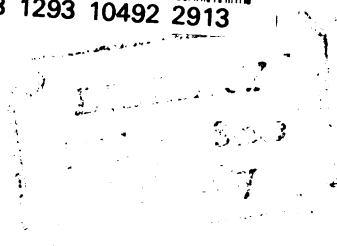


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A SPATIAL ANALYSIS OF CULTURAL FACTORS
AFFECTING CROP AND LIVESTOCK PATTERNS

presented by

Mahmoud Abdalla Najm

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Ph.D. degree in Geography

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AGRICULTURAL LAND USE IN THE BENGHAZI AREA, LIBYA:
A SPATIAL ANALYSIS OF CULTURAL FACTORS
AFFECTING CROP AND LIVESTOCK PATTERNS

By

Mahmoud Abdalla Najm

A DISSERTATION

Submitted to
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DOCTOR OF PHILOSOPHY

Department of Geography

1982

ABSTRACT

AGRICULTURAL LAND USE IN THE BENGHAZI AREA, LIBYA: A SPATIAL ANALYSIS OF SELECTED CULTURAL FACTORS AFFECTING CROP AND LIVESTOCK PATTERNS

By

Mahmoud Abdalla Najm

The Benghazi area is a small, physically homogeneous region in northeastern Libya. This study postulated that the agricultural land-use patterns of this area appear to be more affected by cultural factors, such as farm location, type of land tenure, level of government assistance, and the nature of farmers' characteristics, than the physical characteristics. The research suggested that there is a relationship between the nature of the cultural environment and the land-use patterns found surrounding Benghazi. Any future plans for development should be based on these considerations.

The objectives of this research were: (1) to define the major agricultural land-use patterns of the Benghazi area, (2) to determine how the cultural factors affect types of agriculture, (3) to identify the major difficulties facing agricultural development, and (4) to compare the actual land-use patterns in the Benghazi area with those hypothesized by the von Thunen land-intensity model. To accomplish these objectives, information and data were gathered and a detailed field survey was implemented. Two hundred fifty farmers, selected by a sampling technique, completed interview schedules. The interview

data were analyzed through the use of Pearson correlation, one-way analysis of variance, and chi-square techniques.

The major results of the statistical analysis were:

1. The greater the distance from Benghazi, the larger the sizes of the farms.
2. Close to Benghazi the farms were intensively cultivated with cash crops, whereas grains and grazing occupied a large proportion of farm land located farther away from the city.
3. The nature of land tenure in the Benghazi area affects the types of agricultural land use. Sharecropping farmers produced largely cash crops, whereas squatter's-rights farmers used large parts of their farms for cultivating grains and grazing of animals.

In addition, the study revealed that the major difficulties facing agricultural development in the Benghazi area were: (1) shortage of suitable water for agriculture, (2) inadequate extension services, (3) lack of government agricultural assistance, (4) shortage of spare parts for machinery, and (5) lack of paved roads. Also, it was found that, in general, the von Thunen model is applicable to the actual land-use patterns of the Benghazi area.

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1982

To the memory of my mother for her love,
patience, and encouragement during my early
school years.

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Appreciation is also expressed to Professor Emeritus Georg Borgstrom, the former chairman of the Guidance Committee, for his encouragement and critical review of the manuscripts of this dissertation. For the many hours of dedicated advice and counsel since my arrival at Michigan State University, sincere and warm appreciation is extended to my academic advisor, Professor Lawrence M. Sommers.

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CHAPTER I

INTRODUCTION

Before the discovery of oil in Libya in the early 1960s, agriculture was the most productive sector of the economy. This sector accounted for 70 percent of the labor force and 30 percent of the gross domestic product (GDP). The contribution of agriculture had declined to less than 4 percent of the GDP in the early 1960s. Then efforts were made to expand agricultural production by increasing government expenditures in this sector. Much of the assistance was in the form of credits, price supports, and subsidization of farm machinery and fertilizers. Agricultural production seemed to respond to these stimuli, growing at an average annual rate of 4 to 5 percent during the 1960s and 7 percent during the first half of the 1970s. Even with an estimated decline in agricultural employment of 1 percent per year, labor productivity rose significantly during the same period. However, scarcity of rainfall, shortage of water, and a soil impoverished by centuries of neglect set physical limitations on the expansion of agricultural production. Thus the amount of agricultural land remained at an almost constant 3.8 million hectares (2 percent of the country's total area) in the 1960s and early 1970s.¹ Because of high

¹R. G. Hartley, "Libya: Economic Development and Demographic Response," in Population of the Middle East and North Africa, ed. J. I. Clarke and W. B. Fisher (London: University of London Press, 1972), p. 315.

production costs and a rapidly growing domestic demand, agricultural products are no longer exported.

Within the Libyan agricultural zones, which are defined by rainfall and irrigation potentials, two distinct patterns are imposed on a similar background of physical conditions, indicating the force of nonphysical determinants. One pattern is the traditional system of agriculture as it reflects a natural response to the physical environment; the other is a planned and predetermined agricultural system. The latter is represented by several planned agricultural projects scattered over large areas.

Although in Libya many of the traditional farms have grazing rights, their economic viability is primarily determined by the size and location of irrigated patches in the coastal plain. Despite the fact that the country has a total area of more than 1,700,000 km², its population is among the smallest in the world (2,257,000 in the 1973 census).² One of the reasons for this sparse population is the aridity; nearly 95 percent of the country receives less than 100 mm of rain per year.

Agricultural land use in Libya appears to be affected by many cultural factors, such as location of farms relative to markets, the nature of land tenure, the amount of government assistance, the type of agricultural programs, and the characteristics of farmers. However, very little has been done to analyze and determine the role of

²Peter Beaumont, Gerald H. Blake, and J. Malcolm Wagstaff, The Middle East: A Geographical Study (London: John Wiley and Sons, 1976), p. 489.

such factors in agricultural practices and land-use patterns in the country. To determine the effect of the cultural factors on the types of agricultural land use in Libya, specific data based on small administrative units should be available, such as farm size, distance between the farm and the market, mode of transportation, types of agricultural land use, and government assistance programs. Unfortunately, reliable data of this kind are limited. Thus, the researcher decided to collect data by interview schedules and to focus on agricultural land use in a relatively small, manageable region, namely the Benghazi area in the northeastern part of Libya. In this study, several agricultural zones are identified, and factors affecting the spatial distribution of agricultural activities are analyzed.

The Benghazi area has been chosen as a study site for the following reasons: (1) it is an important agricultural area; (2) it is small enough to lend itself to an in-depth study; (3) the researcher is familiar with the people of the area and their culture and has a special interest in the agricultural land use of Libya; and (4) data and research materials on agricultural land use, although limited, are available based on municipalities and districts.

The Problem

Agricultural development and farm income vary throughout Libya. Inequalities in physical and economic conditions often are major obstacles to economic growth as well as to efficient agricultural land use. Although much of the agricultural-production problem is rooted in the physical characteristics of the area, certain cultural and institutional

factors reflected in the present crop and livestock land-use patterns restrict land-use development. Major constraints include physical and human factors that restrict land use and slow agricultural production.

Geographic factors, such as farm location relative to market or operational center, have a profound influence on the local patterns of agricultural land use. Those crops that require relatively large amounts of labor, such as vegetables grown for home consumption, are generally grown closer to the main settlements. Such intensive activities may occur farther away, however, if the local soil and water conditions are favorable. Cereal growing is less labor intensive and is generally carried out farther away from the market.

The effect of a land-tenure system on land-use patterns is significant. Land-tenure systems in Libya constitute the legal and contractual or customary arrangements whereby farmers gain access to the land. The question that needs to be answered is how the land-tenure system in a relatively small area such as Benghazi determines the pattern of agricultural land use and income distribution in the farm sector.

Government assistance to the farmers is another factor affecting agricultural land use. Subsidies, for example, play a key role in influencing types and intensities of agricultural production. Direct subsidies in the form of cash payments and indirect subsidies, such as subsidization of farm inputs, interest-free loans, guaranteed prices of agricultural products, and research activities, have

been employed to encourage the production of a variety of agricultural commodities. The most important of these include wheat, barley, vegetables, and livestock.

Recent research has concentrated on the effect of a farmer's characteristics on agricultural land-use distribution. Such characteristics as age, level of education, length of time in farming, and the farmer's occupation play a major role in the types of agriculture practiced.

Agricultural land-use patterns in Libya in general, and in the Benghazi area in particular, have not been studied systematically by geographers with emphasis upon the above-mentioned factors. The available literature shows that little attention has been paid to cultural factors affecting the agricultural landscape of the Benghazi area--the farm location relative to markets, the land-tenure system, government-assistance policies, and farmers' characteristics. Determination of the factors that cause variations in crop patterns is important not only to the farmers but also to those who propose future agricultural-development plans.

Objectives

The purpose of the study was to define and analyze the agricultural land-use patterns in the Benghazi area and to relate these patterns to selected cultural factors such as farm location, land-tenure systems, government agricultural policies, and farmers' characteristics. More specifically, the objectives were:

1. To identify and delimit existing crop patterns in the Benghazi area
2. To identify and analyze the major factors affecting the agricultural landscape in the study area
3. To evaluate the influence of farm location relative to the Benghazi market on the types of agriculture practiced
4. To identify the role of government-assistance programs in agricultural development.
5. To determine the role of land-tenure systems in agricultural land-use patterns
6. To determine the relationship between characteristics of farmers and the agricultural land-use pattern
7. To identify what farmers perceive to be the major difficulties facing agricultural development in the Benghazi area
8. To compare the existing land-use patterns in the area to the land-use zones hypothesized in the von Thunen model
9. To provide updated agricultural land-use maps of the Benghazi area that can be used by persons or institutions charged with the regional planning of agriculture.

Hypotheses

A number of research hypotheses were formulated that relate to agricultural land use in the Benghazi area and to factors other than those of a physical nature that could influence crop patterns. The research hypotheses were constructed to fulfill the objectives of this study. The hypotheses are as follows:

Hypothesis I: There is a direct relationship between a farm's size and its distance from Benghazi, the central market of the study area; that is, the greater the distance from the city, the greater the size of the farm.

Hypothesis II: As distance from the city increases, a smaller percentage of a farm's acreage is used for vegetables and fruits and a greater percentage is used for grain cultivation.

Hypothesis III: Other factors being equal, such as water availability, soil fertility, and transportation facilities, the intensity of cultivation is inversely related to the distance of a farm from Benghazi; that is, the greater the distance from the city, the less intensively and more extensively a farm is cultivated.

Hypothesis IV: Farms in the marginal area of the study are more likely to be devoted to grazing and animal husbandry.

Hypothesis V: The land-tenure systems affect the types of crops cultivated. For example, sharecroppers are more likely to concentrate on cash crops such as vegetables, whereas farmers who have squatter's rights and inherited farms are more likely to use large parts of their farms to cultivate grain and to graze animals.

Hypothesis VI: Government-assistance programs have a great effect on the variation of agricultural land use in the Benghazi area. For example, farmers who receive agricultural machinery and interest-free loans are more likely to cultivate a larger part of their farms with grain than those who receive only interest-free loans.

Hypothesis VII: Significant relationships exist between farmers' characteristics (age, family size, level of education, length of time in farming, and occupation) and the types of agriculture practiced in the Benghazi area.

Organization of the Study

The remainder of the study is divided into five chapters. In Chapter II, an overview of the Benghazi area is presented. In addition, a brief description of the area in terms of location, physiographic regions, cultural characteristics, and economic base as well as a review of related literature is given. Since the name

Benghazi is used in this study to identify a market, a city, a plain, a municipality, a subregion, or even all of the region of eastern Libya, a clear description of this area in its physical, cultural, and economic aspects was thought necessary, despite the fact that the study is focused only on the effect of cultural factors on agricultural land use. In Chapter III, the method of research is described. Related theories and methods are discussed, and data collection, sampling design, research assistance, pilot work, procedure of the analysis, and limitations of the study are explained. The spatial location of agricultural land-use patterns and farming systems in the Benghazi area are discussed in Chapter IV. Several agricultural land-use distribution maps based on sample surveys are included to show present variations in land use in the Benghazi area. An analysis of the data tabulated from the interview schedule is given in Chapter V. In this chapter, also the relationships between selected cultural factors and the types of agricultural land use practiced in the area are determined. In Chapter VI, the major findings of the research are given; these include testing of the hypotheses, investigation of the farmers' reaction to major agricultural land-use difficulties, and the comparison between the actual land-use patterns in the study area and those hypothesized by von Thunen's agricultural land-use model. Conclusions and recommendations based on the findings of this study are presented in Chapter VII.

CHAPTER II

OVERVIEW OF THE BENGHAZI AREA

The Benghazi area is the region surrounding Benghazi City. This area is relatively homogeneous physically. It extends from latitude 31°30'N to latitude 32°45'N. The area, located between the first escarpment of the Jabal al-Akhdar (green mountain) to the east and the Mediterranean Sea to the west, forms a triangle about 56 kilometers wide in the south tapering to less than one kilometer wide in the north (see Figure 2.1).

Benghazi is the largest city and the major central market for the whole area. There are medium-sized settlements, such as Suluq and Gaminis in the south and al-Aguria to the north, which serve local areas. The Benghazi area covers about 4600 square kilometers and contains 364,000 inhabitants. More than half of the labor force within the area consists of farmers or agricultural workers. Administratively, the area is part of the Benghazi municipality.

Physical Features

Despite the fact that this study is focused on the effect of selected cultural factors on agricultural land use, physical features are important in presenting an overview of the study area. Thus, this chapter begins with a brief description of some physical elements related to agricultural land use. Variations in physical

Figure 2.1

Figure 2.1

characteristics are limited because of the small size of the study area. Five physical elements are discussed in this chapter: landforms, drainage system, climatic conditions, soil types, and natural vegetation.

Landforms

There are three prominent, distinguishing landforms in the Benghazi area: (1) the coastal plain along the Mediterranean Sea, (2) the Benina Platform, and (3) the first step of the Jabal al-Akhdar Escarpment (see Figure 2.2). These features resulted from tectonic movements of limestone during the Pleistocene period.

The coastal plain in the Benghazi area extends from north of al-Aguria, 76 km northeast of the city, to a point about 14 km south of Gaminis, a distance of about 150 km. This coast is almost completely bounded inland by sand dunes and gently slopes to the Mediterranean Sea.

The Benina Platform runs in a north-south direction between the coastal plain and the Ar-Rajma Escarpment. The platform is wider in the south than in the north; in the figure, its western edge is indicated by the 100 contour line. As shown by this line, most of the Benghazi area is a level plain and the Benina Platform is its extension to the east.

Drainage System

Water has always been a decisive factor in the development of the Benghazi area. The availability of water influences future planning and expansion of domestic agricultural and industrial land

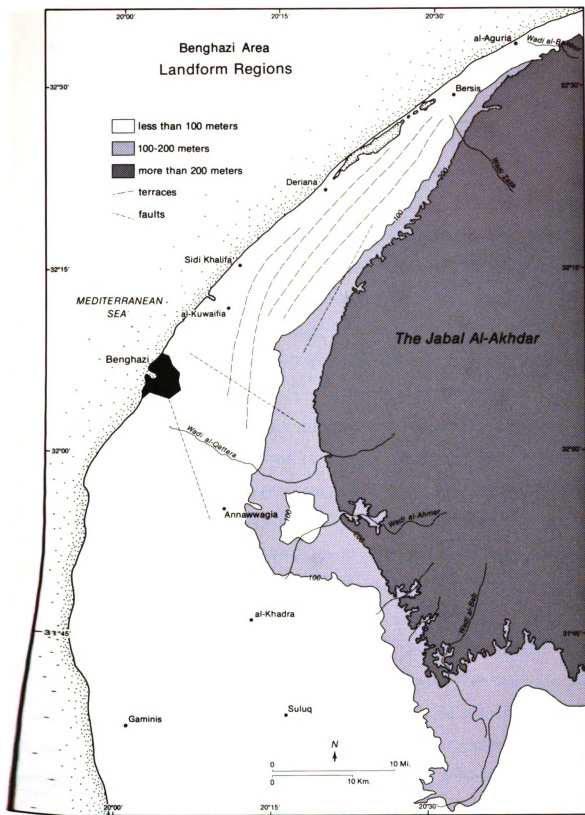


Figure 2.2

uses. A number of studies on water resources were carried out in the study area. Most of these studies noted that, although the Benghazi region, which comprises northeast Libya, is the only region in the country that receives a large amount of precipitation (ranging from 100 to 600 mm each year), there are no perennial streams. The absence of these streams is due to the relief, the geological formation of the underlying rocks, and the relatively short rainy season and long dry season. Consequently, tapping underground water becomes the principal solution to the water shortage not only in the Benghazi region but also in the entire country.

There are a large number of wadis (dry valleys) dissecting the Ar-Rajma Escarpment of the Jabal al-Akhdar. These streams carry water only during heavy rains. Some of this water infiltrates the groundwater system, but much of it goes to the sea or marshes near the coast. As previously mentioned, the slope of the Benghazi area is not steep. This topographic characteristic permits the drained water to collect in ponds near Benghazi City and along the coast. These bodies of saline water limit the area of agricultural land use along the coast.

The Wadi al-Qattara on the western flank of the Jabal al-Akhdar is the major drainage system in the area. It runs from the watershed of the upper escarpments of the Jabal al-Akhdar and enters the Mediterranean Sea southwest of Benghazi City. Along its course, the Wadi al-Qattara forms alluvial deposits close to Benghazi. These

deposits have been estimated to be 15 to 20 meters thick and to contain the highest water table in the Benghazi area.¹

Dams constructed on the Wadi al-Qattara channel have conserved much of the flood water that used to flow into Benghazi. Thus there is increased infiltration into the groundwater system. However, it is estimated that only 10 percent of the rainfall infiltrates the groundwater. It has been suggested that this infiltration could be increased by the construction of artificial recharge structures in several wadis leading from the Ar-Rajma Escarpment. The success of such a scheme would depend upon access to the karstic system, which is generally confined. It is hoped that the surface water being stored behind the Wadi al-Qattara Dam can be used by an agricultural project near the town of Ar-Rajma. This is the only significant use of surface water in the Benghazi area.

