PROJECT TECHNICAL REPORT NO. 6

Egypt Water Use & Management Project
Consortium for International Development

# PROBLEM IDENTIFICATION REPORT FOR KAFR EL SHEIKH STUDY AREA

BY

EGYPTIAN AND AMERICAN FIELD TEAMS

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22 El Galaa St., Bulak, Cairo, Egypt

# PROBLEM IDENTIFICATION REPORT FOR KAFR EL SHEIKH STUDY AREA

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## ABSTRACT

The results of problem identification studies of irrigation agriculture in the Abu Raya District of Kafr El Sheikh Governorate are presented. The report begins with a general review of the historical development of irrigation in the North Central Delta of the Nile River with a focus on soils and irrigation water delivery. A detailed description of irrigation farm systems in the Abu Raya District follows. Included in this are details on: the geography of the area; the topography; specific soil studies to characterize type, texture, salinity, sodicity; Abu Raya village, and farm size and ownership patterns; crops grown and cropping patterns; water distribution and irrigation methods; and a description of the two watercourse command areas on which detailed studies were conducted. Four farms were selected on these two watercourses for intensive interdisciplinary problem identification studies of each individual farming system. These farms were located at the head and tail of each watercourse.

Problem identification procedures used by EWUP engineers, agronomists, economists and sociologists specific to the studies implemented in Abu Raya are presented. The results of these studies are delineated and the interdisciplinary aspects of the problems identified are discussed.

From an economic and sociological perspective major problems identified are related to inadequate support from the local agricultural cooperative in terms of farm crop production inputs such as seed, fertilizers, marketing, credit, mechanization, etc. A significant part of this problem is the lack of timely availability of input factors. Farmers face increasing labor costs and are burdened with the indirect costs of lifting water. Farm product prices, fixed by the government, are below world market prices. Farm record keeping for planning and feasibility analysis of alternatives is non-existent.

From a technical perspective, agronomic and engineering problems are identified which are for the most part overlapping and related to farm water management problems. Specific crop production problems identified are related to minor soil element deficiencies, particularly

zinc; poor plant stands due to such factors as poor seeds; and poor germination caused by soil salinity/sodicity. Specific engineering problems focus on the lack of adequate maintenance in watercourses (canals and drains); large amount of land occupied by on-farm water distribution and drainage ditches and many problems with the delivery system which reduce adequate and equitable distribution to all areas. Water management problems on the farm are related to: poor distribution of applied water and overirrigation which are a result of unlevel fields; poor farm irrigation system layout (i.e., not based on local design conditions); and lack of adequate farmer decision-making in terms of when to irrigate and how much water to apply. These problems are causing high and fluctuating water table levels, are contributing to soil salinity/sodicity problems and overload the drainage system (which is already in poor repair).

# مستخلص

تم عرض وتحليل النتائج وكذا الدراسات اللازمه للتعرف على مشاكل الرى والزراعه فى منطقة ابو ريه بمحافظة كفر الشيخ بجمهورية مصر العربيه ۰ وقد اشتمل التقرير على مراجعه تاريخيه عامه عن تطوير الرى فى المنطقه المتوسطه الشماليه لدلتا نهر النيل ،كما اشتملت الدراسه على نوع التربه وطرق توصيل مياه الرى اللازمه بها ثم قدم التقرير بعد ذلك وصفا تفصيليا لطبيعة وجغرافية المنطقه وقدم دراسات خاصه لنوع التربه من حيث الملمس ونسبة الملوحه ونسبة الصوديوم بها كما اشتمل التقرير على دراسه حقليه لقرية ابو ريه عن المساحات الموجوده وما يتعلق بملكية الاراضى بالمنطقه ووضح التقرير الدراسه التفصيليه الخاصه بالتركيب المحصولى ومراحل النمو للمحاصيل وكذا نظام توزيع المياه وطرق الرى بالمنطقه ۰ وكذلك تم شرح الدراسات التفصيليه التى تمت حول مجريين مائيين بالمنطقه ۰ كما تم اختبار عدد ٤ حقول حول هذين المجريين لعمل دراسات مكثفه لتحديد المشاكل الاوليه بالمنطقه والتى يحددها فريق عمل مشترك للبحث والدراسه لكل حقل على حده ۰ وتركزت الدراسه عند بدايه ونهايه كل من المجريين المائيين ۰

وقد قام بهذه الدراسه للتعرف على المشاكل وتحديدها فريق من المهندسين والزراعيين والاقتصاديين والاجتماعيين بمشروع ال فى منطقة ابو ريه ۰ وتمت مناقشة هذه المشاكل من وجهه نظر كل فريق بحثى ۰

فمن وجهة نظر الاجتماعيين والاقتصاديين كانت المشاكل الرئيسيه هى مشكلة نقص الدعم الكافى من التعاونيات الزراعيه المحليه وموارد التنميه اللازمه

للمحاصيل كالبذور ومواد التسميد ،وعمليات التسويق للمحاصيل ،وعدم توافر القروض والميكنه الزراعيه الخ الخ ....

كما ان عدم توافر المواد اللازمه للانتاج في الوقت المناسب كانت تشكل جزءاً ما من المشكله . أما عن المشاكل الاخرى التى تواجه الفلاحين فهى مشكلة زيادة أجور الايدى العامله ومشكله ارتفاع أسعار رفع المياه ،كما أن الاسعار المنخفضة للانتاج الزراعى والتى تحددها الحكومة اقل بكثير من السعر العالمى مما ينتج عنه مشاكل للفلاحين ،وايضا من ضمن المشاكل عدم وجود أية بيانات او تحليلات سابقه للتخطيط والتنفيذ والتى يمكن تطويرها واستعمالها كحلول بديله .

ومن وجهة النظر الفنيه الخاصه بالمهندسين والزراعيين فقد كانت معظم المشاكل تتداخل مع مشاكل تطوير الرى بالحقل كما تمثلت بعض هذه المشاكل فى ضعف انتاجية المحاصيل بسبب نقص فى عناصر التربه مثل الزنك ،كما وان هناك ضعف فى بعض الزراعات نتيجه لضعف البذور وضعف النمو المتسبب عن ملوحة التربه وزياده الصوديوم بها . وقد تمثلت بعض المشاكل الهندسيه فى عدم وجود الصيانه الكافيه للمجارى المائيه ( الترع والمصارف ) ،كما وان هناك نسبه كبيره من الاراضى مستعمله كمجارى مائيه للرى والصرف . وهناك ايضا عدة مشاكل خاصه بنظام توصيل مياه الرى والذى يتسبب عنه عدم التوزيع المتساوى والكافى لمياه الرى فى كل المساحات .

وتتلخص المشاكل المتعلقه بتطوير الرى فى الحقل فى الاتى : سوء التوزيع لمياه الرى واسراف الفلاح فى استعمالها والذى يعتبر نتيجه لعدم التسوية الدقيقه للاراضى وايضا بسبب رداءة تصميم نظام الرى الحقلى ( والذى لايعتمد على الشروط التصميميه الموضوعه ) ،وكذلك عدم معرفة الفلاح بالمواعيد المناسبه للرى أو بكمية المياه اللازمه لكل ريه . وقد تسببت هذه المشاكل فى ارتفاع فى مناسيب المياه الجوفيه مما ترتب عليه مشاكل الملوحه والقلويه للاراضى وايضا زيادة مشكلة الصرف الموجوده فعلا والتى تعانى من رداءه فى الصيانه .

ACKNOWLEDGEMENTS

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The Consortium for International Development, with executive offices in Tucson, Arizona, is the United States Agency for International Development Contractor for the Project. American Project personnel are drawn from the faculties of Colorado State University, the lead American university taking part in the Project, Oregon State University, New Mexico State University, and Montana State University. The Project Director is Dr. Hassan Wahby and the Project Technical Director is Dr. Eugene Quenemoen. Dr. E. V. Richardson is the Campus Project Coordinator.

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## INTRODUCTION

The Egypt Water Use and Management Project (EWUP) was designed to assist in improving existing management practices of irrigated agriculture in Egypt. Although water use and management is emphasized in the project title, it was realized in the formulization of the project that management of all resources used in modern irrigated agriculture systems must be considered and accomplished for a permanent agriculture in Egypt. The project is structured to function in an interdisciplinary mode to formulate and demonstrate viable on-farm management alternatives for the typical Egyptian farmer. Thus, the Egypt Water Use and Management Project constitutes a new strategy for irrigation development both in approach to project objectives and in staffing. The EWUP team includes agronomists, engineers, economists and sociologists from the United States and Egypt. The team works with the Egyptian farmer at the field level to find out what is being done and what viable alternatives exist for improving our farm management practices.

The basic project procedure is to: first, identify problems quantitatively, second, search for appropriate solutions and finally demonstrate by use of large pilot areas the viable solutions that may be diffused throughout the country on a large scale. These procedures are carried out in three areas in Egypt that represent a range of Egyptian agriculture. These areas are located in Upper Egypt (El Minya), Upper Delta (El Mansouria, near Cairo) and the lower delta (Kafr El Sheikh). A problem identification report has already been prepared for the El Mansouria area near Cairo.

The reader is referred to the Mansouria report for additional details on the objectives and structure of the Project.

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The purpose of this report is to present the problems identified in the lower delta in the Kafr El Sheikh Governorate. The objective of problem identification is to identify and characterize major physical, hydrological, chemical, biological, economic and organizational factors that constitute significant potentials for increasing crop production and keep agriculture viable in Egypt.

This report will summarize the most significant factors and will give the reader a broad overview of the characteristics of the area and its problems. The basic soil and land classification survey for the area selected to represent Kafr El Sheikh will appear as a separate report.

## GENERAL DESCRIPTION OF KAFR EL SHEIKH AREA

The Kafr El Sheikh Governorate, consisting of 815,335 feddan, lies in the lower Nile Delta nearly midway between the two branches of the Nile, Rossitta and Damietta. The agricultural conditions and situations found in Kafr El Sheikh are similar to those found in the other lower Nile governorates, Behera, Sharkia and Dakahlia. Most of this area is composed of newly reclaimed land still under partial reclamation. Irrigated rice has been the main summer crop in these areas for the past 80 years.

### Historical Background

In 1883, the Behera company* started to reclaim the southern portion of Kafr El Sheikh district. The land was leveled, a system of canals and drains were constructed, and small basins were filled with water at frequent intervals for reclamation. The intervals depended upon evaporation and rainfall.

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* This was an English stock company nationalized after the 1952 revolution.

The first reclamation period was completed without cultivation. When the soils were leached to a level that could be tolerated by a submerged crop, Echinochloa cursgalic was planted during the summers of subsequent years.

Later, when the soils had been further improved, a high-tolerance rice seed variety was broadcast directly onto the granulated soil. Continuous flooding during the summer had the effect of producing high rice yields as well as continuing the salt leaching of saline soils. A subsequent period allowed Egyptian clover to be planted during the winter months of low water supply. Finally in 1906, farmers imigrated from the southern governorates to Kafr El Sheikh to purchase the newly reclaimed land from the Behera company for a low price.

Further reclamation was attempted from 1954 to 1967 by the Ministry of Reclamation. However, after the construction of the High Aswan Dam, the schedule established by the Behera Company and followed by the Ministry of Reclamation was abandoned. The demand for irrigation water during the summer increased with the increase in cultivated land and which resulted in the low availability of water for reclamation. Since the construction of the High Aswan Dam, both rice production and reclamation of new land have been hindered by water problems.

Irrigation practices have changed because of the requirements for lifting water using the new perennial irrigation system. Whenever the supply of water is greater than the irrigation requirements, over-irrigation results. This results in an overall system inefficiency which reduces the amount of water for rice production and/or reclamation.

## Soils of the Kafr El Sheikh District

### General

The Kafr El Sheikh governorate consists of seven districts, one of which is called Kafr El Sheikh. A complete soil survey was carried out for the dis-

.../...

trict by the Soil Survey Department, Ministry of Agriculture in 1957 and 1958. Table 1 shows the distribution of cultivated (class A soils) and uncultivated (class B soils) in the district. The classes are subdivided into soils of decreasing productivity because of saline and/or sodic conditions.

In table 2, the increase in the sub classes of cultivated and uncultivated soils is shown since 1958.

Several efforts have been made since 1960 to improve the soils of the Kafr El Sheikh district as well as those of the same type in other North Delta regions. The progress in this regard can be observed from the data presented in Table 2. None of the soils have been changed to class I. Individual farmer effort cannot produce class I soils because of the sub soil sodicity.

Continuous irrigation during a multi-cropping rotation, including paddy rice, leached an appreciable amount of salt from sodic-saline soils, (class III and IV); this is the source of the increase in class II. The percentage of increase by 1978 in the area of class II soils was 151% compared with 1958. However, only slight success was achieved in reclaiming the uncultivated areas during the past 20 years. The increase in cultivated areas in 1978 is only 5% over the cultivated area of 1958.

## The Soils of the Southern Portion of Kafr El Sheikh District

This portion of the district consists of the areas which were cultivated at the time of the Gieth et al (1959) survey and includes Marin alluvial soils classes II and III and IV, respectively. They are formed by the continuous deposition of the suspended matter carried by the River Nile during the flooding season (Ball, 1952). These materials represent the disintegration and weathering porducts of the metamorphic ingenous rocks in Southern Sudan and basalts of the Ethiopian plateau. They are compacted to 150 cm depth below the surface. Only the surface soil is granulated, due to soil tillage. The profiles show no hard pans or rocks to hinder root penetration, Gieth et al (1959). The grain size distribution of Kafr El Sheikh soil sediments was

.../...

Table (1): Soil classification of Kafr El Sheikh District according to land productivity Gieth et al (1959)

| Area of Cultivated Soils (Fed) | | | | | Area of Cultivated Soils (Fed) | | |
|---|---|---|---|---|---|---|---|
| | Sub Classes | | | | Sub Classes | | |
| I | II | III | IV | Total of classes I-IV | V | VI | Total |
| 0 | 31.503 | 70,738 | 8,267 | 110,508 | 48,729 | 9,628 | 168,865 |
| 0 | 19 | 42 | 5 | 65 | 29 | 6 | 100 |

Table (2): Percent increase or decrease in areas of different soil categories of Kafr El Sheikh district from 1958 to 1978.

| Soil Category | Year 1958 | 1978 | % decrease or increase in areas |
|---|---|---|---|
| A. Cultivated Areas in Fed. | | | |
| Class I | --- | --- | --- |
| Class II | 31,503 | 79,176 | + 151 |
| Class III | 70,738 | 32,525 | - 54 |
| Class IV | 8,267 | 4,369 | - 47 |
| Total | 110,508 | 116,070 | - 5 |
| B. Uncultivated Areas in Fed. | | | |
| Class V | 48,729 | 31,986 | - 34 |
| Class VI | 9,628 | 25,756 | + 158 |
| | 58,357 | 57,745 | - 1 |
| Total surface area of the district in feddans | 168,865 | 137,812 | |

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investigated by Khalil et al (1976). They found that this soils is generally compacted, and its structure is blocky. The clay content of soils is slightly greater towards the north than in the southern part of the district. They also stated that the general increase of clay with depth may be related to the migration of the finest clay particles from the upper to the lower horizons.

During the time of the survey of Gieth et al (1959), the groundwater table was not observed within the top 150 cm. of the soil profile, except in some areas which were at lower elevations or were adjacent to canals or drains. The groundwater tables in these areas were measured 80-150 cm. below the soil surface.

Most of the soils in the southern portion of the district were considered, according to the 1959 survey, to be slowly permeable to irrigation water, and to have a high capacity for water retention. The maximum water holding capacity ranged between 55 and 70%. The cation exchange capacity ranged between 30 and 40 meq/100 g soil.

Chemical analysis of most of these soils revealed that they were moderately saline, Gieth et al (1959). The electrical conductivity of the saturation extract of most of the samples ranged between 4 and 8 mmhos/cm. Sodium was found to be the dominant cation. The sodium absorption ration (SAR) of most of these soils ranged between 10 and 15%. Some sodic soils showed higher SAR values. In general, it can be stated that a considerable area of the northern Nile Delta suffers from salinity or alkalinity or both as a result of saline groundwater near the soil surface, (Kovda 1958).

