THE OPERATION AND ECONOMICS OF IRRIGATION DEVELOPMENT IN EGYPT

by

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Note

The metric system is used for all items throughout this thesis and monetary values are expressed in the United States Dollar.

The rate of exchange for the base year of 1972 was $ = L.E. 0.4.

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ABSTRACT

FACULTY OF ENGINEERING
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CIVIL ENGINEERING.

Master of Philosophy

THE OPERATION AND ECONOMICS
OF IRRIGATION DEVELOPMENT IN EGYPT.

by Adel Anwar Khafagi

The aim of this research is to study the economics and operation of irrigation projects in Egypt at the present time in order that the best utilization of such projects may be reached. An economic analysis of an assumed synthetic project is made and the items of reference used with regard to its construction costs and annual expenditures, during the initial years are those of the new irrigation projects executed in Egypt, during the last twenty years. Meanwhile, the details of annual outputs resulting from the assumed synthetic project and its annual expenditures, early in the past, are taken from those of an old irrigation project constructed in Egypt, namely that of the Fayoum Governorate.

For the economic analysis of the said project the modern method of Benefit Cost analysis procedures is applied. This includes various elements, such as the capital cost, the annual recurrent costs and benefits, from the construction of the project to the end of its economic life.

The research presents the construction costs of the new Irrigation projects, their operation and maintenance systems as well as their annual expenditures. It then gives a description of the Fayoum Governorate from where most of the data were collected. In the meantime the size of agricultural production and its relevant cash value and On-Farm Costs are explained. This is followed by an economic analysis of the synthetic irrigation project including several different cases.

From this analysis, it could be concluded that the best method of economic utilization of the new cultivated lands in Egypt is to put them into the farmers possession, on completion of the projects. It could also be deduced, from this analysis, that State farms yield a rather small revenue and they may be unprofitable from the economic point of view.

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CHAPTER 1

THE BACKGROUND AND REASONS FOR IRRIGATION DEVELOPMENT IN EGYPT

1.1 Population Pressure

The size of the population and its rate of growth are important factors in the complex of social and economic factors which affect the welfare of the people of any area. The rate of population growth is an especially important factor in densely populated areas where it is not so easy to extend the area under cultivation or to increase its yeild per additional units of labour. Under these circumstances, population growth may constitute an obstacle to economic and social development.

The total population of the Near East in 1971 was 205 million[1] and around 2/3 of the population of the region depends for its livelihood on agriculture. In contrast with the low rate of production increase in these countries, averaging between one to two percent, population increase is at a high rate, reaching 2.7 percent in 1971. The rate of population increase in the region is even accelerating due to a static high birth rate and a decline in the death rate. It has been estimated that the population of the region will reach 270 million in 1985. It is evident that the growing population needs more food, houses, education and health services as well as more employment opportunities.

During recent decades Egypt has witnessed a rapid rate of population growth. The population which was recorded at 10,542,000 in 1901 increased to 20,871,000 in 1951, 26,650,000 in 1961, 30,121,000 by 1967 and was registered at 33,422,000 in 1970[1]; it is expected to reach 41 million by 1981. The population increased by 3 million between 1901 and 1921, by, 3,700,000 from 1921 to 1941, and registered a growth of 9 million between 1941 and 1961, the population is further expected to increase by 15 million during the two decades ending 1981.

The rapid increase in the rate of population growth is due, as has been said, to the birth rate, which is around

40 per 1,000 as against the declining death rate which has fallen from 26 to 13 per thousand during the last four decades.

Many cultural factors, such as early marriage, high fertility rate amongst rural women, low social and educational standards, ignorance of the methods of birth control, and the fear of divorce are responsible for the high birth rate. Among Egyptians peasants the belief that one's behaviour is predetermined and under the control of a supreme power against whom one is powerless to interfere is still very strong today. This belief prejudices the peasant against any conscious efforts at birth control in the feat that such an action may be contrary to the will of that supreme power. Their thoughts and theories are to a great extent related to their theological philosophy. Furthermore, the practice of family planning and birth control is not simply dependent upon the knowledge and availability of contraceptive devices, but rather on the willingness to use them. Such willingness can only come with a new approach to life and broader horizens for the individual. Moreover, in traditional agricultural societies such as the Egyptians, children are economically productive and inexpensive to rear, in addition to being a social asset contributing to the further prestige of the individual family unit.

As a result of this social climate the birth rate in Egypt has remained largely unaffected by the factors that have brought about their reduction within industrial societies. On the other hand, the extension of modern health measures within rural Egypt has brought about a sharp decline in the death rate.

It is likely that the present trend in population growth will continue. Today, life expectancy is 51 years for males and 53 for females as compared with 32 for males and 34 for girls 30 years ago. Furthermore, the number of females in the most fertile age group (ages 10-29) is expected to double between 1960 and 1980. This is the result of the continued high fertility rate and the sharp decline in infant mortality

rate, which also means that the population has become younger. The country has at present 8.5 children under 15 to every 10 persons between the ages of 15 and 59. In 1947 there were only 7 under 15 per 10 over 15 years old.(1)

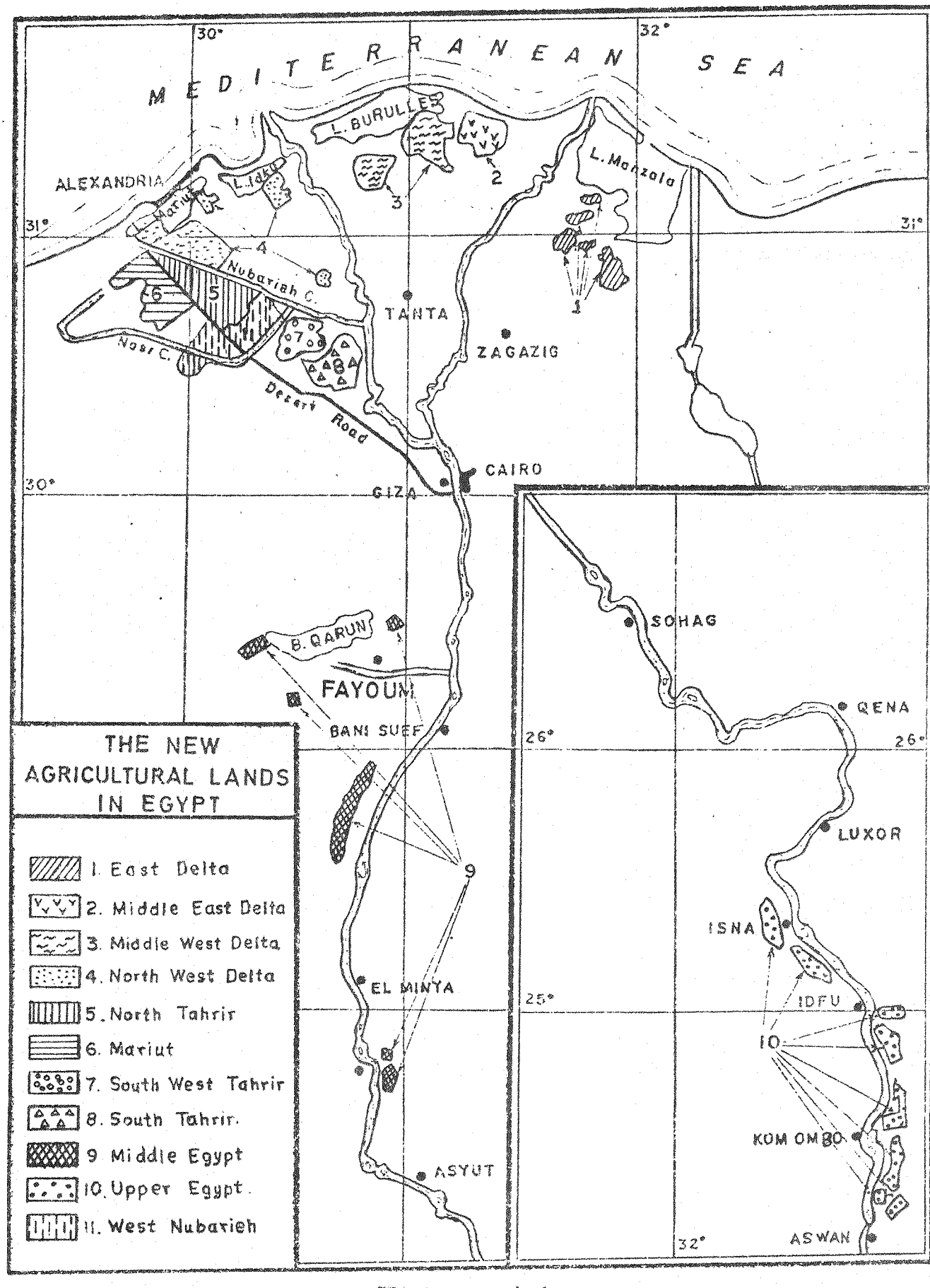
The population pressure on the land in Egypt is tremendous when we consider that only a minor part of the country's area is cultivable. Of a total area of about 1,000 square kilometers, only 24.5 square Kilometers, or about 2.5 percent of the total, are under cultivation. The population density is 860 persons per square kilometer of cultivated land.

The principal problem facing Egypt today is the very low expansion of cultivated land area in comparison with the very rapid numerical increase of the human sector. During the 70 years from 1097 to 1966, the cultivated area increased by 17.6 percent (from 2.14 million hectares to 2.52 million) and the crop area by 53 percent (from 2.86 million hectares to 4.38 million), while the population increased by 216 percent (from 9.7 million to 30.1 million). As a result, the number of persons supported by each hectare of agricultural land rose from 5 to 12. By the end of this century each hectare will be supporting 24 individuals, causing a declining per capita income and a continuous lowering of the standard of living.

As a result of the high rate of population growth and the limited agricultural potentialities, intensive urbanization has taken place over the past 20 years (see Figure 1-1). In 1882, the urban population of Egypt was 19 percent of the total population and it remained at this level during the first decade of this century. By 1972, it climbed to 23 percent, where it remained for another decade, by 1947 it had risen to 31 percent. In 1960 the urban sector of the country made up to 38 percent of the total population. In 1970, the percentage reached 42. Urbanization is always associated with basic social and pathological problems.

1.2 Measures Taken by The Egyptian Government to Meet the Population Problems.

The Egyptian Government has attempted to meet this problem by various industrial and agricultural development schemes,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BANI SUEF
SOHAG
QENA
26°
LUXOR
ISNA
EL MINYA
25°
IDFU
KOM OMBO
ASYUT
ASWAN
32°
THE NEW AGRICULTURAL LANDS IN EGYPT
1. East Delta
2. Middle East Delta
3. Middle West Delta
4. North West Delta
5. North Tahrir
6. Mariut
7. South West Tahrir
8. South Tahrir.
9 Middle Egypt
10. Upper Egypt.
11. West Nubarieh

Figure 1-1

as well as by a programme of family planning.

When the first five year plan (1960 - 1965) was adopted in Egypt its most widely proclaimed objective was to double the National Income in a ten-year period. This plan and the one that followed it, the second five year plan (1965 - 1970), focused on both agriculture and industry.

In agriculture, an important objective was to increase the cultivable area while simultaneously increasing its productivity. As for industrial development, the plan had the twin objectives of preparing the country to enter into an age of heavy industry while promoting the growth of importsubstitute aimed at conserving hard currency resources and providing new employment opportunities.

1.3 The New Agricultural Policy Adopted by The Egyptian Government:-

In 1972 the Minister of Agriculture proposed a new agricultural policy attempting to solve some major agricultural problems such as:

a) Many different varieties of crops grown in the same area, resulting in high unit cost of production.
b) Encroachment on agricultural land by towns and industries.
c) Competition between humans and animals in crop consumption.
d) Fragmentation of holdings resulting from the traditional law of inheritance.
e) Weakness of rural and agrarian institutions.

The new agricultural policy in Egypt is attempting to make a shift in crop choices, from the traditional varieties to other high income crops, especially to export-oriented crops such as vegetables, fruits and flowers. The new policy also calls for specialization in livestock production for products such as milk, meat, poultry and fish.

The new agricultural policy which has been implemented in Egypt since 1972 emphasizes four main areas:

1.3.1 Consolidation

Consolidating farming by fixing crop rotations for the main crops (cotton, wheat) across individual holdings in order to

achieve economies of scale during such operations as cultivation, seeding, application of pesticides, irrigation, harvesting etc., and so reduce costs. The policy aims at inducing farmers to co-operate more closely and benefit from the advantages of large scale agriculture by pooling their resources. Specialization of agriculture according to site conditions and market demand will optimize benefits for the farmers and the country.

1.3.2. Mechanization

The introduction of machines in the new policy is being implemented to replace draft animals and save the limited fodder resources of the country for meat and milk production.

1.3.3 Industrialization of Rural Areas

Industries are now concentrated in the towns. The new policy aims at establishing processing industries in the rural areas based on agricultural raw materials, thus taking advantage of proximity to raw materials and the availability of rural labour.

1.3.4. Strengthening of Agricultural Institutions.

The co-operative structure and the credit institutions are being reformed to delegate more authority to local co-operatives and so encourage them to participate more actively in their own affairs.

1.3.5. Introduction of High Yielding Varieties of Crops

Some high yielding varieties of wheat and rice have been introduced on a large scale and this will in the long run double the national production of these two crops.

1.4 Horizontal Expansion

The Egyptian Government has made serious efforts during the last twenty years to find new methods for land reclamation by studying the available water resources, including investigations into the possibility of using excess drainage water for irrigation, either in its pure form or after mixing with Nile water.

The principal water resources for horizontal agricultural expansion in Egypt are composed of the following:

1.4.1 Nile Water

Before the construction of the High Dam, only 40 billion of the 72 billion cubic meters of water passing through Aswan were utilized in cultivating 2.52 hectares of land, the remain-

ing 32 billion being wasted either through evaporation on or loss into the Mediterranean. The High Dam was built in order to store 20 billion cubic meters, 8 billion of which are to be utilized for irrigating 0.55 million hectares in Egypt; the remaining 12 billion cubic metres being utilized by the Sudan.

1.4.2 Artesian and Underground Water

Various hydrological studies have shown that the eastern and western Deserts have an accumulation of underground water. Nearly 20,000 hectares are presently irrigated by this means. More studies with the technical assistance of the U.N. are being carried out to determine the source of the artesian and underground water and to estimate their quantities, so that more land could be cultivated by this means.

1.4.3 Rainfall Water

Annual rainfall on the northern coast does not exceed 150 mm, and therefore it is only used for pasture and crops such as figs, olives and barley which do not require much water. Nevertheless, nearly 63,000 hectares on the northern coast grow crops dependent on rain and also the remaining 840,000 hectares in that area grow grass for grazing.

Between 1960 and 1973, a total area of 359,000 hectares has been reclaimed based on the Nile Water resources.

331,000 hectares are irrigated from the River Nile out of which 28,000 are scattered spots within the cultivated areas.

Also, as a result of the construction of the High Dam, 393,000 hectares were converted from basin irrigation into perennial irrigation.

CHAPTER 2

THE NEW AGRICULTURAL LANDS IN EGYPT

2.1 Governmental Authorities Responsible for Irrigation and Agriculture in Egypt:-

2.1.1. The Ministry of Lands Reclamation:

It is completely responsible for Land Reclamation projects in Egypt from their inception to the distribution of the reclaimed areas to farmers once the marginal level is reached.

The Ministry of Land Reclamation operates with the help of four autonomous bodies, namely:

(a) The General Egyptian Authority for Agricultural Development (EAAD).

(b) The Executive Organization for desert development (EODD).

(c) The General Authority for Land Development (GALD).

(d) The General Egyptian Organization for Cultivation and Development (GEOCD).

(EAAD) is concerned with the design of irrigation and drainage networks and the general design plans for reclamation projects and new villages as well as the paving of internal canals and the formulation of community infrastructure.

(EODD) deals with the exploration of artesian water and investigation into the agricultural and livestock production most suited to desert areas. The organization's main activities are centered in the New Valley, the Northern West Coastal, project North East Coastal, project in Sinai, Sinai projects East of the Suez Canal, and the Mariut Extension Project.

The main responsibility of the General Authority for Land Development (GALD) is to look after the various land reclamation companies concerned with the execution of reclamation projects.

(GEOCD)'s main function is to bring the reclaimed land areas to a level of soil fertility and productivity adequate for distribution to settlers. (GEOCD) further helps the latter by providing them with a number of community services

designed to bring about an improvement in agricultural and social conditions.

2.1.2. The Ministry of Agriculture:

Increasing the productivity of the existing arable land after distribution to the farmers is the main responsibility of the Ministry of Agriculture. The work of the Ministry is directed towards increasing agricultural productivity through such various means as the improvement and conservation of soil fertility, the introduction of new crop varieties, intensive application of fertilizer, the control of insects and plant diseases, the improvement of livestock through selective breeding and the introduction of new hybrids, the control of animal diseases, and the use of agricultural machinery. Other measures have also been introduced such as the implementation of consolidated agriculture, the strengthening of co-operative societies and the raising of the prices of agricultural commodities.

The programme of the Ministry of Agriculture also includes plans for the improvement of agricultural practices and the dissemination of information through agricultural extension services.

As a result of the Ministry's policies for improving land productivity, the per hectare yield of major crops has been significantly increased. As compared with 1950, the 1970 figures show a 38% increase in cotton (lint), 50% in wheat, 80% in corn, 45% in sorghum and 73% in rice. The high yields in cotton are mainly due to the new hybrid strains introduced by the Ministry of Agriculture. The increase in wheat production is due to the introduction of the high yielding greiza 155 variety. Total wheat production was 1,516,000 tons in 1970, as compared with 1,089,000 tons in 1952. The high harvest of corn is due to the transfer of corn production from the Nili season to the summer season as a result of which the plants receive more water and have a longer duration in the soil. Corn production reached 2,380,000 tons in 1970 as compared to 1,506,000 tons in 1952.

In every Governorate in Egypt, (Egypt consists of 25 Governorate) there is a General Administration for Agriculture attached to the Ministry of Agriculture. This Administration, which includes a large staff of agronomists, is responsible generally for the agriculture in that governorate.

2.1.3. The Ministry of Irrigation:
It is responsible for providing sources of irrigation and drainage in addition to industrial activities and major water lifting stations.

In every governorate in Egypt there is a General Administration for Irrigation attached to the Ministry of Irrigation.

This Administration, which has a number of irrigation Engineers, is responsible for irrigation works and distributing water etc. in that governorate. It is also responsible for solving the problems that may arise between farmers over the distribution of the water.

Note:
In the year 1973, the Ministry of Agriculture and the Ministry of Lands Reclamation were combined into one ministry called the Ministry of Agriculture and Lands Reclamation.

2.2 Stages of Irrigation Development in Egypt:
2.2.1 The Engineering Stage.
This stage includes the levelling of land, the implementation of the major irrigation and drainage schemes, the construction of various types of internal canals and drainage, such construction works on the canals as the building of bridges, barrages, weirs, syphons, culverts, regulaters and distributors, the locating of villages, public utilities and the construction of roads.

2.2.2 The Agricultural Stage
The stage includes the treatment of the different soil types in order to increase their fertility. This stage consists

of two sub-stages:

(a) Soil Investigation

This operation is necessary to determine the physical and chemical structure of the soil in order to arrive at the most adequate type of soil treatment.

(b) Soil Improvement

This sub-stage aims at improving the mechanical, chemical and biological structure of the soil. For instance, methods of leaching or washing of the soil are employed on salty land, gypsum is added in the case of alkaline soil, while on sandy soil the addition of mud or the growing of Alfalfa or Berseem (Egyptian clover) is used. These steps are then followed by the raising of the crops most suitable for the further improvement of the physical and biological conditions of the soil. As soon as the soil responds favourably to the crops, a suitable crop rotation is applied in order to extend further the quality of soil and to raise its productivity to the level necessary for subsequent distribution to permanent settlers. Although varying greatly with the type of soil, the initial stage of its fertility, and the time needed for this subsequent improvement, newly reclaimed land generally reaches a marginal level of productivity after a four to six year period of cultivation. During this stage hired migratory labourers are used for cultivating the soil.

2.2.3 The Social Stage

Land which has been reclaimed, developed and cultivated by the state, and which has reached a level of productivity sufficient to support a family on an average of five feddans (about 2.1 hectares), is distributed to settlers from the neighbouring provinces who meet certain qualifications. They must be literate, able farmers, twenty-five to fifty years old, and of a maximum family of five. Transport for transferring families and their household goods is provided free. Upon arrival in the reclaimed area each family receives a house, a cow, some simple furniture and a maximum of five cultivated feddans (about 2.1 hectares) of land.

The small-holder village type of settlement is composed of approximately 200 houses. For every 300 families an

agricultural co-operative society is organized to deal with the provision to the settlers of agricultural prequisites such as seeds, fertilizers and agricultural equipment. Also, a community development council is formulated in each village to evolve standards of hygiene, informal education and animal care as well as to advance welfare and community spirit by means of self help projects. Government services such as schools, clinics, and post offices are provided through the ministries concerned.

2.3 Planning of Villages

2.3.1. Principles of Planning

The development bases in new rural areas are concerned with the division of each area into main development areas ranging from 4,200 to 5,000 hectares subsequently divided into 5 t 6 service villages one being central village for general services such as the hospital, markets, animal breeding farms, administrations, schools, housing for labourers and for employees, as distinct grom peasant housing and services in every other village. Thus, the precinct allotted to each village is 840 hectares. This area was decided upon bearing in mind that the maximum walking distance of the peasant from his village to his land does not exceed 2 kilometers, and that the number of population per village be proportional to the services allotted to them, e.g. the mosque, school, stores, etc.

In practice, the shape of land and its dimensions do not easily permit this ideal pattern, and sometimes an area exceeding 840 hectares, is allotted, in which case there is a subsidiary small village dependent on the main one with sufficient houses and at such a location as to ensure that the max. walking distance of each peasant is not more than 2,000 meters approximately.

It is clear that the sequence of development of the areas (divided into 4,200 to 5,000 hectares) necessitates that their central villages should all be linked to a main small town to serve a major area of from 21,000 to 25,000 hectares, and which should provide the main public services at this level, and that eventually a bigger town should link these small towns and serve as a governorate of the general areas

ranging from 100,000 to 150,000 hectares.

It was noticed in the service village (240 hectares land area) that it should accommodate 200 peasant houses in the first stage and an extra 200 in the second stage on the assumption of 2.1 hectares per peasant (5 feddans), apart from an area allotted for future extension of the village housing area, and from housing necessary for employees and labourers and public service buildings for the peasants.

2.3.2. Services in Villages

The service village plan thus accommodates:

(a) Housing:
- 400 peasant houses.
- 26 houses for employees
- 40 specialised labourers dwellings of similar type to peasant houses.

(b) Services Buildings:
- 1 School (primary stage)
- 1 Small Market
- 1 Mosque
- 1 Main store for crops and fertilizers.
- Shed for agricultural machines.
- 1 Administration building for the area
- 1 Sports ground.

The main (central) village has more units than stated in the service village. It accommodates secondary stage schools, a central mosque, a hospital and a medical treatment unit, a centre for veterinary medicine to cure animals, a station for animal production, a large market to serve the area, a general administration office and a rest-house for employees and visitors, apart from a mill for grinding grain, a slaughterhouse, a fuel pump, a car repair workshop and a garage, a public club and post office and telephone and telegraph offices and a police station, a play-ground (Sports area) with the necessary buildings for it, and a fire brigade station etc.

As the developed areas increased in number, it was

realised that the construction schemes should fall within the sums allotted to them in the general plan of new land development, taking into account the main peasants needs for housing within the frame-work of their mode of living and the main and essential services necessary for them.

2.3.3. Peasant Housing

The peasant's house now, in this practical new stage of development consists of:

(a) 2 rooms suitable for him and his family.
(b) a water closet.
(c) a cattle stable.
(d) a shed for the oven.
(e) an open court.

(a), (b) & (c) are provided to the farmer by the government while the rest are carried out by himself later.

The gradual introduction of public services (water supply, drainage and electricity) is under consideration. Meanwhile, the village at present is supplied with groups of drinking water taps and with electricity in its main buildings and roads.

Labourers necessary for the maintenance of main buildings are housed in a similar way to peasants, but their houses are adapted to their particular needs.

Employees' houses are limited in number to employees resident in the village and in the general area, for example, teachers, sanitary and social supervisors, agricultural supervisors and administrative employees etc. These buildings are of two types containing either 2 or 3 bedrooms to suit the needs of the employee and his family. The house has a hall for living and dining, a kitchen and a bathroom. It has a suitable garden to supply vegetables and to allow the raising of poultry in the new areas.

2-floor houses are erected for directors and their like, with bedroom accommodation above, living and dining rooms below and lavatory facilities.

In planning each area the need was recognized for a rest

house, on the lines of an hotel, for supervisors and visitors so that they might have temporary residence when in that area. A rest house comprises a number of bedrooms with the necessary bathrooms, dining rooms, halls, and services, and a rest house is also allotted to drivers together with a car shelter.

2.4 Selection of the Settlers

Because of the pressure of population, it is impossible for the Egyptian Government to distribute more than 2.1 hectare (five feddans) per family unit, and while the holding is normally sufficient at present, the real crux of the problem is what is likely to happen in the future. The population will rise substantially and there is bound to be pressure on the land. A pressure which in the old land brought about fragmentations of holdings and deprived the sons of land-holders of any inheritance of land. This situation cannot be allowed to develop in the new land. The obvious answer seems to be the introduction of agro-industries which will both increase return from the land and provide employment for the settlers' families.

A survey is always made of the prospective settlers, eliciting information in the following areas:

i) The demographic structure of each family;

ii) The economic structure of each family, such as main production factors, quantity and availability of man-power.

iii) Social structure of each family, concerning levels of education and health standard;

iv) Attitudes towards settlement;

v) The current level of social and economic services in the departure area in the field of education, health and other government services.

The criteria preferred for selecting prospective settlers in the new land on the Nile Valley basin are:

i) Citizens from the neighbouring villages or provinces;

ii) Non-ownership of land or ownership of limited land;

iii) Married with sufficient number of adults in the family to cope with the needs of the farm units;

iv) Previous experience in land reclamation;
v) Literacy;
vi) Physical fitness in undertaking agricultural works;
vii) Age ranging between 35 and 50 years
viii) Clear police record, with appropriate preference for obviously good conduct.

Other basic requirements such as sincerity, morality, seriousness and desirability to more to the areas are considered. The relative importance of one factor as compared with another under these criteria, is expressed in numerical weights and the applicants who receive the highest numerical weights are selected for land titles.

As soon as the selected settlers are transferred to the new land, another survey is conducted for each settled family every two to three years. The results of the survey made for the same family provide information regarding changes in the socio-economic conditions of the transferred families, including changes in income levels, expenditure patterns, household positions, housing conditions, educational standards, degrees and manners of participation in community life, attitudes and values and the levels of aspiration and ambition. This information is really very valuable in measuring progress and change, as well as revealing some factors which may hinder progressive development. These factors will be reviewed by members of the local community councils and co-operative societies in order to overcome difficulties of development encountered by the groups.

2.5 Problems Facing New Settlers

Though land reclamation and settlement projects in Egypt for areas irrigated by the water of the High Dam are considered as the most important socio-economic development in Egypt during the last two decades, there are still some problems which face the new settlers and the development of the project as a whole. The following are some of them:

a) Low land productivity. The newly reclaimed land often lacks some of the major elements required for really high fertility and remunerative returns and these can-

not be attained until after some years of cultivating the soil have elapsed.

b) Inadequate credit and marketing facilities. In most reclaimed areas, credit is hard to obtain and communication between the communities for marketing and other contacts is often difficult.

c) Failure to relate production to the type of land and marketing demands. Many new settlers are not aquainted with agricultural products for which the new land is suited. Moreover, they know how to raise only one or two of the traditional crops in most instances.

d) Negative aspects of physical layout of settlement. The group settlement sauses in many cases a waste in energy and time due to the long distance between the settler and his farm, while the scattered settlement is not conducive to frequent social gatherings.

e) The heterogeneity of the settlers. The settler may originally have belonged to a homogeneous cultural and religious group but in the new settlement area he becomes part of what may be a heterogeneous group. He should, in such a case know how to adjust to the new social structure.

f) The changed social status of the settler from tenant to landowner. The new pattern of social interaction facing the settler on the new land takes a great deal of adjustment. The tenant's sudden transfer to the status of a landowner strengthens his sense of economic security and helps him to attain the human dignity which is the right of every citizen. However, his sudden transfer from a feudal community in which a man's rights and dities depend on his ascribed status to a community of new ideals where interrelations are determined by the individual's capacity and personal qualities, demands a great deal of adjustment on his part.

g) The drains and canals which were previously owned by the Government are now owned by a large number of small holders. Their maintenance requires much organizational machinery.

2.6 Administrative Units

At the initial stage of the project implementation, the

Ministry of Land Reclamation is attempting to integrate the settlement projects with the administrative units of the country. For this reason, coordinating committees at both the national and the land reclamation zones have been formed, enlisting the representation of all functional ministries to secure the participation of those ministries in installing servicing units in the new land and also in managing such units. The installation of a rural infrastructure in the new land is not considered as the responsibility of one ministry or one department. It requires the contribution of all the functional technical ministries for supporting the development of responsible local citizenship by establishing the essential social institutions.

At the operation stage, the Ministry of Land Reclamation is even more aware of the importance of integrating new communities within the local administrative machinery. This is achieved in two ways:-

First; from the ground up, by encouraging the village councils and cooperative societies to seek out and use available local resources at the provincial 'Mouhafza' level in the fulfilment of their needs. Settlers make the move on their initiative, so the provincial administrative units feel their responsibilities towards them as to other areas within their jurisdiction.

Second; by starting from the top through a provincial coordinating committee with the governor 'Mouhafez' as the chairman, delegating power from the settlement authority to the coordinating committee, to deal with all aspects related to settlement projects within the governorate administration.

Such gradual integration discourages the settler to deal directly with the central government, relying heavily on the lower levels of government which help the new settlement projects to merge gradually into the provincial administration societies and community councils to solve mutual problems

and to plan and execute local development projects.

Through the community councils, such activities as small-scale industries to provide additional income, kindergartens, literacy classes for the elimination of illiteracy, and family planning activities are conducted. It is hoped that through community development activities there will also occur the formation of basic capital through the construction of physical facilities, some of which, including cottage and small-scale industries and cooperative society centres, will be of great value for the increase of production. Whereas production will be stimulated by these new institutions, savings will be encouraged through the cooperative societies. The executive members of the cooperative societies and community councils form a basis for a solid democratic way of life in the new villages in which each settler knows his role and plays it effectively.

The main responsibilities of the cooperative union are:
(a) Enabling the local cooperative to use the existing agricultural machinery to the maximum.
(b) Importing high yielding seeds of crops and vegetables.
(c) Marketing the products of the local cooperatives inside and outside the country in order to obtain for the settlers the highest profit in local as well as foreign currencies.
(d) Taking measures for the strict control of the financial and accounting matters of cooperatives in order to preserve their prosperity and protect the settlers' rights.
(e) Organizing, guiding and carrying out educational campaigns to popularize the cooperative principles as well as to organize the work among women settlers.

The Board of the Animal Husbandry Union formed of elected settlers deals with aspects of animal husbandry including the selection of cows and buffaloes to be distributed to new settlers, the promotion of cattle and sheep-breeding in the new land, the development of dairy industry on a large scale.

2.7 Farmers' Organizations:

When the settlers move to the new land, they are trained to work together in order to promote the economic social and political advancement of the new communities. This is Achieved through the formation of agricultural cooperative and the insurance of the settlers' cattle against death or serious sickness.

CHAPTER 3

COSTS FOR THE NEW IRRIGATION PROJECTS IN EGYPT

3.1 Capital Cost

All capital expenditure, including the disbusement of aid money, should be included in the discounted cash flow analysis as and when the money is spent. Dividends, amortisation and interest payments should not be included (although they are of course relevant to the Financial Analysis). This treatment is based on the assumption that the financial resources used would have been available for investment elsewhere in the country if the particular project concerned had not materialised.

In the case of a large irrigation project, the true economic cost of the project may well include the value of such items as: main canals, drains, headworks, small works, small canals, pumping stations, land washing, levelling, electrical works, transportation, administrative buildings, housing, social services and ameneties.

The costs of all these items of new irrigation projects in the different places in Egypt are shown in Table 3-1. We note from this table that the highest capital cost value is for establishing projects in Kom Ombo in Upper Egypt ($ 2,355/ha) and the lowest capital cost value is for establishing projects in Al-Nahda in West Delta ($1,751/ha). In Figure 1-1 we can see the location of the places mentioned. The difference between the Capital Costs from place to place, is due to some factors such as irrigation method, nature of soil, ground water level and circumstances of planning.

Table 3.1

Average Capital Cost of New Irrigation Projects in Different Places in Egypt (2)
(refer to Figure 1.1)

Item \ Region		East Delta			Middle Delta		West Delta			West	Middle Egypt	Upper Egypt
		Al-Husinea	Al-Matarea	Ezbet El-Burg	Balteem	Al-Zawya	Al-Hager	Al-Nahda	Al-Entelak	Nubaria	Fayoum	Kom Ombo
1	Main Canals, Drains and Headworks	350	350	350	350	350	350	350	350	350	350	350
2	Small Canals, Drains and small works	491	360	360	583	590	334	399	576	350	393	524
3	Lifting stations	79	52	–	46	39	52	–	157	72	79	–
4	Land Washing, Submersion . . . etc	26	26	26	26	26	26	26	26	26	26	26
5	Levelling	246	452	452	321	393	255	314	66	733	628	648
6	Electrical Works	102	102	105	39	66	59	66	138	138	92	92
7	Transportation	131	183	183	183	131	183	98	–	183	183	131
8	Administrative Buildings	88	88	88	45	45	88	88	88	88	45	45
9	Housing	250	250	250	379	379	250	250	250	250	379	379
10	Social Services and Amenities	160	160	160	160	160	160	160	160	160	160	160
	TOTAL	1,923	2,023	1,974	2,132	2,179	1,751	1,751	1,811	2,350	2,335	2,355

3.2 Annual Recurrent Costs

3.2.1. Operation and Maintenance Cost

These are the costs involved in maintaining the capital cost items in their perfect working order, so that they will run the total of their expected economic life without incurring any extra expenditure.

These costs are included:

- Annual wages of all staff designation such as professionals, technicians, clerical skilled and unskilled labours.
- Annual cost of power consumption such as electricity, diesel and oil.
- Annual maintenance cost of the different items such as head work, conveyance to project area, irrigation distribution system, drainage system, mechanical equipment, central workshop housing, social services and project ameneties.

In most cases, except possibly for pumping projects, the O. & M. Costs generally play a much smaller part in economical analysis or planning than capital costs. This is because they are generally smaller than capital cost and also because their incidence is spread out over time, thus they are considerably affected by the discounting process.

3.2.2. Replacement Cost

The annual replacement cost is only concerned with the recurrent cost of major items which need replacing at regular intervals, as in the case of a pump which needs replacing every fifteen years, and not those items which are replaced annually.

This annual replacement cost will be the amount of money which has to be put aside each year in order to replace a particular item at the end of its economic life. This sum will be invested in some sort of fund and the total, together with the interest, which is realised after this period stipulated by the economic life, will be equal to the lump sum required to purchase the item. This can best be illustrated by the following example:-

A pump needs replacing every ten years (its economic life) and costs $20,000 each time. Therefore by investing $1,590 each year at an interest rate of 5%, after ten years the sum realised will be $20,000 from which the new pump can be purchased. This however, does not take into account the salvage value of the pump but this is taken to be zero in economical analysis.

As already mentioned in section (2.1.1.) the GEOCD is the Government Organization which is entrusted with the management and utilization of the new agricultural projects, in Egypt, soon after their construction is completed. This Organization deals with all administrative and supervisory affairs as well as all agricultural processes. Therefore, its annual expenditures include supervisory and On-Farm Costs. However, supervisory expenses only are mentioned here, and will be included in the economic analysis to be explained later in item 6.6.3. As regards On-Farm Costs, incurred by the Organization, they are assumed to be equivalent to those which farmers spend on the old lands they possess, (such expenses will be mentioned in detail in section 5.3). In as much as it concerns officials and employees engaged, at all standards, with the Organization, reference will be made to those responsible for supervisory works only, these being of much the same nature as the responsibilities of the staff working with the agricultural and irrigation circles in the Governorates, in the case of the old cultivated lands.

However, the rate of annual recurrent costs for the new irrigation projects in Egypt are shown in Table 3.2.

Table 3.2

Rate of Annual Recurrent Costs for New Irrigation Projects in Egypt(3)

US $ / ha

1	Wages	44.52
2	Maintenance and Service Expenditures	12.30
3	Cost of Materials	10.50
	TOTAL	67.32

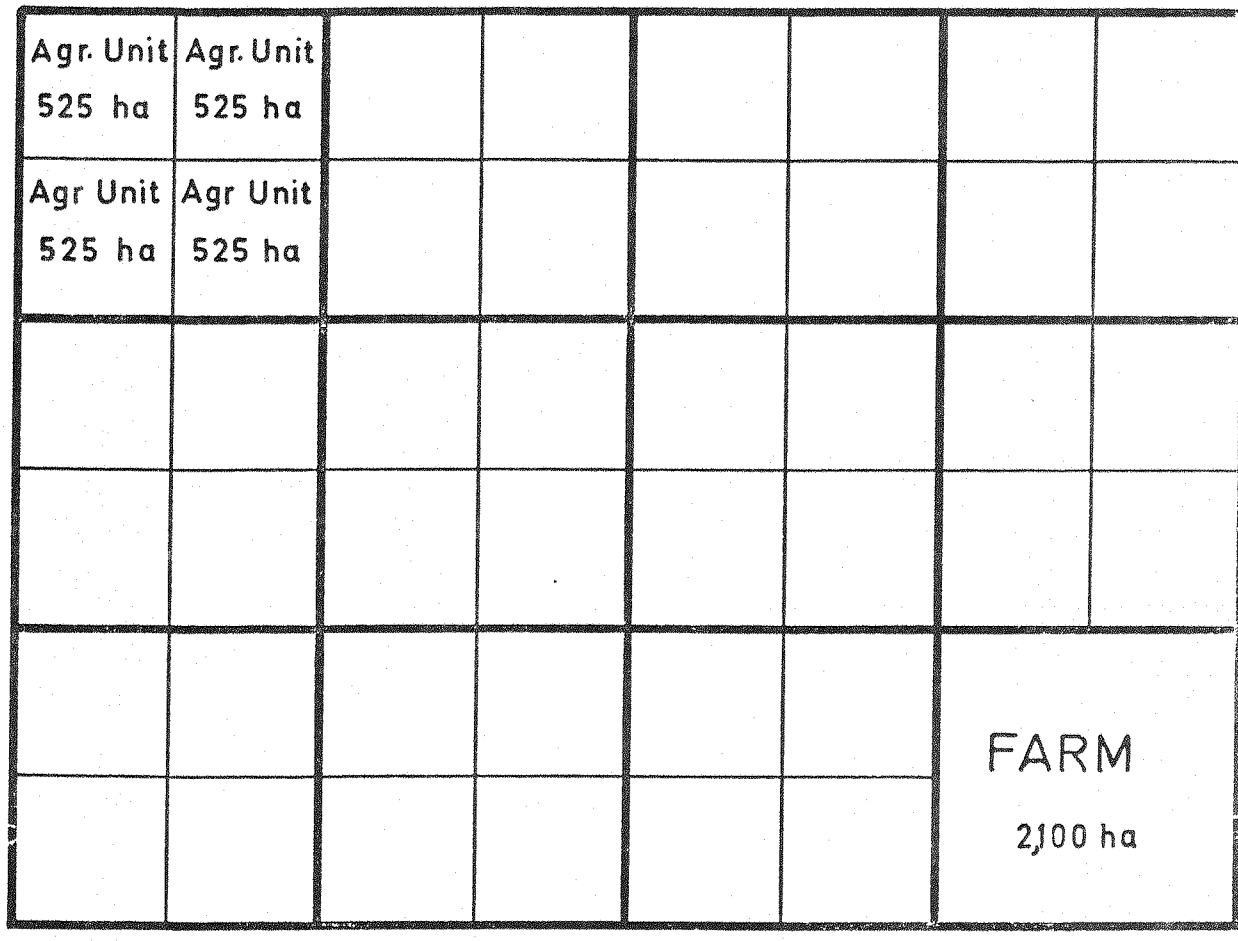
The overall figures for maintenance and service expenditures and cost of materials shown in Table 3-2, were found in the General Egyptian Organization for Cultivation and Development (GEOCD) but no further details could be obtained, and the overall figure for wages of employees in the same table is calculated on the administrative divisions of the new agricultural lands in Egypt during the early years of the projects.

The new agricultural lands in Egypt are divided into a certain number of agricultural sectors related to GEOCD. Every sector has an area of 25,200 hectares approximately which is divided into 12 farms. Every farm has an area of 2,100 hectares which is divided also into 4 agricultural units as shown in Figure 3-1. The administration staff of every sector is shown in Figure 3-2 while Figure 3-3 represents the administration staff of the farm. The agricultural unit administration consists of one agronomist, one accountant, 8 technicians, 3 clerks, and 7 guards.

The annual costs of employees in sectors, farms and agricultural units are shown in Tables 3-3 & 3-4 & 3-5 successively.

Figure 3-1

DIVISIONS OF THE AGRICULTURAL SECTOR



Agr. Unit = 525 ha

Farm = 4 Agr. Unit

= 2,100 ha

Agr. Sector = 12 Farm = 48 Agr. Unit

= 25,200 ha

Figure 3-2

AGRICULTURAL SECTOR ADMINISTRATION

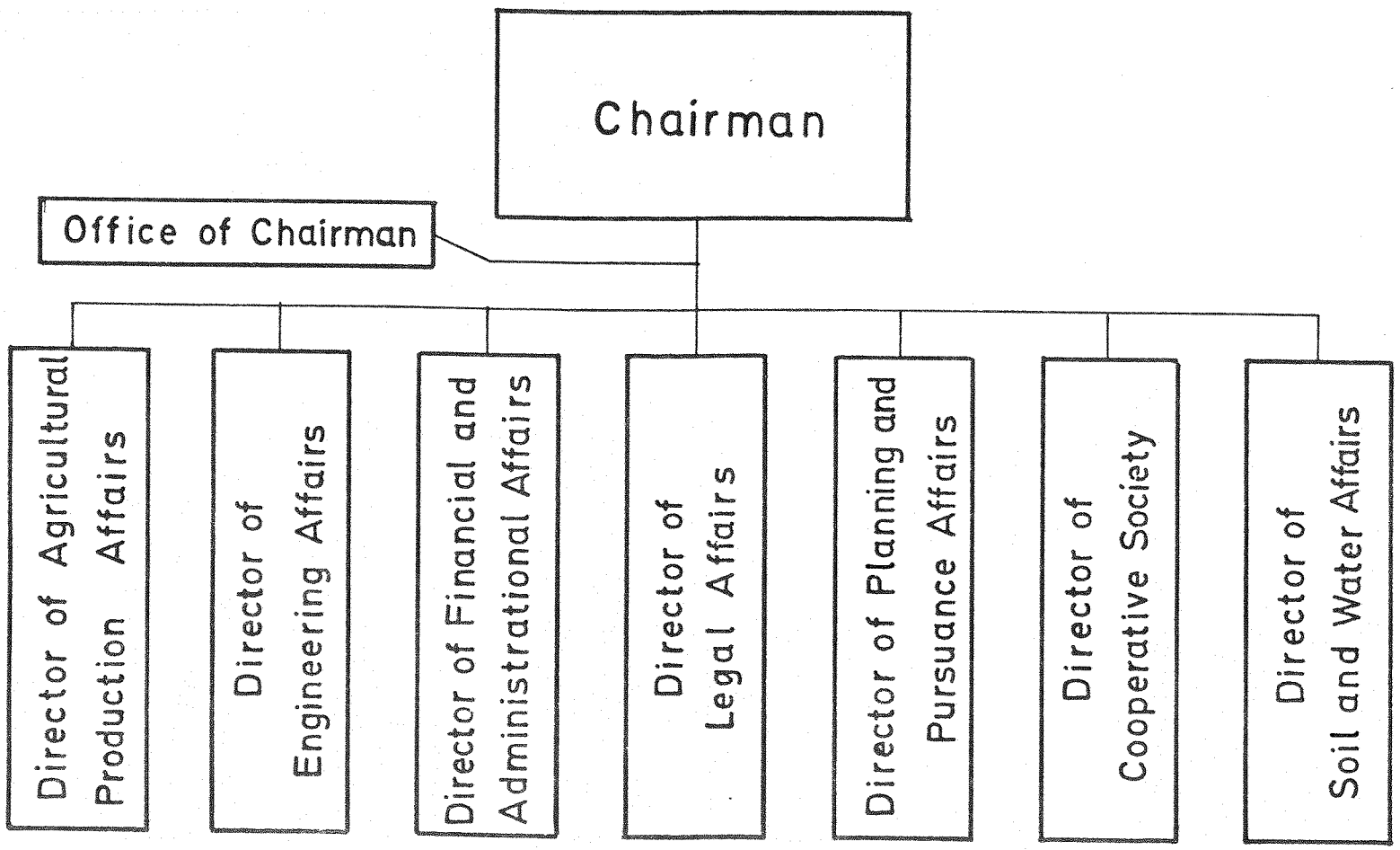


Figure 3-3

FARM ADMINISTRATION

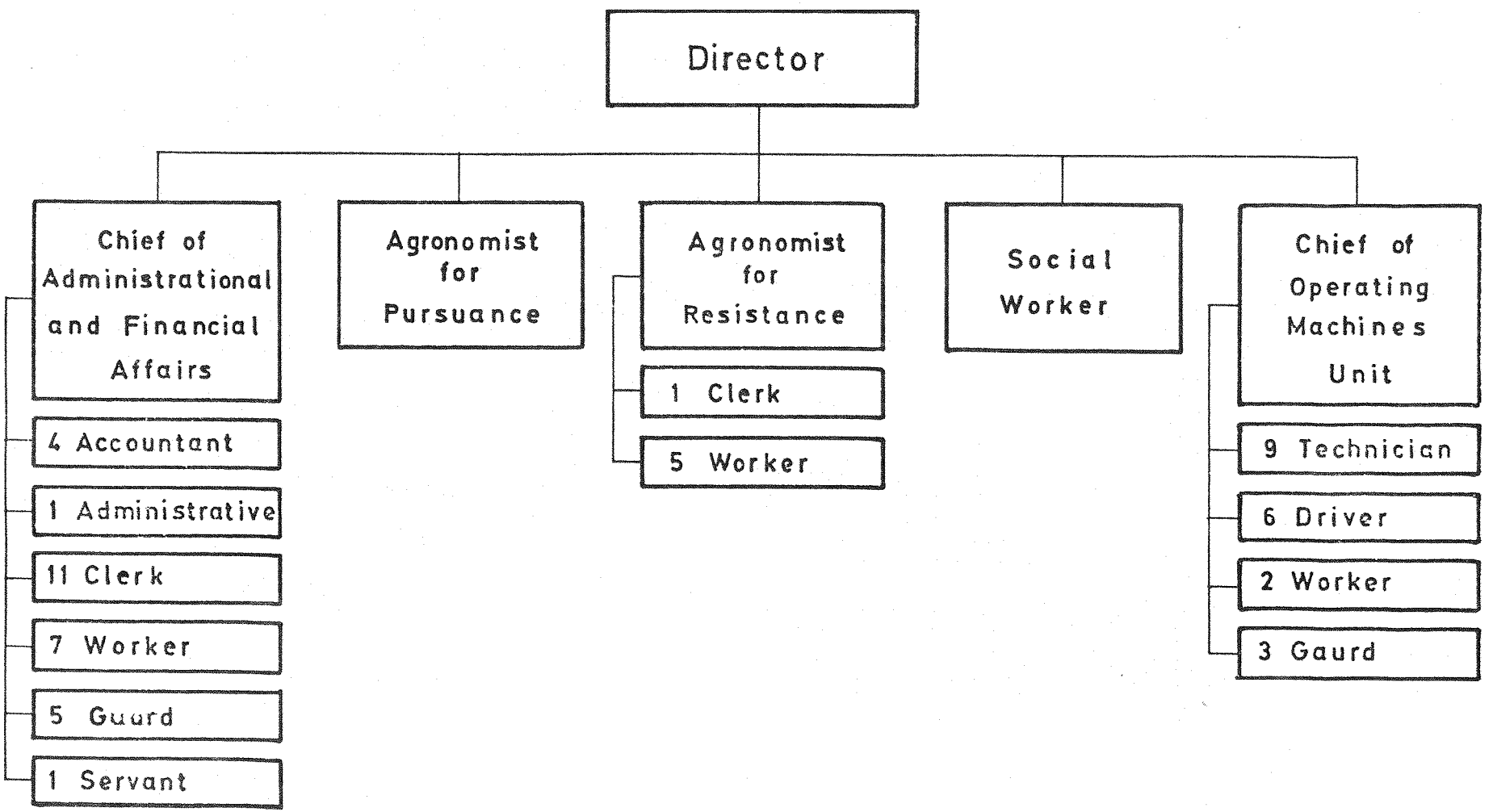


Table 3.3

Annual Costs of The Sector Administration Staff (4)

Job / Financial Category	Agronomist	Civil Engineer	Architect	Mechanical Engineer	Electrical Engineer	Co-operative	Accountant	Administrative	Lawyer	Social Worker	Medical	Technician	Clerk	Nurse	Worker	Driver	Guard	Cook	Servant	Total	Annual Costs U.S. $
Highest	1																			1	5,500
First	1	1					1													3	10,500
Second	5	1					1	1	1											9	22,500
Third	4	1	1	1			4	3	1											15	30,000
Fourth	6	3	2	2		1	11	5	2	1										33	49,500
Fifth	10	3	4		1	2	11	5	2	1	1	1	2							43	48,375
Sixth	13	3	4	1		2	15	4	3	3		2	9							57	57,000
Seventh	8	3	2				21	1	2		1	5	17			4				64	48,000
Eighth												8	52	1	6	10	2		1	80	40,000
Ninth												2	37	1	11	10		1	5	67	28,475
Tenth													4	1	27		23	1	13	69	20,700
Total	48	15	11	4	1	5	64	19	11	5	2	18	121	3	44	24	25	2	19	441	360,550

Total Annual Costs = $ 14.31 / ha

Table 3.4

Annual Costs of the Farm Administration Staff (4)

Job / Financial Category	Agronomist	Mechanical Engineer	Accountant	Administrative	Social Worker	Technician	Clerk	Worker	Driver	Guard	Servant	Total	Annual Costs U.S. $
Highest												–	–
First												–	–
Second												–	–
Third												–	–
Fourth	1											1	1,500
Fifth			1									1	1,125
Sixth	2	1	1									4	4,000
Seventh			3	1	1	1						6	4,500
Eighth						8	7		2	1		18	9,000
Ninth							5	3	4		1	13	5,525
Tenth								10		7		17	5,100
TOTAL	3	1	5	1	1	9	12	13	6	8	1	60	30,750

Total Annual Costs = $ 14.54 / ha

Table 3.5

Annual Costs of the Agricultural Unit Administration Staff (4)

Job / Financial Category	Agronomist	Accountant	Technician	Clerk	Guard	Total	Annual Costs U.S. $
Highest						–	–
First						–	–
Second						–	–
Third						–	–
Fourth						–	–
Fifth						–	–
Sixth	1					1	1,000
Seventh			1			1	750
Eighth		1	1			2	1,000
Ninth			2	2	1	5	2,125
Tenth			4	1	6	11	3,300
TOTAL	1	1	8	3	7	20	8,175

Total Annual Costs = $ 15.57 / ha

CHAPTER 4

STUDY OF AN ESTABLISHED IRRIGATION PROJECT IN EGYPT: THE FAYOUM GOVERNORATE PROJECT

4.1 Historical Background

The Fayoum Governorate is an oasis near the Nile Valley that looks like a leaf whose stalk is attached to the Nile (see Figure 4-1). The origin of the work Fayoum in the ancient Egyptian language is Bayoam, meaning the land that is covered by water. It was given that name because, prior to the dynastic era, it was all covered by water like a huge lake. During the era of the 12th dynasty, that is about the year 2000 B.C., the ancient Egyptians introduced a new way to make use of the Nile's flood waters for the longest possible time in the irrigation of the delta lands. This was achieved through dams to store water in that huge lake. This great project which is considered the first artificial dam ever known in history was constructed by Emnemhat 111, the Pharach of the 12th dynasty who built it to be about 45 kilometers long, thus increasing the cultivable land to almost 12 thousand hectares. He built that Dam over a small opening in the Lybian chain of mountains near Fayoum and about 110 kilometers away from the head of the delta linking the Nile Valley to Fayoum. The north western part of this dam, which held water behind it, still exists as a water reservoir known as Qarun lake.

