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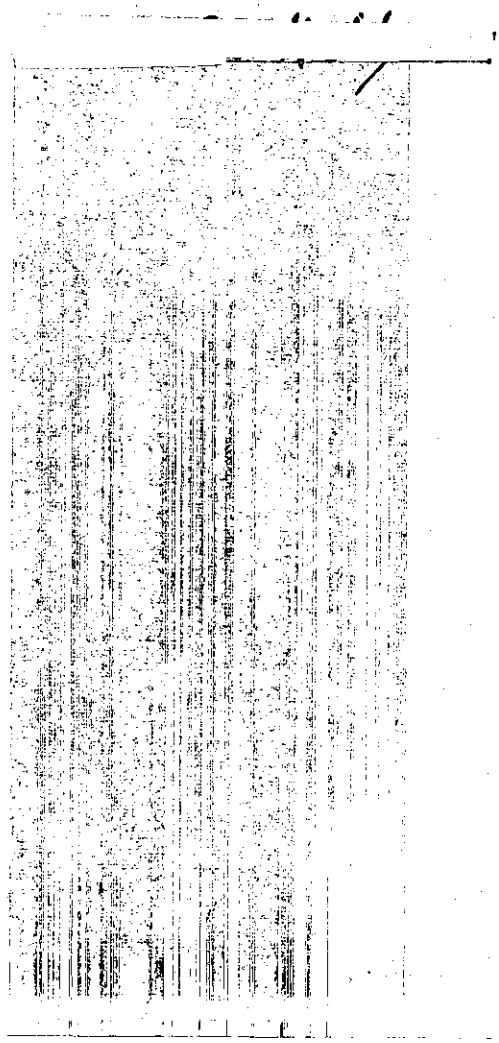

METHODS OF CAPTURING THE POTENTIAL BENEFITS OF THE ASWAN HIGH DAM IN EGYPT, U.A.R.

A THESIS

Presented to

the Faculty of the Graduate Division

by

Salem Nasr Habib

In Partial Fulfillment

of the Requirements for the Degree

Master of City Planning

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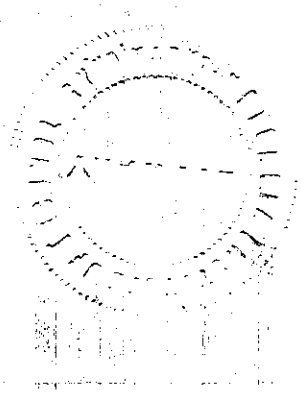

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Finally, the author dedicates this dissertation to the United Arab Republic whose financial support and inspiration were a driving force and whose progress is the aim and duty of all its natives.

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ABSTRACT

The Government of the United Arab Republic is constructing a multi-purpose high dam on the Nile at Aswan, Egypt, U.A.R. The High Dam is designed to impound the excess of flood waters being wasted at present to be released regularly according to Egypt's requirements. The purpose of this study is to develop the programs necessary for utilizing the benefits of the High Dam for promoting better living conditions in Egypt.

By analyzing the present conditions in Egypt, it is found that the main problem facing Egypt's growth is that the existing arable land and industrial developments fail to meet the requirements of the rapidly increasing population. The surface water is limited to the annual yield of the Nile.

In order to show how the water impounded by the High Dam can be used to the best advantage, an attempt is made to analyze Egypt's present and future water requirements for domestic, industrial and irrigation uses and to appraise all water resources available. An integrated water policy is developed, providing for the appropriate uses of each source. According to such policy, a program is developed to utilize the quantities of water available to irrigation for expanding the arable land and increasing the yield of presently cultivated areas.

For help in promoting industries in Egypt and improving living conditions, a program is developed to utilize the water impounded by the High Dam for the generation of hydroelectric power. Policies are recommended with relation to electric power generation, operation, transmission, distribution, sales and rates.

In order to make low-cost transportation available, the water released downstream from Aswan may be used for assuring navigation on the Nile all the year round. The navigation program includes the steps necessary for improving navigation facilities, regulating the operation of carriers and determining shipments and rates. Furthermore, it includes the methods recommended for controlling the developments on the waterfront.

Finally, a program is developed to utilize the High Dam reservoir for recreation purposes. This program includes the development of recreational activities required to promote tourism. It also takes the advantage of the fluctuation of the water level at the reservoir for malaria control.

INTRODUCTION

After several years of scientific studies, the Government of the United Arab Republic has decided to construct a high dam on the Nile about 5 miles to the south of Aswan, Egypt, for over-year water storage. This Aswan High Dam is designed to impound the excess flood waters of the Nile which are wasted at present. They will be utilized for the expansion of cultivated land, the production of hydro-electric power, and the promotion of inland navigation. In the process, floods will be controlled and drainage improved.

The objective of this study is to develop programs for utilizing the potential benefits of the Aswan High Dam to the best advantage possible. These programs include the utilization of the water impounded at the reservoir of the High Dam for irrigation, the generation of power, the improvement of navigation on the Nile and for other purposes.

The method of attack will be to review and analyze the reports of the Egyptian departments involved, reports on the Tennessee Valley Authority (T.V.A.), and personal interviews and correspondence with T.V.A. officials, Egyptian officials and others. Recommendations will be made in the light of the experience in the Tennessee Valley and its possible adaptation to Egypt's policies and conditions.

CHAPTER I

EXISTING CONDITIONS IN EGYPT

In order to develop a program for utilizing the benefits of the Aswan High Dam for improving living conditions in Egypt, it is essential to study existing conditions therein. It is the purpose of this chapter to analyze the present physical, social and economic conditions and appraise the major developments undertaken recently to improve such conditions, with due consideration to the agrarian reform, the new structure of the Government, the national union, the national plan and the Aswan High Dam.

Physical Conditions

Geography.--Egypt is the Southern Region of the United Arab Republic (U.A.R.). Figure 1 (Appendix, p. 121) shows the location of both Egypt and Syria--the two regions of the U.A.R. Egypt occupies the northeastern corner of the African Continent. It comprises about 386,000 square miles. It is bounded on the north by the Mediterranean Sea, on the south by the Sudan, on the west by Libya and on the east by the Red Sea, the Gulf of Akaba and Palestine. It can be divided into the following geographical divisions: The Delta, the Nile Valley, the Eastern Desert, the Western Desert, and the Sinai Peninsula.

Students of history have found that climatic conditions which previously prevailed in Egypt differed greatly from those prevailing at present. Formerly, this area was subjected to heavy rains and the present desert areas were covered with grass and shrubs which were the natural grazing of the deer and other wild beasts. Consequently, man inhabited what is now a desert land and depended on hunting as his principal occupation. He discovered means of cultivation gradually, evolving and developing his methods over a long period of history. Many years later, a dry spell spread gradually over the whole area, driving both man and beast in search of water resources. As a result, they were attracted to the Nile.[1]

The settlements where the people clustered in the Nile Valley increased in number and each created for itself a small nation. At this time, the Nile was not tamed and its waters were discharged through eroded channels, flooding vast areas and causing great damage. The first attempt to control the Nile was made about 6,000 years ago in the reign of King Mena who unified the small nations and regulated the Nile waters through the erection of dikes.[2]

Nature of the land.--One of the most memorable utterings of Herodotus (a Greek historian) is that "Egypt is the gift of the Nile."[3] Without the Nile, the whole area of Egypt would be a desert. All along the Nile's 4,400 mile course, from its remotest source near Lake Tanganyika to the Mediterranean Sea, life is affected in various degrees by the

fluctuation of its water. In Egypt, where rain is very scarce, life depends on the Nile. Not only does it furnish water for drinking and irrigation, but it brings silt that enriches the cultivated land. The cultivated land, which represents about five per cent of the total area in Egypt, has been limited to the land that could be irrigated. This limitation has left vast areas uncultivated though suitable for agriculture.

Climate.--Egypt can be divided into the following climatic regions:

(1) The north coastal region which enjoys a mild climate all the year round because of the influence of the Mediterranean which cools the temperature in summer and warms it in winter. The temperature ranges from 88.7°F. in summer to 45°F. in winter and the annual mean rainfall is about six inches.

(2) The delta region which is less mild than the north coastal region. Its climate is characterized by warm winters and hot summers with temperatures ranging from 90°F. in summer to 45°F. in winter. The annual mean rainfall is about three inches.

(3) The central region which resembles the delta region but is much hotter and has little rainfall.

(4) The upper region which is very hot and dry in summer, and warm and dry in winter. The maximum record of temperature at Aswan Climatic Station in the past thirty years was 125°F.

In general, the north coastal and delta regions have a Mediterranean type of climate, while the central and upper regions are of the desert type.[4]

Population

Egypt has the largest population of all Arab countries. It is the home of about 26 million Arabs. The population has increased from 11.3 million in 1907 to 26.065 million in 1960 at an average rate of two per cent a year.[5] If the same trend continues, and if efforts are aimed at reducing death rates without corresponding reduction in birth rates, the population will increase seriously, requiring more efforts for providing adequate diet for the anticipated people as well as raising their standard of living. Table 1 shows the population estimates in thousands from 1947 to 1982 as prepared by the census officials of Egypt.

Table 1. Estimates of the Population of Egypt in Thousands[6]

Age Groups	1947	1952	1957	1962	1967	1972	1977	1982
Males								
-20 years	4,627	4,916	5,522	6,189	7,071	7,982	8,743	9,631
over 20-65	4,498	5,018	5,509	6,109	6,479	6,943	7,746	8,652
over 65	266	296	347	381	506	630	725	759
Females								
-20 years	4,501	4,939	5,490	6,017	6,758	7,452	8,159	8,984
over 20-65	4,755	5,297	5,897	6,510	7,005	6,733	8,398	9,245
over 65	317	386	500	630	792	943	1,092	1,202
Total	18,936	20,852	23,245	25,845	28,611	31,583	34,863	38,473

The 1960 Census revealed that the population of Egypt has reached 26,065,000 persons, thus exceeding the number predicted for 1962 by 220,000 persons. These data highlight the population problem requiring immediate actions.

Social and Economic Conditions

Background.--One of the main advantages of Egypt is its location at the meeting place of the culture and civilization of Asia, Africa and Europe. It also occupies a central position between two major fields of production, which are the field of tropical production in Asia and Africa restricted to basic materials of vital importance to western countries and the industrial production in Europe which is most in demand in eastern countries. Because of the inefficient governments that ruled Egypt in the past, and the British occupation which lasted 74 years, Egypt could not fully utilize this advantage.

Until recently, the people of Egypt depended on agriculture as their principal occupation. Before the 19th century, the basin system of irrigation made use of the flood waters coming down the Nile between July and October.[7] This system was suitable only for the cultivation of crops, such as wheat, barley and beans, which grow in the warm Egyptian winter. In the 19th century, perennial irrigation was developed in Egypt by the construction of some barrages[8] on the Nile. These barrages were designed to raise the water level sufficiently to feed an extended system of irrigation canals, but they did not increase the total amount of available water.

In 1902, the existing Aswan dam was completed. Since its completion, and later after its increase in height, it has been able to impound a considerable amount of water during the annual flood for use in irrigation during the following dry season. It was designed to impound the end of the flood when the silt content is much reduced. Other barrages were built later to enhance the utilization of the water that could be controlled. As a result, Egypt's production of cotton increased from 350 million pounds in 1890 to 1,100 million pounds in 1938. The present annual production of cotton is less than this amount due to governmental restrictions.[9]

For many years, industrial development was seriously held back under the false assumption that Egypt was primarily an agricultural country--a criterion conveniently coined by the imperialist powers that dominated the country directly or through puppet rulers. Industrial potentials and mineral resources were neither explored nor exploited to the extent that they could diversify Egypt's economy. Consequently, Egypt had to rely mainly on agricultural production for its existence. The rate of population increase exceeded the rate of expansion of arable land. Table 2 illustrates the increase in both population and arable land from 1907 to 1954 and the trend of agricultural labor force during this period.

Table 2. Population, Arable Land, and Agricultural Labor Force in Egypt[10]

Year	1907 million	1954 million	Average Annual Increase
Total number of population	11.3	22.0	about 2%
Agricultural labor (males)	2.3	4.5	about 2%
Arable land	5.4	6.1	about 0.3%

Reliance on imports.--The lack of industry increased the dependence of Egypt on imports. The increasing demand for imports without corresponding exports has adversely affected the Country's trade balance which continued to show a growing deficit, reaching its peak in 1952. Table 3 shows the trade balance in Egypt from 1939 to 1952.

Table 3. Egypt's Trade Balance[11]

Year	Imports L.E.[12]	Exports L.E.	Surplus L.E.	Deficit L.E.
1939	34,091,000	34,831,000	740,000	-
1940	31,337,366	28,321,219	-	3,016,167
1945	59,679,781	45,152,358	-	14,527,423
1950	212,682,206	175,427,539	-	37,254,667
1951	279,594,299	203,079,638	-	76,514,641
1952	225,801,105	145,116,063	-	80,685,042

Importance of agriculture.--Agriculture in Egypt is still the most important sector of national production. In fact, it is the backbone of Egypt's national economy. Furthermore, the greater part of local industries, internal and foreign trade and other services are still based on agriculture. Table 4 shows the relation between Egypt's income realized from agriculture, and the total national income.

Table 4. Egypt's Agricultural Income as Related to its National Income[13]

Year	Total National Income 1000 Egyptian Pounds	Agricultural Income 1000 Egyptian Pounds	Per Cent of Total
1952	742,359	269,000	36
1953	770,540	272,798	35
1954	855,350	310,153	36
1955	887,900	303,000	34
1956	901,100	299,000	33
1957	931,371	304,300	32

The importance of agriculture in Egypt is not limited to its portion of the national income. It is estimated that about two-thirds of the national wealth is vested in agriculture and livestock. Furthermore, about 60 per cent of the working people are engaged in agriculture. Agricultural production with cotton dominating represents about 96 per cent of the value of total exports.

Methods of agriculture.--Most of the farmers in Egypt still use agricultural methods and equipment utilized thousands of years ago. The plough, the waterwheel and the use of cattle for cultivation work are predominant. Agriculture is restricted primarily to row crops and fruit trees. Pastures and commercial livestock scarcely exist.

The limitation of cultivated land with the serious increase in population has resulted in an exhausting utilization of the land to produce the maximum output. As a result, after years of utilization, the production per acre has decreased, requiring increasing mineral fertilizer which is beyond the financial ability of the majority. The limitation of water not only has limited the expansion of arable land, but it has affected the presently cultivated area, threatening some remote places with barrenness. Local industries which might help in absorbing idle seasonal capacity of agricultural labor force have been lacking.

Agricultural land distribution.--In addition to the previous problems, there is the serious one of agricultural land distribution. Until 1952, there was a small number of rich people who inherited wealth, influence and the right to live in luxury, while the majority was suffering poverty, ignorance and disease. As a result, all political decisions were vested in this minority which directed for their benefit most of the developments that took place. Table 5 shows the ownership of cultivated land in Egypt until 1952.

Table 5. Ownerships of Cultivated Land in Egypt Before 1952[14]

Area in acres	No. of Owners	Per Cent of Total Owners	Area Owned in acre	Per Cent of Total Area Owned
Less than 5	2,641,878	94.50	2,121,864	38.3
5 - 15	79,259	2.83	525,904	9.5
16 - 75	69,115	2.50	1,281,433	23.1
76 - 200	3,184	0.11	436,775	7.9
over 200	1,786	0.06	1,176,801	21.2
Total	2,795,222	100.00	5,542,777	100.0

From the table above, it can be seen that more than 94 per cent of the landlords owned only 38.3 per cent of the total cultivated land and that the average ownership was less than one acre per owner. Moreover, a great number of the large as well as small landowners were not engaged in agriculture and leased their lands at high rents to the farmers who had to accept the imposed rents under the fear of being moved off the land. As a result, there were about 4.5 million agricultural laborers among whom a small number owned small parcels of land, while the rest were tenants, sharecroppers or hired in the service of the landlords. Neither the landlords, whose principal aim was to exploit the yield of the land as much as possible, nor the farmers, who had to pay imposed high rents, would do anything to conserve the soil or to maintain the standard of agricultural production.

As the rich landlords were living in cities and their interests were centered there, no efforts were made to improve living conditions in rural areas. Not only did these factors cause a deterioration in Egypt's economy, but they led to social and political deficiencies. The result was that no political, social or economic democracy existed until the advent of the revolution of July 23, 1952.

To deal with this serious heritage, the Government has enacted several provisions to insure an equal opportunity for all and to accomplish a radical social change. Among these provisions are the Agrarian Reform Law, the establishment of a new government set-up, the creation of the national union, the development of a nation-wide plan and the construction of the Aswan High Dam.

The Agrarian Reform Law

The first act undertaken by the Revolution Government was the Agrarian Reform Law. It provided that no person could own more than two hundred acres of cultivated land, with an additional fifty acres for each child, totaling not more than three hundred acres.[15] The excess is acquired by the Government at fair compensation and sold without interest to the landless families, five acres per each. Cooperatives among the beneficiaries have been created to provide the farmers with financial and technical assistance and to avoid any loss that may result from dividing the lands into small lots. The Law also regulated the relationship between tenants and the landowners.

Beneficiaries are required to follow agricultural plans drawn and supervised by the Agrarian Reform Authority and the cooperatives involved.