General Irrigation Distribution System in the Kafr El Sheikh District

Figure 1 shows the geographical location of Kafr El Sheikh and the main travel path for water delivered to the Kafr El Sheikh area. As shown in Figure 1a, water reaches Kafr El Sheikh by a series of main distributory canals. Water is diverted at the Zefta Barrage of the Damietta Branch of the Nile into the El Abasy Branch where a subsequent take-out discharges into the Bahr Shebin Canal. A portion of this flow is discharged into the

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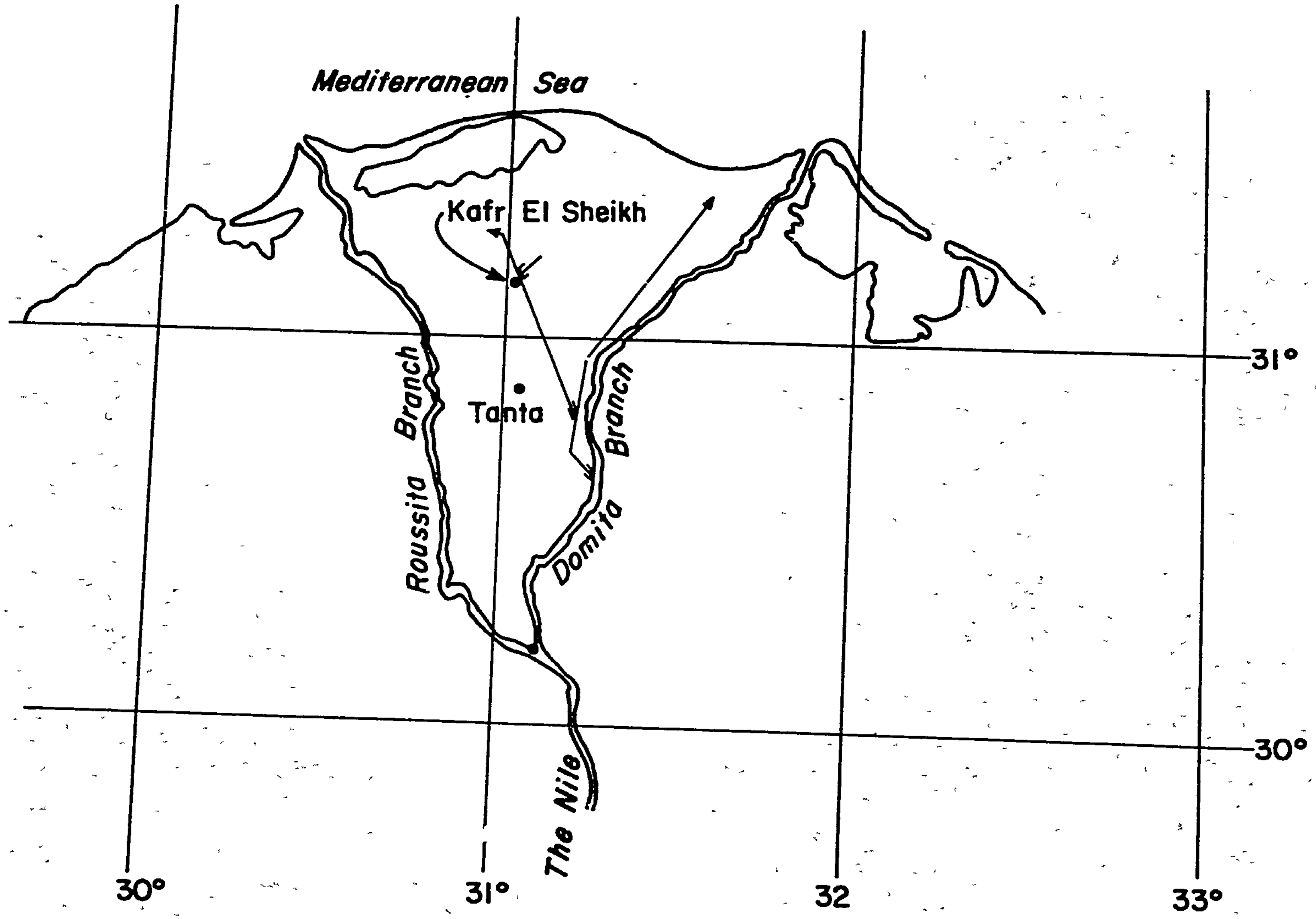


Figure 1. Geographic Location of Main Distributary Canals for Delivery of Water to Kafr El Sheikh

Layout Shows Main Carriers Take From Damietta Br. to Dacalt Canal

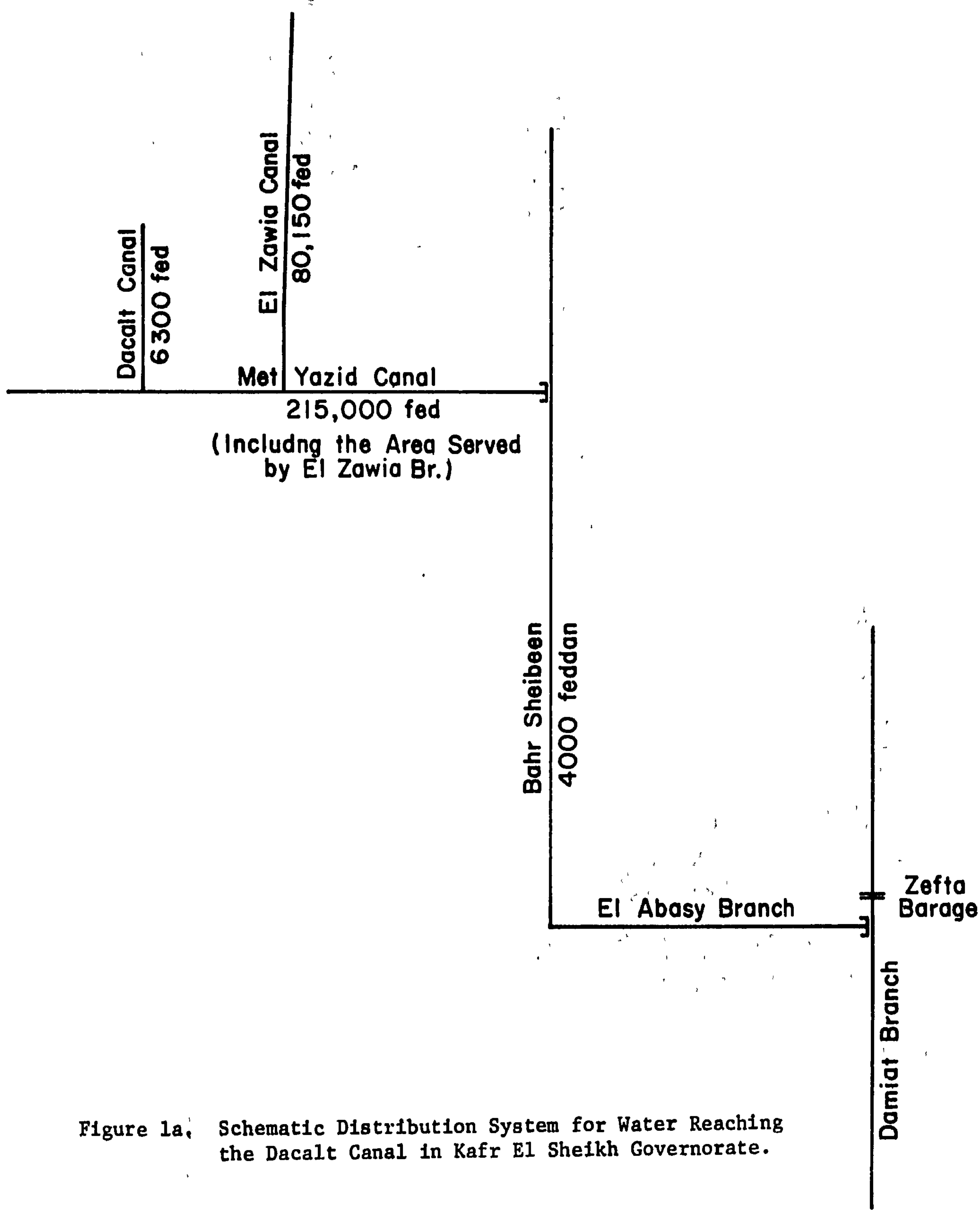


Figure 1a, Schematic Distribution System for Water Reaching the Dacalt Canal in Kafr El Sheikh Governorate.

Meet Yazid Canal. This canal in turn serves the Dacalt canal that is one of the major distributors for the Kafr El Sheikh area. The discharge from the Meet Yazid Canal into the Dacalt Canal averages 7.0 cubic meters per sec. There are two regulators on the canal for controlling and rotating the water in the canal. The basic rotation is 4 days on and 4 days off during the summer months and 7 days on and 7 days off during the winter months.

## DESCRIPTION OF PROJECT AREA, ABU-RAYA

### Physiographic Features

#### Location

The hydrographic irrigation unit chosen for the project work was the downstream end of the Dacalt Canal below the Helal regulator. This reach of the canal serves approximately 3200 feddans. This major hydrologic unit is bounded on the east by drain number 7 and on the west by the El Raghama Drain. The north boundary is the Hamoul Reyadh Road and the south boundary is small branch drain near the Helal regulaor. The Dacalt Canal crosses the area from north to south dividing it into two equal parts.

#### Topography

The land surface is flat and very gently sloping towards the north, and the area in general lies at contour 2 m above sea level.

#### Geomorpholo.y

The soils of Abu Raya area were formed from the Holocene alluvial deposits. These deposits consist essentially of dark greyish brown material formerly carried by the Nile in suspention due to the presence of micaceous-minerals and biotite. These deposits extend to a considerable thickness in depth as a consequence of the river having for thousands of years annually overflowed its banks and deposited its suspension load. The thickness of the deposits varies according to localities as well as to the irregular surface of the sand and gravels on which they were originally laid down and due to

.../...

the fact that the river changed its path from time to time.

However, the mean thickness of the Nile suspended matter varies from about 6-7 meters in Aswan-Qena to about 11.2 meters in the northern Delta; the average thickness in the Delta being about 9.8 meters.

The composition of the Nile sediments throughout its entire thickness coincides substantially with that of the materials carried in suspension by the river at the present time. However, some differences and a certain degree of alteration must undoubtedly have taken place under the action of plant life and percolation water since the time of deposition, yet these differences in composition are relatively small. The principal differences being higher proportions of ferric oxide, alumina and carbonate of lime, and smaller proportions of magnesia and organic matter, in the deeper layers of the Nile sediments as compared with the suspended matter of the river today (Ball, 1952).

## Soils

During the problem identification work, the Soil Survey Department of the Ministry of Agriculture completed a soils survey of the Abu Raya area.

The area was surveyed in detail using the cadastral maps of scale 1:2500 as a base map. The field data were later transferred from those maps to a 1:10,000 scale map to prepare the soil map of the area. Soil profiles (pits) were examined and sampled at an average density of 12 pits per square kilometers. The soils of the area were classified according to the U.S. Soil Taxonomy system. Due to its heavy texture and the montmorillonit nature of their clays, the major part of the area was classified as Virtisols and the remaining part as Entisols Torrifluvents. Results from this classification work will be published as a separate project paper. However the salinity and sodicity status of the soils which in effect relate to the water management problems are given below.

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Soil samples from one hundred sites uniformily distributed over the area were tested for salinity and sodicity. The distribution of salts as well as the values of SAR varied greatly at the different depths of the profiles studied. Therefore, the values of electric conductivity of the saturation extract and those of SAR are presented individally for the root zone, (0-80 cm depth) and for the deeper soil layer (80-150 cm depth).

Soil Salinity

The electrical conductivity of the saturation extract of 100 samples are grouped into 3 categories in Table (3).

Of the 100 samples, only 8% had EC values that were sufficiently high to have a hazardous effect in the root zone of the system. In contrast, 34% of the 96 samples from the deeper zone were strongly saline. High migration of salts by capillary action to the root zone can be expected if irrigation water is applied to upland crops at infrequent intervals and insufficient amounts during the summer.

For soils exhibited as moderately saline, leaching requirements should be calculated in determining the optimum amounts of water to be applied to upland crops in addition to consumptive use. These soil samples represent 48 percent of 100 samples taken from the root zone.

The distribution of surface and subsurface soil salinity for Abu Raya is shown in figures 2 and 3.

Soil Sodicity

The sodium absorption ratios (SAR) of 100 soils samples taken from the root zone and from the deeper soil layer are summarized into three categories in table 4.

Table (3): Salinity status of Abu Raya soils

| Salinity Scale | No. of soils | % in category | Average EC per category |
|---|---|---|---|
| A. <u>Root Zone (0-80 cm)</u>: | | | |
| Non saline, 4 mmhos/cm | 44 | 44 | 2.75 |
| Moderately saline, 4-8 mmhos/cm | 48 | 48 | 5.36 |
| Strongly saline, 8 mmhos/cm | 8 | 8 | 15.24 |
| B. <u>Sub-soil (80-150 cm)</u>: | | | |
| Non saline, 4 mmhos/cm | 24 | 28 | 2.64 |
| Moderately saline, 4-8 mmhos/cm | 33 | 38 | 5.82 |
| Strongly saline, 8 mmhos/cm | 29 | 34 | 12.94 |

Table (4): Soil sodicity at Abu Raya

| SAR | No. of soils | % in category | Average SAR per category |
|---|---|---|---|
| A. <u>Root Zone (0-80 cm)</u>: | | | |
| Low, 10 | 58 | 58 | 6.70 |
| Medium, 10-15 | 30 | 30 | 12.22 |
| High, 15 | 12 | 12 | 18.33 |
| B. <u>Deep sub-soil (80-150 cm)</u>: | | | |
| Low, 10 | 20 | 23 | 7.47 |
| Medium, 10-15 | 22 | 26 | 12.14 |
| High, 15 | 44 | 51 | 20.84 |

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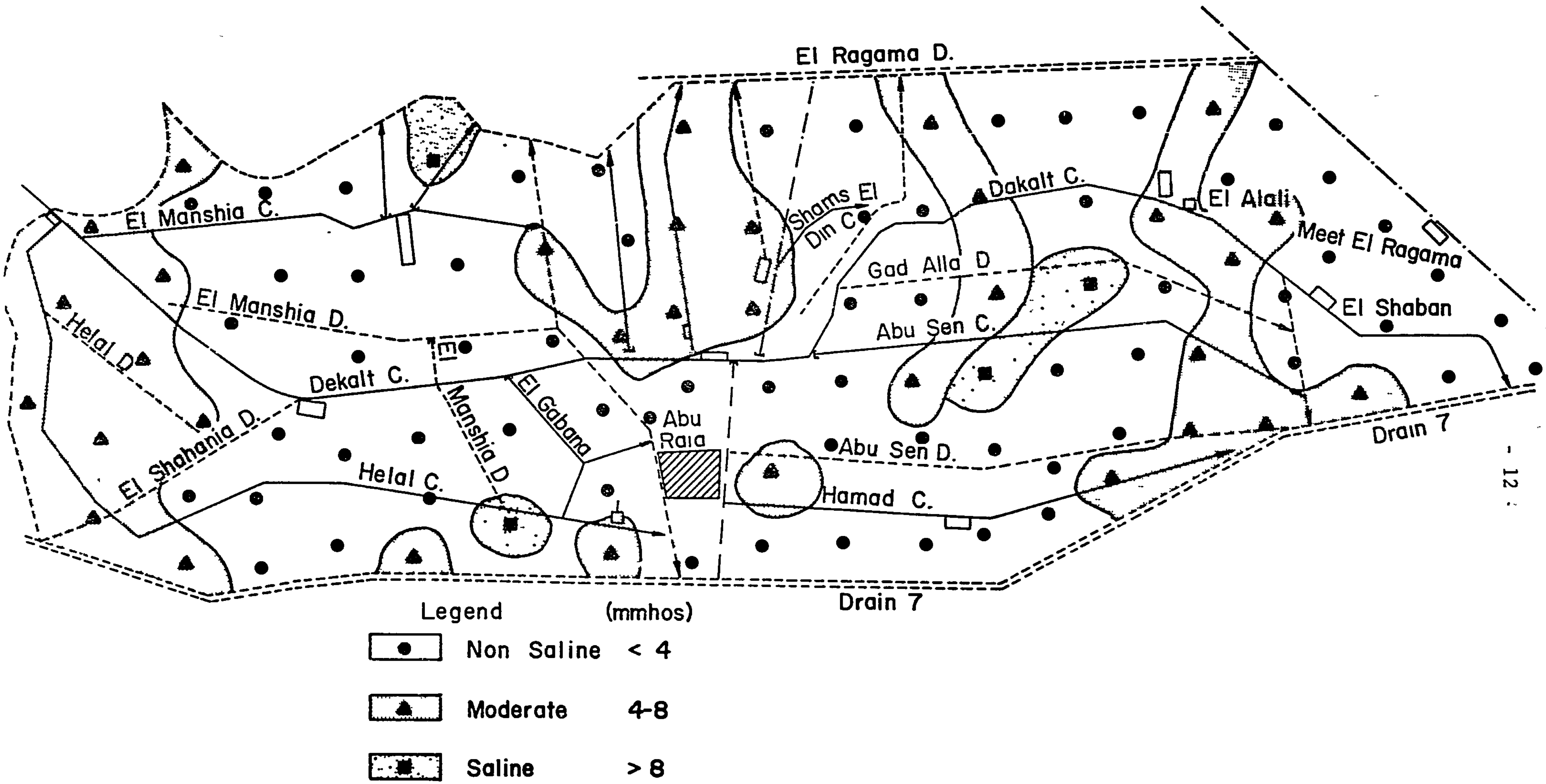


Figure 2. Distribution of Soil Salinity in the Surface Soils (0-25 cms) of the Abou Rayah Area

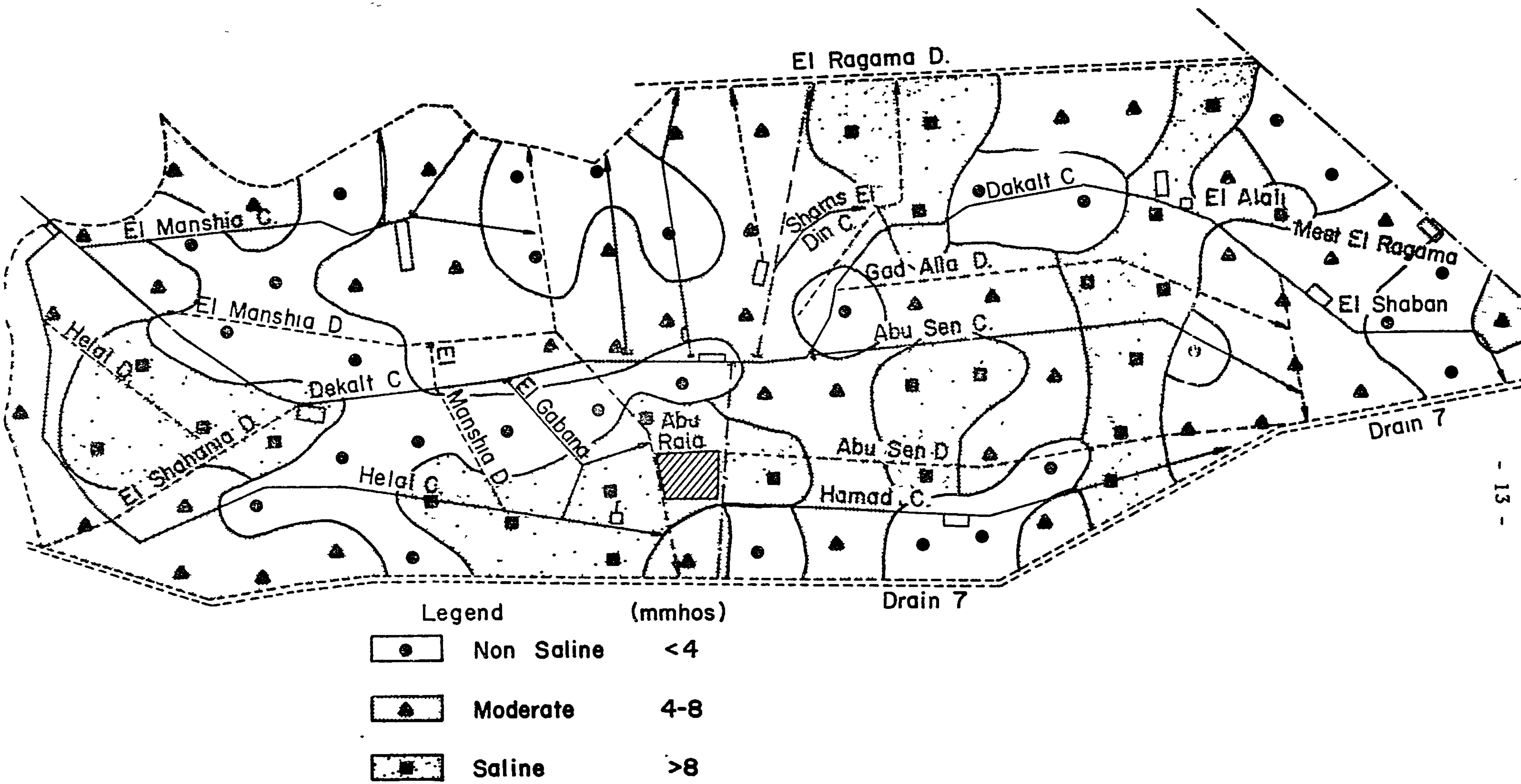


Figure 3. Distribution of Soil Salinity in the Subsurface Soils of the Abou Rayah Area

Potentially serious problems can be expected in 30 percent of the soils where SAR values from the root zone ranged from 10-15. Particularly, if present farm management practices continue. Sodic problems have already developed in the root zone in 12 percent of the area where SAR values are now above 15. While, severe sodic problems have already developed in 51 percent of the deeper soil of the cultivated area where SAR values are now above 20.