The Pharachs of the 12th dynasty preferred living in Fayoum and chose it as the capital particularly because of its location between lower and upper Egypt. During the early years of their reign, the Pharachs of the 12th dynasty established the city of Fayoum which the ancient Greeks called Crocodile Yloyolis, meansing the city of the crocodile. Then it was called Arsinos where a great temple for the god Spek, the crocodile god, was built.

An obelisk built by 'Senusert I' still stands in Abgeeg near Fayoum as well as two great statues of 'Emnemhat III' near the great dam. Furthermore, a grand palace was built on the northern side of the dam which the ancient Greeks called the Labyrant, because of its vastness;

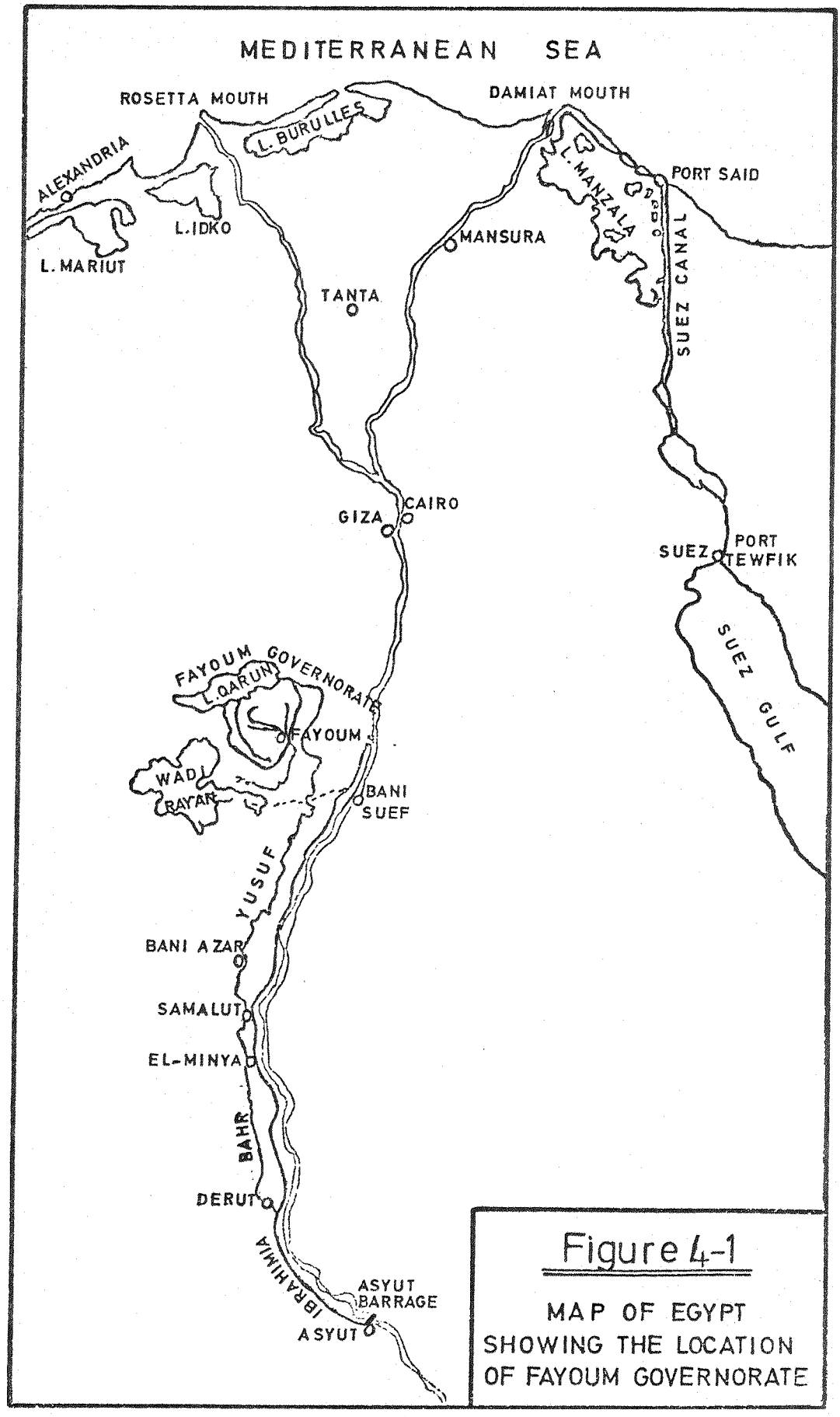


Figure 4-1

MAP OF EGYPT SHOWING THE LOCATION OF FAYOUM GOVERNORATE

and which was the headquarters of the central government. It is said that it had as many rooms as the districts in Egypt.

The great irrigation projects of the Middle Kingdom promoted the prosperity of the Fayoum Governorate until it became one of the most urban and flourishing governorates of ancient Egypt. Of this Emnemhat says: 'It was I who planted the seeds for the god 'Terry' god of the harvest. The Nile greets me, for during my reign no one was hungry and in my time no one was thirsty'; This governorate remained prosperous until the Greco-Roman era from 332 B.C. to 640 A.D., Remains found in this era and in Kum Oshiem (City in Fayoum) prove that crops and fruits were cultivated there.

Qarun lake is one of the natural features of the Fayoum Governorate which was originally called Maurice lake. Herodot visited it in 450 B.C. and described it as a great lake. In 1809 Gaumord, one of the scientists of Nepoleon's expedition in Egypt of 1798, proved that the existing Qarun lake was only part of Maurice lake. He was unable to define exactly how far below the Nile level it was, but he said that in past history the level of the lake was higher 6 or may be 7 meters from its present level. He said that this drop is probably due to the decrease in the water that reached the lake and the gradual and slow rise of its base throughout the years as a result of the sedimentation of large amounts of the Nile silt.

In 1871 Roussow Bey drew a new map for Fayoum in which he proved that the level of the lake is about 41.7 meters below sea level and is 63.5 meters below the cultivated land on the banks of the Nile in the city of Wasta.

The Syrian historian Abu Othman Al Nabulssy, who was appointed govenor of Fayoum from 1245 to 1246 during the reign of the Fatimides, described the Fayoum Governorate as including 22 large cities and about 80 villages, most of which still exist. The city of Fayoum was the most important city in the region and was the seat of government.

Nabulssy states in his book that Fayoum was known for its fruit gardens and good agricultural products which

were irrigated by Bahr Youssof which has two branches ending at Qarun lake. There was a Barrage at Lahoune to stop the flow of water into the lake. This dam was built of stone in a most precise geometrical way to rise about 15 meters. This particular region was chosen to construct the Barrage because its bed was rocky and would not allow for the leakage of water. The construction of this dam was a great architectural achievement which allowed for the drying up of large areas of the lake to be reclaimed and used for cultivation as well as securing the necessary waters for irrigation and cultivation.

The old Lahoune Barrage still stands as evidence of the past glory, and a new dam has been built next to it for the same purpose.

We can deduce from Nabulssy's memories that the water of Qarun Lake was sweet during the era of the Fatimides and that a bridge was built across it from the north to the south next to which a barrage was built to store water for the cultivation of the northern part of the lake. But this bridge fell to ruins, eroded by the waves of the lake, a matter which drove the peasants there to use water wheels to raise the water to their fields, Nabulssy himself had seen one of these wheels.

4.2 Physical Geography

The Fayoum Governorate lies in the heart of the western desert 70 Kilometers south west of Cairo (see Figure 4-1). It is a deep depression in the desert the southern part of which is about 45 meters below sea level, the rest of the depression extends towards Qarun Lake which is also at this level. Furthermore, a number of depressions lie from east to west and extend to the northern part of the western desert including Siwa Aosis and Al Kattara Depression.

The Fayoum Depression resembles the other northern depressions of the western desert in many ways. Like them it is below sea level and its general slope is towards the north. Like them it is surrounded by walls

of high plateaux on almost every side. All these depressions are locally drained regions.

But the Fayoum Depression is characterized by its link to the River Nile through the Bahr Youssof canal, which was originally one of the old branches of the Nile which entered the depression from the eastern side through the natural opening of the depression known as the Lahoun.e Opening. Therefore, along with the common characteristics it shares with the depressions of the western desert it has other common characteristics with the delta and the Nile Valley.

The area of the Fayoum Depression is almost 1800 square kilometers and it slopes towards Qarum Lake in the north west. Qarun Lake is more than 200 square kilometers wide and the most outstanding feature of this region is the presence of high banks which decisively prove that the lake was much bigger in olden times.

Writers and researchers have differed on the history of the depression and how it was formed. Some of them state that erosion began to cut into it in the plabocinic age. Other writers believe that it could not have been created except after this age and during the age of transition between the plabocinic and the plastocinic ages. However the most credible opinion is that the depression started to be created at the end of the plabocinic age.

Some scientists believe that the formation of the Fayoum Depression was made in a closed triangular basin which is due to the presence of two fractures on the eastern and western sides of the depression and other extending from the west to the east along Qarun Lake. There is no doubt that the fractures round the depression have facilitated its formation. Some scientists believe that the depression has been dug by running water, although this alone could not have formed it.

Other scientists believe that winds played an important role in forming the depression, particularly that the rocks

which from the Lybian Desert in this region are not all of solid lime stone, but are penetrated by layers of clay and placticive. These soft materials have helped the winds to wear out the depression. The fractures that led to the depression of one part of the earth's crust as in this depression, are small, being no more than mere cracks which could have had no effect on the formation of the depression.

All this shows that the formation of the depression has occurred following the sedimentation of line and iocinic elements and that the Fayoum region has been subjected to great formative changes in the Oliogecinic age and later age which led to the creation of fractures and curves and the flow of Bezolt found in the northern part of the depression, which combined together to make the iocinic material incoherent, and to fragment it along the fractures. This in turn helped in the process of forming the depression which was already taking place through the water falls which sloped eastward thus widening and deepening the depression.

The Bahr Youssof canal was one of the branches of the Nile, branching near the city of Dayrout (see Figure 4-1) and was characterized by its numerous curves. Some scientists believe that there was a small stream flowing from the eastern edge of the depression and running westward towards the bed of the depression. In the plastocine age, this small stream was able through recessive cutting to increase its length towards the east until it was separated from Bahr Youssof only by a small thin wall which could not resist the pressure of Bahr Youssof during the flood season and it was through this small stream that the Nile waters reached the depression. Thus it may be said that the Al Hawara opening (now called lahoune) has been formed as a result of this water action.

When the Nile waters were let into the depression, they

almost filled it and the area that was covered with water amounted to almost 2800 square kilometers that is about 14 times the present area of Qarun lake. Then water in this land began to shrink gradually in the following ages, its level gradually dropping from 40 meters about sea level to 36 below sea level in the Roman era (a contour map of the Fayoum Governorate is shown in Figure 4-2).

The fluctuations in the water level of this lake and its area are due to the climatic changes which Egypt in general and the Fayoum region in particular underwent, and naturally the effect of these changes was more severely felt during the ages in which there was no direct contact between Fayoum and the Nile valley, a circumstance which made evaporation and rain water decisive factors in the fluctuation of the lake's level.

This fluctuation may also be due to the degree of contact between the Nile Valley and the lake. Perhaps this is the most decisive factor, for when the lake is linked to the Nile its level rises or drops according to the Nile at the Basic Bani Sweif region (refer to Figure 4-1). But, during the eras in which there was no such link, the lake gradually dried and the factor of evaporation became more decisive as it retained only the limited amount of water obtained through local rains.

It is worthy of mention that there is another depression south west of Fayoum separated from it by a thick wall of lime stone. This depression is known as wadi Rayon, and covers about 15 square kilometers.

4.3 Geological Formation

The borings conducted all over the Fayoum Governorate, show that the bottom rock of the governorate was formed in the Iosinic era from lime stone and Marl on top of which is a recent layer of mud and sand, the maximum depth of which is 18 meters near the city of Fayoum. This layer ranges in depth from 0 to 6 meters in the other parts of the governorate as shown in the geological sectors shown in Figure 4-3.

4.4 Climate

The Fayoum Governorate is known for its mild climate which is similar to that of Cairo in summer. The average heat and air pressure in the winter season are somewhat

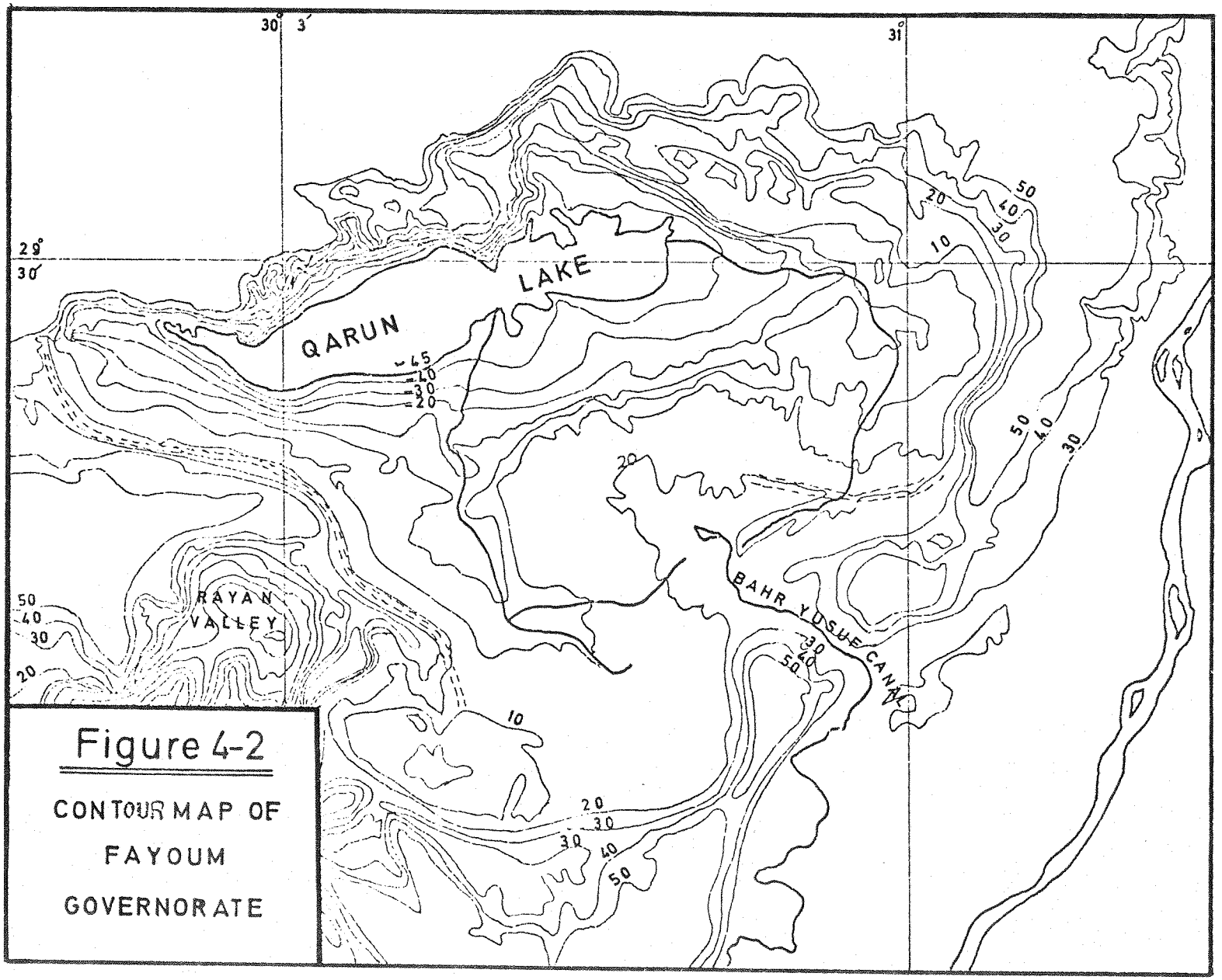
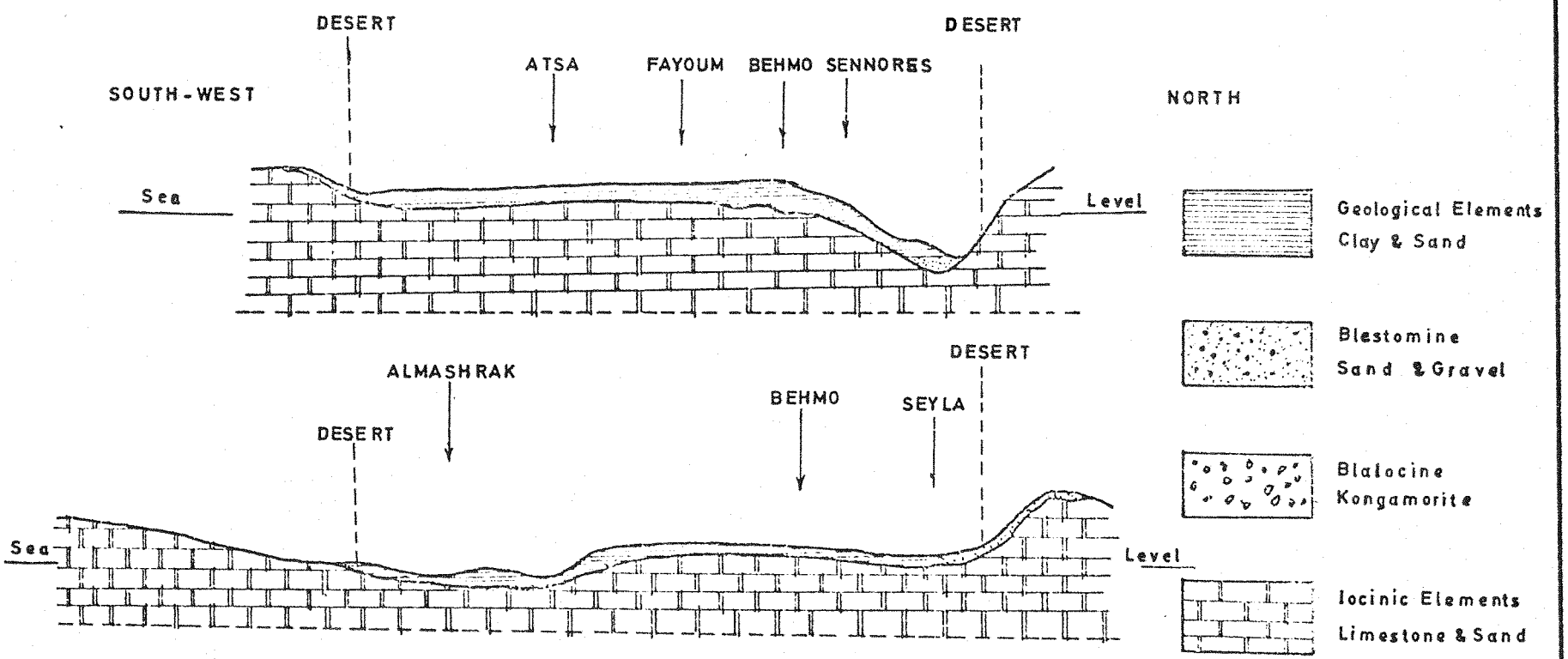


Figure 4-2

CONTOUR MAP OF FAYOUM GOVERNORATE



GEOLOGICAL SECTIONS OF FAYOUM GOVERNORATE

Figure 4-3

Horiz. Scale 1 : 500,000

Vert. Scale 1 : 5000

different from that of Cairo, while relative humidity between them differs a great deal, as it is 28% in Fayoum and 74% in Cairo. As a result, the average annual relative humidity differs.

Table 4-1 shows the Climatological Normals for Fayoum in the period from year 1944 to year 1972.

4.5 Administrative Divisions

The Fayoum Governorate is made up of five administrative centres, namely Abshway, Atsa, Fayoum, Senoures and Tameya. Both the total area and the cultivable areas in these districts greatly vary. Table 4-2 shows the total area, the cultivable area, the barren land, area of Utilities and number of villages in each district.

4.6 Distribution of Inhabitants

According to the 1972 census, as shown in Table 4-3, the number of inhabitants of the Fayoum Governorate is 1,024,000 out of the total inhabitants of Egypt numbering about 34,133,000 that is 3%.

The inhabitants of the Fayoum Governorate amounting to 1,024,000 according to the 1972 census, live in 233,000 houses; that is the average family includes 4.4 persons, and this too is less than the general average in Egypt. In 1907 the average members of a Fayoum family amounted to 5.6.

Table 4-4 shows the number of rustic inhabitants of the Fayoum Governorate classified according to their work in the years 1964, 1968 & 1972.

4.7 Irrigation and Drainage System

The Fayoum Governorate is irrigated by the Nile water at the Lahoune Barrages through the Bahr Youssef canal which takes its water from the Ibrahemia canal at Dairoot city as shown in Figure 4-1 (map).

There are no artesian wells in Fayoum as its soil is made up of sedimentary materials formed on a rocky land.

Most of Fayoum's soil is porous and its drainage is good because of the steep slope towards Qarun lake in the north. For the land level at Lahoune is 24 meters above sea level, and at Fayoum it is 22.5 meters, while the lake is 44 meters below sea level. That is the difference between the land level at Fayoum and the level at the lake is 66.5 meters in a distance not exceeding

Table 4.1

The Climatological Normals for the Fayoum Governorate in the Period from Year 1944 to Year 1972 (5)

Month	Pressure (mb) Mean		Temperature (°C)			Relative Humidity (%)		Cloud Amount (0–8)	Rainfall (mms)	Force (0 – 12)	Wind Direction (8h. + 14h. + 20h.) Percentage Frequency									Evaporation Piche (mms) per day
	Station Level	M.S.L.	Mean Daily Max	Mean Daily Min.	Mean of Day	Mean	14 h.	Mean	Total	Mean	N	NE	E	SE	S	SW	W	NW	Calm	
January	1014.8	1018.6	20.6	6.0	11.6	68	41	2.8	1	1.4	23.8	6.8	1.6	4.9	13.6	8.9	4.1	12.4	23.9	3.4
February	1013.1	1016.8	22.1	7.2	13.2	63	36	2.5	2	1.6	25.5	6.2	2.1	4.8	13.2	9.4	6.0	15.1	17.7	4.4
March	1011.8	1015.4	25.0	9.4	16.1	58	30	2.1	2	2.0	45.1	10.6	2.3	3.5	7.7	4.2	3.4	12.4	10.8	6.0
April	1010.2	1013.8	29.8	12.8	20.4	50	24	1.8	1	2.2	46.1	11.6	2.3	2.5	5.3	3.2	3.0	14.2	11.8	8.6
May	1008.6	1011.9	34.1	17.1	25.1	42	20	1.9	2	2.4	54.7	15.3	2.1	1.1	2.6	1.5	1.7	11.5	9.5	11.8
June	1007.1	1010.4	35.8	19.5	27.2	46	22	0.4	0	2.7	68.5	10.7	0.8	0.6	0.7	0.7	1.1	12.1	4.8	13.3
July	1004.7	1008.0	36.6	21.1	28.1	51	26	0.3	0	2.5	70.9	7.1	0.6	0.2	0.4	0.4	0.4	15.0	5.0	11.8
August	1005.2	1008.6	36.2	21.4	28.0	57	29	0.5	0	2.4	69.7	10.0	0.6	0.1	0.1	0.3	0.5	13.0	5.7	10.1
September	1008.6	1011.9	33.5	19.4	25.6	62	33	0.5	0	2.4	73.5	11.4	0.4	0.0	0.1	0.3	0.2	9.4	4.7	8.0
October	1011.2	1014.8	31.4	17.1	23.2	64	34	1.3	1	2.0	60.5	12.2	1.0	0.3	1.5	1.5	1.0	10.1	11.9	6.5
November	1012.7	1016.3	26.9	13.1	18.7	69	39	2.3	1	1.6	45.4	9.9	1.1	1.7	4.6	3.4	2.1	12.2	19.6	4.5
December	1014.8	1018.6	22.1	8.2	13.5	72	44	3.0	7	1.2	26.5	7.1	1.8	3.5	11.5	6.9	3.1	11.8	27.8	3.2
Annual Mean	1010.2	1013.8	29.5	14.4	20.9	58	32	1.6	17	2.0	50.9	9.9	1.4	1.9	5.1	3.4	2.2	12.4	12.8	7.6

Table 4.2

The Divisions of the Fayoum Governorate Areas
and the Number of Villages in each District (1)

Administrative District	Cultivable Area (ha)	Barren Land (ha)	Utilities (ha)	Total Area (ha)	Number of Villages
Abshway	31,506	9,287	2,116	42,909	33
Atsa	33,825	11,646	2,405	47,876	42
Fayoum	24,745	4,695	2,566	32,006	40
Senoures	20,768	2,446	1,540	24,754	26
Tameya	26,916	5,509	2,155	34,580	20
TOTAL	137,760	33,583	10,782	182,125	161

Table 4.3

Number of Inhabitants of the Fayoum Governorate
According to their Sex (Civil and Rustic)
in Years 1964, 1968 and 1972 (1)

Year	Sex	Civic	Rustic	Total
1964	Male	95.70	355.20	450.90
	Female	95.30	355.80	451.10
	Total	191	711	902
1968	Male	105.40	380.20	485.60
	Female	105.60	380.80	486.40
	Total	211	761	972
1972	Male	113.20	398.50	511.70
	Female	112.80	399.50	512.30
	Total	226	798	1,024

Table 4.4

Number of Rustic Inhabitants in the Fayoum Governorate Distributed in Different Works in Years 1964, 1968 and 1972 (Males and Females) (1)

Work \ Year	1964			1968			1972		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Agriculture	340,708	11,294	352,002	364,741	11,581	376,332	382,273	12,152	394,425
Horticulture	227	14	241	241	14	255	254	17	271
Animal Breeding	7,169	2,251	9,420	7,614	2,411	10,025	7,981	2,531	10,512
Poultry Breeding	56	1,795	1,851	60	1,923	1,983	63	2,018	2,081
Dairy Products in Houses	236	14,236	14,472	253	15,345	15,598	266	16,002	16,268
Bee Keeping	24	5	29	27	6	33	26	5	31
Silkworm Keeping	5	—	5	3	—	3	5	—	5
Ornamental Bird Breeding	—	23	23	—	21	21	—	26	26
Hatching	180	—	180	196	—	196	203	—	203
House Works	2,637	2,315	4,952	2,822	2,481	5,303	2,958	2,603	5,561
Land Ownership	3,869	4,649	8,518	4,141	4,980	9,121	4,341	5,226	5,561
Home Duties	—	319,156	319,156	—	341,899	341,899	—	358,775	358,775
Total	355,111	355,738	710,849	380,098	380,661	760,759	398,370	399,355	797,725
Nomads (Shepherds)	67	42	109	82	52	134	76	46	122
Total	355,178	355,780	710,958	380,180	380,713	760,893	398,446	399,401	797,847

35 kilometers, which is quite a steep slope amounting to two meters per kilometer. And as the lands of Fayoum are in the heart of the desert, some of the waterways such as Bahr Wahbi, Al Haraga and the major gharak drain as well as other auxiliary drains are often filled with sand.

4.7.1. Major Irrigation Sources:

The Fayoum Governorate is irrigated as we said before by Bahr Youssef branching from the Ibrahemia canal at Lahoune Barrages. Fayoum gets about 65.4% of the total amount of water at the Lahoune Barrages, while the Giza canal gets 34.6%. Fayoum gets its irrigation water from two major branches, Bahr Youssef behind the lahoune, giving it 70% of the required water, and the Bahr Hassan Wasef canal giving it 30%. The area of the land irrigated by Bahr Youssef behind the Lahoune Barrages amounts to 101,187 hectares, Bahr Youssef canal is 24.150 Kilometers long and it ends at Fayoum. It has 12 branches; Bahr Wahbi, Arous, Baga, Soliman Dessouki, A'alam, Tenhaha, Abour Seer, Al Hagara, Senoufer, Kahafa, Dar Al Ramad, and Senoures. The area of land irrigated by the Bahr Hassan Wassef canal amounts to 41,598 hectares and it is about 13.755 Kilometers long. At the end it branches into two canals Al Gharak, which irrigates 16,682 hectares and is 28 kilometers long, and Bahr al Nazla which irrigates 24,203 hectares and is 59,700 kilometers (See Figure 4-4).

The amount of water which gets into Fayoum ranges from 5 million cubic meters per day in summer and 8 million cubic meters during the flood season. The amount of irrigation water which the Fayoum Governorate receives annually amounts to 2 Milliard dubic meters.

4.7.2. Rotation System:

The rotation system in the Fayoum Governorate is dual, with seven days high flow, and seven days low flow, for each half of the total irrigated area, the water duty for each hectare being 70 cubic meters. Winter rotations last from 18 February to 30 March, summer rotations are from 1 April to 14 August and nilotic rotations from 15 August to 31 December.

Water is distributed through private joint small canals so that each beneficiary would irrigate his land in the

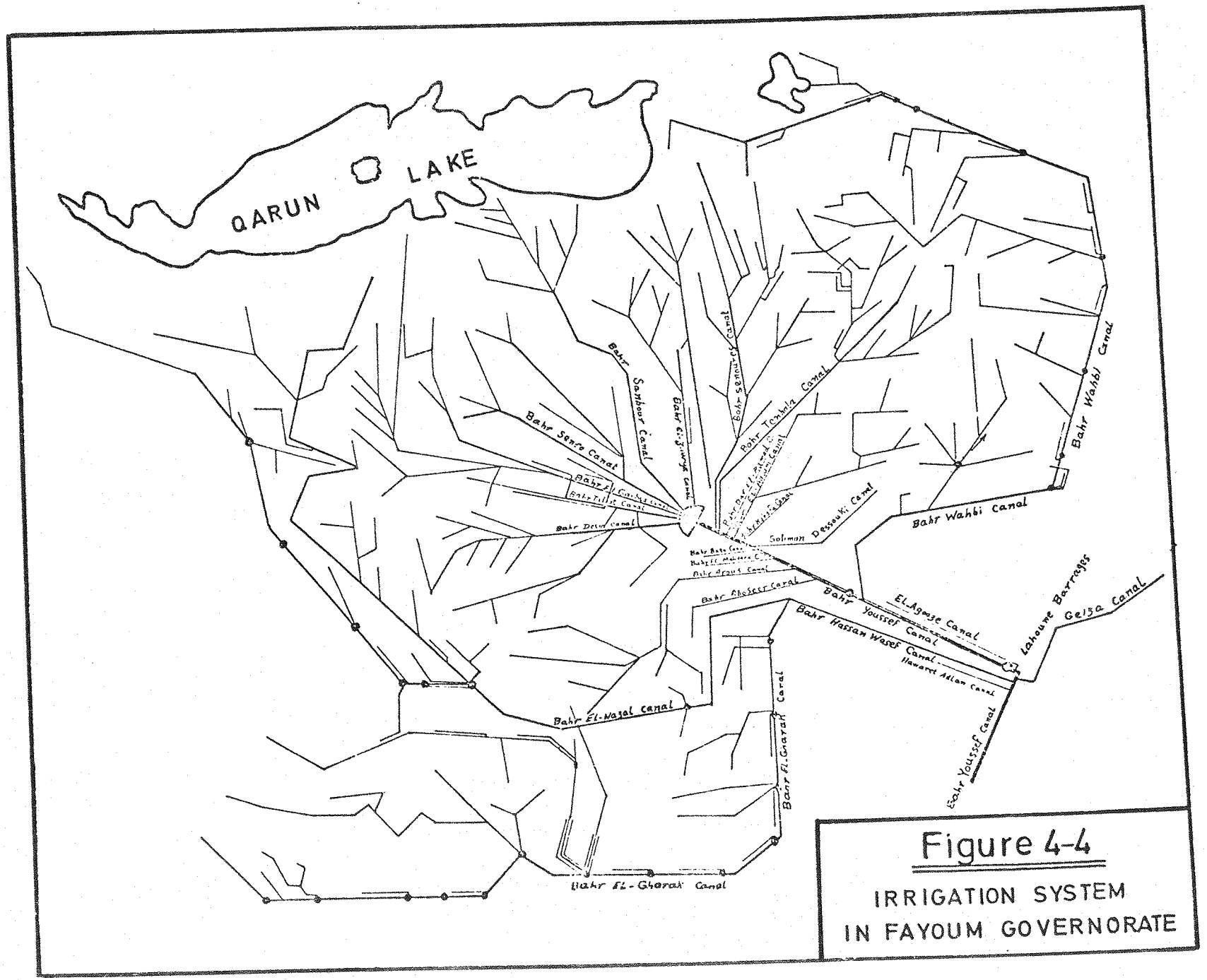


Figure 4-4

IRRIGATION SYSTEM
IN FAYOUM GOVERNORATE

time suitable for its size. He owns the water of his canal during the set period and he must finish irrigating his land in that period. This is called the party system and lists of the parties are prepared by the irrigation authority. This system is applied all year round with the exception of the drought season which lasts throughout January.

The turns system is applied during all irrigation seasons whether, spring summer or Nilotic. The only difference being in the amount of the water duty. During the summer season the water duty per hectare per day is limited according to the amount of irrigation water allotted to Fayoum and this duty is also subject to the relative distribution of water, set according to the amount of water that comes from the Nile in the summer. However in determining the amount of water needed for the irrigation of Fayoum, two factors are taken into consideration:

(1) Most of its land is sand soil which needs a considerable quantity of water.

(2) The amount of salts in the soil is great thus necessitating a large amount of water for the removal of these salts.

(3) The steep slope of its lands causes water to drain directly into Qarun lake so that the cultivable lands do not retain their humidity for long. This is another factor which results in a constant need for irrigation water.

All these factors must be taken into consideration when defining the quota of Fayoum in the relative distribution of the Nile water in summer, particularly as all efforts to find terrestial water which could be used for irrigation have failed till now. That made the use of artesian water in the governorate to meet the deficiency of irrigation water, quite impossible.

During the summer season when the natural water flow is abundant in the months of April and May Fayoum's quota amounts to 5 million cubic meters per day according to the relative distribution of Nile waters. As the total area of cultivable land in Fayoum amounts to 137,760 hectares, the average daily quota of irrigation water per

hectare during these two months is 35 cubic meters. According to the turn system applied in Fayoum which provides for the irrigation of land every 14 days, each hectare gets 490 cubic meter every fortnight. This is much less than the water requirements for the summer crops which amounts to 950 cubic meters every fortnight. Thus the irrigation water allotted for Fayoum during the months of April and May is sufficient for the irrigation of half the cultivable area only, and if the peasants exceed this amount there will not be enough water for the rest of the land, thus the production of crops would drop.

By June the demand for water increases because of the planting of rice. This increase is met by the water stored by the Aswan Dam. During this month, Fayoum's quota rises to 7 million cubic meters per day, and this amount is completely used. The planting of maize is therefore postponed until the Nile floods in August. This causes a drop in the average production of maize in Fayoum to less than 3 tons per hectare. It is believed that the average production per hectare could be increased if maize is planted earlier.

The Moheet drain used to have its end at the Bahr Youssof canal beyond the barrage, and gave 1.5 million cubic meters to it daily. This large amount of water in addition to the already existing waters of Bahr Youssof used to relieve the heavy demand on water in the Fayoum governorate. But this has been changed in recent years when the Moheet drain was excavated so as to pass its waters to the Nile, and Fayoum was then deprived of this source of water. It would be better to give that water back to the Fayoum governorate so that maize may be planted earlier, and its production increased.

During the flood season in the month of August demand for water is at its peak because all land is planted with summer crops such as cotton or Nilotic crops such as rice and maize. At this period, Fayoum needs about ten million cubic meters daily, but the actual quantity given never exceeds 8 million. The reason behind this deficiency in water is that the water level in Qarum lake may rise.

4.7.3. Means of Distributing water:

The slope between Fayoum and lake Qarun is, as we said before, about 66 meters, which is a very steep slope compared with the short distance between them. Thus the best method to ensure a fair distribution of water would be the use of the free steps method. The iron gates are not used except at the mouths of major canals such as Bahr Youssef, Bahr Hassan Wasif, Bahr Al Nazla to the Menya block; and Bahr Wahbi in front of the railway block. Distribution of water through these major canals is done through culverts and pipes because the water level cannot be kept under control to maintain the same level by day and night. Most irrigation water in Fayoum is obtained either by gravity commans or by means of water-wheels. Behind each of these mouths there is a step whose width is proportional to the land area.

To facilitate calculation of the necessary discharges behind the steps, the depths of water behind them have been standarized to 4 thicknesses, each thickness being applied to the appropriate water way to suit the level of the irrigated soil and the slope of the adjacent land. These thicknesses are:

(1) thickness 0.24 meter: could irrigate 200 hectares
(2) " 0.36 " : " " 400 "
(3) " 0.54 " : " " 800 "
(4) " 0.69 " : " " 1200 "

When the canal branches into smaller ones, distribution of water between them is done by a group of these steps called Nasba and every branch has a certain width representing the area served.

The direct distribution of water from the branch to the fields is done through free small united steps in accordance with the original Nasba at the mouth. Thus the total breadth of the steps of openings on the branch is equal to the breadth of the step of the major opening and are all designed for one water duty. These steps of openings are on a straight line parallel to the designed water level of the water way supplying the openings.

This ensures that if the water level rises or falls in the major stream, it still flows equally into all

irrigation openings.

This ensures a just distribution particularly as the width of each opening is approximated to the nearest millimeter according to the land it irrigates. This is contrary to the system applied in other governorates which provides for example the fixing of a 55 cm. pipe; ten meters long for any irrigated area of land ranging between 215 and 265 hectares. Thus an owner of land amounting to 265 hectares gets the same opening as that allotted in an area of 215 hectares; which is definitely unfair.

It is customary for each weir on a public water way to be provided with a pipe placed on the canal bed level and called 'drinking water pipe' and supplied with an iron gate. The main purpose of this pipe is to filter the water at the bed of the water way when it is being dredged. The opening of these pipes during the process of irrigation is strictly forbidden as it upsets the distribution system.

4.7.4. Factors Affecting a Fair Distribution of Irrigation Water in the Fayoum Governorate.

In spite of all these precautions for ensuring a just distribution of water in Fayoum, some factors remain that affect justice in distributing irrigation water, namely:

(a) The sedimentation of silt in the beds of public water ways or the appearance of islands which make the water-way narrower, and in turn affect the slope of water in the region lying between two weirs which does not maintain an equal flow of water at all steps of openings to the same degree. Thus all waterways must be continually dredged.

(b) The appearance of weeds in the bed of the waterway giving the same results. Thus, each irrigation centre should be supplied with teams to remove these weeds as soon as they appear.

(c) The beneficiaries commit a large number of contraventions either by making additional openings next to the ones allotted to them, or by making holes in the buildings of weirs. These contraventions are important elements which disturb the turns system. This is what drove the Ministry of Irrigation to punish

those beneficiaries who committed such contraventions by making them pay the expenses of closing the opening and lining it to a distance of 20 meters on both sides with stones and mortar, even if the place has no buildings. A contravention might cost ₰2000 but this system is no longer applied.

(d) Giving licence to some of the beneficiaries planting rice to put down additional pipes. This greatly prejudices the ajust distribution exactly as contraventions do. It would be better to raise the water level in the waterway which is used by those planting rice. This would be better than using additional pipes, thus giving farmers an equal chance to use this water either in planting rice, in planting maize earlier than August, or in improving summer cultivation.

(e) The drinking water pipes which are put at the control weirs become a source of upset in the water distribution system if they are badly used and are opened to allow the flow of more water than that at the steps of the weirs. These pipes should be continuously supervised to prevent their opening.

(f) Some water ways are sometimes filled with sand, a matter which impedes irrigation.

All these factors may prevent the end weirs from receiving their full quota of irrigation water. It has been noticed for example that some canals give a duty of 43 cubic meters per hectare daily, and by these factors the water duty which reaches the end weirs is 15 or 16 cubic meters only per hectare daily. This means either leaving some of the cultivable area uncultivated or deficiency in its production. If these defects could be combated, no irrigation system would be better than that at Fayoum.

It is noticeable that Ministry of Irrigation does not have full control over private joint irrigation canals except as regards their months only. For it provides these openings with weirs of a limited volume which ensures a proper quota of water. The beneficiaries using these joint private irrigation canals are left to prepare the openings which feed their lands as they deem appropriate

so long as the distribution of water between them is fixed according to tables, kept by the central administration men, who are responsible for their implementation.

These tables determine the period in which each beneficiary becomes exclusively in full control of the irrigation canal water. The period allotted to each beneficiary is determined according to the area of his land. If the sum of the land irrigated by the canal is 200 hectares for example, then each hectare would get 50 minutes in the high flow period which lasts for 7 days. The man who has 2.5 hectares gets only 2 hours of irrigation during the high flow. The table determines the time of these two hours. They may be from 12 midnight to 2 in the early morning. If the beneficiary does not use his share of water during his two hours, he loses his right and his successor on the table is entitled to use this water from 2 o'clock. This issue is worthy of notice, for urgent circumstances may prevent the farmer from getting to his field in the fixed hour, and a farmer with large property who sends one of his helpers to use the irrigation water during his set time, may be harmed as a result of the carelessness of this helper, or his collusion with others to sell them this irrigation water. This not only harms the land owner but affects the production. Thus it would be better if these private joint irrigation canals whose scope of irrigated land exceeds 100 hectares, be transferred into public waterways so that each beneficiary may easily use the opening which is specified for the permenant irrigation of his land. This could be achieved if a certain amount of money is allotted for this purpose in the budgets of the next 10 years.