Upon the application of the Agrarian Reform Law, new investments of old landlords were directed toward land reclamation, mining, industry or trade. Not only have the evils of feudalism been abolished but a new reconstruction of the society providing a more secure living for the farmers has resulted. The Agrarian Reform has also been successful in improving the standard of land production. The redistribution of land has led to the creation of a class of small owners who, when they feel that the land is theirs, are more watchful and ardent in improving its productivity than when working for someone else.[16]

Government and People

Zimmermann stated that man is apt to be more productive when he works in freedom.[17] Freedom involves a good government that represents the people as well as provides a social structure in which adjustment is provided between private and public interest and among individuals themselves with relation to duties and rights and between benefits and sacrifices. The structure of the government as developed recently in Egypt will be discussed in the following.

The Government in general.--On February 5, 1958, based on the results of a universal election, the Presidents of both the Egyptian and

the Syrian Republics announced in their respective National Assemblies the unification of the two countries, forming the United Arab Republic (U.A.R.). The U.A.R. is a democratic, independent, sovereign republic and its people are part of the Arab Nation.

The legislative power in the U.A.R. is vested in a house of representatives called the National Assembly. Its members are elected from both Syria and Egypt through the application of a direct universal ballot. It has the right to initiate, oppose laws recommended by the President or promulgate laws and to exercise control over the actions of executives. The executive power is vested in the president who is also elected and who is assisted by a cabinet appointed by him. The judiciary is independent of the President or National Assembly.[18]

The structure of the Government.--There is one central cabinet for both Egypt and Syria whose ministers are appointed by the president. These central ministers are in charge of supervising the affairs of their ministries and of executing the policies developed by the President of the Republic. They are also responsible for preparing the planning programs in the two regions of Egypt and Syria.

An executive cabinet is set up in each region. It is directed by a chairman appointed by the President. The executive ministers are also appointed by the President but on the recommendation of their chairman. Each executive minister has authority to examine and study matters pertaining to the execution of the general policies in the region.

The recommendations of the executive ministers concerning regional affairs are submitted to the President through the central cabinet. Each executive minister is responsible for the execution of the general policies laid down by the central cabinet and the President. He acts through main departments located at the capital of the region he serves and through subordinate departments distributed in the provinces. Not only is the subordinate department responsible for execution in the area it serves, but it prepares plans and recommends projects to the executive minister. It is independent from the ministry except in decisions related to regional matters, general policy and financial affairs. In large cities, municipal councils of members elected from the inhabitants of the city supervise municipal affairs.[19]

Coordination among government agencies.--In both the central and executive governments, the cabinet consists of a number of ministries, each of which is responsible for a certain activity. Figure 2 (Appendix, p. 122) presents a diagram showing the structure of the government of the U.A.R. and the interrelations between its two levels. Figure 3 (Appendix, p. 123) shows the flow of a decision from the President to a subordinate department responsible for its executive. The Ministry of Municipal and Rural Affairs was used as an example.

As previously pointed out, the central government is responsible for preparing plans. In order to coordinate the activities of the different central ministries, each responsible for particular service, the Government has formed four committees among the central ministers. The

four committees are the Executive Committee, the Legislative Committee, the Economic Committee and the Services Committee. The Executive Committee is in charge of studying all executive questions which require presidential decrees. The Legislative Committee is charged with studying all legislative proposals and financial decisions pertaining to the budget. The Economic Committee is responsible for studying all economic affairs. The Services Committee is charged with preparing and coordinating policies with regard to education, health, social affairs and public utilities. The President is the coordinator of the four committees.

The Executive Cabinet in each of the two regions has formed necessary committees along the lines followed by the Central Cabinet. Recommendations of these committees are submitted to the President through the Central Cabinet. Coordination among the departments of executive ministries is realized through monthly meetings and at other times when deemed necessary.

The National Union

In order to bring citizen participation into effect, and looking forward toward local self-government, the Government has provided for the establishment of the National Union. In 1959, Presidential Decree No. 935 provided for the creation of the National Union and the system of electing its members.[20]

Creation.--The National Union is an organization of the entire United Arab Republic. Its membership is open to all citizens of the two sexes not less than 16 years old. The members are elected through the application of a direct universal ballot. The inhabitants of each village and census tract in cities are called to elect their representatives, who in turn elect the members of the next higher level of the National Union. The National Union has a pyramid-like structure beginning at the village, going up to the district, province or governorate,[16] and ending at the top with the Supreme Committee.

Function.--The members of the National Union at each level are entitled to express their opinions and make suggestions to the different bodies of the National Union at the higher level. At each level, an executive committee, an action committee and a general committee composed of the said two committees have been created. The executive committee submits the proposals studied and approved by the general committee to the governmental and local authorities concerned. It has also the right to ascertain that the local governmental bodies fulfill their duties in the best manner and for the public interest. Any committee is responsible for the expression of the different points of view of the people they represent and the conveyance of the decisions arrived at by the higher committees to their people.

Authority.--Each province or governorate has its own Congress, which together make up the National Union General Congress, that is

the highest authority in the Nation. The National General Congress discusses, recommends, resolves and approves all the decisions of the Government in its annual meetings.

Role of the National Union in planning.--As stated above, there are at each level of the National Union, an executive committee, an action committee and a general committee. Most important in planning is the role of the action committee. It is composed of nine sub-committees each of which is responsible for studying a particular service. These services are:

(1) agriculture guidance, cooperative marketing and assistance;

(2) youth, culture and education;

(3) charitable activities and social affairs;

(4) health and public services;

(5) fuller participation of women in public life;

(6) local administration and complaints;

(7) labor force;

(8) local economic affairs; and

(9) local industry.

The National Plan

In order to promote better living conditions in Egypt, the Government of the U.A.R. has prepared a nation-wide plan which aims at doubling the national income within ten years. On January 2, 1960, the General Congress of the National Union adopted the national plan

introduced by the Government. The plan has two stages of development. In the first 5-year plan, about 4 billion dollars of public and private investments are anticipated. They will be distributed as follows:

Agriculture and related projects about	$1.2 billion
Industry and electric power about	$1.1 billion
Transport and communication about	$0.6 billion
Housing and public utilities about	$0.8 billion
Other public services about	$0.3 billion[22]

It is estimated that the first five-year plan will result in an increase of about 42 per cent in the national income, while the second stage will bring this increase to 100 per cent. The national plan as adopted includes utilizing the Aswan High Dam contributions.

The Aswan High Dam

After several years of scientific studies and consultation at the national and international levels, the Government of the U.A.R. is proceeding with the construction of the Aswan High Dam on the Nile about five miles south of Aswan, Egypt. The Aswan High Dam is designed to impound the yearly and monthly excess flood waters of the Nile to be utilized during the years and months of low flow. It is to be a multi-purpose project. It is primarily built to reserve water for irrigation, to control floods, to improve navigation and drainage and to generate hydroelectric power. An agreement between the U.A.R. Government and the Sudan for the construction of the High Dam has been signed.

Hydrologic data on the Nile at Aswan.--The maximum flow of the Nile at Aswan varies from 5 million c.f.s. (cubic feet per second) in the years of high flood to 2.5 million c.f.s. in the years of low flow. By examining the records of the Nile flow at Aswan, it was found that the total supply of the River in 1878 amounted to 151 billion cubic meters (about 120 million acre feet) while in 1913 it barely reached 42 billion cubic meters (about 34 million acre feet). The arithmetic mean of the total annual supply during the past 55 years is 84 billion cubic meters (about 67 million acre feet).[23]

Site of the High Dam.--The Aswan High Dam is located about four miles south of the existing Aswan dam within its reservoirs. Figure 4 (Appendix, p. 124) shows the location of the High Dam, the existing Aswan dam, and other dams constructed on the Nile. The site selected for the Aswan High Dam has the advantage that both its banks consist of sound rock and rise steeply from the river bed, so that a dam of only moderate length is required.

Structures of the High Dam.--The High Dam project consists of an upstream cofferdam, a downstream cofferdam, the high dam in between, a diversion canal, a power plant and the reservoir. Figure 5 (Appendix, p. 125) shows the several elements of the project.

The upstream cofferdam, 165 feet high, will divert the flow of the Nile during the construction of the main dam. It will remain as an integral structure of the project, storing water up to a level of

about 439 feet above mean sea level, thus providing a storage capacity of about 8 billion cubic meters of water (about 6.5 million acre feet).

The downstream cofferdam, 116 feet high, will prevent flood water from accumulating silt at the foot of the main dam. It will be a rockfill structure equipped with a filter covered with a layer of rubble to protect the downstream toe of the main dam.

The main dam, 366 feet high, will be a rock-fill structure to store the water to a level of about 600 feet above mean sea level. Its storage capacity is designed to be 130 billion cubic meters (about 104 million acre feet) which after providing for evaporation, seepage, silting, and flood protection will have a working capacity of 70 billion cubic meters (about 56 million acre feet).

The diversion canal will be dug on the east bank of the Nile to discharge flood flows. It will be equipped with gates for the regulation of water, and will allow for the passage of a maximum flow of about one billion cubic meters per day (about 0.4 million c.f.s.).

The mammoth hydroelectric plant with potential capacity of six billion k.w.h. will be constructed on the west bank of the Nile. It will be located underground in sheer rock with its diversion tunnels for power generation.

The reservoir behind the High Dam will cover an area of 1550 square miles. It will extend 5 miles east west and 310 miles north south.

Stages of construction.--Originally, the project was designed to be completed in two stages within 10 years. However, upon the agreement between the governments of the U.A.R. and the Soviet Union, whereby the latter will provide financial and technical assistance for the second stage on the same terms of the first, the whole project will be constructed in two stages within seven years.

The first stage consists of the upstream and downstream cofferdams and the diversion canal. The second consists of the main dam and the power plant.

Construction cost.--The total expenditures for the construction of the High Dam, including the erection of eight generating units and land reclamation, are estimated at 209.5 million Egyptian pounds (about $600 million). The expenditures estimated for developing related projects for improving irrigation, drainage, housing, transmission lines, roads and other facilities amount to about $400 million. The total cost of the High Dam and related projects will amount to about $1 billion.[24]

Benefits of the High Dam.--The following benefits are estimated to be realized after the completion of the Aswan High Dam.

(1) It will help to expand the cultivated land by about 1.5 million acres and to convert about 700,000 acres from basin to perennial irrigation, thus increasing the present year-round cultivated land by about 30 per cent.

(2) It will meet the water requirements of the existing and new areas under cultivation, irrespective of the manner of the Nile flow.

(3) It will improve drainage conditions in all areas that can be cultivated.

(4) It will make possible the cultivation of 700,000 acres of rice every year.

(5) It will provide protection against floods.

(6) It will improve navigation conditions.

(7) It will improve hydraulic conditions upstream of the existing Aswan dam, almost doubling its power plant capacity.

(8) It will guarantee a head of water on the existing barrages on the Nile all the year round, available for the production of hydroelectric power with the practicability of constructing more barrages on the Nile to fully utilize the total drop of water from Aswan to Cairo in the production of hydroelectric power.

(9) It will produce a hydroelectric power potential of about ten billion k.w.h. per year.

(10) It will make it possible to reduce the annual consumption of mazout (fuel oil) by about two billion tons.

(11) It will provide employment for hundreds of thousands of laborers in the reclamation of land and the establishment of new industries.[25]

Net increase in the national income.--The national annual income of Egypt is estimated to increase due to the development of the Aswan High Dam and related projects by about $660 million through the following sources.

(1) Income from the expansion in agricultural land about	$179 million
(2) Income from increases in agricultural yields about	$159 million
(3) Damage saved by flood control about	$ 28 million
(4) Savings due to improved navigation about	$ 14 million
(5) Indirect benefits from availability of hydroelectric power about	$280 million
	$660 million[26]

Net increase in Government income.--The Aswan High Dam will make possible to increase the Government income by about $65 million from the following sources.

(1) Taxation on both reclaimed and improved land about	$ 26 million
(2) Saved public expenditures on flood control about	$ 7 million
(3) Net income from hydroelectric power sales, about	$ 32 million
	$ 65 million[27]

Summary

Without the Nile, Egypt would be a desert. Not only does the Nile furnish water for domestic uses and irrigation purposes, but it

brings silt that enriches the cultivated land. For lack of industry, Egypt had to rely on agriculture for its existence. With scarcity of rain, cultivated land has been limited to the area that could be irrigated. Egypt's greatest problem is the serious increase of population without corresponding expansion in cultivated land and development of industry. The inequity of agricultural land distribution and the inefficiency of agricultural methods utilized had reduced agricultural production and led to social and political deficiencies.

To improve social and political conditions and to bring about citizen participation in the process of government and decision making, the Government has provided the Agrarian Reform Law, the establishment of a new government set-up and the creation of the National Union. A nation-wide plan and the Aswan High Dam project have been developed to improve economic conditions. Due regard is given to the Aswan High Dam as the dominant feature of Egypt's struggle toward improved living conditions.

The Aswan High Dam will impound the excess flood waters of the Nile, being wasted at present, to be utilized for agricultural expansion, the production of hydroelectric power and other purposes. It will improve drainage and navigation and provide protection against floods.

The next chapter, will present a recommended water policy for Egypt, which will provide for the appropriate uses of the water

impounded by the High Dam with relation to the development of the areas that will be reclaimed, the basin areas, and other land already under plough, and will present a program utilizing these potential benefits to the best advantage possible.

CHAPTER II

UTILIZATION OF THE WATER IMPOUNDED BY THE HIGH DAM FOR DOMESTIC, INDUSTRIAL AND IRRIGATION PURPOSES

As previously pointed out, Egypt's maximum useable water impounded at the reservoir of the High Dam is estimated at 60 billion cubic meters (about 48 million acre feet) a year. This amount of water exceeds the present requirement of Egypt by 25 per cent.[28] It is essential to determine the appropriate use of such water and utilize it for an orderly development.

The purpose of this chapter is to provide for the regulation of water level at the reservoir of the High Dam so as to meet the requirements of the multiple purposes of the High Dam and to develop a program for the utilization of the water available for domestic, industrial and irrigation purposes. The program includes the use of water devoted to irrigation for increasing the crop acreage in basin areas, expanding the areas cultivated in rice and reclaiming new cultivable land. Finally included are the steps recommended for making the best use of these agricultural benefits through authorizing the villages to develop their agricultural plans and providing for the methods of administration, enforcement, finance and development of such plans.

Regulating Water Level at the Reservoir of the High Dam

The Aswan High Dam is located within the reservoir of the existing Aswan dam. Therefore, the regulation of water level for both the dams must be treated as one operation. In order to provide for sound water level management, it is essential to study the capacity of the dams and reservoirs at Aswan and the different requirements of the multiple purposes.

Elevations and capacities of the dams and reservoirs at Aswan.--The elevation of the top of Aswan High Dam will be 643 feet above the mean sea level. The level of stored water will normally not exceed 597 feet. However, in an exceptionally high flood, the storage level will be allowed to reach 604 feet above the mean sea level. The reservoir of the High Dam has a total capacity of 104 million acre feet. This total capacity includes 24 million acre feet for dead storage, 56 million acre feet for live storage and 24 million acre feet for flood protection. The elevations required to provide the volumes for the dead storage, live storage and flood control will be 476 feet, 574 feet, and 597 feet above the mean sea level respectively. The existing Aswan dam is able to impound water up to about 400 feet above the mean sea level.[29]

Requirements of different purposes.--In the management of water level, competition among different purposes of the High Dam will arise, each requiring a certain level at the expense of the others.

As to the generation of hydroelectric power, there should be adequate water head at both the dams to realize the ultimate production of power from the two plants. For irrigation downstream from Aswan, it is of great importance that the discharge be held nearly constant for weeks. With respect to flood protection, the discharge downstream Aswan should not exceed 2.5 million gallons per second to assure the safety of the Nile's banks without inundating the flood plains. An adequate and continuous flow downstream from Aswan is required to assure the continuity of navigation along the Nile's course all the year round. In order to realize the ultimate benefits of all purposes, a unified water level management program is recommended.

Water level management.--Under the normal operation of the reservoir of the Aswan High Dam, the downstream discharge should be adjusted according to irrigation and navigation requirements. The reservoir level will rise, remain steady or fall depending upon the conditions of the arriving flow and water withdrawal. At the end of July--the normal date of the beginning of the flood season at Aswan--the reservoir level should not exceed 574 feet above the mean sea level. During the flood season, the reservoir level except in very low years will continue to rise. According to the forecast of the flow reaching Aswan, the downstream discharge may exceed the requirements of Egypt in order not to exceed 597 feet above the sea level. In case of exceptionally high or late floods, the excess flow should be

released through the side spillway, and the upstream level may be allowed to rise up to 604 feet above the mean sea level in order to assure the protection of the Nile's banks. The water level upstream from the existing Aswan dam should be kept under 400 feet above mean sea level and its discharge should not exceed 2.5 million gallons per second.

Having discussed the régulation of water level at Aswan to meet the requirements of the multiple purposes of the High Dam, it is essential to provide for the utilization of the water available to the best advantage possible. Before recommendations can be made, it is necessary to analyze the present as well as the future uses of water in Egypt.

Present and Future Uses of Water in Egypt

Water is an indispensable ingredient of human life. It is used for domestic purposes as well as for irrigation, industry and the generation of hydroelectric power. It is an essential factor in the growth of a community. More water for Egypt is crucial to the expansion of arable land. However, after the availability of hydroelectric power generated from the Aswan High Dam, and the consequent industrial programs that will be developed, new competing users of water will appear. If Egypt is to meet its future water requirements, and provide for a balanced orderly growth, studies should be made to analyze and plan for the different uses of water at

present and for the future. In the following, an attempt will be made to analyze water requirements for domestic uses, industries and irrigation.

