mm of NW during the dry season, total amount of water of the whole project area returned in calculated as shown below.

$$(2,247-1,572) \times 10^{-3} \times 0.9 \times 15,600 \times 10^4 = 94,770 \times 10^3 m^3$$

On the other hand, the total amount of evaporation from the water surface of the drainage canal is estimated at 1,283 mm/1 during the dry season. The total amount of evaporation from water surface of the drainage canal is shown below.

$$1,283 \times 10^{-3} \times 254/2 \times 10^4 = 3,259 \times 10^3 m^3$$

/1: Potential evapotranspiration 1,833 mm x 0.7

/2: Surface area of the drainage canal

Finally, the amount of water returned into the drainage canal is calculated as shown follows.

$$94{,}770 \times 10^3 - 3{,}259 \times 10^3 = 91{,}511 \times 10^3 m^3 \doteq 0.09 \text{ milliard } m^3$$

Amount of excess water of the rainfall

Some amount of excess water out of the rainfall is drained into the drainage canal during the rainy season from June to September. Using 271 mm/1 of the total rainfall during the rainy season and 0.8 of the runoff coefficient assumed, this amount of water is estimated as shown below.

$$271 \times 10^{-3} \times 18{,}600/2 \times 10^4 \times 0.8 = 40{,}368 \times 10^3 \doteq \underline{0.04 \text{ milliard } m^3}$$

Net annual amount of irrigation water

Both amounts of water returned out of irrigation water and drained out of the rainfall as mentioned above will be used again for irrigation. Consequently, net annual amount of irrigation water for the project is 0.33 milliard m^3 deducting 0.13 milliard m^3 of these amounts of water from 0.46 milliard m^3 of the diversion water requirement

Net annual consumption of water resource

As mentioned in Annex III, the additional water loss by the creation of the Jebel Aulia reservoir is estimated at about 1.54 milliard m^3. Therefore, the amount of evaporation to be reduced from the Abu Gasaba area having a net acreage of 15,600 ha or 37,100 feddans by land reclamation is assessed as follows.

$$1.54 \times \frac{37{,}100}{233{,}000} = 0.25 \text{ milliard } m^3$$

Accordingly, only 0.08 milliard m^3 deducting 0.25 milliard m^3 from 0.33 milliard m^3 of net annual amount of irrigation water will be additionally dependent upon the water resources of the White Nile as net annual consumption of water resource.

/1: *average rainfall for 74 years at Ed Dueim station*

/2: drainage area (ha)