There are three other wadi systems contributing to the drainage of the study area: the Wadi Zazi system, which facilitates drainage between al-Aguria and Bersis, and Wadi al-Ahmer and Wadi al-Bab in the southern part of the Benghazi area (see Figure 2.2).

Climatic Conditions

Although there are seven meteorological observation stations of different types in the Benghazi area and its adjacent territories, literature on the climatic conditions of the region is meager. This is because most of the stations measure only rainfall, temperature,

¹Salem A. Hajjaji, "The Land Use Patterns and Rural Settlement in the Benghazi Plain" (Ph.D. dissertation, University of Durham, 1969), p. 36.

and relative humidity. Data for these climatic elements, however, are either unreliable or cover only short periods. Thus, the analysis of climatic conditions in the Benghazi area is difficult. However, since agricultural land-use patterns correlate closely to rainfall and temperature, it is necessary to describe briefly the relevant climatic elements in the Benghazi area.

Rainfall. There is general agreement among most researchers who have studied the climatic conditions of Libya in general and the Benghazi region in particular that rainfall in the study area is scanty and erratic, varying from year to year in quantity, frequency, and distribution. About half of the winter rainfall is due to cyclonic depressions originating over the south Adriatic and Aegean Seas. Most of the remaining rainfall is associated with cyclonic depressions that invade the Mediterranean Basin from west to east.²

Annual rainfall data for most of the meteorological stations in the Benghazi area have been collected and tabulated. The statistical parameters of these data are given in Table 2.1. This information supports previous reports that rainfall in the Benghazi area varies from year to year.

Part of the regional isohyetal map for the northeastern zone of Libya is presented in Figure 2.3. The orographic effect of the Jabal al-Akhdar on the distribution of rainfall in the Benghazi area is shown.³

²Ibid., p. 30.

³Doxiadis Associates International, Benghazi Region: Existing Conditions, Projections and Future Development Trends, Vol. 5, No. 1 (Athens: Doxiadis, 1979), p. 201.

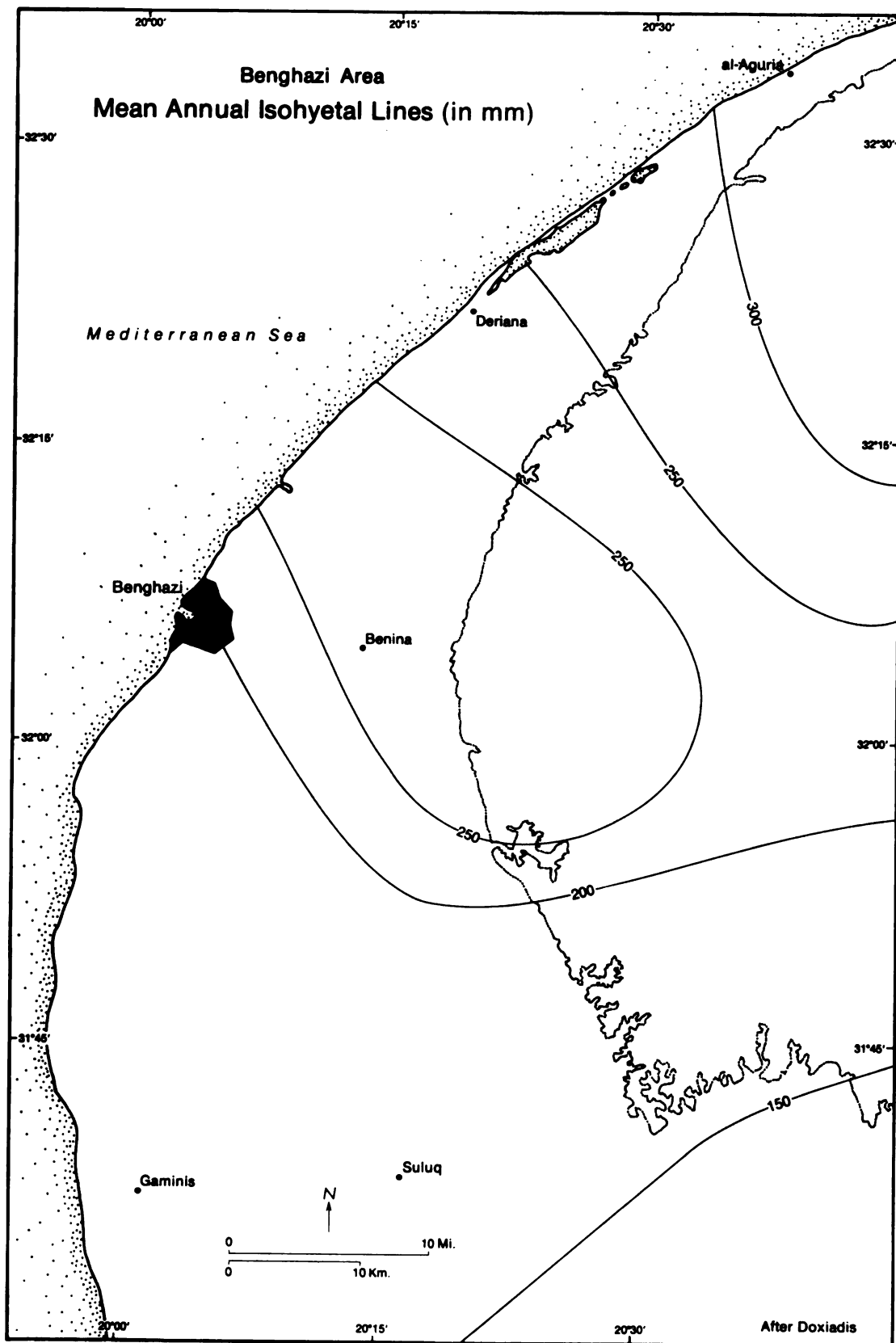


Figure 2.3

Table 2.1.--Rainfall.

Stations	Period of Data	Mean in mm (x)	Standard Deviation in mm (S)	Range of 95% Values $x \pm 2S$ in mm
Benghazi	1881-74 (57 yrs)	252.9	97.0	68.9 - 446.9
	1915-74 (33 yrs)	247.3	88.0	71.3 - 423.3
Benina	1915-74 (29 yrs)	260.8	69.2	112.4 - 399.2
	1956-74 (18 yrs)	248.6	66.2	116.2 - 381.0
Ar-Rajma	1915-74 (21 yrs)	325.8	112.2	23.8 - 472.6
Fuwayhat	1915-74 (36 yrs)	247.9	91.3	65.3 - 430.5
Kuwaifia	1915-74 (44 yrs)	276.8	111.7	53.4 - 500.2

SOURCE: Libyan Arab Republic, Secretariat of Dams and Water Resources, General Water Authority (Benghazi Branch), Investigation of the Municipal Well Field, Benina Area, p. 42.

The rainy season continues for about eight months, from September to April; the remaining four months (May to August) constitute the dry season. In most years, the highest rainfall amounts in Benghazi are recorded in January, but this peak sometimes occurs in December or February. In 1966, for example, the peak (196.0 mm) was in December, and in 1964 the peak (99.0 mm) was in February.⁴ The amount of rainfall increases rapidly between October and December. After February it decreases gradually until it ceases completely in May.

March rains have a special significance to agriculture in the Benghazi area. This is because March is the heart of the growing

⁴Hajjaji, p. 32.

season; hence any excess or shortage of rainfall affects the agricultural production, particularly of wheat and barley, which are almost entirely cultivated by the dry-farming system.

Temperature. The monthly mean temperature in the Benghazi area varies from 12.5° to 26.7°C, but the maximum temperature recorded was 45.6°C in June 1969 at the Benina Station, 18 km east of Benghazi. The minimum temperature was 0.6°C in March 1949 at the same station.

The summer season usually starts in May and extends to late September or early October; the winter season starts in November and continues into April. The hottest months of the year are June, July, August, and September, and the coldest months are December, January, and February. However, altitude and the presence of the sea influence temperatures and cause variations in the isotherms of the Benghazi area. The high temperature in summer has a serious effect on human and thus on agricultural activities--at times, work in the field is completely stopped. Thus, grains are generally harvested before summer starts. Crops in the Benghazi area are in no danger from frost but must be able to tolerate high summer temperatures.

Relative humidity in the Benghazi area is remarkably high and uniform throughout the year. It is, however, affected by variations in local climatic conditions. The hot Gibli winds, for example, which blow from the desert to the Mediterranean Sea, act to decrease the relative humidity. At some weather stations, such as al-Aguria, the records show that the relative humidity drops under 10 percent during the Gibli season.

Winds. Generally, winds in the Benghazi area are not of critical importance because sand storms are not involved, since the Jabal al-Akhdar and neighboring plain are essentially rocky. Also, the Ar-Rajma Escarpment protects the Benghazi area from sand storms. Winds in the Benghazi area are very frequent and to a great extent come from the Mediterranean Sea. About 45 percent of the winds in the area come from the northwest and northeast and are relatively cold.

Although representing only 17 percent of the winds in the Benghazi region, the Gibli winds have the most devastating effects on vegetation and agriculture. They are warm and extremely dry. They occur in an average of three weeks per year, mostly during the spring and fall. If the Gibli winds blow during the period of plant growth, the yield may be completely lost. A hot Gibli during the milk stage of grains can make the difference between a good or bad season. A Gibli during the flowering period of fruit trees may also drastically reduce the crop.

Soil Types

The terra-rossa type of soil. The terra-rossa type of soil is widespread at different levels of the northeast part of Libya, on the Jabal al-Akhdar plateau, and on the terraces of the Benghazi coastal plain. Terra rossa, which is transported primarily by water, is found in vast areas around Benghazi and was brought in through the Wadi al-Qattara. It is found also in the area between Deriana and Bu Jarrar, probably having been brought in by the Wadi Zaza.

The relatively heavy texture of terra rossa gives it a reasonable moisture-holding capacity. This indicates that this soil type is capable of retaining an adequate quantity of water for summer cultivation.⁵

Alluvial soils and lithosols. Alluvial soils and lithosols are formed in wadi beds on alluvial fans. Consequently, their texture is nonhomogeneous. Alluvial soils are found throughout the coastal zone.

Different places in the Benghazi area are covered by alluvial deposits. The most important of these are the flood plains of Wadis al-Bab (about 16 km southeast of Suluq), al-Ahmar, al-Qattara, and Zaza. These soils are also of considerable depth and contain much less organic matter and nitrogen than other soil types such as terra rossa. However, these soils could be used for the cultivation of many agricultural crops if good-quality water were available.

Reddish brown soils. Reddish brown soils occur in the semi-arid regions. They are formed in warm, temperate climates with hot summers. They consist of compact sod that is covered by low, grassy vegetation and scattered dwarf shrubs and small trees. The soil surface is usually reddish brown to red and loose in structure. These soils have high fertility, but dry farming on them is usually impossible because of the arid climate.⁶

⁵Ibid., p. 63.

⁶D. G. Vilenski, The Russian School of Soil Cartography and Its Influence on the Soil Cartography of the World (Washington, D.C.: U.S. Department of Agriculture, 1945), p. 48.

Solonchak soils. The Solonchak soils form one of the main groups of saline and alkaline soils that have a high salt content. Saline solonchak soils are common immediately north of al-Aguria, behind the coastal sand dunes, and along the shoreline where the saline marshes are commonly seen.

There are also less important types of soils in the Benghazi area, such as reddish yellow steppe soils, sand-dune soils, and crust. Soil classifications according to their agricultural values are shown in Figure 2.4.

Natural Vegetation

Taking into consideration several factors such as distribution and frequency of rainfall, the quality, depth, and distribution of soils, and relief, two major generalized types of vegetation can be identified in the Benghazi area: maquis (Mediterranean vegetation) and steppes.⁷ The first can be subdivided into wood forest and brush forest, and the latter can be subdivided into coastal and semi-desert steppes, littoral and sand-dune vegetation.⁸

Cultural Characteristics

In order to show the importance of cultural traits in agricultural land use not only in the Benghazi area but also in the social and economic development of Libya in general, it is necessary to discuss the basic cultural characteristics of the study area.

⁷William B. Fisher, The Middle East, A Physical, Social and Regional Geography (London: Methuen Co., 1971), pp. 75-84.

⁸Hajjaji, p. 85.

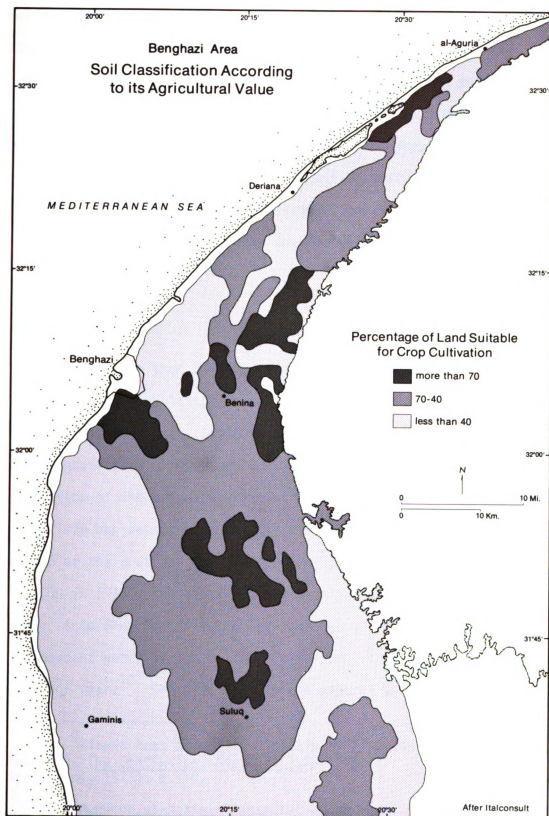


Figure 2.4

Among cultural factors, population distribution and land-tenure systems are most significantly related to variations in the spatial pattern and intensity of land use. Cultural influences, however, are seldom independently linked to the areal pattern of agricultural land use. Rather, they must be analyzed in relation to a number of physical and institutional considerations if a meaningful interpretation of the geographic arrangement of land use is to be made.

Population Size and Past Growth

With more than 364,000 inhabitants, the Benghazi area ranks second in population among Libyan regions. Only Tripoli in the northwest, with 735,000 inhabitants, is more populous than the Benghazi area.⁹ As shown in Table 2.2, from 1963 to 1970 the population of the Benghazi area increased steadily. The growth after 1970 was remarkable; in only one decade (1969-79) the population of the area was doubled, growing from 179,689 in 1970 to 364,500 in 1979. This increase was mainly due to a natural growth rate. According to Kikia, the average natural growth rate is about 3.5 percent per year, whereas migration contributes about 2.5 percent per year.¹⁰ Benghazi City is the central market of the area

⁹Libyan Arab Republic, Ministry of Planning and Scientific Research, The Statistical Abstract 1974 (Tripoli: Department of Statistics, 1975), p. 10.

¹⁰Mansour al-Kikia, "Distribution and Growth of Population in the Benghazi Area" (paper presented at the First Geographical Conference on the Geography of Libya, Benghazi, University of Gar Yunis, 1975), p. 58.

and the major center of population. More than 62 percent of the population of the Benghazi area lives in the city. The density in Benghazi City is about 2,640 inhabitants per square kilometer. Most of the remaining 38 percent of the population of the area lives in other medium-sized urban areas such as Gaminis, Suluq, and al-Aguria.

Table 2.2.--Population of the Benghazi municipality, 1963-1979.

Year	Population	Year	Population
1963	122,553	1973	267,534
1964	137,295	1974	280,045
1965	144,233	1975	315,936
1966	151,734	1976	328,512
1967	157,994	1977	341,073
1968	164,496	1978	355,089
1969	172,894	1979	364,500
1970	179,689		
1971	234,082		
1972	263,788		

SOURCE: Libyan Arab Jamahiriya, Secretariat of Municipalities, Municipality of Benghazi, Evolution of Population and Human Movements (unpublished document, Benghazi, 1979), p. 1.

A population pyramid, based on sex and age, drawn from the 1973 population census, is shown in Figure 2.5. This figure appears normal

Benghazi Area
Age-Sex Pyramid
1973

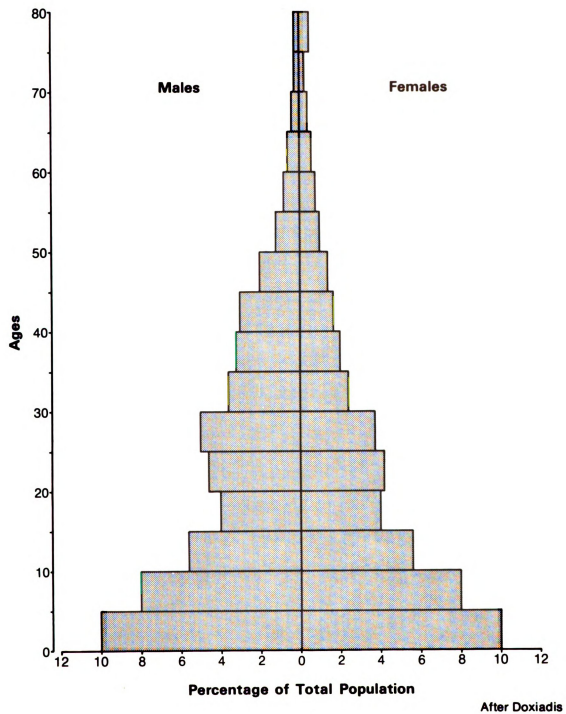


Figure 2.5

and smooth. This age-sex structure resembles that of the developing nations. The young represent the large base of the pyramid, while the old represent a small portion near the top.

The Benghazi area, like any other area in Libya, contains a number of non-Libyans, most of them Egyptians, Palestinians, Sudanese, and Tunisians. They came as workers in agriculture, in blue-collar jobs, and in services. In 1973, there were 45,999 non-Libyans in the Benghazi area, most of them between 15 and 40 years of age.¹¹

Illiteracy in Libya was greatly reduced during the 1964-73 period. In fact, illiteracy in the Benghazi area is substantially lower than the averages either for the Benghazi region, which includes all of northeast Libya, or the nation as a whole. Of the total population of the Benghazi area, 39.78 percent were illiterate in 1973 compared to 50.9 percent in Libya as a whole.¹² However, illiteracy among females is more than double that among males (see Table 2.3).