Water requirements for domestic uses.--In 1960, the population of Egypt reached 26.065 million. Of this total, 9.63 million or 37 per cent live in urban centers.[30] The rate of increase of urban population was much higher than that of rural population because of the limitation of cultivated land and the better opportunities provided in cities. According to the estimates of census officials in Egypt, the population will reach more than 38 million in 1982. Due to the bold industrial programs planned to be carried out by the Government, it can be assumed that about 50 per cent of this number will likely be urban dwellers. It is a fact that urban people utilize much more water than rural inhabitants. Therefore, the water devoted for domestic uses should meet the requirements of an increased future population as well as an increased individual consumption.

In 1945, municipal water systems in the United States supplied water at the rate of approximately 145 gallons per person per day.[31] Although per capita consumption of water in Egypt may be greater than that in the United States due to climatic conditions, the writer will consider the rate of consumption in Egypt in urban centers as equal to that of the United States. As there is no information on rural water consumption available to the writer, it will be considered as 40

per cent of that of urban consumption. This assumption is based on the writer's observations as a former rural inhabitant. Based on these assumptions, the annual water requirement for domestic uses in Egypt will amount to about 1460 billion gallons in 1982.

Water requirements for industry.--Industrial developments at present do not create water problems. But as industrialization proceeds, great quantities of water will be required. The Government of U.A.R. inaugurated on the 23rd of July, 1959, several industrial projects whose costs were estimated at the equivalent of about $88 million.[32] These projects included industries in the fields of food, spinning and weaving, fertilizer, rubber, glass, machinery, wireless sets, batteries and others. Furthermore, the equivalent of about $1.7 billion of private and public investments have been appropriated for industrial developments in the coming five years to be followed by progressive appropriations after the hydroelectric power capacity of the Aswan High Dam is fully developed.[33] There is no information available to the writer as to the present water consumption for industrial use, nor the kinds of industries that will be developed in the future so that industrial consumption potential can be reliably estimated.

For purposes of illustration and possible help in determining the quantity and quality of water required for industrial developments in Egypt, after the kinds, number, and capacity of future Egyptian industry are known, a sample of the results of a study conducted by

the National Association of Manufacturers and the Conservation Foundation in the U.S. is presented here. In the above-mentioned study, an investigation of water use by over 3,000 manufacturing plants was undertaken.

The investigation reveals that water for cooling is one of the principal requirements of industry. Cooling water for such uses as condenser water for steam electric generation, quenching as in steel production, and circulating water for cooling of machinery and equipment as in oil refining and steel mills were found to take almost one-fourth of the water withdrawn by industry. Water for cooling does not have to be pure but may be treated to reduce the growth of algae. Temperature is the principal requirement, given an area of adequate supply. Water for cooling is not a consumptive use except for losses by evaporation. Approximately, 65,000 gallons are required for each ton of finished steel. For each 1000 barrels of refined oil, about 770,000 gallons of water are required.

Process water includes water consumed in the products as in the manufacture of drinks, and for washing and cleaning as in ore washing, chemicals, textiles and paper. Some industries such as those of food, textile, paper and chemicals require a certain quality of water as a prerequisite to its use. The process water accounts for a significant portion of water used by industries. It is estimated that 500,000 gallons are required for producing 1000 yards of woolen cloth and from 35,000 to 80,000 gallons of water are needed for each ton of paper pulp.

Boiler water accounts for from 9 to 12 per cent of the total water use of industry. The need for steam as in food industries and paper digesting demands water that will not cause excessive scaling of boiler tubes.[34]

Water requirements for irrigation.--Irrigation water requirements account for the greatest portion among all water use. According to the estimates of Egyptian officials, the annual gross water requirement for irrigating one million acres is 8 billion cubic meters (about 6.4 million acre feet).[35] The present cultivated land including the basin areas is about 6 million acres. When the amount planned to be reclaimed is added, the total amount of cultivated land will be about 7.5 million acres requiring about 48 million acre-feet of water annually. This amount is equal to the share of Egypt from the water impounded at the Aswan High Dam after providing for the Sudan's share and for the inevitable losses due to seepage, evaporation and sedimentation.

Having analyzed the present and future water requirements, it is recommended that, before developing water policy, an appraisal of all water sources in Egypt be made.

Sources of Water in Egypt

With the scarcity of rain in Egypt, the dependable sources of water are limited to surface water obtained from the Nile and to underground water.

Surface water.--Surface water in Egypt is limited to the flow of the Nile that reaches Aswan. The reservoir of the Aswan High Dam will make it possible to secure an annual withdrawal of about 48 million acre feet of water irrespective of the status of the Nile flow.

The quality of the surface water withdrawn varies depending on the season. During the period of flood, particularly between August and October, the water is full of silt eroded from upper parts of the Nile sources. The water's content of silt is useful to the soil and fertiles the land for agriculture. During the other months, the water is siltless. Surface water is usually softer and its temperature is less uniform than that of underground water. Pollution of surface water is a problem requiring costly treatment for domestic uses and most industrial uses.

Underground water.--Egypt has the advantage of having subsoil conditions that are capable of providing considerable amounts of underground water. In most of upper Egypt, the so called "new valley" that includes the oases in the western desert and most parts of lower Egypt to within 50 miles south of the Mediterranean, artesian water can be obtained. Recent investigations made by the Desert Reclamation Authority have proved the existence of an underground reservoir of water with a capacity of 17 million cubic meters (about 3.8 billion gallons) a day.[36] This reservoir extends along the new valley from Quattara Depression which lies at the northwest of Egypt

to the borders of the Sudan. Several thousands of public and private wells have been developed in different parts of the Country, most of which have presented good results. During the writer's employment at the Government of U.A.R., he observed that in several locations, an 8-inch well, if properly developed, could produce an output ranging from 30 to 40 gallons per second.

In order to utilize all underground water resources, it is recommended that the Department of Geology with the cooperation of Health Laboratories Department prepare a comprehensive survey of the geological conditions throughout the areas of potential development. Data on the wells already developed, with relation to characteristics of wells, depth, diameter, pump utilized, output, method of construction, depth and elevation of screens, effect on neighboring wells and chemical analysis of the water produced, should be gathered to determine the underground water potentials and the appropriate uses underground water may serve. There are some advantages to the use of such water. It may be much cheaper than treated surface water, particularly for small cities and industries. It may be available in areas remote from streams and the cost of development may be lower than for a surface water supply. Temperatures of underground water are likely to be more uniform than they are for surface water. If the wells are drilled deep enough to avoid bacteria, the underground water is apt to be free from

contamination though, in some cases, it may contain higher mineral contents.

From the preceding appraisal of water recources in Egypt, the water problem seems to be not a matter of quantity but of utilizing a particular source for its appropriate use. Experts in the field of water supply point to the many factors involved in planning for the use of a given water source. Climate, topography, land-use practices, subsoil water conditions and the chemical characteristics of the water, underground strata, water withdrawal and the expense of development effect the water resources. The combined effect of these factors determines the most economical development of future expansion. Based on these studies, an integrated water policy for distributing available water can be drawn and the appropriate use of each source can be determined. The limited amount of surface water available should be reserved for areas where subsoil conditions are not favorable for the production of ground water. Along the lines of such policy, Egypt can provide for the appropriate quantities and sources of water to be devoted to irrigation.

Having decided on the amounts and sources of water for irrigation, it is essential to establish a distribution policy of such water in a manner economically justified. As flood plains and rice areas are inexpensive to develop, it is recommended that they be given the first priority. The remainder of water devoted for irrigation can be utilized for land reclamation.

Switching Flood Plains to Perennial Irrigation

About 700,000 acres of land in upper Egypt, highly productive in agriculture, are flooded every year to help protect the banks of the Nile during the flood period. These flood plains are subjected to heavy losses in cultivation and business. They are exposed to flood waters from August to October every year and cultivation is limited to one crop a year planted upon the discharge of the flood. The only communication available in these areas during the period of flood is by boats. As this measure of lood protection is taken to save other parts of the Country, the Government compensates the farmers for the damage to crops that are in the fields at the time of flooding. Due to the flooding of these plains, malaria-carrying mosquitoes breed, causing a great number of malarial infections.

After the construction of the High Dam, the water level will be controlled, assuring the protection of the Nile banks without flooding the plains of upper Egypt. This is in addition to the elimination of damage usually caused to many crops and of the costs for the Nile watchmen during the flood periods. Being relieved from flooding, flood plains will be switched over to a perennial system of irrigation requiring water for development.

In order to fully develop the present flood plains, it is suggested that in each village, an agricultural plan be prepared in accordance with which the necessary irrigation and drainage systems should be

constructed. Agricultural roads should be repaired, widened and extended to link the villages to each other and to serve the region as a whole. Upon the conversion of flood plains to perennial irrigation, malaria mosquitoes can be eliminated and control over this debilitating disease will be much more feasible. The Ministry of Public Health should conduct a program for eradicating this disease.

Increasing the Area Cultivated in Rice

In Egypt, rice ranks second after cotton as a main export item. It is a vital foodstuff for the people. In the areas close to the Mediterranean and surrounding the lakes in lower Egypt, the subsoil water is very near the surface and contains a high percentage of salts. Under these conditions, rice is the most suitable crop. As this crop requires great quantities of water, and this area is the remotest land in the irrigation system, the cultivation of rice depends on the volume of the Nile's water reaching Aswan and the quantity of stored-up waters. Between 300,000 and 700,000 acres are annually grown in rice according to the availability of water.

The area described above is best suited for the cultivation of rice. All it needs is ample water supply. It is therefore recommended that necessary quantities of water be made available to assure the cultivation of 700,000 acres of rice every year. Irrigation and drainage systems and water control at the barrages should be arranged to assure the needed water to the area and thus realize the maximum

utilization of the land possible. A plan providing for scientific plantation of rice, and the development of its varieties, supplemented by related processing industries is recommended for this region.

Having provided for the water necessary to fully utilize the rice areas, the remainder of the water devoted for irrigation can be utilized for reclaiming new cultivable land.

Reclaiming New Cultivable Land

The Government of the U.A.R. is making great efforts to reclaim additional areas to be cultivated upon the availability of water for irrigation. Several authorities and private companies are entrusted with the task of reclamation through public and private funds. About 300,000 acres of land are already reclaimed and ready for cultivation as soon as water becomes available. The reclaimed area lies in lower Egypt. It will be irrigated by gravity flow. The Government has planned to reclaim an additional 400,000 acres during the construction period of the Aswan High Dam and another 600,000 acres during the ten years following the High Dam completion.[37] There is no information available to the writer on the exact locations selected for future reclamation. Therefore, the writer will limit his study to the development of criteria for site selection to be used as a guide for defining future reclamation areas.

Criteria of site selection.--The area of Egypt is approximately 385,000 square miles. About 5 per cent of this total is presently

cultivated. Vast areas of the remainder will be suitable for agriculture if water is available. The moors of lower Egypt need water, an efficient system of drainage, and little or no levelling. The barren lands along the Nile Valley in upper Egypt require water, expensive levelling, and little or no drainage. The underground water at the moors is not suitable for irrigation because of the nearness to the lakes and the Mediterranean, resulting in salinity, while it is much more suitable in upper Egypt. Surface water can be applied in the moors by gravity flow, while in upper Egypt, irrigation will be mostly by lift.

Other than the preceding observations, there are several factors involved in selecting suitable sites for reclamation. The weather of any particular location, the topography, the capability of the soil, the availability of water and its characteristics, the expenses involved in furnishing water for irrigation and domestic uses and the types of crops that can be planted as well as the extent of production, that can be realized are major determinant factors in site selection. Another important factor is the distance to inhabited areas.

The weather prevailing at any site will affect the moisture of the soil, evaporation losses, the amount of water required for irrigation, biologic process of life in plants and animals, the crop that can be cultivated, human energy, comfort of prospective inhabitants and the types of industry that can be developed. Topography will

determine the method of irrigation, the type of cultivation, the feasibility of levelling and expenditures involved and the use of the land. Depending on the capability of the soil, the kinds of crops best suited and the suitable fertilizer can be determined. While the quantity of water available at any site determines the extent of its development, its quality will determine its usefulness. If the site is distant from inhabited areas, adequate highways and means of transportation for linking it with central activities and for establishing wider market areas will be required. Otherwise, the site will not be desirable from the standpoint of either the new occupants or the economy. The desirability of a site depends also on the expenditures involved in its reclamation and putting it into use. The combined effect of the preceding factors will determine site selection. It is therefore recommended that the Government prepare such studies for all areas of potential cultivation in order to select the most desirable sites.

Having selected the desirable sites for reclamation, the next step will be to provide for their development along the lines of Egypt's policies for newly developed land.

Egypt's policies for newly developed land.--In order to reduce the high density of population on presently cultivated land, and for the purpose of improving living conditions for the farmers, the Government of the U.A.R. has decided to distribute the reclaimed land to the landless families--ten acres per each. It should be noted that

this amount of land, if properly cultivated, will be able to produce a net profit of not less than the equivalent of $1000 a year. Necessary housing and services will be provided by the Government. Each beneficiary will be required to pay the appraised value of his land and house in annual installments.[38] But the availability of cultivable land is not adequate to assure prosperous development. There are other factors affecting new land development.

Factors affecting new land development.--Land subject to reclamation is, in most cases, far from presently inhabited areas. The general feeling among the farmers in Egypt is against emigration. They prefer to stay where they are, even though living under bare subsistence conditions. It will not be easy to convince them that they should start a new life away from their own home village.

In 1946, the author was engaged in preparing the first agrarian reform project undertaken in Egypt. The project was aimed at distributing to landless families the publicly owned cultivated land at Kafr Saad, Gharbia, Egypt. New settlements provided with minimum services were constructed by the Government. Five acres, a house, a buffalo and a grant-in-aid equivalent to about $60 were given to each family to be repaid in annual installments over a long period of years. At first, beneficiaries selected were attracted by the glamour of the idea, but later, the result was not encouraging. Several families returned to the places from which they came.

The facts associated with 1946's agrarian reform compared with the successful results achieved by the application of the Agrarian Reform Law since 1952 reveal some of the reasons behind the failure of the first project. Among these reasons are the meagre production of the land, the inadequacy of services provided, unwise selection of the beneficiaries and their strong attachment to their relatives as well as the lack of cooperation among them.

If the new agricultural development is to achieve its purpose, the land must not be distributed before being made sufficiently productive to support its owners at a reasonable standard of living. Repayments should be scheduled according to the yield of the land. As the land would not reach its ultimate productivity in the first stage of development, repayments should be scheduled at a progressive rate starting with the lowest possible amounts. To increase the land production, improved agricultural methods should be applied.

The application of improved agricultural methods.--The new land will not be of much significance if developed by the same methods presently utilized. Rather, new techniques should be developed to increase production. All the land that will be reclaimed is owned by the Government. This will make the application of improved agricultural methods much more feasible.

Maximum production can be realized by intensive mechanization and by the application of science, both of which are beyond the

ability of the farmers at present. Therefore, the Agrarian Reform Authority is best suited to develop the land until a stage of reasonable production is reached. However, in the case of Egypt, where idle agricultural labor force is abundant, only a moderate amount of mechanization with intensive application of science is recommended, whereby, the optimum production can be reached. As non-farm employment opportunities increase due to industrialization, a gradual shift to agricultural mechanization will occur.

As the land is publicly owned, it will be easy for the Government to reserve land for experiment stations, where agriculture diversification and fertilizer application can be tested. In order to realize the ultimate benefits possible and to make beneficiaries able to carry on cultivation by the recent methods from the day they receive the land, educational programs and cooperation among the farmers should be a prerequisite to their holding of the land. Technical assistance should be available through extension service units. Adequate low rate loans should be available to cooperatives through the agricultural cooperative bank. Processing industries as well as those which employ women should be developed in order to realize full participation of the total labor force. To relocate the beneficiaries, new settlements furnished with the services required should be constructed.

New settlements.--New settlements should be constructed on the least productive land. They should be furnished with all the services

and public utilities required. They should be linked together and connected with marketing areas and central urban communities by an improved road system and efficient communication. Each settlement should be located near the center of the area it serves in order to minimize the distance between field and home. As the houses will be built by the Government, suitable materials and reasonable standards should be selected not only to meet the interest of the occupants, but to last long enough to outlast the period of repayments.

Social considerations.--Being landless should not be the sole qualification of beneficiaries. Age, background and education should be considered. Socially related groups should be selected and located together to provide for a stable social structure and to make cooperation among the beneficiaries more feasible.

Having discussed the utilization of water for irrigation and the development of flood plains, rice areas and reclaimed land, it should be noted that the ultimate production will not be reached unless efforts are made to make the best use of the land and water. This result can best be realized by increasing the yield of present and future cultivated land.

Increasing the Yield of Cultivated Land

Increasing agricultural production requires efforts by the central Government as well as the utilization of services provided at the local level. Reviewing Egypt's policy, it can be seen that the

Government of U.A.R. is exerting every possible effort to increase agricultural production in Egypt.

Efforts made by the Government.--Soil being the main source of agricultural production, studies were made of its natural and chemi- characteristics. Other studies probed the various problems involved in its utilization and proper exploitation. Research studies and analyses were thus conducted on soil classification and reclamation. Up to the end of 1959, a total of 1,696,785 acres of cultivated land as well as an area of 198,660 acres for future reclamation were thus classified.

A research laboratory was established to carry out experiments on salt and alkaline soils with a view to the development of the best means of their reclamation. A center for plant nutrition and soil fertility was also set up to study fertility factors and to promote land productivity through proper fertilizing and the utilization of three crop rotations each year as well as the use of mechanical equipment.