The distribution of values of SAR in the surface and subsurface soils of Abu Raya are shown in figures 4 and 5.

The exchangeable sodium percentage (ESP) of 26 soil samples taken from the root zone and from the deep soil layer are summarized in three categories in Table 5.

Unlike salinity, most of the soils show alkalinity. Of the 26 samples, 58% had ESP values that are moderately alkaline in the root zone and 38% were highly alkaline.

## Abu Raya Village

The principal village for the downstream reach of the Dacalt canal is the village of Abu Raha which is located in the northern part of the southern portion of the Kafr El Sheikh district. It is a relatively small Egyptian village (approximately 3500 population) situated near the geographical mid point of the Delta region and lies nearly in the center of the eastern half of the hydrographic study area. Although on "old lands", the village became a viable community as recently as the early 1930s (typical of many villages in the central and northern Delta region). Government services based in the village include an agricultural coop service center, a human health unit, and a school. The village at this time does not have electrical service, a potable water system, resident village bank and vetinary medicine service, or reliable all-weather roads to area service centers. Commercial and repair

Table (5): Alkalinity status of Abu Raya soils

| ESP | | No. of soils | % in category | Average ESP per category |
|---|---|---|---|---|
| **A.** | **Root Zone (0-80 cm):** | | | |
| Low, | 10 | 1 | 4 | 9.25 |
| Medium, | 10-15 | 15 | 58 | 12.73 |
| High | 15 | 20 | 38 | 18.62 |
| **B.** | **Deep sub-soil (80-150 cm):** | | | |
| Low, | 10 | 0 | -- | --- |
| Medium, | 10-15 | 1 | 5 | 13.2 |
| High, | 15 | 20 | 95 | 24.57 |

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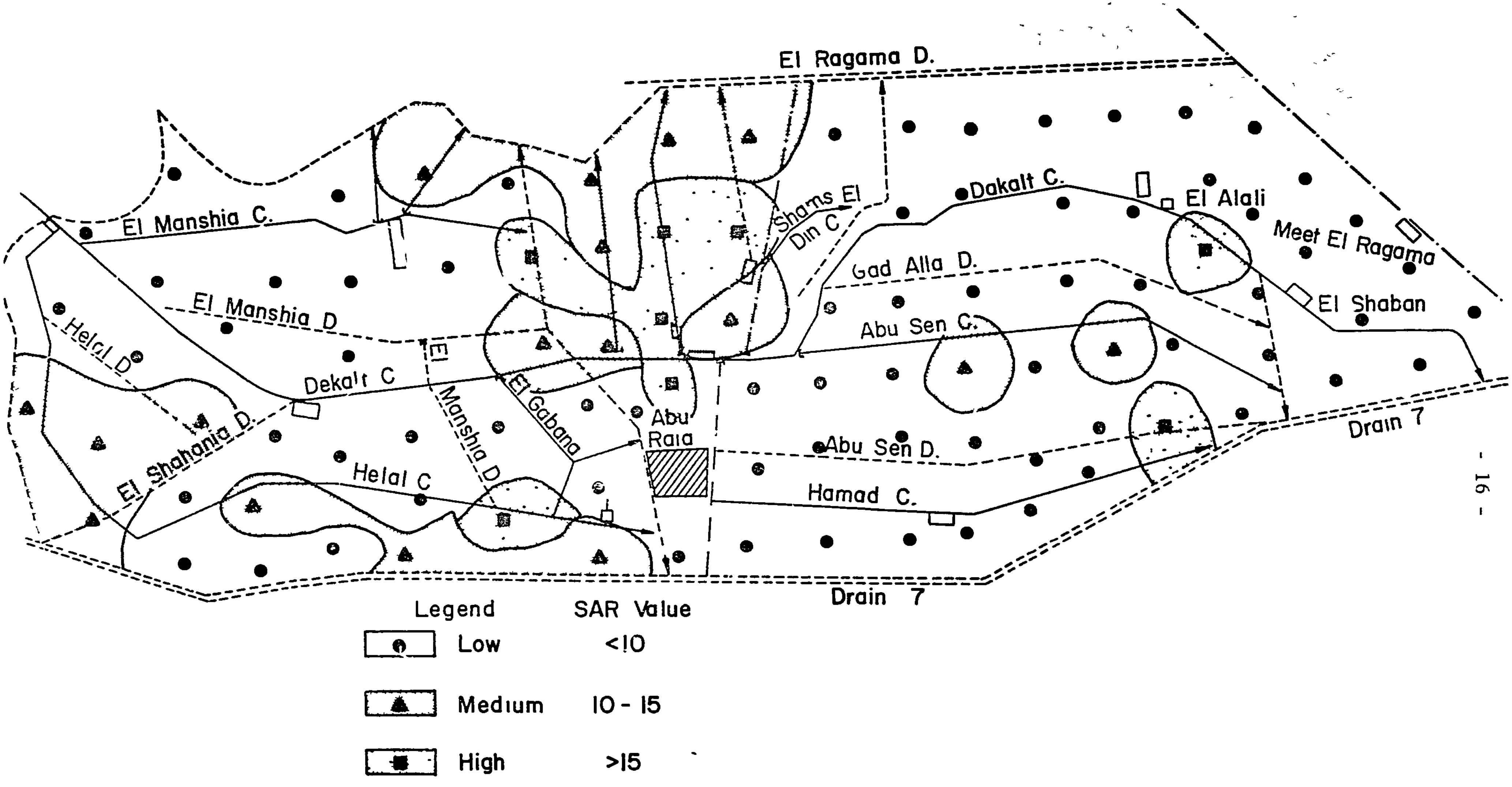


Figure 4. Distribution of Values of SAR in the Surface Soils (0-25 cms) of Abou Rayah

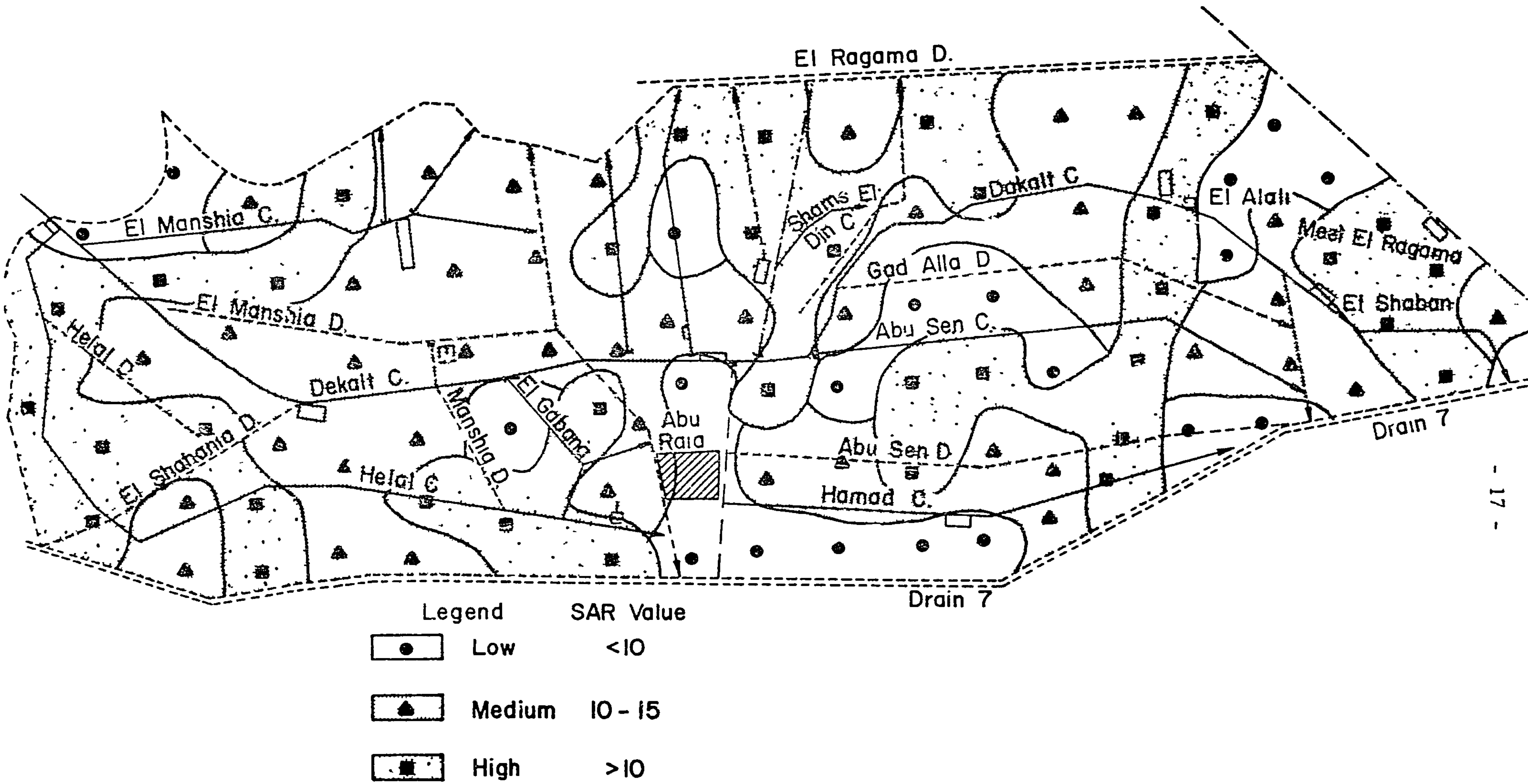


Figure 5. Distribution of Values of SAR in the Subsurface (>25 cms) of Abou Rayah

services are very limited in the village.

Abu Raya is overwhelmingly Moslem. It has an age-sex population distribution typical of those portions of rural Egypt not in close proximity to very large urban centers (eg. a very young population, close male/female ratio, etc.). The village is politically stable and lacks factional stress (although there is considerable rivalry between it and several politically appended sub-villages and neighboring villages). Indigeneous leadership in the village appears capable and strong. Local decision-making process operate smoothly, and seem characterized by pragmatic expediency, informal consensus and a broadly-based desire to avoid confrontation among community participants. In consequence, the general social atmosphere of the village is pleasant, peaceful and friendly.

The characteristics do not imply individual passivity, however, Abu Raya adults (as in common in more remote Egyptian villages) are markedly independent in attitude and action, reasonable self reliant, and evidence considerable initiative and dedication in their favorite persuits. Accordingly, they tend to be quite open and candid as individuals, and are not easily intimidated by outside authority or policy, which they often take issue with. Although, formal education levels tend to be quite low (illiteracy predominates among adults), practical insights and personal creativity appear quite high. Research data show an average level of receptivity to innovation and change considerably higher than we had expected. Generally, the Abu Raya population demonstrates good trust and respect for fellow-citizens and outsiders until they sense evidence that it is undeserved.

## General Agriculture and Cropping Patterns

Farm holdings by Abu Raya farmers vary in size from less than one feddan to more than 20. These farms produce a variety of winter and summer crops. The major winter crops are wheat, flax, berseem, beans, and vegetables while the summer crops are cotton, rice, corn and vegetables.

.../...

The distribution of farm size for the Abu Raya cooperation is given in table 6. These data indicate that more than one half of the farmers have less than three feddans. As a matter of fact, forty seven percent are in the 1-3 feddan class and thirty percent are in the 3-5 feddan class. Only seventeen percent have more than 5 fed. Given the need for achieving economies of scale for modern agricultural technology, one is tempted to define one of the constraints to agriculture as the small farm. However, looking at the political realities of Egyptian agriculture and Egyptian society in general it is not likely that anything will be done to change this situation in the near future. It is perhaps realistic, therefore to accept small farm size as a "given" rather than defining it as a problem.

Data obtained from 12 farmers along two water courses in the Abu Raya area given in table 7 shows that the major winter crops are berseem and wheat. In fact, fifty eight percent of the area is in berseem while twenty three percent is in wheat during the winter assuming these farmers typically represent the area. For summer crops, on the other hand, rice represents forty seven percent of the area and cotton thirty six percent. According to governmental policy only 50% of the land should be in rice production on a given water course. One should not assume from the data shown in table 7 that farmers follow the governmental policy. This will be brought out later in the report as a problem in water management.

## Water Distribution and Irrigation Methods

As typical throughout Egypt, water is distributed from the main canals into branch canals or meskas for distribution on the fields or farms. The Helal regulator serves as the control for water distribution downstream on the Dacalt canal to its end. This downstream reach of the canal serves 6 branch canals which supply water for on-farm irrigation. The Dacalt canal not only serves as a carrier but also has legal outlets for on-farm irrigation.

.../...

Table (6): Distribution of farm size Abu Raya Cooperative Kafr El Sheikh

| Size Class | Number of farmers | Percent of total farmers | Number of fed. | Percent of total fed. |
|---|---|---|---|---|
| Less than 1 fed. | 59 | 6 | 36 | 1 |
| 1 to 3 fed. | 430 | 47 | 820 | 26 |
| 3 to 5 fed. | 284 | 30 | 937 | 30 |
| 5 to 10 fed. | 124 | 13 | 809 | 26 |
| 10 to 20 fed. | 30 | 3 | 380 | 12 |
| 20 to 50 fed. | 6 | 1 | 139 | 5 |
| Total | 933 | 100 | 3121 | 100 |

Table (7): Winter and summer cropping patterns among 12 farms along two water courses in the Abu Raya area

| Winter crops | Area Feddans | % of Total | Summer Crops | Area Feddans | % of Total |
|---|---|---|---|---|---|
| Wheat | 16.25 | 23.3 | Cotton | 25.50 | 36.4 |
| Flax | 7.54 | 10.8 | Rice | 33.20 | 47.4 |
| Berseem | 40.33 | 58.0 | Maize | 7.20 | 10.3 |
| Beans | 2.2 | 3.3 | Vegetables | 4.08 | 5.9 |
| Vegetables | 3.25 | 4.9 | | | |
| Total | 69.57 | 100 | | 69.98 | 100 |

Water is primarily lifted by sakias for irrigation on the farm. The method of on-farm water distribution is similar to that described in the Mansouria problem identification report. Water is lifted into a Marwa and then distributed into small flat basins with or without furrows. As described in the above mentioned report; the basins are filled with water until the surface is completely covered. Preplanting irrigations are generally the rule before seeds are sown for most crops.

## Water Course Sites

Two water courses, Om'Sen and Hammad Canals, were selected in the Abu Raya area for intensive problem identification work. Both of these water courses serve land at the extreme downstream end of Dacalt canal. The area is shown in figure 6. The Hammad canal runs mostly parallel and adjacent to deep drain No. 7, while Om'Sen lies nearly midway between deep drains No. 7 and El Raghama drain. Both canals are served by smaller drains parallel to the canals.

Four common sites were selected by an interdisciplinary team. There are two sites on each of the Hammad and Om'Sen canals. One site is at the head of each canal and the other at the tail. Two sites were in cotton allocations, one at the tail of the Hammad canal and one at the head of the Om'Sen canal. Alternately the head of the Hammad canal and the tail of the Om'Sen canal will be areas allocated to rice production.

### Om'Sen Canal

The inlet to Om'Sen Canal is on the right hand side (east side) of Dacalt canal approximately 8.4 km from the beginning of Dacalt canal at Meet Yazid canal. The meska serves 34 sakias over its approximate 1700 m length. The area served in 205 feddans. The downstream boundary condition is blocked. At one time there was free outlow to Gadalla Drain. The area served by Om'Sen canal is bounded by Gadalla and Om'Sen drains on the west and east sides, respectively. The north end of this area is also bounded by Gadalla Drain with the south end being bounded by Hammad Canal and Dacalt canal. The canal is served by a 5 day on/10 day off rotation in winter season and by a 4 day on/4 day off rotation in summer season. Sakias are unevenly spaced along the canal; the first one is located after only 30 m. The first nine sakias are within the first 400 m. Then there is about 60 m with no sakias. Seven more sakias are evenly spaced in the next 270 m; then there are 70 m of no sakias. Then there are 11 sakias within a 350 m reach, after which there is a 130 m reach with no sakias. The final seven sakias are spaced in the final 400 m reach. 80% of the sakias are within the first two-thirds of the canal. This is a major factor contributing to the perceived water shortage at the end of the canal. During critical periods the end of the canal will not receive the necessary amount of water without some fixed scheme of rotation of sakia operation along the canal.

Hammad Canal

The inlet to Hammad Canal is on the right hand side (east side) of Dacalt Canal approximately 8.1 km from the beginning of Dacalt Canal at Meet Yazid Canal. The canal serves 26 sakias over its approximate 2230 m length. The area served is 210 feddans. The downstream boundary of the canal is blocked (as apposed to free outflow condition). Hammad Canal follows Abu Raya Road for the first 550 m, after which is takes a $90^{o}$ turn north and continues the final 1680 m approximately mid way between Om'Sen Drain and Drain No. 7 (see figure 6). During the winter cropping season the canal is served by a 5 day on/10 day off rotation. The main winter crops are wheat, berseem, flax and broadbeans. During the summer season the canal is served by a 4 day on/ 4 day off rotation. The main summer crops are rice, cotton and some corn. There are only 2 sakias in the 1st 500 m of the canal. The remainder are spaced fairly evenly down the rest of the length. The Omda of Abu Raya owns the land around the portion of the canal adjacent to Abu Raya Road and has control of the first 3 or 4 sakias on the canal.