Land-Tenure Systems

One of the major cultural factors influencing the character of agricultural land use, particularly in the Benghazi area, has been disputes over land ownership. Disputes, especially in the southeast portion of the study area, occur almost daily during the plowing season, which usually starts during September and October. When a piece of land is under dispute, it cannot be cultivated. In some cases, the

¹¹Doxiades Associates International, Benghazi Region, Master Plan and Layout Plan Areas, Vol. 5, No. 2 (Athens: Doxiadis, 1979), p. 23.

¹²Ibid., p. 31.

dispute is settled by local authorities. In other cases the government intervenes to resolve the dispute. Nevertheless, until recently many of the disputes were protracted, resulting in land lying unused for a long period.

Table 2.3.--Population of the Benghazi area ten years and older by sex and level of education, 1973.

Educational Level	Males		Females		Total	
	Pop.	%	Pop.	%	Pop.	%
Illiterate	16,712	23.7	35,694	58.2	52,406	39.7
Read only	873	1.2	294	0.5	1,167	0.9
Read and write	29,971	42.5	17,066	27.8	47,037	35.7
Primary school or equivalent	12,531	17.8	5,417	8.9	17,948	13.6
Preparatory, secondary school, or equivalent	9,138	12.9	2,591	4.2	11,729	8.9
Post-secondary	154	0.2	14	--	168	0.1
University	932	1.3	115	0.2	1,047	0.8
Graduate school	155	0.2	13	--	168	0.1
Undefined	129	0.2	127	0.2	256	0.2
Total	70,595	100.0	61,331	100.0	131,296	100.0

SOURCE: Libyan Arab Republic, Secretariat of Planning, Final Results of the Population Census (Libya: 1973), p. 27.

According to Gannaus, disputes over land and water have existed for a long time. But the effects of these disputes were much less serious economically in the past than they are today, when intensive farming systems have become so important for supporting the growing urban centers with agricultural products.¹³ The major matters involved in the disputes have to do with issues of descent or of kinship relationships. Although these continue to be immediate causes, what is fundamental in the present situation is that changes have been taking place in the area since 1963 because of technological developments based on huge oil revenues. Because of these changes, it is necessary that land ownership, rights of usufruct, water rights, and so on be given far greater precision of meaning than was ever necessary in the past.

Although land-tenure systems in the Benghazi area are still not clear today because of the occasional intervention of the authorities to redistribute land, Gannaus and Hajjaji have classified the land, based on the Turkish Land Registration Act, into five broad categories:

Melk. The land is owned by individuals or groups. The owners have full rights to benefit from the income from their land. These lands can also be sold or bought, mortgaged, or inherited by the owner's children. Most of this land is found in the rural parts of the Benghazi area.

¹³Subhi M. Gannaus, "The Social Structure of al-Abiyar Township" (Ph.D. dissertation, University of Manchester, 1977), p. 212.

2. Ard al-Miri or state land. This land can be leased to individuals for a long period of time, but it cannot be owned indefinitely by one person, inherited, or mortgaged. Very often this kind of land includes agricultural land, but also sites that were earmarked for summer camping, wooded areas, and other lands are included.

3. Ard al-waqf. These are lands that are dedicated to religious or cultural purposes. The waqf land can be utilized on either rental or sharecropping bases. The income derived from this land may be assigned for religious purposes such as building a mosque or sponsoring religious celebrations.

4. Two other classes of land are found in the Benghazi area: matruk (abandoned) and mawat (waste land). The first is developed for the public interest; the latter are waste lands that have not been cultivated before. Both classes have limited value for agricultural uses.¹⁴

There were four land registration acts passed by the Libyan government in the last three decades to regulate land ownership in the country. However, the problem of determining the land-tenure system is still far from being resolved. This stems from the fact that farmers did not follow what the government told them to do. In the last ten years, the government has concentrated on high-cost planned agricultural projects; little attention has been paid to the

¹⁴For more details on land-tenure systems, see Fouzi Eid Sahawneh, "Irrigation and Irrigated Agriculture in Jordan: An Economic Geographic Appraisal" (Ph.D. dissertation, Michigan State University, 1970).

private farms, which, as we will see, depend on unorganized, irregular assistance from the government.

The land-tenure systems, which will be analyzed in terms of their effects on agricultural land use, are those systems defined by the field survey and personal observation as well as by the Land Registration Act of 1970. These systems are as follows:

a. Wada Yad (squatter's rights). In this system, the farmer usually does not initially own the land, but because he uses it for a long period of time (at least ten years), he owns it by squatter's rights.

b. Merath (inheritance). In this case, the farmer inherits a farm from his father, brother, or other relatives.

c. Shera (purchase). The farm in this category is paid for.

d. Musharaka (sharecropping). In this system, the owner usually furnishes the agricultural inputs and the sharecropper is responsible for labor. The annual net return is divided between the two according to an agreement.

e. Ijar (rent). In this category, the farmer rents use of the farm from the owner on a monthly or yearly basis. An agreement is signed between the owner and the tenant to specify the rental period, the amount of payment, and whether the rent is paid on a monthly or yearly basis.

The Economic Base

There are a number of economic indicators that define present economic activities in the Benghazi area. An understanding of the

roles of income and employment and their effects on the pattern of agricultural production is basic to a meaningful interpretation of areal differences and relationships in land use.

It is true that most of the population in the Benghazi area, including the city of Benghazi, depends directly or indirectly on agriculture for their living. However, for many farmers, the farm is more a symbolic rather than a real source of income; other sources of income are necessary. Of the 250 farmers surveyed in 1980, 99 (40 percent) had off-farm jobs: 14 percent were school teachers in villages or towns near to their farms; 70 percent were government employees; and 16 percent were private-enterprise workers. Thus, there are two sources of income for most of the farmers in the Benghazi area: farm income and off-farm income.

Farm Income

Because farmers need much of their produce for home consumption, they do not sell all of their agricultural products in the market. In some cases, farmers save some of the crops as seed for the next year's cultivation season or as a hedge against drought years. This usually occurs in the dry-farming system in the southeastern part of the Benghazi area, for example in the districts of Suluq, Annawwagia, Gaminis, and Swani Tika, where cereal cultivation predominates. It has been found that the most important source of farm income comes from vegetables, especially for those farms located close to Benghazi City or near an access road into the market.

The 250 farmers surveyed in the Benghazi area were asked to give an approximation of the annual income value of what they derived from their farms. It was found that 73 of them (32 percent) earned less than \$5000 per year and only 52 farmers (23 percent) earned more than \$15,000 per year (see Table 2.4). (In 1980 the value of 1 Libyan dinar = 3.29 U.S. dollars.) Although these figures are probably not very accurate, they give an idea of the farm-income variations in the Benghazi area.

Table 2.4.--Distribution of farm income in the Benghazi area, 1980.

Farm Income in Dollars	Number of Farms	Percentage
Less than \$5,000	73	32%
\$5,000-\$10,000	70	30%
\$10,001-\$15,000	35	15%
More than \$15,000	52	23%

Off-Farm Income

Since farm income represents only a symbolic rather than a real source of income for many farmers in the Benghazi area, income from off-farm jobs becomes an important part of the net income of the farmer. In many cases a farmer can also get assistance from members of his family who work in off-farm jobs such as government agencies or the army. Almost half of the farmers surveyed reported a farm income insufficient to support their families, and 75 percent

of them received support from off-farm jobs or from members of their families.

There are two other major sources of off-farm assistance: credits (interest-free) from the National Agricultural Bank of Libya (established in 1957) and loans from private creditors (mostly from friends and relatives). Between 1957 and 1965, the National Agricultural Bank of Libya, because of its limited capital, granted only short- and medium-term loans for the purchase of engine pumps, tractors, and other farm inputs. After 1965 it started granting long-term loans for the improvement and establishment of new farms.¹⁵ Unfortunately, many farmers spent their loans on private and/or nonagricultural purposes, such as building homes for rent, buying cars, and even financing the marriages of their sons or remarrying themselves.¹⁶ Consequently, the bank reduced the number of farmers who could benefit from the interest-free loans and increased the subsidization of agricultural inputs such as machinery, fertilizers, and seeds.

Generally speaking, the per capita income in the Benghazi area is 24 percent higher than the national average,¹⁷ a fact that is partially correlated with the high educational population and with

¹⁵David Lalenic, Agriculture in Libya and a Plan for Its Development (Tripoli: Government Press, 1967), p. 112.

¹⁶Hajjaji, p. 305.

¹⁷Libyan Arab Republic, Ministry of Planning and Scientific Research, Settlement Pattern Study, Benghazi Region, 1976, p. 56.

a relatively high proportion of foreign population.¹⁸ The area also has received a relatively high proportion of investments in the past, indicating the priority given to its development by policy makers. However, a rapid development of services has not been able to keep pace with recent population increases.

After the discovery of oil, a large migration of young farmers moved from their farms in the rural areas to urban centers such as Benghazi City. These centers provided nonfarm employment opportunities in various types of construction and development projects for the oil companies as well as various positions in government departments. Consequently, farming was left to the older people, women, and children.

This situation led to stagnation in the agricultural sector, especially during the 1960s and the early 1970s. Thus, the Libyan government adopted a program to develop the agricultural sector by increasing expenditures, by encouraging foreign laborers to migrate and work in the agricultural fields, and by engineering a number of planned agricultural projects.

Related Literature

Literature Concerning Libya in General

Several studies of the general conditions of agricultural land use in Libya provided essential background information and valuable insights into the problems of the agricultural sector.

¹⁸According to Doxiadis, in 1978, 17.3 percent of the population in the Benghazi area were foreigners.

Undoubtedly, the most important of these was a report issued in June 1976 by the Secretariat of Planning.¹⁹ This report condensed the results of more than three years' work by an interdisciplinary team from Italconsult, an Italian consultant company. This study was begun in 1973 to obtain more factual documentation on the living conditions of those segments of the national population who live in isolated villages and oases scattered over the vast Libyan desert or who roam the uninhabited steppe land. In addition to an account of the present situation of these people, the government wanted clear guidelines about how to spread the benefits of the new national prosperity to these marginal populations and also policy suggestions about how to make these people into active participants in the national development process. Another reason for the study was the increasing awareness by the Secretariat of Planning of the importance of spatial dimensions in the development process and of the need for achieving greater urban-rural balance and interregional equity. Although the report yielded a great deal of information and statistics, it has been criticized by agricultural planners of the Secretariat of Planning for its unreliable analysis and poor organization.

A number of articles have appeared in both geographic and nongeographic journals during the last three decades that shed additional light on agricultural problems in Libya, in general, and in the Benghazi area in particular. Allan and McLachlan emphasized the

¹⁹Libyan Arab Republic, Ministry of Planning, Settlement Patterns Study: Libya (Rome: Italconsult, 1976).

Libyan government's role in agricultural development.²⁰ They gave an historical account of the discovery of oil and its impact on diversification of the economy, including the agricultural sector. Monetary allocations to agriculture in the First Five-Year Plan (1963-68), as Allan and McLachlan reported, were substantial, amounting to 17 percent of the country's development budget. But monetary allocations in the Second Five-Year Plan (1969-74) to the agricultural sector amounted to only 13.1 percent. This reduction in expenditure was a result of severe overuse of groundwater resources in the country. Groundwater levels were declining at over one meter per year in some areas, particularly in the coastal plain.

After the 1969 revolution, a group of executive administrators came to power with perceptions of what was possible in various sectors of the Libyan economy that were very different from those that had guided decisions of the authorities in the prerevolution years of rising oil revenues. One major accomplishment was the allocation of 25 percent of the budget to the agricultural sector, an allocation almost double that of the First Five-Year Plan.

Lawless was concerned with new agricultural projects in Libya.²¹ He discussed the social, cultural, and environmental problems that faced these projects.

²⁰J. Allan and K. S. McLachlan, "Agricultural Development in Libya After Oil," African Affairs (July 1976): 331-49.

²¹R. I. Lawless, "New Agricultural Projects in the Libyan Arab Republic" (paper presented at the First Geographic Conference on the Geography of Libya, Benghazi, March 15-17, 1975).

In another study, agricultural production and its value in the whole country was analyzed in an economic survey of the Libyan economy in 1971-72 and was issued as a supplement to The Arab Economist.²²

Three well-known general studies of agricultural development in Libya are worthy of mention. The report of the Ministry of Planning, Agriculture in Libya and a Plan for Its Development, was based on the stated objectives of three agricultural experts. It consisted of three parts: an analysis of the existing human and natural possibilities of Libyan agriculture, a comprehensive program for agricultural development, and recommendations to policy makers for planned measures of agricultural development.²³ Although most of the statistics and information in this work are outdated, the description of the agricultural situation in Libya is still valid.

Libya: Agricultural and Economic Development by Allan, McLachlan, and Penrose was the result of the London-Libyan Universities Joint Research Project.²⁴ Economic and geographic considerations were foremost in the analysis of changes in land use. The volume concluded with 22 computer maps based on a questionnaire survey taken throughout the settled area of western Libya.

²²"Libya: The Three-Year Agricultural and Development Plan 1972/73-1974/75," The Arab Economist (Beirut) 59 (December 1973).

²³Libyan Arab Republic, Ministry of Planning and Development, Agriculture in Libya and a Plan for Its Development (Tripoli: Government Printing Press, 1966).

²⁴J. A. Allan, K. S. McLachlan, and E. T. Penrose, Libya: Agricultural and Economic Development (London: Cass, 1973).

Johnson dealt primarily with contemporary pastoral ecology, both in its traditional context and in the changes experienced in this century.²⁵ Johnson also investigated the use of ecological insights to illuminate an area's settlement history. The relationship of agrarian and pastoral modes of livelihood in eastern Cyrenaica, a term used to refer to northeastern Libya, was also discussed. The study was more historical than geographic, giving a great deal of information about the region's past.

Literature Concerning the Benghazi Area

In general, research concerning agricultural land use in Libya refers to the Benghazi area only briefly. However, there are a few significant works that concentrate on the area. Hajjaji's study of the Benghazi Plain was the most comprehensive study of the Benghazi area.²⁶ The plain covers an area extending from al-Dersia in northeast Benghazi to Sidi Abdul Ati, south of the city, a distance of about 240 kilometers, varying in width from about 200 meters to about 50 kilometers. Although Hajjaji's study was not scientific in its approach, it provided much information about the area on such topics as land-use patterns, the land-tenure system, and dry- and irrigated-farm crops.

²⁵Douglas Johnson, Jabal al-Akhdar, Cyrenaica: An Historical Geography of Settlement and Livelihood. Research paper 148 (Chicago: University of Chicago Press, 1973).

²⁶Hajjaji.

In 1977, a study was conducted by a group of engineers from Italy.²⁷ They found that the shortage of water is the basic limiting factor for agricultural development not only in the Benghazi area but throughout Libya. Only 5 percent of the country receives more than 100 mm of rainfall, an amount considered to be the absolute minimum for marginal dry farming. Thus, after the 1969 revolution, the General Water Authority was established with branches in Tripoli and Benghazi. The Ministry of Dams and Water Resources was also established. The objective of these agencies was to facilitate searches for new underground water resources for agricultural development.

The purpose of the Lotti study was to carry out investigations to (1) define hydrogeological conditions and to assess the groundwater potential of the Benghazi area, (2) define additional groundwater resources that could be exploited for agricultural development of the area under consideration, (3) to find drilling locations for establishing a network of exploitation wells, and (4) provide blueprints for well construction. The study yielded a multivolume technical report with geological and hydrological maps for an area of 1900 km² located north of Benghazi City. The report evaluated groundwater resources, the recharge of groundwater flow, the discharge of the aquifers, and also recommended limited agricultural development in the Benghazi Plain.

²⁷ Lotti and Associati, Consulting Engineers, in collaboration with Hydrogeo of Pisa, Investigation for Water Resources Development in the Area Between Sidi Khalifa and Tolmetha in the Project of Benghazi Plain (Rome: Lotti, 1977).

During the period of 1957-58, Dogel and Maguire investigated the water resources of an area of approximately 300 km² that lies on the coastal plain east and south of Benghazi city.²⁸ This work was done under the direction of the United States Army Corps of Engineers. The study indicated that water in sufficient quantities for additional public supplies could probably be produced from wells in some areas, but since the water is moderately to highly mineralized, it would require desalination treatment. Much of the available water could be used directly for irrigation, but careful attention would have to be given to cultivation, drainage, and cropping practices.

Between 1959 and 1961, Newport and Haddor investigated the groundwater resources of an area extending northeast from Benghazi to al-Marj.²⁹ Their research included reconnaissance hydrogeological studies and the drilling of 21 exploratory wells. They reached conclusions that were nearly the same as those of Dogel and Maguire.

Geozavod carried out a groundwater field-research project in a 800 km² portion of the Benghazi area.³⁰ The study included hydrogeological mappings, water-quality determinations, geophysical surveys, exploratory drilling, and test pumpings.

²⁸W. W. Dogel and F. J. Maguire, "Groundwater Resources of Benghazi Area, Cyrenaica, United Kingdom of Libya" (unpublished paper, United States Geological Survey, Benghazi, 1964).

²⁹T. G. Newport and Y. Haddor, "Ground Water Exploration in al-Marj Area, Cyrenaica, United Kingdom of Libya" (unpublished paper, United States Geological Survey, Benghazi, 1963).

³⁰Geozavod, "Investigations on Groundwater Tapping Possibilities in the Localities of al-Fuwayhat, Sidi Mansur and al-Kuwaifia Caves" (Belgrade: 1966-68).

A French company, the Groupment d'Etude Français EL-Libye, studied almost all of the Benghazi Plain during a survey of water resources in the northern flank of the Jabal al-Akhdar.³¹ The study was of a reconnaissance nature since the company covered a large area in a relatively short time.

Finally, since the study of agricultural land use is part of the general study of agricultural development, the most widely known text is by Mellor.³² Despite the fact that this research focuses on specific issues, Mellor's work could be of benefit to land-use-distribution studies.

Conclusion

To conclude, the physical features of the Benghazi area appear less heterogeneous than expected. The area is mostly a plain; there are no high mountains. Variations in precipitation are limited since the area is located between 150 mm isohyets in the south and 300 mm isohyets in the north and since most of the rainfall occurs during the winter months. Although soil types vary in the Benghazi area, terra rossa or red soil predominates, especially in the cultivated areas.