The Ministry of Agriculture, with the cooperation of the Ministry of Public Works is studying the improvement of irrigation and drain- age systems. Selecting seeds, combating waste, improving storage, eradicating agricultural pests, controlling of animal diseases, im- proving animal wealth and increasing agricultural guidance are some of the measures undertaken by the Government to improve land pro- duction.[39]

How the services provided by the Government are furnished.--National policy and agricultural projects of regional character are prepared and executed by the Government through the Ministry of Agriculture, the Agrarian Reform Authority, the Institute of Researches, and the Permanent Board of Reclamation. At the local level, namely the villages, services are avilable to the farmers through agricultural extension service units--each serving a political unit called the district, with the combined services units serving 15,000 rural inhabitants. The function of these units is to provide assistance and advice to the farmers as well as to execute the policies of the Government. Services other than agricultural are provided in the same manner. It is observed that coordination at the village level is lacking. The village has no single agency to coordinate such activities and to develop plans and programs. No developmental program, coordinated in the full sense, has been made for any village, except in the areas subject to the Agrarian Reform Law. In order to make the best use of available services, and for the purpose of achieving the foundation for future local self-governments (the concept for which the Government is working at present) it is recommended that the Government provide general enabling legislation authorizing the villages to develop their own programs for such things as land-use, crop rotation, drainage, and irrigation.

General Enabling Legislation for Agricultural Development

The purpose of the general enabling legislation is to authorize the villages to establish separate or joint planning commissions to provide for the preparation and amendment of overall agricultural plans for their respective villages, to provide for the regulation of the use of land, to regulate the types and rotation of crops to be cultivated, to provide for improved drainage and irrigation systems, and to provide for administration, enforcement, remedies and penalties. Necessary studies will be made by the Government through appropriate departments.

Planning commission.--It is recommended that the planning commission be composed of not less than 5 nor more than 9 members. One of them should be an ex-officio member who is the head of the agricultural division in the combined services unit serving the village. The members of the local national union in the village will be called upon to elect among themselves half of the rest, and the members of the local cooperative will elect the remainder in the same manner. As the agricultural crop rotation cycle lasts two years, elected members will serve for overlapping terms of five years without compensation.

The planning commission will prepare and recommend to the Government an agricultural plan based on experiments, tests and other necessary studies furnished by the governmental departments concerned, providing for the classification of land with regulations to

control the use of such land and the erection of buildings thereon. It will prepare and adopt a land use ordinance providing for the appropriate use of the land. It will prepare and adopt a crop rotation ordinance every two years for regulating the kinds and rotation of crops, guided by the studies and tests prepared for this purpose. The planning commission will have also the power to prepare and adopt an irrigation and drainage ordinance based on the agricultural plan and on the technical assistance provided by the officials of Ministry of Irrigation and Public Works.

The agricultural plan. --The purpose of the agricultural plan is to coordinate all the services available through governmental authorities as well as to utilize the experience of the farmers in order to provide for an integrated development harmonious with the national plan. Based on the studies provided by the Government, the planning commission will prepare an agricultural plan for the area within its jurisdiction.

The agricultural plan should be aimed at the development of the appropriate use of the land and the promotion of prosperity, convenience, safety or the general welfare. The plan will show, among other things, the areas devoted to agriculture, residence, industry, grazing, fisheries and public uses. It should relate the village to the land as an integrated part and should provide for building and sanitary codes. Such codes will be prepared by the Ministry of Municipal and

Rural Affairs and adopted by the planning commission. The plan will include studies of factors that increase productivity for the village.

The Department of Agriculture at the province in which the village is located will approve the plan recommended by the planning commission in conformity with the Country's needs and policies. The plan will be a public record, but its purpose and effect will be to aid the planning commission in performing its duties. It is recommended that the planning commission, with the aid of governmental divisions concerned, up-date planning studies continuously so as to achieve their purpose. Upon the approval of the agricultural plan by the department of agriculture at the province in which the village is located, the planning commission should prepare and adopt the following ordinances to put the plan into effect.

Land-use ordinance.--For the purpose of promoting health, convenience, order, prosperity, increasing land production or the general welfare, the planning commission prepares a land-use ordinance. The ordinance should be based on soil capability classification providing for the appropriate use of the land including residence, agriculture, industry, grazing, fisheries, and public uses as well as the location and width of streets and agricultural roads existing or proposed. It should be accompanied by a map or maps dividing the whole areas into districts and showing the use recommended for each district. The planning commission adopts the ordinance after a public hearing,

provided that the time and place of said hearing will be announced at the main door of the mosque in the village. Amendment of the ordinance may be made when deemed necessary following the same procedures.

Crop rotation ordinance.--The function of crop rotation is to eliminate the effect of small ownerships on the productivity of the land, and to facilitate agricultural mechanization and the application of recent agricultural methods. Upon the approval of the agricultural plan, the planning commission will have the power to restrict the type of crops to be cultivated.

The planning commission will prepare a crop rotation ordinance, with maps required to be adopted after a public hearing, provided that the time and place of said hearing be announced at the main door of the mosque in the village. Amendments may be made when deemed necessary, or in the light of experiments, and will be adopted in the same manner as the original ordinance. The crop rotation ordinance will be reviewed at least each two years after the agricultural cycle is completed.

Irrigation and drainage ordinance.--Irrigation and drainage have been the responsibility of the Government. At the local level, they were directed to meet the interests of the former powerful landlords, creating unnecessary length and water losses. It is the purpose of the irrigation and drainage ordinance to provide for efficient integrated local systems.

According to the agricultural and crop rotation plans, the planning commission will have the power to provide for an irrigation and drainage ordinance regulating the manner of irrigation and drainage, and to establish improved facilities. The planning commission will have the power to rearrange, widen, reduce, abandon, exchange existing public and private facilities, recommend to the Government the condemnation of land needed for new projects and to determine the means and manner of irrigation and drainage activities.[40] The provision and amendments of irrigation and drainage ordinance are recommended to follow the procedures of the crop rotation ordinance.

Enforcement and remedies.--Each farmer will be required to obtain a permit before preparing his land for planting. It is the responsibility of the head of the agricultural division of the combined services unit serving the area to issue the permit required in conformity with the provisions of the crop rotation and irrigation and drainage ordinances, providing for timing of planting, manner of irrigation and drainage, and recommending the quality and quantity of fertilizer to be used. No fee is required for issuing the permit. The head of the agricultural division of the combined services unit should inspect the fields periodically and record data, in the light of which future decisions will be made.

Any person before altering, demolishing or building any structure will be required to obtain a permit which will be issued by the

building inspector of the nearest municipality in conformity with the ordinances and codes adopted for said village. Fees for issuing the building permits will be determined by the planning commission in each locality. Any person violating any provision of any of the ordinances persuant to the provisions of this legislation will be punished and fined as provided by law.

The omda (sheriff) and his assistants will serve as a board of appeals. Any person aggrieved by a decision of the planning commission or the administrators may appeal to the board. Upon appeal, such board will have the power to hear and decide appeals, where it is alleged there is error in the enforcement of the ordinances or upon finding by the board there is a case of individual unnecessary hardship in the execution of any of the provisions of any ordinance persuant to this legislation, and to provide necessary remedies. Relief in terms of variances and special exceptions will be offered by the board when deemed reasonable and not detrimental to the original concept.

Having discussed the provisions of a general enabling legislation authorizing the villages to develop their own agricultural plans, it is necessary to provide for the implementation of such plans.

Implementation of the Agricultural Plan

Implementation of the agricultural plan involves the method of finance as well as the means by which the plan can best be developed.

Methods of finance.--In developing the agricultural plan, several projects may be required, particularly with relation to planning the village as well as improving irrigation and drainage systems. It is recommended that the Government furnish the studies and other technical assistance required for developing the plans, and finance major projects, which involve expenditures more than the equivalent of about $6000, as well as projects of a regional character such as main canals, drains, roads or public buildings.

It is recommended that other projects be financed by the local cooperatives. The cooperative can make low-interest loans from the Agricultural Cooperative Bank to be repaid in annual installments by the beneficiaries, each according to the amount of benefit he realizes. A board of assessment composed of the omda, the principal of the cooperative and the secretary of the local national union will be created to assess the benefits on each improved property. Appeals from assessments can be introduced to the Board of Assessment in the province for final decision. The tax collector employed by the Government will have the power and will be responsible for collecting the annual installments along with the general tax.

How the plan will be developed.--The general enabling legislation, as recommended, is permissive. It is not expected that all the villages will accept the idea, even if it seems advantageous. Traditions, fear of imposts and interference would make the farmers hesitate to accept

the idea. It is therefore recommended that in each district, the agricultural office, with the aid of the combined services unit, select one village willing to join the program for the purpose of demonstration.

Faced with similar problems, T.V.A. encouraged cooperatives, experiment stations, farmers and others to work together in an effort to prevent soil erosion in the Tennessee Valley, in part by the use of fertilizer. This was accomplished primarily through test demonstration programs. Test demonstration farms are selected to represent insofar as possible a cross section of the Valley. T.V.A.'s fertilizers are given to test demonstration farmers who pay transportation costs to induce them to follow the program.[41] The results of this program, as indicated in T.V.A.'s annual reports and the several material proofs which the writer saw during his visit to a test demonstration farm in the Tennessee Valley, are undoubtedly affirming the great success realized by T.V.A. in this respect.

It is therefore recommended that the Government of the U.A.R. contract with fertilizer companies to develop and experiment with new compounds recommended by the Fertilizer Research Laboratory. Under tests, fertilizer should be experimented with on 10 acres provided at each of the 1000 combined services units distributed throughout the Country. If proved to be successful, new fertilizer should then be tested in demonstration villages. These villages should have such fertilizer free as an inducement to join the program

until the new fertilizer stands the test on a large-scale use. The production of high analysis fertilizers that contain high percentage of plant food will help reduce the cost of fertilizer. Reduced costs along with education of the farmers in the best use of fertilizer will promote sales, thus, producing better returns not only for the farmers in terms of high production, but also for the Government in increased revenues, as well as for fertilizer companies in more profit.

Conclusions and Recommendations

Egypt's maximum useable share of the water impounded by the Aswan High Dam is estimated at 48 million acre feet a year. In order to utilize this amount of water to the best advantage possible, the water level at the reservoir should be regulated in a manner meeting the different requirements of the multiple purposes. The future domestic, irrigation and industrial requirements exceed the amount contributed by the High Dam. With the scarcity of rain, the only other dependable source is underground water. The water problem is the utilization of the proper source for a particular use. It is therefore recommended that before preparing a water policy, underground water potentials be studied and appraised. Based on these studies, Egypt can determine future uses of water along with its development policies. An integrated water policy should make use of surface water in areas of potential development where subsoil conditions are not favorable for underground water and vice versa.

As present flood plains are highly productive and need few expenditures to be fully developed after being relieved from annual inundation, they should be given the first priority. In rice areas, rice is the sole valuable crop suited to soil conditions. Such areas need only water to be highly productive. Therefore, it will be highly advantageous to provide rice areas with the water required. The remainder of water devoted for irrigation can be utilized for reclaiming additional land.

Determinant factors for site selection for reclamation include the weather at any location, topography, soil capability, source of water and its characteristics, production and the expenses involved for reclamation. In developing a new area, improved agricultural methods should be followed. Settlements furnished with all services and public utilities should be constructed before the land is distributed. Socially related groups of people should be selected and located together to provide for a stable social structure. Age composition, background and education should be considered.

The Government is exerting undeniable efforts to improve productivity. But the ultimate production will not be realized unless governmental activities and local efforts are coordinated. It is recommended that the Government provide general enabling legislation authorizing the villages to draw their own plans.

The legislation recommended provides for the creation of local planning commissions, each of which will be responsible for preparing

a coordinated plan for the area within its jurisdiction to guide the development. The planning commission will have the power to adopt ordinances for land use, crop rotation and improved irrigation and drainage. The legislation provides for the methods of administration, enforcement, remedies, penalties, finance and development.

The next chapter deals with the use of water for the generation of hydroelectric power.

CHAPTER III

UTILIZATION OF THE WATER IMPOUNDED BY THE HIGH DAM FOR THE GENERATION OF HYDROELECTRIC POWER

Introduction

As previously pointed out, the Aswan High Dam is a multi-purpose project. One of its main functions is the generation of hydroelectric power. It should provide for irrigation, power generation, flood control and navigation. A power plant with an annual capacity estimated at 1860 million kwh has been constructed to generate hydroelectric power at the existing Aswan dam. Furthermore, about 268 million dollars have been appropriated to build a power plant for generating hydroelectric power from the Aswan High Dam and to construct transmission facilities from Aswan to Cairo. The Aswan High Dam plant will consist of four power stations having together 16 turbines with a total potential capacity estimated at ten billion kwh annually.[42]

The purpose of this chapter is to develop a program for the utilization of the power generated to aid in developing a sound economy and improved living conditions in Egypt. The program includes the regulation of water level upstream and downstream of the High Dam, so as to obtain the ultimate production of hydroelectric power from

both the plants mentioned above. Principal attention is given to an analysis of the present electric power situation in Egypt to recommended steps for the utilization of the power generated, in the light of the experience of the Tennessee Valley.

Regulating Water Level at the High Dam for the Ultimate Production of Power

Two water level operations are involved in the generation of hydroelectric power from the power plants at Aswan. One is the water level upstream from the High Dam which should not exceed 604 feet above mean sea level, and the second is the water level upstream from the existing Aswan dam which should not be more than 400 feet above mean sea level.

The water level upstream from the High Dam will vary according to the flow reaching Aswan and the water withdrawal. But the water level upstream from the existing dam can be constant if adjustments are made between water requirements and the discharge released from the High Dam.

It is therefore recommended that the water level upstream from the existing dam be kept as constant as possible. By doing so, the power plant at the existing dam will be able to produce its maximum capacity constantly, and the High Dam plant will be able to generate certain amounts of power continuously while the rest of its capacity will be produced in varying amounts.

It is essential to make the best use of the power generated by the two Aswan dams. Before recommendations for the use of this power can be drawn, it is necessary to analyze the present situation with respect to electric power in Egypt in order to provide for a related power development.

Present Situation of Electric Power in Egypt

The lack of adequate supply of electric power has been one of the main problems facing Egypt. The limitation of electric power supply has held back the Country's progress. The following is a summary of current conditions in respect to electric power generation and distribution, power rates and development.

Electric power generation and distribution.--Electric power is publicly owned in Egypt. In most cities and towns, municipal authorities are responsible for generating and distributing electric power to the ultimate consumers. Where power plants are lacking, cities buy the power required from regional plants constructed and operated by the Government. Some of the existing power plants were built a long time ago and can hardly meet the requirements of domestic consumption. In rural areas, electric power rarely exists.

Electric power rates.--For normal domestic consumption, the retail rates per kilowatt-hour (kwh) range from about 7 cents in large cities to about 11 cents in small towns. When electrical appliances are intensively used in homes, consumers can obtain power at the rate

of about 4 cents per kwh. There is no information available to the writer as to the rates for industrial and commercial consumers. The writer believes that they are not much less than the reduced rates for residential use. The high cost of electric power, the limited power supply, and the inefficiency of the existing facilities have held back industrial developments, thus adversely affecting Egypt's economy. In order to improve such conditions, the Government of the U.A.R. is exerting great efforts.

The Government electric power program.--The Government of the U.A.R. has set up a special commission to supervise and prepare a 20-year electrification program which started in 1955. The program includes the exploitation of power now being generated and the increased power that will be generated from the two power plants at Aswan. It is also endeavoring to meet the Country's electric requirements prior to the completion of the High-Dam by establishing thermal electric stations. Its program includes the electrification of Quattara Depression as well as the extension of networks to connect power plants together, particularly the network connecting Cairo and Alexandria with lower Egypt. Furthermore, the program includes the supplying of some cities, public utilities, industries, irrigation and drainage stations with electricity from principal networks.

A significant portion of the program has been completed. The power network of Cairo metropolitan area has been already connected

with the network of lower Egypt. A new power station at northern Cairo has been constructed at a cost equivalent to about $19 million. About $25 million have been appropriated for constructing two power stations at southern Cairo and Altabin--a suburb of Cairo. Work is also under way for power plants, transformers and networks to furnish electric power for industrial purposes and for a number of towns.[43]

The following steps are recommended for making the best use of the power generated from the Aswan High Dam and from other projects as well.

Steps Recommended to Make the Best Use of Power Generated

The main objectives of electric power are the convenience of the people and the promotion of economic activities. The key issue for stimulating the expansion of economic activities as well as the betterment of living conditions is the availability of an ample supply of electrical energy at the lowest possible cost when and where it is needed. The following are some of the policies recommended for achieving that goal.

Coordinating major electrical projects.--From the previous review of the efforts made by the U.A.R. Government with respect to electric power, it can be seen that major electrical projects are located in Cairo metropolitan area, Alexandria, lower Egypt, Quattara Depression and Aswan in addition to the steam plants located in cities. The

plants at Aswan and Quattara Depression will generate hydroelectric power. In other projects, power will be generated through steam plants or thermal electrical stations.[44] Due to the inadequacy of local fuel in Egypt, the production cost of steam power is much greater than that of hydroelectric power. In order to make low cost power available throughout the Country and for the purpose of making the best use of electric power generated, all major electrical projects should be connected together and with main centers of power consumption by a complete system of transmission facilities. To make the operation of such system more efficient, control units at central locations are required. Such units should be furnished with modern equipment whereby the cheapest power for a given load at any particular location can be provided.