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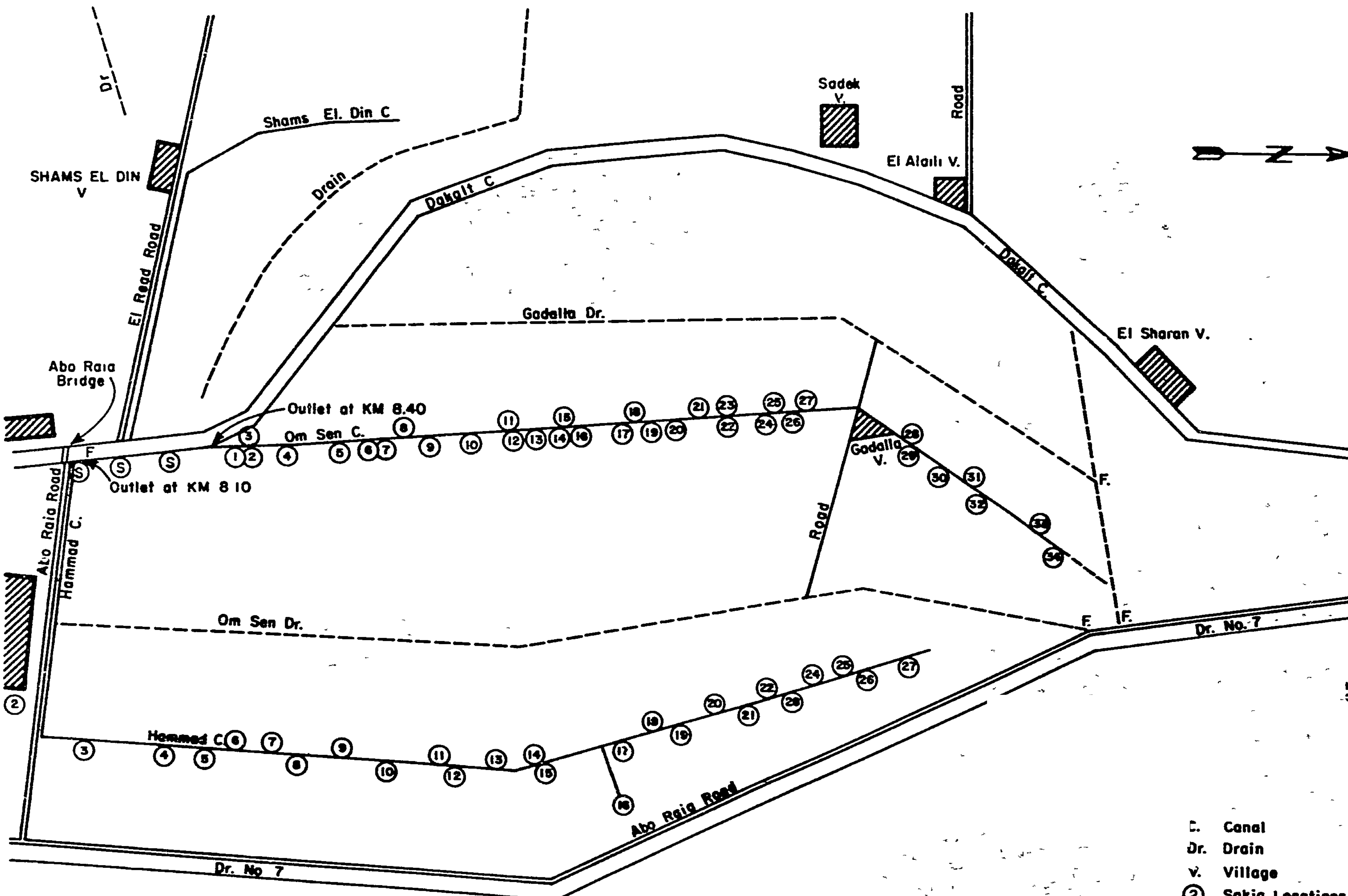


Figure 6. Geographic Location of Om Sen and Hammad Canals Showing Location of Sakias and Other Important Geographic Features

## PROBLEM IDENTIFICATION PROCEDURES

The hydrological units mentioned and described in the previous section were selected to represent a typical set of soils, cropping and irrigation patterns of "lower delta" Egypt. Within these units, individual farms were selected to represent those same sets of conditions and situation that may be typical of lower delta farmers.

Before selection of individual farms, a pre-project activity team visited the area of Abu Raya to orient the village officials and representative farmers about the goals and objectives of the project and to solicit their support. After receiving full support, farms were then selected at the upper and lower reaches of each hydrologic unit for intensive data collection pertaining to agronomic and on-farm water management practices.

The main office staff in cooperation with representative team members develop criteria for selecting farms along the water courses.

Some of these criteria included type of crop, method of irrigation, position along the meska and size of the farm.

With inputs from all disciplines, questionnaire and interview forms were developed to obtain socio-economic data by selecting additional farmers and farms to obtain a larger representative sample of the village and hydrologic unit. A number of farms were selected along each water course by the economists to obtain farm records for the development of a farm planning field trial. Records of present farming activity among farmers were essential to show how farm record keeping can become a valuable tool for farm planning to increase incomes of farmers.

Detailed procedures were developed by the engineers and agronomists and socio-economic groups for obtaining on-farm water management problem identi-

.../...

fication data for the intensive study site mentioned above. Every effort was made to observe and quantify present practices so as to determine the technical problems encountered on the farm. An outline of the measurements and information collected from these farms is given below. The details are a matter of team record in the Kafr El Sheikh files.

Measurement and information to be collected by various discipline groups of the field team include:

Engineering

During the initial period of problem identification data should be gathered that will help formulate hypotheses for water management for the Abu Raya area. The following are some of the measurements and information that should be collected by the engineers:

1. Obtain the best available map of the Abu Raya area. Change the scale if necessary. Fill in any field boundaries approximately, which are not already shown on the map. Establish some kind of temporary code system to identify each field.

2. Observe and record each irrigation on some fields by date and time. Include the time period during the irrigation. Observe whether or not runoff occurs, and measure the amount, in relation to the amount applied. Estimate the precision of the land leveling by observing the uniformity of water coverage as the last portion is absorbed. Note the time required for the ponded water to disappear from 50% of the surface area of a basin.

3. Observe and record on the map the location of all meskas, the direction of flow, the area served by each meska, the method of control of water entering the meska, and runoff from the end if any.

4. Note the use of water lifting devices if any.

5. Observe the operation of the canal serving the area, its basis of delivery, including the rotation schedule if any, its normal water levels and their fluctuations within a 24 hour period, within a rotation, and with increasing crop demand.

6. Measure the quantity of water applied in the daytime vs night.

7. Observe the need for drainage if any.

8. Observe the apparent adequacy of the water supply in general.

9. Assist with team interviews of farmers at the Abu Raya site. (rotate with other disciplines)

Economic

1. Assist with team interviews of farmers at the Abu Raya site.

2. Obtain data from the Cooperative regarding:
   a. Number of farms
   b. Classification of ownership and tenure status
   c. Farm size
   d. Inventory of pumps, tractors and farm machinery
   e. Water delivery methods to the farms, e.g. tambour, gravity, pumps, etc.
   f. Cropping pattern for Abu Raya area.

3. Collect all secondary data about Abu Raya area and request translation to English if appropriate.

Sociology

The main office sociologists in cooperation with other discipline leaders have prepared an interview questionnaire that will be employed by the sociologists of the Kafr El Sheikh field team to obtain an idea of what the farmers

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think regarding how to increase their production and how to create a better life for village people. Other team members from other disciplines will assist in the interview. Discipline team members will rotate as members of the interview teams so that all team members may participate. The following are specific information to be gathered:

1. Make general observations of local field conditions and in general will support team building activities and other disciplines technical observations.

2. Short interview willbe undertaken with a cross-section of typical farm operators in the Abueha area in collaboration with toher disciplines, until sufficient numbers are completed to affort confidence that we know sufficiently what farmers feel and think about their problems of production.

Agronomy

The agronomic team will visit as many farms as practical and make observations on agronomic and management practices. Agronomic team members should make the following observations and obtain as much quantitative information as possible regarding farming practices and conditions on individual farms.

1. Type of crops cultivated and growth characteristics
   a. Condition of crop (general)
   b. Plant density
   c. Pest infestations
   d. Weed infestations
   e. Drought or wet feet growth characteristics
   f. Foliar diagnosis for nutrient deficiency

2. Soil Characteristics
   a. Crusting, cracking, etc. impermeable layers

b. Evidence of salinity or sodicity

c. Seed bed type

d. Brief classification of surface and 30 cm using "spit" method

3. Management Practices

a. Cropping patterns, intercropping patterns

b. Fertilizer practices

1. animal residue

2. plant residue

c. Method of varietal selection

d. Cultivation methods

e. Insect disease control methods

f. Seedbed preparation methods

Before making the observations, agronomists in cooperation with engineers should establish a temporary coding system for each field for indentification.

A general surface and sub-surface soil texture survey was taken by the soil survey department in the Ministry of Agriculture. Standard soil survey practices were followed to obtain representative data for the hydrologic area to determine soil structure, consistency, color, mottling depth, and water table location. Soil profiles from representative sites were analyzed for exchange capacity, exchangeable sodium and water soluble salts, Ph, gypsum requirement, soil organic matter, soil fertility analysis, lime and moisture retention curve.

In addition to the above, an extensive soil testing survey was made to identify problems in the village so that sampling procedures can be designed for fertility recommendations.

The results of the fertility and soil surveys will be presented in separate reports and are not included herein, except for the salinity and sodicity status of the soils.

.../...

It is well to note here that problem identification procedures can be generally defined here, but specific details on the procedures followed to identify a specific problem will be reserved for reports dealing with quantitative description of the problems. The results of this problem identification report are mostly qualitative and will serve as a guide for more intensive investigations needed for problem solution.

## RESULTS OF PROBLEM IDENTIFICATION STUDY

### Social and Economic Problems

#### Introduction

Some of the major procedures, findings and conclusions of problem identification research conducted by the EWUP sociology group in the area around Abu Raya village from July, 1978 to April, 1979 are given below. The purpose of this work was to characterize social psychological, organizational and cultural factors of relevance to project effectiveness in the area as applied activities are undertaken.

Included are: (1) identification of "felt needs" and problems from sample farmer's perspectives; and (2) identification of constraints and opportunities for irrigated agriculture development from our professional perspective.

The conclusions are based largely in three sets of detailed interviews with each of twenty farmers operating case study sites being investigated by the other EWUP disciplines. Precautions were taken to insure that these farmers were generally representative of the farmers operating in the area. As well, conclusions are based in secondary data obtained from local government sources (eg. coop records, district reports, etc.) and from national sources (eg. census records and published government reports). Direct observation of the field team and special topical studies undertaken to follow up general leads also have contributed data and interpretive insights reported here.

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The economists worked closely with the sciologists in the development of a questionnaire which was subsequently administered by the sociologists. The economists took as much information from the questionnaire as was available and used it in the development of the farm plans. This avoided the problem, from the farmers' point of view, of making repeated inquiries about the same information.

The economics team developed a farm plan with three farmers at each site. The initial farm plan was for the agricultural crop year 1978. The primary purpose in developing these farm plans, which were actually developed in an ex-post sense, was to provide training for the Economics team in farm planning and farm management data analysis. An additional benefit was to meet the farmers and begin the establishment of a long term relationship with them.

## Major Irrigated Agriculture Problems

All of the problems defined in this section were compiled from interviews and questionnaires conducted with individual farmers. They therefore reflect his perception of irrigated agriculture problem and his "felt" needs. The conclusion and discussion raised in this section are given as a result of the research efforts of the sociologists and the economists of the project.

### Commercial Chemical Fertilizer

Farmers report that there is an insufficient supply of fertilizer. The fact the free market prices are usually 150 to 180 percent of official prices supports the contention of farmers that there is not enough available. Given the price differential, it is clear they would use more if it were available at official prices. This problem needs further clarification. Soil tests indicate that farmers may be using phosphate in quantities which do not give economical responses. There is also some evidence that nitrogen fertilizer may be wasted through leaching associated with poor water management. At the same time experiments show very high yield reponses to certain micro-nutrients when applied to the plants as a foliar spray. Per-

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haps the problem should be described as inappropriate allocation of fertilization of fertilizer rather than a general shortage.

*Increasing Labor Costs*

Farmers report that farm labor is becoming scarce and expensive. Many of them give this as the reason for (1) not keeping the private drains clean and (2) poorly time harvesting. The farmers and qualified professional experts who have visited the Abu Raya site seem to agree that the private drains are very inefficient because soil and plant growth is not removed frequently enough. It is also generally reported by farmers and other observers that crop production is lost because harvesting is done too early or too late. Figure 7 indicates the average wage rates for farm labor at Kafr El Sheikh during the calendar year 1978. Wage rates of LE 1.3 occur during peak labor demands of June to November. The peak daily wage for "boys and girls" reaches LE 0.6 per day and LE 0.5 per day respectively for these two peak periods. Although these wage rates are low relative to developed countries they nevertheless present a serious burden to small farmers who need to hire labor for various farming operations. As economic development takes place in Egypt, however, it should be anticipated that farm wage rates will continue increasing. Therefore it seems that appropriate action on the part of farmers would be to gradually adopt capital intensive technology to replace the relatively more expensive labor. This implies finding some means to achieve economies of scale which will permit the adoption of capital intensive technologies.

*Crop Allocation System*

The farmers are dissatisfied with the crop allocation system which includes: (a) inability to devote a portion of one's fields to crops desired for domestic use without being fined; (a) inability of many to grow crops giving the highest cash returns and/or that demand less routine labor. It may be noted, some of the dissatisfaction with the "block rotation" system results from this being a newer "old lands" area, where factionalization of land holdings, with dispursed small plots, is not as common as in areas that have

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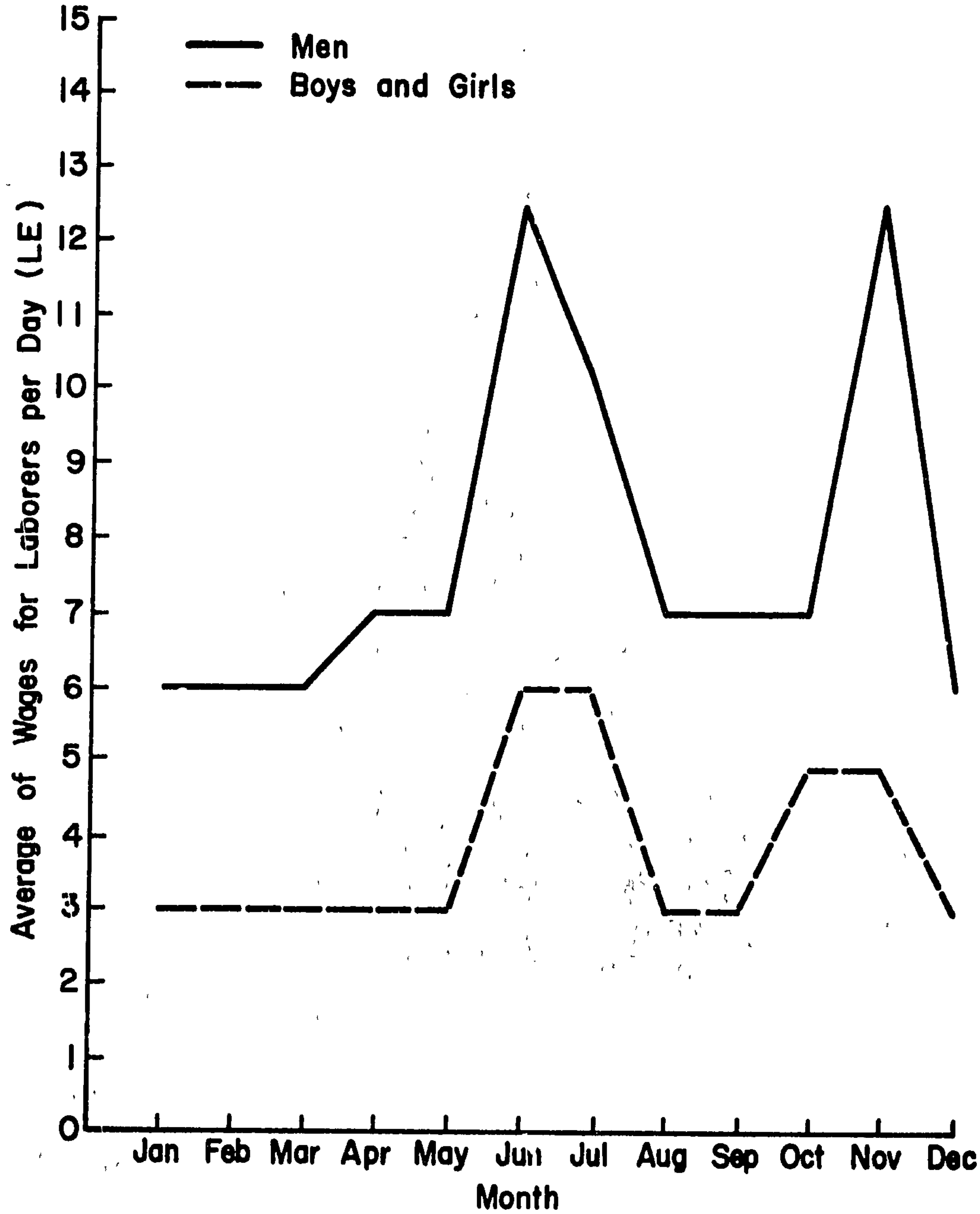


Figure 7. Average Wage Rates for Farm Labor at Kafr El Sheikh (1978)

been operated for more than two generations. Perhaps justifying some official exemptions where consolidation of holding is presently greater.

With respect to (a) above, the farmers experience a shortage of summer feed supplies for animals and would like large official allocation and/or adjustment in the crop assignment system so they could grow more forage during the summer. Based upon data collected from 12 farmers along the Om'Sen and Hammad canals, Tables 8 and 9 show the distribution of types of animal units among these farms and their value. The data show that these 12 farmers have slightly more than one animal unit per feddan. The predominate units being cows, buffalo and calves which produce meat and milk and as well as serve as work animals. The average value that these animals produce per feddan is 112 Egyptian Pounds. This value seems significant when compared with the average farm income shown in table 10. Adequate feed supplies during the summer would no doubt increase the production value of these animals.