The high lands which are not irrigated by the flush system are irrigated by the Roaring Wheels or by a water wheel turned by animals or by simple lifting instruments. The Roaring Wheels are wheels turned automatically by water falls at 'Nasbas' established on canals and constantly turning so long as the water is falling. Water falls are also used in running mills.

The steps established on the major waterway are supplied with pipes with iron gates which are fixed in

the step at the bed of the waterway. These pipes are never opened except in cases of urgent emergency when the canals are dredged, or for the maintainance of industrial works. They are likewise opened during the drought, or the rice cultivation seasons.

4.7.5. Drainage.

Drainage of most of the land of the Fayoum Governorate is done by flush drainage through two drains which are two ancient natural creeks; Al Bats and Al Wadi drains both flowing into Qarun lake. The first drains 57,480 hectares, the second 73,530 (See Figure 4-5).

It is worthy of mention that the amount of drainage water which flows into the lake annually amounts to 350 million cubic meters. Al gharak region does not apply the natural flush drainage system because of its deep low level, thus the Ministry of Irrigation has built three drainage stations to take the drainage water to Al Wadi drain. These have been designed to take the water through pumps and make it flow with natural and reasonable slopes parallel to Al Wadi drain which has very steep slopes. When the water reaches Al-Moktallate (lying about 10,300 kilometer from the last pump), we find that the level of the transferred water has reached Zero or is exactly at sea level, while the surface of Al Wadi drain is 25 meters below sea level. The Ministry of Irrigation has meters of difference in water levels and the produced water falls are used in electricity generation.

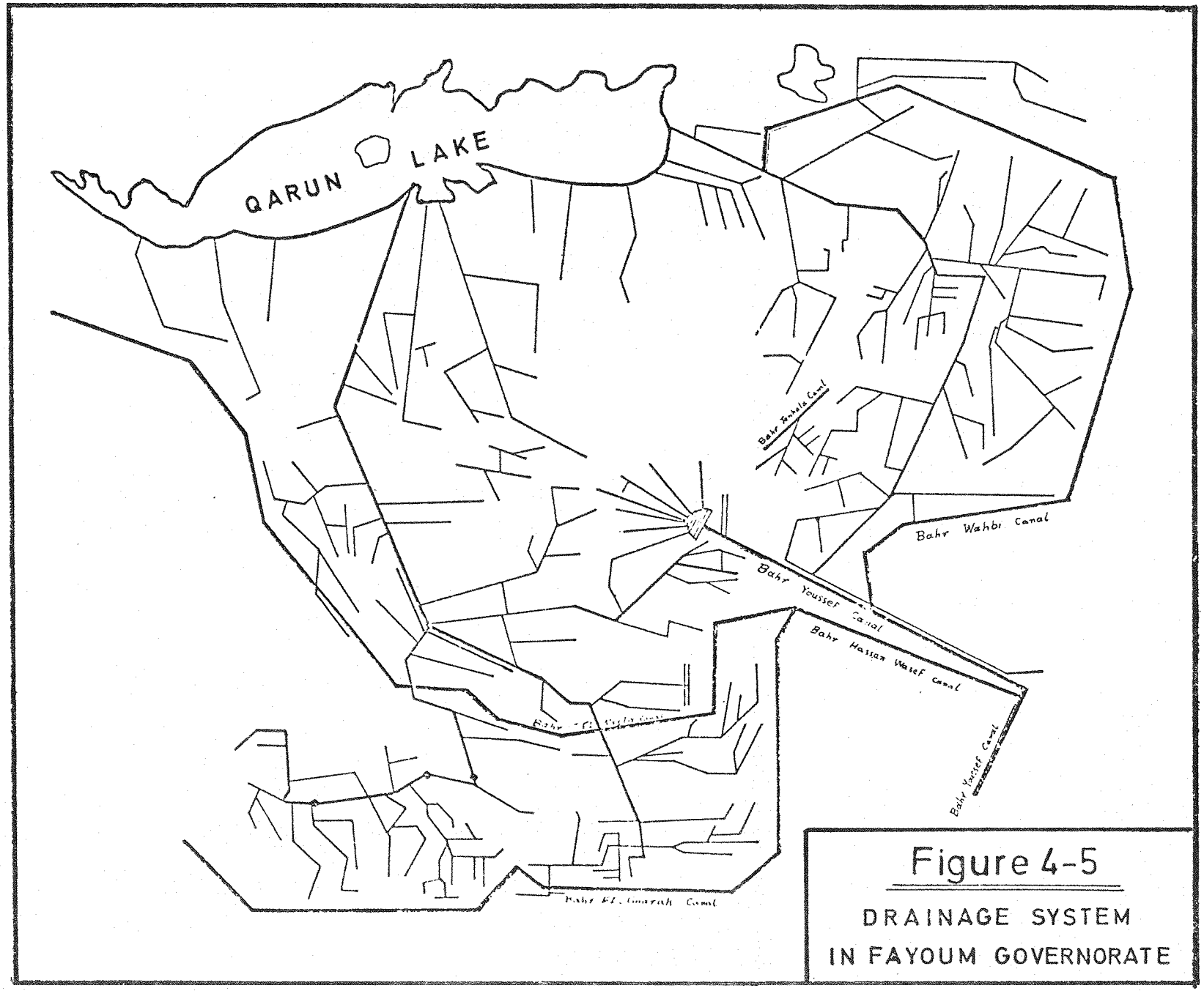


Figure 4-5

DRAINAGE SYSTEM
IN FAYOUM GOVERNORATE

CHAPTER 5

RECURRENT COSTS AND BENEFITS FOR THE ESTABLISHED IRRIGATION PROJECT IN THE FAYOUM GOVERNORATE

5.1 Recurrent Costs.

As we said before, in every governorate in Egypt there is a general administration for irrigation which belongs to the Ministry of Irrigation. This administration is responsible for the maintenance of canals, drains and irrigation structures in that governorate and also for distributing water between the farmers. In the Fayoum Governorate, there is a general administration for irrigation responsible for the previous items.

Also, in every governorate, there is a general administration for agriculture belonging to the Ministry of Agriculture and this administration is responsible generally for agricultural production in that governorate, for guiding the farmers in choosing suitable crops, for the different types of soil and for the selection of crop rotation etc. (refer to 2.1.2). In the Fayoum Governorate, there is a general administration for agriculture responsible for the previous items.

If we make a comparison between the recurrent costs of the old agricultural lands and the recurrent costs of the new agricultural lands, we will notice that the recurrent costs of the old lands is very much less than those for the new lands. When we refer to Chapter 3 we find that the rate of annual recurrent costs expended by The General Egyptian Organization of Cultivation and Development (GEOCD) for the new land is $67.32/ha (see Table 3-2), and when we refer to this Chapter (Chapter 5) we find that the whole annual recurrent costs expended on the old lands by both The General Administration of Irrigation and The General Administration of Agriculture of the Fayoum Governorate is $11.59/ha. (see Table 5-14). The reason for that great difference in expenses refers to the fact that, in the case of newly cultivated lands, the Government is fully responsible for the management of the projects. This needs a large number of agronomists, engineers and workers of different standards, whether that

of the sector, farm or agricultural unit (as indicated in Chapter 3). This large number of employees entails the increase of Government expenses, with regard to salaries, transport allowances, for inspection, fuel consumption and cars, etc. - a factor which causes this evident rise in annual expenses. As regards the already cultivated lands in individual ownership, the Government function, in this case, is of a supervisery nature to be practised over major works only.

However, we are interested here to know the annual recurrent costs of both the general administration of irrigation and the general administration of agriculture in the Fayoum Governorate.

5.1.1. The General Administration of Irrigation:

Figure 5-1 shows the arrangement of The General Administration of Irrigation in the Fayoum Governorate.

As we see, the head of the administration(an irrigation engineer) is called the General Manager and he works with the help of some irrigation engineers.

The administration is divided into two departments one of them is for the East Fayoum and the other is for the West Fayoum. The head of each department is called the Irrigation Inspector. Each department is divided into four irrigation centres, the chief of each centre is an irrigation engineer and he is responsible for the different irrigation works in his centre.

However, The General Administration of Irrigation in the Fayoum Governorate consists of:

(1) 22 irrigation engineers.
(2) 2 mechanical engineers.
(3) 32 technicians, such as draftsmen and caligraphists.
(4) 89 vocationals, such as drivers, painters and mechanics.
(5) 464 service men, work in the general administration, in the irrigation centre and rest houses.

There are some transports, excavators and irrigation machines in the Administration which are shown in Tables 5-1, 5-2, 5-3 successively.

It may be observed that the said administration has a staff of 22 civil engineers, including those of senior posts, such as the General Manager, his Deputy, Inspectors

Figure 5-1

FAYOUM IRRIGATION GENERAL ADMINISTRATION AUTHORITY

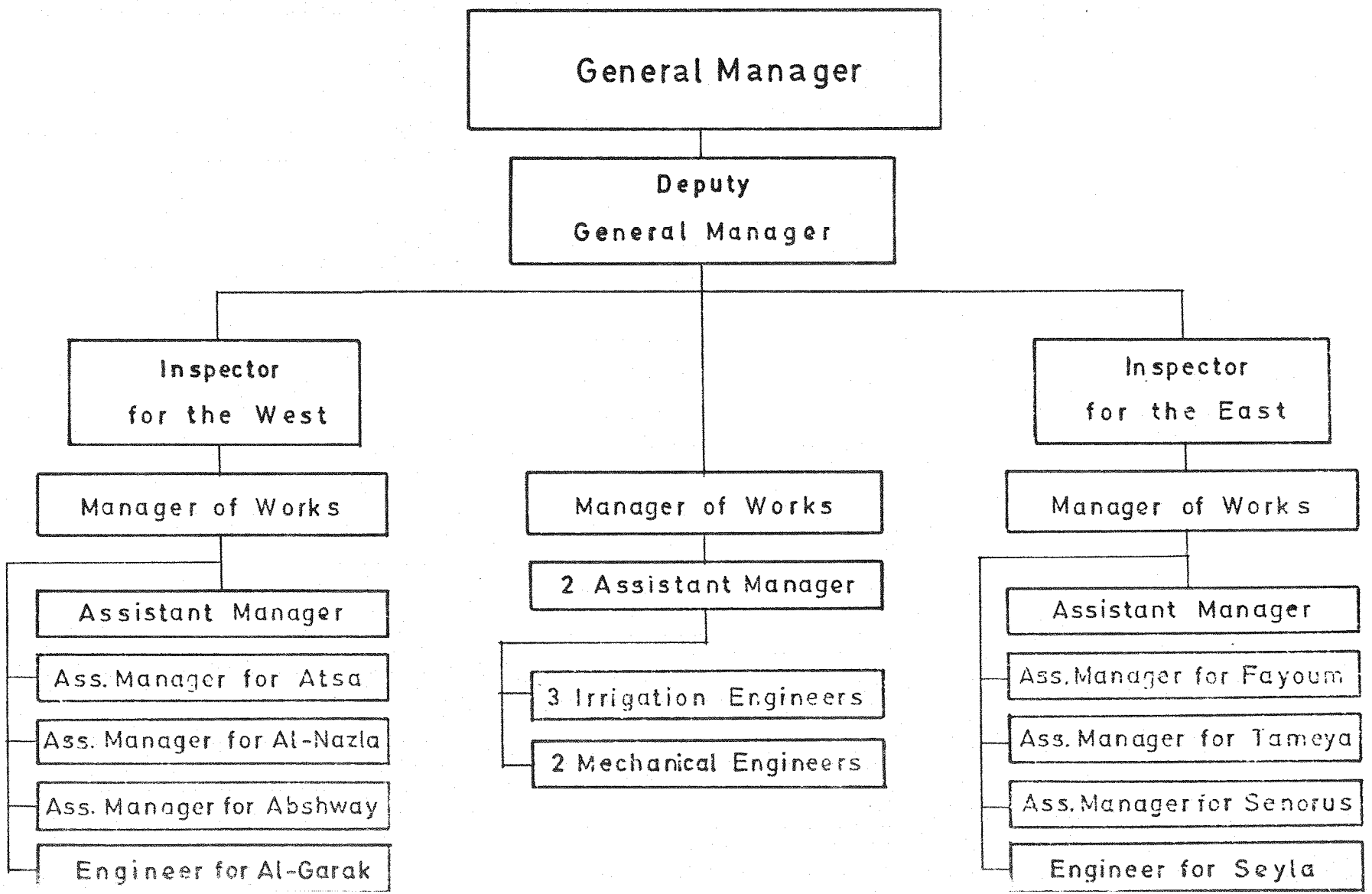


Table 5.1

Transports Found in The General Administration of Irrigation in the Fayoum Governorate (6)

Type	Number	Model	Fitness %	Use
Ford Limousine	1	1955	65	For Engineers Movements
Ford Station	1	1956	65	For Engineers Movements
Russian Jeep	4	1966	50	For Engineers Movements
Russian Jeep	3	1966	60	For Engineers Movements
Fargo	1	1951	55	For Transferring Provisions
Ford Pick Up	1	1953	35	For Transferring Provision
Ford Pick Up	1	1954	50	For Transferring Provision
Jeep Wiles	1	1950	45	For Transferring Provision
Scoda Truck	1	1966	65	For Transferring Provision
Ford Truck	1	1956	50	For Transferring Provisior

Table 5.2

Excavators Found in The General Administration of Irrigation in the Fayoum Governorate (6)

Type	Model	Number	Fitness %
Big Polish	1966	9	65
Big Polish	1955	2	55
Small Polish	1966	3	60
Big English	1950	2	65
Small English	1950	2	65
Russian	1960	1	50

Table 5.3

Irrigation Machines and Other Equipment Found in
The General Administration of Irrigation
in The Fayoum Governorate (6)

Kind	Type	Model	Number
Irrigation Machine	Egyptian	1967	3
Irrigation Machine	American	1949	1
Irrigation Machine	German	1950	1
Irrigation Machine	English	1945	1
Irrigation Machine	Russian	1960	5
Lighting Machine	English	1945	1
Turning Machine	Egyptian	1968	1
Drill	Roman	1957	1
Whetstone	Russian	1965	1
Battery Charger	Russian	1966	1
Electric Welding Apparatus	Russian	?961	1
Oxyacetaline Welding App.	French	1965	1

and Managers of Works. It would be better to increase this number to 30 civil engineers, in order that every irrigation centre be staffed with 2 engineers instead of one, as the case is now, to supervise its irrigation works.

The phenomenon of the shortage in the number of engineers is common in irrigation circles in all the Governorates of Egypt, as well as in other authorities. This is due to the fact that they are badly needed in all sectors. This is contrary to the case of agronomists, engaged in agricultural circles, where they are available in excess numbers, as indicated in the following few pages.

It may be recognised from the previous tables, that most of the cars, excavators and irrigation machines, stocked at the administration have been in use for much longer than their economic life. For example, it may be observed that some of them have been used for more than twenty years. This, of course, results in huge annual expenses incurred for their operation and maintenance. Thus, it will be more profitable if they could be dispensed with and replaced by others. However, various studies were conducted by the Egyptian Government to remedy such a state of affairs in all Ministries and Government Departments. Such studies deal with both the technical and economic points of view. The first aim was to determine how to keep a Government machine, or car, in good condition, for the longest possible period. It has practically been proved that this cannot be achieved other than by drawing the attention of workers and drivers to the importance of the good use of the machine or car. Meanwhile, steps were taken to realize this aim. As regards cars, for example, the idea of giving, free of charge, the Government car, after a period equivalent to its economic life, or one or two years later, into the possession of the driver who works on it, came to mind. This, in fact, promotes the driver's efforts and care to a maximum, in order to keep the Government car, he works on, in good condition, because he knows that it will be his own property, after a few years. As regards the other machines, financial gratuities were

earmarked to be paid, in case their maintenance costs fall, to their operating mechanicians. In general, the Egyptian Government should issue instructions to the authorities, under its control, to dispense completely with any car or machine, beyond its economic life, and replace it with a new one, in order to save the annual recurrent expenses.

However, the average annual recurrent costs of the Administration of Irrigation is equal to £688,255 = £5.00/ha as follows:

(a) Wages = £238,150 = £1.73/ha (details are shown in Table 5-4)

(b) irrigation and drainage works = £129,644 = £0.90/ha (details are shown in Table 5-5)

(c) service expenditures = £305,750 = £2.22/ha (details are shown in Table 5-6)

(d) Costs of materials = £14,671 = £0.11/ha (details are shown in Table 5-7)

5.1.2. The General Administration of Agriculture

Figure 5-2 shows the arrangement of The General Administration of Agriculture in the Fayoum Governorate as we see, the head of the administration is an agronomist called the General Manager and he works with the help of two assistant Managers and some agronomists.

This administration is devided into five centres namely: Tameya, Senorus, Abshway, Atsa and Fayoum. The head of each centre is called the Inspector and he works with the help of two agents and some agronomists.

However, The General Administration of Agriculture in the Gayoum Governorate consists of 1352 employees as follows:

(1) 239 agronomists.
(2) 4 lawyers.
(3) 5 administratives.
(4) 57 clerks.
(5) 875 technicians.
(6) 74 skilled.
(7) 98 unskilled.

Table 5.4

Annual Wages of Employees in The General Administration of Irrigation in the Fayoum Governorate (7)

Job / Financial Category	Civil Engineer	Mech. Engineer	Clerks	Tech-nicians	Skilled	Un-skilled	Total	Cost
First	1						1	3,500
Second	3						3	7,500
Third	5						5	10,000
Fourth	8						8	12,000
Fifth	1						1	1,125
Sixth	1	1	2	4			8	8,000
Seventh	3	1	3	6	2		15	11,250
Eighth			15	9	29		53	2,650
Ninth			30	13	58		101	42,925
Tenth						464	464	139,200
Total	22	2	50	32	89	464	659	238,150
Total / ha								1.73

Table 5.5

Annual Recurrent Cost of Irrigation and Drainage Works of The General Administration of Irrigation in the Fayoum Governorate (7)

U.S. $

Improving irrigation and drainage system	94,313
Improving irrigation and drainage openings	3,659
Constructing bridges on water ways	21,276
Construction and demolition of weirs	5,460
Obtaining and operating parts for mouths of canals	4,936
Total	129,644
Total / ha	0.94

Table 5.6

Annual Services Expenditures of The General Administration of Irrigation in the Fayoum Governorate (7)

U.S. $

(1) Transportation and Communication:	
Transport of equipment	178
Transport of employees and labourers	5,179
Fixed inspection allowances for engineers	8,524
Telephone, telegram and mail	8,233
(2) Maintenance Expenses:	
Maintenance and dredging for water ways	265,380
Maintenance and restoration of buildings	1,505
Maintenance of roads, bridges and banks	480
Maintenance of equipment and machines	11,579
Maintenance of means of transportation	3,647
Maintenance of furniture and other office equipment	144
(3) Varied Service Expenditure:	
Printing costs	115
Publication and advertisement costs	416
Subscription to newspapers and magazines	56
Aids given on occasions such as feasts and burials	324
Total	305,760
Total / ha	2.22

Table 5.7

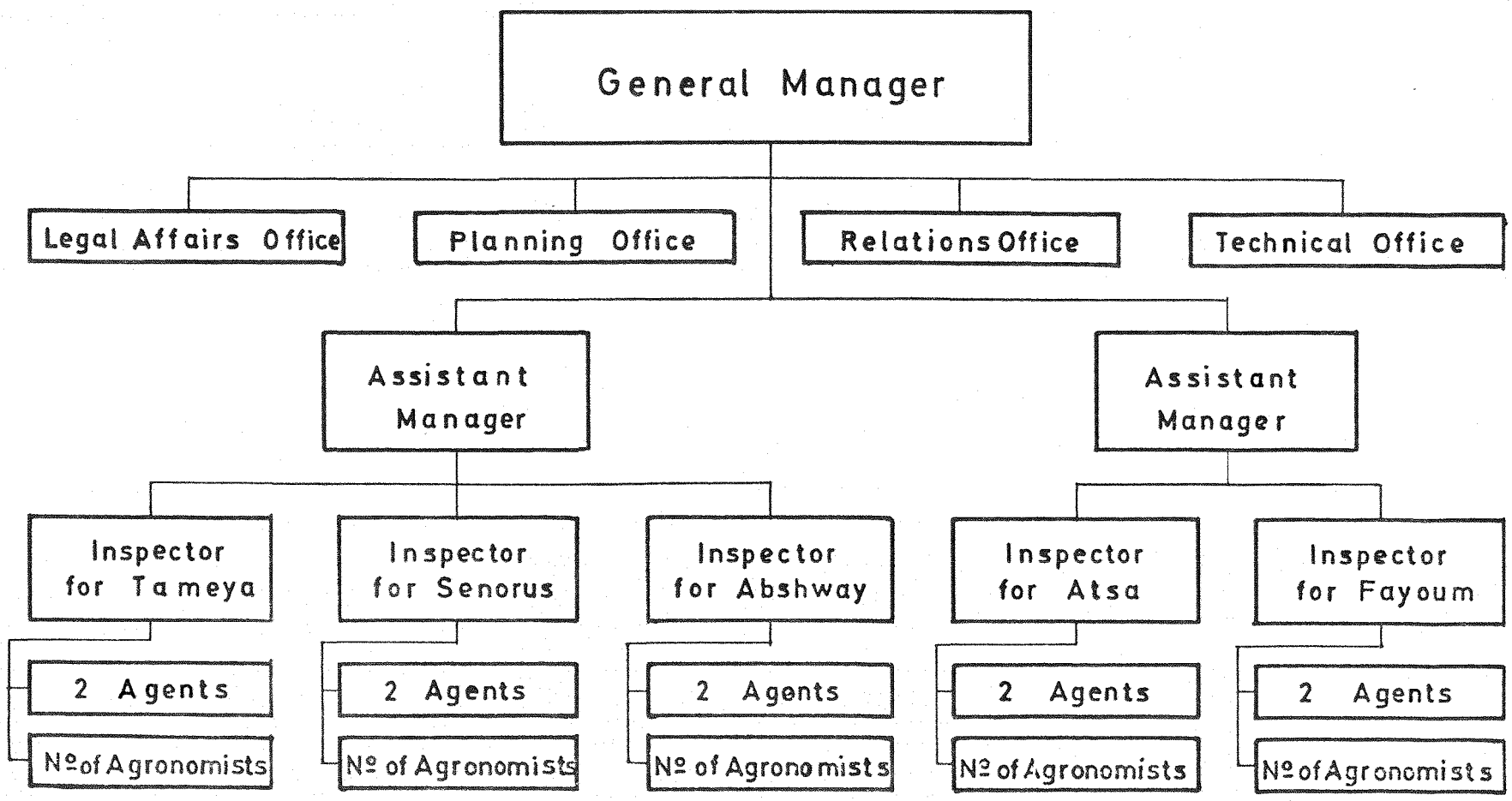
Annual Costs of Materials of The General Administration of Irrigation in the Fayoum Governorate(7)

U.S. $

Fuel, Oil and Power	9,713
Spare parts and maintenance materials	2,442
Water and light	1,820
Stationery	99
Furniture and cooling and heating apparatus	357
Equipment for gardening and other implements	240
Total	14,671
Total / ha	0.11

Figure 5-2

FAYOUM AGRICULTURAL GENERAL ADMINISTRATION AUTHORITY



There are some transports in the administration shown in Table 5-8 and Table 5-9.

As regards the 239 egronomists available within the agricultural circle, 20 of them occupy senior posts, such as the General Manager, his Assistants, Inspectors and Sub-Inspectors. The other 219 agronomists are supposed to be specially assigned for field inspection to advise and instruct the farmers in all that concerns agricultural affairs. They should also supervise and control the execution of Government instructions, with regard to the various cultivations, and perform all the other supervisory works. There are also, as already mentioned, 875 technicians, who assist and participate in such works.

In view of the fact that the cultivated area in the Fayoum Governorate covers 137,760 hectares, this means that an agronomist and 4 technicians are assigned for the supervision of cultivation in every stretch of 629 hectares. In our opinion, this number exceeds that required. In fact, one fourth of this number of agronomists and technicians is quite sufficient.

It may be noticed, from Tables 5-8 and 5-9, showing the number of cars and motor-cycles available at the administration, that the number of cars is 21 and the motor-cycles 51. Such cars and motor-cycles are supposed to be used for the field inspection of all areas. If it is assumed that there are 51 agronomists and technicians using these motor-cycles, a car will be assigned for every 50 persons, out of the remaining number of staff, and this rate is abnormal. In our opinion, this does not represent a shortage in the number of cars and motor-cycles, but an evident excess in the number of agronomists and technicians.

The phenomenon of employing excess numbers of agronomists and agricultural technicians is common in agricultural circles in all Governorates of Egypt.

Table 5.8

Transport Found in the General Administration of Agriculture
in the Fayoum Governorate (8)

Type	Model	Number	Use
Chevrolette	1956	1	For Agronomists Movements
International Pick Up	1961	5	For Agronomists Movements
Ford Pick Up	1956	3	For Agronomists Movements
Studebaker Pick Up	1958	2	For Agronomists Movements
Russian Jeep	1966	2	For Agronomists Movements
International Truck	1962	1	For Transferring Provisions
Fargo Truck	1962	1	For Transferring Provisions
Dodge Truck	1951	2	For Transferring Provisions
Russian Truck	1961	2	For Transferring Provisions
Times Truck	1952	1	For Transferring Provisions
Russian Truck	1962	1	For Transferring Provisions

Table 5.9

Motor-Cycles Found in The General Administration of Agriculture
in the Fayoum Governorate (8)

Type	Number	Use
With Side Car	10	For Agronomists Movements
B.S. Single	11	For Agronomists Movements
Gawa Single	30	For Agronomists Movements

This is due to the great numbers of agronomists who annually graduate from the universities and Agricultural Institutions, and the Government responsibility to find posts for all of them - a situation that leads to this over-employment phenomenon.

The tendency now prevailing in the Government is to dispense with the services of these excessive numbers of agronomists and technicians, and put into their individual possession a stretch of the newly cultivated lands, in order that they themselves cultivate same and apply the latest modern methods of cultivation, they studied at the universities and institutions. This, of course, will lead to the increase of the land productivity, and offers a useful job to such graduates. Moreover, it will also result in the reduction of the annual recurrent expenses, which the Ministry of Agriculture incurs to pay their salaries.

What was said about the General Administration of Fayoum Irrigation, with regard to using old-fashioned cars and machines, should also be said here about the Agricultural Circle, where such cars have been in use for nearly 20 years. Such usage is absolutely uneconomic. The Government should pay attention to this fact, issue instructions to dispense with these cars and equipment, the economic life of which has gone far beyond the usual known limits, and replace them by other new ones. This will, undoubtedly, lead to minimizing the annual maintenance costs. However, the average annual recurrent costs of the administration is equal to £908,054 = £6.59/ha as follows

(a) Wages = £238,158 = £6.15/ha (details are shown in Table 5-10)

(b) Service expenditures = £37,377 = £0.27/ha (details are shown in Table 5-11)

(c) Costs of materials = £23,552 = £0.17/ha (details are shown in Table 5-12)

The total annual recurrent cost of both the General Administration of Irrigation and the General Administration of Agriculture is equal to £1,291,779 = £9.38/ha (details are shown in Tables 5-13 & 5-14)

Table 5.10

Annual Wages of Employees in the General Administration of Agriculture in the Fayoum Governorate (9)

Job / Financial Category	Agronomist	Lawyer	Administrative	Clerk	Technician	Skilled	Unskilled	Total	Costs U.S. $
First	1							1	3,500
Second								—	—
Third	8		1					9	18,000
Fourth	9		1					10	15,000
Fifth	26				5			31	34,875
Sixth	54	2	2	1	53			110	110,000
Seventh	141	2	1	10	195	13		361	270,750
Eighth				43	611	50	3	707	353,500
Ninth				3	11	8	22	44	18,700
Tenth						3	73	76	22,800
Total	239	4	5	57	875	74	98	1,352	847,125
Total / ha									6.15

Table 5.11

Annual Service Expenditures of The General Administration of Agriculture in the Fayoum Governorate (9)

U.S. $

(1) Transportation and Communication	
Transport of equipment	2,495
Transport of employees and labourers	22,988
Telephone, telegram and mail	1,750
(2) Maintenance Expenses	
Maintenance of water ways	60
Maintenance and restoration of buildings and constructions	288
Maintenance of equipment and machines	160
Maintenance of means of transportation	3,043
Maintenance of furniture and other office equipment	215
(3) Varied Service Expenditures	
Printing, publication and advertisement costs	428
Subscription to newspapers and magazines	25
Aids given on occasions such as feasts and burials	275
Other expenditure	5,650
Total	37,377
Total / ha	0.27

Table 5.12

Annual Cost of Materials of The General Administration of Agriculture in the Fayoum Governorate (9)

U.S. $.

Fuel, Oil and Power	13,005
Spare parts and maintenance materials	5,750
Water and light	1,873
Stationery	1,188
Furniture and cooling and heating apparatus	1,363
Equipment for gardening and other implements	373
Total	23,552
Total / ha	0.17

Table 5.13

Total Annual Recurrent Cost of both The General Administration of Irrigation and The General Administration of Agriculture in The Fayoum Governorate (9)

U.S. $

	Item \ Administration of	Irrigation	Agriculture	Total
1	Wages	238,150	847,125	1,085,275
2	Irrigation and Drainage Works	129,644	—	129,644
3	Service Expenditures	305,760	37,377	343,137
4	Cost of Materials	14,671	23,552	38,223
	Total	688,225	908,054	1,596,279

Table 5.14

Total Annual Recurrent Cost / ha of both The General Administration of Irrigation and The General Administration of Agriculture in the Fayoum Governorate (9)

U.S. $

	Item \ Administration of	Irrigation	Agriculture	Total / ha
1	Wages	1.73	6.15	7.88
2	Irrigation and Drainage Works	0.94	—	0.94
3	Service Expenditures	2.22	0.27	2.49
4	Cost of Materials	0.11	0.17	0.28
	Total / ha	5.00	6.59	11.59

5.2 Agricultural Production and Sale Price in the Fayoum Governorate.

5.2.1. Crop Rotation:

The basis of establishing the annual area cropped is first, the water availability and secondly the selection of a suitable crop rotation, having regard to both ecological and human factors. The ecological limitations are probably the more easily determined. The development of a cropping pattern can merely reflect the analyst's best judgment as to what is feasible in the light of demand and changes in cultivation practices. In many cases it may be desirable to plan initially on introducing as little change as possible into the present system of agriculture; this may not be the best technically possible, but it tends to facilitate the transition from dryland farming. Also it may be the best feasible pattern having regard to the time element. Undiscounted benefits may be smaller but discounted benefits larger if a cropping pattern is adopted which provokes amongst farmers the least resistance to change. The turns irrigation system in the Fayoum governorate is dual, with seven days high, and seven days low for each half of the total irrigated area. The water duty of each hectare being 70 cubic meters. Winter turn starts from 18 February to 30 March, Summer turn starts from 1 April to 14 August, Nilotic turn starts from 15 August to 31 December. The Crop rotation for the main crops cultivated in the Fayoum Governorate is shown in Figure 5-3.

5.2.2. Cropped Area:

There is a whole series of definitions in current usage relating to the area served by an irrigation scheme.

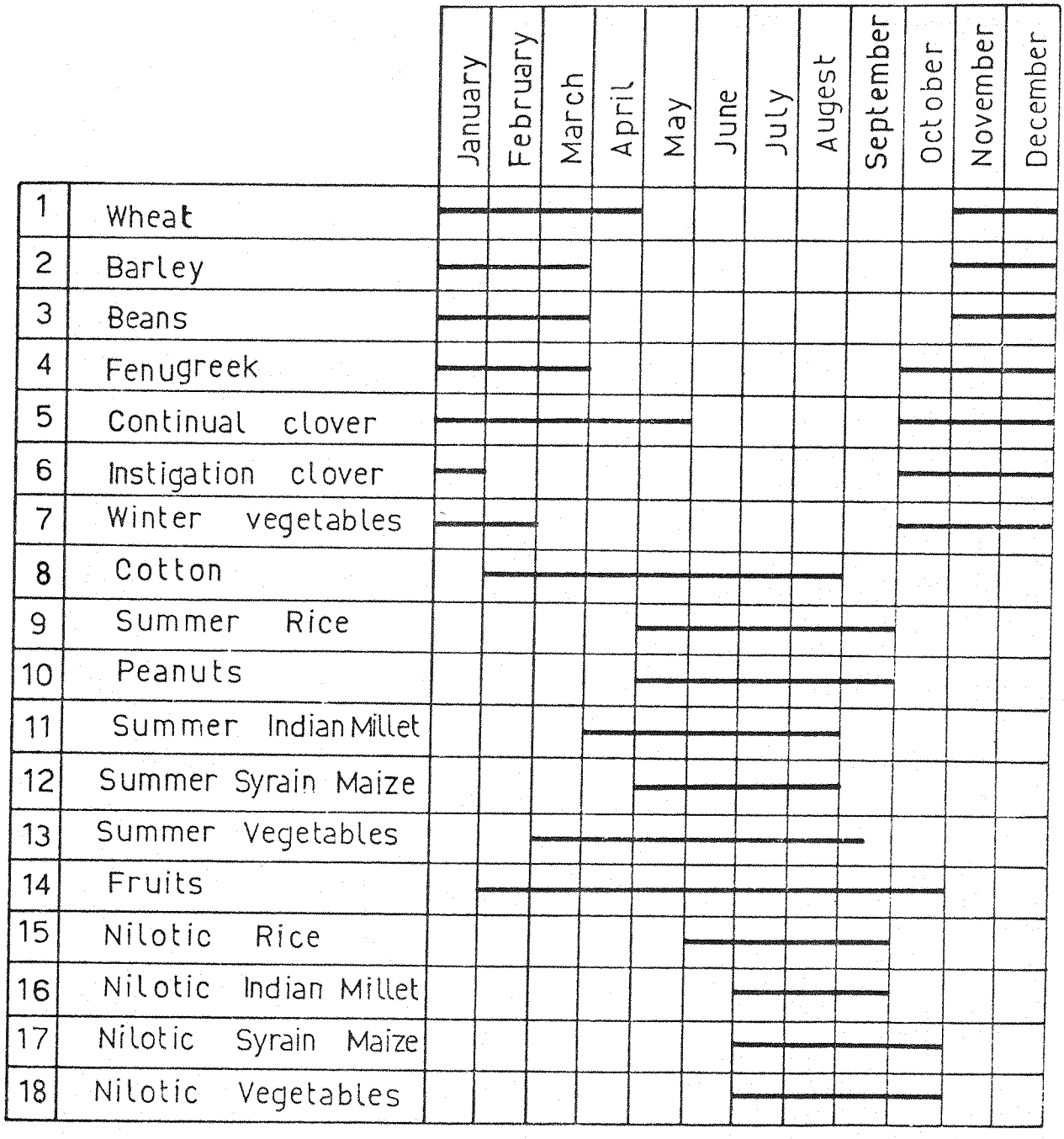
Gross Area: is defined as the total area within the extreme limits set for irrigation by a project. This area may include land which is neither commanded (by the canal system) nor culturable, as well as land which is unsuitable for irrigation.

Gross Commanded Area: is that portion of the gross area which is commanded by flow irrigation.

Culturable Commanded Area: is that portion of the

Figure 5_3

Crop Rotation in Fayoum Governorate



gross commanded area which is suitable for cropping and thus excludes villages, graveyards, roads and canals, etc.

Area Irrigated: is the area of land that receives water in any one year. This may exceed the area actually sown or cultivated.

Cropped Area: is the area of crops grown each year.

Cropping Intensity: is the ratio of the sums of the cropped areas each year to culturable commanded Area.

While all of the above terms are of importance in the design of irrigation schemes, the two most important from the point of view of project evaluation techniques are: cropped areas and cropping intensity. Table 5-15 represents cropped areas and cropping intensity in the Fayoum Covernorate from year 1961 to year 1972.

We notice from that table that the greatest areas is cultivated with clover (which is used as a food for animals) then syrien maize, wheat and cotton. In the year 1972 for example we find that the area cultivated with clover in the Fayoum Governorate reached 59,200 ha and the areas cultivated with syrian maize, wheat and cotton reached 40,600; 31,100 and 31,100 ha successively.

We notice also from that table (5-15) that the average cropping intensity in the Fayoum Governorate is 1.78 between years from 1961 to 1972.

Every year, the Egyptian Government should issue periodical decisions, defining the areas where wheat and cotton crops are to be cultivated. In the meantime, such areas should be distributed to the various localities throughout the Republic, due to the significant value of these very same crops. Consequently, cultivators will be obliged to execute the Government instructions, with regard to the areas where they must grow cotton and wheat every year. Agricultural circles in governorates should have supervision and control over the execution of these instructions. As regards the other crops, cultivators should be free to assign every year the areas of their cultivation; but with some coordination on the part of agricultural circles in the Governorates. The extension of these

Table 5.15

The Cropped Areas and Cropping Intensity in the Fayoum Governorate from Year 1961 to Year 1972 (10)

unit area = ha

Crop \ Year		1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	42,500	41,400	36,200	38,500	37,100	36,100	36,400	38,400	34,900	34,400	34,700	31,100
2	Beans	7,420	8,200	9,250	11,420	11,200	10,200	8,500	7,500	9,720	9,900	8,230	10.080
3	Barley	1,300	1,635	1,560	2,060	2,400	2,020	2,200	1,880	1,470	1,460	1,040	1,660
4	Fenugreek	1,920	1,940	1,900	3,010	2,970	2,200	2,140	2,660	2,315	2,810	2,380	2,540
5	Cotton	36,900	32,400	32,900	33,50	37,700	36,400	36,300	36,300	35,100	33,000	31,100	31,100
6	Rice	5,020	8,220	7,600	7,900	6,920	5,800	7,420	10,400	11,200	10,300	8,350	8,200
7	Peanuts	784	1,080	1,260	920	1,065	768	545	740	915	520	475	371
8	Indian Millet	21,600	22,800	20,600	24,500	21,200	24,100	23,200	24,600	24,500	26,200	23,500	22,500
9	Syrian Maize	39,400	54,500	54,000	51,200	54,000	47,800	42,500	40,800	41,000	39,500	42,000	40,600
10	Clover (seeds)	11,400	7,550	6,090	5,770	5,400	8,700	7,500	7,350	7,200	7,350	9,000	7,700
11	Sesame	153	193	274	287	291	402	275	341	395	585	600	632
12	Onions	860	852	1,210	860	675	630	590	677	1,620	630	1,195	790
13	Vegetables	7,350	7,600	8,800	9,800	10,000	9,750	9,740	8,200	10,820	11,500	12,550	9,000
14	Fruits	4,650	4,620	4,780	4,820	5,000	5,220	5,400	5,400	5,600	5,900	6,150	5,320
15	Clover	61,300	61,000	61,300	55,000	53,200	60,000	61,800	46,500	51,000	55,400	58,700	59,200
16	Others	1,234	624	855	2,079	532	887	1,577	1,784	2,118	1,857	2,222	3,750
TOTAL		243,791	254,614	248,579	251,626	249,653	250,977	246,087	233,532	239,853	241,312	242,192	234,550
Cropping Intensity		1.77	1.85	1.80	1.83	1.81	1.82	1.79	1.70	1.74	1.75	1.76	1.70

Average Cropping intensity = 1.78

areas, which are cultivated yearly, depends on the price of crops in the previous year. For example, if the price of peanuts, in one year, is high, cultivators are encouraged to increase its cultivated area in the following year. The case is the same with other crops. Sometimes, the Government issues decisions prohibiting the growing of certain crops in certain areas, due to special circumstances connected with irrigation and drainage, or, to various environmental conditions. In Figure 5-4, showing the major cropped areas in the Fayoum Governorate, during the period from 1961 to 1972, vibrations in all cropped areas, during various years, may be recognized. It may also be observed that the stress of these vibrations decreases with regard to cotton and wheat crops, the assignment of whose areas is subject, as already mentioned, to the Government control and runs with the countries requirements of the produce as well as with the import and export conditions of the year.

5.2.3. Yields

Projections of the expected increase in crop yields over time, which constitute a vital part of the project evaluation procedure, are frequently hampered by the lack of reliable historical statistical data pertinent to the area. This is particularly true of the developing countries where the statistical data, even if available, are often unrelable. A procedure frequently adopted in these circumstances is to base the projections on statistical data obtained from other countries.

Table 5-16 represents the different yields per cropped hectare in the Fayoum Governorate from the year 1961 to the year 1972, we notice from this table that the yield/ha for all crops is swinging between high and low from year to year but by low percentage, i.e. we could say that the yield/ha in the Fayoum Governorate is approximately constant for the different crops in the different years, and this is natural for the old agricultural land as it

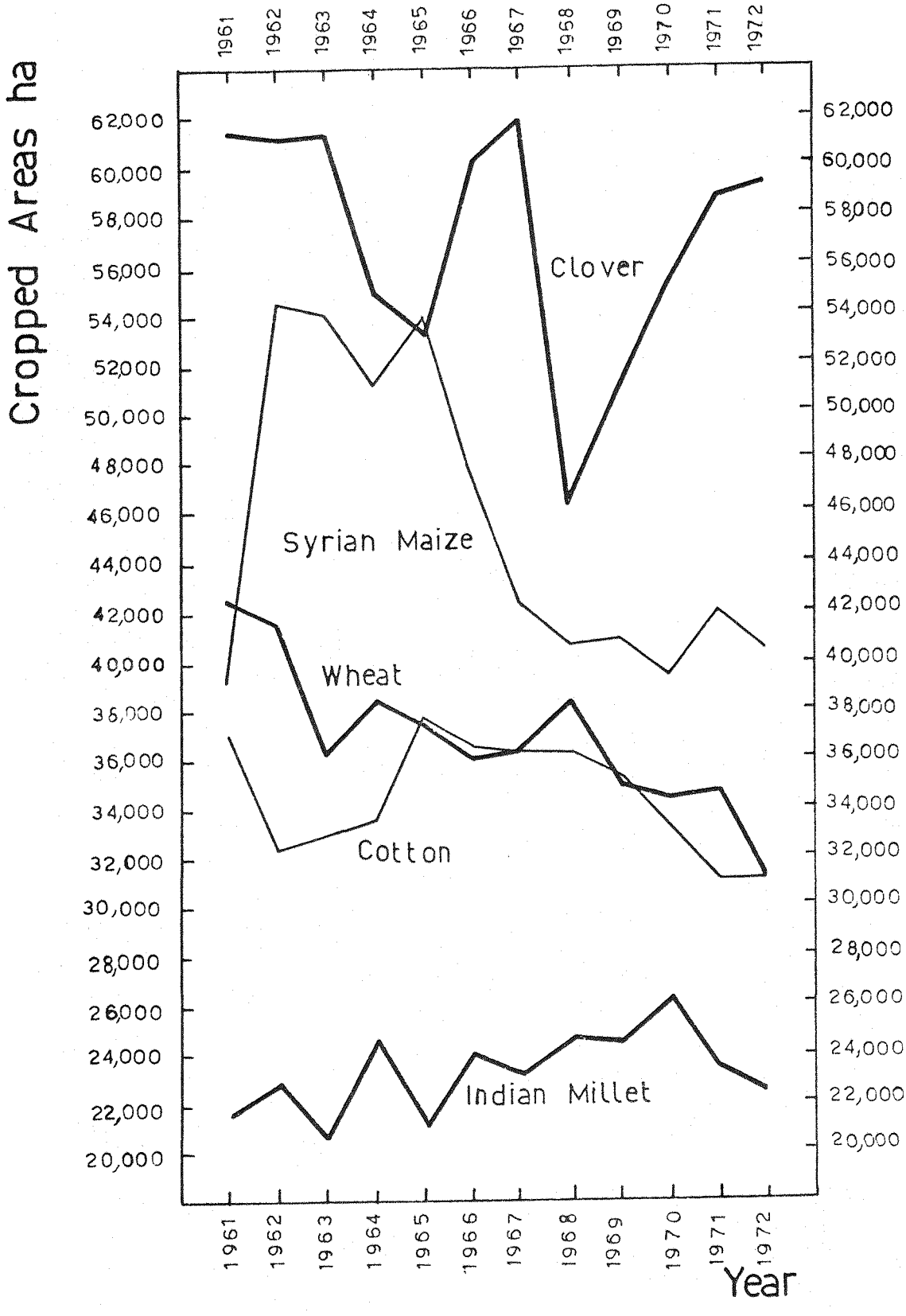


Figure 5_4

The Major Cropped Areas in Fayoum Governorate

Table 5.16

The Different Yields per Cropped Areas in the Fayoum Governorate from Year 1961 to Year 1972 (10)

ton/ha

	Yield \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	2.27	2.28	2.34	2.32	2.40	2.66	2.61	2.46	2.26	2.37	2.82	2.67
2	Beans	1.30	2.34	1.43	1.77	1.84	2.05	1.14	1.86	1.98	1.67	2.14	2.28
3	Barley	1.92	2.01	2.03	2.38	2.54	2.32	2.18	2.37	2.39	2.47	2.46	2.50
4	Fenugreek	0.47	1.14	0.96	1.08	1.11	1.16	1.18	1.19	1.29	1.31	1.37	1.42
5	Cotton	1.16	1.68	1.66	1.54	1.38	1.62	1.51	2.82	3.20	3.39	4.17	1.82
6	Rice	3.60	4.12	3.33	3.60	3.35	3.39	4.05	4.03	3.97	3.75	4.10	4.20
7	Peanuts	1.64	1.68	1,67	1.59	1.67	1.38	1.64	1.65	1.59	1.66	1.65	1.62
8	Indian Millet	3.00	3.10	3.12	3.15	3.29	3.50	3.65	3.72	3.80	3.95	4.10	4.16
9	Syrian Maize	3.02	2.93	2.78	2.81	3.09	3.05	3.00	3.31	3.36	3.42	3.00	2.79
10	Clover (Seeds)	0.31	0.39	0.50	0.61	0.38	0.45	0.44	0.49	0.49	0.54	0.56	0.58
11	Sesame	0.58	0.61	0.64	0.65	0.67	0.60	0.59	0.62	0.82	1.15	1.28	1.36
12	Onions	14.90	13.80	14.10	15.00	15.30	15.40	13.00	11.90	12.50	12.10	14.10	15.30
13	Vegetables	15.80	16.20	15.50	16.00	16.60	17.20	15.00	15.80	16.00	17.00	17.20	17.00
14	Fruits	11.80	12.00	12.90	12.70	12.80	12.90	14.20	11.70	11.60	9.00	9.30	12.50
15	Clover	38.12	38.20	38.55	38.58	38.24	38.43	38.47	38.53	38.51	38.64	38.77	38.82

has reached a point of fertility where its annual production is nearly constant. But there are some factors such as weather and the quantity of blights which may affect the crop production.

We notice as an example from Figure 5-5 that the production of cotton in the Fayoum Governorate in the year 1972 is noticably lower than its production in the year 1971, the yield was 4.17 ton/ha in the year 1971 and it dropped to 1.82 ton/ha only in the year 1972, the reason for that drop is the cotton worm which is a great danger to cotton production in Egypt, but this noticeably great drop is a very special case as the cotton worm was to be found in great quantities in the year 1972 and in a surprising shape that lowered the production. We consider also that the comparison between cotton yield in the year 1972 and its yield in the year 1971 is not at all representative because the cotton yield in that year gave a remarkable amount in the high production.