In the Tennessee Valley, it has been found that the connection of the electric systems together and the use of electronic computers have enabled T. V. A. to make the most efficient loading of generation and transmission facilities. Twice each hour, calculations are made of a variety of complex variables, including the efficiencies of more than 200 generating units in the system, the varying cost of fuel at the steam plants, the value of water stored behind the dams and the transmission losses involved in supplying electricity from alternative generating stations. With these data, T. V. A. makes immediate changes in system operations and thus supplies power requirements at the lowest cost possible.[45]

Therefore, it is recommended that, after providing for the coordination of major electrical projects, the Government utilize such electronic computers for help in furnishing electric power more efficiently and economically. As such an extended system of electric transmission requires continuous inspection to maintain its operation, the use of helicopters is recommended, whereby, periodical inspections and immediate repairs can be easily and efficiently applied.

Modernizing outmoded facilities.--As pointed out, some of the power plants run by the municipalities are outmoded and inadequate to cope with future demand. The required expansion of power output will need a vast modernization program, thus reducing the proportion of old and inefficient capacity in the total power supply. Such a program should apply recent technological advancements in the field of power production. Experts in this field have stated that a steam plant of 40,000-60,000 kwh can be built today to generate power at a cost of 20-25 per cent less than the kwh cost of those built 12 years ago. Also, with larger plants within a range of 200,000-300,000 kwh, generating costs are lower by 10-15 per cent than the modern plants of 40,000-60,000 kwh.[46]

It is not within the ability of the municipalities to modernize or to replace such outmoded facilities, nor they will be able to produce power at the rates of the power produced by the Government. It is therefore recommended that the Government of U.A.R. take

over all generation facilities owned by the municipalities, replace inefficient plants by modern ones, and integrate all the power plants into the national electrification system. As the Government of the U.A.R. will be the exclusive agency for generating electric power in Egypt, the making of electricity available in rural areas will be one of its responsibilities. Power should be available in rural areas to enhance agricultural economy and improve living conditions for the farmers.

Rural electrification.--Rural inhabitants represent more than 60 per cent of the total population of Egypt. The rural people live in sub-standard houses at low standard of living. Almost all rural inhabitants still use petroleum lamps for lighting. Cotton and corn straws are used as fuel for baking and cooking. At night, most of the villages are covered with darkness which fills the hearts of youngsters with fear and superstitions and facilitates the occurrence of crimes. In order to promote agricultural economy and improve living conditions for the farmers, rural electrification is essential.

Rural electrification in Egypt should include street and home lighting, the use of minor electrical appliances, water pumping, drainage, refrigeration, storage, dairy and poultry operations, and processing industry operations. Due to the physical conditions of housing and because of income limitation, intensive use of electrical appliances is not expected to ccur in the near future. However, as

economic conditions improve, rural housing will be modernized and a greater demand for electric power will consequently take place.

It is recommended therefore that electric power be made available to rural cooperatives at the lowest cost possible. Cooperatives should be assisted financially and technically to establish local distribution systems. Financial assistance can be made through low-interest loans from the Agricultural Cooperative Bank to be paid from power revenues. Technical assistance can be provided through the Department of Power by appointing electric technicians responsible for providing the assistance required, with a minimum of one technician for each combined services unit.

Having provided electric power in both urban and rural areas, the following policies with respect to power distribution are recommended.

Power distribution policy.--The distribution systems are presently owned and operated by the municipalities. They may be adequate to some extent as to the present requirement. As industrialization proceeds, such systems will not be able to meet the requirements of future loads. It is therefore recommended that municipal authorities be authorized to issue revenue bonds for improving distribution facilities. The Government, being the owner and operator of all electric generation and transmission facilities, will be responsible for providing electric power required at the wholesale price

to the distributors who in turn will furnish the power to the ultimate consumers. Industries which require unusual loads should be provided with power directly from the principal networks to relieve municipal distribution systems. In order to make sure that the power will reach the ultimate consumers at the rates decided upon, arrangements for power sale and distribution should be made between the Government and distributors through formal contracts.

The contracts should define the responsibilities of both parties, the regulation of loads, wholesale rates, retail sales rates, the periods of the contracts and the methods of power revenues disposal. As the funds required for improving distribution systems may not be available for all distributors, it is recommended that the provision of efficient distribution systems by local cooperatives or municipalities be a prerequisite to the use of low-cost power, provided that such power is available. In doing so, distributors will struggle to make available the funds necessary for extending and improving distribution facilities.

For distributing electric power in the Tennessee Valley, contracts were made between the T.V.A. and the distributors for 20-year periods, subject to termination by either party after not less than 10 years, on at least four years' notice. The contract reserves to the T.V.A. Board the right to revise the wholesale rates when necessary through negotiations with the other party involved.[47]

However, Egypt should draw the contracts according to its conditions, needs and policies.

It is essential to adopt a schedule of power rates at which power can be made available at the lowest possible cost without being subsidized.

The adoption of a low-rate policy.--Two main theories have been suggested for establishing power-rate policies. One method is to determine the rate so as to protect the investment by assuring a certain return from the beginning of operation. The drawback of this policy is that it results in higher rates which limit the use of electricity and hinder the growth of economy, particularly when there is no other way to obtain cheaper power. The second method is based on long range objectives, whereby, rates are fixed the lowest possible, thus encouraging the use of electric power and realizing more earnings from the greater volume that will be sold. The difference between the two theories is best illustrated in the following.

> In determining the rates of power sales, one does not start with a rate that will produce a return and struggle to build business at that price. Just the opposite; one sets a goal and then finds out what price is necessary to reach that goal.[48]

For distributing electric power in the Tennessee Valley, the T.V.A. Act stipulated that the power projects should as soon as practical become self-supporting and self-liquidating and that when

operated at their normal capacity, they should produce gross revenues in excess of the cost of production.[49] To achieve this purpose, the T.V.A. Board adopted a low-rate policy. This policy has encouraged greater use of electricity; and this in turn has reduced costs and increased earnings. In the area served by T.V.A. power, the sale of electric energy has been growing at an average rate of approximately 12 per cent annually.[50] In 1959, the average wholesale price of T.V.A. power was 4.32 mills and its average retail price was less than one cent for each kwh. For the same year, the average residential use of electricity in the area served by T.V.A. was 7863 kwh at a rate of 1.03 cents per kwh, while the same average for the U.S. was 3450 kwh at a rate of 2.52 cents per kwh.[51]

T.V.A.'s low-rate policy for wholesale power has increased earnings on investment. In 1959, T.V.A.'s net accumulated earnings for 26 years reached $519,242,000 while the total power investments amounted to $1,700 million.[52] The average annual return on power investment for the 26-year period was 3.9 per cent. In addition, by restricting the disposal of power revenues from retail sales to the expansion and improvement of power facilities, about half of T.V.A. power distributors could apply rates 10-20 per cent below the basic level established in 1933.[53]

The conclusion of the preceding discussion affirms the benefits and the economic validity of a low-rate policy. Therefore, it is

recommended that the Government and distributors establish the rates of wholesale and retail sales of power as low as possible, so as to encourage the use of electric power, thus promoting economic activities and improving living conditions. More than the required return on power investment will be realized through the greater volumes of power which will be used. In fact, the less the price is, the more the profit will be to a certain extent.

For the purpose of assuring equal opportunity for all, and in order to provide for a balanced and harmonious growth throughout the Country, the wholesale price of electric power should be uniform for all distributors, including industries served directly from the principal networks. For one particular use--residential, industrial, commercial or other--, wholesale rates and retail rates should be uniform, but the rates for any use may differ from those for other uses. Both wholesale and retail rates should decline as consumption increases in order to promote the use of electric power.

In order to maintain the low-rate policy recommended, the production cost should be reduced as much as possible. Reducing production cost cannot be realized unless idle capacity is largely eliminated. Proper rates can facilitate this objective.

Power plant operation and power sales.--The domestic use of electric power varies between days and nights and seasons. Nevertheless, it is the most stable element of power consumption.

Commercial and industrial uses are subject to interruptions with varying load requirements. These variations require different capacities of electric power. As there is no other source from which electric power can be obtained or exchanged, the Government and distributors should be able to meet various power demands.

If electric facilities are to meet the peak demand, idle capacity during the periods of low consumption will be expected, resulting in economic losses from power investment. On the other hand, inadequate power hinders the growth of industries and other economic activities, affecting the Country's economy as a whole. Therefore, it is recommended that the operation of power plants meet varying demands as economically as possible. To achieve this objective, firm power demand can be met from the production of the steam plants, the Aswan dam plant and the portion of firm power produced by the High Dam plant. If the demand for firm power is less than the firm production available, it is preferable to keep out of work some of the plants which have high production costs. The peak demand can be met by putting all firm power generators into work and operating the High Dam plant at the capacity which the water level upstream the High Dam can provide. For help in reserving power for peak demand, the water should be stored at the reservoir of the High Dam during the periods of low power consumption to be released as the power is needed. The extent to which the peak demand

can be met through the High Dam plant will be limited by the maximum storage level of the High Dam. Therefore, it is recommended that firm and peak power demands be adjusted according to the conditions of power generation, whereby the firm power demand should not exceed the firm production, and the daily or seasonal peaks must be within the total power production available.

The cycle of the Nile floods plays also an important role in power economy. For flood protection, the water impounded at the High Dam reservoir should be released down to the normal storage level before the end of July every year. This operation involves the possibility of producing dump power or keeping some steam plants out of work. But power economy can be realized only when the capacity installed in power generation, transmission and distribution is kept in a relatively constant use.

Therefore it is recommended that separate rates be established for different types of power. The rates for continuous power should be the highest of all. The dump power should be sold at the lowest price possible. Rates for interruptible and off-peak power should be set in between. In doing so, industries and other power consumers will seek the types of power appropriate for their operation . Each type of power available will find its consumer and every power requirement will be met and the capacity installed is kept in a relatively constant use. The types of power, the load and the rates of each type

should be included in the power contracts to prevent any misunderstanding.

Having discussed the policies recommended for power economy, it is essential to develop a program for promoting power sales for help in reducing the production cost and the rates as well.

Promotion of electric power sales.--In order to obtain high-levels of electric power consumption, whereby production costs and power rates can be reduced, efforts should be made to promote power sales. Electric sales activities cover the fields of residential, farm, commercial and industrial uses. A coordinated program should be conducted by the Government, municipalities, cooperatives, and electric equipment dealers and industries to promote electric sales. The program should demonstrate to the ultimate consumers the benefits and convenience of using electrical equipment as well as the comparability of electric power over other fuels. Such program may run all the way from short intensive campaigns to increase the sales of domestic electric appliances to long-range educational efforts. The use of television, radio, motion pictures, newspapers, special publications and periodic fairs may be the means for promoting power sales in cities. The combined services units offer the best place for carrying such programs in to rural areas. Another effective means for promoting power sales is the adoption of lay-away and credit plans at easy terms for buying electric appliances.

In the Tennessee Valley, widespread programs for promoting power sales have been undertaken. Demonstration farmers have been assisted in setting up modern material-handling methods and bringing farming operations as near to production-line methods as possible. Electric equipment has been moved about on trailers to show how grains and feeds can be brought from the field, dried, processed and delivered to the feed trough without manual labor. As a result of these programs, materials-handling installations in dairy farming, poultry raising and livestock farming are bringing significant changes. At the end of 1960, almost all the farms in the Tennessee Valley have been electrified. The number of rural homes furnished with electric cooking, refrigeration and heating appliances have amounted to 20 per cent of the total rural housing in the Tennessee Valley.[54] In fact, the sales promotion program in the Tennessee Valley has proved to be an effective method of increasing sales and reducing costs of power.

The program of promoting power sales in rural areas of Egypt should not encourage extensive use of electric appliances at the present time. Due to the physical, economic and social conditions at present and those expected in the near future, the program should promote activities which such conditions will permit. In cities, the program should cover all of the uses of electricity.

As power sales increase, it will be necessary for the U.A.R. to keep pace with the increasing power demands and to provide for the future power requirements.

Planning for future power requirements.--As power consumption increases, continuous efforts should be made to make the power available when and where it is needed. Power should be leading not following industries and other activities.

It is therefore recommended that a program be developed for studying the possibility of generating hydroelectric power at the dams existing on the Nile between Aswan and the Mediterranean. Such a program should be supplemented by establishing steam plants or thermal electrical stations. In order to maintain high standards of power production, it is recommended that the Government and distributors provide for continuous improvement and maintenance of electric facilities. Research should be directed toward improving power generation, transmission and utilization. For further power supply, investigations of the possibility of using the tide of the Mediterranean and the Red Sea for generating power energy should be encouraged.

Conclusions and Recommendations

The Government of the U.A.R. has constructed a power plant with a capacity of 1860 million kwh annually at the existing Aswan dam and appropriated about 260 million dollars for building a power

plant at the Aswan High Dam to make use of the water impounded at the High Dam reservoir for the generation of power. As the High Dam is a multi-purpose project lying in the reservoir of the existing Aswan dam, water regulation at both the dams should be treated as one operation providing for the multiple purposes.

The water level upstream of the existing Aswan dam should be kept constant as possible at a level not exceeding 400 feet, and the reservoir between the two dams will consequently act as an equalizing basin. In doing so, the plant at the existing dam will generate electricity continuously at its maximum capacity and the High Dam plant will generate at varying rates to meet the changing power demands. To make the best use of the power generated, it should be integrated with the power produced at existing and proposed power projects.

Electric power in Egypt is publicly owned. Municipal authorities are responsible for producing and distributing power to the ultimate consumers. Some of the power plants are inefficient, and power rates are unusually high, thus, limiting the use of electric power and holding back industrial expansion. For these reasons, the Government is exerting great efforts to make available ample power at low cost. The power projects at Aswan, Quattara Depression, Cairo and the extension of networks to connect the stations together are some of the efforts made or underway.

In order to take the best advantage of the power generated at Aswan, all major electric projects should be coordinated and connected with a complete system of transmission facilities. Control units furnished with electronic computers are the means whereby the efficient loading of generation and transmission facilities can be determined and power requirements can be supplied at the lowest cost possible. As municipalities will almost certainly be unable to modernize or replace their outmoded facilities, the Government should take over such facilities and provide for a vast modernization program. In order to improve living conditions in rural areas, the availability of electric power for the farmers should be one of the responsibilities of the Government. Rural cooperatives should be assisted financially and technically in establishing electric power distribution systems.

The Government should provide electric power to municipalities, cooperatives and industries with unusually large power requirements at the wholesale price and distributors in turn will furnish the power to the ultimate consumers. Arrangements should be made between the Government and distributors through formal contracts regulating the loads, rates of wholesale and retail sales, the periods of the contracts and the methods of power revenue disposal.

The Government and distributors should adopt a low-rate policy whereby the use of electric power will be promoted, thus enhancing

economic activities, realizing more earnings on the greater volumes that will be used and improving living conditions as a whole. Rates should be uniform for each particular use and should decline as sales volume increases.

The maximum utilization of the power investment will be realized if the capacity installed for power generating, transmission, and distribution is kept in constant use. To reach this goal, differences in rates for continuous, interruptible, off-peak and dump power should be made so that electric consumers may select the type of power appropriate for their operations and idle capacity may be reduced. The water should be stored at the High Dam reservoir during the periods of low power consumption to be released as the power is needed. If some facilities have to be idle, they should be those which have the highest production cost.

In order to provide for a volume creating policy, low rates should be supplemented by a sales promotion program. As electric sales cover many fields, the program should be carried out by all agencies and industries concerned. The program should show to the consumers the convenience, profitability and the comparability of electric power over other fuels.

For the purpose of keeping pace with increasing power demand, and in order to prepare for future power requirements, the Government should undertake a continuous program to keep electric power

production ahead of need. A program for the continuous improvement and maintenance of electric facilities should be carried out and research in the field of electric power should be encouraged.

CHAPTER IV

UTILIZATION OF THE WATER IMPOUNDED BY THE HIGH DAM FOR IMPROVING NAVIGATION ON THE NILE

Introduction

Inland navigation in Egypt is one of the most important means of freight transportation. Navigation channels consist of the course of the Nile from Aswan to the Mediterranean and some irrigation canals. In the fiscal year 1957-58, about one-third of the total freight in Egypt was carried by inland navigation carriers.[55] Since new industrial projects have been developed, it has been found that both navigation channels and carriers can hardly cope with the resulting shipments. For help in establishing a navigation system, capable of coping with present as well as future commodities more economically and efficiently, the Government of U.A.R. has provided that water-level management at the Aswan High Dam should take into consideration the water requirements for navigation on the Nile downstream from Aswan. Furthermore, the Government has appropriated about the equivalent of six million dollars for improving the inland navigation system.[56]

The purpose of this chapter is to develop a program for the utilization of the water impounded by the High Dam for assuring

efficient navigation on the Nile all the year round. The program in-includes the steps necessary for assuring navigation on the Nile downstream from Aswan all the year round, improving and regulating transportation on the Nile, constructing efficient terminals, and recommending policies with relation to the effects of navigation on the Nile on its waterfront development.

Steps Necessary for Assuring Navigation on the Nile all the Year Round

There is no navigation lock in the Aswan High Dam. Local navigation above the High Dam is limited because there are few people and hazardous because of cataracts. There are eight dams on the Nile downstream from the existing Aswan dam to the Mediterranean. Figure 4 (Appendix, p. 124) shows the location of these dams. The two dams located where the two branches of the Nile meet the Mediterranean are constructed to prevent the salt water from entering the Nile. Each of the other six dams is designed primarily to raise the water level for an extended system of irrigation canals. There are also several bridges on the Nile built to connect transportation systems. Others are of sufficient height above the water to permit the passage of navigation carriers.