The review of cultural characteristics in the Benghazi area indicated that the population structure and land-tenure systems are the most important cultural traits to be analyzed in relation to

³¹Groupment d'Etude Français EL-Libye, Soil and Water Resources Survey for Hydro-Agricultural Development, Eastern Zone, Libya. Water Resources Survey, Vol. II (France: GEFLI, 1972).

³²John W. Mellor, The Economics of Agricultural Development (New York: Cornell University Press, 1974).

agricultural land use. Although the region has different economic resources, agriculture is the income base for most of the Benghazi people.

Unfortunately, literature related to agricultural land use in Libya in general or to the Benghazi area in particular was limited. Most of the studies were either descriptive or reports from consulting companies. It is the purpose of this study to provide specific research on the role of selected cultural factors in relation to agricultural land uses in the Benghazi area.

CHAPTER III

THE DESIGN OF THE STUDY

In this chapter the research design is presented in relation to some previously developed agricultural land-use theories. Also, methods employed in selecting samples, research assistants, and pilot work carried out before the field survey was conducted are discussed. The analysis procedures and statistical methods are also presented. At the conclusion of the chapter, certain factors that complicated the field work are briefly mentioned.

Theoretical Considerations

Geography is a distinct discipline in the sense that its primary concern is spatial patterns or the relationships of physical and cultural factors in earth space. Since the earliest geographic research, spatial variation has been the unifying theme. Griffin pointed out, however, that geographers have shared this concern for spatial variations with others.¹ During the nineteenth century, for example, economists became involved in analyzing the relationship between geographic locations and land-use patterns to determine which factors affected such economic characteristics as the intensity of land use, competition between land uses, and the

¹Ernst C. Griffin, "Agricultural Land Use in Uruguay" (Ph.D. dissertation, Michigan State University, 1972), p. 17.

locations of enterprises. Many agricultural land-use theories developed from these early studies.² A discussion of some of these theories follows.

The Land-Use Model of von Thunen

Today, most geographers work with several theories. Agricultural geographers, for example, try to explain the location of distinctive agricultural types with an agricultural-location model formulated by Johann Heinrich von Thunen, a nineteenth-century German agricultural economist. Von Thunen (1783-1850) is credited with formulating the first theory of location in modern science. He was a pioneer in the theoretical analysis of relationships between agricultural land use and geographic location.³

In simplified terms, von Thunen, in his book Isolated State (1826), envisioned one central city, the market, and around it a plain of tillable land, uniform in its physical characteristics, served by only one mode of transportation, and inhabited by farmers. These farmers supplied the central city and had no difficulty in adjusting the use of their resources to any economic conditions that might evolve.

In Isolated State, von Thunen explained the relationships among (1) the distance of farms from the market, (2) prices received by farmers for their products, and (3) land rent. The relationship between the first two was very simple. The price that a farmer

²Raleigh Barlowe, Land Resource Economics (Englewood Cliffs, N.J.: Prentice-Hall, 1958), pp. 32-33.

³Griffin, p. 18.

received for a given unit of commodity, von Thunen argued, was equal to its market price minus the cost of shipping it to the market. This cost of transportation increased with the distance from the market. The third factor, land rent, was defined as the return from investment in the land. This rent decreased for any given crop as the distance from the market increased because of the increased cost of transportation (see Figure 3.1). The formula given below indicates how land rent for any one product can be derived:

$$R = YP - E - Yfk$$

in which:

R = land rent per acre

E = production expenses per acre

Y = yield in units of commodity per acre

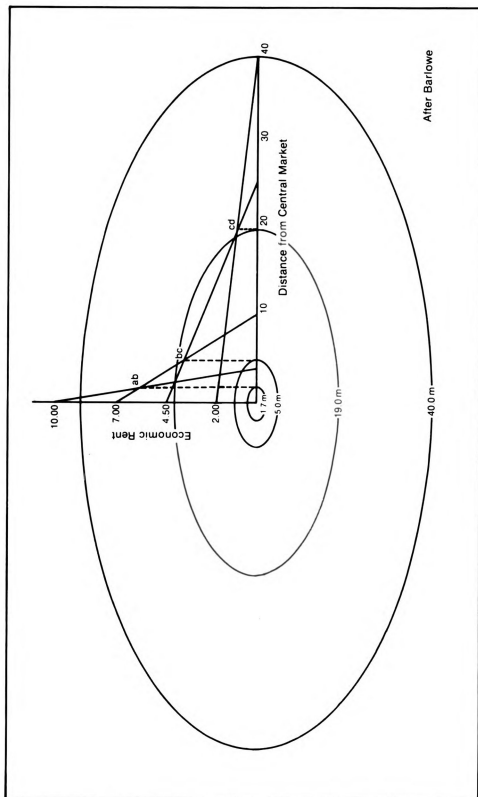
P = market price per unit of commodity

f = freight rate (the cost of shipping a unit of commodity over the distance of one mile)

K = number of miles from the market

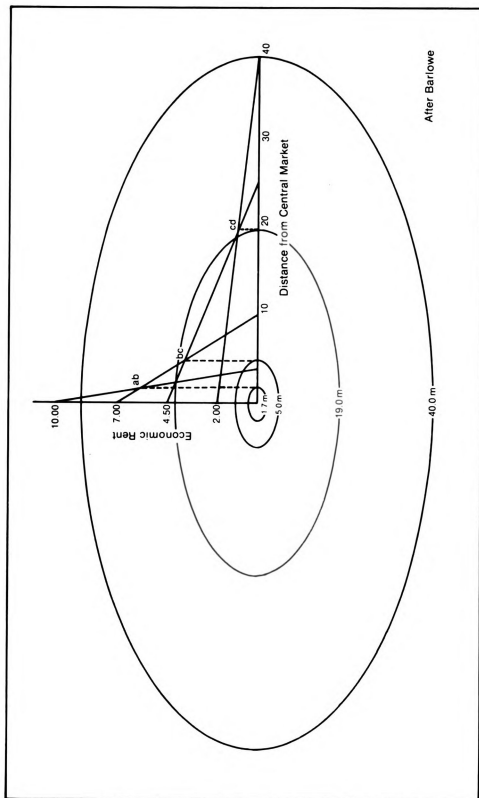
In Isolated State, von Thunen hypothesized that land use and agricultural production were the result of three forces: (1) the types and quantities of agricultural products needed in the central market, (2) the technology employed in the production and transportation of such commodities, and (3) the endeavor of each farmer to maximize his land rent by producing commodities for which the location of his land relative to the market offered the greatest advantage.⁴

⁴Andreas Grotewold, "Von Thunen in Retrospect," Economic Geography 48 (1962): 349.



Land Rent and Concentric Rings Derivation

Figure 3.1



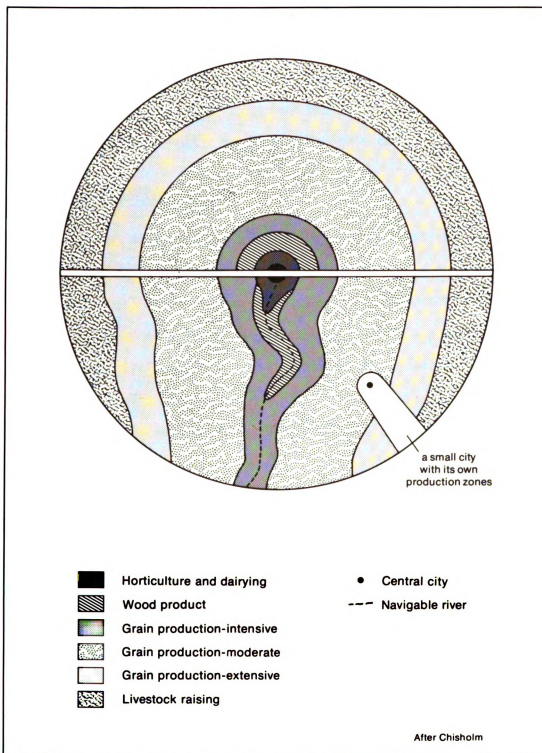
Land Rent and Concentric Rings Derivation

Figure 3.1

Naturally, von Thunen assumed that the conditions of his time would be valid for all times and situations. During von Thunen's time, the only means of transportation was the horse and wagon. Multiple freight rates depending on the commodities shipped did not exist. Refrigeration in transit had not yet been invented. Under such conditions, the land nearest the market produced milk, vegetables, and commodities that had high economic rents and were expensive to transport because of their perishability. Next, there was a zone devoted to wood products, which were bulky and expensive to haul to the market. Beyond this area, there were rings of land given over to grain production. The outermost areas were zones of grassland used for grazing and highly transportable industrial crops⁵ (see Figure 3.2). Von Thunen discovered and examined the laws that governed patterns of agricultural land use in his time. He recognized that land-use patterns depended on competition among the various types of agricultural land use possible for a particular piece of land.

Although the present research is not an application of von Thunen's theory, it is interesting to note certain basic parallels. In the Benghazi area, there is a central market, Benghazi, a surrounding plain, and, as mentioned before, relatively homogeneous physical and cultural features. In this study, a pattern of agricultural land use similar to the pattern in von Thunen's model is apparent. However, the factors affecting these patterns are different from those in von Thunen's model. In this research, emphasis is given to

⁵William Norton, "Land Use Theory and the Pioneering Economy," Geografiska Annaler 56-B (1975): 44.



Variations in Zonal Patterns in the
Land-Use Model of von Thunen

Figure 3.2

cultural factors such as distance from the market, the land-tenure system, government agricultural policies, and farmers' characteristics, whereas transportation cost was the only factor affecting agricultural land-use patterns in von Thunen's model.

Agricultural Patterns Developed by Robert Sinclair

Another method of describing agricultural land use was developed by Robert Sinclair. Although this theory was developed through empirical observations in the United States, these patterns may also be found in agricultural land use in the Benghazi area. In Sinclair's model, the effect of urban encroachment on investment of labor and capital in land is shown. In his article, "Von Thunen and Urban Sprawl," Sinclair distinguished his model from von Thunen's in this way:

Land near urban areas is subject to an air of anticipation of urban encroachment. The degree of this anticipation has a direct influence upon agricultural land use practices, particularly upon the intensity of agriculture. For, obviously, the greater the chances of urban land uses taking over, the less practical it becomes for the owner to invest highly in capital and labor for agricultural purposes. The degree of anticipation declines with distance from the encroaching city. Hence, distance from the city again becomes the factor which determines the agricultural land use pattern. However, whereas in von Thunen's Isolated State distance was meaningful in terms of transportation costs to the market, it is here meaningful in terms of anticipation of urban encroachment.⁶

The effect of distance from the city is expressed in the following simple relationship: as the urbanized area is approached from

⁶Robert Sinclair, "Von Thunen and Urban Sprawl," Annals of the Association of American Geographers 57 (March 1967): 78.

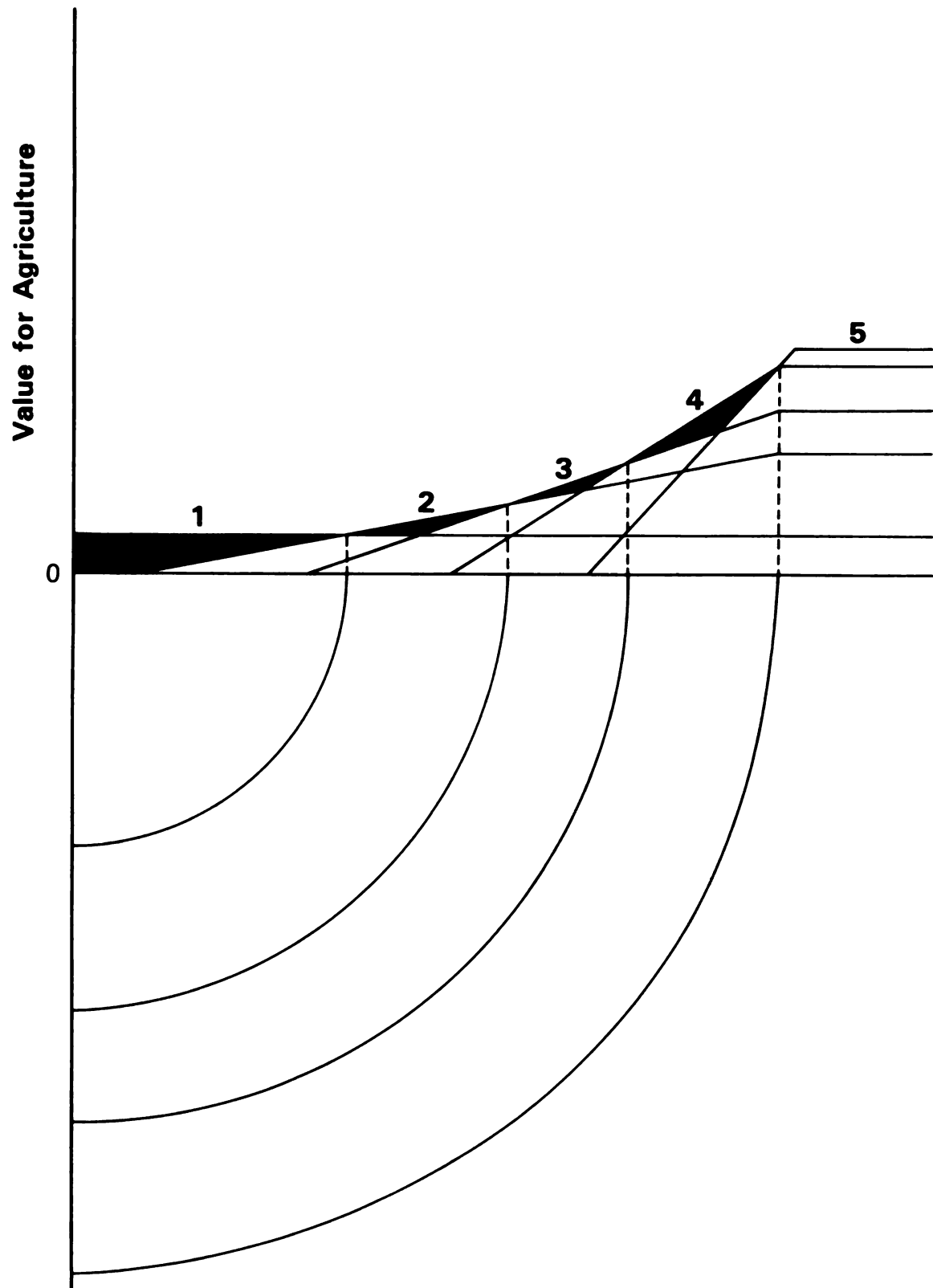
a distance, the degree of anticipation of urbanization increases and the relative value of the land for agricultural use decreases. Consequently, the intensity of use of agricultural land decreases. The result of this process is the development of a basic agricultural land-use pattern that is the opposite of von Thunen's (see Figure 3.3).

Patterns of Agricultural Land Use Developed by Ester Boserup

As noted above, von Thunen used the cost of transportation of agricultural products to the central market as an indicator of the intensity of agricultural land use, whereas Sinclair's indicator was the anticipation of urban encroachment. For Boserup, population growth was the major factor determining agricultural land use around the urban areas.⁷ She classified the agricultural land-use system based on intensity as follows: (1) forest-fallow cultivation, (2) bush-fallow cultivation, (3) short-time-fallow cultivation, (4) annual cropping, and (5) multicropping.

Boserup noted that, with increasing population pressures, there has been a shift from more extensive to more intensive systems of land use, particularly in underdeveloped regions. In some parts of the world, cultivators in the forest-fallow system have been unable to find sufficient secondary forest. They have had to recultivate

⁷Ester Boserup, The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure (London: George Allen and Unwin, 1965), pp. 15-16.



Variations in Zonal Patterns in the Land-Use Model of Sinclair
Figure 3.3

areas not yet bearing fully grown forest. Thus the forest has receded and been replaced by bush. Again, in bush-fallow areas, the cultivators have changed to short-time-fallow systems or annual cropping with or without irrigation. In densely populated regions, there has been a rapid spread of multicropping.⁸

Many economists criticized Boserup's theory because it did not take into consideration the income of the population or the elasticity of land in many portions of the world. Population growth in some regions may not affect agriculture without also changing per capita income.

Boserup's position was that subsistence agricultural communities are dynamic and subject to continual changes in agricultural technology because of population pressure. In Libya in general and in the Benghazi area in particular, the population in the urban areas and per capita income have increased dramatically. But it is not clear how these increases in population and income affect agricultural land use around the urban areas.

Other Approaches to the Land-Use Problem

Writers on agricultural land use have cited many empirical applications of classic and modern theories for determining agricultural patterns and farm practices. In 1969, Richard Peet proposed a

⁸Ibid., p. 17.

type of agricultural system similar to the von Thunen system that appeared in Britain, Western Europe, and northeastern North America in the nineteenth century. Peet described a central market area surrounded by a series of large concentric agricultural zones. However, he linked the boundaries of these zones to growth in food demand and raw materials in the market rather than to land rent and transportation costs, as von Thunen's model had hypothesized. Peet explained the outward expansion of these zones as follows:

A rise in demand for any crop, or group of crops, will lead in the short run to a rise in price. This will have two main effects on supply: (1) it will be profitable to intensify production within the zones already raising the crop; (2) both higher prices and the resulting intensification raise the rent yielded by the crop, and this creates pressure for zonal expansion. The contiguous zones resist such expansion and contraction in their supplies through prices and rent rises. Eventually, a new equilibrium is reached in which the zone producing the newly-in-favor crop is usually wider and the total agland larger.⁹

Horvath found locational patterns similar to von Thunen's in present-day Ethiopia. These patterns center on the principal urban market of Addis Ababa.¹⁰ Similar distance-crop relationships have been noted in Japan, where fresh vegetables and fruits needed in the Tokyo market are drawn from areas close at hand.¹¹ Chisholm cited

⁹J. Richard Peet, "The Spatial Expansion of Commercial Agriculture in the Nineteenth Century: A von Thunen Interpretation," Economic Geography 45 (March 1969): 288.