We notice in the relevant tables of crops that we mentioned vegetables and fruits cultivated in the Fayoum Governorate as a whole and we used average values of yields and sale price etc. We wish to mention here that the most important vegetables cultivated in the Fayoum Governorate are Tomato, Cabbages, Okra, Pepper , Melon and Cucumber, and the most important fruits cultivated in that Governorate are Dates, Oranges, Lemons, Grapes, Mango and Apricots.

Table 5-17 represents total yield of the different crops cultivated in the Fayoum Governorate in years from 1961 to 1972.

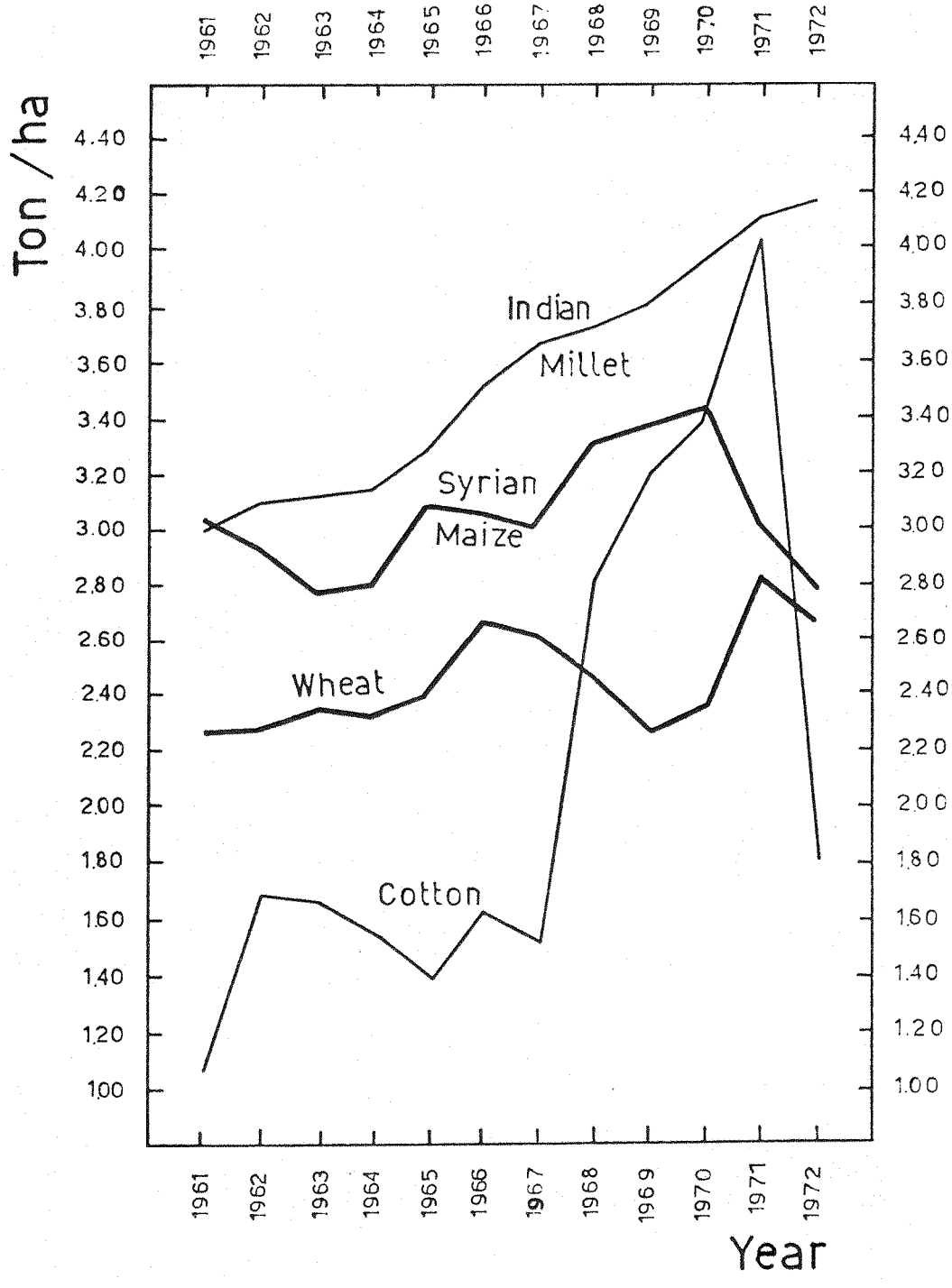


Figure 5_5

Yields per Cropped Areas for Some Crops Cultivated in Fayoum Governorate

Table 5.17

Total Yield of the Different Crops Cultivated in the Fayoum Governorate (10)

ton

	Crop \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	96,475	94,392	84,708	89,320	89,040	96,026	95,004	94,464	87,874	81,528	97,854	83,037
2	Beans	9,646	19,188	13,228	20,213	20,608	20,910	9,690	13,950	19,246	16,533	17,612	22,982
3	Barley	2,496	3,450	3,167	4,903	6,096	4,686	4,796	4,456	3,518	3,606	2,558	4,150
4	Fenugreek	902	2,212	1,824	3,251	3,297	2,552	2,525	3,165	2,986	3,681	3,260	3,607
5	Cotton	42,804	54,432	54,614	51,590	52,026	58,968	54,813	102,366	112,320	111,870	129,687	66,602
6	Rice	18,072	33,862	25,308	28,440	23,182	19,662	30,051	41,912	44,464	38,625	34,235	34,440
7	Peanuts	1,285	1,814	2,104	1,463	1,779	1,060	894	1,221	1,455	863	784	601
8	Indian Millet	64,800	70,680	64,272	77,175	69,748	84,350	84,680	91,512	93,100	103,490	96,350	93,606
9	Syrian Maize	118,988	159,685	150,120	143,872	166,860	145,790	127,500	135,048	137,760	135,090	126,000	113,274
10	Clover (Seeds)	3,534	2,945	3,045	2,943	2,052	3,915	3,300	3,602	3,528	3,969	5,040	4,466
11	Sesame	89	118	175	187	195	241	162	211	324	673	768	860
12	Onions	12,814	11,758	17,061	12,900	10,328	9,702	7,670	8,056	20,250	7,623	16,850	12.087
13	Vegetables	116,130	123,120	136,400	156,800	166,000	167,700	146,100	129,560	172,800	195,500	215,860	153,000
14	Fruits	54,870	55,440	61,662	61,214	64,000	67,338	76,680	63,180	64,960	53,100	56,888	66,500
15	Clover	2,336,756	2,330,200	2,363,115	2,121,900	2,034,368	2,305,800	2,377,446	1,791,645	1,964,010	2,140,656	2,275,799	2,298,144

5.2.4. Prices of Agricultural Output.

The value of agricultural output is usually converted to monetary units by using the local market or farm-gate prices, except in the case of export crops for which export prices are considered. The local market prices, however, are frequently distorted by a more or less elaborate set of constraints in addition to which variation in transport costs and malfunctioning of the distribution system can introduce further abnormalities. It is evident that, from a national point of view, investment decisions based on such distorted prices may prove to be misleading. Also, local market prices are subject to seasonal variation unless adequate storage facilities are available to regulate the flow of commodities according to market requirements. Market prices, even if not basically distorted, have therefore to be carefully analysed.

To overcome these difficulties shadow prices, based on import or export prices, are frequently developed whether or not the output in question is intended for export or actually to displace imports. In arriving at the shadow prices or, in the case of export crops, their value, it is necessary to include in the export price the cost of transport to the port of shipment, (the f.o.b. price is strictly speaking required). Here again, however, it is necessary to ensure that the real costs are used and not the costs in items of market prices. For instance, if transport facilities are not fully utilized and the cost of additional transport is consequently very small, only these small costs should be deducted and not the perhaps much higher freight charges actually paid. In other instances the adjustment necessary may be in the reverse direction. The established transport charge may for political or other reasons be such as to favour unduly the conveyance of agricultural commodities. In this case the analysis should take into consideration the real cost of transportation and should not be based on the subsidized rates.

However, agricultural world markets are also subject to distortion through quotas, subsidies, international agreements, regional preferences etc., and in the case

of commodities of a purely 'national' characher relevant international (border) prices may be impossible to establish.

It is therefore considered that the local market or farm-gate prices will in nearly all cases provide the most meaningful basis of evaluation, and may be adjusted if necessary to take account of any distortions. The degree to which such distortions exist should be assessed in the light of export or import substitution prices.

Forecasts of future price levels are sometimes developed as they are required by legislation to evaluate the stream of benefits over time. Such forecasts, however, are difficult particularly in respect of international commodities and may be subject to a considerable margin of error. Frequently it will be found that changes in relative prices may cause a change in the cropping pattern and this secondry effect may compensate for changes in price level.

It must be borne in mind that what is required is a forecast of any variation in the true value to the nation of the particular commodity, and not an estimate of possible changes in the price that the farmer will in fact receive for his crop. Thus it would appear to be more reasonable to prepare forecasts of supply and demand for the particular crop concerned in order to assess whether the true value of a unit of the scheme's output will alter when taken within the context of the national economy and population growth. Within this framework it is felt that in most cases present-day prices will be found to be an adequate representation because it is unlikely that national agencies will purposely plan for deficiencies in food production to such an extent as to cause marked increase in the 'value' of particular agricultural commodities.

Table 5-18 shows the Farm-Gate Price of the different crops cultivated in the Fayoum Covernorate during the period from 1961 to 1972. It may be observed, from this table, that the prices rise from one year to another. This is a normal thing, and is due to the annual increase in labour wages and the rise in prices of machines, pesticides, etc. In case a comparison, between the 1972

Table 5.18

Farm-Gate Price of the Different Crops Cultivated in the Fayoum Governorate for Years from 1961 to 1972 (10)

U.S. $ / ton

	Crop \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	65.25	68.13	69.50	71.00	72.50	81.00	88.50	76.50	88.13	90.63	93,50	97.13
2	Beans	120.50	124.25	125.20	131.00	129.00	129.50	129.00	125.75	103.00	103.75	145.00	150.50
3	Barley	62.00	66.00	70.50	82.00	57.75	73.13	108.75	76.25	66.75	79.25	98.75	104.50
4	Fenugreek	110.25	113.00	114.50	118.50	127.00	132.50	153.00	134.50	147.00	133.50	142.50	155.00
5	Cotton	230.00	238.00	240.00	250.00	240.00	233.00	245.00	258.00	265.00	265.00	268.00	278.00
6	Rice	42.00	42.75	43.25	46.33	57.73	67.00	75.03	79.50	75.68	70.65	67.83	77.13
7	Peanuts	127.00	130.00	132.00	133.00	225.00	225.00	225.00	225.00	196.00	200.00	200.00	278.00
8	Indian Millet	54.00	57.75	61.75	63.75	59.25	67.75	87.75	62.50	67.75	84.00	75.75	89.50
9	Syrian Maize	61.25	62.52	63.00	67.75	64.25	85.25	98.50	98.75	84.25	87.25	78.00	99.50
10	Clover (Seeds)	243.00	245.00	250.00	258.00	325.00	310.00	293.00	243.00	348.00	340.00	278.00	320.00
11	Sesame	205.75	210.50	214.00	219.50	230.00	247.50	292.50	270,00	283.75	308.75	312.50	320.00
12	Onions	15.25	16.00	16.00	16.65	23.33	29.00	30.50	28.88	27.78	30.00	36.65	42.20
13	Vegetables	73.75	74.75	76.00	78.00	79.00	76.00	81.50	84.63	79.48	87.10	95.48	106.00
14	Fruits	63.50	67.25	73.25	75.50	76.00	73.00	75.50	78.25	73.50	77.00	78;80	82.25
15	Clover	3.55	3.59	3.62	3.69	3.78	3.93	4.12	4.33	4.58	4.83	4.98	5.29

prices and those of 1961, is made, a big difference may be clearly noticed. For example, the price per ton of onions, reached in 1972, more than twice and a half that of 1961, as indicated in Table 5-18. Meanwhile, the price of one ton of peanut, amounted, in 1972, to more than double that of 1961, while the price of one ton whether of barley, rice, Indian millet, Syrian maize and sesame, rose, in 1972 to more than one and a half times that of 1961. However, it may be noticed, in this table, that in a few cases, the price per ton of a certain crop, in one year, falls below that of the year before. For example, the price per ton of wheat reached in 1967, ₤88.5 and, then in 1968, it fell to ₤76.5 and so does the price per ton of barley, in 1967 it amounted to ₤108,75 and then decreased in 1968, to ₤76.25. This is due to the fact that although crop prices rise, as a result of the increase in wages and prices of materials, yet there are other factors; the value of such an increase hampers its occurrence, or leads to a reduction, such as marketing conditions, offer and demand, and the quantity, etc. However, the common feature is that prices are continually increasing.

Table 5-19 and Table 5-20 represent the Gross Benefit and the Total Gross Benefit for the different crops cultivated in the Fayoum Governorate. We note from this table that the greatest values of the Gross Benefit resulted from cultivating vegetables, fruits, onions and cotton. For example, in the year 1972, we find that the values of Gross Benefit from cultivating vegetables, fruits, onions and cotton are ₤1,802; 1,208,10; 645.70 and 606.70/ha respectively. This is does not mean that those yields are greater in benefit for the farmer, because we have to obtain the Farmer Benefit after subtracting the On-Farm Costs for the different crops.

The Tables from 5-21 to 5-35 represent the Cropped Areas, Agricultural Production, Farm-Gate Price and Gross Benefits for the different crops cultivated in the Fayoum Governorate in the period from 1961 to 1972.

Table 5.19

Gross Benefit of the Different Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

U.S. $ / ha

	Crop \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	148.20	155.30	162.60	164.70	174.00	215.50	231.00	188.20	199.20	214.80	263.70	259.30
2	Beans	156.70	290.80	179.00	231.90	237.40	265.50	147.10	136.60	203.90	173.10	310.30	343.10
3	Barley	119.00	132.70	143.10	195.20	146.70	169.70	237.10	180.70	159.50	195.80	242.90	257.30
4	Fenugreek	51.80	129.00	109.90	128.00	141.00	153.70	180.50	160.10	189.60	174.90	195.20	220.10
5	Cotton	266.80	399.80	398.40	385.00	331.20	377.30	370.00	727.60	848.00	898.40	1,117.60	505.70
6	Rice	151.20	176.10	144.00	164.80	193.40	227.10	303.90	320.40	300.50	268.90	278.10	324.00
7	Peanuts	208.30	218.40	220.40	211.50	375.80	310.50	369.00	371.30	311.60	332.00	330.00	450.40
8	Indian Millet	162.00	179.00	192.70	200.80	194.90	237.20	320.30	232.50	257.50	331.80	310.60	372.30
9	Syrian Maize	185.00	183.20	175.10	190.40	198.50	260.00	295.50	326.90	283.10	298.40	234.00	277.60
10	Clover (Seeds)	75.30	95.60	125.00	131.60	123.50	139.50	128.90	119.10	170.50	183.60	155.70	185.60
11	Sesame	119.30	128.40	137.00	142.70	154.10	148.50	172.60	167.40	232.70	355.10	400.00	435.20
12	Onions	227.20	220.80	225.60	249.80	357.00	446.60	396.50	343.70	347.30	363.00	516.80	645.70
13	Vegetables	1,165.30	1,211.00	1,178.00	1,248.00	1,311.40	1,307.20	1,222.50	1,337.20	1,271.70	1,480.70	1,642.30	1,802.00
14	Fruits	749.30	807.00	944.90	958.90	872.80	941.70	1,072.10	907.70	852.60	693.00	728.90	1,208.10
15	Clover	135.30	137.10	139.60	142.40	144.50	151.00	158.50	167.00	176.40	186.60	193.10	205.50
16	Others	155.10	188.20	181.00	181.50	213.20	238.60	254.90	264.70	283.10	305.90	349.80	343.20

Table 5.20

Total Gross Benefit of the Different Crops Cultivated in the Fayoum Governorate (10)

10^3 U.S. $ / ha

	Crop \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	6,299	6,429	5,886	6,341	6,455	7,780	8,408	7,227	6,952	7,389	9,150	8,064
2	Beans	1,163	2,385	1,656	2,648	2,659	2,708	1,250	1,125	1,982	1,714	2,554	3,458
3	Barley	155	217	223	402	352	343	522	340	235	286	253	427
4	Fenugreek	100	250	209	385	419	338	385	426	439	492	742	559
5	Cotton	9,845	12,954	13,107	12,898	12,486	13,741	13,431	26,412	29,765	29,647	34,757	15,727
6	Rice	759	1,448	1,094	1,302	1,338	1,317	2,255	3,332	3,366	2,770	2,322	2,657
7	Peanuts	163	236	278	195	400	239	201	275	285	173	157	167
8	Indian Millet	3,499	4,081	3,970	4,920	4,132	5,714	7,431	5,720	6,309	8,693	7,299	8,377
9	Syrian Maize	7,289	9,984	9,455	9,749	10,720	12,428	12,559	13,338	11,607	11,787	9,828	11,271
10	Clover (Seeds)	858	722	761	759	667	2,137	967	875	1,228	1,349	1,401	1,429
11	Sesame	18	25	38	41	45	60	48	57	92	208	240	275
12	Onions	195	188	273	215	241	281	234	233	563	229	618	510
13	Vegetables	8,565	9,204	10,366	12,230	13,114	12,745	11,907	10,965	13,734	17,028	20,611	16,218
14	Fruit	3,484	3,728	4,517	4,622	4,364	4,916	5,789	4,902	4,775	4,089	4,483	5,470
15	Clover	8,294	8,363	8,558	7,832	7,687	9,060	9,795	7,766	8,996	10,338	11,335	12,166

Table 5.21

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(1) Wheat

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	42,500	41,4000	36,200	38,500	37,100	36,100	36,400	38,400	24,900	34,400	34,700	31,100
Yield (ton/ha)	2.27	2.28	2.34	2.32	2.40	2.66	2.61	2.46	2.26	2,37	2.82	2.67
Total Yield (ton)	96,475	94,392	84,708	89,320	89.040	96,026	95,004	94,464	87,874	81,528	97,854	83,037
Farm-Gate Price (U.S. $ / ton)	65.25	68.13	69.50	71.00	72.50	81.00	88.50	76.50	88.13	90.63	93.50	97.13
Gross Benefit (U.S. $ / ha)	148.20	155.30	162.60	164.70	174.00	215.50	231.00	188.20	199.20	214.80	263.70	259.30
Total Gross Benefit (10^3 U.S. $)	6,299	6,429	5,886	6,341	6,455	7,780	8,408	7,227	6,952	7,389	9,150	8,064

Table 5.22

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(2) Beans

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	7,420	8,200	9,250	11,420	11,200	10,200	8,500	7,500	9,700	9,900	8,230	10,080
Yield (ton/ha)	1.30	2.34	1.43	1.77	1.84	2,05	1,14	1.86	1.98	1.67	2.14	2.28
Total Yield (ton)	9,646	19,188	13,228	20,213	20,608	20,910	9,690	13,950	19,246	16,533	17,612	22,982
Farm-Gate Price (U.S. $ / ton)	120.50	124.25	125.20	131.00	129.00	129.50	129.00	125.75	103.00	103.75	145.00	150.50
Gross Benefit (U.S. $ / ha)	156.70	290.80	179.00	231.90	237.40	265.50	147.10	136.60	203.60	173.10	310.30	343.10
Total Gross Benefit (10^3 U.S. $)	1,163	2,385	1,656	2,648	2,659	2,708	1,250	1,125	1,982	1,714	2,554	3,458

Table 5.23

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(3) Barley

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	1,300	1,635	1,560	2,060	2,400	2,020	2,200	1,880	1,470	1,460	1,040	1,660
Yield (ton/ha)	1.92	2.01	2.03	2.38	2.54	2.32	2.18	2.37	2.39	2.47	2.46	2.50
Total Yield (ton)	2,496	3,450	3,167	4,903	6,096	4,686	4,796	4,456	3,513	3,606	2,558	4,150
Farm-Gate Price (U.S. $ / ton)	62.00	66.00	70.50	82.00	57.75	73.13	108.75	76.25	66.75	79.25	98.75	104.50
Gross Benefit (U.S. $ / ha)	119.00	132.70	143.10	195.20	146.70	169.70	237.10	180.70	159.50	195.80	242.90	257.30
Total Gross Benefit (10^3 U.S. $)	155	217	223	402	352	343	522	340	235	286	253	427

Table 5.24

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(4) Fenugreek

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	1,920	1,940	1,900	3,010	2,970	2,200	2,140	2,660	2,315	2,810	2,380	2,540
Yield (ton/ha)	0.47	1.14	0.96	1.08	1.11	1.16	1.18	1.19	1.29	1.31	1.37	1.42
Total Yield (ton)	902	2,212	1,824	3,251	3,297	2,552	2,525	3,165	2,986	3,681	3,260	3,607
Farm-Gate Price (U.S. $ / ton)	110.25	113.00	114.50	118.50	127.00	132.50	153.00	134.50	147.00	133.50	142.50	155.00
Gross Benefit (U.S. $ / ha)	51.80	129.00	109.90	128.00	141.00	153.70	180.50	160.10	189.60	174.90	195.20	220.10
Total Gross Benefit (10^3 U.S. $)	100	250	209	385	419	338	385	426	439	492	742	559

Table 5.25

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(5) Cotton

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	36,900	32,400	32,900	33,500	37,700	36,400	36,300	36,300	35,100	33,000	31,000	31,100
Yield (ton/ha)	1.16	1.68	1.66	1.54	1.38	1.62	1.51	2.82	3.20	3.39	4.17	1.82
Total Yield (ton)	42,804	54,432	54,614	51,590	52,026	58,968	54,813	102,366	112,320	111,870	129,687	56,602
Farm-Gate Price (U.S. $ / ton)	230	238	240	250	240	233	245	258	265	265	268	278
Gross Benefit (U.S. $=/ ha)	266.80	399.80	398.40	385.00	331.20	377.50	370.00	727.60	848.00	898.40	1,167.60	505.70
Total Gross Benefit (10^3 U.S. $)	9,845	12,954	13,107	12,898	12,486	13,741	13,431	26,412	29,765	29,647	34,757	15,727

Table 5.26

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(6) Rice

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	5,020	8,220	7,600	7,900	6,920	5,800	7,420	10,400	11,200	10,300	8,350	8,200
Yield (ton/ha)	3.60	4.12	3.33	3.60	3.35	3.39	4.05	4.03	3.97	3.75	4.10	4.20
Total Yield (ton)	18,072	33,862	25,308	28,440	23,182	19,662	30,051	41,912	44,464	38,625	34,235	34,440
Farm-Gate Price (U.S. $ / ton)	42.00	42.75	43.25	46.33	57.73	67.00	75.03	79.50	75.68	70.65	67.83	77.13
Gross Benefit (U.S. $ / ha)	151.20	176.10	144.00	164.80	193.40	227.10	303.90	320.40	300.50	268.90	278.10	324.90
Total Gross Benefit (10^3 U.S. $)	759	1,448	1,094	1,302	1,338	1,317	2,255	3,332	3,366	2,770	2,322	2,657

Table 5.27

Agricultural Pruduction in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(7) Peanuts

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	784	1,080	1,260	920	1,065	768	545	740	915	520	475	371
Yield (ton/ha)	1.64	1,68	1.67	1.59	1.67	1.38	1.64	1.65	1.59	1.66	1.65	1.62
Total Yield (ton)	1,285	1,814	2,104	1,463	1,779	1,060	894	1,221	1,455	863	784	601
Farm-Gate Price (U.S. $ / ton)	127	130	132	133	225	225	225	225	196	200	200	278
Gross Benefit (U.S. $ / ha)	208.30	218.40	220.40	211.50	375.80	310.50	369.00	371.30	311.60	332.00	330.00	450.40
Total Gross Benefit (10^3 U.S. $)	163	236	278	195	400	239	201	275	285	173	157	167

Table 5.28

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(8) Indian Millet

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	21,600	22,800	20,600	24,500	21,200	24,100	23,200	24,600	24,500	26,200	23,500	22,500
Yield (ton/ha)	3.00	3.10	3.12	3.15	3.29	3.50	3.65	3.72	3.80	3.95	4.10	4.16
Total Yield (ton)	64,800	70,680	64,272	77,175	69,748	84,350	84,680	91,512	93,100	103,490	96,350	93,600
Farm-Gate Price (U.S. $ / ton)	54.00	57.75	61.75	63.75	59.25	67.75	87.75	62.50	67.75	84.00	75.75	89.50
Gross Benefit (U.S. $ / ha)	162.00	179.00	192.70	200.80	194.90	237.10	320.30	232.50	257.50	331.80	310.60	372.30
Total Gross Benefit (10^3 U.S. $)	3,499	4,081	3,970	4,920	4,132	5,714	7,431	5,720	6,309	8,693	7,299	8,377

Table 5.29

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)
(9) Syrian Maize

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	39,400	54,500	54,000	51,200	54,000	47,800	42,500	40,800	41,000	39,500	42,000	40,600
Yield (ton/ha)	3.02	2.93	2.78	2.81	3.09	3.05	3.00	3.31	3.36	3.42	3.00	2.79
Total Yield (ton)	118,988	159,685	150,120	143,872	166,860	145,790	127,500	135,048	137,760	135,090	126,000	113,274
Farm-Gate Price (U.S. $ / ha)	61.25	62.52	63.00	67.75	64.25	85.25	98.50	98.75	84.25	87.25	78.00	99.50
Gross Benefit (U.S. $ / ha)	185.00	183.20	175.10	190.40	198.50	260.00	295.50	326.90	283.10	298.40	234.00	277.60
Total Gross Benefit (10^3 U.S. $)	7,289	9,984	9,455	9,749	10,720	12,428	12,559	13,338	11,607	11,787	9,828	11,271

Table 5.30

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(10) Clover (Seeds)

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	11,400	7,550	6,090	5,770	5,400	8,700	7,500	7,350	7,200	7,350	9,000	7,700
Yield (ton/ha)	0.31	0.39	0.50	0.51	0.38	0.45	0.44	0.49	0.49	0.54	0.56	0.58
Total Yield (ton)	3,534	2,945	3,045	2,943	2,052	3,915	3,300	3,602	3,528	3,969	5,040	4,466
Farm-Gate Price (U.S. $ / ton)	243	245	250	258	325	310	293	243	348	340	278	320
Gross Benefit (U.S. $ / ha)	75.30	95.60	125.00	131.60	123.50	139.50	128.90	119.10	170.50	183.60	155.70	185.60
Total Gross Benefit (10^3 U.S. $)	858	722	761	759	667	2,137	967	875	1,228	1,349	1,401	1,429

Table 5.31

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)
(11) Sesame

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	153	193	274	287	291	402	275	341	395	585	600	632
Yield (ton/ha)	0.58	0.61	0.64	0.65	0.67	0.60	0.59	0.62	0.82	1.15	1.28	1.36
Total Yield (ton)	89	118	175	187	195	241	162	211	324	673	768	860
Farm-Gate Price (U.S. $ / ton)	205.75	210.50	214.00	219.50	230.00	247.50	292.50	270.00	283.75	308.75	312.50	320.00
Gross Benefit (U.S. $ / ha)	119.30	128.40	137.00	142.70	154.10	148.50	172.60	167.40	232.70	355.10	400.00	435.20
Total Gross Benefit (10^3 U.S. $)	18	25	38	41	45	60	48	57	92	208	240	275

Table 5.32

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)
(12) Onions

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	860	852	1,210	860	675	630	590	677	1,620	630	1,195	790
Yield (ton/ha)	14.90	13.80	14.10	15.00	15.30	15.40	13.00	11.90	12.50	12.10	14.10	15.30
Total Yield (ton)	12,814	11,758	17,061	12,900	10,328	9,702	7,670	8,056	20,250	7,623	16,850	12,087
Farm Gate Price (U.S. $ / ton)	15.25	16.00	16.00	16.65	23.33	29.00	30.50	28.88	27.78	30.00	36.65	42.20
Gross Benefit (U.S. $ / ha)	227.20	220.80	225.60	249.80	357.00	446.60	396.50	343.70	347.30	363.00	516.80	645.70
Total Gross Benefit (10^3 U.S. $)	195	188	273	215	241	281	234	233	563	229	618	510

Table 5.33

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)
(13) Vegetables

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	7,350	7,600	8,800	9,800	10,000	9,750	9,740	8,200	10,800	11,500	12,550	9,000
Yield (ton/ha)	15.80	16.20	15.50	16.00	16.60	17.20	15.00	15.80	16.00	17.00	17.20	17.00
Total Yield (ton)	116,130	123,120	136,400	156,800	166,000	167,700	146,100	129,560	172,800	195,500	215,860	153,000
Farm-Gate Price (U.S. $ / ton)	73.75	74.75	76.00	78.00	79.00	76.00	81.50	84.63	79.48	87.10	95.48	106.00
Gross Benefit (U.S. $ / ha)	1,165.30	1,211.00	1,178.00	1,248.00	1,311.40	1,307.20	1,222.50	1,337.20	1,271.70	1,480.70	1,642.30	1,802.00
Total Gross Benefit (10^3 U.S. $)	8,565	9,204	10,366	12,230	13.114	12,745	11,907	10,965	13,734	17,028	20,611	16,218

Table 5.34

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)

(14) Fruits

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	4,650	4,620	4,780	4,820	5,000	5,220	5,400	5,400	5,600	5,900	6,150	5,320
Yield (ton/ha)	11.80	12.00	12.90	12.70	12.80	12.90	14.20	11.70	11.60	9.00	9.30	12.50
Total Yield (ton)	54,870	55,440	61,662	61,214	64,000	67,338	76,680	63,180	64,960	53,100	56,888	66,500
Farm-Gate Price (U.S. $ / ton)	63.50	67.25	73.25	75.50	76.00	73.00	75.50	78.25	73.50	77.00	78.80	82.25
Gross Benefit (10^3 U.S. $ / ha)	749.30	807.00	944.90	958.90	872.80	941.70	1,072.10	907.70	852.60	693.00	728.90	1,028.10
Total Gross Benefit (10^3 U.S. $)	3,484	3,728	4,517	4,622	4,364	4,916	5,789	4,902	4,775	4,089	4,483	5,470

Table 5.35

Agricultural Production in the Fayoum Governorate and Values of Outputs from Year 1961 to Year 1972 (10)
(15) Clover

Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Area (ha)	61,300	61,000	61,300	55,000	53,200	60,000	61,800	46,500	51,000	55,400	58,700	59,200
Yield (ton/ha)	38.12	38.20	38.55	38.58	38.24	38.43	38.47	38.53	38.51	38.64	38.77	38.82
Total Yield (ton)	2,336,756	2,330,200	2,363,115	2,121,900	2,034,368	2,305,800	2,377,446	1,791,645	1,964,010	2,140,656	2,275,799	2,298,144
Farm-Gate Price (U.S. $ / ton)	3.55	3.59	3.62	3.69	3.78	3.93	4.12	4.33	4.58	4.83	4.98	5.29
Gross Benefit (U.S. $ / ha)	135.30	137.10	139.60	142.40	144.50	151.10	158.50	167.00	176.40	186.60	193.10	205.50
Total Gross Benefit (10^3 U.S. $)	8,294	8,363	8,558	7,832	7,687	9,060	9,795	7,766	8,996	10,338	11,335	12,166

5.3 On-Farm Costs

The study of the On-Farm Costs of the different agricultural crops aims at reaching a general average of the On-Farm Cost for each crop each year.

The studies related to the On-Farm Costs constitute one of the most important subjects in economic research and help draw up the policy of agriculture. In the governorates of Egypt, employees of the Ministry of Agriculture collect data on the cost of production of each crop from the field by asking a number of farmers in every centre of the governorates, so that they may represent all the cases in which cost of production varies from one crop to another. This means that one and the same agricultural operation may be carried out with diverse means of ploughing. Thus, there may be areas in which this process would be carried out mechanically, and where it is carried out by means of cattle, with the result that cost differs in both situations. Therefore, data are compiled from farmers whose lands are ploughed mechanically and others in which this is done by means of cattle, and on the basis of the area which is ploughed mechanically and that ploughed by cattle, it becomes possible to find the average cost of ploughing a unit area.

What is said of ploughing may also be said of irrigation, for some areas at the centre are irrigated by falling waters and others by manpower. The latter may use the sakieh, or the Archimendan screw or machines etc. and expenses vary in each case. This is taken into account when selecting the sample of farmers who will be questioned by the employees in charge of ascertaining the cost of irrigation per Unit area for any crop, and on the basis of the area which is irrigated by one of these methods, it would be possible to find out the average cost of irrigation per Unit area, as well as the cost of fertilization. Thus, for each crop the fertilizer used differs as well as the amount used per Unit area whether for small or large land-owners. All these are taken into account when selecting the sample of farmers from whom the data on average fertilization will be taken, and from these date it will be possible to find the average amount of fertilizers used per

Unit area in small handholdings or large handholdings separately. On the basis of the area of land cultivated by each group, it would be possible to find the general average of fertilizers used for a crop in the centre as a whole. Threshing and sowing are also among the agricultural operations which may be conducted by manpower or cattle or threshing machines, but expenses vary in each case. Thus, the sample of farmers selected is taken from those who use various methods and on the basis of the area grown in the centre with a certain crop and on the basis of the method used, it would be possible to find the general average of cost for this operation per Unit area.

The final results are recorded on a statistical form in each centre of the governorate, indicating the average cost of each of the agricultural operations including ploughing, irrigation and fertilization. An overall statistical form is laid down for the governorate indicating the average cost of each operation on the level of the governorate in general.

Figure 5-6 shows the number of agricultural-working days, with regard to men and boys, during the various months of the year. From this figure, it may be seen that the biggest number of agricultural-working days, with regard to men, come within the months of May and September, every year, and, as regards boys, they fall within the months of June, July and September. This is because in May, June and July, work is at full swing in resisting cotton pests, and this needs a large number of men and boys to fulfil. In addition to this, the month of September, every year, is the time of harvesting cotton crop, which also needs a large number of men and boys. This, in turn, leads to the rise of wages of agricultural workers, during these very same months more than at any other time in the whole year.

The same Figure also shows that the least number of agricultural-working days, with regard to men and boys, comes within the months of December and January, due to fewer agricultural functions, such as the irrigation of wheat and harvesting some clover, during this time of the year. As a result, the wages of agricultural workers fall during these months more than at any other time of

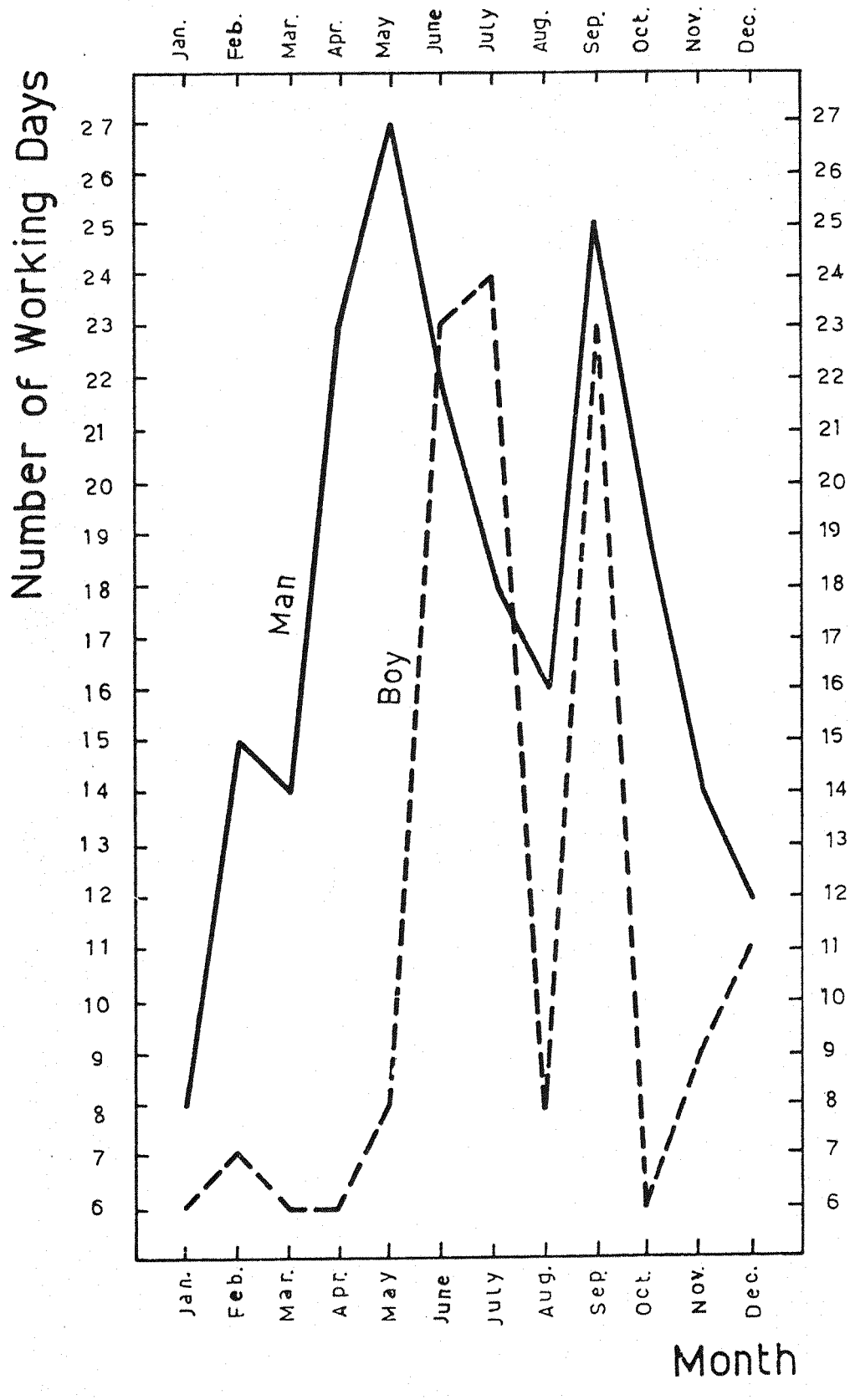


Figure 5_6

Number of Agricultural Working Days for Men and Boys in the Different Months

the year. Figure 5-7 shows the mean average of labour necessary for every hectare of the various crops cultivated in the Fayoum Governorate. It may be concluded, from this Figure, that the greatest number of workmen required is for fruit production, onion and peanuts, whilst, the smallest number is for barley, wheat and fenugreek. It may also be observed that the greatest number of workmen and boys needed, is for cotton and then for vegetables and peanuts, and the smallest number is for clover, fenugreek, wheat and barley. Meanwhile, Figure 5-8 illustrates the average of daily wages paid to agricultural workers (men and boys in the Fayoum Governorate), during the various years from 1961 to 1972. The figure also shows that the wages have risen from one year to another, until they reach, with regard to men, a climax, in 1966, when the average of the daily wages per man amounted to ₰0.48. As for boys, the wages reached a maximum, in 1969, when their daily average (per boy) amounted to ₰0.24. The reason why the wages of employed workers slightly decreased, during the last few years, is the use of agricultural machines in certain localities. This has led to an excess in labour power; thus, the wages decreased accordingly, though such a decrease is hardly undistinguishable, as shown on the Figure. It can also be noticed that the daily wage of the employed agricultural worker, in the Fayoum Governorate, is low. In 1972, it reached ₰0.4 per man and ₰0.19 per boy. In certain other Governorates, the wage is higher than that, due to the relatively available manpower in the Fayoum Governorate. Tables from No. 5-36 to No.5-48 include On-Farm Costs of the various crops grown in the Fayoum Governorate, during the period from 1961 to 1972. Every table is divided into two parts, one of which presents these expenses, according to the various agricultural processes, such as the preparation of the land for cultivation, seeding, field irrigation, fertilizing, etc., whilst the other shows these in accordance with the workers' wages, prices of materials, such as livestocks, machines, plant seeds, fertilizers and pesticides. From these tables, it may be generally noticed that the costs rise, from one year to another, with regard to the various crops. If a comparison, between the figures of 1972 and those of 1961, is made, a big difference will be clearly observed.