After the completion of the High Dam, all the waters reaching Aswan will be impounded at the High Dam reservoir to be released according to the requirements of the multiple purposes among which is navigation on the Nile downstream from Aswan. Hence, every

one of the six dams should be operated in a manner meeting irrigation and navigation requirements, and the operation of the series of dams should be integrated into one unified water-level-management plan. This type of operation will be somewhat similar to the operation of the dams on the Tennessee River. In order to benefit from the experience in the Tennessee Valley, it is essential to know the similarities and differences between the functions of the two systems.

Functions of the Tennessee River dams and the Nile dams.--For help in developing the water resources of the Tennessee River, T.V.A. has built nine dams on the main Tennessee River to provide for flood control, navigation and the generation of hydroelectric power. Each dam is built at the proper height to form a reservoir, which extends the navigation channel to the next dam up the River. A regular flow of water in the Tennessee River has to be maintained to keep the generators running. Yet, there must be a space available in the reservoir to store water caused by heavy rains or melting snow. By doing so, the cycle of flood and drought no longer stops traffic on the Tennessee River and the requirements of the multiple purposes are maintained.[57]

Contrary to the conditions on the Tennessee River, there will be no cycle of flood on the Nile downstream Aswan. Due to the construction of the High Dam, and because of the scarcity of rainfall in Egypt, the dams on the Nile downstream Aswan will have no flood

control function, but they will take care of irrigation and navigation requirements instead. Irrigation of course involves water consumption. The amount of water available for this purpose decreases steadily downstream owing to withdrawals. The dams existing on the Nile are not designed for the generation of hydroelectric power. However, the possibility of producing power at these dams in the future depends on their water storage capacities as well as other physical conditions. As there is no information available to the writer about the characteristics of these dams, the water level management plan that will be developed here will be limited to irrigation and navigation purposes.

Water level management at the dams on the Nile downstream from Aswan.--In order to secure unified water-level management at the dams on the Nile downstream Aswan, it is recommended that the water reaching any dam should be at least equivalent to the consumption of surface water in the areas lying downstream of said dam. The water level upstream of any dam should be adequate to feed irrigation canals which have openings between the said dam and the dam ahead. If due to excessive length of the waterway between any two consecutive dams or because of variations in the elevations of the bottom of the Nile, such water conditions do not assure the water depth required for navigation, there are two possible solutions. The first solution is to increase the quantity of water in this portion of

the waterway until the water depth required for navigation is reached. The second solution is to dredge a navigation channel in the bed of the Nile. Leaving the additional quantity of water to spread over the whole width of the Nile may involve great quantities of water to be kept idle. In this case, it is preferable to develop a compromise between the two solutions by maintaining a certain level at each dam and dredging all the parts of the bottom which may block navigation at the given level. The extent to which the bottom of the Nile will be dredged should be economically justified by evaluating the quantities of water which will be kept idle and the expenditures involved in dredging the channel.

Dredging a navigation channel in the bed of the Nile.--In order to maintain navigation on the Tennessee River, T. V. A. has secured a minimum navigation channel at least 11 feet deep and 350 feet wide to provide an effective cross section of 9 feet deep and 300 feet wide.[58] The channel of the Nile in width and depth for navigation should be adequate for 2-way operation. The width and depth of the channel should be related to the size and number of carriers anticipated to use the facility.

Owing to the physical conditions of the soil in Egypt, and because of the sedimentation of water deposits that takes place every year, continuous clearance of the channel is required to maintain the efficiency of navigation thereon. The effective use of navigation

channel depends on the efficiency of its operation and on the degree of safety provided. The following includes the methods recommended with respect to these two considerations.

Effective operation and safety of navigation on the Nile.--In order to realize efficient and safe navigation on the Nile, it is recommended that the Government mark the channel with lights and buoys and establish safety harbors at locations which would become dangerous because of swift currents. The operators should be informed about navigation conditions. Navigation charts should be available to the operators showing the sailing lines, the channel marking system, the depth of water at main points, the vertical and horizontal clearances at every bridge, the size of navigation locks and other importants features such as highways, railroads, bridges, wire-crossings, terminals and cities. Any change or non-emergency repair in the navigation system should be declared and published at least two months in advance.

The program recommended requires the cooperation of governmental agencies concerned. For maintaining such program on the Tennessee River, a cooperative management has been developed, under which the T.V.A. operates the dams, the Corps of Engineers operates the locks and the Coast Guard safeguards navigation. In Egypt, it is recommended that the Ministry of Irrigation and Public Works operate the dams and locks and the Coast Guard Department supervise navigation.

Having provided for the regulations and improvements necessary to make navigation possible all the year round on all portions of the Nile downstream from Aswan, it is essential to improve and regulate transportation on the Nile so as to meet the present as well as the future shipments more economically and efficiently.

Improving and Regulating Transportation on the Nile

No charges are imposed on navigation carriers operating on the Nile. Nevertheless, shipping rates, though lower than those of any other means of transportation, are considerably higher than they should be. The present rates for shipping freight on the Nile vary from about 1.1 cents per ton-mile in case of cotton to about 0.55 cent per ton-mile for other goods.[59] Shipping rates on the Tennessee River vary from 3 to 5 mills per ton-mile.[60] By comparing the rates on both the Nile and the Tennessee River, taking into consideration the differences in the standards of wages and living conditions in the two countries involved, the rates of shipping on the Nile seem to be unreasonably high. Among the causes for these high rates is the inefficiency of the present navigation carriers.

Present navigation carriers.--In 1959 the number of freight carriers operating on the Nile and navigable irrigation canals was estimated at 6,557 having the capacity to carry a total load of 384,349 tons.[61] The majority of these carriers are sailing boats. With few industries in existence and most of the agricultural products consumed locally,

these facilities may be adequate. But they will not be adequate when industries are developed. This fact has been apparent since the development of the steel plants which is located at Helwan--a suburb of Cairo--, while the iron ore is mined near Aswan. In order to be able to ship new commodities more efficiently and economically, the replacement of these carriers by modern tow-boats is recommended.

The use of tow-boats on the Nile.--The use of tow-boats on the Tennessee River has helped T. V. A. to maintain efficient navigation. The T. V. A. has found that by installing the engine power of an ocean freighter in tow-boats, a tow of modern integrated barges can haul 20-train loads of commodities.

In Egypt, the use of tow-boats will not only increase the efficiency of navigation but will solve the problem of vertical clearance required at the non-opened bridges. With the abandonment of sails, vertical clearance requirements will need be only sufficient to clear the smokestacks of the tow-boats. The barges can pass easily without opening the bridges. Another benefit that will be realized by the use of tow-boats is that the barges can be pushed in a manner which will enable them to pass through the existing locks and bridges without any difficulty.

Regulating the operation of freight carriers.--In order to increase the efficiency of navigation on the Nile, the carriers should meet certain standards. It is recommended that the Ministry of Irrigation and Public Works set the standards required. To enforce these

standards, any operator should be required to obtain a license for each carrier through the Ministry of Irrigation and Public Works. Sailing freighters should be eliminated on the Nile within a specified number of years. They may continue to be used on navigable irrigation canals. Recreational navigation should be regulated and pleasure sailing boats should be licensed and required to meet certain standards. As navigation carriers will be privately owned and operated, it is recommended that their operation be regulated so as to avoid haphazardous operations and to prevent destructive competition.

For purposes of regulating the operation of navigation carriers on the Tennessee River, they are classified into three categories. These categories are: (1) private carriers including those which serve their owners only; (2) contract carriers which serve other agencies through contracts at negotiated rates; and (3) common carriers for open service. Operators of common carriers are required to obtain a certificate of convenience and necessity in order to be allowed to operate. The Interstate Commerce Commission, upon a finding of necessity, issues a permit which gives the right to operate between two points.[62]

The same method used on the Tennessee River can be applied in regulating the operation of carriers on the Nile. In Egypt, there will be large industries able to operate their own carriers. Other industries may ship their products by contract carriers. Agricultural products, as well as other individual shipments, may be

carried by common carriers. If, for any reason, a commodity has to be shipped within a certain time and the use of common carriers will cause a delay, such commodity may be shipped by the railroads which run parallel to the waterway.

There are several thousands of people whose sole business is the operation of existing boats. It may not be within their ability to own or operate modern carriers. It is recommended the Government assist the operators technically and financially to enable them to stay in business. In order to prevent destructive competition which may arise among different operators, policies regulating shipments and rates should be developed.

Shipments and rates.--Policies regulating shipments should seek to have each carrier transport those commodities it can carry most economically. It is also important that any one carrier should not be the exclusive carrier of a particular commodity, otherwise a monopoly will be created. The rates should be set in a manner that will serve the interest of the people but not be detrimental to the operators.

In the development of the Tennessee River, the Interstate Commerce Commission determines the rates for all means of transportation and makes adjustments when necessary. In Egypt, it is recommended that a joint commission be established representing the chambers of commerce, operators of navigation carriers,

truck companies, railroads and Ministries of Industry and Supply. Such commission would be entrusted with the task of determining the kinds of shipments suitable for any freight carrier, of establishing the rates in accordance with national policy and of providing relief through rate adjustments for any means of transportation when necessary.

Modern river transportation requires efficient river terminals for loading and unloading economically so that shipping rates may be kept as low as possible. The terminals are discussed next.

The Development and Operation of Efficient Commercial Navigation Terminals

In order that navigation on the Nile may fully develop, it is essential that there be a system of river terminals available to shippers at reasonable cost. River terminals will be of two types. The first type includes terminals developed and operated by large industries for their own service. Such terminals will be developed according to the particular requirements of said industries and will not be discussed here. The second type includes terminals open to public use and small industries. Terminals of the second type will be referred to as public terminals.

Responsibility for developing public terminals.--As public terminals serve numerous water carriers, they may be developed by individuals, corporations or the Government. Private enterprise may be reluctant

to invest money in such terminals whose use, and hence financial return, depend on uncertain shipments. In this case, and in order to achieve a thorough going development of navigation in the first instance, it is recommended that the Government build public terminals at points where terminals are most needed. Such terminals will demonstrate to private enterprise the efficiency and profitability of modern terminals.

The method mentioned above has proved to be sound in the development of the Tennessee River. In the early development of the Tennessee River navigation system, T. V. A. built four public terminals to realize the benefits of navigation facilities from the beginning and to stimulate private enterprise to carry on. As commercial navigation on the Tennessee River has developed, 85 terminals have been built by private enterprise since 1933.[63] Some of these terminals serve private industries and the others are open to public use.

Location and size of public terminals.--Public terminals will be located at cities along the Nile and at intersections of transportation routes where the construction of such terminals is economically justified. With too many terminals, the cost of operation would become excessive and there might not be enough business at any one to justify the construction of a modern terminal. Also, if mainline boats must stop at too many terminals doing but a limited

business at each, the rates will inevitably be high. Therefore, it is recommended that in order to insure an economical handling of freight, a proper distribution of large and small terminals should be provided for, based on the present as well as the anticipated tonnage of commodities that may be shipped by river transportation. For help in distributing terminals on the Nile properly, it is recommended that the permits for building such terminals be restricted through requiring the applicant to obtain a certificate of convenience and necessity. The Ministry of Irrigation and Public Works would issue a terminal building permit.

Site selection and design of public terminals.--Sites for terminals should be selected with relation to railroads, highways and existing and desirable future land uses along the waterway. Such terminals should be designed according to modern standards, providing efficient loading and unloading facilities. They should be provided with docks and warehouses as well as other facilities necessary for the convenience of shippers. In order to promote the use of navigation facilities, terminals should be served by short-haul truck lines, thus extending the service to the interior of cities and to locations beyond the waterway.

Operation of public terminals.--Public terminals should be operated in the public interest and not as a source of profit exploitation. Public terminals constructed by private enterprise may be privately

operated but should be subject to restrictions imposed by the Joint Commission with respect to the manner of operation and rates. Terminals constructed by the Government may be operated by the Government or leased to private enterprise subject to the restrictions mentioned above.

At the beginning of the Tennessee River development, T.V.A. operated the four publicly built terminals. In 1952, T.V.A. leased these terminals to private operators on lease-purchase agreements. The Government of the U.A.R. has to decide which policy is more beneficial in the light of both private and public interest.

Navigation will have many effects on the development of the waterfront along the Nile. These effects will be considered next.

Effects of Navigation on the Waterfront Development of the Nile

Transportation expenditures constitute a significant portion of the production costs of many commodities. Navigation is undoubtedly the cheapest means of transportation. As efficient navigation becomes available on the Nile, waterfront lands will be subject to pressures from many industries, particularly those requiring great quantities of water or seeking an easy waste disposal or attracted by the low rates of navigation. The development of these industries on the waterfront lands will encourage related industries and activities to locate nearby. This fact is best illustrated in the following. A flour mill built on the waterfront of the Tennessee River at the City

of Decatur has induced several related industries to locate there. Consequently, the City of Decatur has become one of the important industrial centers on the Tennessee River.[64]

The waterfront lands are also desired for residential, commercial and recreational purposes. If the development on the waterfront land is left without control, the result will be an inefficient and haphazardous use of the Nile resources. Therefore, it is recommended that some means for waterfront development control be adopted.

Methods of Controlling Waterfront Development

For help in developing a program for controlling waterfront developments on the Nile, it is beneficial to illustrate some of the policies adopted in similar situations. The following includes some of the policies adopted by the T. V. A. in this matter.

Policies of waterfront control on the Tennessee River.--In order to create good public relations, T. V. A. purchased the land required for the reservoirs and other purposes at its free market value including an allowance for the expenses involved in moving. In order to control the development along the waterfronts of the first reservoirs created, T. V. A. bought a hundred-foot ribbon around the edge of the reservoirs. The portions of this strip which were not needed to be retained in public ownership were sold with development restrictions at public auction. To protect the access roads to the dams, T. V. A. purchased the development rights of the fronting

lands to the width necessary. In order to control the development of the waterfront of the Tennessee River, the construction of terminals and the disposal of waste into the River are required to meet certain standards and are subject to the approval of the T. V. A. The T. V. A. is also undertaking a program to assist states, counties and cities to provide for the proper use of the land fronting the waterway with relation to the development of the political unit as well as the region as a whole.[65]

Policies recommended for waterfront control on the Nile.--Having a single governmental authority in Egypt facilitates the control of development along the banks of the Nile. At present, most of the land fronting on the Nile outside of the cities is in agricultural use. It will be easy and inexpensive for the Government to control waterfront development through zoning. As future uses for the waterfront lands along the whole course of the Nile cannot be predicted in advance, it is recommended that development control be exercised in two steps. The first step provides for reserving the land for future uses and the second step deals with zoning the land for its appropriate uses.

In order to reserve the waterfront lands for future uses, it is recommended that a use ordinance be provided to restrict the use of such land between the incorporated areas to agriculture, prohibiting the construction of any buildings thereon except those

needed for agricultural purposes. In order to provide for the future uses of such land, necessary studies should be made with the cooperation of the Ministries of Irrigation and Public Works, Industry, and Municipal and Rural Affairs. It is recommended that a zoning ordinance, based on these studies, be provided defining the areas to be devoted to future uses of the waterfront land and spelling out the regulations necessary for each particular use and district. The change from agricultural use to any other use should be in conformity with the zoning ordinance provided. Developers of these areas should obtain building permits through the Ministry of Municipal and Rural Affairs. Cities should be assisted in developing their waterfront lands in accordance with regional policies.

At present, the disposal of waste in the Nile is prohibited. But as industries locate along the waterway, the situation becomes different. Prohibiting entirely the disposal of industrial wastes in the Nile may create hardships on industries and may hinder industrial growth on the waterfronts. It is therefore recommended that the disposal of industrial waste be permitted in the Nile after meeting certain standards, subject to the approval of the Ministries of Health and Irrigation and Public Works.

Faced with the same problem, T.V.A. requires that municipal and industrial wastes meet certain standards before being emptied into the Tennessee River. For help in reducing obnoxious

waste, T.V.A. assists industries in their efforts to produce useful by-products from their wastes. Following the same policy, the Government of the U.A.R. may cooperate with industries in conducting such research.

Conclusions and Recommendations

To improve navigation on the Nile, the Government of the U.A.R. has provided that the operation of the Aswan High Dam should assure navigation on the Nile downstream from Aswan and has appropriated about six million dollars for improving navigation facilities. On the Nile downstream from Aswan, there are six dams built primarily for irrigation purposes but they have navigation locks. After the completion of the High Dam, these dams will meet both irrigation and navigation requirements.

To achieve a unified water-level management at these dams, the water reaching any dam should be at least equivalent to the consumption of water in the areas lying downstream of said dam, and the upstream level should be adequate to supply water to irrigation canals which have openings between this dam and the dam above. If such water conditions do not provide the water depth required for navigation, studies should be made to determine whether it is more economic to raise the water level as necessary, to dredge the bottom of the Nile or to work out a compromise of the two solutions.

If the dredging of a navigation channel is decided, its depth and width should be related to the size and number of carriers that will use the facility. For the safety of navigation, the channel should be marked and boat operators informed of navigation conditions.

To help realize efficient navigation, old freight carriers should be modernized or replaced by tow-boats. Freight carriers as well as pleasure boats operating on the Nile should meet certain standards. According to their functions, freight carriers should be classified as private carriers, contract carriers and common carriers.