*Lack of Data for Farm Planning and Feasibility Analysis*

With reference to item (a) and (b) for the "Crop Allocation System" mentioned above. Even, if the crop allocation system were modified in their favor, the farmers at Abu Raya are poorly equiped to analyze complex production and marketing alternatives even though they are good at crop and animal husbandry. They lack basic information about input-output relationships and analytical skills to evaluate alternative agricultural systems. Attempts to get data through farmer interviews were frustrated by memory bias, poor communications and general distrust between farmers and professional staff. This problem will be approached in the future through: (1) a farm planning and record keeping activity, (2) cost-return studies of crop enterprises and (3) a continued search of secondary data sources. Such an approach, with appropriate extension programs, should help farmers to allocate production resources into the most profitable crop and livestock enterprises. Tables 11 and 12 indicate differences in the profitability of alternative crops and the need for more planning data. It appears net income may be increased by

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## AVERAGE ANIMAL UNITS PER FEDDAN

## STUDY CASES AT ABU RAYA SITE

## TABLE 8

| Farm No. | COW | | BUFFALO | | CALF | | DONKEY | | CAMEL | | GOATS & SHEEP | | POULTRY | | TOTAL ANIMAL UNITS | AREA | | AVERAGE A.U. PER FEDDAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | A.U. | No. | A.U. | No. | A.U. | No. | A.U. | No. | A.U. | No. | A.U. | No. | A.U. | | Fed | Kar. | |
| 1 | | | 2 | 2 | 1 | 1 | 2 | 1.6 | | | | | 39 | 0.39 | 4.99 | 6 | 9 | 0.78 |
| 2 | 1 | 1 | 1 | 1 | 4 | 4 | 2 | 1.6 | | | | | | | 7.60 | 6 | 19 | 1.12 |
| 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1.6 | | | | | 8 | 0.08 | 6.68 | 8 | 8 | 0.80 |
| 4 | 1 | 1 | 1 | 1 | | | 1 | 0.8 | | | | | | | 2.80 | 4 | - | 0.70 |
| 5 | 1 | 1 | 1 | 1 | | | 2 | 1.6 | | | | | | | 3.60 | 6 | 16 | 0.54 |
| 6 | 4 | 4 | 2 | 2 | 3 | 3 | 2 | 1.6 | | | | | 10 | 0.1 | 10.70 | 10 | 18 | 0.99 |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.8 | | | | | 3 | 0.03 | 3.83 | 4 | 14 | 0.84 |
| 8 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 0.8 | 1 | 1.1 | | | 33 | 0.33 | 7.23 | 10 | 6 | 0.70 |
| 9 | | | 2 | 2 | 2 | 2 | 1 | 0.8 | | | | | 22 | 0.22 | 5.02 | 3 | - | 1.67 |
| 10 | 1 | 1 | 1 | 1 | | | 1 | 0.8 | 1 | 1.1 | | | 500 | 5 | 8.90 | 3 | - | 2.97 |
| 11 | | | 2 | 2 | 1 | 1 | | | 1 | 1.1 | | | 25 | 0.25 | 4.35 | 3 | 4 | 1.38 |
| 12 | | | 2 | 2 | 3 | 3 | 1 | 0.8 | | | | | 37 | 0.39 | 6.17 | 3 | 4 | 1.95 |
| TOTAL | | 13 | | 17 | | 19 | | 12.8 | | 3.3 | | | | 6.77 | 71.87 | A.U. | | |

Animal Units are based on the following multiplicative factors:

Camel 1.1 Cow, Buffalo 1.0 Donkeys 0.8 Goats, Sheep 0.1 Poultry 0.01

AVERAGE VALUE OF LIVESTOCK PRODUCTION PER 1 ANIMAL UNIT

TABLE 9

| NO. OF STUDY CASES | TOTAL AREA | | TOTAL ANIMAL UNITS | AVERAGE ANIMAL UNIT PER FEDDAN | TOTAL VALUE OF LIVESTOCK PRODUCTION L.E. | AVERAGE PRODUCTION PER 1 A.U.* L.E. |
|---|---|---|---|---|---|---|
| | Fed. | Ker. | | | | |
| 12 | 70 | 2 | 71.87 | 1.02 | 8084 | 112.48 |

* A. U. - ANIMAL UNIT

AVERAGE NET FARM INCOME PER FEDDAN AND AVERAGE NET FARM INCOME PER PERSON

FROM THE STUDY CASES AT ABU RAYA SITE.

TABLE 10

| NO. OF STUDY CASES | TOTAL AREA | | TOTAL INCOME L.E. | AVERAGE OF TOTAL INCOME PER FEDDAN L.E. | TOTAL EXPENSES L. E. | AVERAGE OF TOTAL EXPENSES L.E. | TOTAL NET FARM INCOME L.E. | AVERAGE NET FARM INCOME L.E. | TOTAL FAMILY MEMBERS | AVERAGE NET INCOME PEP PERSON L.E. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fed. | Ker. | | | | | | | | |
| 12 | 70 | 2 | 20284 | 289.44 | 9807 | 132.8 | 10977 | 156.6 | 106 | 103.5 |

PROJECTED INCOME AND EXPENSES FOR ONE FEDDAN OF W.NTER CROPS, ABU RAYA, 1979.

TABLE 11

| CROP OR CROP COMBIN-ATION | PRODUCTS | UNITS | USUAL YIELD PER FEDDAN | PRICE PER UNIT L.E. | GROSS INCOME PER FEDDAN L.E. | EXPENSES L.E. | RETURN TO LAND AND MANAGEMENT L.E. | MONTHS FOR ONE CROP | AVERAGE RETURN PER MONTH L.E. |
|---|---|---|---|---|---|---|---|---|---|
| Berseem | Forage | Kt. Cut | 72 | 1.500 | 108.0 | | | | |
| | Seed | Kaila | 8 | 4.000 | 32.0 | | | | |
| | Straw | C. Load | 4 | 1.250 | 6.0 | | | | |
| | | | | | 146.0 | 58.6 | 87.4 | 7 | 12.5 |
| Broad Beans | Beans | Ardab | 3.5 | 20.000 | 70.0 | | | | |
| | Straw | C. Load | 5 | 4.000 | 12.0 | | | | |
| | | | | | 82.0 | 42.00 | 40.0 | 6 | 6.7 |
| Wheat | Grain | Ardab | 8 | 9.000 | 72.0 | | | | |
| | Straw | C. Load | 5 | 7.000 | 35.0 | | | | |
| | | | | | 107.0 | 65.0 | 42.0 | 7 | 6.0 |
| Flax | Seed | Kilogram | 500 | 0.200 | 100.0 | | | | |
| | Straw | Ton | 1.5 | 30.000 | 45.0 | | | | |
| | | | | | 145.0 | 82.0 | 64.8 | 6 | 10.8 |

## PROJECTED INCOME AND EXPENSES FOR ONE FEDDAN OF SUMMER CROPS, ABU RAYA, 1979.

TABLE 12

| CROP OR CROP COMBIN-ATION | PRODUCTS | UNITS | USUAL YIELD PER FEDDAN | PRICE PER UNIT L.E. | GROSS INCOME PER FEDDAN L.E. | EXPENSES L.E. | RETURN TO LAND AND MANAGEMENT L.E. | MONTHS FOR ONE CROP | AVERAGE RETURN PER MONTH L.E. |
|---|---|---|---|---|---|---|---|---|---|
| Maize | Grain | Ardab | 12 | 7.800 | 93.6 | | | | |
| | Green Tassles | Feddan | 1 | 5.000 | 5.0 | | | | |
| | Straw | C. Load | 6 | 1.000 | 6.0 | | | | |
| | | | | | 104.6 | 73.3 | 31.3 | 4 | 7.8 |
| Cotton | Lint | Kentar | 5 | 33.000 | 165.0 | | | | |
| | Stalks | C. Load | 5 | 3.000 | 15.0 | | | | |
| | | | | | 180.0 | 122.7 | 57.3 | 8 | 7.2 |
| Rice | Grain | Ton | 2 | 55.0 | 110.0 | | | | |
| | Straw | Feddan | 1 | 4.0 | 4.0 | | | | |
| | | | | | 114.0 | 82.7 | 31.3 | 5 | 6.3 |
| Egg Plant | July Picking | Kilogram | 7200 | .035 | 252.0 | | | | |
| | August Picking | Kilogram | 900 | .040 | 36.0 | | | | |
| | Sept. & October Picking | Kilogram | 4800 | .050 | 240.0 | | | | |
| | | | | | 528.0 | 426.5 | 101.5 | 7 | 14.5 |

## FINANCIAL STATEMENT AND THE AGRICULTURE ROTATION FOR THE SELECTED FARMERS AT ABU RAYA SITE

TABLE 13

| FARMERS | | | AREA | | | LIVESTOCK | | | | | | | | Land & Live-stock Value | CROPS ROTATION | | | | | | | | | | | | | | | | | | FAMILY MEMBERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | Winter Crops | | | | | | | | | | Summer Crops | | | | | | | | | | |
| | | | | | | | | | | | | | | | Wheat | | Flax | | Ber-seem | | Bean | | Veg. | | Cotton | | Rice | | Maize | | Veg. | | | | |
| # | Name | Address | F. | K. | Total Value | Cow | Buffalo | Calf | Donkey | Camel | Goats & Sheep | Poultry | Total Value L.E. | L.E. | F. | K. | F. | K. | F. | K. | F. | K. | F. | K. | F. | K. | F. | K. | F. | K. | F. | K. | Male | Female | Total |
| 1 | Shams El Deen | Abu Raya | 6 | 9 | 11750 | - | 2 | 1 | 2 | - | - | 39 | 596 | 12345 | 1 | 15 | - | 15 | 4 | 2 | - | - | - | - | 2 | 20 | 2 | 21 | - | 16 | - | - | 6 | 3 | 3 |
| 2 | Marey Yosef | Abu Raya | 6 | 19 | 13583 | 1 | 1 | 4 | 2 | - | - | - | 898 | 14481 | 2 | 16 | - | 12 | 3 | 10 | - | - | - | - | 1 | 2 | 3 | 16 | - | 10 | 1 | 12 | 2 | 4 | 6 |
| 3 | Serreya Abdo | Abu Raya | 8 | 8 | 14800 | 2 | 1 | 2 | 2 | - | - | 8 | 652 | 15452 | 1 | 12 | 1 | 12 | 4 | 8 | 1 | - | - | - | 2 | - | 5 | 8 | 1 | - | - | - | 7 | 11 | 18 |
| 4 | Hamed El Behary | Abu Raya | 2<br>1 | 12<br>12 | 5000 | 1 | 1 | - | 1 | - | - | - | 405 | 5405 | 2 | - | - | - | 3 | - | - | - | - | - | 1 | 12 | 2 | - | - | 12 | - | - | 4 | 4 | 8 |
| 5 | Abdel Hamid Shaban | Abu Raya | 4<br>2 | 16<br>- | 8000 | 1 | 1 | | 2 | - | - | - | 410 | 8410 | 1 | - | - | 12 | 4 | 16 | - | 12 | - | - | 3 | 16 | 2 | - | 1 | - | - | - | 4 | 6 | 10 |
| 6 | Ahmed Abdel Baki | Abu Raya | 10 | 18 | 21500 | 4 | 2 | 3 | 2 | - | - | 10 | 1864 | 23364 | 1 | - | 2 | - | 5 | 6 | - | - | 1 | - | 5 | 6 | 4 | - | - | - | - | - | 6 | 2 | 8 |
| 7 | Gaber Abou Seef | El Raghama | 4 | 14 | 9170 | 1 | 1 | 1 | 1 | - | - | 3 | 499 | 9669 | - | 14 | - | - | 2 | 19 | - | - | 1 | 5 | - | - | 1 | 14 | - | 10 | 2 | 14 | 2 | 2 | 4 |
| 8 | Ahmed Shoaib | Abu Raya | 10 | 6 | 22000 | 2 | 1 | 2 | 1 | 1 | - | 33 | 1021 | 23021 | 3 | 3 | 1 | 12 | 4 | 22 | - | 17 | - | - | 3 | 6 | 5 | 14 | 1 | 10 | - | - | 15 | 6 | 21 |
| 9 | Salem Mariy | Farag Kobra | 3 | - | 6600 | - | 2 | 2 | 1 | | | 22 | 809 | 7409 | 1 | - | - | - | 2 | - | - | - | - | - | 1 | - | 1 | - | 1 | - | - | - | 3 | 2 | 5 |
| 10 | Mohamed Mariy | Farag Kobra | 3 | - | 6500 | 1 | 1 | - | 1 | 1 | - | 500 | 1280 | 7780 | - | - | - | 12 | 1 | 16 | - | - | - | 20 | 1 | 12 | - | 12 | - | - | - | - | 3 | 1 | 4 |
| 11 | Abdel Aziz Mariy | Farag Kobra | 3 | 4 | 7100 | - | 2 | 1 | - | 1 | - | 25 | 1025 | 8125 | - | 18 | - | - | 2 | 10 | - | - | - | - | 2 | 10 | - | 18 | - | - | - | - | 2 | 3 | 5 |
| 12 | Aly Mariy | Farag | 3 | 4 | 7180 | - | 2 | 3 | 1 | - | - | 37 | 946 | 8046 | 1 | - | - | 9 | 1 | 19 | - | - | - | - | - | - | 2 | 8 | - | 20 | - | - | 4 | 4 | 8 |

F = Feddan
O = Owned

## SUMMARY OF PLANNED PRODUCTION AND NET FARM INCOME AT ABU RAYA SITE, 1979

TABLE: 14

| PLANNED PRODUCTION AND DISPOSITION OF CROPS | | | | | | PLANNED PRODUCTION AND DISPOSITION OF LIVESTOCK | | | | | | | SUMMARY OF PLANNED FARM INCOME AND EXPENSES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed To Live-Stock | Used In Home | Dona-tion And Wages | Crops Sales | Total Value Of Pro-ducts | Av. Value Per Fed. | Live-stock & Pro-ducts used in Home | Live-stock & Pro-ducts Sales | Total Value Of Pro-ducts | *Prod-minus Crops Fed. | Cost Pur-chased Feed | **Gain Over Costs Of All Feed | Value Of Total Pro-ducts Fed. | Crops Sales | Live-stock & Pro-ducts Sales | Pro-ducts Used In Home | Misc. In-come | Gross Farm In-come | Farm Ex-pense | Net Farm In-come | Total Family Mem-bers | Av. Net Farm In-come/ Per-son |
| LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE | LE |
| 350 | 292 | 56 | 691 | 1329 | 218 | 241 | 35 | 276 | -74 | 4 | -78 | 43 | 691 | 35 | 533 | 56 | 1315 | 528 | 787 | 9 | 87 |
| 275 | 199 | 51 | 804 | 1329 | 196 | 65 | 738 | 803 | 528 | 212 | 316 | 118 | 804 | 738 | 263 | - | 1805 | 923 | 882 | 6 | 147 |
| 305 | 327 | 103 | 891 | 1626 | 195 | 265 | 184 | 449 | 144 | 4 | 140 | 54 | 891 | 184 | 592 | - | 1667 | 751 | 916 | 18 | 51 |
| 162 | 186 | 55 | 469 | 872 | 218 | 182 | 64 | 246 | 84 | 4 | 80 | 61 | 469 | 64 | 368 | - | 901 | 471 | 430 | 8 | 54 |
| 213 | 176 | 48 | 889 | 1326 | 199 | 239 | 118 | 357 | 144 | 6 | 138 | 54 | 889 | 118 | 415 | - | 1422 | 770 | 652 | 10 | 65 |
| 202 | 256 | 108 | 1660 | 2226 | 207 | 651 | 390 | 1041 | 839 | 38 | 801 | 97 | 1660 | 390 | 907 | 70 | 3027 | 1260 | 1767 | 8 | 221 |
| 228 | 144 | 36 | 629 | 1037 | 230 | 239 | 30 | 269 | 41 | 3 | 38 | 59 | 629 | 30 | 383 | - | 1042 | 277 | 454 | 4 | 116 |
| 339 | 660 | 113 | 1263 | 2375 | 232 | 523 | 295 | 818 | 479 | 6 | 473 | 80 | 1263 | 295 | 1183 | 100 | 2841 | 919 | 1922 | 21 | 91 |
| 206 | 116 | 37 | 287 | 646 | 215 | 312 | 116 | 428 | 222 | 3 | 219 | 143 | 287 | 116 | 428 | - | 831 | 274 | 557 | 5 | 111 |
| 63 | 38 | 5 | 751 | 857 | 286 | 348 | 2048 | 2396 | 2333 | 1387 | 946 | 798 | 751 | 2048 | 386 | 130 | 3314 | 2316 | 997 | 4 | 250 |
| 97 | 61 | 27 | 579 | 764 | 242 | 266 | 68 | 334 | 273 | 58 | 215 | 69 | 579 | 68 | 327 | 130 | 1104 | 534 | 570 | 5 | 114 |
| 202 | 204 | 72 | 243 | 721 | 227 | 342 | 325 | 667 | 465 | 5 | 460 | 210 | 243 | 325 | 446 | - | 1014 | 284 | 730 | 8 | 91 |

* Total value of livestock production minus the value of crops produced on the farm and fed to the Farmer's livestock.

** Including the costs of purchased feed.

as much as 100 percent for individual farms through selection of the most profitable crops.

The data were collected from 12 farmers in Abu Raya regarding their financial situation and planned income for 1979 as shown in tables 13 and 14.

The variability in crop and livestock production per feddan indicates the potential income gains which may be possible through better planning. Summaries of farm record data will eventually provide more reliable data sources.

*Owner-Tennant Relationship*

Problematic law of owner-tennant relationships, favor the tennant eg., low permitted rental rates encourages owners to continue marginal operation of land that they would prefer to rent. The law, in other ways, favors the owner who can sometimes benefit from some agricultural inputs intended for the rented land. In either case, production suffers.

Table 15 indicates that most farms in the Abu Raya area are owned by the operators. As a matter of fact 96 percent of the farmers on record at the Abu Raya cooperative own their own land.

Table 15: Farm Tenure at Abu Raya Cooperative, Kafr El Sheikh

| Size Class | Number of farmers | Number of owners | No. of renters | No. of squatters |
|---|---|---|---|---|
| Less than 1 fed | 59 | 59 | 0 | 0 |
| 1 to 3 feddans | 430 | 417 | 10 | 3 |
| 3 to 5 feddans | 284 | 274 | 4 | 6 |
| 5 to 10 feddans | 124 | 116 | 2 | 6 |
| 10 to 20 feddans | 30 | 26 | 0 | 1 |
| 20 to 50 feddans | 6 | 5 | 0 | 1 |
| Total | 933 | 897 | 16 | 20 |
| Percentage | 100 | 96 | 2 | 2 |

.../...