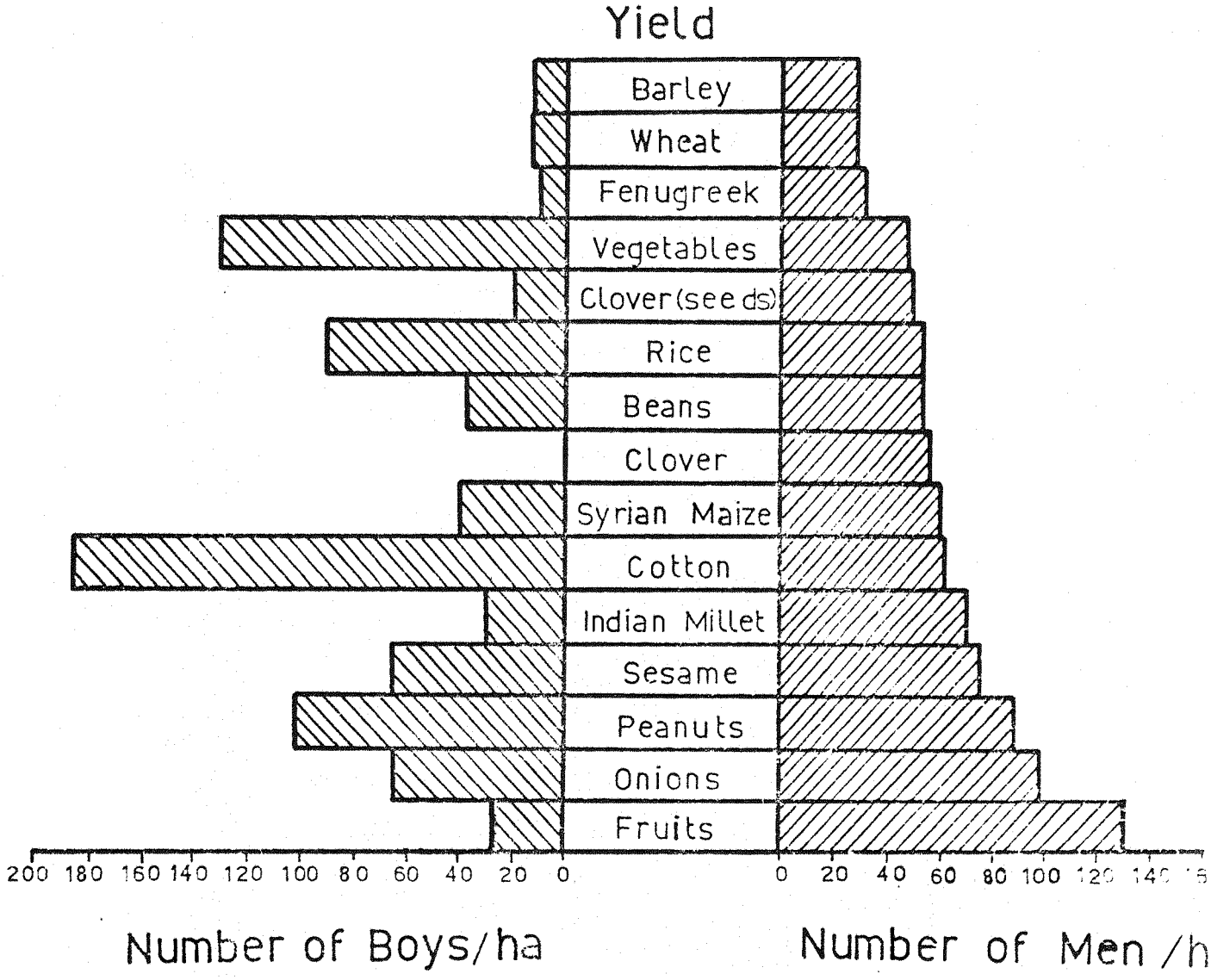


Figure 5_7

Rate of Agricultural Workers per hectare for the Different Crops Cultivated in Fayoum Governorate

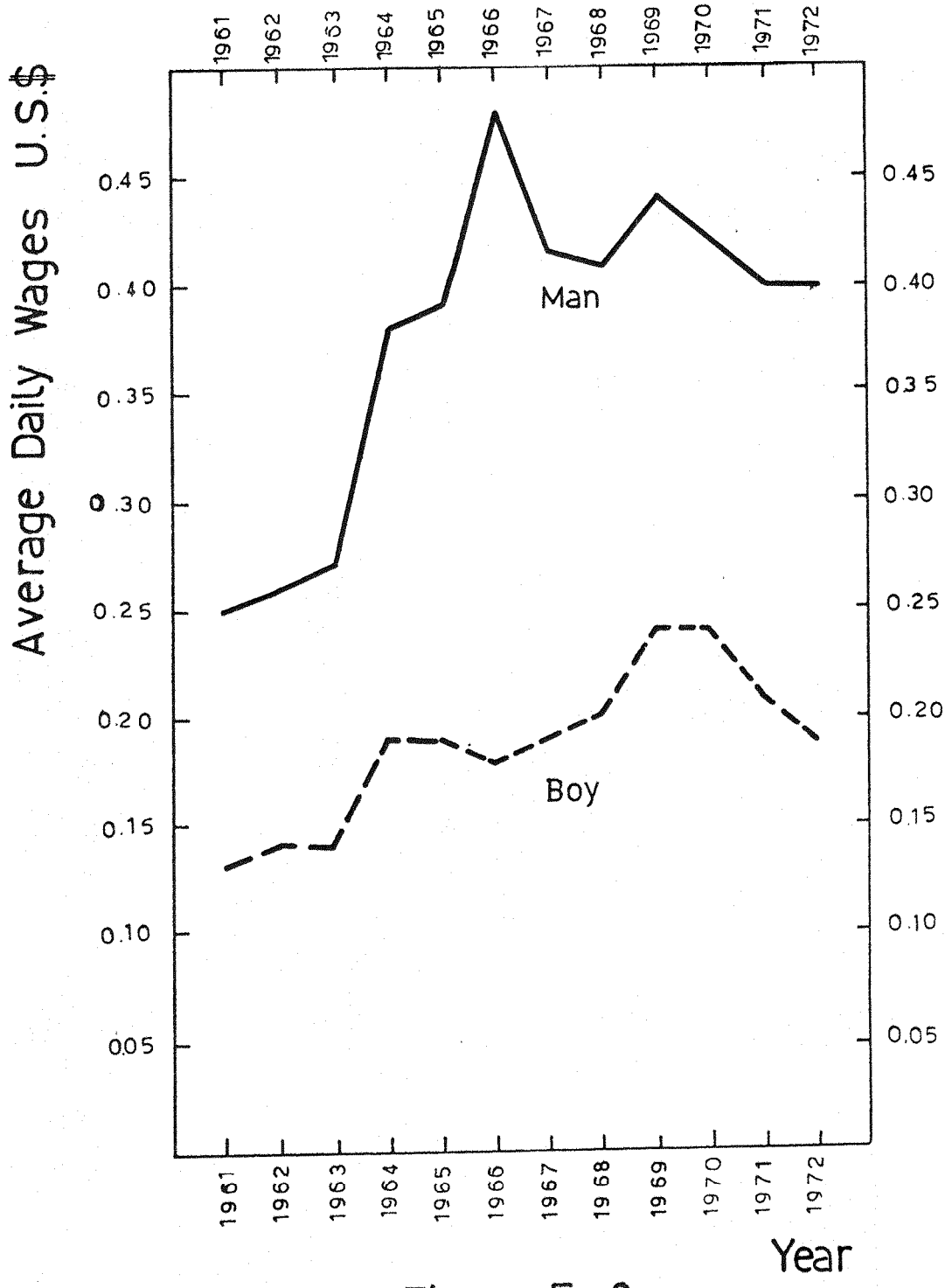


Figure 5_8

Average Daily Wages for the Agricultural Workers in the Different Years in Fayoum Governorate

Table 5.36

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(1) Wheat

U.S. $/ha

On Farm Costs classified according to Agricultural Operations												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Preparation of land	9.00	9.00	9.00	9.20	12.50	13.90	14.80	13.80	14.10	13.60	13.60	9.80
Seeds & Cultivation	17.60	17.10	16,50	14.60	14.90	14.50	18.40	18.30	18.30	18.30	18.30	21.90
Irrigation	0.90	1.50	1.50	1.50	3.00	2.70	2.20	1.80	2.20	2.20	2.20	2.20
Fertilizing	21.50	26.00	28.80	37.50	41.00	54.30	55.00	55.50	55.00	54.50	54.50	60.00
Others	26.30	27,00	27.30	27.70	50.00	40.60	45.00	43.80	42.50	46.80	47.50	45.50
Total	75.30	80.60	83.10	90.50	121.40	126.00	135.40	133.20	132.10	135.40	136.10	139.40
On Farm Costs classified according to Rents and Costs												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Hire of labour	16.30	16,80	17.80	18.30	36.30	32.00	34.30	32.00	32.00	33.70	33.70	32.50
Hire of Animals	17.40	17.80	17.30	17.30	27.00	23.30	27.00	27.00	22.80	25.00	26.20	20.30
Seeds	17.40	17.20	16.30	14.30	14.30	14.30	14.30	17.90	17.90	17.90	17.90	21.50
Organic Fertilizer	6.00	8.60	11.90	11.90	14.90	17.90	17.90	17.90	17.90	14.90	14.90	22.30
Chemical Fertilizer	14.30	17.00	16.30	25.00	25.00	34.50	34.50	34.50	34.00	36.60	36.60	34.50
Rent of Machines	–	–	–	–	–	–	–	–	4.30	1.60	1.10	2.40
Pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Others	3.90	3.20	3.50	3.70	3.90	4.00	3.80	3.90	3.20	5.70	5.70	5.90
Total	75.30	80.60	83.10	90.50	121.40	126.00	135.40	133.20	132.10	135.40	136.10	139.40

Table 5.37

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(2) Beans

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Preparation of land	6.30	6.30	7.20	7.50	12.10	13.00	11.60	11.60	11.60	12.30	12.30	12.30
Seeds & Cultivation	21.60	36.70	29.50	29.00	29.30	30.90	30.00	29.00	29.00	29.00	29.00	30.60
Irrigation	0.60	0.70	0.70	0.70	0.90	0.90	1.40	1.40	1.30	1.40	1.40	1.40
Fertilizing	3.90	4.50	7.20	7.80	7.80	8.40	8.40	8.80	8.20	8.20	8.50	8.50
Others	16.80	17.50	17.60	23.70	30.00	29.40	30.30	30.30	30.30	33.80	34.50	35.50
Total	49.20	65.70	62.20	68.70	80.10	82.60	81.70	81.10	80.40	84.70	85.50	88.30
On-Farm Costs classified according to Rents and Costs												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Hire of labour	10.30	11.60	12.50	13.30	22.80	23.60	23.30	24.40	24.50	26.50	31.10	30.50
Hire of animals	10.70	10.90	10.80	10.80	15.30	15.30	18.00	17.70	17.70	16.40	16.40	17.70
Seeds	20.70	35.50	28.50	28.00	27.50	28.30	28.30	26.50	26.50	26.50	26.50	28.30
Organic Fertilizer	–	–	–	–	–	–	–	–	–	–	–	–
Chemical Fertilizer	3.60	4.20	7.20	7.40	7.40	7 .90	7.90	8.30	7.80	7.80	7.90	7.90
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	–	–	–	–	–	–	–	3.80	–	–
Others	3.90	3.50	3.20	9.20	7.10	7.50	4.20	4.20	3.90	3.70	3.60	3.90
Total	49.20	65.70	62.20	68.70	80.10	82.60	81.70	81.10	80.40	84.70	85.50	88.30

Table 5.38

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate
from Year 1961 to 1972 (10)
(3) Barley

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Preparation of land	6.30	6.30	6.00	6.30	10.50	10.50	13.70	14.30	14.30	13.80	13.80	12.40
Seeds & Cultivation	7.70	7.40	7.50	10.50	10.90	12.90	14.80	14.80	13.00	12.90	13.00	14.80
Irrigation	1.20	1.20	1.10	1.20	1.80	1.80	2.20	2.20	2.20	1.80	1.80	1.80
Fertilizing	7.60	8.50	8.50	17.00	17.10	26.20	26.20	26.20	26.20	18.00	18.00	18.00
Others	16.80	17.80	22.10	22.70	36.50	36.50	39.00	39.50	41.00	39.00	35.50	29.70
Total	39.60	41.20	45.20	57.70	76.80	87.90	95.90	97.00	96.70	85.50	82.10	76.70
On-Farm Costs classified according to Rents and Costs												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Hire of labour	12.00	12.20	13.20	14,40	22.50	21.70	27.60	27.20	27.60	24.60	24.80	23.00
Hire of animals	11.00	11.40	14.50	12.60	23.70	24.00	24.00	25.20	26.00	26.00	22.60	17.20
Seeds	7.40	7.20	7.20	10.40	10.40	12.40	14.20	14.20	12.40	12.40	12.40	12.40
Organic Fertilizer	–	–	–	–	–	–	–	–	–	–	–	–
Chemical Fertilizer	7.40	8.30	8.30	16.60	16.60	25.70	25.70	25.70	25.70	17.50	17.50	17.50
Rent of machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Others	1.80	2.10	2.00	3.70	3.60	4.10	4.40	4.70	5.00	5.00	4.80	4.80
Total	39.60	41.20	45.20	57.70	76.80	87.90	95.90	97.00	96.70	85.50	82.10	76.70

Table 5.39

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate
from Year 1961 to Year 1972 (10)
(4) Fenugreek

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Preparation of land	–	–	6.00	6.00	8.90	10.10	10.10	9.50	10.80	11.80	11.80	10.20
Seeds & Cultivation	7.30	18.00	16.40	16.20	16.20	16.20	16.40	16.40	14.80	14.80	14.80	14.80
Irrigation	0.60	0.60	0.60	0.60	0.90	0.90	1.40	1.50	1.30	1.30	1.30	1.30
Fertilizing	–	–	–	8.60	8.80	8.50	8.60	8.50	8.50	8.50	8.00	8.00
Others	16.00	16.20	17.00	16.20	18.80	21.90	28.00	28.70	26.50	29.00	29.00	27.50
Total	23.90	34.80	40.00	47.60	53.60	57.60	64.50	64.60	61.90	65.40	64.90	61.80
On Farm Costs classified according to Rents and Costs												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Hire of labour	7.90	7.90	8.90	9.60	12.40	13.60	18.30	21.60	18.80	18.50	18.50	15.20
Hire of animals	6.60	6.80	11.20	11.40	16.50	17.00	19.00	16.20	17.80	21.50	21.50	21.70
Seeds	17.10	17.80	17.40	16.00	16.00	16.00	16.00	16.00	14.20	14.20	14.20	14.20
Organic Fertilizer	–	–	–	8.30	–	–	–	–	–	–	–	–
Chemical Fertilizer	–	–	–	–	8.30	8.00	8.20	8.00	8.00	8.00	7.80	7.80
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Others	2.30	2.30	2.50	2.30	0.40	3.00	3.00	2.80	3.10	3.20	2.90	2.90
Total	23.90	34.80	40.00	47.60	53.60	57.60	64.50	64.60	61.90	65.40	64.90	61.80

Table 5.40

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate
from Year 1961 to Year 1972 (10)
(5) Cotton

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	61	62	63	64	65	66	67	68	69	70	7 1	72
Preparation of land	18.40	17.80	18.40	23.70	27.00	28.70	22.50	25.00	25.70	32.00	29.70	31.00
Seeds & Cultivation	8.30	7.10	7.70	8.20	9.10	9.40	9.80	9.50	8.60	9.20	8.60	8.60
Irrigation	3.60	3.60	3.60	5.00	6.40	7.20	7.20	7.20	5.40	5.40	5.40	5.40
Fertilizing	32.00	36.50	44.20	47.50	60.00	73.00	70.00	74.00	76.80	73.20	91.00	86.00
Others	57.20	70.00	77.60	83.50	99.50	122.00	111.00	124.00	142.00	127.00	130.00	94.00
Total	119.50	135.00	151.40	167.60	202.00	240.30	219.50	239.70	258.50	246.80	264.70	225.00
On-Farm Costs classified according to Rents and Costs												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Preparation of land	45.00	56.20	59.50	77.50	96.00	111.00	116.00	124.00	124.00	108.00	105.00	91.00
Hire of animals	15.20	14.20	13.70	16.60	20.30	21.40	13.10	12.80	16.30	15.80	15.50	13.70
Seeds	6.00	5.00	5.30	5.60	5.80	5.80	6.30	6.30	6.30	6.30	6.30	6.30
Organic Fertilizer	17.80	17.80	23.70	10.20	30.00	30.00	30.00	30.00	30.00	30.00	37.20	37.20
Chemical Fertilizer	14.90	17.00	19.00	29.90	26.50	39.50	35.70	39.40	42.00	40.20	46.20	44.50
Rent of Machines	–	–	–	–	–	–	3.20	6.60	3.00	10.00	10.10	11.50
Pesticides	8.00	21.80	29.50	23.70	19.70	27.20	8.80	15.30	31.60	30.50	34.50	14.80
Others	12.60	3.00	0.70	4.40	3.70	5.40	6.40	5.40	5.30	6.00	9.90	6.00
Total	119.50	135.00	151.40	167.60	202.00	240.30	219.50	239.70	258.50	246.80	264.70	225.00

Table 5.41

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(6) Rice

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Preparation of land	13.50	13.60	13.20	15.40	24.60	25.00	23.40	23.80	21.70	21.60	22.70	22.40
Seeds & Cultivation	39.70	41.70	45.00	47.70	53.10	56.80	60.00	63.40	62.50	62.00	61.00	57.70
Irrigation	4.00	4.00	4.00	4.20	4.20	4.20	4.30	4.30	4.30	4.40	4.40	4.40
Fertilizing	31.00	29.70	36.70	35.50	42.00	60.80	61.20	63.10	64.10	64.10	62.80	64.00
Others	36.80	37.50	32.30	60.00	47.80	65.00	65.00	68.20	66.30	66.30	69.80	69.20
Total	125.00	126.50	131.20	162.80	171.70	211.80	213.90	222.80	218.90	218.40	220.70	217.70
On-Farm Costs classified according to Rents and Costs												
Item \ Year	61	62	63	64	65	66	67	68	69	70	71	72
Hire of labour	47.40	51.10	58.70	82.00	78.80	86.00	86.00	90.00	87.40	76.40	75.00	73.50
Hire of animals	29.60	30.50	32.00	33.40	36.50	51.40	49.00	51.40	17.00	23.20	26.80	24.70
Seeds	17.20	16.90	17.60	17.80	20.20	22.90	24.70	26.70	27.80	25.70	25.50	23.40
Organic Fertilizer	7.40	7.10	3.10	6.30	10.90	17.80	17.50	18.00	17.60	16.40	16.40	16.70
Chemical Fertilizer	17.80	17.10	17.20	21.20	22.00	30.00	30.00	30.70	30.70	33.70	32.50	32.70
Rent of Machines	3.40	1.40	–	–	–	–	3.70	3.60	36.70	40.00	41.00	43.50
Pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Others	2.20	2.40	2.60	2.10	3.30	3.70	3.00	2.40	1.70	3.00	3.50	3.20
Total	125.00	126.50	131.20	162.80	171.70	211.80	213.90	222.80	218.90	218.40	220.70	217.70

Table 5.42

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(7) Peanuts

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	13.00	13.80	13.30	17.20	12.00	10.70	11.60	11.60	12.50	12.50	9.50	9.50
Seeds & Cultivation	12.50	13.20	12.80	14.50	12.00	11.30	23.70	21.50	21.50	21.50	19.00	19.00
Irrigation	2.40	2.40	2.40	3.60	3.00	3.60	5.40	5.30	5.40	5.40	3.60	3.60
Fertilizing	34.00	34.00	34.00	30.50	27.70	21.70	21.70	24.60	24.60	24.60	18.80	19.00
Others	24.00	33.00	31.90	40.50	38.00	44.00	52.00	53.00	51.20	51.20	67.10	67.20
Total	85.90	96.40	94.40	106.30	92.70	91.30	114.40	116.00	115.20	115.20	118.00	118.30
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	30.50	40.00	31.50	44.00	38.50	45.50	62.00	62.00	61.00	61.50	76.70	76.70
Hire of animals	13.10	14.20	14.20	17.80	11.60	8.90	14.00	14.00	14.80	14.60	10.40	10.40
Seeds	7.20	7.90	7.40	7.40	8.40	9.50	16.60	14.20	14.20	14.20	11.80	11.80
Organic Fertilizer	23.70	23.70	23.70	23.70	18.40	14.80	14.80	17.80	17.80	17.80	11.80	11.80
Chemical Fertilizer	8.30	8.30	8.30	4.20	6.30	4.10	4.10	4.20	4.20	4.20	4.20	4.50
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	7.20	6.80	7.00	6.00	–	0.80	–	–	–	–
Others	3.10	2.30	2.10	2.40	2.50	2.50	2.90	3.00	3.20	2.90	3.10	3.10
Total	85.90	96.40	94.40	106.30	92.70	91.30	114.40	116.00	115.20	115.20	118.00	118.30

Table 5.43

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(8) Indian Millet

U.S. $ / ha

On- Farm Costs classified according to Agricultural Operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	9.40	9.60	10.00	11.60	14.80	11.30	11.30	11.30	11.30	11.30	11.30	11.30
Seeds & Cultivation	3.60	2.60	2.60	2.70	3.40	3.40	5.40	5.40	4.20	4.20	2.80	2.90
Irrigation	2.40	2.40	2.40	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
Fertilizing	27.00	26.50	28.20	31.50	47.00	48.20	49.50	49.50	49.50	57.80	56.50	56.50
Others	22.00	22.70	22.50	28.00	27.30	27.30	28.80	28.80	28.80	31.50	31.50	33.00
Total	64.40	63.80	65.70	77.40	96.10	93.80	98.60	98,60	97.40	108.40	105.70	107.30
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	26.50	26.00	26.70	34.60	35.50	34.70	37.00	37.00	37.00	39.80	41.00	40.20
Hire of Animals	7.50	8.10	9.90	8.30	10.70	8.60	8.60	8.60	8.60	8.10	6.00	8.30
Seeds	2.40	2.40	2.40	2.40	2.40	2.40	3.60	3.60	2.40	2.40	2.40	2.40
Organic Fertilizer	10.00	9.60	6.60	11.90	14.40	11.90	11.90	11.90	11.90	11.90	11.90	11.90
Chemical Fertilizer	14.90	14.90	19.00	16.60	29.70	33.50	34.50	34.50	34.50	4.30	4.17	4.17
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Others	3.10	2.80	1.10	3.60	3.40	2.70	3.00	3.00	3.00	3.20	2.70	2.80
Total	64.40	63.80	65.70	77.40	96.10	93.80	98.60	98.60	97.40	108.40	105.70	107.30

Table 5.44

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(9) Syrian Maize

US $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	8.60	8.30	9.50	11.30	13.70	12.00	11.40	13.00	13.00	13.00	13.20	13.70
Seeds & Cultivation	10.80	9.50	7.90	7.70	8.10	8.10	8.40	8.40	6.60	6.60	7.30	6.30
Irrigation	2.30	2.20	2.20	3.60	3.60	4.80	3.60	3.60	3.60	3.60	3.60	3.60
Fertilizing	37.30	39.40	36.00	37.70	54.50	56.80	61.00	60.50	49,20	49.20	64.00	66.00
Others	19.10	28.50	20.00	28.50	27.80	29.00	28.00	29.10	30.30	30.20	28.70	28.30
Total	78.10	87.90	75.60	88.80	107.70	110.70	112.40	114.60	102.70	102.60	116.80	117.90
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	21.70	23.20	23.10	32.70	29.50	31.50	35.20	36.20	37.60	37.50	36.20	36.50
Hire of animals	8.40	6.80	8.10	8.40	11.30	10.40	10.40	11.60	11.90	11.90	11.00	10.40
Seeds	9.50	8.80	7.30	7.20	7.20	7.20	7.20	7.20	4.80	4.80	6.30	5.30
Organic Fertilizer	20.50	22.40	19.00	17.80	26.70	18.60	17.80	17.80	23.70	23.70	21.00	23.50
Chemical Fertilizer	14.80	14.80	14.80	16.60	24.50	34.70	38.60	38.60	21.40	21.40	38.70	38.70
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	8.30	–	2.70	4.70	5.40	–	–	–	–	–	–
Others	3.20	3.60	3.30	3.40	3.80	2.90	3.20	2.90	3.30	3.30	3.60	3.50
Total	78.10	87.90	75.60	88.80	107.70	110.70	112.40	114.60	102.70	102.60	116.80	117.90

Table 5.45

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(10) Clover (Seeds)

U.S. $ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	–	–	–	–	–	–	–	–	–	–	–	–
Seeds & Cultivation	16.20	13.20	9.80	12.20	18.40	18.30	18.30	18.30	13.80	13.80	13.80	13.80
Irrigation	2.30	2.30	2.30	2.40	3.30	3.60	5.40	5.40	5.40	5.40	5.40	5.40
Fertilizing	8.70	8.60	8.60	8.50	8.60	8.70	8.70	8.70	8.90	8.90	9.00	8.90
Others	15.80	28.70	31.70	29.00	38.20	37.60	45.20	44.70	36.70	36.70	37.00	36.20
Total	43.00	52.80	52.40	52.10	68.50	68.10	77.60	77.10	64.80	64.80	65.20	64.30
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	11.80	16.20	17.70	18.00	30.20	26.00	34.20	30.50	28.20	28.20	28.50	28.30
Hire of animals	5.00	5.10	5.70	6.00	9.20	8.00	9.10	11.20	11.60	11.60	11.60	7.80
Seeds	16.00	13.10	9.60	10.80	17.80	17.80	17.80	17.80	13.40	13.40	13.40	13.40
Organic Fertilizer	–	–	–	–	–	–	–	–	–	–	–	–
Chemical Fertilizer	8.60	8.50	8.30	8.30	8.30	8.30	8.30	8.30	8.40	8.40	8.40	8.40
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	8.30	9.30	6.00	–	5.40	5.40	7.20	–	–	–	–
Others	1.60	2.00	1.80	3.00	3.00	2.60	2.80	2.10	3.20	3.20	3.30	6.40
Total	43.00	52.80	52.40	52.10	68.50	68.10	77.60	77.10	64.80	64.80	65.20	64.30

Table 5.46

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

(11) Sesame

U.S.$ / ha

On-Farm Costs classified according to Agricultural Operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	7.20	7.30	7.30	8.40	11.50	10.80	10.80	10.80	10.80	10.80	9.60	9.60
Seeds & Cultivation	4.00	4.40	4.40	4.70	4.60	5.00	5.00	5.40	5.00	5.00	5.50	6.30
Irrigation	2.20	2.20	2.30	3.60	3,60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
Fertilizing	–	–	–	–	17.10	18.20	18.20	24.50	28.70	33.50	17.80	17.80
Others	18.50	18.90	20.80	25.00	26.40	26.80	28.50	28.50	28.50	28.50	28.50	28.50
Total	31.90	32.80	34.80	41.70	63.20	64.40	66.10	72.80	76.60	81.40	65.00	65.80
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	21.60	22.40	23.50	30.70	31.70	32.20	32.80	33.00	33.00	33.00	32.00	32.00
Hire of animals	6.30	6.00	6.60	6.90	9.50	9.50	9.80	10.10	10.10	10.10	8.90	8.90
Seeds	1.90	2.20	2.30	2.20	2.20	2.30	2.30	2.00	2.30	2.30	2.90	3.60
Orgainc Fertilizer	–	–	–	–	–	–	–	6.00	11.90	14.90	–	–
Chemical Fertilizer	–	–	–	–	16.60	17.20	17.20	17.20	15.50	17.30	17.30	17.30
Rent of machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Others	2.10	2.20	2.40	1.90	3.20	3.20	4.00	4.50	3.80	3.80	3.90	4.00
Total	31.90	32.80	34.80	41.70	63.20	64.40	66.10	72.80	76.60	81.40	65.00	65.80

Table 5.47

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate from Year 1961 to 1972 (10)

(12) Onions

U.S. $ / ha

On-Farm costs classified according to Agricultural Operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	14.20	14.30	14.30	14.30	23.80	26.20	18.20	21.90	19.00	20.00	20.90	27.70
Seeds & Cultivation	55.80	56.00	63.20	51.20	70.00	74.10	94.00	68.50	69.00	80.10	83.10	85.80
Irrigation	1.70	1.80	1.80	1.80	2.70	2.70	2.70	3.60	3.60	3.60	2.70	2.70
Fertilizing	32.50	33.50	45.00	46.00	38.00	45.50	38.00	57.80	57.80	69.50	102.00	102.00
Others	25.00	25.70	26.00	25.80	44.00	45.20	35.00	35.50	43.00	78.10	90.00	74.00
Total	129.20	131.30	150.30	139,10	178.50	193.70	187.90	187.30	192.40	251.30	298.70	292.20
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	31.40	32.50	32.40	32.10	58.00	57.00	44.80	51.80	51.00	58.00	65.80	66.00
Hire of animals	11.70	11.80	11.90	11.90	21.50	25.00	15.60	17.80	15.50	16.60	22.40	22.60
Seeds	52.50	52.50	59.50	47.70	60.90	65.50	98.30	59.50	61.20	71.50	71.50	71;50
Organic Fertilizer	13.70	14.80	26.20	19.20	17.80	17.80	11.90	11.90	11.90	17.80	29.70	29.70
Chemical Fertilizer	16.90	16.90	16.60	25.00	16.60	25.00	21.50	43.10	43.10	49.00	67.00	67.00
Rent of Machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	–	–	–	–	–	–	–	–	7.20	35.70	35.80	29.70
Others	3.00	2.80	3.70	3.20	3.70	3.40	4.80	3.20	2.50	2.70	6.50	5.70
Total	129.20	131.30	150.30	139.10	178.50	193.70	187.90	187.30	192.40	251.30	298.70	292.10

Table 5.48

On-Farm Costs for the Main Crops Cultivated in the Fayoum Governorate
from Year 1961 to Year 1972 (10)
(13) Vegetables

U.S. $ / ha

On-Farm Costs classified according to Agricultural operations												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Preparation of land	17.60	18.40	19.00	20.70	30.20	31.70	30.50	29.50	30.20	31.40	33.00	31.70
Seeds & Cultivation	10.00	10.20	11.80	12.50	15.20	17.70	19.80	22.00	22.60	25.00	29.20	26.70
Irrigation	3.80	3.80	5.00	5.00	5.00	6.00	6.00	6.00	7.20	7.20	7.20	7.20
Fertilizing	44.50	47.00	48.20	49.00	71.80	78.00	77.00	77.50	78.50	76.70	77.00	83.00
Others	42.70	45.90	46.50	47.90	74.00	79.20	80.00	81.30	85.00	90.50	97.00	97.00
Total	118.60	126.00	130.50	135.10	196.20	212.60	213.30	216.30	223.50	230.80	243.40	245.60
On-Farm Costs classified according to Rents and Costs												
Item \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Hire of labour	41.60	44.30	46.50	48.20	76.10	79.10	79.80	81.80	84.00	92.00	100.00	97.70
Hire of animals	16.20	16.80	17.60	18.20	20.50	25.70	26.80	27.50	30.70	31.20	32.80	33.20
Seeds	6.60	6.90	7.20	7.40	10.70	11.60	11.60	11.60	11.40	12.70	13.30	13.50
Organic Fertilizer	22.60	26.00	26.00	25.20	39.00	42.50	42.10	43.00	42.00	40.30	40.80	42.00
Chemical Fertilizer	18.50	20.00	20.90	21.70	31.20	34.00	33.20	34.00	36.00	34.50	35.00	38.10
Rent of machines	–	–	–	–	–	–	–	–	–	–	–	–
Pesticides	8.30	8.80	9.20	9.50	13.90	14.80	15.00	15.10	15.80	16.20	16.80	17.20
Others	4.80	4.20	3.10	4.90	4.80	4.90	4.80	3.30	3.60	3.90	4.70	3.90
Total	118.60	126.00	130.50	135.10	196.20	212.60	213.30	216.30	223.50	230.80	243.40	245.60

It will be seen, for example, that the On-Farm Costs, in 1972, of fenugreek per hectare rose two and a half above that of 1961. Meanwhile, in 1972 production costs, per hectare, of sesame, onion and vegetables amounted to more than double those of 1961. As regards the other crops, with the exception of peanut, their On-Farm Costs per hectare, in 1972, rose to more than one and a half those of 1961. Figure 5-9 shows the On-Farm Costs, per hectare, of the important crops cultivated in the Fayoum Governorate, during various years. From this Figure, it may be seen that such costs generally rise from one year to another, as already mentioned. However, it may be observed that the 1972 On-Farm Costs, per hectare, of cotton noticeably decreased below those of 1971. Such costs were $264.7 in 1971, and, in 1972, they decreased to $225 only. This is because the Government decided to incur yearly, and as from 1972, half the costs of cotton-pest resistance. This has led to the decrease in cotton production costs incurred yearly by farmers.

5.4 Calculation of Farmer Benefit

What is meant by the Farmer Benefit are the returns to the farmer from the crops sale price after subtracting the On-Farm Costs. We calculate here the Farmer Benefit per hectare from the cropped areas of the different crops for the years from 1961 to 1972. After this, we calculate the Farmer Benefit per hectare from the command cultivated areas for each crop every year as follows:

$$\text{Average Farmer Benefit} = \frac{\text{Total Benefit}}{\text{Command Area}}$$

$$= \frac{\sum (D(A-B))}{\text{Command Area}} \quad \text{U.S.\$ /ha}$$

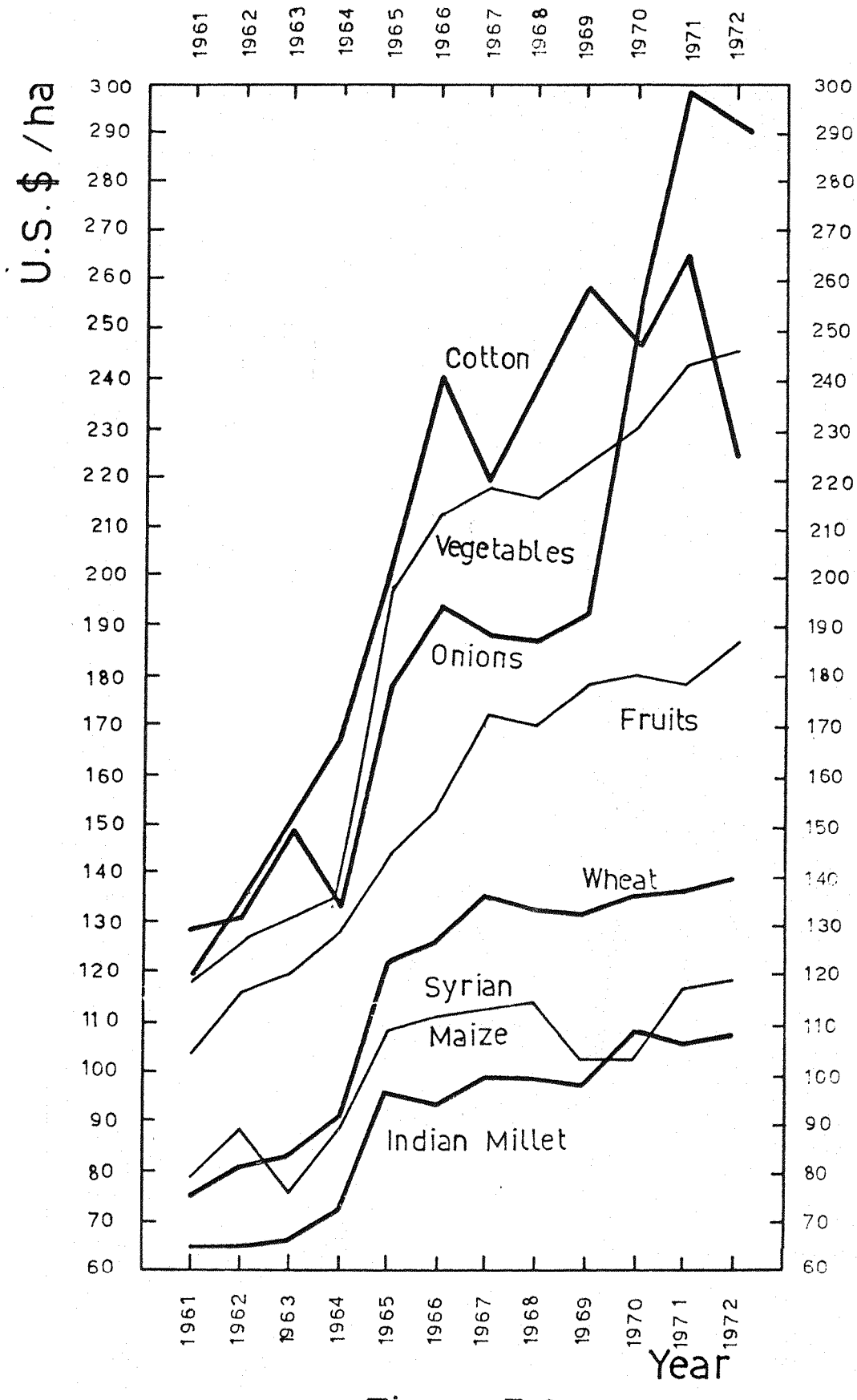


Figure 5_9

On-Farm Costs for Some Important Crops Cultivated in Fayoum Governorate

Where:

A = Gross Benefit for a certain crop in a certain year (From Table 5-20)

B = On-Farm Costs for a certain crop in a certain year (From Table 5-49)

A-B = Farmer Benefit for a certain crop in a certain year (From Table 5-50)

D = Cropped Area for a certain crop in a certain year (From Table 5-15)

Command Area = 137,760 ha

We obtain the average Farmer Benefit per year by dividing the Figures of the Total Benefit (shown in Table 5-51), by the Command Area (137,760 ha). These averages of the Farmer Benefit are shown in Table 5-52 for years from 1961 to 1972.

In the next chapter, we transfer the values of these benefits to 1972 prices, for use in the economic analysis.

Table 5.49

On-Farm Costs for Different Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972 (10)

U.S. $ / ha

	Crop \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	75.30	80.60	83.10	90.50	121.40	126.00	135.40	133.20	132.10	135.40	136.10	139.40
2	Beans	49.20	65.70	62.20	68.70	80.10	82.60	81.70	81.10	80.40	84.70	85.50	88.30
3	Barley	39.60	41.20	45.20	57.70	76.80	87.90	95.90	97.00	96.70	85.50	82.10	76;70
4	Fenugreek	23.90	34.80	40.00	47.60	53.60	57.60	64.50	64.60	61.90	65.40	64.90	61.80
5	Cotton	119.50	135.00	151.40	167.90	202.00	240.30	219.50	239.70	258.50	246.80	264.70	225.00
6	Rice	125.00	126.50	131.20	162.80	171.70	211.80	213.90	222.80	218.90	218.40	220.70	217.70
7	Peanuts	85.90	96.40	94.40	106.30	92.70	91.30	114.40	116.00	115.20	115.20	118.00	118.30
8	Indian Millet	64.40	63.80	65.70	77.40	96.10	93.80	98.60	98.60	97.40	108.40	105.70	107.30
9	Syrian Millet	78.10	87.90	75.60	88.80	107.70	110.70	112.40	114.30	102.70	102.60	116.80	117.90
10	Clover (Seeds)	43.00	53.00	52.50	52,10	68.50	68.10	77.60	77.10	64.80	64.80	65.20	64.30
11	Sesame	31.40	32.80	34.80	41.70	63.20	64.40	66.10	72.80	76.60	81.40	65.00	65.80
12	Onions	129.20	131.30	150.30	139.10	178.50	193.70	187.90	187.30	192.40	251.30	298.70	292.20
13	Vegetables	118.60	126.00	130.50	135.10	196.20	212.60	213.30	216.30	223.50	230.80	243.40	245.60
14	Fruits	103.70	115.30	119.20	127.50	144.10	152.90	171.50	169.80	177.70	179.80	178.40	186.70
15	Clover	52.20	64.80	64.10	68.20	72.30	74.40	78.80	81.30	81.00	82.30	88.70	91.70
16	Others	70.60	78.00	80.80	89.90	106.50	115.60	119.00	122.00	121.40	126.30	131.70	128.20

Table 5.50

Farmer Benefit per Cropped hectare from the Different Crops Cultivated in the Fayoum Governorate from Year 1961 to Year 1972

U.S. $ / cropped ha

Crop \ Year		1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1	Wheat	72.90	74.70	79.50	74.20	52.60	89.60	98.60	55.00	67.10	79.40	127.60	119.90
2	Beans	107.50	225.10	116.80	163.20	157.30	182.90	65.40	55.50	123.50	88.40	224.80	254.80
3	Barley	79.40	91.50	97.90	137.50	69.90	81.80	141.20	83.70	62.80	110.30	160.80	180.60
4	Fenugreek	28.10	94.20	69.90	80.40	87.40	96.10	116.00	95.50	127.70	109.50	130.30	158.30
5	Cotton	147.30	264.80	247.00	217.10	129.20	137.20	150.50	48.79	589.50	651.60	852.90	280.70
6	Rice	26.20	49.60	12.80	2.00	21.70	15.30	90.00	9.76	81.60	81.60	50.50	57.40
7	Peanuts	122.40	122.00	126.00	105.20	283.10	219.20	254.60	25.53	196.40	216.80	212.00	332.10
8	Indian Millet	97.60	115.20	127.00	123.40	98.80	143.30	221.70	133.90	160.10	223.40	204.90	265.00
9	Syrian Maize	106.90	95.30	99.50	101.60	90.80	149.30	183.10	212.60	180.40	195.80	117.20	159.70
10	Clover (Seeds)	32.30	42.60	75.50	79.50	55.00	71.40	51.30	42.00	105.70	118.80	90.50	121.30
11	SEsame	87.40	95.60	102.20	101.00	90.90	84.10	106.50	94.60	155.90	273.70	335.00	369.40
12	Onions	98.00	89.50	75.30	110.70	178.50	252.90	208.60	156.40	154.90	111.70	218.10	353.50
13	Vegetables	1,046.70	1,085.00	1,047.50	1,112.90	1,115.20	1,094.60	1,009.20	1,120.90	1,048.20	1,249.90	1,398.90	1,556.70
14	Fruits	635.60	691.70	825.70	831.40	728.70	788.80	900.60	737.90	674.90	513.20	550.50	841.40
15	Clover	83.10	72.30	75.50	74.20	72.20	76.60	109.70	85.70	95.40	104.30	104.40	113.80
16	Others	84.50	110.20	100.20	91.60	106.70	123.00	135.90	142.70	161.70	179.60	218.10	215.00

Table 5.51

Total Benefit from the Different Crops Cultivated in the Fayoum Governorate
from Year 1961 to Year 1972

U.S. $

	Crop \ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1971
1	Wheat	3,098,250	3,092,580	2,877,900	2,856,700	1,951,460	3,230,950	3,307,780	2,112,000	2,341,790	2,731,360	4,427,720	3,728,890
2	Beans	797,650	1,845,820	1,080,400	1,863,744	1,761,760	1,865,580	555,900	416,250	1,200,420	875,160	1,850,104	2,568,384
3	Barley	103,220	149,603	152,724	283,250	167,760	164,630	310,640	157,356	91,875	161,038	167,232	299,796
4	Fenugreek	53,952	182,748	132,810	242,004	259,578	211,420	248,240	254,030	295,626	307,695	310,114	402,082
5	Cotton	5,435,370	8,579,520	8,126,300	7,272,850	4,870,840	4,994,080	5,463,150	17,710,770	20,691,450	21,502,800	26,525,190	8,729,770
6	Rice	131,524	40,771	97,280	15,800	149,730	88,740	667,800	1,015,040	913,920	520,150	479,290	871,660
7	Peanuts	95,962	131,760	158,760	96,784	301,502	168,346	138,757	188,922	179,706	112,736	100,700	123,209
8	Indian Millet	2,108,160	2,626,560	2,616,200	3,023,300	2,094,560	3,453,440	5,143,440	3,293,940	3,922,450	5,853,080	4,815,150	5,962,500
9	Syrian Maize	4,211,860	5,193,850	5,373,000	5,201,920	4,903,200	7,136,540	7,781,750	8,674,080	7,396,400	7,734,100	4,922,400	6,483,820
10	Clover (Seeds)	368,220	321,630	441,525	458,715	297,000	621,180	384,750	308,700	761,040	873,180	814,500	934,010
11	Sesame	13,372	18,451	28,003	28,987	26,452	33,808	29,288	32,259	61,581	160,115	201,000	233,461
12	Onions	84,280	76,254	91,113	95,202	120,488	159,327	123,074	105,883	250,938	70,371	260,630	279,265
13	Vegetables	7,693,245	8,246,000	9,218,000	10,906,420	11,152,000	10,672,350	9,829,608	9,191,380	11,320,560	14,373,850	17,556,195	14,007,600
14	Fruits	2,955,540	3,195,654	3,946,846	4,007,348	3,643,500	4,117,536	4,863,240	3,984,660	3,779,440	3,027,880	3,385,575	4,476,248
15	Clover	5,094,030	4,410,300	4,628,150	4,081,000	3,841,040	4,596,000	6,779,460	3,985,050	4,865,400	5,778,220	6,128,280	6,736,960
16	Others	104,273	68,765	85,671	190,436	56,764	109,101	214,314	254,577	342,481	333,517	484,618	807,755
$\Sigma[D(A-B)]$		32,348,908	38,180,176	39,054,682	40,624,460	35,597,634	41,623,118	45,841,171	51,684,897	58,415,077	64,415,252	72,428,698	56,645,410

Table 5.52

Average Annual Benefit
from The Established Irrigation Project in the Fayoum Governorate
for Years from 1961 to 1972

Year	Annual Benefit U.S. $ / ha
1961	234.80
1962	277.20
1963	283.50
1964	294.90
1965	258.40
1966	303.10
1967	332.80
1968	375.20
1969	424.00
1970	467.60
1971	525.80
1972	411.20

CHAPTER 6

ECONOMIC ANALYSIS FOR A TYPICAL SYNTHETIC IRRIGATION PROJECT IN THE FAYOUM GOVERNORATE.

6.1 The Purpose of the Economic Analysis.

We have already mentioned that the Egyption Government proceeds with the construction of irrigation projects by GALD. Such projects are then managed and their lands are governmentally cultivated by GEOCD. When these lands reach their maximum productivity, after intervals, ranging between 4 to 7 years, the Government then puts them into the farmers' possession to continue their cultivation and benefit by their use with the help of Cooperative Societies.

However, there are, in fact, two different opinions, with regard to the methods of utilizing the cultivated lands in Egypt, at present:

(1) The first favours the method, which is actually followed, i.e. the management of projects by the Government during the early years, and then comes the distribution of the lands to farmers, when the land productivity reaches a maximum, in order that they themselves proceed with their cultivation, under the cooperative regime. Some of those who support this opinion suggest the distribution of the lands to farmers be effected immediately after the completion of the project, or the elapse of one or two years only from date of completion, i.e. before the land productivity reaches a maximum. This is on the basis that farmers themselves then utilize the lands by the help of Cooperative Societies.

(2) The second opposes the method followed at present, and suggests that the Government goes on with the management of projects, without distributing the lands to farmers, i.e. the new cultivated lands to be utilized as State farms.

The object of the economic analysis of the synthetic irrigation project of the Fayoum Governorate is:

Firstly to know whether or not the irrigation projects in Egypt are successful, from the economic

point of view;

Secondly: To know the best economic utilization possible of such projects. Is it the distribution of lands to farmers, in order that they themselves proceed with their utilization by the help of the services the Cooperation Societies offer, i.e. the method of individual land ownership, or, the application of the State Farm method.

6.2 The Synthetic Project:

The reason of assuming the synthetic irrigation project of the Fayoum Governorate is the unavailability of full and complete data on the benefits and costs of any individual irrigation project in Egypt. This is because irrigation projects in Egypt are divided into two parts, viz:- The major part of irrigation projects was erected hundreds of years ago, in the Nile Delta as well as along its banks from north to south. Furthermore, the Nile Valley is of a cultivable fertile soil that reached its full production long ago. An example of this is the old irrigation project constructed in the Fayoum Governorate. The data concerning the agricultural production and the annual return as well as the annual expenditure of this project (already mentioned in Chapter 5) are available. As regards the information about the construction costs of this project it is, of course, unknown to us, due to its execution hundreds of years ago.

The other part of the irrigation projects is that which concerns those recently constructed in various regions in Egypt, during the last twenty years only. The data concerning the construction costs of these projects and their annual expenditure are available. However, as regards the information and annual return, it is not available in a fully complete and clear condition, due to the recent execution of same and certain problems they faced, when first initiated.

The assumed base of the synthetic irrigation project of the Fayoum Governorate is that the fertility of the lands of the new irrigation projects, recently executed, becomes the same as that of the lands of the old project of the Fayoum Governorate, i.e.yield the same output, when they reach their full production, a few years later.

Details of the construction costs of the synthetic irrigation project and its annual recurrent costs, during its early years, were taken from those of the new irrigation projects constructed in Egypt, during the last twenty years. As for the details concerning the annual return of the synthetic project and its annual expenses, during the remainder years, they were taken from those of the old irrigation project of the Fayoum Governorate.

The reason, why the Fayoum Governorate itself is selected as a reference in details and information, is that its soil is considered fair in quality, if compared with the other types of soil in Egypt. It is neither very good, as that of Monofia Governorate, nor bad, as in the case of El-Behaira Governorate. Thus, the annual return of the Fayoum Governorate's land may be considered, in approximation, representative of the annual return of the cultivated lands elsewhere in Egypt.

6.3 Discounted Measure of the Project Worth

The most important discounted measures of project worth in common use is the benefit/cost ratio. That is to say,

$$\frac{\text{Present worth of Benefits}}{\text{Present worth of Costs}} = \text{Benefit/Cost Ratio} \quad (11)$$

The benefit-cost ratio is used almost exclusively as a measure of social benefit for economic analysis and most commonly for water resource projects. It is almost never used for private investment analysis.

The formal mathematical statements of this measure are

$$\text{Benefit/Cost Ratio} = \frac{\sum_{t=1}^{n} \frac{B_n}{(1+i)^n}}{\sum_{t=1}^{n} \frac{C_n}{(1+i)^n}}$$

$$\text{Net present worth} = \sum_{t=1}^{n} \frac{B_n - C_n}{(1+i)}$$

Internal rate of return is that discount rate, i, such that

$$\sum_{t=1}^{n} \frac{B_n - C_n}{(1+i)} = 0$$

Where

B_n = benefit in each year

C_n = Costs in each year

n = number of years

i = interest (discount) rate

In practice, it is probably more common not to compute the Benefit/Cost Ratio using gross costs and gross benefits, but rather to compare the present worth of the net benefits with the present worth of the investment cost plus operation, maintenance and replacement costs. This reflects United States government practice where the Benefit/Cost ratio has been a common measure applied to assess the "national economic development" effect of water resources projects.

The ratio is computed by taking the present worth of the gross benefits less the On-Farm Costs and comparing it to the present worth of the project economic costs (operation, maintenance and replacement costs).

The accounting convention is that all costs and all benefits are discounted for the first year and for each year thereafter. To many people, this seems inconsistent. Investment must be made before the first year is ended, they say, so how can you assume that they be discounted-that is, that their present worth is something less than their actual face value? The answer is somewhat arbitrary; first, in projects lasting over several years, it makes no difference in the relative ranking; second, costs in actual practice are paid out during the course of each year and not all on January 1 and to allow for this on something like a day-to-day basis is just too complicated to be worth the effort. In any event, we note that World Bank usage is to discount both costs and benefits beginning with the first year but that some international lending agencies discount costs beginning with the second year. In our analysis we adopt the World Bank convention.

6.4 The Choice of Discount Rate

In principle the discount rate should be set at that level at which the total cost of all the potential projects in a country which could show a positive present value (however small) at that discount rate, and which

could be implemented in a particular period, is just equal to the total amount of investible resources available; this is called the 'Accounting Rate of Interest'. In practice it is very difficult to estimate what this rate is, and it is recommended that 8% be used unless there are good indications that is too high or too low (e.g. if the recipient country uses a test rate of discount considerably above or below 8%) in which case a different rate can be used and the rationale for doing so should be included in the appraisal.(12)

In our economic analysis of the synthetic irrigation project in the Fayoum Governorate in Egypt, we used discount rates of 6%, 8% and 10% for the assumed thirty-two cases (shown in Table 6-1), to know the effect of changing discount rates upon the project's economy.

6.5 Length of the Project Period.

Where the whole project, or a very major part of it, has an obvious finite economic life, then benefits and costs should be normally calculated year by year over the duration of that life, or over thirty years whichever is the less. In the case of exceptionally long lived assets, e.g. dams, a period of up to fifty years may be taken. If should be remembered that is a discount rate of 8% or more is used, the costs or benefits expected to accrue after thirty years or so, will be so reduced by the discounting procedure that even the grossest errors in estimating their amount, will make little difference to the final result. It is therefore often satisfactory to assume an economic life of say thirty years even if the physical life of the project is expected to be much longer that this. Another inference is that there is little point in incurring expenditure today to save money many years hence (e.g. in a hydro-electric project where the maximum capacity may not be required for many years ahead). At 8% discount rate, for instance, it would be worth spending only £2 now in order to save £100 in fifty years time. (12)

In some cases, where the project's economic life is not obviously finite, it is difficult to forecast the pattern of capital expenditure in the future, e.g. it is known that the switchgear of a hydro-electric scheme

will need replacing in due course but one cannot say exactly when, perhaps every twenty years, perhaps every twenty-five. In such circumstances it is convenient to assume that once the project has achieved its long term level of operational efficiency, its net benefits will remain constant to infinity. This can be achieved by expressing the discreet capital inputs (such as the switchgear) from this 'Plateau' point onwards as an annual average cost.

However, in the economic analysis of the synthetic irrigation project in the Fayoum Governorate in Egypt, we assumed that the economic life of this project is forty years, for more accuracy, because it is a big project (covering an area of 137,760 ha).