In order to prevent destructive competition among the operators of different freight carriers and other means of transportation, shipments and rates should be regulated. It is recommended that a joint commission be established to determine the kinds of commodities suitable for each means, to fix the rates and to offer relief through rate adjustments when necessary.

The construction of efficient terminals on the Nile is a prerequisite to the realization of the full development of navigation. In order to realize the benefits of navigation promptly, it is recommended that public terminals be constructed by the Government to stimulate private enterprise to carry on as the demand for such terminals increases. The location and size of river terminals should be based on the business they may serve and their construction

should be subject to the approval of the Government. Terminals on the Nile should be related to other means of transportation and should be designed according to modern standards in order to increase their efficiency.

Improved navigation on the Nile will promote industrial development along its waterfront. Waterfront lands are also subject to pressures from other uses. In order to accomplish a harmonious growth on the waterfront lands, development thereon should be controlled. Control can be realized in two steps. The first step might be the provision of a use ordinance restricting the use of the waterfront lands lying in unincorporated areas to agriculture. In the second step, a future land-use plan for such land enforced by a zoning ordinance is recommended. With respect to the waterfront lands in incorporated areas, cities should be assisted in developing their plans in accordance with regional policies.

As industries develop along the waterfront, the disposal of their waste into the Nile may be permitted after certain standards are met, subject to the approval of the Government. It is also recommended that the Government cooperate with industries to encourage research in the utilization of industrial wastes to aid in reducing the degree of its undesirability.

CHAPTER V

UTILIZATION OF THE WATER IMPOUNDED BY THE HIGH DAM FOR RECREATIONAL PURPOSES

As previously pointed out, the Nile's waters reaching Aswan will be impounded by the High Dam and released regularly according to Egypt's requirements. The impounding of these waters will create a reservoir above Aswan High Dam of about 1500 square miles. The reservoir will be about 300 miles long with portion thereof lying in the Sudan's territory. The land around the portion of the reservoir lying in Egypt is publicly owned. Figures 4 (Appendix, p. 124) shows the location of the reservoir.

The purpose of this chapter is to develop a program for the utilization of the reservoir for recreational purposes. The program includes an appraisal of the present and future demands for recreation at Aswan, recreational activities that can be developed at the reservoir, the factors limiting the use of these activities and the steps recommended for the development of fishing in the reservoir.

Present and Future Demands for Recreation at Aswan

The City of Aswan is located on the east bank of the Nile near the south border of Egypt. The population of Aswan Province in 1960 amounted to 385,000 persons among whom 98,000 were urban people.[66]

The average individual income in Aswan Province has been less than the national average. Outdoor recreation is enjoyed through pleasure sailing boats on the Nile and public parks developed on the east bank of the Nile and on Phila Island in front of Aswan.

Recreational facilities provided at Aswan may be adequate at present but they will fail to meet future demands. The presence of iron ore and other minerals in the soil of Aswan Province with the availability of electric power, water and a labor force will help promote industrial growth. As a result, the population of Aswan Province is expected to increase considerably and a significant change in population characteristics and incomes will occur, requiring more recreational facilities.

Aswan is an international winter resort. Because of its favorable climate in winter, rich people from Egypt and all over the world enjoy staying at Aswan during the winters. Its climate desirability induced the late Agha Khan to request his burial at Aswan. Since his death, several thousands of pilgrims from his followers travel from different countries to visit his tomb at Aswan every year.

Aswan is also an important center of tourism. In winter each year, several thousands of tourists, students and scientists interested in ancient civilizations visit Aswan Province. The presence of the High Dam along with the records of its ancient civilization in one

place will help increase Aswan visitors. The miraculous efforts being made by the Government of the U.A.R. and UNESCO to preserve the temples which would otherwise be flooded due to the construction of the High Dam will arouse the interest of many people and promote tourism.

Aswan has been fortunate to have one of the most famous hotels in the world. It is the Cataract Hotel. But the expense of accommodations in this hotel is beyond the financial ability of the average person. Therefore, it is essential that more hotels, motels and tourist courts be available at reasonable expense. The fact that most of such facilities will be used seasonally will result in high accommodation-costs. For help in reducing the cost of accommodations as much as possible, it is recommended that the Government furnish the land required for such development with utilities and sell it to private enterprise at the actual costs. The availability of long-term loans at low interest will encourage such development. The Tourism Department and developers should cooperate in conducting a program for promoting tourism to Aswan in Egypt and abroad.

Recreational facilities should be available to take care of future local demand and to meet the interest of visitors as well as to promote tourism, which in turn will help improve the local and national economy. The reservoir will present a natural resource where recreational activities can be developed.

Recreational Activities in the Reservoir Area

Aswan Province is dry all the year round. The average annual rainfall in the period 1935-1945 was about 0.01 inch.[67] This fact makes it inevitable to provide irrigation for developing any park or forest. The soil of the land surrounding the reservoir is composed of very hard rocks in which plants can hardly grow. If some areas can be planted, they would have to be irrigated by lift and the expenditures involved in their development would become very excessive. These physical conditions eliminate the possibility of developing any large parks or wildlife activities.

Migrating birds pass through Egypt in early August and late September every year. At this time, the reservoir will be at its maximum level. Efforts to attract water fowls would be economically prohibitive. Therefore, the only possible recreational activities at the reservoir are fishing and pleasure boating. The extent to which these activities can be developed will be determined by the following factors.

Factors Limiting Recreational Activities on the Reservoir

Physical, social and economic factors limit the scope of recreation on the reservoir. The following includes some of these factors.

Populated territory.--The populated territory of Egypt is a narrow valley following the Nile from Egypt's south border to Cairo and then

stretching in a delta-like shape, embracing the branches of the Nile until they meet the Mediterranean. Consequently, almost all urban centers are located on the Nile. As these cities enjoy the availability of waterfronts, they will not be affected by the development of recreational activities on the reservoir.

Distribution of population.--Outdoor recreation in Egypt at the present time is sought by urban people only. In rural areas, the fields present the places for both work and outdoor recreation. Out of the total of 9,630,000 urban people living in Egypt, 7,732,000 live in Cairo and cities in northern Egypt.[68] The two million live in cities lying on the Nile from south Cairo to Aswan. As the majority of urban people live far from the reservoir, the use of its facilities will be limited to a small number of people.

National average income.--The average annual per capita income in Egypt varies from about $80 in rural areas to about $280 in urban centers. The Government is exerting great efforts to double the national income within the next ten years. Even after this increase in income is realized, the portion of income that might be utilized for recreation will be small. The great bulk of population will still be working too hard to reach subsistence level. This factor will limit the number of people who might use recreational activities on the reservoir.

Accessibility of the reservoir area.--Aswan Province is accessible by train, automobile and plane. A trip by train from Cairo to Aswan takes at least 16 hours and costs about $20 for a coach seat. By plane, the trip will cost about $80 and will take only a short time. By automobile, the trip cannot be made in one day. However, private transportation in Egypt is lagging. The number of private cars registered in 1959 was 59,042 or an average of about one car for each 400 persons of the total population.[69] The expenditures required for transportation with the limited income would discourage and prohibit many people from different parts of Egypt from seeking recreation at the reservoir.

Leisure time.--A paid vacation of about a month is offered to all governmental and private employees each year. Summer is the season of vacations. Unfortunately, in summer, the temperature at Aswan becomes too high to bear. People who can afford the trip to Aswan would prefer to resort to the beaches of the northern coasts.

Analyzing the above factors, it can be seen that the High Dam reservoir will present a natural gift but in the wrong place with respect to recreation. Therefore, it is recommended that the Government develop commercial and recreational fishing at the reservoir so as to fish for local consumption and to provide recreation for local people all the year round as well as for tourists and visitors in winter.

The Development of Fishing in the Reservoir

Fishing as a hobby is not at present popular in Egypt. The expenditures involved in purchasing and operating fishing boats have limited their use to commercial purposes. With regard to the prospectives anticipated for Aswan, it is recommended that fishing on the reservoir be developed for commercial as well as recreational purposes.

The T.V.A. has developed a bold program for fishing at the reservoirs of the Tennessee River primarily for recreational purposes. It was found later that commercial fishing is essential to aid in fish harvesting. The operation of the reservoirs on the Tennessee River, falling into one broad pattern, has been helpful in maintaining fish growth. As a result of this program, expanded fish and game resources have aroused great interest among millions of sportsmen and brought also commercial benefits to many people. In 1959, it was estimated that sports and commercial fishing yielded about $2 million.[70]

The High Dam reservoir will present a suitable place for fishing activities. It will have gently sloping banks and a slow current. The water level at the reservoir will rise or fall gradually with a range of fluctuation of about 23 feet in the normal years. All these factors will make the reservoir desirable for the growth of fish.

It is therefore recommended that the Department of Fishing prepare a scientific program for developing fishing. Studies should

be made to keep track of fish population and their composition. Data on the effects of the reservoir levels and different temperatures and contents of water on fish should be recorded for help in maintaining a sound program. Studies should be conducted to select the kinds of fish most appropriate for reservoir conditions.

According to the kind, age and growth, and water temperature fish live at different levels under water. It is essential to select the kinds of fish which are not harmful to each other.

With respect to fish harvesting, it is essential to restrict the size of fish that might be caught in both commercial and recreational fishing. The development of boat docks will facilitate fishing and stimulate harvesting.

The extent to which fishing on the reservoir will perform its purposes depends on the degree of safety provided. In order to provide a safe operation, it is essential that each fishing boat be licensed. Reasonable standards for such boats should be set and enforced. It is recommended that owners and operators of fishing boats seek the licenses required through the Ministry of Irrigation and Public Works. For help in maintaining the safety of fishermen on the reservoir, it is recommended that the Department of Fishing supervise the activity. As the reservoir is distant from Aswan where commuters and visitors stay, transportation facilities should be available to connect boat docks with the City as well as with other historic locations. An improved road system should be extended as required.

The waters accumulated at the reservoir may result in attracting mosquitoes carrying malaria. A program for malaria control is discussed next.

Malaria Control

The reservoir, being a large water body, will be a place to which mosquitoes carrying malaria may be attracted. Fortunately, the reservoir area is depopulated. However, after developing recreation at the reservoir, habitation is expected to creep to the area. Facilities for visitors and the residential area of the employees of the Dam will be fronting the reservoir. Therefore, a program should be developed to protect the reservoir area against malaria bearing mosquitoes.

The T.V.A. has faced the problem of malaria control in the Tennessee Valley. It was found that through fluctuating the water level at the reservoirs to make them undesirable for mosquitoes breeding and by dusting the area with DDT when necessary, the T.V.A. could control malaria in the Valley.

The water level at the High Dam reservoir will be constantly fluctuating up and down according to the variations of flows and discharges. This fact will discourage mosquitoes breeding at the reservoir. However, continuous inspection is necessary for help in eliminating such insects. By the use of helicopters, the area can be easily dusted with DDT and thus be protected against the spread of malaria.

Conclusions and Recommendations

Outdoor recreational facilities presently provided at Aswan will fail to cope with future demand particularly after the City realizes its industrial growth potential. It is also expected that Aswan will gain more visitors due to the construction of the High Dam and the efforts being made to preserve the temples that would otherwise be subject to flood. Consequently, Egypt has to provide the facilities required to meet such demand. The High Dam reservoir will present a natural place for the development of recreational activities.

Due to the dryness of the reservoir area all the year round, and the rocky soil of the area and its surroundings, the development of large parks or wildlife activities will not be justified. The activities which can be developed at the reservoir are fishing and pleasure boating.

The effective territory of Egypt and the resulting distribution of urban population with the limited income and the inadequacy of private transportation will be deterrent to the extensive reservoir activities. As vacations are usually taken in summer when the temperature is very high in Aswan, the people who can afford the trip to the reservoir would prefer to vacation at summer beaches in the north. It is therefore recommended that the Government develop fishing on the reservoir to provide local requirements and to meet the interest of visitors in winter.

The program of fishing on the reservoir should be developed scientifically. Studies should be made to keep track of fish population and to select the kinds appropriate for the reservoir conditions. The size of fish that might be caught commercially should be restricted in order to maintain a good production. The safety of fishing on the reservoir is important. It is recommended that fishing boats meet certain standards and the Coast Guard Department supervise fishing activities.

CHAPTER VI

CONCLUSION

Agriculture is the principal occupation of a majority of the people in Egypt. Egypt's greatest problem is the serious increase of population without corresponding expansion in cultivated land and development of industry. The inequity of agricultural land distribution and the inefficiency of agricultural methods utilized have reduced agricultural production and led to social and political deficiencies. To improve social and political conditions, the Government has provided the Agrarian Reform Law, the establishment of a new government set-up and the creation of the National Union. A nation-wide plan and the Aswan High Dam project have been developed to improve economic conditions.

The Aswan High Dam will impound the excess flood waters of the Nile being wasted at present to be utilized for agricultural expansion, the production of hydroelectric power and other purposes. The total capacity of the reservoir is estimated at 104 million acre feet. This total capacity includes 24 million acre feet for dead storage, 56 million acre feet for live storage and 24 million acre feet for flood protection.

The High Dam is located within the reservoir of the existing Aswan dam. Therefore, the regulation of water level for both the dams must be treated as one operation and should provide for the requirements of the multiple purposes. After providing for evaporation and seepage losses, the annual amount of water assured by the High Dam for Egypt's use is estimated at 48 million acre feet. This amount of water would fail to meet future domestic, irrigation and industrial requirements unless it is supplemented by underground water. It is therefore recommended that an integrated water policy be drawn, whereby the amounts and sources of water for each particular use and location can be determined.

Having decided on the amounts and sources of water for irrigation, it is recommended that the first priority in distributing such water be given to switching over present flood plains to perennial irrigation and increasing the rice areas. The remainder of water devoted to irrigation can be utilized for reclaiming additional land. Sites for reclamation should be selected on a scientific basis. In developing a new area, improved agricultural methods should be followed and social conditions of beneficiaries must be considered.

The Aswan High Dam will assure the annual water requirements for the land already under plow. To make the best use of this water, efforts should be made to improve agricultural methods on such lands for help in increasing the yield per acre. Coordination

of the efforts being made by the Government is essential. It is recommended that the villages be authorized to develop and execute their agricultural plans with the aid of the Government. Such plans should provide for the regulation of the land-use and crop rotation and the improvement of irrigation and drainage methods.

Industrial development is essential for help in diversifying Egypt's economy. Lack of power is one of the greatest problems holding back industrialization. It is recommended that the water impounded by the High Dam be used for the generation of hydro-electric power. Electric generation and transmission facilities are owned either by the municipalities or the Government. Distribution facilities are owned by the municipalities. In order to take the best advantage of the power generated at the High Dam it is recommended that the Government take over all electric generation and transmission facilities and provide for their modernization. All electric projects should be coordinated and connected together with a complete system of transmission facilities furnished with control units.

For help in improving living conditions in rural areas, rural electrification is essential. Cooperatives should be assisted to establish their electric distribution systems. The Government, being the exclusive wholesaler of electric power, should provide municipalities, cooperatives and large industries with their electric power requirements according to formal contracts between the parties involved.

Rates of electric power should be as low as possible to promote the use of electric power, thus enhancing economic activities and improving living conditions. To be able to maintain such a low-rate policy, the capacity installed for power generation, transmission and distribution should be kept in a relatively constant use. The demand for electric power varies from time to time. It is recommended that the water be impounded at the reservoir during the periods of low consumption to be released as the power is needed. If some facilities have to be idle, they should be those which have the highest production cost. The differences in the rates of firm, interruptible, off-peak and dump powers will help keep the capacity installed in a relatively constant use. A coordinated program for the promotion of electric sales should be conducted. To meet the increasing demand for electric power, it is recommended that the Government undertake a continuous program to keep power production ahead of need.

The course of the Nile downstream from Aswan is suitable for navigation during the periods of high flow. During the periods of drought, navigation is obstructed in some parts of the Nile. After the completion of the High Dam, a regular flow will be released according to Egypt's requirements. To take the advantage of this regular flow, a unified water-level-management at the dams existing on the Nile is recommended, whereby irrigation and navigation water

requirements can be met all the year round. If water conditions between any two consecutive dams do not assure the depth required for navigation, it is recommended that a compromise between raising the water level and dredging a navigation channel be worked out.

To realize efficient navigation, old freight carriers should be modernized or replaced by tow-boats. Freight carriers as well as pleasure boats operating on the Nile should meet certain standards. In order to prevent destructive competition among operators of different freight carriers and other means of transportation, shipments and rates should be regulated. It is recommended that a joint commission be established to determine the kinds of commodities suitable for each means, to fix the rates and to offer relief through rate adjustments when necessary.

In order to realize the benefits of navigation promptly, it is recommended that public terminals be constructed by the Government to stimulate private enterprise to carry on as the demand for such terminal increases. The location and size of such terminals should be based on the business they may serve.

Improved navigation on the Nile with the availability of its water will promote industrial developments along its waterfront. Waterfront lands are also subject to pressures from other uses. In order to provide for a harmonious development on the waterfront,

it is recommended that a use ordinance be provided to reserve such land in unincorporated areas for their appropriate future uses. After preparing the studies necessary for future land-use plans, it is recommended that a zoning ordinance be provided and enforced. Cities should be assisted in developing their plans in accordance with regional policies.

Out-door recreational facilities presently provided at Aswan will fail to cope with future demand. The High Dam reservoir will present a natural place for the development of recreational activities. Due to the dryness of the reservoir area and the rocky soil of the area and its surroundings, the reservoir will be suitable only for fishing and pleasure boating. Because of the physical, social and economic conditions in Egypt, the use of reservoir recreational activities will be limited to the people of Aswan and tourists. However, the program of fishing should be developed scientifically.