¹⁰Ronald J. Horvath, "Around Addis Ababa: A Geographical Study of the Impact of a City on Its Surroundings" (Ph.D. dissertation, University of California, Los Angeles, 1966), Chapters 3 and 5.

¹¹John D. Eyre, "Sources of Tokyo's Fresh Food Supply," Geographical Review 49 (October 1959): 455.

many cases of adjustment of land use to distance in the Netherlands, Finland, Italy, and Spain.¹²

In his analysis of the relationship between distance and size of the farm, Edgar Dunn observed that farms closer to the market are smaller than those farther away. Dunn's theory was based on classical theories of agricultural land use wherein farms closer to the market are intensively cultivated and those farther away are extensively cropped.¹³

Despite the fact that no theory will be tested in this research, the spatial concept of the agricultural land use in the Benghazi area will be determined. Also, comparison between the actual land-use pattern of the area and the agricultural land-use model of von Thunen will be thoroughly explained.

Methodology

The research for this study was divided into three phases: (1) background research, (2) the field survey during which interview schedules were conducted with 6 percent of the 4,150 farmers who live in the Benghazi area,¹⁴ and (3) analyses of the data. Most of the background research was completed in the summer of 1979. During

¹²Michael Chisholm, Rural Settlement and Land Use (London: Hutchinson University Press, 1962), p. 50.

¹³Edgar Dunn, The Location of Agricultural Production (Gainesville: University of Florida Press, 1954), p. 45.

¹⁴According to Margaret Peil (1972), the primary difference between questionnaires and interview schedules is that questionnaires are self-administered, whereas interview schedules are administered by an interviewer who asks the questions and writes down the answers.

this period, an attempt was made to collect, read, and evaluate as much of the English and Arabic literature as possible concerning not only the area of the study but also relevant literature of all kinds. A number of individuals in institutions such as the University of Gar Yunis at Benghazi, the Benghazi Plain Agricultural Project Headquarter at al-Marj, the al-Gawarisha Settlement Project, the General Water Authority (Benghazi branch), the Secretariat of Planning, and the Secretariat of Agrarian Reform and Land Development supplied useful information and valuable suggestions. The researcher had no difficulty making contact with officials in the study area because he had lived in this region and had known these officials before conducting the research. The background materials obtained in this period were revised and classified, and additional materials were gathered from the Michigan State University and University of Michigan libraries. It is not surprising, however, that few materials dealing directly with the Benghazi area and considerably fewer referring to agricultural land use and its problems were found.

The actual field survey lasted approximately four months, commencing on June 26, 1980, and terminating on October 28, 1980. The research effort, as mentioned later in this section, was greatly facilitated by the Faculty of Education at the University of Gar Yunis at Beida and by the Secretariats of Planning and Agrarian Reform and Land Development at Benghazi. During this period, the interview schedules prepared for this study were carefully translated into the local Arabic dialect (see Appendix), and the total farm population in the study area was determined.

The method used to determine the total farm population in the Benghazi area was to list the farmers by their names and the locations (mahallat) of their farms as shown in the records available in the Secretariat of Agrarian Reform and Land Development, Benghazi branch.¹⁵ Then these lists were cross-checked with the 1974 agricultural census and with records of the agricultural cooperatives in each administrative unit.¹⁶

The field study was primarily concerned with private farms in which variations in acreage and crop patterns can be identified and analyzed. Thus, public farms or farms resulting from agricultural projects, such as those distributed by the Wadi al-Qattara Agricultural Project, the Benghazi Plain Agricultural Project, and the al-Qawarisha Land Settlement Project, were eliminated from the study. These government or agricultural-project farms are identical in size, and allowable crops are specified by the government. Therefore, the importance of these farms in this study was limited. Farms located within the Benghazi city limits were also left out of the

¹⁵In 1974, the Secretariat of Agrarian Reform and Land Development adopted a new system of register farmers and their farms--Hasr al-Hiazat Azzera'Aih (Determination of the Agricultural Lands). According to this system, each farmer reports to the secretariat his agricultural land and animals. In return, the secretariat opens a file with complete information about his farm and also issues a book containing this information called Kutaib al-Hiaza Azzera'Aih (Book of Agricultural Lands). Any change in the farmer's agricultural land or animals is reported to the secretariat immediately.

¹⁶Each administrative unit in the study area has its own agricultural cooperative. It is also a unit of distribution for seeds, fertilizer, and pesticides. Thus, each farmer should sign his name and indicate the number of animals and amount of his agricultural land to his cooperative.

study because they are few in number and have little relation to agricultural patterns in the study area.

Methods of Selecting the Sample

With limited time and facilities at the writer's disposal, it would have been difficult to interview all the farmers in the Benghazi area. Therefore, sample methods were used for selecting the number of farmers to be interviewed.

Berry and Baker pointed out that if the spatial distribution of any phenomenon being studied is random, any of four probability sampling methods--random, systematic, stratified, or a combination of any two--will give unbiased estimates with approximately equal variations.¹⁷ Thus, because the farm population in the Benghazi area is randomly distributed, stratified simple random sampling was used. According to Blalock, a stratified sampling method can be used to improve the efficiency of the sampling design. Hence, in a stratified sample, all the individuals are divided into groups or categories, and then independent samples are selected within each group or stratum. In the simplest and most frequently used types of stratified sampling, either a simple random sample or a systematic sample within each stratum is taken.¹⁸

¹⁷J. L. Berry and Allan M. Baker, "Geography Sampling," in Spatial Analysis, ed. B. J. Berry and Duane F. Marble (Englewood Cliffs, N.J.: Prentice-Hall, 1967), pp. 91-100.

¹⁸Hubert M. Blalock, Jr., Social Statistics, 2nd ed. (New York: McGraw-Hill, 1972), p. 516.

The total farm population in the Benghazi area at the time of the survey, according to the records of the Secretariat of Agrarian Reform and Land Development, was 4,150 farmers. This number was divided into 21 groups according to the district (mahalla) in which the farm was located (see Figure 3.4). Then 6 percent of each group was randomly surveyed. Thus a total of 250 farmers was surveyed. Therefore, the number of farmers interviewed in each district was proportional to the total number of farmers living in that district and proportional to the total number of farmers living in the study area (see Table 3.1).

The administrative units shown in Figure 3.4 are not necessarily mahallat; in some cases they are municipality branches, and in other cases they are a combination of mahallat and branches. These units were established basically for the purpose of the sampling and are used throughout the study.

Research Assistants

Although the study area was relatively small and the sample size was manageable, it would have been difficult for the writer to conduct the interviews without assistance. Therefore, field assistants were chosen for interviewing purposes. Assistants were selected based on their previous experience in field surveys, their knowledge of the region, their ability to speak the local Arabic dialect, and their ability to devote substantial amounts of time to the field survey.

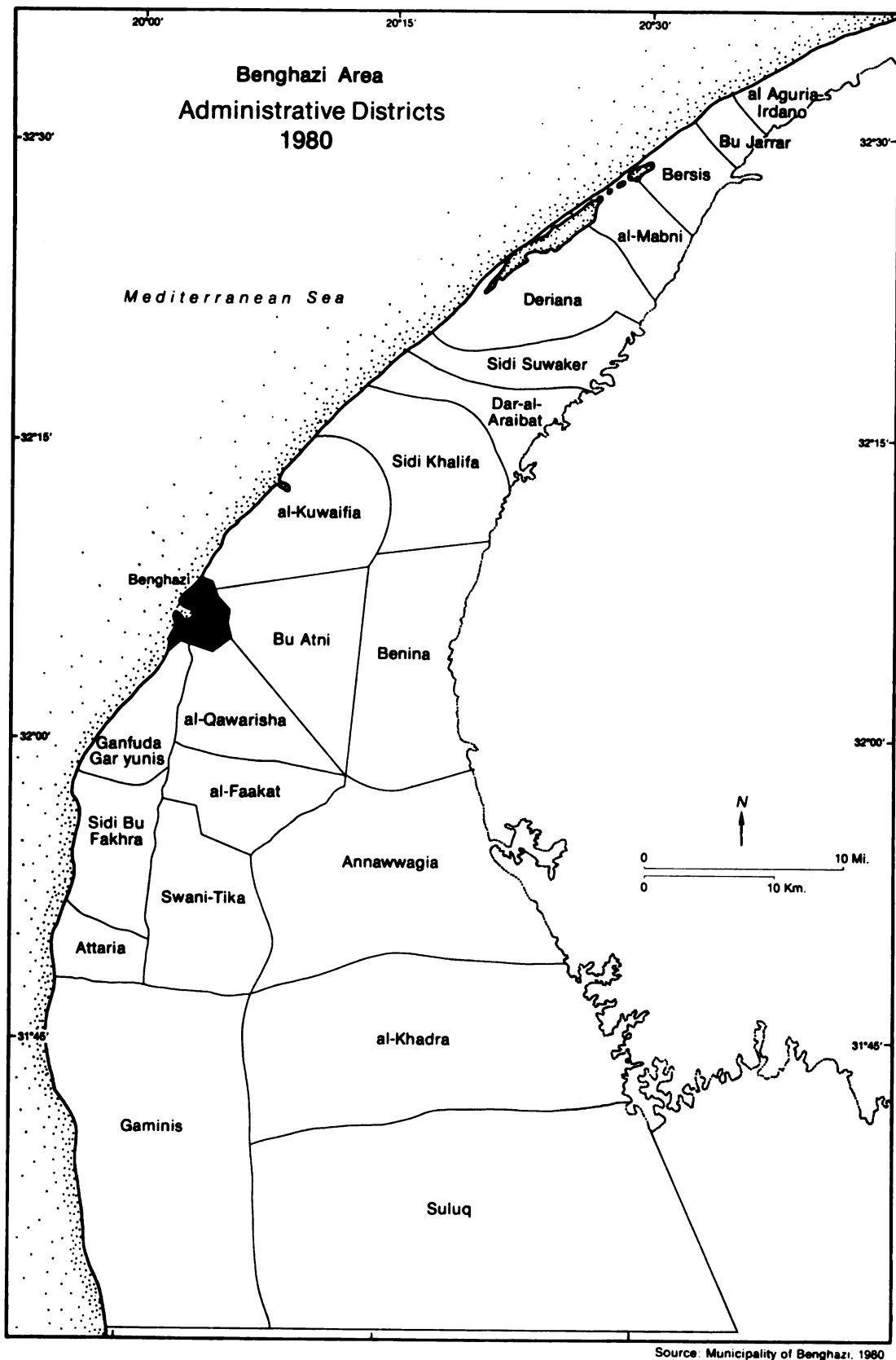


Figure 3.4

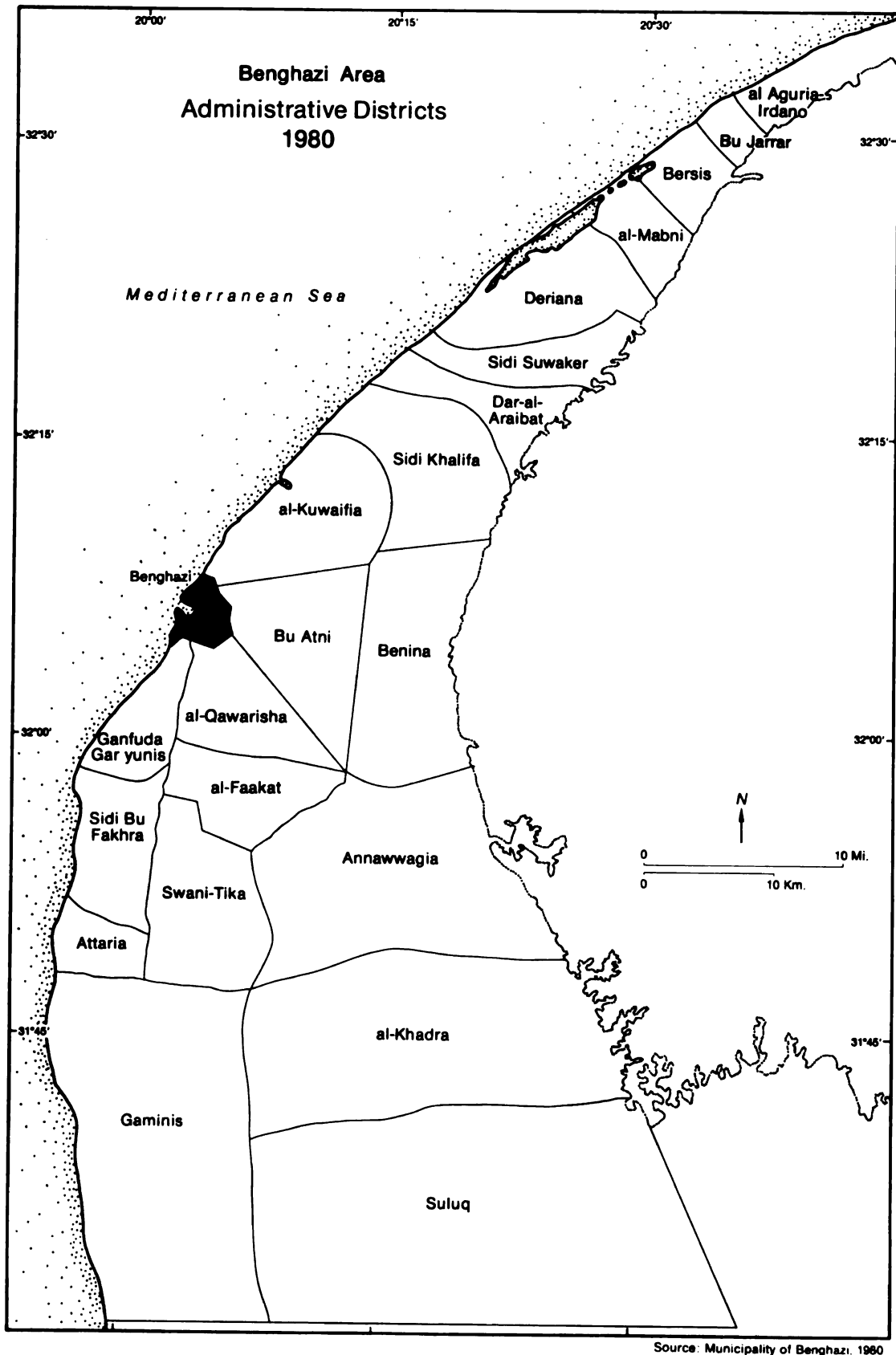


Figure 3.4

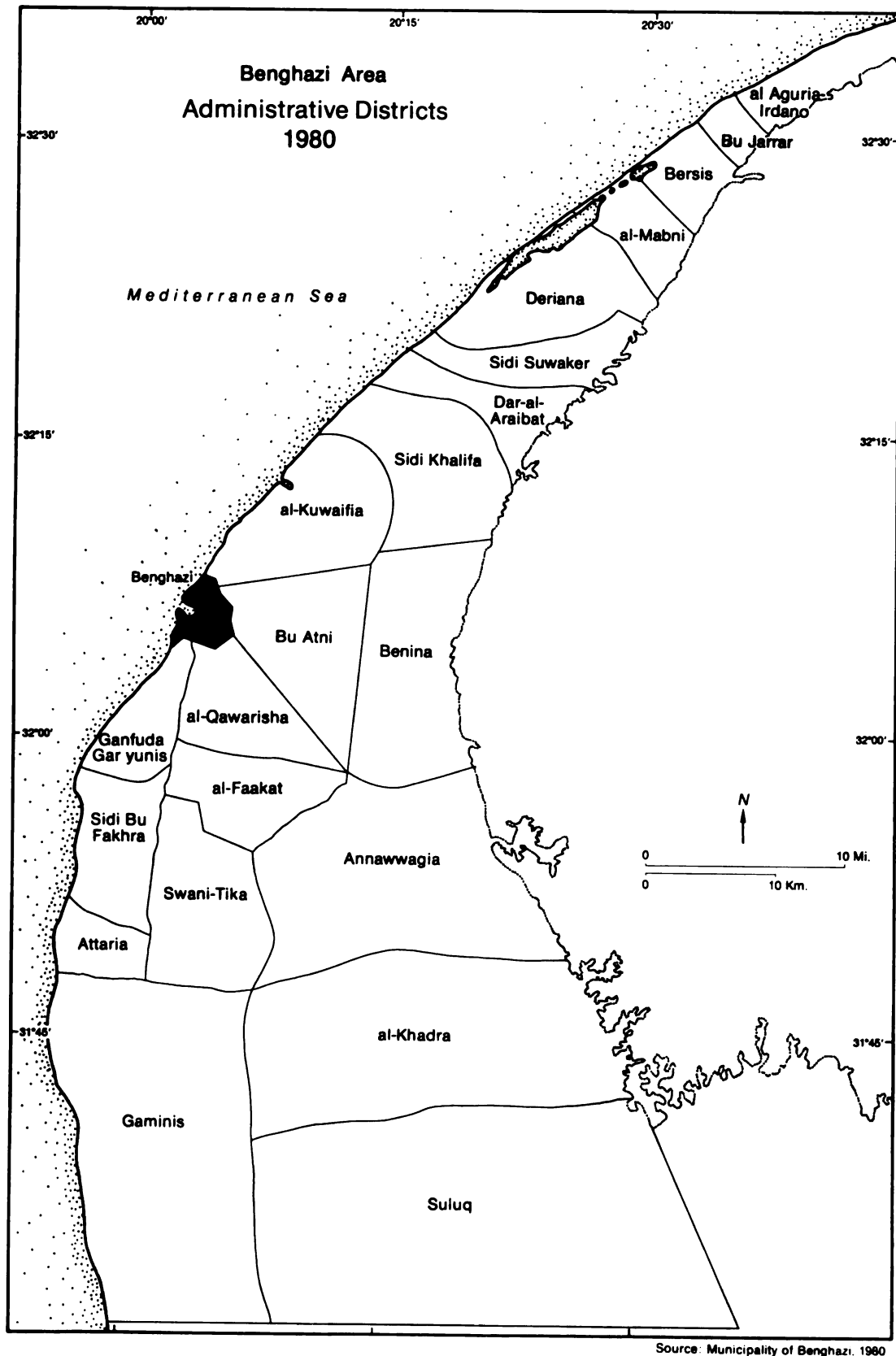


Figure 3.4

Table 3.1.--Farm survey of the Benghazi area: districts, total farms, and number of farms surveyed.