6.6 The Currency Used:

The currency used in the process of economic analysis of the synthetic irrigation project of the Fayoum Governorate is the United States Dollar, on the grounds that it is of an international nature and used by the World Bank as well as all the international economic authorities. All the values of the synthetic project's expenses and revenues are transformed from the Egyptian Pound to the United States Dollar, on the basis that the Dollar's price = 0.4 Egyptian Pound (according to official price at Bank Misr, in 1972, which is the base year assumed in the process of economic analysis of the said project).

6.7 Exclusion of Changes in Currency Value (Choice of the Base Year)

When comparisons are made with regard to the values of benefits and costs of any project, for many different years, or, in case such values are used in the economic analysis of a project, it is wrong to use such values free just as they are, because the currency value changes, according to circumstances from one year to another, either by rising or falling. Therefore, such a change in currency value should be excluded through the transformation of all the currency values in the various years to any one year and the consideration of same as the base year.

As any other international currency, the value of the Egyptian Pound is exposed to rise or fall, from one year

to another. Nevertheless, as regards the process of the economic analysis of the synthetic irrigation project of the Fayoum Governorate, the year 1972, is considered the base year. All the values of benefits and costs were transformed to those of the said year, in accordance with the values of the Egyptian Pound in the various years shown on Figure 6-1 (1)

6.8 A Study on the System Used for the Utilization of the Cultivated Lands in Egypt

6.8.1. The Various Assumed Cases:

The economic analysis of the synthetic irrigation project is made hereon the basis of the method, now in use in Egypt, of the utilization of cultivated lands, i.e. the Government to manage the project for some years and then the distribution of the project lands to farmers.

Thirty-two cases, wherein the Government distributes the lands to farmers immediately after the construction of the project, or after the elapse of one year, two years and so on till seven years, are assumed. In all these cases, it is assumed that the land reaches its full production after periods of 4,5, 6 or 7 years, as shown on Table 6-1. This enables us to distinguish between the best and the worst of these cases, and put them in order, starting with the best and ending with the worst.

It may seem that the assumed 6 or 7 years, following the construction of the project, for the land to reach its marginal level of production, are relatively long periods; but, in fact, they are not so, because most of the recently reclaimed lands are not of good quality.

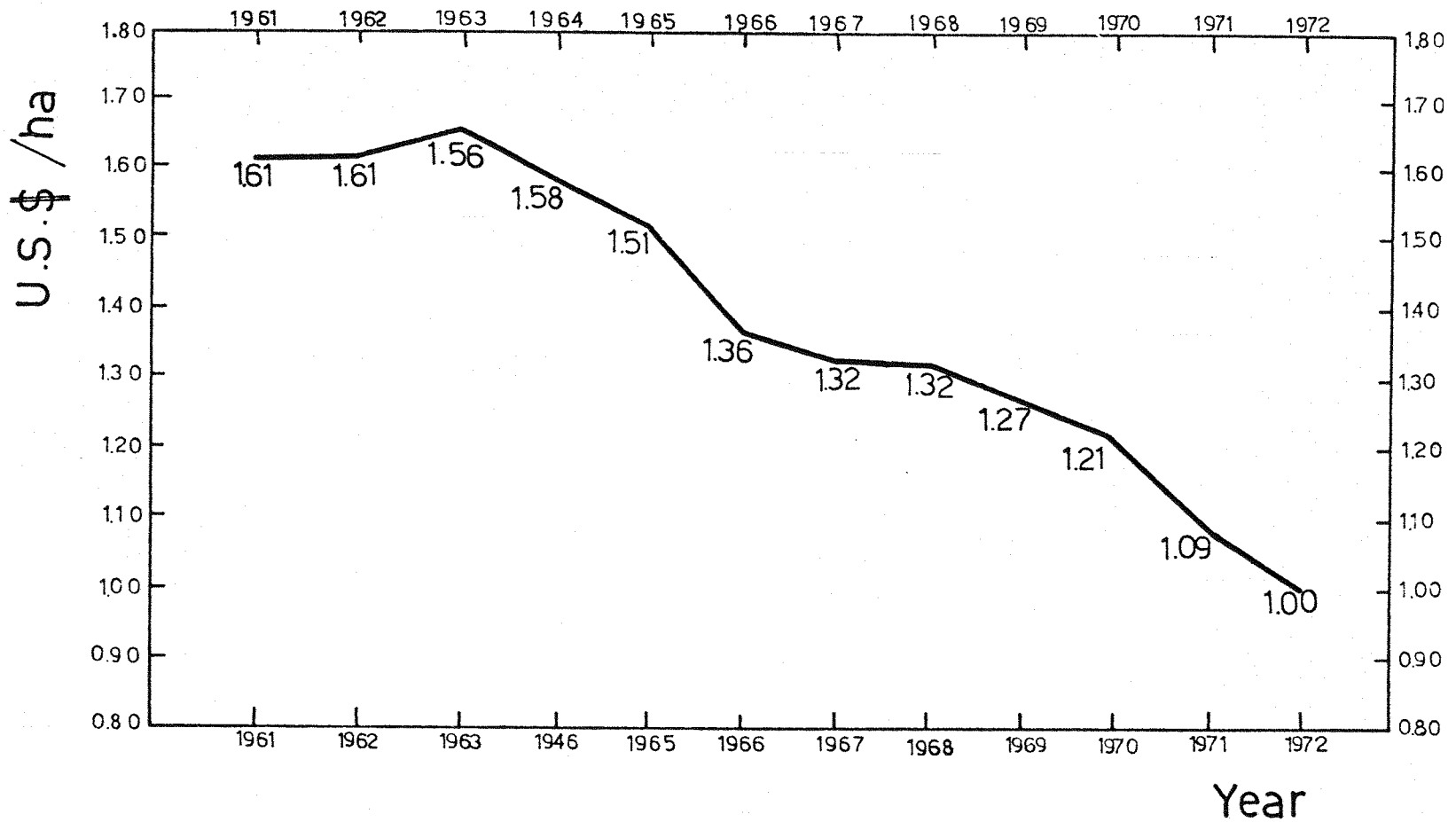


Figure 6_1

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Table 6.1
Different Cases Considered in
Benefit/Cost Analysis

Y \ X	4	5	6	7
Zero	Case 1	Case 9	Case 17	Case 25
1	Case 2	Case 10	Case 18	Case 26
2	Case 3	Case 11	Case 19	Case 27
3	Case 4	Case 12	Case 20	Case 28
4	Case 5	Case 13	Case 21	Case 29
5	Case 6	Case 14	Case 22	Case 30
6	Case 7	Case 15	Case 23	Case 31
7	Case 8	Case 16	Case 24	Case 32

X = Number of years required to reach full crop production

Y = Number of years of directing the project by the Government before distributing the lands to the Settlers

Some of them need all these years to reach their marginal level of production, specially as it is assumed that such level of production is equivalent to that of the fertile cultivated lands, represented by the ancient ones of the Fayoum Governorate.

6.8.2 Capital Cost

The capital cost estimate should include the value of all the resources and activities required to design, construct and put the project into operation, whether such costs are incurred on the site itself or elsewhere. (14).

In the case of a large irrigation project, the true economic cost of the project may well include the value of such items as: preliminary investigations; design and direct construction costs; housing for the construction workers; new access roads and specialized rail wagons for the transport of bulk cement; increased maintenance costs of existing roads arising solely from the project traffic; new harbour facilities; administrative costs; land acquisition and resettlement of the population displaced by the inundation of reservoir areas; relocation of highways and other services in the reservoir area; new police stations and post offices including the salaries of necessary staff; schools and hospitals. All of these facilities or services, in so far as they are provided specifically for or are occasioned by the undertaking of the project are in fact part of its cost because they represent the diversion of national resources to the project. However, certain items enumerated above are commonly not specifically accounted for in the economic capital cost estimate as they can more easily be dealt with by offset against other items.

In the past, very few estimates used for the purpose of economic analysis have included all the true items of cost for instance, increased maintenance on existing roads within the project is generally from the budget of the 'roads department' and thus fails to appear as a cost item in the project estimate. Also, the cost of new police stations and post offices are carried by the relevant government departments and are rarely charged to the project. The omission of such items may frequently result in a considerable underestimation of the project costs and introduces a degree of error at least equal to, if not greater than, any errors that may exist in the estimate of the direct cost of the structure itself.

Normally considerable time and effort are spend in the preparation of reliable estimates of project capital costs, principally because they are used in making the necessary arrangements for the financing of a scheme. Such financial estimates, however, have to be modified for the purpose of economic analysis. The importance of accuracy in such estimates is great because they have a nearly direct effect on the results of the economic analysis. The capital cost of every item of the new irrigation projects in the Fayoum Governorate are shown in Table 6-2 and Figure 6-2 from which we note that the highest value is for levelling which represents 26.90% from the total capital cost and the lowest value is for land washing which represents 1.11% from the total cost.

In the economic analysis of the synthetic irrigation project in the Fayoum Governorate, we assume that the project is completely established throughout the first three years of its economic life and the expenses throughout those three years represent 30%, 40% and 30% from the total capital cost i.e. ₰700/ha, ₰935/ha and ₰700/ha respectively.

Table 6.2

Average Capital Cost of New Irrigation Projects in the Fayoum Governorate (2)

	ITEM	U.S. $ / ha
1	Main Canals, Drains and Headworks	350
2	Small Canals, Drains and small headworks	393
3	Lifting Stations	79
4	Land Washing, Submersion . . . . etc.	26
5	Levelling	628
6	Electrical Works	92
7	Transportation	183
8	Administrative Buildings	45
9	Housing	379
10	Social Services and Amenities	160
	TOTAL	2,335

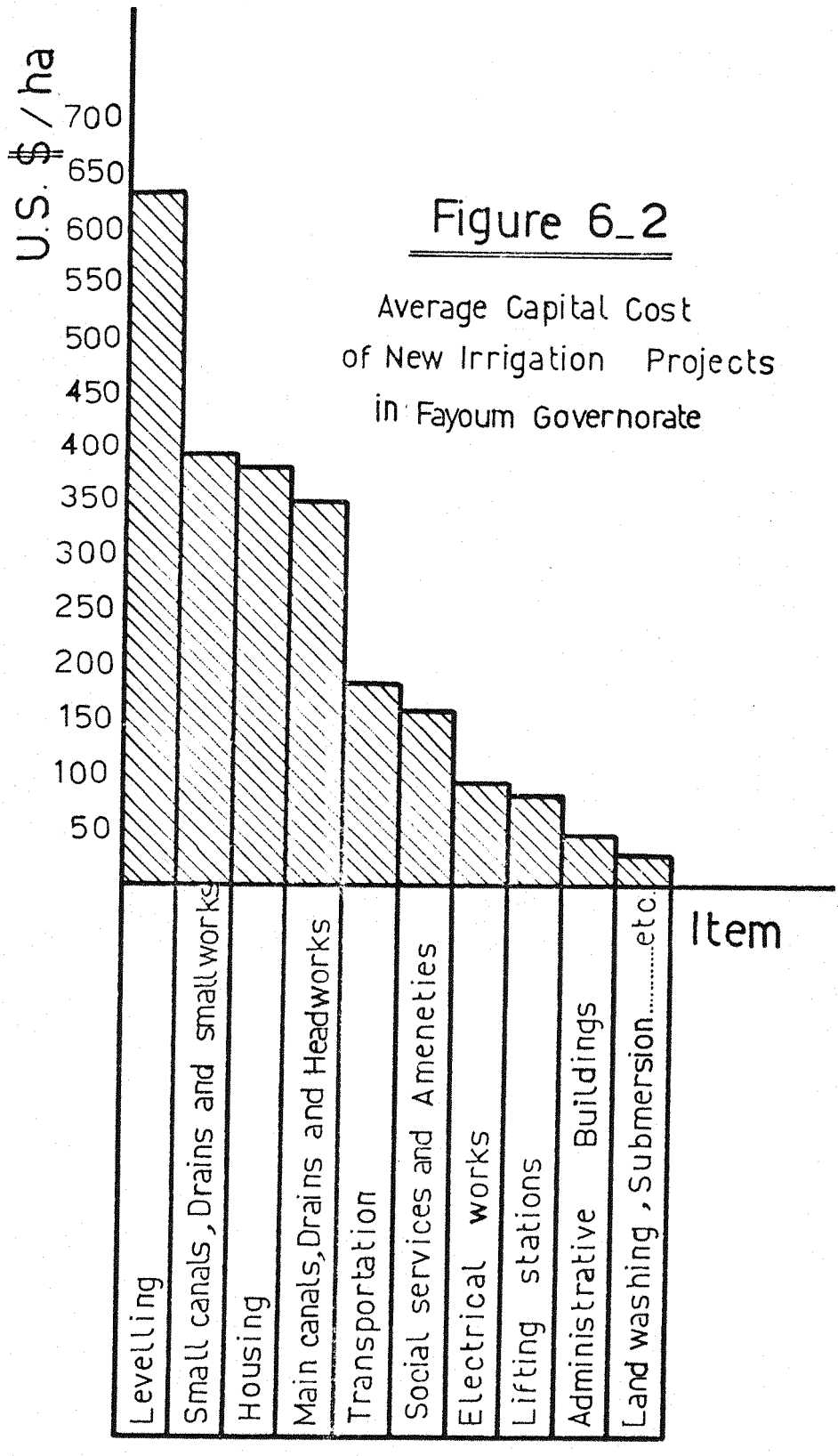


Figure 6_2

Average Capital Cost
of New Irrigation Projects
in Fayoum Governorate

6.8.3. Annual Recurrent Costs.

6.8.3.1 Operation and Maintenance Costs.

The operation and maintenance (O.&M.) costs of irrigation projects are usually very small in comparison with capital cost, particularly in the case of large projects. The O & M costs must, however, be estimated and their incidence taken into account in the economic analysis so as to arrive at the full cost of making the specific facilities available.

In the irrigation projects, large costs are likely to be incurred in the annual maintenance of canals. These costs are frequently not borne directly by the project agency but by the irrigators themselves or by a separate irrigation authority responsible for distribution of water provided from the storage reservoir. Because such costs represent a use of resources, even though they may not be reflected in the operational budget of the dam authority, they must be taken into account in accessing the merits of the proposed development.

The O & M costs generally play a much smaller part in economic analysis or planning than capital cost. This is because they are generally smaller than capital cost and also because their incidence is spread out over time, thus they are considerably affected by the discounting process.

It must, however, be borne in mind that O & M costs may be much more important from the financial point of view than from the economic standpoint. Capital costs are usually financed as a 'one shot' operation at a time when the project has the support and interest of those sponsoring it. In later years, however, when the project may have become an accepted part of the local infrastructure, O & M costs have to be met from the annual revenue of the project and the project will then, in most cases, have to be self-sufficient. Therefore, even though O & M costs may have but a minor effect on the Benefit-Cost Ratio, they should be studied closely in connection with the financial viability of the scheme.(13).

6.8.3.2 Replacement Costs.

The analysis of normal business undertakings requires that considerable sums be provided for the replacement of worn and obsolete equipment. Of these two causes perhaps

obsolescence is the most usual reason for replacement. Machine tools and other manufacturing devices produced today are generally of such quality that, provided they are well maintained, replacements due to excessive wear and tear are seldom called for. Technological progress is, however, proceeding at such a rapid pace that machines are frequently obsolescent and uneconomic to operate long before the end of their physical operating life.

The physical structures associated with Irrigation projects are unusual in this regard; they seldom become obsolete even though their life span greatly exceeds that of the majority of other physical production means. Also, replacements are seldom required because the major structures are built to last, as their replacement would frequently be impracticable. This of course, does not apply to all mechanical items associated with Irrigation projects. Pumps, valves, pipelines and screens require replacing at regular intervals and the costs thereof must be provided for in the project estimates.

There are a few notable exceptions to the statement in the previous paragraph relating to obsolescence of water resources structures; The Aswan Dam in Egypt, in this case the original structure is being superseded by more modern structure (the Saad-el-Ali project). It is suggested that in this case obsolescence of the original structure arises not from an inherent defect of the structure or from any inadequacy in its ability for fulfilling efficiently and economically the purpose it was originally designed to fulfil but rather from startling changes in the economic development of the area which it serves. Although such changes are difficult to foresee, adequate planning and foresight should usually serve to ensure that such obsolenscence is avoided.(13)

The annual recurrent costs which are used in our economic analysis of the synthetic irrigation project in the Fayoum Governorate is divided into two parts:

-the Government expenses through the period of its complete operation of the project before distributing the land to the farmers. We assume that this period is ranged between 1 to 7 years due to the different assumed cases shown in Table 6-1. These mentioned expenses are equal to $72.32/ha as shown in Table 6-3.

- the Government supervision expenses through the other years after distributing the land to the farmers. These expenses are equal to $11.59/ha, as shown in Table 6-4.

Table 6.3

Rate of Annual Recurrent Costs for New Irrigation Projects in the Fayoum Governorate

Item	U.S. $ / ha
Expenditure of Ministry of Irrigation (details are shown in Table 5.14)	5.00
Expenditure of (GEOCD) (details are shown in Table 3.2)	67.32
TOTAL	72.32

Table 6.4

Rate of Annual Recurrent Costs for An Established Irrigation Project in the Fayoum Governorate

Item	U.S. $ / ha
Expenditure of Ministry of Irrigation (details are shown in Table 5.14)	5.00
Expenditure of Ministry of Agriculture (details are shown in Table 5.14)	6.59
TOTAL	11.59

6.8.4. Benefits

The values of benefits used in our economic analysis of the synthetic irrigation project in the Fayoum Governorate are calculated on the value of the yearly average benefit of the established irrigation project in the governorate and this value is equal to $465/ha at 1972 prices, as shown in Table 6-5. We assumed also that the mentioned value represents the maximum output per hectare from the cultivated land in this governorate because this land had reached its marginal level a very long time ago.

In the case of the new irrigation projects in the Fayoum Governorate, we assumed that the cultivated land gives its maximum output ($465/ha) after a period ranging between 4 and 7 years in the assumed thirty-two cases shown in Table 6-1.

We assumed in our economic analysis of the synthetic irrigation project that the increase to full output is linear between the output value at the beginning of the project operation (which equals zero) and the maximum output value (which equals $465/ha.)

Figure 6-4 represents the distribution of benefits and costs for case No.1 during the economic life of our synthetic irrigation project in the Fayoum Governorate (40 years) while Figure 6-5 represents the distribution of benefits and costs for case No.32.

6.8.5. The Economic Analysis

Here we use discounting to help us compare the cost and benefit streams of our synthetic irrigation project in the Fayoum Governorate. We must first discount each stream in order to find its present worth. The streams of benefits for the different cases, mentioned in Table 6-1, are shown in Tables from 6-6 to 6-9 and also in Figure 6-6 at discount rates of 6%, 8% and 10%. The streams of costs are shown in Tables from 6-10 to 6-17 and in Figure 6-7 at the same discount rates. We can see that this has been done for the total costs and the net benefits. Dividing the present worth of the net benefits by the present worth of the total cost we find the benefit - cost ratio.

Table 6.5

Average Annual Benefit from The Established Irrigation Project in the Fayoum Governorate

Year	Annual Benefit U.S. $ / ha	Conversion Factor for 1972 Prices	Annual Benefit at 1972 Prices U.S. $ / ha
1961	234.80	1.61	378.03
1962	275.00	1.61	442.75
1963	283.50	1.65	467.78
1964	294.90	1.58	465.94
1965	258.40	1.51	390.18
1966	303.10	1.36	412.22
1967	332.80	1.32	439.30
1968	375.20	1.32	495.26
1969	424.00	1.27	538.48
1970	467.60	1.21	565.80
1971	525.80	1.09	573.12
1972	411.20	1.00	411.20
		Average	465.00

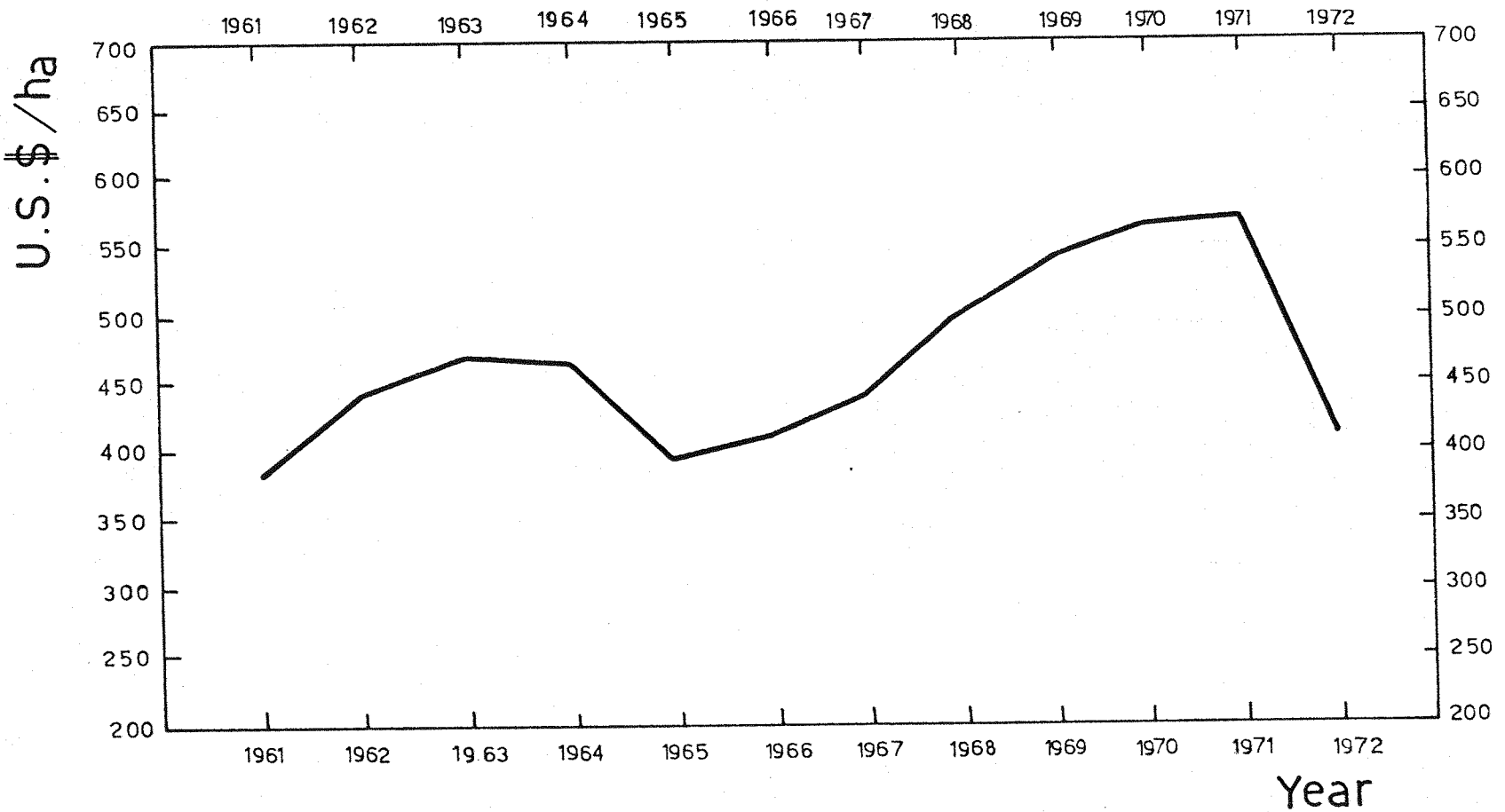


Figure 6_3

Average Annual Benefit (at 1972 Prices)

from the Established Irrigation Project

in Fayoum Governorate

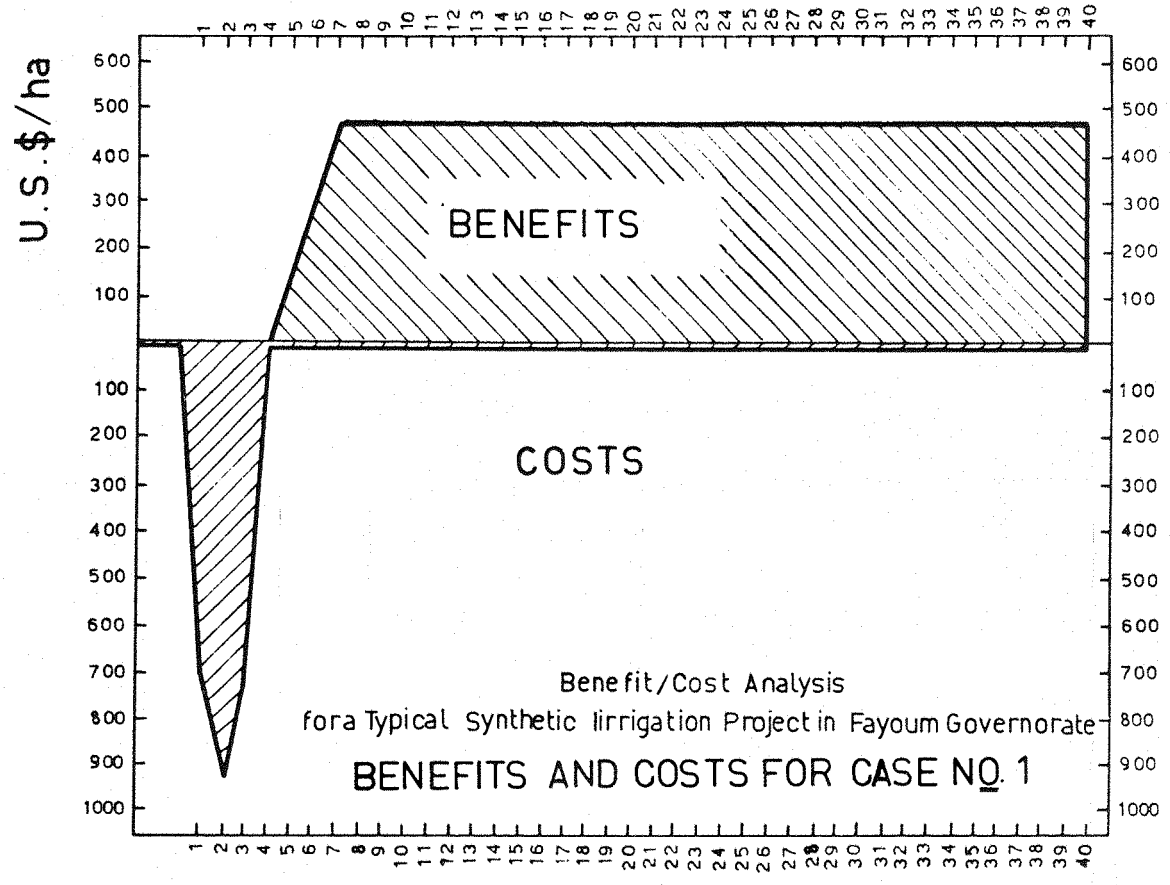


Figure 6_4

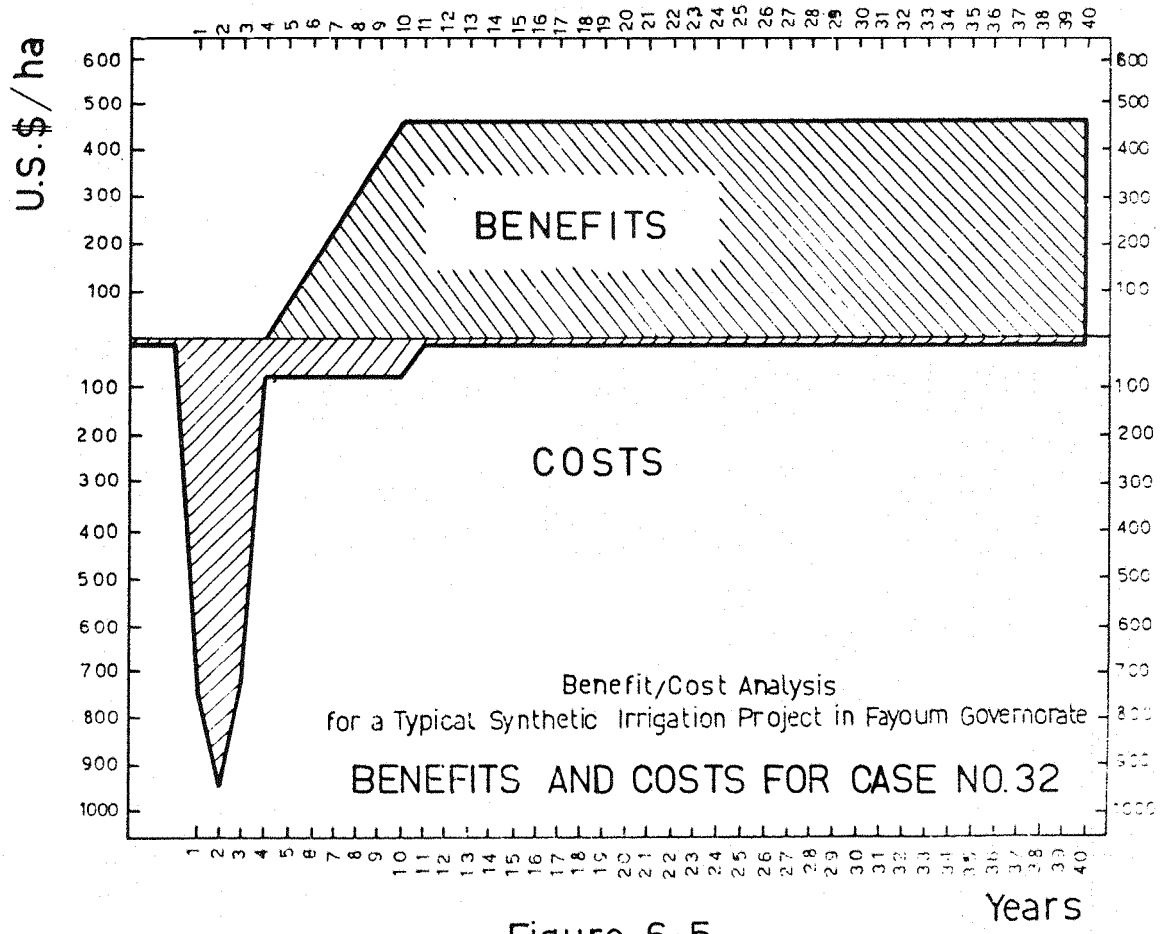


Figure 6_5

Table 6.6

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Benefits for Cases from 1 to 8 — U.S. $ / ha

Year	Annual Net Benefit	Present Worth at Discount Rate of		
		6%	8%	10%
1 – 4	–	–	–	–
5	155	116	106	96
6	310	219	195	175
7 – 40	463	4,710	3,395	2,522
		5,045	3,696	2,793

Table 6.7

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Benefits for Cases from 9 to 16 — U.S. $ / ha

Year	Annual Net Benefit	Present Worth at Discount Rate of		
		6%	8%	10%
1 – 4	–	–	–	–
5	116	87	79	72
6	233	164	147	132
7	349	232	204	179
8 – 40	465	4,401	3,124	2,284
		4,884	3,554	2,667

Table 6.8

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Benefits for Cases from 17 to 24

U.S. $ / ha

Year	Annual Net Benefit	Present Worth at Discount Rate of		
		6%	8%	10%
1 – 4	–	–	–	–
5	93	70	63	58
6	186	131	117	105
7	279	186	163	143
8	372	233	201	174
9 – 40	465	4,109	2,873	2,067
		4,729	3,417	2,547

Table 6.9

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Benefits for Cases from 25 to 32

U.S. $ / ha

Year	Annual Net Benefit	Present Worth at Discount Rate of		
		6%	8%	10%
1 – 4	–	–	–	–
5	78	58	53	48
6	155	109	98	88
7	233	155	136	120
8	310	195	168	145
9	388	230	194	165
10 – 40	465	3,834	2,640	1,869
		4,581	3,289	2,435

Table 6.10

Benefit/Cost Analysis
for a Typcial Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 1, 9, 17 & 25

U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 40	–	11.59	11.59	143	108	85
				2,237	2,127	2,033

Table 6.11

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 2, 10, 18 & 26

U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4	–	72.32	72.32	57	53	49
5 – 40	–	11.59	11.59	134	100	77
				2,285	2,172	2,074

Table 6.12

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 3, 11, 19 & 27 — U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 5	–	72.32	72.32	111	102	94
6 – 40	–	11.59	11.59	126	92	69
				2,331	2,213	2,111

Table 6.13

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 4, 12, 20 & 28 — U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	935	837	806	777
3	700	5	705	592	560	530
4 – 6	–	72.32	72.32	162	148	135
7 – 40	–	11.59	11.59	117	85	63
				2,373	2,252	2,146

Table 6.14

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 5, 13, 21 & 29 — U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 7	–	72.32	11.59	210	190	172
8 – 40	–	11.59	11.99	110	78	57
				2,414	2,287	2,177

Table 6.15

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 6, 14, 22 & 30 — U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 8	–	72.32	72.32	256	229	206
9 – 40	–	11.59	11.59	102	72	52
				2,452	2,320	2,206

Table 6.16

Benefit/Cost Analysis
for a Typical Snythetic Irrigation Projèct in the Fayoum Governorate

Stream of Costs for Cases 7, 15, 23 & 31 — U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 9	–	72.32	72.32	299	265	237
10 – 40	–	11.59	11.59	96	66	47
				2,489	2,350	2,232

Table 6.17

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate

Stream of Costs for Cases 8, 16, 24 & 32 — U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	Present Worth at Discount Rate of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 10	–	72.32	72.32	339	299	265
11 – 40	–	11.59	11.59	89	60	42
				2,522	2,378	2,255

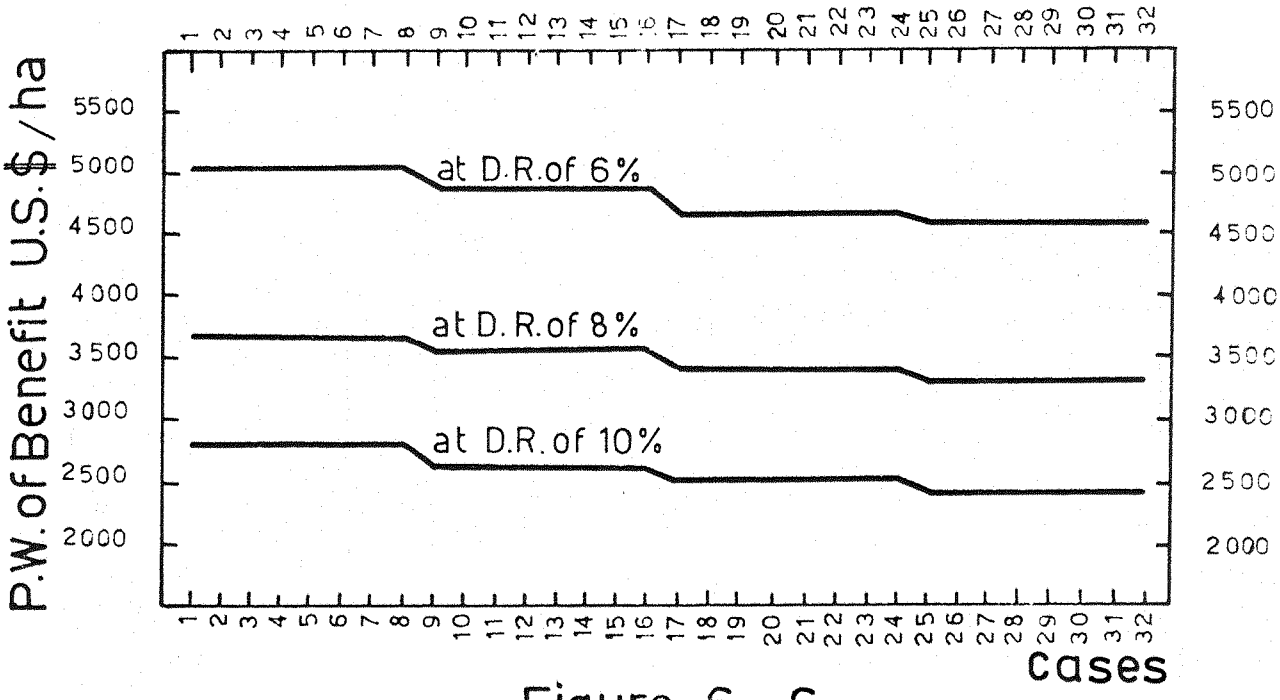


Figure 6_6

Present Worth of Benefit for the Different Cases

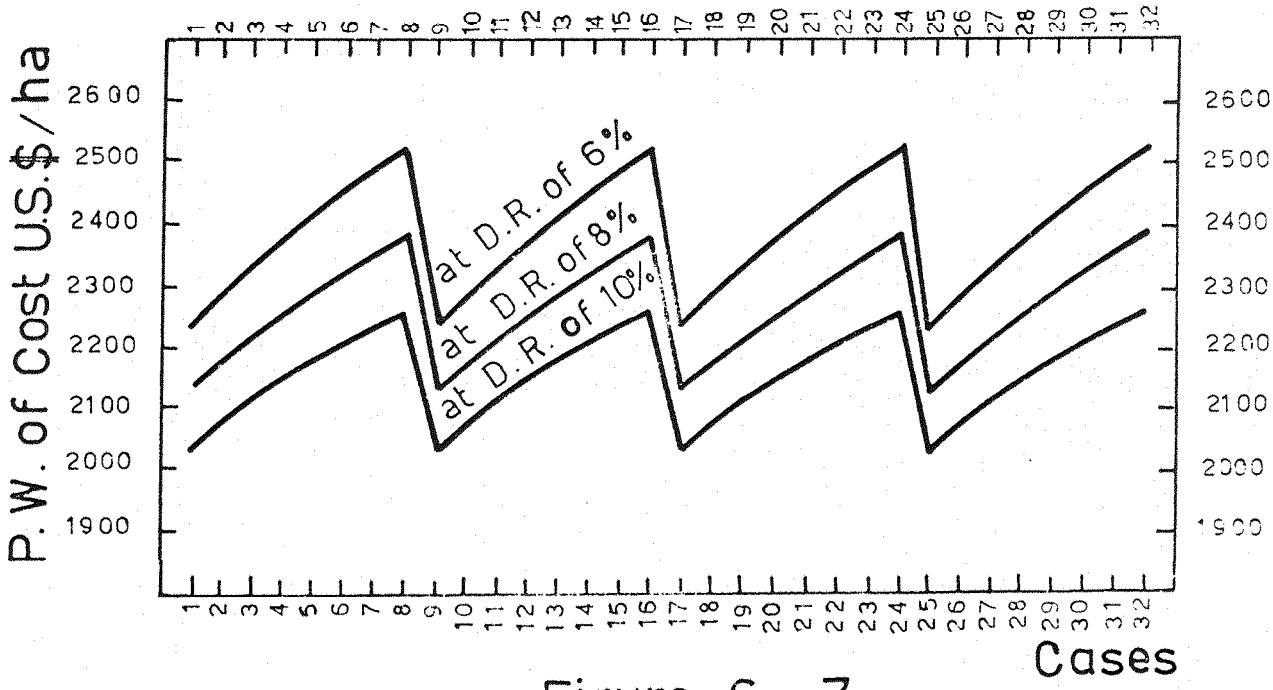


Figure 6_7

Present Worth of Cost for the Different Cases

Table 6-18 represents present worth of benefit, present worth of cost and benefit/cost ratio for the different cases at discount rates of 6%, 8% and 10%. In Table 6-19 and Figure 6-8, the value of benefit/cost ratio are arranged from the higher value of the lower value. We can see from these tables and figures that the best case is case number 1 which has values of benefit/cost ratio equal to 2.23 at D.R. of 6%, 1.74 at D.R. of 8% and 1.37 at D.R. of 10%. We also note that the worst case in our analysis is case number 32 which has values of benefit/cost ratio equal to 1.82 at D.R. of 6%, 1.38 at D.R. of 8% and 1.08 at D.R. of 10%.

There is an important point about the computation in that we cannot take the total of the discount factors and multiply it by the total of the cost or benefit stream to come out with the present worth. Taking the total cost stream of any case, we cannot reach the present worth of that case by multiplying the undiscounted total of the costs, by the total of the discount factors. We must follow the year-by-year procedure.

We note from Table 6-19 that the absolute value of the Benefit/Cost ratio varies depending on the discount rate chosen. The higher the discount rate, the smaller the resulting benefit-cost ratio. For the assumed thirty-two cases, we note from the same table that all values of benefit/cost ratio are greater than one at the chosen discount rates of 6%, 8% and 10%. If a high discount rate is chosen, the benefit/cost ratio will be driven to less than one. For example, if the discount rate is greater than 13% in case No.1, as shown in Figure 6-9, the benefit/cost ratio will be driven down to less than one. The same thing is shown in the same figure for case No.32 if the discount rate is greater than 10.7%.