The reservoir will be a place to which mosquitoes carrying malaria may be attracted. Through the fluctuation of water level at the reservoir and by dusting the area with DDT or other chemical agent, mosquitoes can be eliminated and malaria can be easily controlled.

Desribing the High Dam, President Nasser said,

> The Aswan High Dam is a monument whose hugeness, value and effect correspond with the greatness of the Nation which is developing it. It is more than a mere mute monument of solid rock; it is a live creative body; it is a new rejuvenating life;

> a developing power as well as a support; it is a bulwark and a storehouse for strides that dot the long way to the attainment of the great National and Arab objectives.

The author hopes that the policies and programs recommended in this study would help fulfill some of the objectives called for. It is also his hope that these recommendations will be taken into consideration by those concerned and that this study will open the way to other detailed programs necessary for carrying out Egypt's development.

APPENDIX

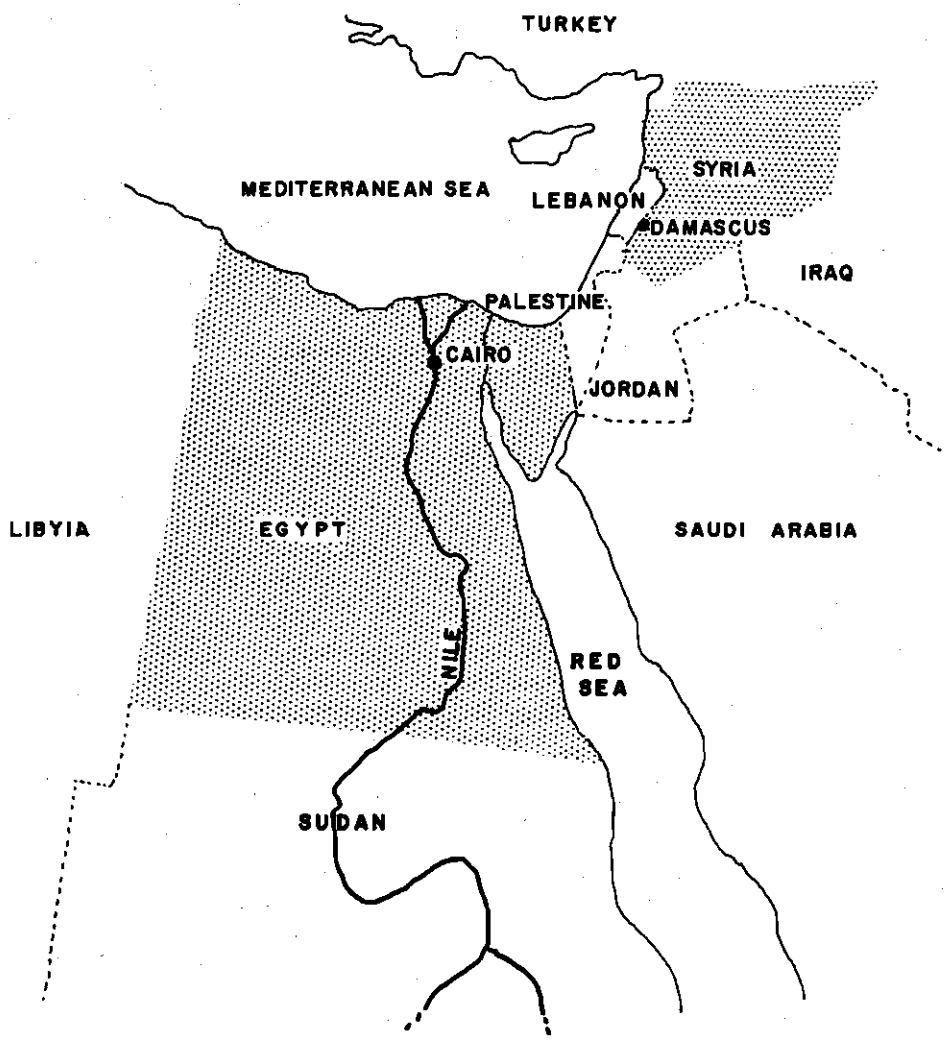

FIGURE 1

UNITED ARAB REPUBLIC

160 0 160 MILES

NORTH

TERRITORY OF EGYPT & SYRIA, THE TWO REGIONS OF U.A.R.

SOURCE. WORLD GEOGRAPHIC ATLAS BY H. BAYER

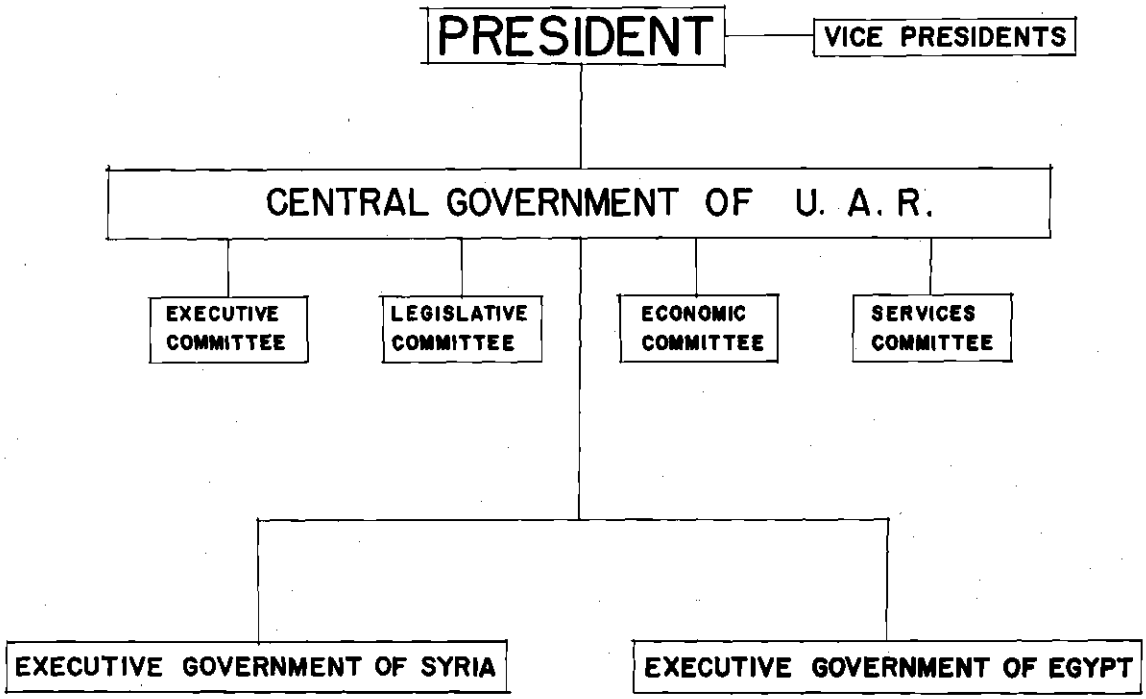

FIGURE 2

THE STRUCTURE OF THE EXECUTIVE POWER IN THE U. A. R.

SOURCE. THE CONSTITUTION OF U.A.R.

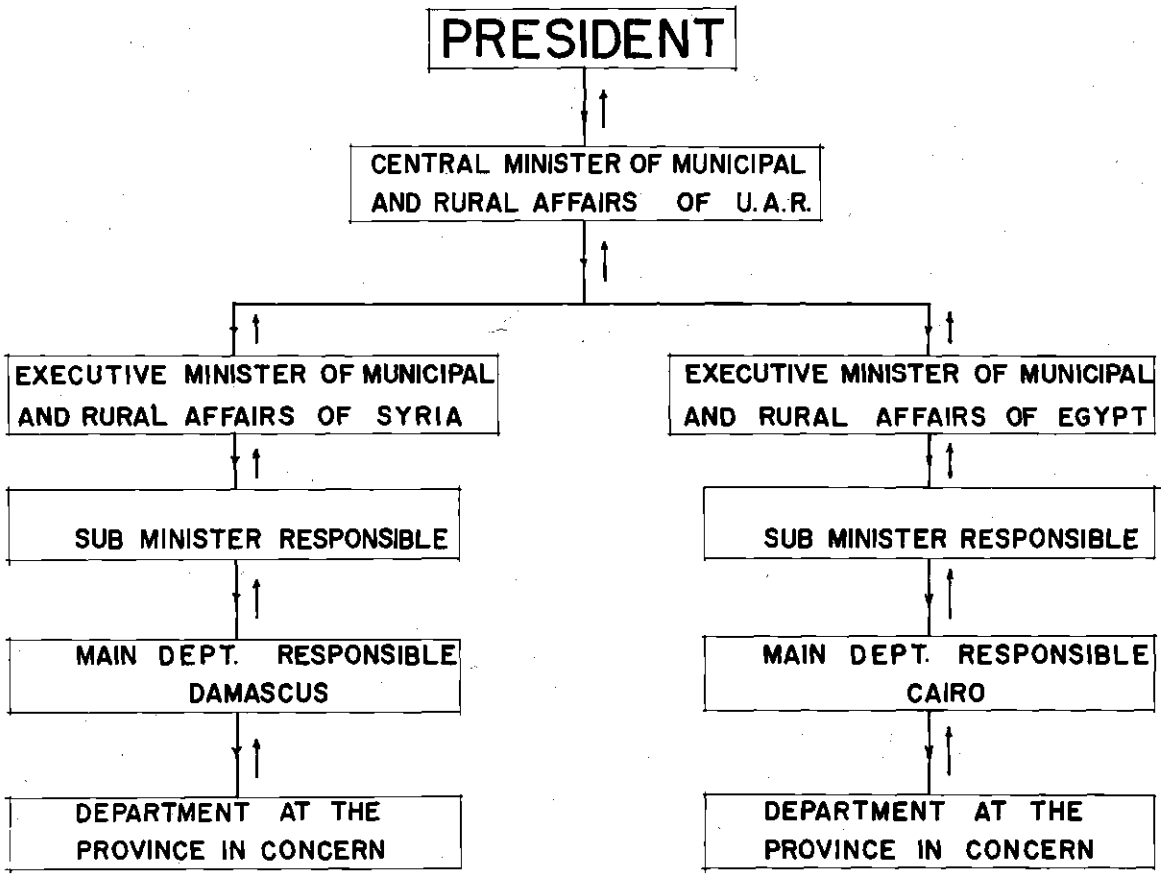

FIGURE 3

CIRCULATION OF DECISIONS AND RECOMMENDATIONS IN MINISTRY OF MUNICIPAL AND RURAL AFFAIRS OF U.A.R.

LEGEND

↓ DECISIONS

↑ RECOMMENDATIONS

SOURCE. THE CONSTITUTION OF U.A.R.

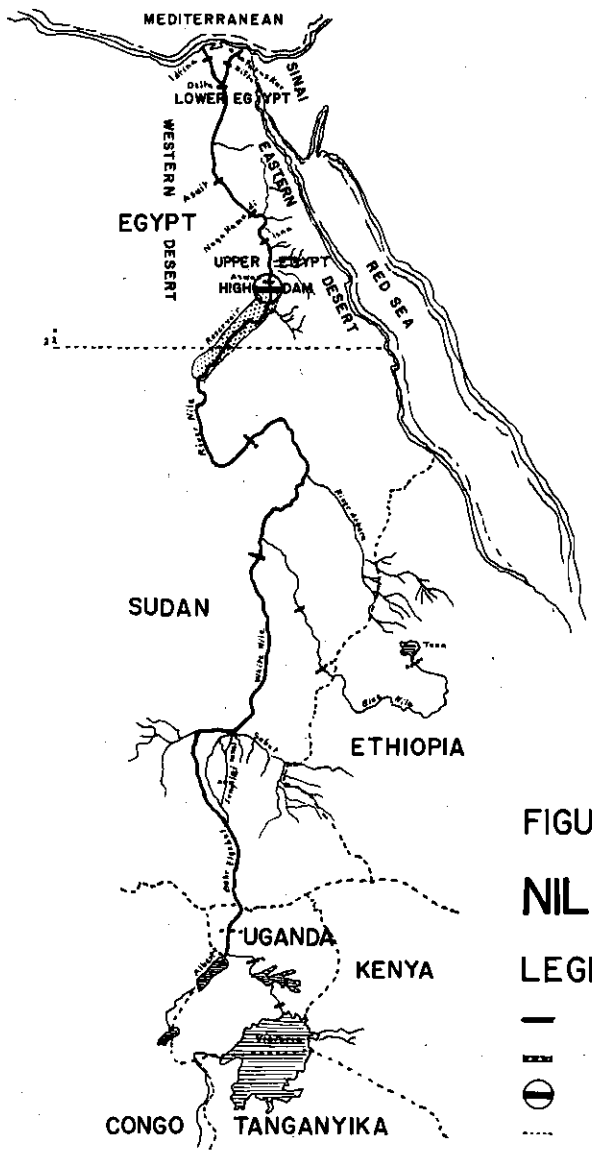

FIGURE 4

NILE BASIN WATER PROJECTS

LEGEND

- EXISTING DAMS
- PROPOSED DAMS
- ASWAN HIGH DAM
- BORDERS OF COUNTRIES

NORTH

SOURCE. WORLD GEOGRAPHIC ATLAS BY H. BAYER

160 0 160 miles

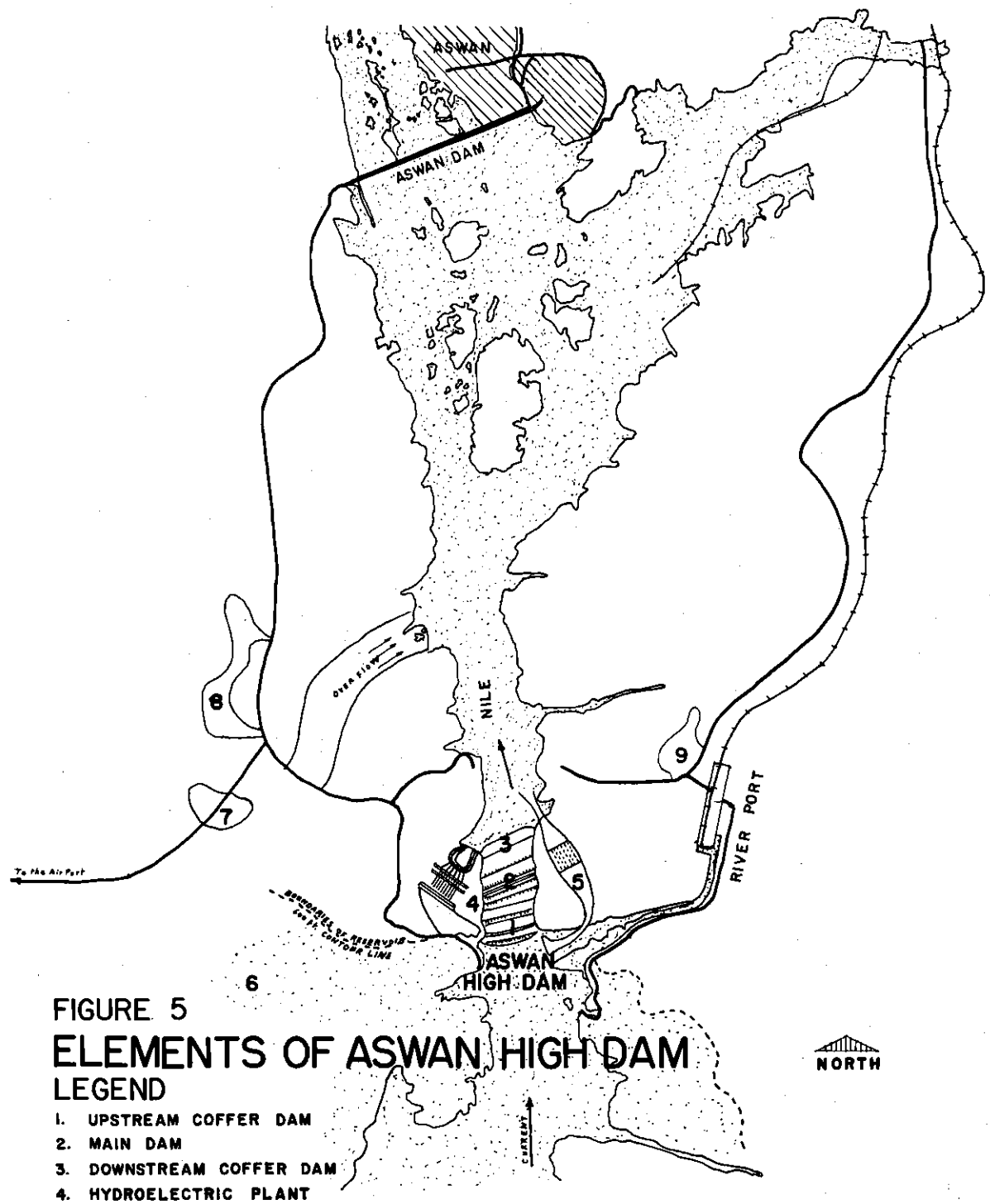

FIGURE 5

ELEMENTS OF ASWAN HIGH DAM

LEGEND

1. UPSTREAM COFFER DAM
2. MAIN DAM
3. DOWNSTREAM COFFER DAM
4. HYDROELECTRIC PLANT
5. DIVERSION CANAL
6. RESERVOIR
7. EMPLOYEES RESIDENCE
8. WINTER RESORT AREA
9. CONSTRUCTION VILLAGE

RAILROADS

ACCESS ROADS

SOURCE. PLANNING DEPT., EGYPT

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