## *Marketing*

The farmers at Abu Raya complain about poor prices and marketing services. They seem to support Dr. H. A. El Tobgy's contention that "... satisfactory cooperation marketing operations must await the development of a truly efficient agricultural cooperative system and a sound and fair price policy".[1] EWUP personnel can help restructure marketing institutions by becoming familiar with the operations of the local cooperative and providing leadership for analyzing problems and helping farmers to participate in the affairs of the local cooperative.

## *Excessive Costs for Lifting Water*

Our research at Kafr El Sheikh is consistent with our previous work at Mansouria, viz. farmers who lift water with tambours and sakias incur excessive costs of production. Water lifting at Abu Raya is done almost exclusively by sakia (each one of the twelve case study farms uses sakias). Some farmers indicate they are ready to change this practice but to date there is very little use being made of diesel and/or electric pumps for lifting water. Experience gained at Mansouria indicates it will require a major effort to organize the small farmers into groups large enough to make pumping economically feasible. On the average, net gains associated with shifting by diesel or electric pumps should exceed LE 20.00 per feddan. An additional benefit could be the gain from better irrigation efficiency through using larger flows of water.

## *Inequitable Official Treatment of Farmers*

Examples of inequitable official treatment, include: (A) illegal intakes being ignored when set by persons of local power/influence; (B) gatekeepers showing favoritism at precise times some farmers have arranged to irrigate, sometimes providing levels which permit gravity delivery to field at meska heads; (C) some favoritism by the coop peronnel/council (eg. priority access to equipment and services, unequal inspection enforcement, and considerations in crop allocation, inputs supply and market provisions), etc. We have no hard evidence on these matters beyond some farmers complaints.

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(1 H. A. El Tobgy, Contemporary Egyptian Agriculture, Ford Foundation, Beirut, Lebanon, 1977.

### *Ineffective Cooperative*

Generally the coop is not being as effective as it should ideally be, particularly since the loss of basic functions to the non-local village bank. It is limited in the services and equipment it can provide and has no extension officer, etc.

### Sociological Factors and Problems

From the vantage point of the sociologists who have worked with the farmers through questionnaires and various interviews the following comments are offered.

1. Abu Raya farmers do indeed, often suffer from a weaker sense of self respect and self-confidence than is supportive of highly-rational farm management practices (which depend upon personal inclination to plan, experiment, and understand better farm operations, as well as demonstrate the discipline born of independant convictions). Given the social science doctrine of the "looking-glass itself" (eg., we think of ourselves as we think significant others think of us), systematic project attention should be given to bolstering the farmer's self respect and confidence by: (A) acting toward them with respect and confidence, and (B) arranging experiences in planning, experimenting, and understanding in which they are guaranteed reassuring success in response to their own personal initiative and effort.

2. There seems among Abu Raya farmers to be too great a lack of confidence in the government officials who have the responsibility of supporting their irrigated agriculture activities. As a result, the farmers do not typically have an optimistic view of their potentials for improving agricultural production or profit, which is usually a prerequisite in the development process. Instead, they tend to aspire more, on average, to reducing the effort they must invest in their operations. They seem to assume that they will "get by" (perhaps with sustained/ greater government support and assistance), but that the real opportun-

.../...

ity for a good life (for their children, for instance) lies elsewhere. Whether or not this mind-set is realistic, it is not healthy for them or the nation.

Confidence in those government personnel and the program intended to encourage and facilitate irrigated agriculture development on established lands can presumably best be advanced by: (A) a stronger administrative attitude of "working partnership" with the farmers (vs. direction and control of their activities); (B) their spending more time in informal field contact with their rural constituency; and (C) increasing the effectiveness of their service to the farmer under conditions of very limited resources by emphasizing field-level extension, teaching "appropriate technology" and self-help strategies in agricultural development. Strengthening functions and effectiveness of the local coops and district-level irrigation and agriculture departments would facilitate this process most dramatically, but they must be supported by strong and sincere proclamations of understanding and support from the national level.

3. Social organization and effective (i.e. meaningful, non-superficial) communication patterns among neighboring farmers, and within the village area as a whole, should be strengthened for the success of low-capital-resource irrigated agriculture development efforts. Presently, congenial social relationships dominate functionally viable ones in Abu Raya. Yet cooperation in timing irrigations, sharing equipment and labor, planning crops, etc. depend upon good communication and informal organization. There is recognition of this among Abu Raya farmers, but since they give priority to congenial interpersonal relations, they must depend upon others, such as the coop and the project, to take the lead in this process. Presently, the cooperative is not strong enough, and, perhaps does not know enough about procedures to effectively pursue this challenge. The project is, for other reasons, not now in a good position to take the lead. Presumably, project assistance in supporting the coop's effectiveness and functional

.../...

viability is the most appropriate strategy in the shorter run. During the project's initial period in the area, attention has been given this approach with substantial progress being made in the service areas of agronomic practices, farmer organization and farm machinery.

4. In the case of Abu Raya, a labor shortage for periodic labor-intensive farming operations (i.e., rice transplanting and cotton harvesting) suggest the need for: (A) increased availability of some available machinery that would help during high-labor demand times without displacing laborers who depend upon steady employment for their support, and (B) developing new "low technology" technique and equipment to ease the seasonal high-labor demands. Both, of course, are being done by the project in coordination with coop personnel. Doubtless, developing new "appropriate" technology and practices should receive much greater emphasis by the project in the future, given very limited local investment capital resources, which ultimately must be the basis of irrigation and agriculture development efforts in Abu Raya and similar areas of Egypt and elsewhere.

In conclusion it must be added that a review of these farmer's perceptions of agriculture operations problems show their concerns largely focus on the implementation of government policies and practices. Although the project's research effort by several disciplines show most of their concerns are at least partly justified, it must be recognized that these are matters the project cannot do much to change in the shorter run. Nevertheless, we should investigate such matters further, and, as data are available for documenting an objective case, attempt to sway government policy and its application toward approaches which will better serve the interests of the nation and the farmer.

In the meantime, we must remain sensitive to the "felt needs" expressed by the Abu Raya farmers. In many ways, we can capitalize on their frustrations and desires in order to involve them in a vigorous partnership for development of the area's water and agricultural resources which involve

.../...

innovative farm management alternatives to reduce problematic consequences of some policies and administrative practices that are bothersome to them.

To the extent that we can encourage their individual and collective initiative in making their on-farm managmenet practices more productive, profitable and pleasurable, we must concentrate our efforts there. To the extent that we can facilitate their individual and collective self-help efforts, we must give them our full support. To the extent we can strengthen their local institutions, organizations and leadership, we must do so without hesitation. To the extent we can informally contribute to their creative understanding of efficient, rational grass-roots management and problem solving processes in irrigated agriculture and other life-sectors as well, we must make it a total educational effort, conceived and implemented to ensure their success and satisfaction.

Of course, the phrase "to the extent ..." implies that our contribution to the process be a highly sensitive, incremental one, similar to that which skilled musicians term "playing it by ear" or experienced pilots call "flying by the seat of one's pants". The general comments contained in the section above dealing with our sociological insights from interview data and field observations highlight our judgement of priority matters for project attention in Abu Raya's irrigated agriculture development.

## Agronomic and Engineering Problems

Most of the technological problems can be grouped into two general categories; agronomic and engineering. This section discusses problems that have been identified by the agronomists and engineers. Most of the problems presented are actually interdisciplinary and overlapping with respect to disciplines. The common denominator of all these problems to be mentioned is "water management". However, since the above two staff disciplines arrived at these problems by disciplines they shall be referred to as such herein.

.../...

## Agronomic Problems

Crop productivity in Abu Raya area is high and this can be attributed to the relatively fertile alluvial soils, the adequate amount of good quality irrigation water, the ample amount of sunlight, freedom from killing frosts which permits year round cultivation and skilled farmers. Despite all of these favorable attributes there still remain several serious constraints to maximizing crop production. Listed below are some of the constraints identified:

1. Problems of minor soil element deficiencies
2. Lack of adequate plant populations in certain crops
3. Salinity problems

### *Problems of Minor Soil Element Deficiencies*

Next to nitrogen and phosphorus deficiencies, minor element deficiencies are important nutritional factors limiting the growth of many important Egyptian crops such as rice and cotton. Deficiencies in these elements at times are not visible but they do restrict crop growth by not allowing plants to give maximum response to macro-nutrients such as nitrogen and phosphorus.

One of the best ways to evaluate the status of micronutrient level in soils is to determine crop response by field trials. This was done during the 1978 rice and cotton growing season and the effect of zinc and Bayfolan on these crops were evaluated. The details of this field test will appear as a seperate EWUP publication.

### *Rice and Cotton Studies*

The rice belt in Egypt is restricted to the northern half of the Delta due to its special irrigation needs. The rice grown in this area is the short grain variety and its is grown in paddies during the summer months. When a soil is flooded for relatively long periods of time it undergoes chemical reductions that can strongly influence the availability of certain minor elements.

.../...

In field trials conducted at Abu Raya, the addition of zinc sulphate to the field prior to transplanting of rice, increased yields by 28% compared to those fields not treated with zinc. When zinc was applied to the nurseries, yield increases in rice grain were on the order of 40%. Not only were increases reflected in grain but straw yields increased also. Where zinc was applied in the filed, straw yields increased by 36% and with zinc applied in the nurseries the straw yield increased by 59%. These responses occurred with no change in water management practices, macro-fertilizer practices, or soil preparation, outside of the application of zinc sulphate to the field at rates of 10 kg. per feddan or in the nursery at 20 kg. per feddan.

The application of foliar fertilizer (Bayfolan) to cotton was also evaluated during the 1978 season. Where the foliar fertilizers were applied twice during the growing season yield increases of 28% were recorded. This translates into an average increase of 353 kgs. of seedcotton per feddan. In addition, these increases in yield resulted without the addition of any extra irrigation water as the farmers used their normal management practices.

From these studies it is evident that the minor element fertility levels in northern delta soils are an important constraint to maximizing crop production. One can speculate that by the addition of minor elements and small amounts of macro-nutrients, causes an increased efficiency in the use of nitrogen and phosphorus as they alone can not account for the large increases in yield. In addition, these increases were obtained without any increase in the amount of water applied thus increasing the efficiency in water use.

## *Plant Populations*

Plant population is a very serious constraint to maximizing crop production. Results obtained in Abu Raya confirm those obtained in the Mansouria area. Forty five individual farms in the Abu Raya were sampled for the number of cotton plants per feddan as well as for the yield of seedcotton. In evaluating the data there was a significant positive correlation of 0.73

.../...

between seedcotton yields and plant populations. The mean for number of plants per feddan was 34,879 while 1064 kgs. per feddan was the average yield. The range in plant numbers was from 18,750 to a high of 46,350 while in seedcotton yields ranged from 488 kgs. to 1613 kgs. Data clearly show that yield of seedcotton is highly dependent upon the number of plants present at harvest time in the field. Similar studies on corn indicated that as population increased subsequent increases in yield occurred.

## Salinity Problems

Soil salinity and sodicity can be a serious constraint to crop production. As described earlier in the section dealing with soils of the Abu Raya area, a significant number of soil samples are still moderately saline in the root zone. A highly significant positive relationship exists between soil salinity and yields. However, the relationship is complicated by the presence of sodium. For example 44% of the soils in Abu Raya had low EC values that could be considered as class I. Furthermore, the mode of frequency distribution of salinity if these soils would lead one to believe that there are no salinity problems for 44% of the cultivated area as shown in figure 8. However, rice paddy production in 1978 for Abu Raya was not favorable. Figure 9 shows paddy rice production for these categories of soil salinity. Obviously, soil sodicity have had an important effect upon yield, other things being equal.

## Rice Cultivation Problems

Rice is the second most important export crop of Egypt and occupies an area of more than one million feddans. Because of its special irrigation needs and that it lends itself to land reclamation, it is restricted to the northern half of the Nile delta. The most common method of cultivating rice in the delta is to transplant from nurseries rather than to broadcast seeds directly onto the fields.

After seeds are grown under normal conditions in the nursery, seedlings are manually pulled, the mud is washed from their roots and they are moved

.../...

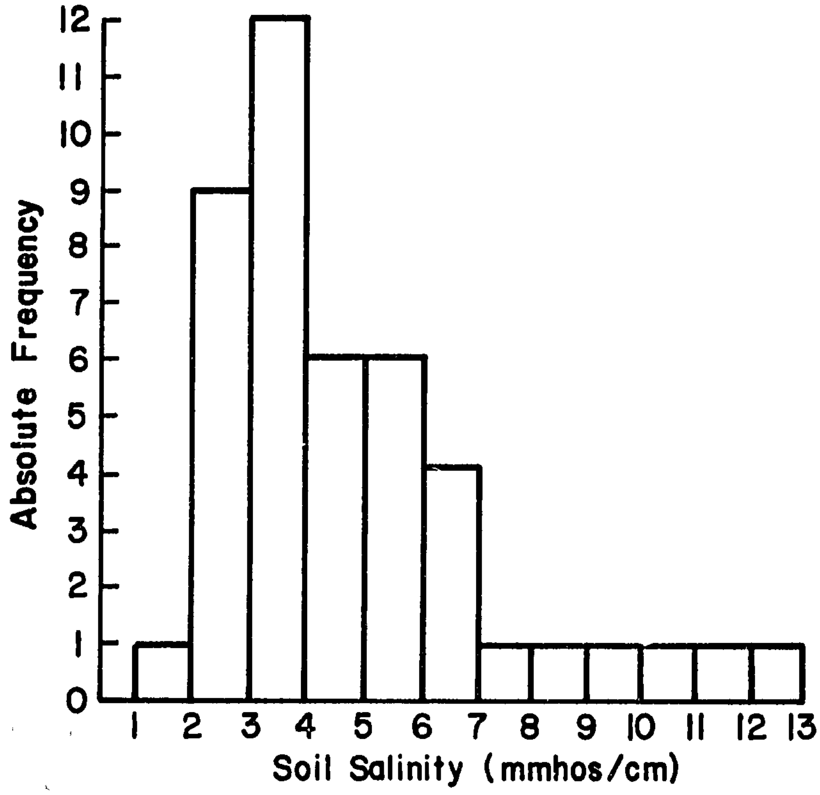


Figure 8. Distribution of Salinity Levels for Abu Raia Soils, (1978)

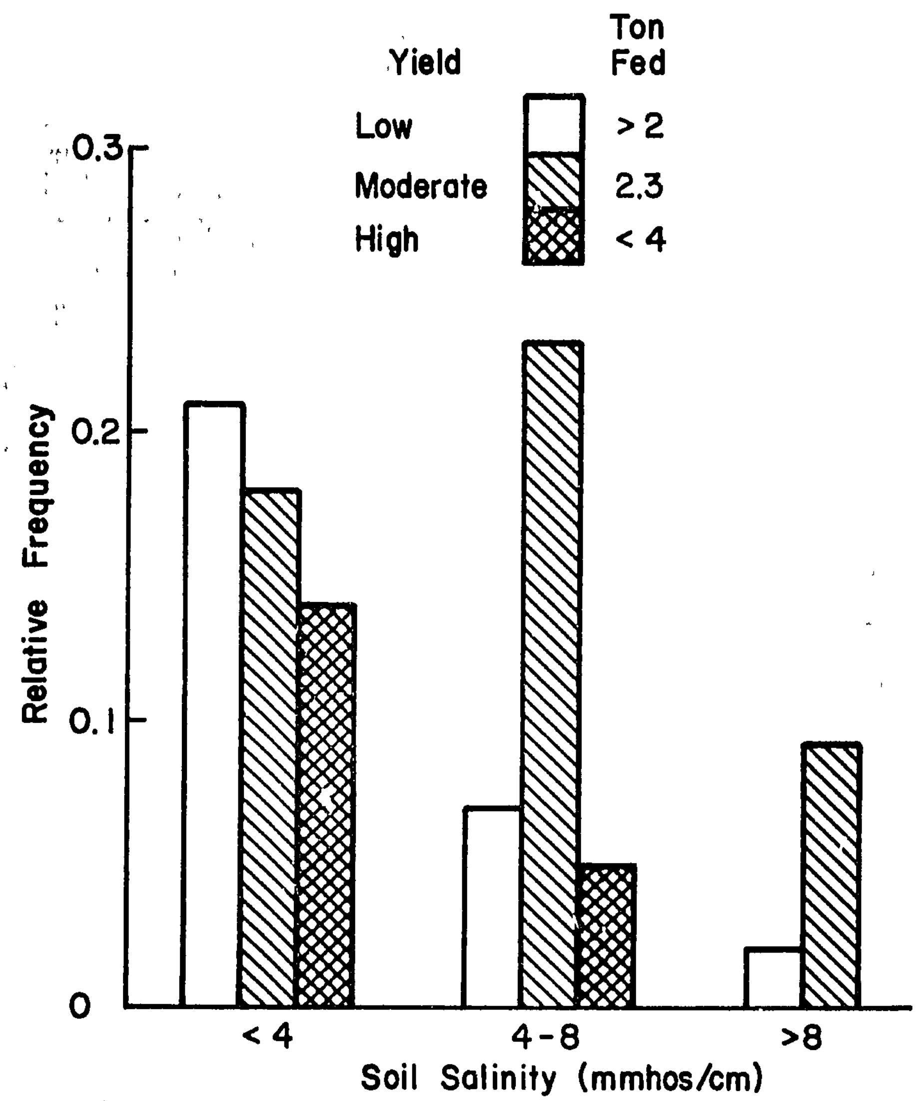


Figure 9. Rice Production in Abu Raia Area on Soils Grouped into Three Categories of Salinity, (1978)

to the main field. Eight well trained young laborers can transplant one feddan of rice seedlings per day. These laborers can maintain a standard of a certain number of seedlings per hill and a certain spacing between hills and rows. Studies have shown that 3 plants per hill, with 15 cm. between hills and 20 cm. between rows are best for optimum production. Field uniformity promotes maximum tillering for all hills and facilities manual weeding between rows. This uniformity can't be approached by untrained young labroers. Since 1960, well trained transplanters have been migrating to the cities. They receive higher wages for easier work. The younger laborers nowadays are reluctant to be trained as transplanters. The shortage of well trained transplanters is now a major constraint in paddy rice production. Farmers cultivate their nurseries from May 1 to May 30. It is recommended that rice seedlings be transplanted between June 1 and June 30. When farmers cannot complete transplanting their fields during this period because of the shortage of transplanters, they must either use a larger number of untrained laborers or transplant their fields late. Every week's delay in transplanting results in an appreciable reduction in paddy production. A shortage of skilled laborers, resulting in a larger input of unskilled laborers, results in reduced productivity and increased production costs. The following table shows the increased costs for transplanters over the past 13 years.

| Year | Money paid to one transplanter(LE/hr) | No. of transplanters needed(per feddan) | Cost per feddan -(LE) |
|---|---|---|---|
| 1965 | 0.15 - 0.25 | 14 | 2.10 - 3.80 |
| 1970 | 0.40 - 0.60 | 16 | 6.40 - 9.60 |
| 1978 | 1.00 - 1.50 | 18 | 18.00 - 27.00 |

Egyptian farmers usually level their land under flooded conditions before transplanting rice seedlings. This process is called "Talweet". It is carried out by using animals to draw a heavy piece of wood over the saturated soil. This process compacts the soil more than when water is simply added

.../...

to a well granulated soil without "Talweet".