Table 6.18

Calculation of Benefit/Cost Ratio for the Different Cases

Case	Present Worth of Benefit at Discount Rate of			Present Worth of Cost at Discount Rate of			Benefit / Cost Ratio at Discount Rate of		
	6%	8%	10%	6%	8%	10%	6%	8%	10%
1	5,045	3,696	2,793	2,237	2,127	2,033	2.23	1.74	1.37
2	5,045	3,696	2,793	2,285	2,172	2,074	2.21	1.70	1.35
3	5,045	3,696	2,793	2,331	2,213	2,111	2.16	1.67	1.31
4	5,045	3,696	2,793	2,373	2,252	2,146	2.13	1.64	1.30
5	5,045	3,696	2,793	2,414	2,287	2,177	2.10	1.62	1.28
6	5,045	3,696	2,793	2,452	2,320	2,206	2.07	1.59	1.26
7	5,045	3,696	2,793	2,489	2,350	2,232	2.04	1.57	1.24
8	5,045	3,696	2,793	2,522	2,378	2,255	2.00	1.54	1.22
9	4,884	3,554	2,667	2,237	2,127	2,033	2.18	1.67	1.31
10	4,884	3,554	2,667	2,285	2,172	2,074	2.14	1.64	1.30
11	4,884	3,554	2,667	2,331	2,213	2,111	2.10	1.61	1.26
12	4,884	3,554	2,667	2,373	2,252	2,146	2.07	1.58	1.24
13	4,884	3,554	2,667	2,414	2,287	2,177	2.03	1.55	1.22
14	4,884	3,554	2,667	2,452	2,320	2,206	2.00	1.53	1.21
15	4,884	3,554	2,667	2,489	2,350	2,232	1.96	1.51	1.18
16	4,884	3,554	2,667	2,522	2,378	2,255	1.96	1.50	1.18
17	4,729	3,417	2,547	2,237	2,127	2,033	2.10	1.61	1.26
18	4,729	3,417	2,547	2,285	2,172	2,074	2.07	1.57	1.24
19	4,729	3,417	2,547	2,331	2,213	2,111	2.03	1.54	1.22
20	4,729	3,417	2,547	2,373	2,252	2,146	2.00	1.52	1.19
21	4,729	3,417	2,547	2,414	2,287	2,177	1.95	1.49	1.16
22	4,729	3,417	2,547	2,452	2,320	2,206	1.93	1.47	1.16
23	4,729	3,417	2,547	2,489	2,350	2,232	1.90	1.45	1.14
24	4,729	3,417	2,547	2,522	2,378	2,255	1.88	1.44	1.12
25	4,581	3,289	2,435	2,237	2,127	2,033	2.03	1.55	1.22
26	4,581	3,289	2,435	2,285	2,172	2,074	2.00	1.51	1.18
27	4,581	3,289	2,435	2,331	2,213	2,111	1.96	1.49	1.16
28	4,581	3,289	2,435	2,373	2,252	2,146	1.93	1.46	1.14
29	4,581	3,289	2,435	2,414	2,287	2,177	1.90	1.44	1.12
30	4,581	3,289	2,435	2,452	2,320	2,206	1.87	1.42	1.10
31	4,581	3,289	2,435	2,489	2,350	2,232	1.84	1.40	1.09
32	4,581	3,289	2,435	2,522	2,378	2,255	1.82	1.38	1.08

Table 6.19

Benefit/Cost Ratio for the Different Cases
Arranged from the Higher Value to the Lower Value

Case	Benefit/Cost Ratio at Discount Rate of			Case	Benefit/Cost Ratio at Discount Rate of		
	6%	8%	10%		6%	8%	10%
1	2.23	1.74	1.37	8	2.00	1.54	1.22
2	2.21	1.70	1.35	14	2.00	1.53	1.21
9	2.18	1.67	1.31	20	2.00	1.52	1.19
3	2.16	1.67	1.31	26	2.00	1.51	1.18
10	2.14	1.64	1.30	15	1.96	1.51	1.18
4	2.13	1.64	1.30	16	1.96	1.50	1.18
5	2.10	1.62	1.28	27	1.96	1.49	1.16
11	2.10	1.61	1.26	21	1.95	1.49	1.16
17	2.10	1.61	1.26	22	1.93	1.47	1.16
6	2.07	1.59	1.26	28	1.93	1.46	1.14
12	2.07	1.58	1.24	23	1.90	1.45	1.14
18	2.07	1.57	1.24	29	1.90	1.44	1.12
7	2.04	1.57	1.24	24	1.88	1.44	1.12
13	2.03	1.55	1.22	30	1.87	1.42	1.10
25	2.03	1.55	1.22	31	1.84	1.40	1.09
19	2.03	1.54	1.22	32	1.82	1.38	1.08

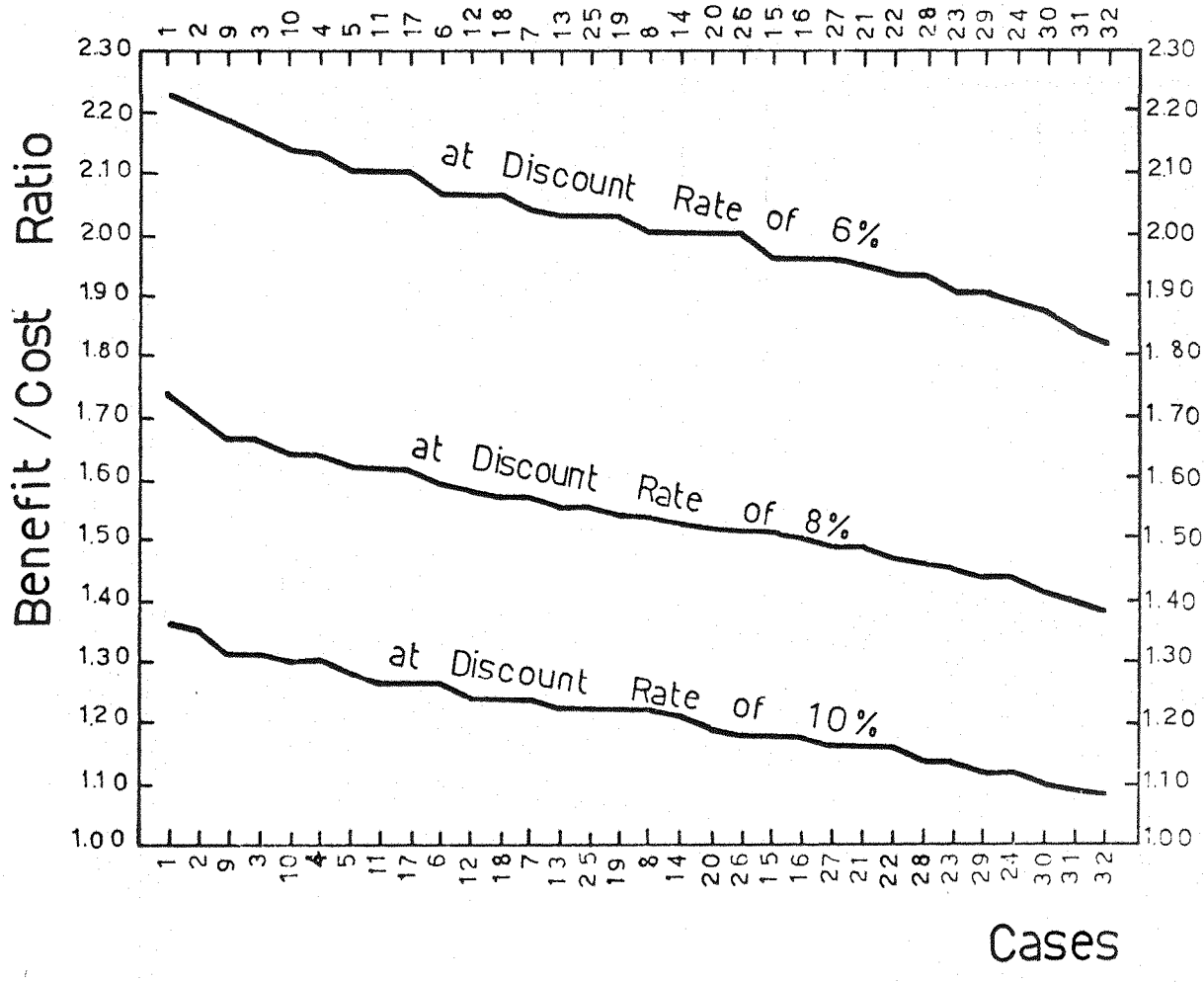


Figure 6_8

Benefit/Cost Ratio for the Different Cases

at Discount Rates of 6%, 8%, 10%

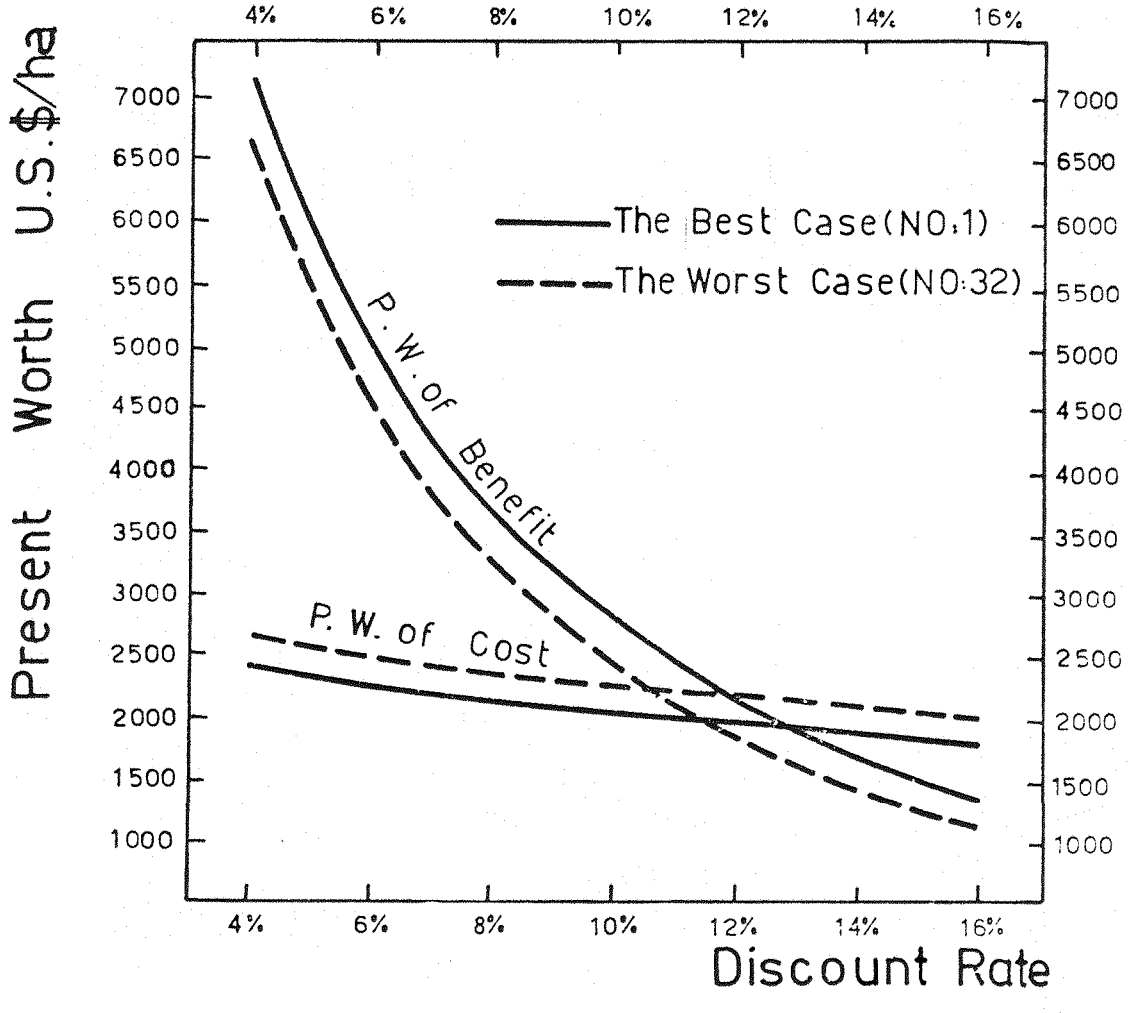


Figure 6_9

Present Worth of Benefits and Present Worth of Costs for the Best and the Worst Cases at the Different Discount Rates

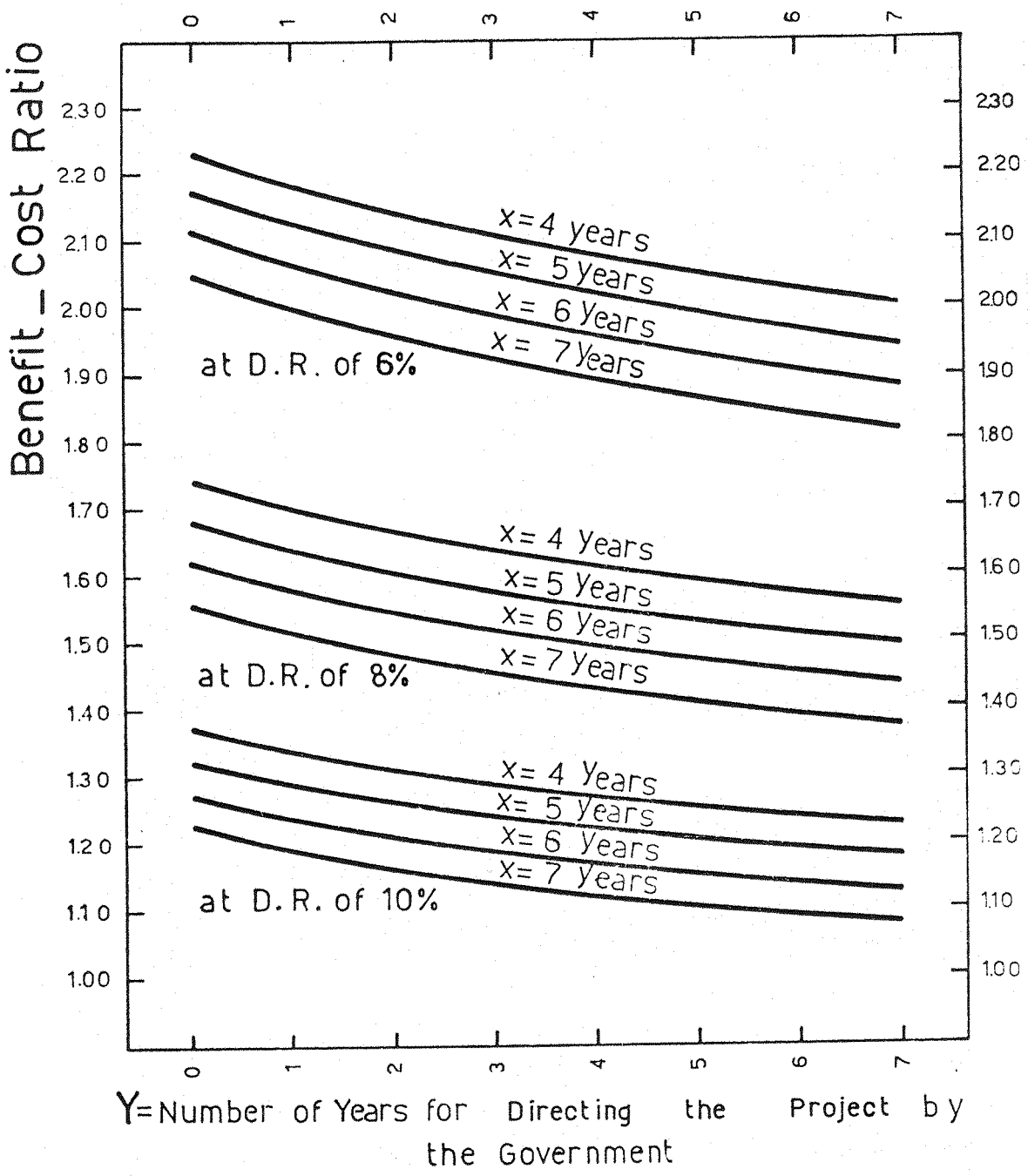


Figure 6_10

"the Synthetic Irrigation Project in Fayoum Governorate"

Relation between Benefit/Cost Ratio and Number of Years for Directing the Project by the Government

If the benefit-cost ratio, in some cases, worked out to be less than one, this is because we have cases where at the discount rate assumed, the present worth of the benefits is less than the present worth of the costs and the investment is not recovered. In these cases, it would be better to put the money in a bank at the assumed interest rate than to invest it in the project.

6.9 A Study on State Farms

State farms are those where the Government practises, through a governmental organization, the management and utilization of agricultural projects. As regards the economic analysis of the synthetic irrigation project of the Fayoum Governorate, we assumed the application thereto, of the state farm system, on the basis that this project be managed and utilized by the Government, during its expected economic life (40 years), through the GEOCD.

Table 6-20 shows the Present Worth of the benefits in this case, when the Discount Rate = 6%, 8% and the value of X = 3, 4, 5, 6 and 7 (where X = the number of years necessary for the land to reach its maximum production).

From Table 6-21, it is evident that the annual recurrent costs = $72.32/ha, on the assumption that they are stable all the operation years round.

Table 6-22 shows the values of Benefit-Cost Ratio, reduced to a certain extend. It may be noted that when X = 7, i.e. in case the land production reaches its maximum, after 7 years and when the Discount Ratio = 10% the value of Benefit/Cost Ratio then = 0.98 (less than 1).
This means that the State farm system, in this case, will be uneconomic.
Therefore, the value of Benefit/Cost Ratio decreases under 0.98, the more the value of X rises over 7, and also when the Discount Rate increases.

In such cases, it will be much better to invest the capital cost in any other project, or to deposit it with any Bank at the same value as Discount Rate.

Table 6.20

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate
Benefits for the Case of Governmental Farms U.S. $ / ha

X	P.W. at D.R. of		
	6%	8%	10%
4	5,045	3,696	2,793
5	4,884	3,554	2,667
6	4,729	3,417	2,547
7	4,581	3,289	2,435

Table 6.21

Benefit/Cost Analysis
for a Typical Synthetic Irrigation Project in the Fayoum Governorate
Stream of Costs for the Case of Governmental Farms U.S. $ / ha

Year	Capital Cost	Recurrent Cost	Total Annual Cost	P.W. at D.R. of		
				6%	8%	10%
1	700	5	705	665	653	641
2	935	5	940	837	806	777
3	700	5	705	592	560	530
4 – 40	–	72.32	72.32	895	676	527
				2,989	2,695	2,475

Table 6.22

Benefit/Cost Ratio
for the Case of Governmental Farms
at Discount Rates of 6%, 8% & 10%

X	B/C Ratio at D.R. of		
	6%	8%	10%
4	1.69	1.37	1.13
5	1.63	1.32	1.08
6	1.58	1.27	1.03
7	1.53	1.22	0.98

6.10 Discussion.

Following the economic analysis of the synthetic irrigation project in the Fayoum Governorate we made, and after obtaining the value of Benefit-Cost in the 32 assumed cases, with regard to the method used for the utilization, at present, of the newly cultivated lands in Egypt, i.e. that which concerns putting the lands into the possession of farmers, many years after the completion of projects, we have observed, from Table 6-19 and Figure 6-10 and by referring to Table 6-1, that the value of Benefit-Cost Ratio generally increases the more the value of Y decreases, i.e. the more the number of years during which the project is managed by the Government. It was also found that the value of Benefit-Cost Ratio reaches its maximum when Y = 0, i.e. in case where the lands are put into farmers' possession, soon after the completion of the project. The value of Benefit-Cost Ratio that decreases the more the value of Y increases, i.e. the more the number of years, during which the project is managed by the Government, increases. We found that the value of Benefit-Cost Ratio reaches a maximum in case No.1, where Y = 0 and X = 4, (whereas X is the number of years needed for the land to reach maximum production). Furthermore, we have found that the value of Benefit-Cost Ratio reached its minimum in the case No.32, where Y = 7 and X = 7.

As regards State farms, assumed in this research, it was found that the value of Benefit-Cost Ratio, in this case, was relatively less than the values of the 32 other cases concerning the vesting of the cultivated-land ownership to farmers. If we make such a comparison between a case of putting the lands into the possession of farmers, immediately after the completion of the project (case No.1 of the economic analysis) and that of State farms, wherein the project is managed by the Government until the end of its economic life. It may be observed, however , that the value of Benefit-Cost Ratio in the former case exceeds that in the case of State farms at different values of Discount Rates. It increases at a rate of 25% when D.R. = 6%, at 21% when D.R. = 8% and at 18% when D.R. = 10%.

As regards State farms, it may be noted that when the land production reaches its maximum after 7 years, when D.R. = 10%, the project, in this case, becomes uneconomic, as the value of Benefit-Cost Ratio = 0.98 (less than 1).

And so, figures have shown that the best possible method of economic utilization of the newly cultivated lands in Egypt is to put them into the possession of farmers, immediately after the completion of projects, and that the worst economic utilization of such lands is the State farm method.

It may be observed that in the comparison previously made, the value of X was constant. This means that the new cultivated lands, when put into farmers' possession, reach their maximum production after the same number of years of that in the case of State farms. This, in fact, is absolutely countrary to reality. Practice in Egypt has proved that where lands are put into the farmers' possession, they reach their maximum production, a few years after the completion of projects. In the case of State farms, practice has proved that the land needs many years to reach its maximum production - a situation that causes damage to such farms.

The cause of this lies in the beliefs and traditions of the Egyptians as well as in their inherited cultural background and their understanding of freedom. The significance of freedom to the Egyptian farmer is meaningless without private ownership. In a case where a stretch of land is made available to a farmer and his family for private ownership, he will exert all his efforts to obtain, as urgently as possible, the maximum return of his new land. Furthermore, he does all he can to realize the best utilization of the land and to increase its production, as he feels that this production will be for him solely. In fact, the creation of this personal incentive and its fruitful effort cannot be realized if the farmer is employed as a paid worker on another's land.

There is too, a further reason. The farmer migrated to a new land to become its owner, he and his family members establish themselves within an integrated social enviroment, and all contribute to the development of economic and social life. This is contrary to what happens in State farms, where

seasonal workers are employed. They live in the new land away from their families, thus causing many complicated social and psychological problems to arise and reflect their results in the amount of effort exerted in land service.

In the case of State farms, the personal motice to exert the maximum effort is lacking, and all farmers become paid workers, who receive their wages whether for major or for minor efforts. This is clearly evident in the new irrigation projects in Egypt. These projects for long after completion have been managed or their lands have been cultivated by the Government, which failed to develop them to the range of productivity, even after many years have elapsed. This, in fact, has disturbed the economis value of these projects.

Consequently and as a remedy for such a state of affairs, the Egyptian Government put these lands into the farmers' possession so that they might themselves proceed with their cultivation. Thus, after being put into the farmers' possession, the lands actually realized more than expected. Some of these lands are situated in the following areas:- Abis, Kom Ombo, El-Mataana, Armant, The Tahrir Province, Wadi Natroun and the New Valley (14).

From the foregoing, it is clear that the method of putting the cultivated lands into the farmers' possession not only gives a more economic return than the State farms, as evidenced by the results of the economic analysis of the synthetic irrigation project, but it also has another advantage that raises the economic value of projects. This is the fact that the productivity of the lands in the farmers' possession, reaches its maximum in less time than that of State farms.

From this fact, we may conclude that the best possible method for the utilization of the new cultivated lands in Egypt is to place them in the farmers' possession, in order that they themselves use them from the very beginning, with the help of the cooperative regime, which provides the various requirements of production, such as machines, seeds, fertilizers, pesticides, etc. and help in marketing the different crops.

However, there is only one disadvantage with regard to

individual landownership in Egypt. It is that the distribution of cultivated lands to farmers, in small stretches of about 2 hectares each, means fragmentizing the cultivated lands, particularly if we take into consideration that such areas are liable to be sub-divided amongst the inheritors and the descendants of the successive generations, or partially sold in some cases, such as marriage or payment of debts.

Undoubtedly, the phenomenon of fragmentizing the ownership of the cultivated lands has its harmful effects on agricultural production, due to the difficulty of applying a suitable agricultural rotation and the infeasibility of using the mechanical agricultural tools, on a large scale, in the small areas of the land owned. There is also the difficulty of serving the land, particularly if the adjacent areas are growing different crops, each of which requires special treatment.

To remedy the problem of fragmentizing the ownership of cultivated lands in Egypt, protective measures against further minimization and dispersion of these ownerships should be taken. Moreover, measures should also be taken to assemble and to integrate the scattered landlordships.

As regards protection against the decline of the ownership of cultivated lands, the Government has decided that in a case where the landlord dies and the division of his land amongst his inheritors results in reducing the areas of the inherited land to less than 1.25 hectares, such division shall be prohibited, and the land shall be owned by one or two of the inheritors, according to its area. The remainder of the inheritors shall be compensated in cash payments, to be incurred by those who possessed the land.

In our opinion, should the inheritor who possesses the land according to this system, fail to pay the compensation promptly in cash money to the other inheritors, the Government should do so on his behalf, provided that he repays the compensation to the Government in annual instalments. It is also necessary that this scheme be administered by an official independent authority, provided with all the technical and financial resources required.

As regards the measure taken by the Government to re-

assemble the scattered lands in private ownership, it adopted a method, namely 'method of accumulating the fragmentized cultivated lands and organization of the agricultural rotations.'

In short the said accumulation method invites farmers to agree themselves, through their Agricultural Cooperative Societies, to divide all the village lands, considering them as being one unit, into two or three parts, and to apply a doubled or tripled rotation, suitable to the conditions of the lands and their owners. They should also agree on the crop to be cultivated in each part of the rotation. Each farmer will then cultivate the whole of his land to grow the crop already determined for the area where his land is situated. In order to give the opportunity to farmers to benefit by the different rotation crops, an agricultural exchange takes place between themselves. Thus, every farmer can benefit by the kinds of crops, which were grown outside his own land.

This method was applied for the first time in Egypt, in 1956, in Nawag village area, Gharbia Governorate. The result was truly encouraging. The yield of the cotton crop, in this village area, increased during the following three years, from 1.61 tons per hectare, in the first year, to 2.55 tons per hectare in the second, and to 2.89 tons per hectare in the third.

CHAPTER 7
CONCLUSIONS.

7.1.

From the foregoing, it may be concluded that the best economic utilization possible with regard to the new irrigation projects in Egypt is to put the cultivable lands into the possession of farmers immediately after the completion of projects in order that they themselves may proceed with the utilization of the lands with the assistance of Agricultural Cooperative Societies, which provide them with machines, seeds, fertilizers, etc.
It has been proved that the utilization of lands in this way has a significant economic value for two main reasons; the first is that because no administrative expenses are incurred the annual expenses for the land are reduced and the second is the large and swiftly gained yield obtainable from the land, due to the availability of the farmer's personal incentive to exert all efforts to serve his land. This is because he feels that he is its proprietor and that its yield will solely be for him.

7.2

From the foregoing, it may also be concluded that the more the years of government management of agricultural projects increases, the more their economic value decreases. This is due to the huge administrative expenses incurred and to the lack of personal incentives offered to officials and employed labours to work as hard as they can; the lands then fail to reach their maximum production.

7.3

It may also be concluded that the utilization of irrigation projects in Egypt, through the application of State Farm system is unprofitable from the economic point of view and may expose the investment of such projects to become a real loss.

From the above the following suggestions could be considered:

(1) It is suggested with regard to irrigation projects that the Egyptian Government proceeds with the landlordism of the newly cultivated lands immediately after the completion of such projects. Meanwhile, it is proposed that the Government also proceeds with the liquidation of the present State Farms and distributes its lands to farmers, in order

to obtain the maximum benefit at the lowest cost.

(11) It is proposed that the Egyptian Government should encourage the foundation and propagation of Agricultural Cooperative Societies amongst farmers in the country, and should offer them the necessary aids, having regard to the important role such societies play in serving farmers, and, in other words, the agricultural production.

(111) In order that the individual landownership system, which is recommended becomes exemplary, it is suggested that agricultural rotations in villages be systematized, through the application, in all villages, of the already-mentioned system, namely, 'the integration of frittered lands and systematization of the agricultural rotation' with a view to benefiting from its advantages.

APPENDEX (A)

SOIL SURVEY and LAND CLASSIFICATION OF THE FAYOUM GOVERNORATE (15)

A.1 Land Classification According to Productivity:

Land productivity classification of the Fayoum Governorate includes six classes, according to the three major following factors:

1. Present productivity.
2. Chemical and physical properties of the soil.
3. Costs of management.

The land classes are:

A.1.1. Class 1 land.

At the south east of Ibshwai and the south west of Sinoris, the soil is alluvial, loamy or clay loam. The majority of these soils are very suitable for raising all kinds of field crops and fruit trees. The area amounts to 4,535 hectares or 2.49% of the total area.

A.1.2. Class 2 land.

These soils are in the middle of the Governorate. They are fertile soils and raise good crops, supplied with adequate canals and drains and free from injurious soluble salts, the electrical conductivity does not exceed 4 mmhos/cm at 25 . C and are free from alkalinity. The area is about 27,173 hectares i.e. 14.92% of the total area.

A.1.3. Class 3 land.

These lands are in the north east, north west and south of the Governorate. They give rather moderate yields. The soils are alluvial light to heavy clay. These soils contain a moderate amount of salts and fair alkalinity due to the inadequate means of drainage. These soils do need an efficient drain system along with proper field operations. The area is nearly 82,612 hectares or 45.36% of the total area.

A.1.4 Class 4 land.

These soils are rather poor, just newly cultivated or under reclamation; they are located on the north part of the Governorate adjacent to Qarun lake and at the eastern and southern parts adjacent to the hilly area, beside some scattered spots in the middle and western parts of the

Governorate.

Some are sandy or under reclamation. These need leaching and efficient irrigation and drainage systems.

These soils give poor yields i.e. much less than the total average yields. The area is nearly 24,059 hectares or 13.21% of the total area.

A.1.5 Class 5 land.

The majority of this area is in the east, south, north and north-west of the Governorate. The soils under this class are barren and swampy soils:

(a) The barren soils have not been put under reclamation and are in need of irrigation and drainage projects. The total area of these lands is about 21,709 hectares i.e. 11.92% of the total area.

(b) Swamps: these are the low-lying soils which are highly impregnated with salty water. The reclamation of these areas needs a good system of drainage to get rid of the high ground water level. The total area of the swamps is 1,475 hectares i.e. 0.81% of the total area.

A.1.6 Class 6 land.

This compromises the following:

(a) Area occupied by public utilities such as roads, drains, railways and cities. It amounts to 9,562 hectares i.e. 5.25% of the total area.

(b) Uncultivable land including rocky and shallow soils and this is about 11,000 hectares i.e. 6.04% of the total area.

Figure A-1 (map) comprises the soil classes as mentioned above.

A.2 Land Classification According to the Soil Texture.

After the field investigation and laboratory analysis, the soils of the Fayoum Governorate could be classified, according to the description of the major kinds of soil profiles, into the following groups:

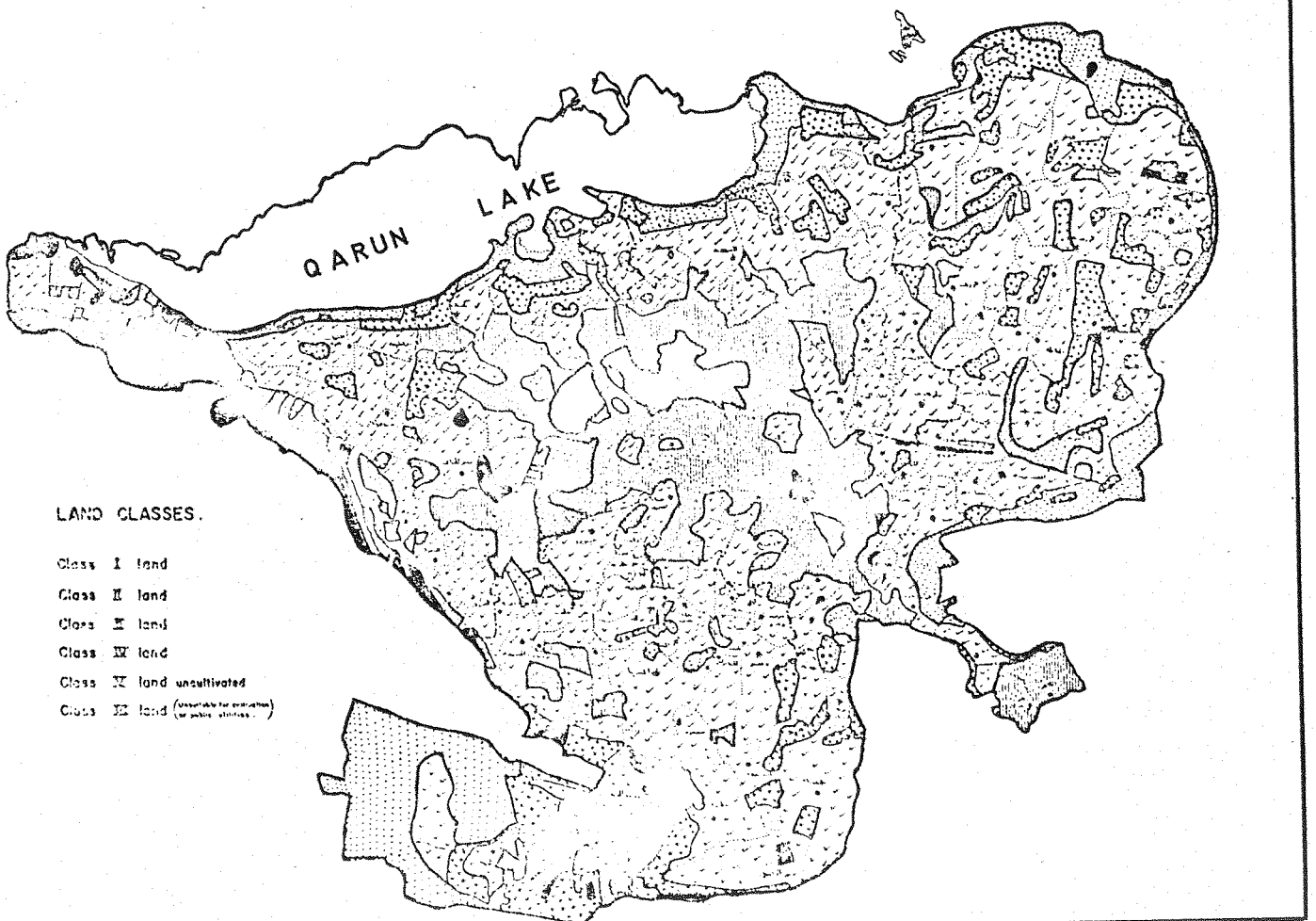
A.2.1. Heavy Texture Soils:

(a) Deep soils, light to heavy clay. The top soil may be light clay underlain by a heavy clay or the topsoil may be clay loam or sandy loam and the subsoil is clay. The structure is columnar or blocky. The water saturation capacity is 50-100%.

The calcium carbonate content is 2-4%, the clay is 50-80%, silt is 10-15%, fine sand is 10-25% and coarse sand is 4-15%.

Figure A-1

LAND CLASSIFICATION OF FAYOUM PROVINCE ACCORDING TO PRODUCTIVITY



(b) Deep soils, heavy or light clay soils, rather calcareous, the calcium carbonate content is about 10%.

The water saturation capacity is 100-150%. The hydraulic conductivity is less than o.ol Cm./hour.

(c) Light to heavy clay and highly calcareous, gypsum is widely scattered in the profile either as craystals or in alternate layers of 1-5 Cm. thickness. These layers are found at 25 Cm. from the soil surface.

Table A-1 shows the chemical and mechanical analysis of some representative profiles of the heavy soils.

A.2.2 Medium Textured Soils:

(a) Deep clay loam or loamy soils. The top layer may be medium texture of clay loam, sandy clay or sand followed by clay loam or loam.

The structure is granular, the colour is brown to dark brown, Ca Co_3 content is 2-4%. The water saturation capacity is 30-60%, the hydraulic conductivity is rather moderate i.e., 0.1 Cm. Per hour. The clay content is 15-40% silt is 10-25%, fine sand is 12-25% and the coarse sand is 2-19%.

(b) Deep soils, loamy clay or calcareous loamy soils, the Ca Co_3 content is 10%, gypsum crystals or clusters are apread through the whole profile. The soil is rather compacted with granular structure and yellowish colour, the water saturation capacity is more than 60% while the water permeability is less than 0.1 Cm/hour.

Table A-2 shows the chemical and mechanical analysis of some representative profiles of the medium texture soils.

A.2.3. Coarse Textured Soils.

(a) Deep soils, coarse textured, i.e. sandy loam or loamy sand, or the surface soil may be of medium texture i.e. clay loam or loam and the subsoil is loamy sand or sandy loam, generally speaking, the soil is rather compacted, with granular structure, the water saturation capacity is 25-40%. It is rather permeable to water i.e. more than 1 Cm/hour. The clay content is 15-35%, silt is 2.5-11%, fine sand is 15-40% and the coarse sand is 30-35%.

(b) Deep calcareous coarse textured soils i.e. sandy loam or loamy sand, the Ca Co_3 is 10%, the soil is compacted with a granular structure. The water saturation capacity

Table A – 1

The Chemical and Mechanical Analysis of Some Representative Profiles of the Heavy Soils in the Fayoum Governorate

Depth	pH 1 : 2.5	Saturation Capacity %	E.C. mmhos/cm. at 25°	Meq/L. in the extract of saturated paste							Mechanical Analysis					
				Cations				Anions			Clay	Silt	F.S.	C.S.	$CaCO_3$	T.S.S.
				Ca	Mg	Na	K	CO_3	HCO_3	C 1	%	%	%	%	%	%
0 – 30	8.2	72	1.9	2.1	0.9	18	0.2	traces	7.6	9	46.00	31.50	11.40	4.93	5.80	0.37
30 – 60	8.2	90	5.6	4.3	4.7	53	0.4	"	4.0	32	54.00	19.00	17.00	2.64	6.20	0.66
60 – 90	7.3	85	7.1	5.0	9.6	60	0.4	–	1.9	43	57.50	26.00	4.32	4.18	7.30	0.70
90 – 120	7.3	84	7.6	6.9	11.3	63	0.5	–	1.6	48	67.00	6.50	15.98	2.36	7.40	0.76
120 – 150	7.3	85	7.9	7.9	13.8	64	0.5	–	2.0	50	64.50	23.00	1.02	2.30	8.40	0.78
0 – 40	7.5	75	39.6	102.0	75.0	385	5.5	–	1.1	435	49.01	12.14	7.68	4.17	22.00	5.0
40 – 100	7.7	66	38.9	79.0	779.0	390	5.0	–	0.8	412	52.14	10.11	6.69	4.66	22.00	4.4
100 – 150	7.7	67	28.3	54.0	50.0	305	3.5	—	1.0	282	45.32	13.21	10.06	7.81	20.00	3.6
0 – 30	7.8	47	43.1	83.6	18.7	390	5.0	–	1.3	390	51.00	4.50	21.88	15.00	2.42	5.2
30 – 80	7.8	71	26.75	45.6	25.6	230	4.0	–	1.3	202	70.50	6.00	11.63	6.33	0.94	4.6
80 – 100	7.5	73	26.2	38.4	16.7	267	3.0	–	1.3	209	67.50	4.50	16.40	4.78	1.62	5.2

T.S.S. = Total soluble salts as determined from (1 : 20) soil water extract

Table A – 2

The Chemical and Mechanical Analysis of Some Representative Profiles of the Medium Texture Soils in the Fayoum Governorate

Depth	pH 1 : 2.5	Saturation Capacity %	E.C. mmhos/cm. at 25°	Meq/L. in the extract of saturated paste							Mechanical Analysis					
				Cations				Anions			Clay	Silt	F.S.	C.S.	$CaCO_3$	T.S.S.
				Ca	Mg	Na	K	CO_3	HCO_3	C l	%	%	%	%	%	%
0 – 30	7.4	32	0.80	2.60	3.40	3.00	0.3	–	3.00	4	40.00	12.50	35.77	10.19	1.40	0.14
30 – 60	7.4	30	0.60	3.70	0.30	2.20	0.2	–	2.00	2	31.00	10.50	39.31	18.00	1.07	0.12
60 – 100	7.4	29	0.43	2.11	1.42	1.80	0.15	–	1.50	2	36.00	8.00	44.72	10.29	0.86	0.13
100 – 150	7.5	30	0.42	2.65	0.39	2.00	0.10	–	1.40	2	30.50	9.50	48.93	9.51	1.44	0.12
150 – 200	7.3	30	0.56	3.17	0.87	2.00	0.20	–	1.00	3	28.00	9.50	55.78	9.19	1.40	0.13
0 – 25	7.4	49	7.60	33.00	14.00	50.00	0.90	–	1.80	36	37.50	6.00	29.26	17.28	9.20	0.76
25 – 50	7.7	40	5.20	23.00	7.60	42.50	1.10	–	3.00	30	39.00	10.50	30.50	7.95	10.04	2.00
50 – 100	7.5	50	10.50	36.00	12.00	103.00	1.20	–	2.10	69	31.50	26.50	15.67	2.55	22.58	1.20
100 – 150	7.5	43	3.50	36.00	10.40	99.00	2.00	–	2.00	66	33.50	19.00	12.77	1.44	29.69	3.60

is more than 40% and the permeability to water is less than 1 Cm/hour. This may be due to the high content of Ca Co_3.

(c) Coarse textured soil as the above mentioned type, contains gypsum veins or gypsum in alternate layers of 1-5 cm thickness. The majority of these soils are yellowish, with granular structure.

Table A-3 shows the chemical and mechanical analysis of the coarse textured soils.

A.2.4. Very Coarse Textured Soils.

(a) Deep sandy soils through the whole profile, the surface soil may be sandy loam or loamy sand or clay loam underlain by sand. Generally speaking, the soil is rather friable, with granular structure yellowish in colour. The water saturation capacity is 15-20%. The soil is very permeable to water.

These soils are widely spread close to the barren and the rocky area. The clay content is 4-10%, silt is o.5-15%, fine sand is 12-70% and the coarse sand is 3-80%.

(b) Deep calcareous sandy soils, Ca Co_3, content is more than 10%, water saturation capacity is more than 20%, soil water permeability is less than the above mentioned soils.

(c) Calcareous sandy soils, containing gypsum either in alternate layers of 1-5 Cms. In thickness or as an impervious layer.

Table A-4 shows the chemical and mechanical analysis of the very coarse textured soils.

A.2.5 Shallow Soils.

Due to the presence of extended calcareous stones layer, or impervious gypsum and Ca Co_3, layers. These impervious layers may be at 30 Cms. from the soil surface, the top layer may be clay, loam or generally calcareous sand.

A.2.6 Rocky Soils Which are uncultivable.

Generally speaking according to the field study, we may say that the soil of the whole Governorate is alluvial soil, light to heavy clay through the whole profile, the top soil may be light clay and the subsoil is heavy clay, or the surface soil is clay loam, sandy loam or sand, while the subsoil is clay. The majority of the soils in the west, east and south are light or heavy clay textured and rather

Table A – 3

The Chemical and Mechanical Analysis of the Coarse Textured Soils in the Fayoum Governorate

Depth	pH 1 : 2.5	Saturation Capacity %	E.C. mmhos/cm. at 25°	Meq/L. in the extract of saturated paste							Mechanical Analysis					
				Cations				Anions			Clay	Silt	F.S.	C.S.	$CaCO_3$	T.S.S.
				Ca	Mg	Na	K	CO_3	HCO_3	C 1	%	%	%	%	%	%
0 – 30	7.4	29	2.5	9.8	3.5	11.50	0.5	–	2.6	20	15	8.5	21.3	52.3	2.8	0.16
30 – 60	7.35	27	2.6	10.4	4.0	10.30	0.5	–	2.0	20	13	2.0	17.5	64.92	2.4	0.14
60 – 100	7.5	25	1.4	5.8	1.6	6.9	0.3	–	1.8	10	8.5	1.5	4.2	85.3	0.4	0.10
0 – 30	7.7	28	3.5	8.7	9.1	43.50	0.45	–	3.6	36	17	2.0	15.4	52.2	13.2	0.2
30 – 60	7.8	30	4.4	3.5	5.1	38.50	0.4	–	3.6	30	18.5	1.0	38.5	26.7	15.1	0.2
60 – 100	7.2	20	4.8	10.7	7.7	29.00	0.7	–	1.3	36	13.0	2.5	26.0	75.3	7.4	0.2

Table A – 4

The Chemical and Mechanical Analysis of the Very Coarse Textured Soils in the Fayoum Governorate

Depth	pH 1 : 2.5	Saturation Capacity %	E.C. mmhos/cm. at 25°	Meq/L. in the extract of saturated paste							Mechanical Analysis					
				Cations				Anions			Clay	Silt	F.S.	C.S.	$CaCO_3$	T.S.S.
				Ca	Mg	Na	K	CO_3	HCO_3	C 1	%	%	%	%	%	%
0 – 25	7.4	15	33.96	6.4	2.3	350	5.5	–	2	315	4	0.5	12.8	78.46	1.44	2.8
25 – 50	7.4	15	33.96	5.3	1.8	360	5.5	–	3	311	10	1.0	19.52	59.20	4.28	5.0
0 – 25	8.0	36	2.8	2.1	1.0	23.2	0.6	–	3	7	5.5	0.5	69.23	0.89	23.66	0.22
25 – 50	7.6	35	2.8	4.3	3.9	17.5	0.42	–	1.5	12	7.0	1.5	66.50	3.84	20.98	0.18

calcareous as the $Ca\ Co_3$ content is 10%. The rocky soils are spread rather in the east and south of the Governorate while the sandy soils are in the south east. In the north west the soil contains clusters of gypsum as crystals or in alternate layers of 1-5 Cm in thickness. These layers are found generally at 20 Cms from the soil surface. Figure A-2 (map) illustrates the above soil classification according to texture.

A.3 Land Classification According to Salinity.

Corresponding to the soil analysis, the soils of the Governorate are classified according to salinity into:-

A.3.1. Non-Saline Soils:

In which the electrical conductivity of the soil paste extract is less than 4 mmhos/Cm at 25°C. the majority of these soils are in the east and the middle of the Governorate, these are fertile and highly productive soils.

A.3.2 Soils with Moderate Salt Content.

The electrical conductvity is between 4-8 mmhos/Cm at 25°C. Salinity may be moderate at the top layer while it is highly saline in the subsoil. The majority of these soils are moderately productive and need heavy leaching to get rid of the excess soluble salts.

A.3.3 Soils with High Salt Content.

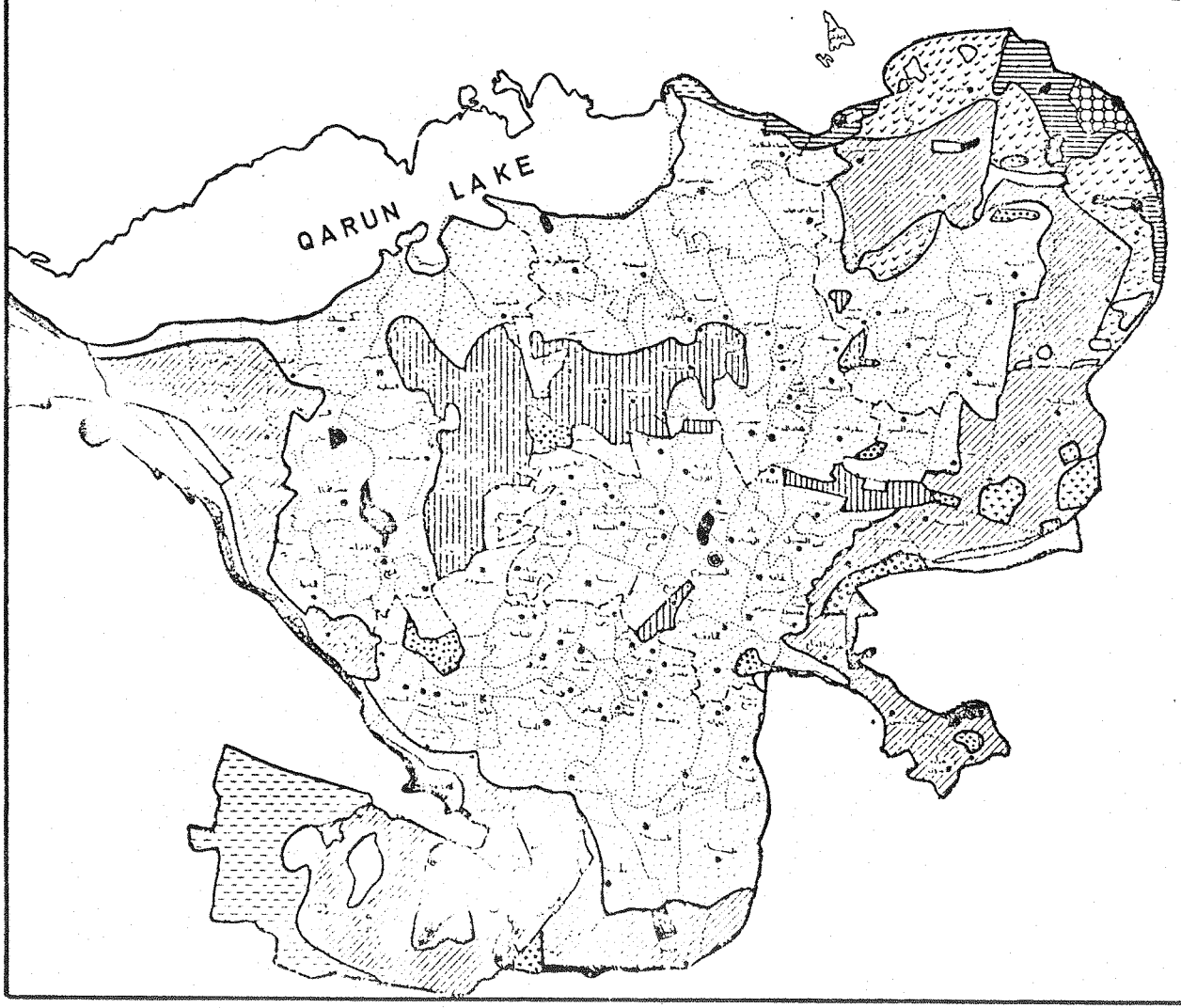
The electrical conductivity is more than 8 mmhos/Cm at 25°C. These are the soils close to Qarun lake, and to the hilly area. They are low productive soils. The soil needs the increase of irrigation water and water application should be at short intervals in order to get rid of the soluble salts.

The Salinity may be due to:

1. Soil of low elevation as can be seen in soils adjacent to the Qarun lake. These soils are nearly on the same level as the lake which is - 45m Below sea level. This leads to the flooding of these soils by the lake water most of the year.
2. Some soils are below the canal and drain levels which leads to the infiltration of these water systems through the soil, causing a high water table.
3. The inadequacy or lake of field drainage.
4. The variation of the soil elevation which leads in

Figure A-2

LAND CLASSIFICATION OF FAYOUM PROVINCE ACCORDING TO THE PROPERTIES of soil profile



GROUP 1

Deep fine textured soils, light to heavy clay. The topsoil may be light clay underlain by heavy clay, or the topsoil may be clay loam or sandy loam and the subsoil is clay. The soil is compact. The structure is blocky or columnar. The hydraulic conductivity is low.

Deep soils, heavy or light clay soils, calcareous, $CaCO_3$ content about 10 %. The hydraulic conductivity is low, less than 0.01 cm / hr.

Light to heavy clay, highly calcareous, gypsum is found in abundance scattered through the soil profile either as crystals or in alternate layers of 1-5 cms thickness at 25 cms depth or below.

GROUP 2

Deep medium textured soils, clay loam or loamy soils. The top layer till 50 cms depth may be sandy loam, loamy sand or sand followed by clay loam or loam. The soil is firm. The structure is granular. The colour is brown to dark brown. The hydraulic conductivity is from 0.1-1.0 cm / hr.

Deep medium textured soils, loamy clay or calcareous loamy soils, $CaCO_3$ content is about 10 %, gypsum crystals or clusters are spread through the whole profile. The soil is firm, the structure is granular the colour is yellowish. The hydraulic conductivity is less than 0.1 cm / hr.

GROUP 3

Deep soils, coarse textured, sandy loam or loamy sand through the whole profile or the surface may be of medium texture i.e. clay loam or loam and the subsoil is loamy sand or sandy loam. The soil in general is firm with granular structure. The soil is very permeable to water. The hydraulic conductivity is more than 1.0 cm / hr.

Deep soils, calcareous coarse textured i.e. sandy loam or loamy sand, $CaCO_3$ is about 10 %. The soil is compacted with granular structure. The hydraulic conductivity is less than 1.0 cm / hr.

Deep calcareous coarse textured soils as the type mentioned above but with the presence of gypsum in veins or in alternate layers of 1-5 cm thickness. Most of these soils are barren, yellowish in colour, granular in structure.

GROUP 4

Deep coarse textured soils through the whole profile, or the surface soil may be sandy loam or loamy sand or clay loam underlain by sand. In general the soil is rather friable, with granular structure and yellowish in colour. The soil is very permeable to water.

Deep calcareous sandy soils, $CaCO_3$ content is more than 10 %. The soil permeability to water is lower than in the above mentioned type.

Calcareous sandy soils containing gypsum either in alternate layers of 1-5 cms in thickness or as an impervious layer.