District (Mahalla)	Total Farms	Number of Farms Surveyed
al-Faakat	141	8
al-Kuwaifia	173	11
al-Mabni	123	7
al-Qawarisha	166	10
Annawwagia	331	20
Attaria	138	8
Benina	166	10
Bersis	178	9
Bu Atni	89	5
Bu Jarrar	64	4
Dar al-Araibat	111	7
Deriana	334	20
Ganfuda-Gar Yunis	53	3
al-Khadra	256	16
Gaminis	397	21
Sawani Tika	101	6
Sidi Bu Fakhra	55	4
Sidi Khalifa	207	13
Sidi Suwaker	86	5
Suluq	789	47
al-Aguria-Irdano	192	13
Total	4,150	250

Despite the fact that all the assistants (a high school teacher and four university students) were from the Benghazi area and had experience in conducting field surveys, an intensive one-week interviewer-training program was conducted by the writer at the beginning of the research project. In addition to introducing the interviewers to the principles of interviewing and the methods of sample design, the training period provided time for detailed instructions to be given on how to complete the interview schedules. During the interview period, the writer worked in the field with the assistants. Thus, if problems arose, they were solved in the field and did not interfere significantly with conducting the interview schedules.

Pilot Work

The importance of a careful pilot study or pretest was stressed by some staff members of the Faculty of Education at Beida before the final field survey, for pilot work helps with the design of letters of introduction, the final wording of interviews, the ordering of question sequences, and the reduction of nonresponse rates. Because of time limitations, most of the pilot work was done by the writer. It included a review of the interview schedules, talks with knowledgeable Libyan administrative officials, and study of relevant literature. Then, 35 randomly selected farmers from different locations in the study area were interviewed. Their answers were helpful as a basis for modifying or eliminating many questions in the interview schedules.

The survey team used the offices of the Secretariat of Agrarian Reform and Land Development at Benghazi as headquarters. Letters of introduction were issued from the University of Gar Yunis and the Secretariat of Agrarian Reform and Land Development. The team obtained a large-scale topographic map of the study area from the municipality of Benghazi. The letters of introduction and the map were helpful in the field survey and in administering the interview schedules. Transportation facilities were furnished by the Faculty of Education and the Secretariat of Planning.

Analysis Procedures

Although supervision of the interviews carried out in the field was rigorous, it was necessary to edit the completed interview schedules. The forms were checked and double-checked for completeness and consistency. In about 15 cases, it was necessary to have a follow-up field visit to obtain necessary information or more accurate data. In other cases, replacement of a farmer in the sample was necessary because of a change in his status or because he had migrated to another district outside the study area. The replacement was accomplished by the same random-selection method as used for the original sample.

The editing was carried out in Libya. The construction of coding instructions, which made it possible for all responses to be key-punched on computer cards as numerical values, was done at the Michigan State University Computer Center, East Lansing, Michigan.

Methods of Data Analysis

For initial familiarity with the data, such simple measures as determining means and frequency distribution and cross-tabular survey responses were used. Since the major part of the analysis was based on data taken from tabulation of the answers of the interview schedules, two basic analyses were applied to test the main hypotheses. First, an analysis was performed to determine the actual agricultural land-use patterns of the Benghazi area. Second, an analysis to determine factors that influence these patterns was completed.

Determination of the existing agricultural land-use patterns is an important objective of this research. Its importance stems from the fact that determining the patterns of agriculture in the area was the first step in testing the factors influencing agricultural land use. Thus, special care had to be taken to insure that descriptions of actual land-use patterns reflected the greatest degree of accuracy. Since this research was based on analysis of data tabulated from the interview schedules, the degree of accuracy was measured by the reliability of the sampling design and the method used in completing the interviews. This method, which was described in the foregoing sections, yielded accurate data. Then, the data were broken down to produce a description of subpopulations based on districts. The distribution results were mapped, resulting in a series of crop- and livestock-distribution maps based on acreages or livestock numbers.

Three statistical methods were used in the second portion of the study. Pearson correlation analysis yielded coefficients of correlation to indicate the strength and weakness of pair-wise associations or relationships between the variables. A one-way analysis of variance (ANOVA) was used to test for differences among the means. This kind of test can generally be used to test for a relationship between nominal and interval data.

The chi-square test was also used especially for variables that were nominal and categorized. The chi-square test is a very general test for evaluating whether frequencies that have been empirically obtained differ significantly from those that would be expected under the research hypotheses.

All of the routines were conducted using the Statistical Package for the Social Sciences (SPSS). These statistical techniques are appropriate for small samples, as is the case in this study.

Limitations of the Study

In a less-developed country such as Libya, in which a researcher often has to work with limited and unreliable data, personal observations, questionnaires, and interviews become important devices for research. However, the accuracy of these devices is limited because of political and cultural restraints. Even though the writer has field experience in the Benghazi region, was born and raised in the region, speaks the local Arabic dialect, and is acquainted with the local people and their culture, some unexpected problems did occur. These complications and consequent limitations of the scope of the study are described below.

The farmers of the study area, especially in the districts of Suluq and Annawwagia southeast of Benghazi, are not familiar with research inquiries and are always prone to confuse field surveys with taxation measures, despite the fact that taxation in Libya was abolished in 1963. Because of this confusion, some of the farmers questioned were reluctant to reveal facts about their farms, fearing that such information might be used against their interests.

The lack of paved roads made it difficult to reach farmers whose fields were located off the major coastal highway, the only paved access road in the study area. There are some short roads connecting settlements and towns in the area with Benghazi, such as the road connecting Suluq, Annawwagia, al-Khadra, and al-Hawwari with Benghazi. Most of these roads, however, are either still under construction or are in bad condition. For this reason, the survey team spent hours, sometimes on foot, surveying the distant farms. (The survey team's car twice became stuck for hours in the sand dunes of the Deriana district.)

Two of the new agricultural projects, the Benghazi Plain Agricultural Project and the Southwest Benghazi Project, were designed to modify farm size and the type of crops produced in the area. Although this study concentrated only on private farms, many of these private farms were located in areas allocated for the two above-mentioned projects. Unfortunately, during the field survey there was a rumor that, because of a water shortage in the Benghazi area, the Secretariat of Agrarian Reform and Land Development would limit the size of individual farms in the area allocated for the agricultural

projects. Thus, the survey team found it difficult in some cases to convince farmers that this survey was completely different from inquiries related to the agricultural projects. Farmers were very careful in their responses to some questions, especially those dealing with the size of their farms and the number of their animals. Farmers often gave low estimates of the size of their farms. Some measures, which are discussed below, were incorporated to obtain correct answers.

In the tribal (communal) agricultural lands, especially in al-Khadra, Suluq, part of Annawwagia, and Gaminis, the survey team had difficulty determining the size of dry farms. Many farmers had no clear idea of the size of the land they cultivated, for there are no permanent boundary lines between these lands. Since this land is cultivated only once each year with only wheat or barley, the writer adopted the following technique to estimate the size of these farms. Using the quantity of grain that the farmer cultivated each year and the quantity of grain cultivated on one hectare, the size of the cultivated land was estimated using the following equation:

$$S = \frac{Q_y}{Q_h}$$

in which:

S = the size of the cultivated land

Q_y = total quantity of grain planted each year

Q_h = quantity of grain needed to plant one hectare

This technique was used in some cases, particularly in the Suluq district, in which farmers usually know how much grain is needed to plant one hectare.

The survey was carried out in the late summer and early fall of 1980. Unfortunately, at this time, most of the seasonal farmers had already gathered their crops and left for permanent residences, usually in Benghazi or the nearby towns and villages. Therefore, they were not available for direct interviews in the field, and the survey team spent much time trying to locate farmers at their permanent residences.

Most of the field survey was done during August and September. These two months are the warmest of the year in Libya and are subject to the unusually dry, hot winds from the south, the Gibli. The presence of these climatic factors during the survey period restricted the team's movement.

The amount of time needed to collect necessary data and library materials and to conduct a field survey for this study was estimated in the proposal to be no less than six months. However, the Libyan cultural section of the Libyan People's Bureau in Washington, D.C., allows students in the United States to return to Libya to conduct field studies for only three months. Considering the above limitations, this period of time was not enough to carry out adequately a field survey of this type.

Despite all of these difficulties, the writer followed a plan that minimized their effects on the results of the research. This plan was to visit each district (mahalla) more than once. On the first visit, the survey team was introduced to the local administrative officers and the Secretary of the People's Committee of the district. The team discussed with these officials the scope and nature of the

study, and letters of introduction were presented. During the second visit, the selection of farmers for interviewing was determined by the sampling method discussed previously. The local administrative officer or the Secretary of the People's Committee of the mahalla usually accompanied the survey team. As a security precaution, but in order not to influence the respondent's answer, the officer was not allowed to participate in the interview.

CHAPTER IV

AGRICULTURAL LAND-USE PATTERNS

Although the Benghazi area is relatively small compared to other Libyan agricultural areas, it has several crop zones with distinguishable characteristics. These distinct characteristics are identifiable as agricultural land-use patterns that can be delimited, defined, and analyzed.

In general, the intensity of agricultural land use is measured by the presence of irrigation, type of crops, application of chemical fertilizers, and the level of farm income. Based on these factors, the greatest intensity of agricultural land use is found in districts close to Benghazi City. Farther from the city, the intensity of land use generally decreases. There are two intensive agricultural land-use zones in the Benghazi area in which crop cultivation greatly exceeds livestock in importance. Each is dominated by a distinctive crop combination or agricultural system. The vegetable-and-fruit area supplies the Benghazi market daily with valuable, bulky, perishable truck crops and horticultural produce. To the south and east of the fruit-and-vegetable-growing areas is an area of somewhat less intensive land use that furnishes the Benghazi market with about 60 percent of its wheat and barley needs. To the east and southeast of the grain area is the grazing and animal-husbandry land. Despite

the fact that some grain is grown here, the area can be distinguished by the greater number of animals and the decreasing area per farm allocated to grain cultivation.

Before the existing patterns of agricultural land use in the Benghazi area are discussed in detail, it is important to determine the relative amount of cultivated land and to differentiate between irrigated, semi-irrigated, and dry-farming systems. Most irrigated land is cultivated with vegetables and fruits, whereas dry-farming areas are planted with grain (mainly wheat and barley) or left for grazing animals. The agricultural land use in the study area is also affected by available water, since the government sometimes limits the amount of water available for irrigating or prevents cultivation of specific kinds of vegetables, such as tomatoes, which consume more water. Water availability for irrigation is often taken into consideration in the planned agricultural projects in many parts of the study area.

Size of the Cultivated Land

According to the 1974 agricultural census, more than 233,000 hectares in the Benghazi area were farmed.¹ However, of this cultivated land, only 143,785 hectares were devoted to vegetables and fruits² in small gardens around towns and

¹This number includes land not in the study area.

²Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974 (Tripoli: 1979), p. 34.

villages such as Gaminis, al-Gawarisha, Sidi Khalifa, and Benina. The remaining cultivated land was dry or under a semi-irrigated system (see Table 4.1).

Irrigated Farming

Because of the long, dry summer season, which dominates the Benghazi region, irrigation has become very important, especially in the cultivation of cash crops. Irrigation permits intensive use of land and a wider choice of crops than does the dry-farming system, in which cultivation of wheat and barley occurs in only one crop per year. However, if additional suitable water were available, increased yields on the existing cropland would be possible, and new areas could be brought into cultivation of cash crops with a consequent increase in agricultural production.

Despite the fact that irrigation in the Benghazi area is important, the 1974 agricultural census showed that only 2 percent of all farms in the area were completely irrigated; another 11 percent of the farms were partially irrigated³ (see Table 4.2). The irrigated area, however, increased since the 1974 agricultural census. Of the 250 farms surveyed in the summer of 1980, 66 farms (27 percent) were less than 10 years old, and most of them had areas under irrigation.

More than 60 percent of the farms in the districts of al-Gawarisha, Sidi Khalifa, Bersis, and Bu Atni were under irrigation, whereas fewer than 20 percent of the farms in the districts of Gaminis, Suluq, al-Khadra, Annawwagia, Sidi Suwaker, and al-Aguria were under

³Ibid., p. 16.

Table 4.1.--Size of land allocated for vegetables and fruits in the Benghazi area, 1974.

District or Mahalla	Total Number of Farms	Vegetable Land in Hectares			Fruit Land in Hectares		
		Irrigated	Dry	Total	Irrigated	Dry	Total
al-Aguria ^a	236	1,208	34,651	35,859	194	43	237
Deriana ^a	242	822	1,426	2,248	29	12	41
Dar al-Araibat	154	550	345	895	143	90	233
Benghazi ^a	151	431	1,517	1,947	200	54	254
Benina ^a	172	980	3,214	4,195	232	47	279
al-Qawarisha	539	2,357	8,635	10,992	343	275	618
Sidi Khalifa	147	173	656	828	36	65	101
Gaminis ^a	360	31	11,263	11,294	19	54	74
Suluq	673	93	22,257	22,350	147	35	182
al-Khadra	290	172	42,297	42,468	75	445	80
Total	2,903	6,817	134,869	141,686	1,418	1,120	2,099

SOURCE: Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974 (Tripoli: 1979), p. 36.

^aDistricts that include more than one mahalla.

Table 4.2.--Size of agricultural land-use systems in the Benghazi area, 1974.

District or Mahalla	Irrigated Farms Only		Dry Farms Only		Irrigated and Dry Farms	
	Total Number	Area in Hectares	Total Number	Area in Hectares	Total Number	Area in Hectares
al-Aguria ^a	76	757	92	55,977	68	1,517
Deriana ^a	47	334	122	1,186	73	934
Dar al-Araibat	60	345	17	41	77	833
Benghazi ^a	88	416	29	997	31	902
al-Qawarisha	120	1,508	235	4,297	184	6,997
Sidi Khalifa	20	95	91	554	36	537
Gaminis	3	5	327	12,752	30	826
Suluq	1	--	669	21,015	6	1,057
al-Khadra ^a	--	--	269	47,254	21	1,714
Total	455	3,421	1,964	146,513	544	18,247

SOURCE: Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974 (Tripoli: 1979), p. 16.

^aDistricts that include more than one mahalla.

irrigation. In the districts of Benina, al-Faakat, al-Kuwaifia, Attaria, and Ganfuda-Gar Yunis, 40 to 60 percent of the farms were irrigated (see Figure 4.1).

In many districts, irrigation is limited first because of the water shortage and second because the consumption of water per unit of land is smaller in the coastal area because of the influence of the Mediterranean Sea, which brings greater rainfall than in the inland areas. The consumption of water is higher in the semiarid districts, such as Annawwagia, al-Khadra, and Suluq in the southeast part of the study area, where rainfall is less than 200 mm per annum, than in those districts located in the northern part, where rainfall is more than 300 mm per annum.

Dry Farming

Dry farming occurs in 66.3 percent of the Benghazi area and covers 146,513 hectares.⁴ Most of the farms included in this system are watered only with rainfall. Thus, wheat and barley and unirrigated vegetables such as tomatoes and watermelon are the main crops. Unirrigated vegetables are confined to the coastal sand-dune areas such as Deriana, Attaria, and Ganfuda-Gar Yunis districts, where underground water for irrigation is low in quality and contains a high percentage of salt.

Most dry farming is found in the districts of Suluq, Gaminis, al-Khadra, Annawwagia, and al-Aguria-Irdano, where more than 80 percent of the cultivated land is under the dry-farming system. There

⁴Ibid.

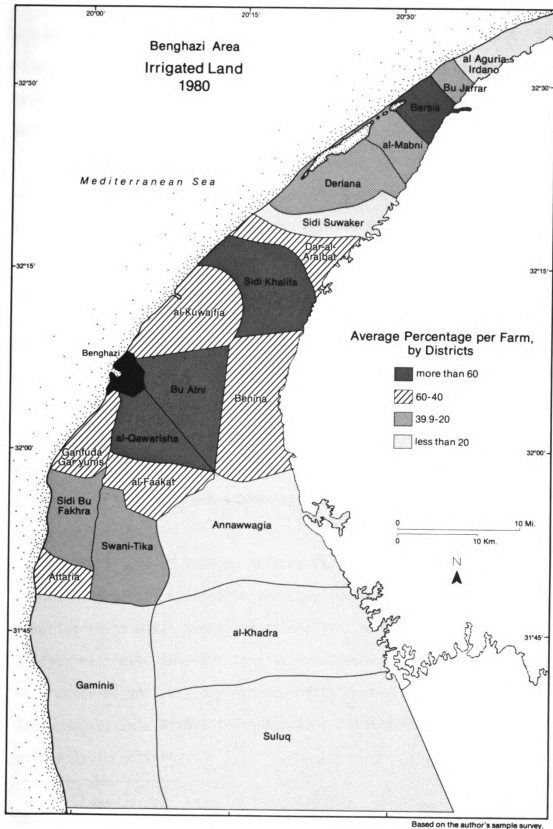


Figure 4.1

are also unirrigated farms, which produce fruits such as grapes, figs, palms, and almonds, which have been included in this system. This type of farming dominates the districts of al-Gawarisha, al-Kuwaifia, Deriana, and Benina.

According to Hajjaji, other arable areas could be brought under dry farming such as those areas in the northern part of Benghazi, notably between Deriana, al-Aguira, and the Ar-Rajm Escarpment. This area, which has relatively fertile soil, receives an annual rainfall ranging between 250 mm and 350 mm.⁵

Semi-irrigated Farming

The semi-irrigated system of agriculture is still practiced in large areas of Libya, particularly in the coastal plain. Unfortunately, there is no reliable information or data available for the amount of land under this system. However, it is mixed in the irrigated and dry-farming areas and represents no distinguishable pattern of agriculture.

This type of farming differs from dry farming in that a small amount of water is applied to the crop (mainly vegetables) at the planting stage until the first rainfall or at critical times, such as delayed rainfall, in order to give the crop advantages it would not have under an entirely dry system. Watermelons cultivated in the Ganfuda-Gar Yunis district and tomatoes planted in Deriana are grown primarily in this way.⁶

⁵Hajjaji, p. 134.

⁶Ibid., p. 135.