When water is added to soil, the soil aggregates absorb moisture and swell. At the moisture equivalent most of the soil water is held in pores of capillary dimensions and as a film in the micro-pores. With continuous flooding, free water moves through the soil pores vertically and laterally. Such movement increases with increasing porosity. As described above, the farmer, by means of "talweet", reduces the porosity of the soil surface (10 cm). The mechanical forces cause compaction of the top soil and in turn reduces both the rate of percolation and of infiltration. After "talweet" and immediately after transplanting the farmer maintains a 5 cm head of water on the soil surface. Without "talweet" he can only approach and maintain this depth after excessive daily irrigations. For this reason, farmers who broadcast rice seeds on granulated soil and grow seedlings under lowland conditions can not maintain this water depth unless he can irrigate daily for 30 days. Thus, farmers are reluctant to follow the broadcast method in spite of saving time and labor required for transplanting rice.

Even with the process of "talweet" large quantities of water are required by the farmers along any given water course during and after the time of transplanting. This high demand for water during "talweet" and transplanting time of rice causes farmers to feel a severe water shortage. The situation is further aggrevated when more than 50% of the land along the water course is in rice cultivation. Obviously scheduling and planning would alleviate this apparent water shortage problem.

The data in figure 10 show cummulative depth of irrigation water applied to a rice paddy as a function of time after planting rice. The slope of the curve is the sum of the deep seepage rate and rate of evapotranspiration. A total of 213 cm of water was applied over 113 day period. It appears that after nearly 60 days the rate reduces to its smallest value and becomes constant.

.../...

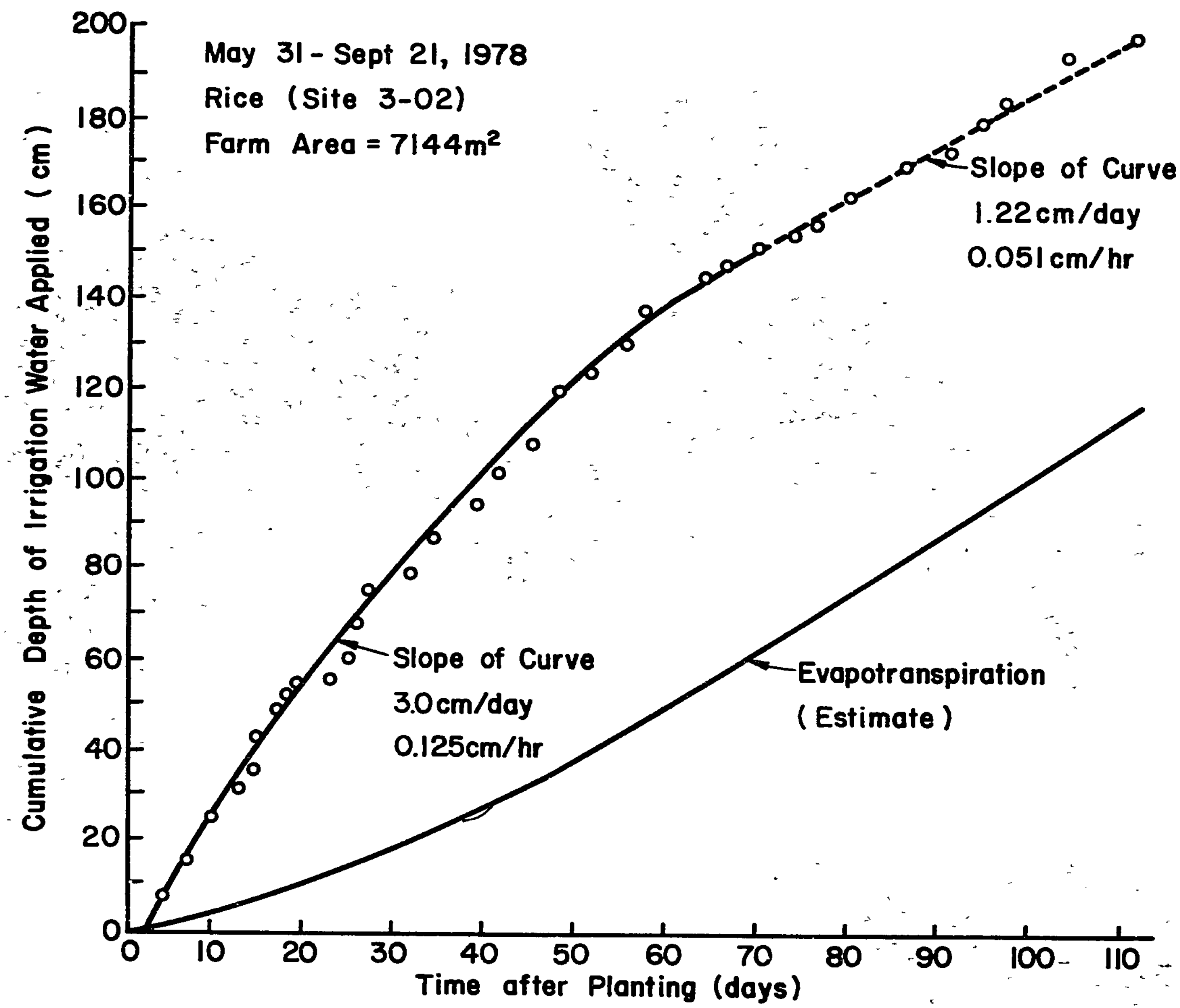


Figure 10. Cummulative Irrigation Water Applied to a Rice Field During the Growing Season

If one assumes that evapotranspiration is relatively small immediately after transplanting, deep seepage is nearly 3 times greater immediately after talweet than the combined ET and deep seepage rate during the last 30 days of irrigation. From the soil hydraulics point of view, it would be expected that the seepage rate would be small near the end of the irrigation season and rate of irrigation water applied would be approximately the evapotranspiration rate, (1.2 cm/day). These data shown in fig. 10 do not account for any water drained from the field to the drain. If such occurred, the magnitude of the analysis above would not be as large. However, the data illustrate the relatively large quantities of water used for rice during early stages of culture by one particular farmer.

## Engineering Problems

A considerable effort was spent by the engineering discipline in measuring water on and off of farm sites selected on the Om'Sen and Hammad Canals as well as hundreds of observations regarding irrigation practices. The detailed analysis of these measurements will be published as EWUP technical reports at a subsequent time. From these observations and measurements the following problems have been defined that deal with the management of water to and on the farm.

1. The proportion of land occupied by canals, ditches, and drains is relaively large.

   The following calculations from the rice area in Site 1 on the Om'Sen Canal and from the cotton area on Site 3, Hammad Canal show the magnitude of this problem.

.../...

| Site No. | Total area owned (fed.) | Area in branch canal & Community drain (fed.) | Gross area remaining (fed.) | Gross area remaining (%) | Area in sakia, ditches, & drains (fed.) | Cultivated area remaining (fed.) | Cultivated area remaining (% of gross) | Cultivated area remaining (% of total) |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 1.1 | 8.9 | 89 | 1.6 | 7.3 | 82 | 73 |
| 3 | 8.97 | 0.88 | 8.09 | 90 | 1.15 | 6.94 | 86 | 77 |

On Site 1 the width of borders ranged from 12 to 15m, and the width of the drains paralleling the borders averaged 2.2 m. If we assume a typical border total width is 13.5 m plus 2.2 m, and if we replace the drain ditch with a dike that occupies only 0.7 m, then we have gained 1.5 m and have increased the effective growing strip width from 13.5 to 15.0 m, a gain of 11%. Additional, smaller gains could perhaps be obtained by replacing the sakia with a pump and by replacing the head ditch with a pipe.

For the cotton field on Site 3 the potential gain is greater. Borders are somewhat wider, ranging from 14 to 20 m. However, if the side drains were eliminated they would not need to be replaced by a dike, and perhaps the marwa in the center could be eliminated if the fields were leveled. If we assume a typical border has a cropping width of 17 m, and that the marwa rèduces its effective width to 16.5 m, and if we assume that eliminating the side ditch would increase the growing area by 1.8 m, then the potential increase of cropped area by eliminating these two ditches is

$$\frac{0.5 + 1.8}{16.5} = 14\%$$

2. In some places, the water table fluctuates close to the soil surface.

Two observation wells in the corn field on Site 4, at the end of

.../...

Hammad Canal, revealed the following water table positions:

Water Table Depth Below Ground Surface, Meters

| Well No. | Range of Measurements before irrigation | Range of Measurements after irrigation |
|---|---|---|
| 4 | 0.43 to 0.49 | 0.15 to 0.24 |
| 5 | 0.51 to 0.56 | 0.07 to 0.29 |

The rise from just before irrigation to one day after ranged from 0.19 m to 0.45 m.

In the cotton field on Site 2 near the end of Om'Sen Canal two observation wells located near a marwa and near a small field drain respectively showed similar readings, but a well in the center of the field showed a deeper water table before irrigation.

Water Table Depth Below Ground Surface, Meters

| Well No. | Measurements before irrigation | Measurements after irrigation |
|---|---|---|
| Near ditch | 0.66 to 0.86 | 0.28 to 0.40 |
| Center | 1.01 | 0.35 |

These water table positions are close enough to the surface to cause an accumulation of salt on the surface without adequate leaching, and may also restrict soil aeration enough to limit crop yield.

3. There are severe weed problems, especially in the drains.

Weeds come back quickly into canals and drains after cleaning. Drains are less likely to be cleaned regularly than canals.

.../...

Gadalla drain, for example, has been observed backing water into small field drains, and even spilling excess water into the Om'Sen Canal. A method of keeping weeds continuously under control is needed.

4. The distribution of irrigation water over a field is not always uniform.

When a system of small basins supplied by a marwa down the center of a field is used, it is possible to estimate the depth of water applied to each basin by noting the size of the basin and the length of time that a steady stream of water is diverted into it. During a test a special effort can be made to keep a sakia turning at a relatively constant speed. Figure 11 shows the results of such a test during three irrigations in a cotton field on Site 3, near the inlet of Hammad Canal.

The curves show the uniformity of distribution among the basins. During the fourth irrigation, the median depth applied was slightly less than 9 cm. However, 10% of the field received less than 6 cm and 20% received less than 7 cm. Also, 10% received more than 11 cm, according to this curve. Actually, this uniformity is not too bad, and the 6th irrigation is even better. The median was 12 cm and only 30% of the field received less than 11.

The 5th irrigation was somewhat of a disaster by comparison. With a median about 9.5 cm, the curve shows that 20% of the field received more than 17 cm. The excess must go to surface runoff or to the water table.

Perhaps more damaging at times is the unlevel character of the soil surface within a basin. Noticeable differences in vegetative growth have been observed between the high spots and the low spots. Identification of the highs and lows has been observed in the field in the fol-

.../...

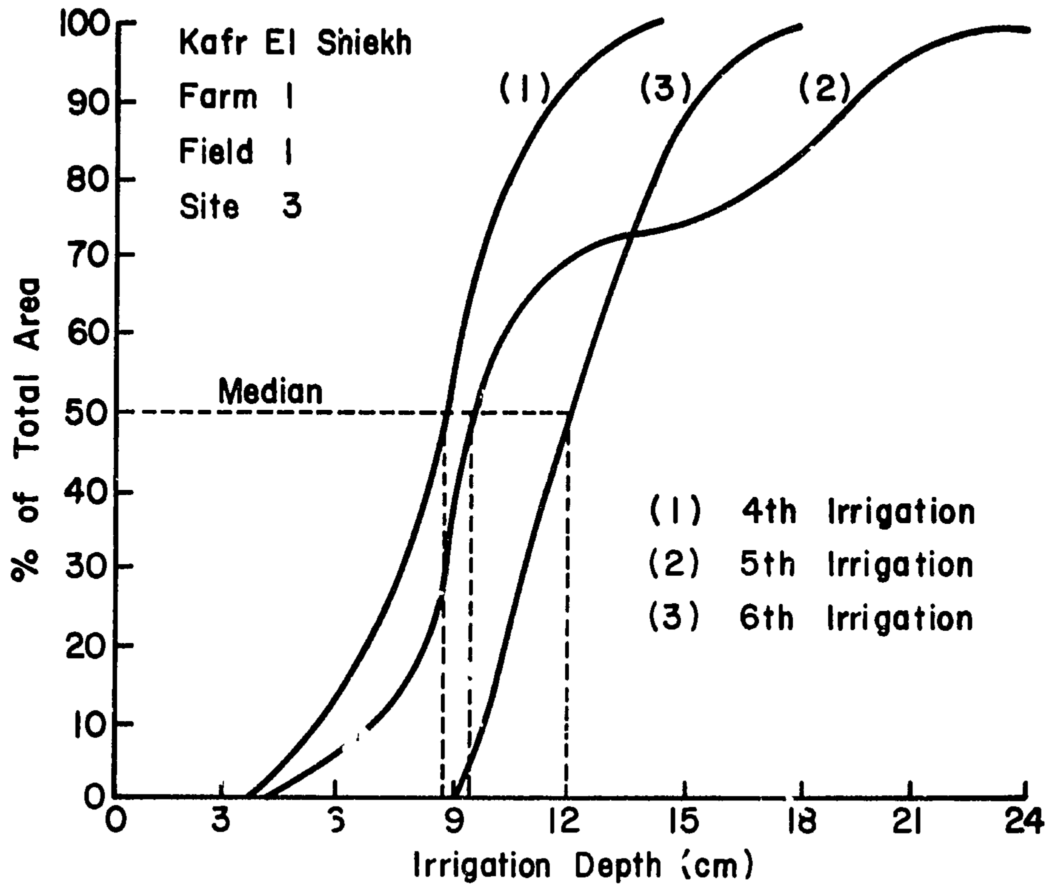


Figure 11. Distribution of Irrigation Water Over a Farm Area for Various Irrigation Sequences

lowing ways:

a. Watch when the water recedes after irrigation, exposing only the high spots.

b. Notice the salt appearing on high spots first.

c. Notice the darker color of the soil in the low spots.

d. If the soil is premitted to dry before harvest, notice that the high spots dry first.

e. Notice that the plant color becomes a darker green on the high (dry) spots as the drying continues.

5. The conveyance loss from sakia to field can be excessive.

Because one sakia is used to serve several fields, the ditch carrying the water may be quite long and thus lose much water to leakage or seepage. Perhaps an even greater loss occurs as a result of the storage remaining in the ditches after an irrigation. The water lost in storage is greatest when the long field drains are deliberately filled during an irrigation, as an aid to water distribution. It is assumed that most of the water stored in the drains seeps to the water table, and that the remainder evaporates.

One calculation of the combined conveyance loss due to leakage/seepage and storage in ditches was made for a rice field in Site 4. During those irrigations when the field already contained ponded water, an average quantity equivalent to 5.62 cm of water was lifted by the sakia whereas an increase of only 3.44 cm depth of water average at each irrigation was measured into the field. The difference amounted to 39% of the lifted water unaccounted for. The portion unaccounted for, however, did also include the deep percolation from the field during the irrigation and any loss through the dikes that occurred during the irrigation.

In this case the supply ditch between the sakia and the field was 187 m long. The observed storage in this ditch at the end of the irrigation and the leakage and seepage loss from it during irrigation are believed to be the major components of the water not accounted for.

6. Of the water successfully ponded in a basin during an irrigation, a large fraction is released to surface drains.

Very few measurements of surface runoff were made, but many observations indicate that the losses are significant for both cotton and rice.

Farmers know, or at least believe, that irrigation water must not stand too long in a cotton field. A typical irrigation practice is to fill two basins with the stream coming from the sakia, then divert the stream into the next two basins. However, by the time the second two basins are filled, the irrigator may have already cut the bank and released the water from the first two to the drain. Perhaps one reason for his action is that the land within the basin is not level, and the water will damage the plants in the low spots if it is allowed to remain longer. Perhaps he may also know that he has applied more water than the necessary to fill the root zone, and wishes to remove the excess.

In rice fields, surface water is deliberately drained on occasion to permit agronomic practices such as spreading fertilizer and killing algae. Perhaps most of these occasions are necessary, but in anticipation that water will be in increasingly greater demand to irrigate new land, field trials to seek alternative practices may be justified. Already some farmers drain their fields less frequently than others.

An unintended loss from the ponds of water in rice fields results from seepage through the dikes. Often this occurs from a break in the dike which could have been prevented.

The quantity of water applied to three rice fields in 1978 illustrates the importance of various drainage practices. The measured applications were about 5,000, 8,000 and 10,000 $m^3$ per feddan respectively in the three fields (about 1200, 1900, and 2400 mm depth). According to prior studies made by the Water Distribtuion and Irrigation Methods Institute on economical water duty for rice at Kafr El Sheikh experiment station over a period of about 20 years, the 8000 $m^3$ per feddan figure is the most logical. The field which received only $5000^3$ had little opportunity to remove excess water because the level in the adjacent drain was too high. In the opinion of the engineer in charge of the measurements, the difficulty of removing water accounted for most of the 3000 $m^3$ reduction in the amount applied to this fied. Other components of the difforence could be errors in water measurement and differences in the infiltration rates of the two fields.

Consumptive use of rice in Kafr El Sheikh was measured by Abdel Hafez to be 1026 mm in 1978. Comparing this to the 1200 mm measured application suggests that on this field the loss to deep seepage and lateral seepage was very small. Further measurements would be required to confirm this. Field trials would also be needed to find out how yield could be affected by the various water management practices.