GROUP 5

Shallow soils due to the presence of extended calcareous stones layer or impervious gypsum and $CaCO_3$ layers, occuring at a depth starting from about 30 cms from the surface, the top layer may be clay, loam or generally calcareous sand.

GROUP 6

Rocky soils uncultivable, or very high level soils that cannot be irrigated under the present conditions.

infiltration from high land to low land. Figure A-3 (map) shows the different classes of soil salinity.

A.4 Land Classification According to Alkalinity.

Figure A-4 (map) shows the different classes of soil alkalinity as follows:

A.4.1. Alkalinity Free Soils through the Whole Profile.

A.4.2. Soils with Moderate Alkalinity of High Alkalinity in the Subsoil.

These soils need improvement of the drain system as well as ploughing.

A.4.3 Soils with High Alkalinity through the Whole Profile.

These soils need the application of gypsum.

Alkalinity may be due to:

(a) Inefficient drain system causing a high water table.

(b) The dominance of exchangeable sodium in the soil complex leading to a decrease of calcium.

(c) Improper tillage operations.

As a matter of fact, the main important factor in the productivity of soils in Egypt is the level of water table, the salinity and the alkalinity is but a result of this, accordingly, this factor was put into consideration in our field study as follows:

(a) Soils with an efficient drainage system and consequently with a low water table about 150 Cms. From the soil surface; all these are highly productive and salt free. These soils are in the middle of the Governorate and include Sinru, El-Agamin, Tobhar, Nassaria, Der El-Ramad, El-Fayoum, Minshat Fitaeh.

(b) Soils with an inefficient drainage system in which the water table is 80-150 Cms from soils surface; these areas need the improvement of drainage system and field drainage in order to reclaim and raise the productivity of the land.

(c) Soils devoid of drains, these are the soils adjacent to Qarun lake and table to be flooded by the lake or the soils close to the hilly area.

A.5 Nitrogen, Phosphorus & Organic Matter Status:

The soluble nitrogen was estimated by using a 1% solution of potassium sulphate in some representative surface soils of the Governorate. It is noticed that most of the soil of Tamia district contains from 25 to 50 p.p.m. soluble nitrogen, soils of the other districts contain more than

Figure A-3

LAND CLASSIFICATION OF FAYOUM PROVINCE ACCORDING
to the average of salinity in the soil profile to the depth of 150 cm

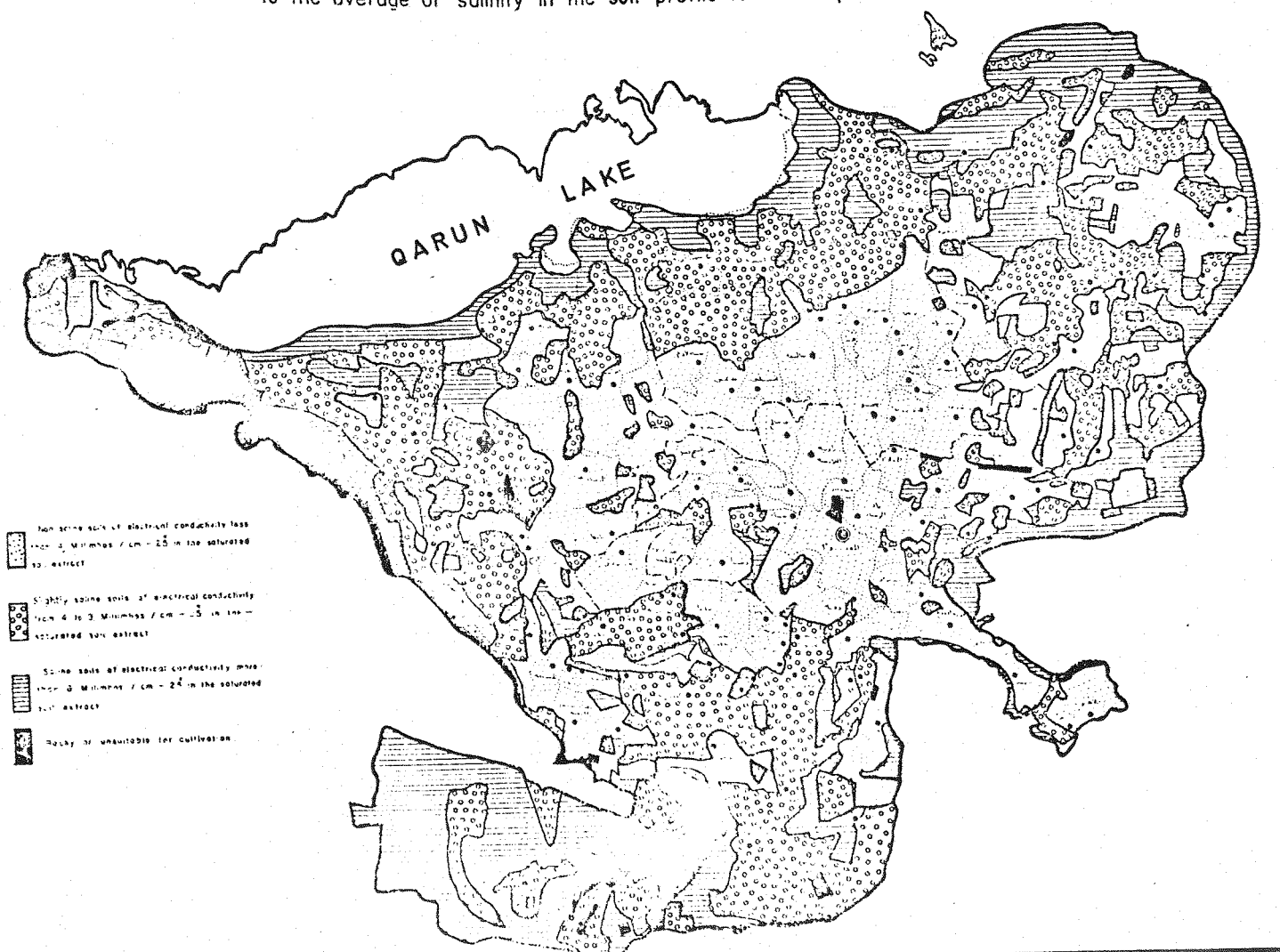
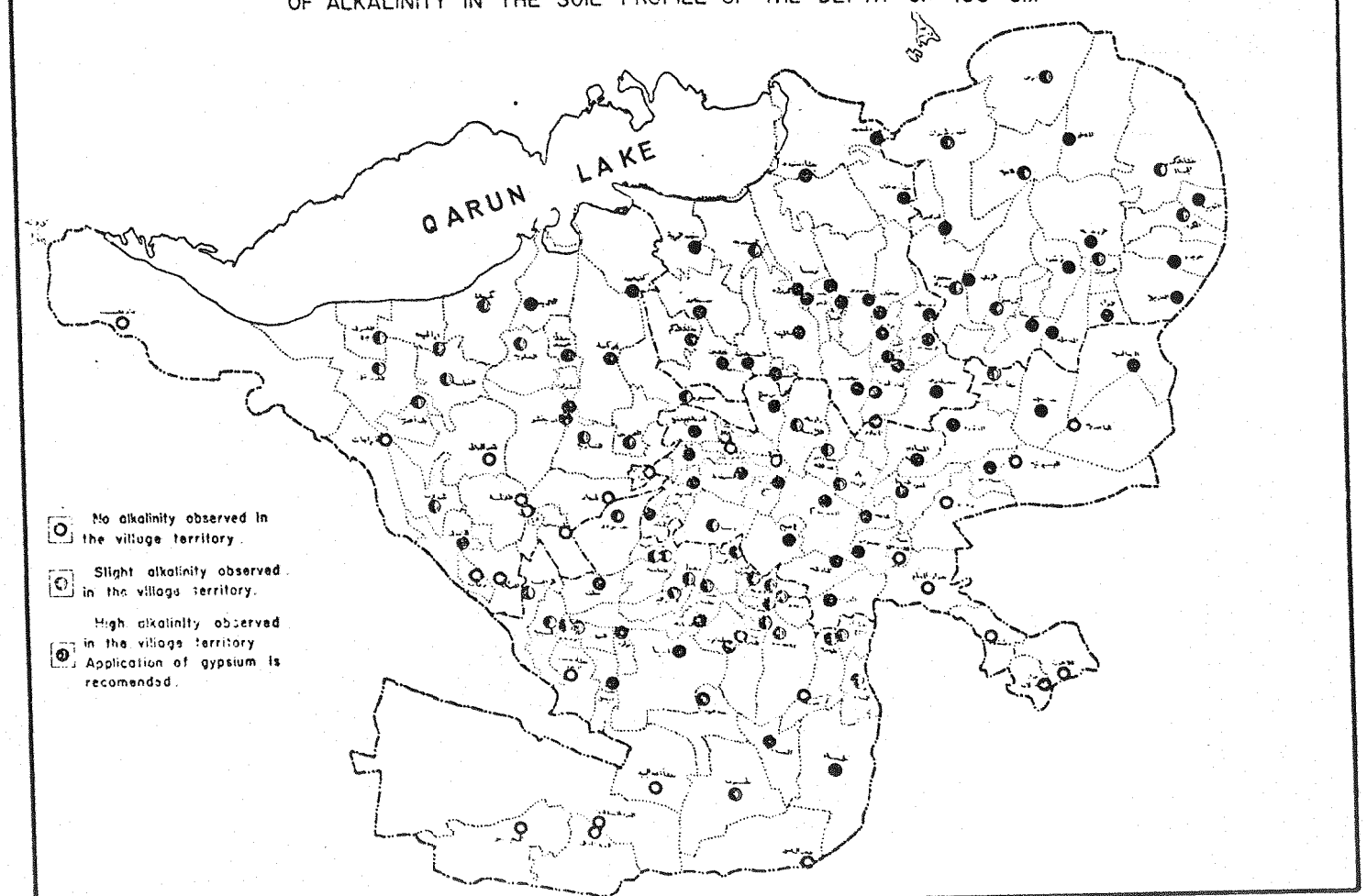


Figure A-4

LAND CLASSIFICATION OF THE FAYOUM PROVINCE BASED ON OCCURANCE OF ALKALINITY IN THE SOIL PROFILE OF THE DEPTH OF 150 CM



50 p.p.m.

The water soluble phosphate as P_2O_5 was determined in some composite surface soils. It can be considered that the major soils of that Governorate contain less 2.0 P.Pm. P_2O_5.

Organic matter was also determined in composite surface soils to a depth of about 30 Cm. It can be concluded that the amount of organic matter in the soils of this Governorate differs widely as shown in Table A-5:

Table A – 5

The Amount of Organic Matter in the Soil of the Fayoum Governorate

Region	Organic matter percent
Tameya district	0.14 – 1.62
Fayoum district	0.22 – 2.75
Sanouris district	0.10 – 3.58
Atsa district	0.81 – 2.08
Ebshaway district	0.85 – 1.70

APPENDIX (B)

WATER BALANCE OF THE FAYOUM GOVERNORATE

STUDYING THE INFLOW AND THE OUTFLOW OF WATER

B.1 Studying the Outflow

B.1.1 Water Consumption of the Main Products

A crop's consumption of water is known to be the total amount of water used in the process of respiration in addition to the amount of water used up in evaporation from the soil where the plant grows.

B.1.1.The Process of Respiration:

This process is the transfer of irrigation water absorbed by the plant from the soil through its various tissues and its return back to the atmosphere in the form of water vapour.

For any plant, the rate of respiration varies from one hour of the day to the other due to temperature, sunshine, available humidity for absorbtion and other atmospheric factors.

The rate of respiration varies during the different phases of growth of the plant.

As the rate of respiration varies with the temperature, it also varies according to relative humidity and the velocity of the wind.

Rates of respiration also differ greatly from night to day as it is in parallel relation with the growth of the plant which basically depends on the sunshine, thus the process of respiration essentially depends on the number of light hours.

B.1.1.2 Evaporation from the Agricultural Soil:

This is the process by which the soil loses its humidity through the direct evaporation from the surface of the soil or layers close to the surface.

The rate of evaporation depends on the same atmospheric factors and conditions affecting the rate of respiration and on other factors such as air pressure.

As this proves that the rate of water consumption of the various crops depends on atmospheric factors, many researchers have tried to link these atmospheric factors with the consumption of irrigation waters and have deduced the factors affecting the water consumption of each plant.

The most famous of these researchers are Charles Hydeck, Blaney and Criddle and Herrgreves.

The equation of Blaney and Criddle which is the most popular has proved successful in Egypt.

Researchers in this field in Egypt were able to obtain the factor of the different plants which differ with the prevelant atmospheric differences in Egypt.

This method has been pursued in our research in estimating the consumption of irrigation waters of the different plants.

B.1.1.3 Blaney-Criddle's Method

Blaney and Criddle have proved that there is a relation between the rate of water consumption and atmospheric factors prevelant in the area where a plant is cultivated.

A special coefficient for each plant has been found out and appears on Table B-1. This relation is:

$$M = 1.82\ KP\ (t + 17.8)$$

Where:

M = Amount of water consumed by a plant per month.

P = The percentage of the total number of daily hours per month in relation to its total amount per year.

K = Blaney and Criddle's coefficient for the consumption of irrigation water.

T = Average monthly temperature in Fahrenhiet.

It is noticed that the average water consumption of the different plants does not depend on the type of soil but only on atmospheric factors and the kind of plant.

The application of this relation in Egypt has proved successful and the average rate of water consumption of the different plants was determined by this equation according to Table B-1.

Table B-2 shows the percentage of daylight hours on latitude 30.

Table B-3 shows the average monthly temperatures for years 1964, 1968 & 1972 in the Fayoum Governorate. Through the application of Blaney-Criddle's equation on the different atmospheric factors for the years 1964, 1968 and 1972, the average monthly and annual rates of water consumption of the different crops was obtained as shown in Tables B-4, B-5 and B-6.

In Blaney-Criddle's equation, the monthly and annual water consumption of the different products mentioned in Tables 4-11, 4-12 & 4-13 have been substituted on the basis of the cultivation and harvest seasons of each crop in the Fayoum Governorate as shown in Table B-7.

The actual cultivated areas of basic crops have been amended to ensure accuracy in calculating the total monthly and annual water consumption of the different crops in years 1964, 1968, 1972 as shown in Tables B-8, B-9 & B-10 and Tables B-11, B-12 & B-13.

B.1.2 Evaporation Water Losses From Qarun Lake

Evaporation from the surface of lake Qarun is affected just as other water surfaces - by the following factors:

-a- Air temperature.
-b- Water temperature.
-c- Pressure of water vapour on the surrounding air.
-d- Pressure of water vapuur on air.
-e- Wind velocity.
-f- Barometric pressure.
-g- Kind of water, (sweet or salty).

The losses of water from evaporation from lake Qarun is estimated through measuring water vapour from a measurable square shaped basin on the shores of the lake in 'Shakshouk' region.

A Curve was drawn to show the relation between the area of the lake and its levels on a contourian map of a scale of 1 : 100,000 as shown in Figure B-1 from which we may

Table B – 1

Blaney-Criddle's Coefficients for Irrigation Water Consumption for the Different Crops

	Yield	Coefficient
1	Wheat	0.50
2	Beans	0.70
3	Clover	0.65
4	Barley	0.50
5	Winter Vegetables	0.60
6	Fenugreek	0.65
7	Cotton	0.70
8	Rice	1.25
9	Indian Millet	0.80
10	Syrian Maize	0.85
11	Summer Vegetables	0.60
12	Fruits	0.65
13	Peanuts	0.60
14	Nilotic Vegetables	0.50

Table B – 2

The Percentage of Daylight Hours on Latitude 30 (5)

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Percentage	7.30	7.03	8.38	8.72	9.53	9.49	9.67	9.22	8.34	7.99	7.19	7.14	100

Table B – 3

Average Monthly Temperatures for years 1964, 1968 & 1972 in the Fayoum Governorate (5)

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1964	11.70	13.90	18.40	20.30	24.20	27.80	27.80	28.40	25.10	24.20	18.50	14.00
1968	10.30	12.02	15.00	20.75	25.82	28.57	28.65	27.72	25.65	21.72	17.20	10.52
1972	12.40	13.60	16.80	21.30	24.60	27.50	28.20	29.20	27.00	23.80	18.00	13.40

Table B – 4

Rate of Monthly and Annual Water Consumption for Main Crops Cultivated in in the Fayoum Governorate

	YIELD	Rate of Monthly Water Consumption m^3/ha												Rate of Annual Water consumption m^3/ha
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1	Wheat	467	483	657	719	–	–	–	–	–	–	566	493	3,385
2	Beans	650	674	916	–	–	–	–	–	–	–	788	685	3,713
3	Instigation Clover	605	–	–	–	–	–	–	–	–	943	733	638	2,919
4	Continual Clover	605	626	852	935	1,125	–	–	–	–	943	733	638	6,457
5	Barley	467	483	657	–	–	–	–	–	–	–	566	493	2,666
6	Fenugreek	605	626	852	–	–	–	–	–	–	943	733	638	4,397
7	Winter Vegetables	564	583	–	–	–	–	–	–	–	878	683	595	3,303
8	Cotton	–	671	914	1,004	1,209	1,307	1,335	1,288	–	–	–	–	7,728
9	Summer Rice	–	–	–	–	2,168	2,344	2,392	2,311	1,942	–	–	–	11,157
10	Peanuts	–	–	–	–	1,050	1,128	1,150	1,111	935	–	–	–	5,374
11	Summer Indian Millet	–	–	–	1,152	1,390	1,504	1,533	1,480	–	–	–	–	7,059
12	Summer Syrian Maize	–	–	–	–	1,476	1,597	1,628	1,571	–	–	–	–	6,272
13	Summer Vegetables	–	–	995	869	1,050	1,128	1,150	–	–	–	–	–	4,992
14	Fruits	–	626	852	935	1,126	1,216	1,238	1,200	1,000	943	–	–	9,136
15	Nilotic Rice	–	–	–	–	–	2,344	2,392	2,311	1,942	–	–	–	8,989
16	Nilotic Indian Millet	–	–	–	–		–	1,533	1,480	1,245	–	–	–	4,258
17	Nilotic Syrian Maize	–	–	–	–		–	1,628	1,571	1,319	1,238	–	–	5,756
18	Nilotic Vegetables	–	–	–	–			954	923	776	726	–	–	3,379

Table B – 5

Rate of Monthly and Annual Water Consumption for Main Crops Cultivated in the Fayoum Governorate Year 1968

	YIELD	Rate of Monthly Water Consumption m^3/ha												Rate of Annual water consumption m^3/ha
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1	Wheat	445	455	595	728	–	–	–	–	–	–	545	438	3,206
2	Beans	595	633	828	–	–	–	–	–	–	–	762	612	3,430
3	Instigation Clover	576	–	–	–	–	–	–	–	–	888	707	569	2,740
4	Continual Clover	576	590	771	995	1,169	–	–	–	–	888	707	569	6,215
5	Barley	445	455	595	–	–	–	–	–	–	–	545	438	2,478
6	Fenugreek	576	590	771	–	–	–	–	–	–	888	707	569	4,101
7	Winter Vegetables	538	550	–	–	–	–	–	–	–	826	659	528	3,101
8	Cotton	–	631	828	1,016	1,257	1,330	1,359	1,269	–	–	–	–	7,690
9	Summer Rice	–	–	–	–	2,254	2,385	2,437	2,278	1,966	–	–	–	1,130
10	Peanuts	–	–	–	–	1,090	1,147	1,171	1,095	947	–	–	–	5,450
11	Summer Indian Millet	–	–	–	1,166	1,442	1,528	1,561	1,459	–	–	–	–	7,156
12	Summer Syrian Maize	–	–	–	–	1,533	1,623	1,657	1,547	–	–	–	–	6,360
13	Summer Vegetables	–	–	719	881	1,090	1,147	1,171	–	–	–	–	–	5,008
14	Fruits	–	590	771	945	1,169	1,235	1,261	1,181	1,014	888	–	–	9,054
15	Nilotic Rice	–	–	–	–	–	2,385	2,437	2,278	1,966	–	–	–	9,065
16	Nilotic Indian Millet	–	–	–	–	–	–	1,561	1,459	1,259	–	–	–	4,279
17	Nilotic Syrian Maize	–	–	–	–	–	–	1,657	1,547	1,335	1,164	–	–	5,703
18	Nilotic Vegetables	–	–	–	–	–	–	973	909	785	683	–	–	3,350

Table B – 6

Rate of Monthly and Annual Water Consumption for Main Crops Cultivated in the Fayoum Governorate Year 1972

	YIELD	Rate of Monthly Water Consumption m^3/ha												Rate of Annual water consumption m^3/ha
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1	Wheat	478	478	628	738	–	–	–	–	–	–	557	483	3,362
2	Beans	666	666	876	–	–	–	–	–	–	–	778	671	3,657
3	Instigation Clover	619	–	–	–	–	–	–	–	–	933	724	626	2,902
4	Continual Clover	619	621	814	957	1,135	–	–	–	–	933	724	626	6,429
5	Barley	478	478	628	–	–	–	–	–	–	–	557	483	2,624
6	Fenugreek	619	621	814	–	–	–	–	–	–	933	724	626	4,337
7	Winter Vegetables	578	578	–	–	–	–	–	–	–	871	674	583	3,284
8	Cotton	–	664	874	1,031	1,221	1,300	1,347	1,309	–	–	–	–	7,746
9	Summer Rice	–	–	–	–	2,190	2,328	2,413	2,351	2,028	–	–	–	1,130
10	Peanuts	–	–	–	–	1,059	1,121	1,161	1,131	978	–	–	–	5,450
11	Summer Indian Millet	–	–	–	1,183	1,402	1,492	1,547	1,507	–	–	–	–	7,131
12	Summer Syrian Maize	–	–	–	–	1,492	1,585	1,642	1,599	–	–	–	–	6,318
13	Summer Vegetables	–	–	759	893	1,059	1,121	1,161	–	–	–	–	–	4,993
14	Fruits	–	621	814	957	1,135	1,207	1,247	1,219	1,045	933	–	–	9,178
15	Nilotic Rice	–	–	–	–	–	2,328	2,413	2,351	2,028	–	–	–	9,120
16	Nilotic Indian Millet	–	–	–	–	–	–	1,547	1,507	1,300	–	–	–	4,354
17	Nilotic Syrian Maize	–	–	–	–	–	–	1,642	1,599	1,378	1,226	–	–	5,845
18	Nilotic Vegetables	–	–	–	–	–	–	964	940	809	719	–	–	3,432

Table B – 7

Period of Staying the Different Crop in the Ground
in the Fayoum Governorate

	Product	Appointment of Plantation	Appointment of Reaping	Period of Staying in the Ground (Months)
1	Wheat	November	May	6
2	Barley	November	April	5
3	Beans	October	April	5
4	Instigation Clover	October	January	4
5	Continual Clover	October	May	8
6	Fenugreek	October	April	6
7	Winter Vegetables	October	February	5
8	Cotton	February	September	7
9	Summer Rice	May	October	5
10	Peanuts	May	October	5
11	Summer Indian Millet	April	August	5
12	Summer Syrian Maize	May	September	4
13	Summer Vegetables	March	July	5
14	Fruits	February	October	9
15	Nilotic Rice	June	September	4
16	Nilotic Indian Millet	May	September	3
17	Nilotic Syrian Maize	July	November	4
18	Nilotic Vegetables	July	October	4

Table B – 8

Modification of Agricultural Areas to Areas of Main Products Cultivated in the Fayoum Governorate Year 1964

Winter Products					
	Yield	Cropped Area (ha)	Percentage	Modified Percentage	Modified Area (ha)
1	Wheat	38,500	32.90	34.27	40,106
2	Beans	11,420	9.74	10.14	11,867
3	Instigation Clover	32,804	28.03	29.21	34,185
4	Continual Clover	22,196	18.97	19.77	23,137
5	Barley	2,060	1,76	1.88	2,200
6	Fenugreek	3,010	2,57	2.67	3,125
7	Vegetables	2,314	1.98	2.06	2,411
8	Other	4,727	4.05	–	–
	Total	117,031	100 %	100 %	117,031

Summer Products					
	Yield	Cropped Area (ha)	Percentage	Modified Percentage	Modified Area (ha)
1	Cotton	35,500	58.37	60.61	36,865
2	Rice	5,050	8.30	8.62	5,243
3	Peanuts	920	1.51	1.57	955
4	Indian Millet	8.015	13.18	13.69	8,327
5	Syrian Maize	615	1.01	1.05	639
6	Vegetables	3,645	5.99	6.22	3,783
7	Fruits	4,820	7.92	8.24	5,012
8	Other	2,259	3.72	–	–
	Total	60,824	100 %	100 %	60,824

Nilotic Products			
	Yield	Cropped Area (ha)	Percentage
1	Rice	2,850	3.86
2	Indian Millet	16,495	22.36
3	Syrian Maize	50,585	68.57
4	Vegetables	3,841	5.21
	Total	73,771	100 %

Table B – 9

Modification of agricultural areas to areas of Main Products Cultivated in the Fayoum Governorate Year 1968

Winter Products					
	Yield	Cropped Area (ha)	Percentage	Modified Percentage	Modified Area (ha)
1	Wheat	38,400	36.64	38.33	40,165
2	Beans	7,500	7.16	7.49	7,849
3	Instigation Clover	26,120	24.93	26.08	27,330
4	Continual Clover	20,380	19.45	20.33	21,304
5	Barley	1,880	1.79	1.87	1,960
6	Fenugreek	2,660	2.54	2.65	2,777
7	Vegetables	3,256	3.11	3.25	3,406
8	Other	4,595	4.38	–	–
	Total	104,791	100 %	100 %	104,791

Summer Products					
	Yield	Cropped Area (ha)	Percentage	Modified Percentage	Modified Area (ha)
1	Cotton	36,300	50.88	55.22	39,400
2	Rice	7,930	11.11	12.03	8,584
3	Peanuts	740	1.04	1.12	799
4	Indian Millet	12,200	17.10	18.53	13,221
5	Syrian Maize	990	1.39	1.50	1,070
6	Vegetables	2,234	3.13	3.39	2,419
7	Fruits	5,400	7.57	8.21	5,858
8	Other	5,557	7.78	–	–
	Total	71,351	100 %	100 %	71,351

Nilotic Products			
	Yield	Cropped Area (ha)	Percentage
1	Rice	2,470	4.30
2	Indian Millet	12,400	21.61
3	Syrian Maize	39,810	69.37
4	Vegetables	2,710	4.72
	Total	57,390	100 %

Table B – 10

Modification of agricultural areas in areas of Main Products Cultivated in the Fayoum Governorate Year 1972

Winter Products

	Yield	Cropped Area (ha)	Percentage	Modified Percentage	Modified Area (ha)
1	Wheat	31,100	27.27	28.96	33,023
2	Beans	10,080	8.84	9.39	10,708
3	Instigation Clover	28,398	24.90	26.44	30,150
4	Continual Clover	30,802	27.01	28.69	32,716
5	Barley	1,660	1.46	1.55	1,768
6	Fenugreek	2,540	2.23	2.37	2,703
7	Vegetables	2,788	2.45	2,60	2,963
8	Other	6,665	5.84	–	–
	Total	114,033	100 %	100 %	114,033

Summer Products

	Yield	Cropped Area (ha)	Percentage	Modified Percentage	Modified Area (ha)
1	Cotton	31,100	42.50	46.34	33,908
2	Rice	7,408	10.12	11.06	8,093
3	Peanuts	371	0.51	0.56	410
4	Indian Millet	16,932	23.14	25.41	18,593
5	Syrian Maize	2,890	3.95	4.31	3,154
6	Vegetables	2,938	4.02	4.38	3,205
7	Fruits	5,320	7.27	7.94	5,810
8	Other	6,214	8.49	–	–
	Total	73,173	100 %	100 %	73,173

Nilotic Products

	Yield	Cropped Area (ha)	Percentage
1	Rice	792	1.67
2	Indian Millet	5,568	11.76
3	Syrian Maize	37,710	79.65
4	Vegetables	3,274	6.92
	Total	47,344	100 %

Table B – 11

Total of Monthly and Annual Water Consumption for Main Crops cultivated in the Fayoum Governorate Year 1964

	Yield	Modified Area (ha)	Total of Monthly Water Consumption (million m^3)												Total of Annual water consumption (million m^3)
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1	Wheat	40,106	18.730	19.371	26.350	28.836	–	–	–	–	–	–	22.700	19.772	135.759
2	Beans	11,867	7,714	7.998	10.870	–	–	–	–	–	–	–	9.351	8.129	44.062
3	Instigation Clover	34,185	20.682	–	–	–	–	–	–	–	–	32.237	25.058	21.810	99.787
4	Continual Clover	23,137	13.998	14.484	19.713	21.633	26.029	–	–	–	–	21.818	16.959	14.761	149.395
5	Barley	2,200	1.027	1.063	1.445	–	–	–	–	–	–	–	1.245	1.085	5.865
6	Fenugreek	3,125	1.891	1.956	2.663	–	–	–	–	–	–	2.947	2.291	1.994	13.742
7	Winter Vegetables	2,411	1.360	1.406	–	–	–	–	–	–	–	2.117	1.647	1.435	7.965
8	Cotton	36,865	–	24.736	33.695	37.013	44.570	48.183	49.215	47.482	–	–	–	–	284.894
9	Summer Rice	5,243	–	–	–	–	11.367	12.290	12.541	12.117	10.182	–	–	–	58.497
10	Peanuts	955	–	–	–	–	1.003	1.077	1.098	1.061	0.893	–	–	–	5.132
11	Summer Indian Millet	8,327	–	–	–	9.593	11.575	12.524	12.765	12.324	–	–	–	–	58.781
12	Summer Syrian Maize	639	–	–	–	–	0.943	1.021	1.040	1.004	–	–	–	–	4.008
13	Summer Vegetables	3,783	–	–	3.764	3.287	3.972	4.267	4.351	–	–	–	–	–	19.641
14	Fruits	5,012	–	3.138	4.270	4.686	5.644	6.095	6.205	6.014	5.012	4.726	–	–	45.790
15	Nilotic Rice	2,850	–	–	–	–	–	6.680	6.817	6.586	5.535	–	–	–	25.618
16	Nilotic Indian Millet	16,495	–	–	–	–	–	–	25.287	24.413	20.536	–	–	–	70.236
17	Nilotic Syrian Maize	50,585	–	–	–	–	–	–	82.352	79.469	66.722	62.624	–	–	291.167
18	Nilotic Vegetables	3,841	–	–	–	–	–	–	3.664	3.545	2.981	2.789	–	–	12.979
		251,626													1,333.318

Table B – 12

Total of Monthly and Annual Water Consumption for Main Crops cultivated in the Fayoum Governorate Year 1968

	Yield	Modified Area (ha)	Total of Monthly water consumption (million m^3)												Total of Annual water consumption (million m^3)
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1	Wheat	40,165	17.873	18.275	23.898	29.240	–	–	–	–	–	–	21.890	17.592	128.768
2	Beans	7,849	4.670	4.968	6.499	–	–	–	–	–	–	–	5.981	4.804	26.922
3	Instigation Clover	27,330	15.742	–	–	–	–	–	–	–	–	24.269	19.322	15.551	74.884
4	Continual Clover	21,304	12.271	12.569	16.425	21.198	24.904	–	–	–	–	18.918	15.062	12.122	133.469
5	Barley	1,960	0.872	0.892	1.166	–	–	–	–	–	–	–	1.068	0.859	4.857
6	Fenugreek	2,777	1.600	1.638	2.141	–	–	–	–	–	–	2.466	1.963	1.580	11.388
7	Winter Vegetables	3,406	1.832	1.873	–	–	–	–	–	–	–	2.813	2.245	1.798	10.561
8	Cotton	39,400	–	24.861	32.623	40.030	49.526	52.402	53.545	49.999	–	–	–	–	302.986
9	Summer Rice	8,584	–	–	–	–	19.348	20.473	20.919	19.554	16.876	–	–	–	97.170
10	Peanuts	799	–	–	–	–	0.871	0.917	0.936	0.875	0.757	–	–	–	4.356
11	Summer Indian Millet	13,221	–	–	–	15.416	19.065	20.202	20.638	19.289	–	–	–	–	94.610
12	Summer Syrian Maize	1,070	–	–	–	–	1.640	1.737	1.773	1.655	–	–	–	–	6.805
13	Summer Vegetables	2,419	–	–	1.739	2.131	2.637	2.775	2.833	–	–	–	–	–	12.115
14	Fruits	5,858	–	3.456	4.517	5.536	6.848	7.235	7.387	6.918	5.940	5.202	–	–	53.039
15	Nilotic Rice	2,470	–	–	–	–	–	5.891	6.019	5.627	4.856	–	–	–	22.393
16	Nilotic Indian Millet	12,400	–	–	–	–	–	–	19.356	18.092	15.612	–	–	–	53.060
17	Nilotic Syrian Maize	39,810	–	–	–	–	–	–	65.965	61.586	53.146	46.339	–	–	227.036
18	Nilotic Vegetables	2,710	–	–	–	–	–	–	2.637	2.463	2.127	1.851	–	–	9.078
		233,532													1,273.497

Table B – 13

Total of Monthly and Annual Water consumption for Main Crops cultivated in the Fayoum Governorate Year 1972

	Yield	Modified Area (ha)	Total of Monthly water consumption (million m^3)												Total of Annual water consumption (million m^3)
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1	Wheat	33,023	15.785	15.785	20.738	24.371	–	–	–	–	–	–	18.394	15.950	111.023
2	Beans	10,708	7.132	7.132	9.380	–	–	–	–	–	–	–	8.331	7.185	39.160
3	Instigation Clover	30,150	18.663	–	–	–	–	–	–	–	–	28.130	21.829	18.874	87.496
4	Continual Clover	32,716	20.251	20.317	26.631	31.309	37.133	–	–	–	–	30.524	23.686	20.480	210.331
5	Barley	1,768	0.845	0.845	1.110	–	–	–	–	–	–	–	0.985	0.854	4.639
6	Fenugreek	2,703	1.673	1.679	2.200	–	–	–	–	–	–	2.522	1.957	1.692	11.723
7	Winter Vegetables	2,965	1.714	1.714	–	–	–	–	–	–	–	2.583	1.998	1.729	9.738
8	Cotton	33,908	–	22.515	29.636	34.959	41.402	44.080	45.674	44.386	–	–	–	–	262.652
9	Summer Rice	8,093	–	–	–	–	17.724	18.841	19.528	19.027	16.413	–	–	–	91.533
10	Peanuts	410	–	–	–	–	0.434	0.460	0.476	0.464	0.401	–	–	–	2.235
11	Summer Indian Millet	18,593	–	–	–	21.996	26.067	27.741	28.763	28.020	–	–	–	–	132.587
12	Summer Syrian Maize	3,154	–	–	–	–	4.706	4.999	5.179	5.043	–	–	–	–	19.927
13	Summer Vegetables	3,205	–	–	2.433	2.862	3.294	3.593	3.721	–	–	–	–	–	15.903
14	Fruits	5,810	–	3.608	4.729	5.560	6.594	7.001	7.245	7.082	6.072	5.421	–	–	53.312
15	Nilotic Rice	792	–	–	–	–	–	1.884	1.911	1.862	1.606	–	–	–	7,223
16	Nilotic Indian Millet	5,568	–	–	–	–	–	–	8.614	8.391	7.238	–	–	–	24.243
17	Nilotic Syrian Maize	37,710	–	–	–	–	–	–	61.920	60.298	51.964	46.233	–	–	220.415
18	Nilotic Vegetables	3,274	–	–	–	–	–	–	3.156	3.078	2.649	2.354	–	–	11.237
		234,550													1,315.377

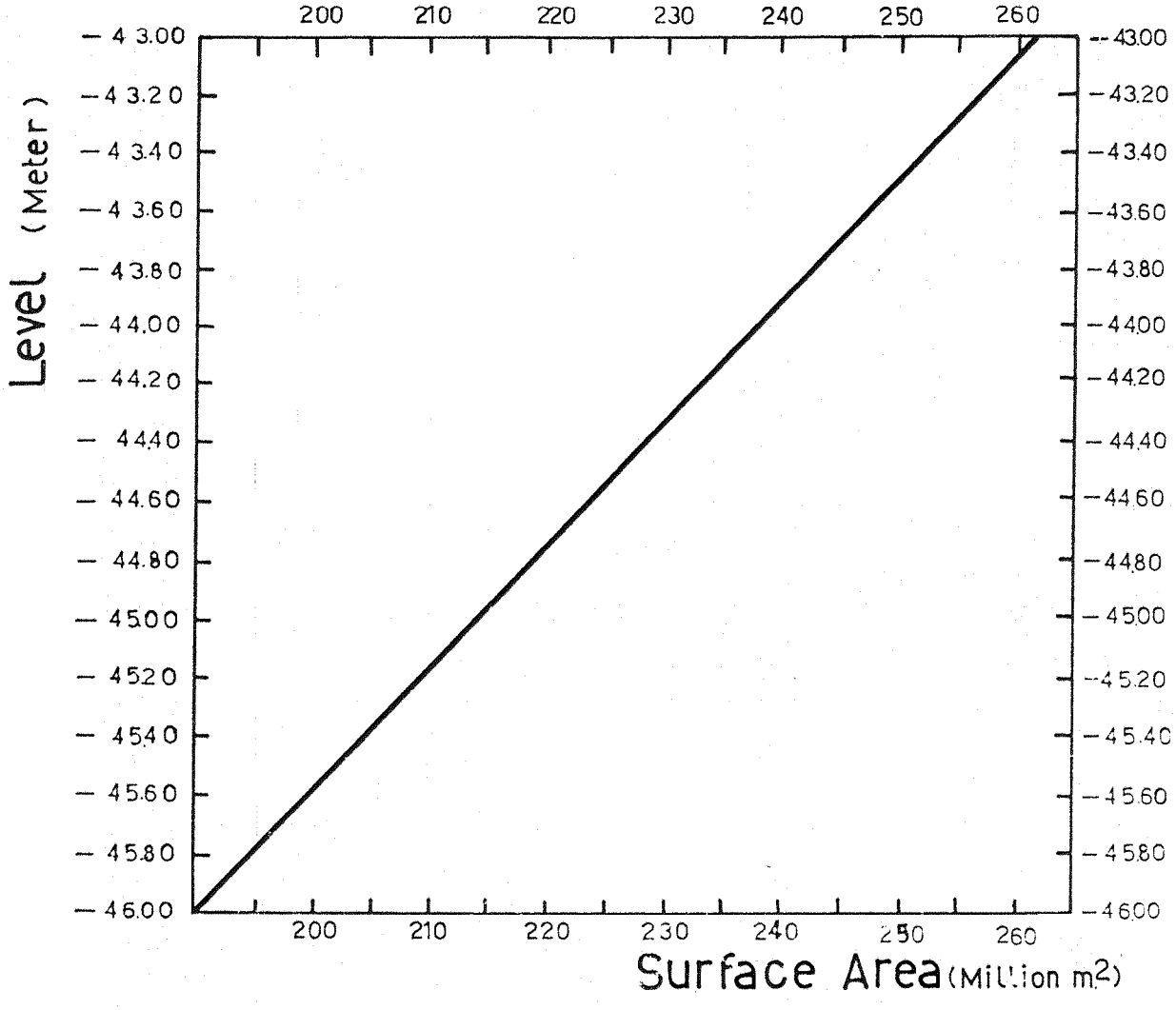


Figure B_1

Relation between Levels of Qarun Lake and its Surface Areas

determine the actual area of the lake to each level when we estimate the amount of water losses from evaporation.

We may also accurately estimate the fluctuations of the levels of the lake as shown in Table B-14.

B.1.3 Evaporation Water losses from Canals and Drains

We estimate water losses from canals and drains in the Fayoum Governorate each year as follows:

Water Losses = C x B x L x E

Where:

C = Coeffecient of the standard basin in Shakshouk region in the Fayoum Governorate = 0.5

B = Average width of canals and drains = 10 meters

L = Length of general canals and drains in the Fayoum Governorate (shown in Table B-15)

E = Total annual evaporation from the Fayoum Governorate (shown in Table B-16)

∴ Water losses by evaporation year 1964 = 35.55 Million m^3

" " " " " 1968 = 37.56 Million m^3

" " " " " 1972 = 22.95 Million m^3

B.1.4 Gain or loss of Water Stored in Qarun lake:

For completion of the calculation of water balance, one must calculate the gain or loss in water stores in Qarun lake; this amount of water has been calculated by Knowing as the water level of the lake at the beginning of the year and the water level at the end of the same year, after finding out the surface area of the lake from Figure B-1 . We recognize from Table B-17 that there is an amount of water gained and not lost in years 1964, 1968 & 1972.

B.1.5 People's Drinking Water Consumption:

So as to have accurate calculation of the water balance, we will calculate the amount of water consumed by the inhabitants of the Fayoum Governorate in the years 1964, 1968 & 1972. This could be calculated by finding the

Table B – 14

The Evaporation Water losses from Qarun Lake Years 1964, 1968 & 1972

Month	1964				1968				1972			
	Average Level	Meeting area (mill. m^2)	Total of Vessel Evaporation Readings (millemeter)	Evaporation Value (mill. m^3)	Average Level	Meeting area (mill. m^2)	Total of Vessel Evaporation Readings (millemeter)	Evaporation Value (mill. m^3)	Average Level	Meeting area (mill. m^2)	Total of Vessel Evaporation Readings (millemeter)	Evaporation Value (mill. m^3)
January	– 44.00	237.70	104	12.360	– 43.84	241.75	134	16.197	– 43.70	245.00	98	12.005
February	– 44.00	237.70	142	16.877	– 43.82	242.00	138	16.698	– 43.69	245.25	86	10.546
March	– 43.97	238.50	220	26.235	– 43.79	242.75	190	23.062	– 43.62	247.00	160	19.760
April	– 43.98	238.25	266	31.687	– 43.78	243.00	286	49.049	– 43.59	247.75	182	22.545
May	– 43.99	238.00	350	41.650	– 43.82	242.00	382	46.222	– 43.60	247.50	250	30.938
Ju ne	– 44.05	236.55	428	50.622	– 43.92	239.75	436	52.266	– 43.64	246.50	364	44.863
July	– 44.15	234.25	444	51.582	– 44.01	237.50	464	55.100	– 43.74	244.00	428	52.216
August	– 44.23	232.30	396	45.995	– 44.13	234.70	454	53.277	– 43.82	242.25	412	49.904
September	– 44.30	230.70	346	39.911	– 44.18	233.56	400	46.712	– 43.85	241.37	372	44'895
October	– 44.29	230.72	274	31.609	– 44.15	234.25	280	32.795	– 43.84	241.75	316	38.197
November	– 44.22	232.60	158	18.375	– 44.07	236.39	176	20.802	– 43.75	243.75	164	19.988
December	– 44.05	236.55	100	11.828	– 43.90	240.25	108	12.974	– 43.58	248.00	148	18.352
Total of evaporation / year				378.731				425.154				364.209

$$\text{Evaporation Value} = \text{Meeting Area} \times \frac{\text{Total of Vessel Evaporation Readings}}{2}$$

Table B – 15

Total Lengths of General Canals and Drains
in the Fayoum Governorate (16) (Kilometers)

Year	General Canals	General Drains	Total Length
1964	1250.500	912.000	2162.500
1968	1258.300	920.362	2178.662
1972	1263.355	924.480	2188.035

Table B – 16

Total Annual Evaporation from the Fayoum Governorate (16)

Year	Total Monthly Evaporation (millemeters)												Total Annual
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
1964	104	142	220	266	350	428	444	396	346	274	158	100	3,228
1968	134	138	190	286	382	436	464	454	400	280	176	108	3,448
1972	98	86	160	182	250	364	428	412	372	316	164	148	2,980

Table B – 17

Gain or loss of Water Stored in Qarun Lake (16)

Item \ Year	1964	1968	1972
Level at the beginning of the year	– 44.075	– 43.875	– 43.710
Level at the end of the year	– 43.955	– 43.825	– 43.485
Difference between the two levels (meters)	+ 0.120	+ 0.050	+ 0.225
Area of the lake (m^2) million m^3)	239.20	242.50	250
Gain or loss in water (million m^3)	+ 28.704	+ 12.125	+ 56.250

number of inhabitants surviving in the three mentioned years, and assuming that each person uses 10 litres of water per day as shown in Table B-18.

From what was previously said, we could gather up the outflow of water from the Fayoum Governorate in the years 1964, 1968 & 1972 as shown in Table B-19. We recognize from that table that the amount of water outflow from the governorate in each of the three years is approximately 1.76 million m^3.

B.2 Studying the Inflow:

After calculating previously the amount of water outflow from the Fayoum Governorate in the three years, we have to compare it with the amount of water inflow to the governorate. Table B-20 shows the monthly amount of water inflow to the Fayoum Governorate in those three years upstream Lahoun Barrage.

B.3 Comparison between the Inflow and the Outflow:

From what has been previously said we would compare the inflow and outflow of water of the Fayoum Governorate in the years 1964, 1968 & 1972 as shown in Table B-21. We could easily recognize from that table that there is actually a difference between the outflow and inflow in the water in the three years mentioned which approximates to 249,275 & 209 Million cubic meters in years 1964, 1968 & 1972 successively. The reason for this is that this amount of water is swallowed underground.

Table B – 18

People's Drinking Water Consumption in the Fayoum Governorate
in the years 1964, 1968 & 1972

Item \ Year	1964	1968	1972
Average Drinking water consumption/person/day (litre) (assumed)	10	10	10
Number of days	365	365	365
Number of inhabitants (person)	902,000	972,000	1,024,000
Total Drinking water consumption (million m^3)	3.292	3.548	3.738

Table B – 19

Total Outflow of Water in the Fayoum Governorate
in the years 1964, 1968 & 1972 (16)

	Item	1964	1968	1972
1	Products water consumption	1,333.318	1,273.497	1,315.377
2	Evaporation losses from Qarun lake	378.731	425.154	364.209
3	Evaporation losses from Canals & Drains	35.550	37.560	22.950
4	Gain or loss of water stored in Qarun lake	28.704	12.125	56.250
5	People's drinking water consumption	3.292	3.548	3.738
	Total	1,779.595	1,751.884	1,762.524

Table B – 20

Discharges coming to the Fayoum Governorate
Upstream Lahoune Barrage
in Years 1964, 1968 & 1972 (16)

Month	Year		
	1964	1968	1972
January	28.201	55.200	30.750
February	110.907	115.400	133.431
March	184.017	177.000	169.952
April	161.817	158.186	154.724
May	163.852	167.344	166.868
June	218.738	214.231	193.678
July	236.235	248.000	233.383
August	228.221	237.500	229.480
September	190.229	193.650	193.892
October	187.595	171.381	177.042
November	167.823	157.112	163.620
December	150.558	132.112	124.296
Total	2,028.203	2,027.116	1,971.116

Table B – 21

Comparison between Inflow and Outflow of water in the Fayoum Governorate years 1964, 1968 & 1972 (million m^3)

Year	Inflow	Outflow	Difference
1964	2028.203	1779.595	248.608
1968	2027.116	1751.884	275.232
1972	1971.116	1762.524	208.592

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