Crops produced under the semi-irrigation system are very costly because water has to be brought long distances in tanks. However, the system is very successful, and its yields are high enough to justify high production costs.

Farm Fragmentation

Fragmentation in the Benghazi area refers to the fact that a single farm may consist of more than one piece of land. In many cases, fields of the same farm are separated and cultivated by brothers or relatives. These pieces of land are identified in this section of the study as plots.

There is a vast contrast in the size of farms and the degree of fragmentation in the Benghazi area. Fragmented farms range from those with a very small single plot (less than one-half a hectare) to very large farms with five or six plots (more than 500 hectares). The degree of farm fragmentation shows little relationship to the physiography of the Benghazi area but rather is influenced by social customs. In the Islamic Law of Inheritance, fixed or equal shares are required, with every heir demanding his or her due. Usually each farm is divided accordingly. However, in the tribal areas, especially in the southeast part of the study area, land is not divided, but each farmer knows the areas he cultivates each year.

According to the 1974 agricultural census, of 4,521 farms of the Benghazi area, 3,051 farms (67.4 percent) consisted only of one plot, 904 farms (20 percent) had two plots, 311 farms (14.3 percent) had three plots, 129 farms (2.3 percent) had four plots, 75 farms

(1.6 percent) had five plots, and 51 farms (1 percent) had six or more plots (see Table 4.3).⁷ Since water is the vital factor in agricultural practices and since it is very scarce in the Benghazi area, the pressure for land where water is found increases steadily; there is intense competition for lands on which water is found. Frequently these plots are small in size and patchily distributed.

Vegetable- and Fruit-Cropping Pattern

As previously mentioned, vegetables and fruits are intensively cultivated in the Benghazi area. Farmers consider vegetables to be the most profitable cash crops throughout the year, especially early-harvested or off-season vegetables such as tomatoes, cucumbers, green chili peppers, and lettuce.⁸

The outstanding characteristic of the vegetable-and-fruit zone is the area dominated by fruit trees--citrus, date palms, figs, almonds, pomegranates, olives, and other fruits grown in combination with grapes. Approximately one-third of the area under cultivation in this pattern is dedicated to fruits. However, since the land between fruit trees is exploited for vegetable cultivation, it is difficult to determine the amount of land allocated to each crop. These crop combinations produce an intensive agricultural system, which distinguishes this cropping pattern.

⁷Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974, p. 37.

⁸Hajjaji, p. 302.

Table 4.3.--Degree of farm fragmentation in the Benghazi area, 1974.^a

Farm Size in Hectares	Total Number of Farms	Number of Plots Per Farm					
		One	Two	Three	Four	Five	Six
<1	91	89	1	-	-	1	-
1	175	162	9	2	1	-	1
2	235	210	23	2	-	-	1
3	184	161	16	7	-	-	-
4	369	330	31	5	3	-	1
5	741	554	145	30	4	4	4
10	601	407	146	32	9	5	2
15	309	192	89	22	1	3	2
20	454	273	110	46	19	4	2
30	289	154	74	29	12	13	7
40	234	120	55	29	18	9	3
50	147	71	41	17	13	2	3
60	126	66	31	13	5	8	3
70	72	33	23	5	5	4	2
80	77	34	18	11	7	3	4
90	21	6	6	7	1	1	-
100	178	71	43	30	18	10	6
150	45	19	11	8	2	3	2
200	88	57	15	4	6	1	5
300	27	14	6	4	1	2	-
400	19	10	5	2	1	-	1
500	26	16	4	1	1	1	1
>500	13	2	2	4	1	1	3
Total	4,521	3,051	904	311	129	75	51

SOURCE: Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974 (Tripoli: 1979), p. 73.

^aIncludes farms not in the study area.

Table 4.3.--Degree of farm fragmentation in the Benghazi area, 1974.^a

Farm Size in Hectares	Total Number of Farms	Number of Plots Per Farm					
		One	Two	Three	Four	Five	Six
<1	91	89	1	-	-	1	-
1	175	162	9	2	1	-	1
2	235	210	23	2	-	-	1
3	184	161	16	7	-	-	-
4	369	330	31	5	3	-	1
5	741	554	145	30	4	4	4
10	601	407	146	32	9	5	2
15	309	192	89	22	1	3	2
20	454	273	110	46	19	4	2
30	289	154	74	29	12	13	7
40	234	120	55	29	18	9	3
50	147	71	41	17	13	2	3
60	126	66	31	13	5	8	3
70	72	33	23	5	5	4	2
80	77	34	18	11	7	3	4
90	21	6	6	7	1	1	-
100	178	71	43	30	18	10	6
150	45	19	11	8	2	3	2
200	88	57	15	4	6	1	5
300	27	14	6	4	1	2	-
400	19	10	5	2	1	-	1
500	26	16	4	1	1	1	1
>500	13	2	2	4	1	1	3
Total	4,521	3,051	904	311	129	75	51

SOURCE: Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974 (Tripoli: 1979), p. 73.

^aIncludes farms not in the study area.

Another distinctive characteristic of the vegetable-and-fruit areas is the small size of the farms. Throughout this area, the average farm size is less than ten hectares.⁹ A farm that is small usually uses major inputs of manual labor provided chiefly by the farmer's family or agricultural workers receiving daily wages. In addition to raising crops, family members commonly market their fruits and vegetables at the Benghazi market (al-Funduk al-Baladi).

As shown in Figure 4.2, in the districts of al-Faakat, Bu Atni, Sidi Khalifa, Ganfuda-Gar Yunis, and al-Gawarisha, which represent the core of the vegetable-growing area, the average farm size is less than ten hectares. In contrast, the average farm size in the districts of Suluq, al-Khadra, Swani Tika, and al-Aguria, where a small portion of the farms are devoted to vegetables, is more than 50 hectares.

Although the labor inputs in the Benghazi-area farms are still largely manual, the level of technology employed is moderately high by Libyan standards. A large proportion of farms are fertilized and sprayed with herbicides and pesticides. It was found that out of 250 farms surveyed in the Benghazi area, 88 (35.2 percent) used both chemical and organic fertilizers. Ten farms used only chemical fertilizers, and 67 used only organic fertilizers. Fertilizers of one type or the other were thus used by 66 percent of the farms in the study area. Most farms using fertilizers were located in districts close to Benghazi City and to the north, where rainfall is more reliable,

⁹Some large truck farms exist in the Benghazi area, especially in the districts of Benina, Annawwagia, al-Gawarisha, Bu Atni, and Sidi Khalifa. These farms contribute about 30 percent of the fresh fruits and vegetables to the Benghazi market.

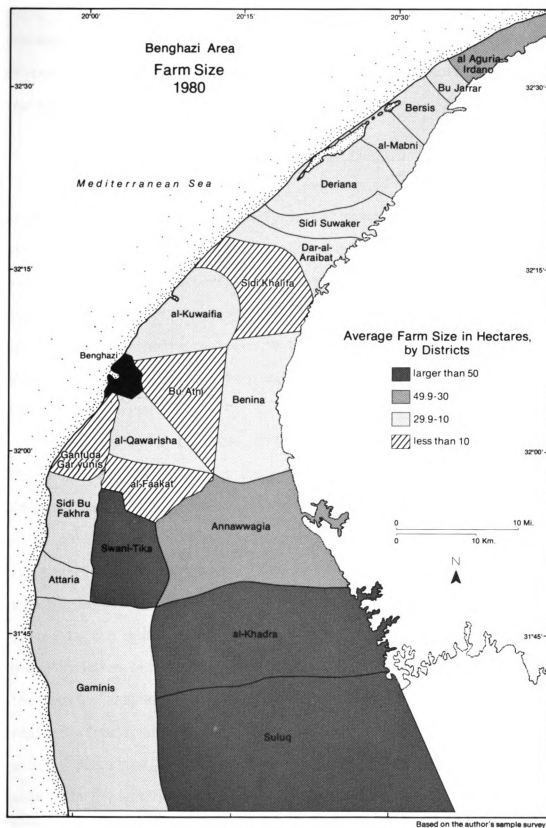


Figure 4.2

whereas in districts relatively far from the city, a lower percentage of the farms used fertilizers (see Figure 4.3). The more intensive the agriculture, the greater the use of fertilizer.

Grains and Shifting Crop Pattern

Grains (mainly wheat and barley) have always been a principal staple crop in Libya, particularly in the northeastern part (Cyrenaica). This is basically due to physical conditions (see Chapter II). Grains are the principal foodstuff of the urban as well as the rural population in the Benghazi area. This fact explains why the largest and most extensive cropping pattern in the area under consideration is planted in grain. This pattern was practiced by 70 percent of the 250 farms surveyed in 1980.

According to the 1974 agricultural census, about 40 percent of the total land farmed in the Benghazi area was cultivated with grains. However, data available in the same census showed that the area from which crops were harvested was less than 21 percent of the total cultivated land in the area under consideration in this study. This means that large areas planted with grain in the Benghazi area were not harvested in the census year. The reason for this could be either drought, which affects the germination of seeds and the plants during the growing season, or that some areas were devoted to livestock feed instead of to food production. The latter type of cultivation is usually practiced in districts where animal husbandry is more profitable than grain cultivation, such as Annawwagia and Sidi Khalifa.

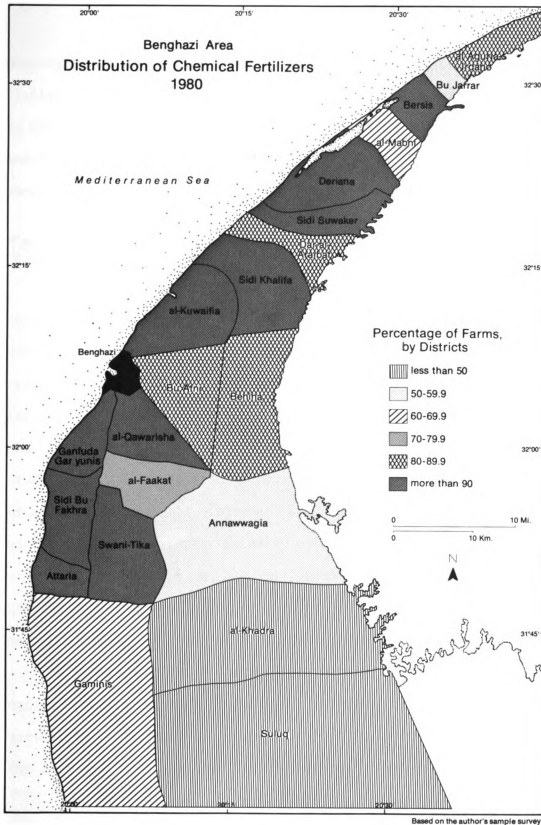


Figure 4.3

In the southeastern districts of Suluq, al-Khadra, and Annawwagia, more than 90 percent of the area under cultivation was planted with wheat and barley. In the districts of al-Gawarisha, Bu Atni, and al-Kuwaifia, less than 10 percent was planted with wheat and barley. Farmers close to Benghazi practiced less grain cultivation than did farmers at a greater distance (see Figure 4.4).

Modern versus Traditional Methods of Grain Cultivation

To show the impact of technology on grain cultivation, it is necessary first to show how the method of sowing grain affects the quantity and quality of production. In the terra-rossa red soils, especially in the north and in the sloping areas near the Ar-Rajma Escarpment, for example, shallow plowing is preferable for both wheat and barley. In the yellowish red soils of the southern part of the study area, shallow plowing is not suitable because grains here are usually sown early in the plowing season, early fall, and seed germination might occur after an early rain. Then if rain is delayed or early Gibli winds blow, the small plants wither and die (see Chapter II). Therefore, deeper plowing of 10 to 15 centimeters is more desirable.¹⁰

It has been found that no fertilizers are applied to grains except for that obtained by pasturing livestock on the ground after harvesting or during grazing when the land is fallow. After the area has been sown, it receives little or no attention, because as soon as

¹⁰Hajjaji, p. 277.

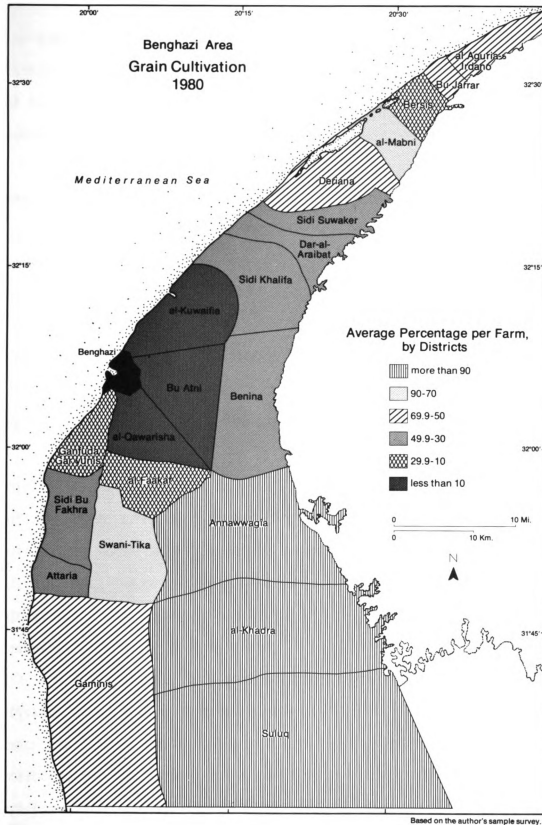


Figure 4.4

the sowing is over, the cultivators return to permanent residences either in Benghazi City or in nearby towns and villages. The majority of the cultivators return to their fields in late spring and early summer to harvest their crops.

The harvesting of wheat and barley starts in April or May and sometimes extends to July. It was customary for farmers to be accompanied by their families in the harvesting season to collect their crops, but this is no longer necessary because of the availability of machinery, which shortens the harvesting season. Another important change affecting the traditional ways of harvesting is the increase in available transportation vehicles, such as cars and trucks, and an increase in all-season paved roads. Both of these factors have made farms more accessible.

The traditional method of harvesting the grains was very primitive, time consuming, and wasteful. Ripe grain was either pulled out of the ground by hand or with a simple sickle (manjal). However, since 1965, when the oil revenues began to bring income for economic development, the primitive methods of sowing and harvesting have gradually disappeared from most Libyan agricultural territories, especially from the coastal plain.

The wooden or iron plow drawn by animals and the simple iron sickle for harvesting have been replaced by planting and harvesting machines. These machines are more profitable than traditional methods, for they reduce labor needs by about 80 percent. Hajjaji pointed out that modern sowing of seven hectares takes only three

days, whereas, when done in the traditional way, it takes about 40 days.¹¹ The writer witnessed the 1980 sowing season, when most of the sowing in the districts of Annawwagia, al-Khadra, Suluq, and Gaminis was done in only one week.

Mechanization is widespread in the grain-producing areas. Topographically suited to mechanical farming, the gentle slopes and relatively large average size of farms further enhance the economic feasibility of mechanization, as does the relatively limited supply of agricultural labor. As a result, most farm operations for wheat and barley production are mechanized.

Most farm machinery is owned by agricultural cooperatives as public-sector property. During plowing or harvesting season, the farmer hires machinery from the agricultural cooperatives of the district and pays in cash or in kind. Because of a lack of spare parts for the machinery and the limited supply of agricultural labor, many farmers suffer delays in sowing or collecting their produce, which, of course, affects the yields.

In general, the average yield of wheat and barley in normal years is about 21 quintals¹² for each quintal sown. However, grain yield varies from district to district and from year to year in the Benghazi area, due mainly to climatic and soil limitations. The 1974 agricultural statistics for the Benghazi area showed that the average yield of wheat and barley was about 3.8 quintals per hectare.

¹¹Ibid., p. 278.

¹²One quintal = 100 kilograms.

Even though rainfall determines the ultimate yield, productivity is usually high in the headwaters of the wadis so that a nominal output can be expected in all but the worst years.¹³

According to Hajjaji, the most common local varieties of wheat are maghrabia, dbaka, and idkeer. The latter, despite its small seeds and relatively low yield, is the most widespread variety grown in the Benghazi area, mainly because of its good adaptation to low-rainfall areas such as southern Benghazi.¹⁴

Some of the soft-wheat varieties grown in the Benghazi area have, however, outyielded some of the famous hard-wheat varieties.¹⁵ Although local wheat varieties were traditionally satisfactory in adaptability and production for local environmental conditions, they are to some extent no longer satisfactory. An intensive research project to discover new high-yield varieties has been carried out since the early 1960s by the Food and Agricultural Organization (FAO) and by agronomists from the United States at the agricultural research station at al-Hawwari, six kilometers southeast of Benghazi. As a result of this project, a new high-yield variety has been developed and introduced to farmers not only in the Benghazi area but throughout the Cyrenaica region.¹⁶ In recent years, a Mexican variety has also

¹³Johnson, p. 50.

¹⁴Hajjaji, p. 146.

¹⁵Inas Abu Sharr, "Crop Agronomy and Improvement in Cyrenaica," Report No. 1577 (Rome: Food and Agricultural Organization, 1962), p. 4.

¹⁶The most cultivated variety of hybrid wheat in the Benghazi area is mahmodi D 981.

been introduced. The introduction of these hybrid varieties not only changed the practice of wheat cultivation, but also increased yields by almost 50 percent.

New varieties of barley were also introduced to farmers in the Benghazi area, although the local variety (baladi) still dominated cultivation. This was probably because the local variety was more resistant to drought and could be used in a number of ways.

Extensive Livestock Farming

The landscape of the Benghazi area as well as of most of northeast Libya is dominated by extensive livestock grazing. There are four native kinds of animals that the Cyrenaicans graze: sheep, goats, cattle, and camels. Behnke pointed out that a study of man-land relationships in Cyrenaica must begin with a consideration of needs, productive capabilities, and technical processes associated with each kind of animal.¹⁷

Since the focus of this chapter is on the agricultural land-use patterns in the Benghazi area, it is necessary to emphasize that agriculture and pastoralism are not separate or alternative productive systems but rather mutually supportive and interdependent parts of a single system. Similarly, no pure grazing has been found in the Benghazi area, but livestock raising is an integral part of the agricultural system, although its importance is considerably less than grain cultivation.