7. The first irrigations tend to exceed the soil moisture deficit.

The first irrigation after land preparation, perhaps pre-planting or at planting timo, if often greater than the available storago coapcity in the soil. One reason is a desire by the farmer to wet the soil at the surface thoroughly so the clay clods will soften. Another may be the higher intake rate that occurs as a result of the dry cracked soil and recent tillage. Still another is the desire to leach salts from the profile.

Most of the early irrigations occurred before water measurement began, but on one cotton field, estimated applications for the first four irrigations, between March 15 and May 29, ranged between 12 and 24 cm at each irrigation. Consumptive use during this period, while the plants are still small, could not have equalled this application rate. These large applications result from several factors including unlevel fields, ditch losses and lack of control during application. Excess amounts were most likely drained off after only short opportunity times.

As the cotton plants grew larger, there appeared to be less tendancy to over-irrigate, as indicated in figure 12 and 13. In one field site, the accumulated water application curves, shown in figure 12, gradually exceed the measured soil moisture extraction, but for the other field site, the daily-rate curves suggest that two of the irrigations may actually have been inadequate. However, the two relatively high values for soil moisture extraction raise some doubts concerning validity of the extraction data.

8. Rice is irrigated much more frequently than the implied once each "on" period or each 8 days.

In figure 14, frequency of irrigation is plotted as a function of number of days.

As the following frequency curve shows, about 44% of the irrigations on this particular rice field were performed after an interval of only 2 days and 88% had an interval not exceeding 6 days. These data are typical of all fields monitored. The rotation schedule assumes an interval of 8 days (4 on...4 off).

The high occurrence of the 2-day interval suggest that water is available during the off-period. Observations confirm that this can and does happen, since there is available storage in

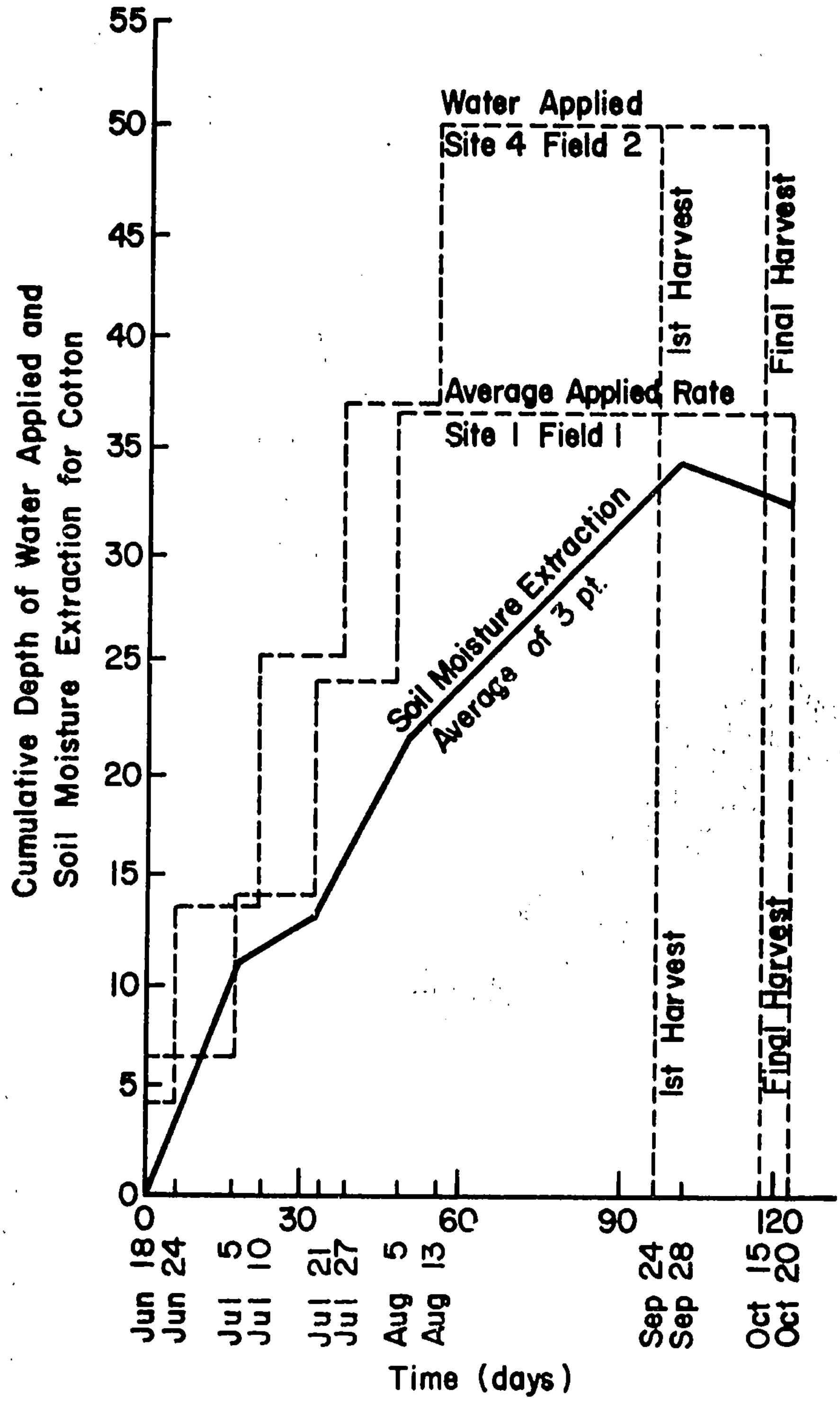


Figure 12. Cummulative Irrigation Water Applied to Cotton and Soil Moisture Extraction as a Function of Time for two Field Sites

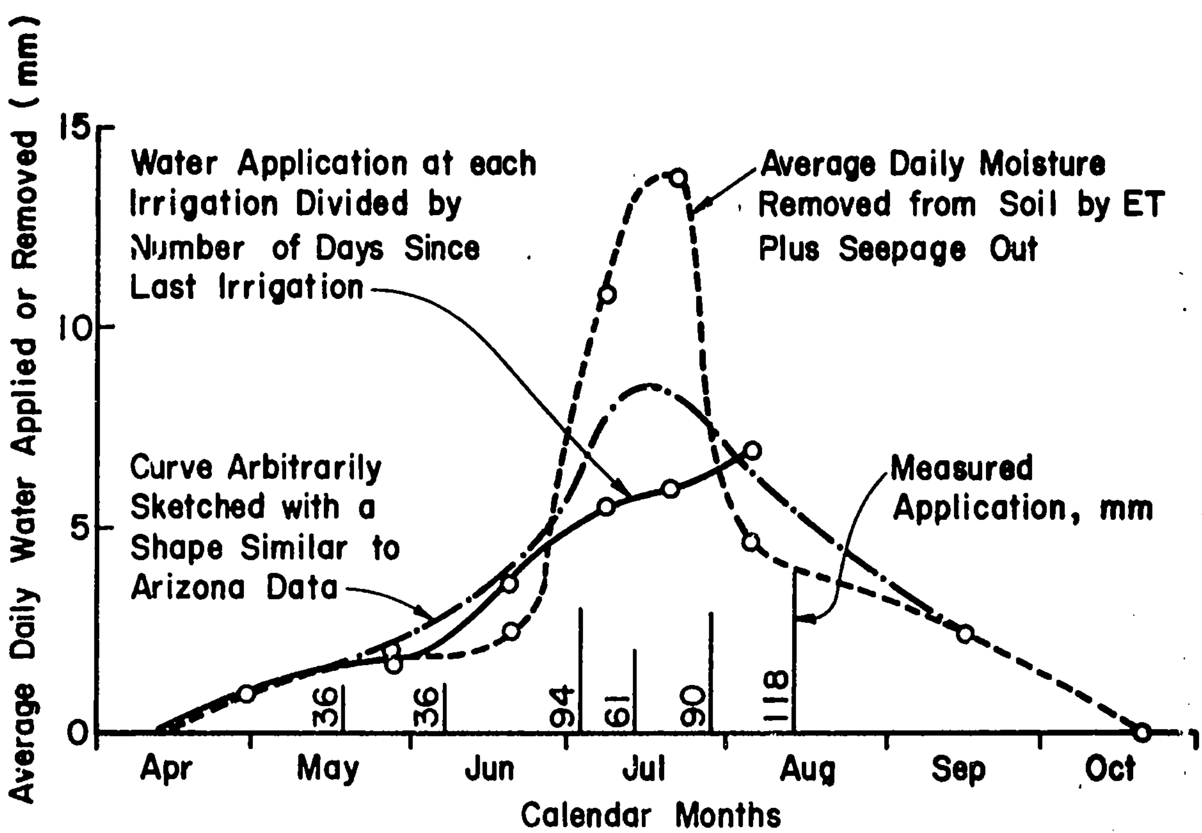


Figure 13. Water Applied to and Soil Moisture Removed from a Cotton Field

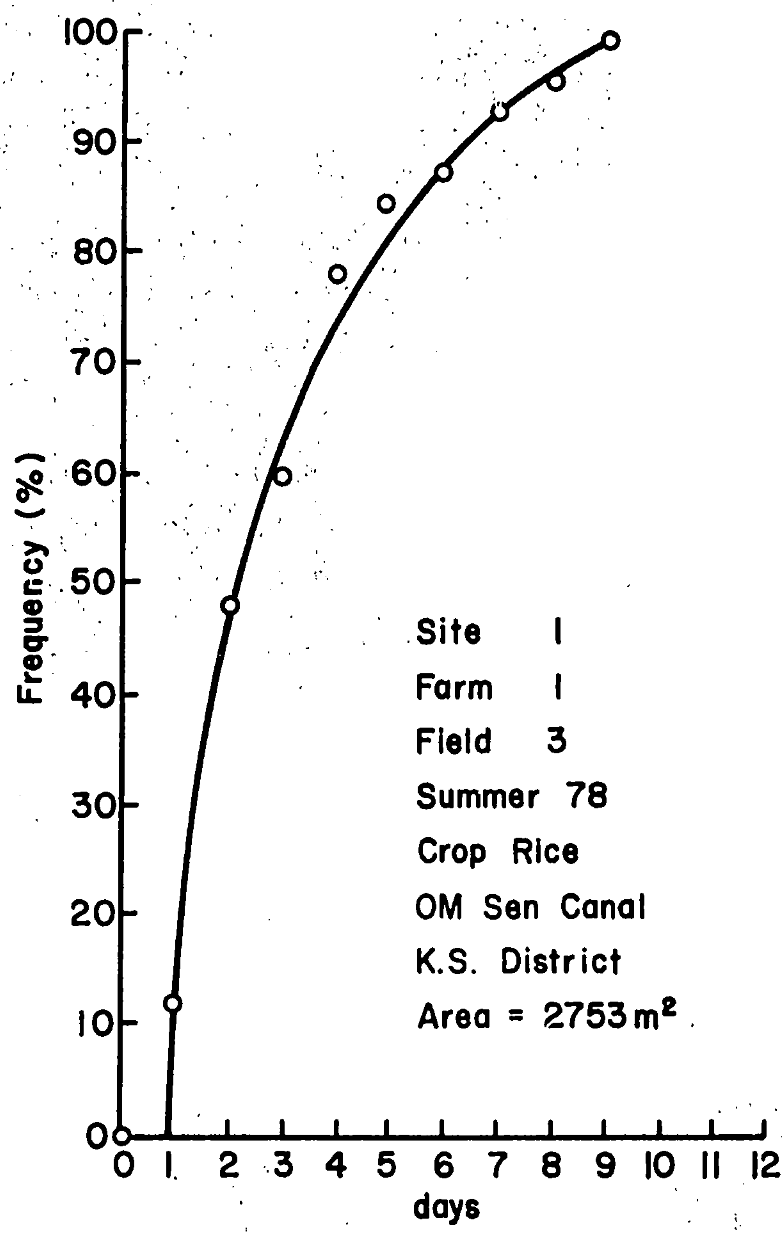


Figure 14. Frequency of Irrigation for Rice

canals due to over-excavation. It may also be abetted by a leaky gate on occasion. The over excavation apparently results from ditch cleaning, prompted partly by the need for material for making bricks.

The penalities to be paid for too-frequent irrigations include the extra labor required and the extra water applied, most of which apparently reaches the water table. The extra water is required to fill the supply ditches each time.

Records kept on one farm indicate that this farmer desires the ponded depth in his field to be between 3.43 and 6.87 cm. Perhaps a field trail could show that a slightly lower depth would be adequate if the field were level.

Further investigation might also show that irrigations would be less frequent if a dependable water supply were available continuously instead of on rotation.

9. The farmer has no modern methods available for helping him decide when to irrigate and how much to apply.

Modern techniques could perhaps increase his yield and reduce the water he applies. They might effect a lowering of the water table and reduce the danger of excess moisture stress in the root zone.

Note that items 4 through 9 above all deal directly or indirectly with saving water and increasing yield.

10. While the water in the canals is of high quality, the drain water is much less suitable for irrigation.

The EC of the irrigation water averaged about 0.54 millimhos for the period of measurement, with relatively low sodium. It classifies as $C_2$-$C_1$ by the U.S. Salinity Lab system, which means moderate salinity. While the salinity is greater here than in Mansouria, the calculated leaching requirement does not exceed 15%. The sodium hazard is low.

The average EC at the various sampling points in the drains ranged from 1.06 to 3.26 millimhos. The highest were Drain No. 7 at 2.23 and Gadalla Drain at 3.26. Drain No. 7 classifies as $C_3 - S_2$, moderately high salinity with moderate sodium hazard. The calculated leaching requirement is 56%, which suggests that a bit more water is required for leaching than for consumptive use. The Gadalla Drain classifies as $C_4 - S_2$, very high salinity, and should not be used for irrigation if there is any other alternative.

11. Considerable skilled labor is required for irrigation.

A minimum of two irrigators are required in order to obtain a relatively high efficiency using present methods and practices. One irrigator must be skilled at handling the stream of water as it is diverted from one basin or one set of furrows to the next. He must be equipped with a time piece and must understand how long the stream should be applied to each basin or furrow or strip.

The second irrigator must keep the sakia running and must continually police the supply ditch to prevent bank failures and/or seepage through the banks. Often a small boy is used for this task and falls short of fulfilling all requirements. In fact, any time the sakia is left unattended even for a few minutes, the animal may slow down and interrupt the stream flow. Therefore two men and a boy would be an even more adequate team.

12. Many factors thwart the efforts of the district to delivery adequate water to all areas. They include:

.../...

a. Obstruction deliberately placed in canals, such as dams and nets for fishing.

b. Incidental obstructions, such as tree roots, kenaf steam, tree branches, and weeds.

c. Floating debris in canals, including grass, weeds, and tree branches.

d. Leakage through gates during the time they should be closed.

e. Erroneous gage readings that allocate too much water to some areas, leaving too little elsewhere.

f. Sloughing of canal banks.

g. Over-excavation of some canals to clean the canal and obtain material for making bricks. For a given discharge, this tends to lower the head available at the intakes to private ditches.

h. Inability to accurately anticipate the demand one day or one week in advance.

i. Fluctuating supply of water.

# AMERICAN EQUIVALENTS OF EGYPTIAN ARABIC TERMS AND MEASURES COMMONLY USED IN IRRIGATION WORK

| LAND AREA | IN SQ METERS | IN ACRES | IN FEDDANS | IN HECTARES |
|---|---|---|---|---|
| 1 acre | 4,046.856 | 1.000 | 0.963 | 0.405 |
| 1 feddan | 4,200.833 | 1.038 | 1.000 | 0.420 |
| 1 hectare (ha) | 10,000.000 | 2.471 | 2.380 | 1.000 |
| 1 sq. kilometer | $100 \times 10^4$ | 247.105 | 238.048 | 100.000 |
| 1 sq. mile | $259 \times 10^6$ | 640.000 | 616.400 | 259.000 |

| WATER MEASUREMENTS | FEDDAN-CM | ACRE-FEET | ACRE-INCHES |
|---|---|---|---|
| 1 billion $m^3$ | 23,809,000.000 | 810,710.000 | |
| 1,000 $m^3$ | 23.809 | 0.811 | 9.728 |
| 1,000 $m^3$/Feddan (= 238 mm rainfall) | 23.809 | 0.781 | 9.372 |
| 420 $m^3$/Feddan (= 100 mm rainfall) | 10.00 | 0.328 | 3.936 |

| OTHER CONVERSTION | | METRIC | U.S. |
|---|---|---|---|
| 1 ardab | = | 198 liters | 5.62 bushels |
| 1 ardab/feddan | = | | 5.41 bushels/acre |
| 1 kg/feddan | = | | 2.12 lb/acre |
| 1 donkey load | = | 100 kg | |
| 1 camel load | = | 250 kg | |
| 1 donkey load of manure | = | 0.1 $m^3$ | |
| 1 camel load of manure | = | 0.25 $m^3$ | |

EGYPTIAN UNITS OF FIELD CROPS

| CROP | EG. UNIT | IN KG | IN LBS | IN BUSHELS |
|---|---|---|---|---|
| Lentils | ardeb | 160.0 | 352.42 | 5.87 |
| Clover | ardeb | 157.0 | 345.81 | 5.76 |
| Broadbeans | ardeb | 155.0 | 341.41 | 6.10 |
| Wheat | ardeb | 150.0 | 330.40 | 5.51 |
| Maize, Sorghum | ardeb | 140.0 | 308.37 | 5.51 |
| Barley | ardeb | 120.0 | 264.32 | 5.51 |
| Cottonseed | ardeb | 120.0 | 264.32 | 8.26 |
| Sesame | ardeb | 120.0 | 264.32 | |
| Groundnut | ardeb | 75.0 | 165.20 | 7.51 |
| Rice | dariba | 945.0 | 2081.50 | 46.26 |
| Chick-peas | ardeb | 150.0 | 330.40 | |
| Lupine | ardeb | 150.0 | 330.40 | |
| Linseed | ardeb | 122.0 | 268.72 | |
| Fenugreek | ardeb | 155.0 | 341.41 | |
| Cotton (unginned) | metric qintar | 157.5 | 346.92 | |
| Cotton (lint or ginned) | metric qintar | 50.0 | 110.13 | |

EGYPTIAN FARMING AND IRRIGATION TERMS

fara = branch
marwa = small distributer, irrigation ditch
masraf = field drain
mesqa = small canal feeding from 10 to 40 farms
qirat = cf. English "karat", A land measure of 1/24 feddan, 175.03 $m^2$
qaria = village
sahm = 1/24th of a qirat, 7.29 $m^2$
saqia = animal powered water wheel
sarf = drain (vb.), or drainage. See also masraf, (n.)

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## PROJECT TECHNICAL REPORTS

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