¹⁷Roy H. Behnke, The Herders of Cyrenaica: Ecology, Economy, and Kinship Among the Bedouin of Eastern Libya (Urbana: University of Illinois Press, 1980), p. 26.

Although livestock are found everywhere in the area under consideration, sheep and goats are more numerous than cattle in all districts of the Benghazi area (see Table 4.4). The total number of sheep in the Benghazi area, according to the 1974 agricultural census, was about 250,000; there were about 62,000 goats. Cattle are less desired in the area because they require daily watering in all seasons. Most native cattle are raised for meat, but there is an increase in the use of imported cattle for both milk and meat, resulting in a decrease in importance of local species. However, there were about 14,600 cattle in the Benghazi area in 1974.

Camels were once used extensively by herders and farmers for transportation over long distances. But with an increase in the number of cars and construction of paved roads in the Benghazi area, the number of camels has decreased dramatically in the last decade. In 1980, the writer found only 15 camels being prepared for sale in the camel market of Suluq, the largest in the Benghazi area. Furthermore, the 1974 agricultural census showed only 5,177 camels roaming the area under consideration.

Livestock-Grazing Areas

The feed and water requirements for the four major animal types in the Benghazi area are shown in Table 4.5. Sheep prefer and need an abundant supply of grasses. They are watered every third day in the summer only. Sheep do not graze at great distances, as goats will, and thus need pastures in which to feed. This is why sheep grazing has been concentrated in southeastern districts of the study

Table 4.4.--Distribution of animals in the Benghazi area, 1974.

District	No. of Farms	No. of Sheep	No. of Goats	No. of Camels	No. of Cattle
al-Aguria ^a	482	10,044	7,387	31	5,478
Deriana ^a	374	13,273	8,906	25	916
Dar Alaraibut	220	14,743	2,053	3	945
Benghazi ^a	218	12,131	763	17	644
Benina	405	21,538	3,599	148	1,778
al-Gawarsha	478	23,664	3,013	37	1,847
Sidi Khalifa	233	10,404	418	4	1,144
Gaminis	425	14,637	325	100	570
Suluq	798	88,986	29,293	4,662	334
al-Khadra	359	39,643	5,772	150	971
Total	4,092	249,063	61,529	5,177	14,627

SOURCE: Libyan Arab Republic, Secretariat of Planning, Final Results of the General Agricultural Census, Benghazi, 1974 (Tripoli: 1979), p. 38.

^aIncludes more than one district.

area, where grasses are available and no trees are found. In the districts of Suluq, al-Khadra, Annawwagia, Swani Tika, and Benina, the average number of sheep per farm exceeds 100, whereas in districts close to Benghazi and along the coastal plain, the number of sheep per farm decreases to fewer than 50 head (see Figure 4.5). The only two districts in the northern part of the study area where the average number of sheep per farm is more than 100 were Deriana and Sidi Suwaker. This is probably because farms in these two districts are less important for vegetable cultivation due to salinization and salt-water intrusion.

Table 4.5.--Feed and water requirements of animals in the Benghazi area.

Livestock	Feed	Water
Sheep	Annual grasses	Watering every third day in summer only
Goats	Trees and shrubs	Watering every third day in summer only
Cattle	Fodder and feed grains	Daily watering in all seasons
Camels	Perennial shrubs and seasonal vegetation	Watering every one to two weeks in summer only

SOURCE: Modified from Roy H. Behnke, The Herders of Cyrenaica: Ecology, Economy, and Kinship Among the Bedouin of Eastern Libya (Urbana: University of Illinois Press, 1980), p. 27.

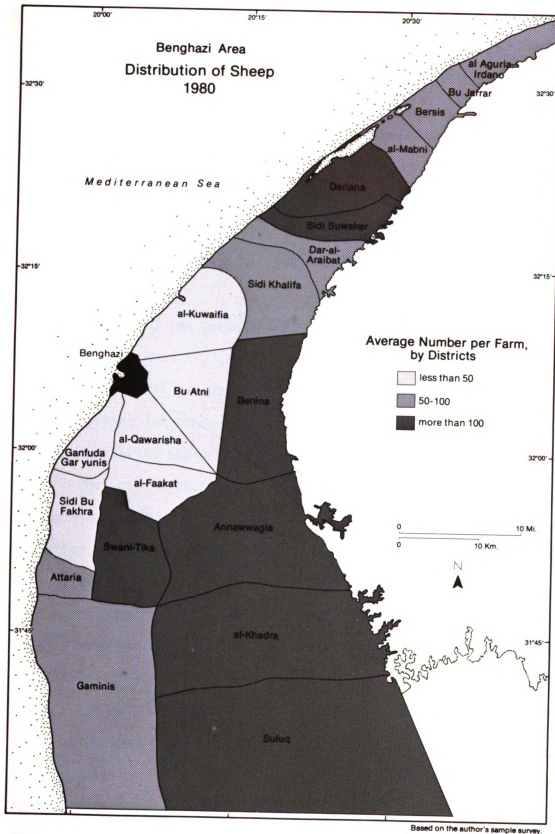


Figure 4.5

Goats can travel long distances daily in search of food, and although they depend on trees and shrubs for food, the water requirement for goats is the same as for sheep. The average number of goats per farm varied from district to district. In the districts of Suluq and al-Khadra, the average exceeded 30 head, whereas in the irrigated districts around Benghazi, the average decreased to fewer than 10 head. In the northern districts, where trees are dominant, the average number of goats per farm was between 20 and 30 head (see Figure 4.6).

Because of the large water needs of cattle and the regularity with which they need it, cattle are tied closely to a plentiful supply of water. For this reason, although cattle wander around on a daily basis searching for food, they spend the entire year in one location and do not migrate seasonally.

Most of the cattle are found in the northern districts of the Benghazi area, such as Sidi Khalifa, Sidi Suwaker, Bersis, and Bu Jarrar, where the average number per farm exceeded 10 head. The only district in the south of Benghazi that had sizable numbers of cattle was Swani Tika (see Figure 4.7). Thus the cattle area is located between the irrigated-farming areas around Benghazi and the dry-farming districts in the south.

Although camels represent no major pattern in the Benghazi area, their importance increases to the south, because camels can resist drought, in summer needing watering only twice a month. Formerly, camels were used as draft, baggage, riding, and dairy animals. Because of the rise in meat prices and the introduction

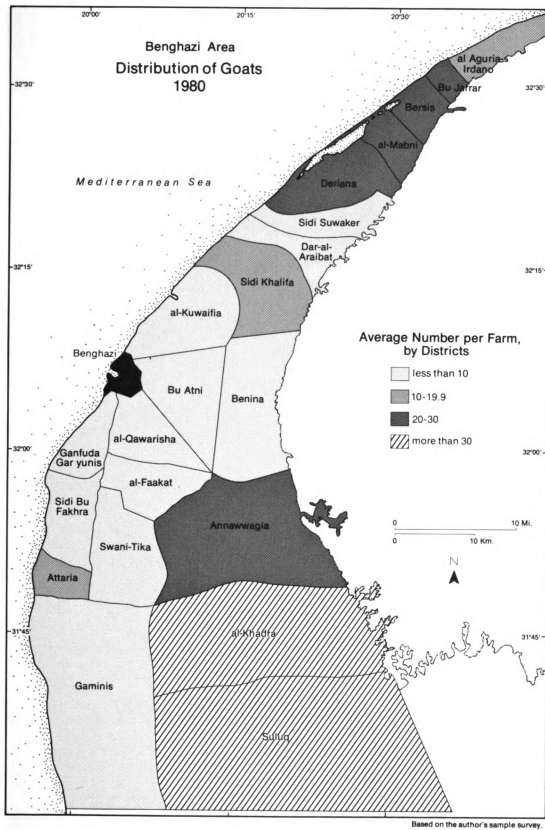


Figure 4.6

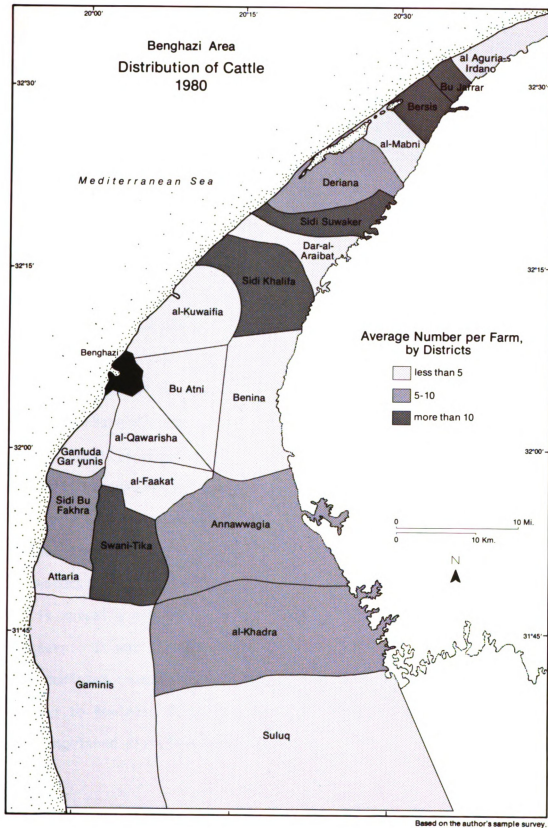


Figure 4.7

of mechanized transport, camels are today raised for sale as butcher animals.

In concluding this discussion, the cultivated land in the Benghazi area was divided into three main patterns: irrigated, dry, and semi-irrigated. The irrigated land appears to occupy the districts that are located closer to Benghazi City, whereas dry farming is practiced in districts farthest from the city. However, there are no distinguishable patterns for the semi-irrigated area. It is integrated with the other two patterns.

Three main patterns of agriculture are practiced in the study area: vegetable and fruit, grain, and extensive livestock farming. Vegetables and fruits are dominant crops in irrigated agriculture, which is characterized by intensive land use, small farms, and locations closer to Benghazi City. The grain cultivation is the largest and most extensive pattern in the area. It occupies almost all of the dry-farming area and is distinguished by its extensive land use, large farms, and locations away from Benghazi City. The pattern of livestock farming is not separate from other patterns of agriculture. It is mutually supportive and is an interdependent part of a single pattern. It was found that sheep, goats, cattle, and camels are the dominant animals in the Benghazi area. Sheep, goats, and camels appear to dominate districts away from Benghazi; cattle represent no distinguished distributional pattern.

CHAPTER V

SELECTED CULTURAL FACTORS AFFECTING AGRICULTURAL LAND USE IN THE BENGHAZI AREA

The spatial pattern of agricultural land use in the Benghazi area is causally related to a number of physical, cultural, and economic factors. Because the area is relatively small, there are no significant variations in physical features that affect the agricultural landscape. Thus, four cultural and institutional factors were selected to be analyzed in relation to different types of agricultural land use. These factors were farm location in relation to the Benghazi market, land-tenure systems, government agricultural assistance, and farmers' characteristics.

Various methods were used to analyze the relationships among these factors and the agricultural land-use variables. In the first section of this chapter, a general idea of the association between variables is presented as it is defined by the Pearson correlation. By this method, the direction and strength of the relationship between two variables is ascertained as well as whether the relationship is positive or negative, weak or strong. In subsequent sections of the chapter, the four factors are each discussed in terms of the research variables. The one-way analysis of variance was used

to test the first six hypotheses, and chi-square was used to test the seventh hypothesis.

The Pearson Correlation Analyses

The Pearson correlation coefficients are presented in Table 5.1. The table can be easily interpreted. Its range is from 1.0 to -1.0. A correlation coefficient (indicated by the letter r) has limits of 1.0, which indicates a perfect positive relationship, or -1.0, which indicates a perfect negative relationship. If the r value is zero, no relationship is indicated. The better the fit, the larger the magnitude of r .

The second rows in the correlation-coefficient table show the levels of significance. The level of significance in this study was .05, meaning that any relationship lower than .05 was statistically significant.

For this research, the Pearson correlation coefficient was used to analyze 15 variables in relation to each other. Stated differently, each one of these variables was correlated with each of the remaining 14 variables. The variables included in the correlation analysis were as follows: distance of farm from the Benghazi market in kilometers (DISFBM), size of each farm in hectares (SIZOFARM), area cultivated in grain on each farm in hectares (ARALGRIN), area cultivated in vegetables on each farm in hectares (ARALVEG), area on each farm planted in fruits in hectares (ARALPCP), area on each farm allocated for grazing and animal husbandry in hectares (ARALFGRZ), area of irrigated land on each farm in hectares (IRRAREA), amount of

Table 5.1.--Pearson correlation coefficients.^a

	DISFBM	SIZOFARM	ARALGRIN	ARALVEG	ARALPCP	ARALFGRZ	IRRAREA	CHFERT	INCOMFAR	NUMSHP	NUMGTS	NUMCTL	NUMOA	CHEFHA	FAINPHA
DISFBM		.376 (.001)	.418 (.001)	-.259 (.001)	-.156 (.014)	.378 (.001)	-.067 (.388)	-.152 (.131)	.072 (.279)	.303 (.001)	.269 (.001)	-.143 (.050)	.321 (.001)	-.281 (.001)	-.300 (.001)
SIZOFARM			.893 (.001)	.046 (.473)	-.040 (.537)	.865 (.001)	.631 (.087)	.172 (.060)	.125 (.001)	.622 (.001)	.245 (.001)	.105 (.153)	.102 (.165)	-.223 (.001)	-.262 (.001)
ARALGRIN				-.115 (.072)	-.160 (.012)	.891 (.001)	.435 (.001)	-.003 (.978)	.035 (.699)	.618 (.001)	.336 (.001)	.086 (.244)	.164 (.025)	-.221 (.001)	-.258 (.001)
ARALVEG					.299 (.001)	-.124 (.091)	.821 (.001)	.350 (.001)	.424 (.001)	-.088 (.234)	-.097 (.188)	.131 (.074)	-.132 (.072)	.073 (.251)	.124 (.052)
ARALPCP						.190 (.009)	.538 (.001)	.088 (.383)	.102 (.127)	-.179 (.014)	-.025 (.735)	.062 (.397)	-.101 (.168)	.007 (.914)	-.028 (.622)
ARALFGRZ							.459 (.001)	.003 (.981)	.081 (.288)	.707 (.001)	.335 (.001)	.086 (.248)	.184 (.012)	-.259 (.001)	-.318 (.001)
IRRAREA								.360 (.001)	.426 (.001)	.291 (.001)	.119 (.197)	.148 (.109)	.148 (.107)	-.064 (.412)	-.040 (.603)
CHFERT									.580 (.001)	.225 (.063)	.098 (.425)	-.135 (.270)	-.088 (.475)	.504 (.001)	.269 (.001)
INCOMFAR										.237 (.002)	.136 (.076)	.040 (.603)	-.011 (.888)	.214 (.001)	.613 (.001)
NUMSHP											.469 (.001)	.158 (.031)	.374 (.001)	-.214 (.003)	-.154 (.036)
NUMGTS												.117 (.111)	.457 (.001)	-.132 (.071)	-.065 (.378)
NUMCTL													.081 (.270)	-.070 (.340)	-.007 (.925)
NUMOA														-.098 (.182)	-.094 (.200)
CHEFHA															.477 (.001)
FAINPHA															

Significant $r = \pm .150$ ^aSee pp. 99 and 101 for explanation of the agricultural land-use variables.

chemical fertilizers used annually per farm in kilograms (CHFERT), annual income per farm in dollars (INCOMFAR), number of sheep per farm (NUMSHP), number of goats per farm (NUMGTS), number of cattle per farm (NUMCTL), number of other animals per farm (NUMOA), amount of chemical fertilizers used annually on each farm in kilograms per hectare (CHEFHA), and annual farm income in dollars per hectare (FAINPHA). These variables were chosen for two reasons: first, they were the most important variables in this research, and second, they were the only variables in the interview schedules that gave raw numerical (metric) data that could be analyzed by the Pearson correlation coefficient.

The most significant correlations (r) found among the 250 respondents were as follows:

1. A positive correlation between DISFBM and SIZOFARM ($r = .376$), implying that, as the distance of farms from the Benghazi market increased, farm size increased.
2. A positive correlation between DISFBM and ARALGRIN ($r = .418$), indicating that, as the distance of farms from the Benghazi market increased, a larger area of these farms was devoted to grain cultivation.
3. A negative correlation between DISFBM and ARALVEG ($r = -.259$), implying that, as the distance of farms from the Benghazi market increased, a smaller area of these farms was cultivated in vegetables.
4. A negative correlation between DISFBM and ARALPCP ($r = -.156$), showing that, as the distance of farms from the Benghazi

market increased, a smaller area on these farms was devoted to growing fruits.

5. A positive correlation between DISFBM and ARALFGRA ($r = .378$), implying that, as the distance of farms from the Benghazi market increased, a larger area of each farm was allocated for grazing and animal husbandry.

6. A positive correlation between DISFBM and NUMSHPL ($r = .303$), indicating that, as the distance of farms from the Benghazi market increased, the number of sheep per farm increased.

7. A positive correlation between DISFBM and NUMGTS ($r = .269$), showing that, as the distance of farms from the Benghazi market increased, the number of goats per farm increased.

8. A negative association between DISFBM and NUMCTL ($r = -.143$), implying that, as the distance of farms from the Benghazi market increased, the number of cattle per farm decreased.

9. A positive relationship between DISFBM and NUMOA ($r = .321$), showing that, as the distance of farms from the Benghazi market increased, the number of other animals increased.

10. A negative correlation between DISFBM and CHEFHA ($r = -.281$), indicating that farther from Benghazi, the amount of chemical fertilizer used per hectare decreased substantially.

11. A negative correlation between DISFBM and FAINPHA ($r = -.300$), implying that the greater the distance of a farm from Benghazi, the lower the farm income per hectare.

12. A strong positive correlation between SIZOFARM and ARALGRIN ($r = .893$), implying that, as farm size increased, more area was allocated to grain cultivation (wheat and barley).

13. A strong positive correlation between SIZOFARM and ARALFGRZ ($r = .865$), implying that with increases in farm size, greater area was allocated for grazing and animal husbandry.

14. A strong positive correlation between SIZOFARM and NUMSHP ($r = .622$), indicating that the larger the farm, the greater the number of sheep raised.

15. A positive relationship between SIZOFARM and NUMGTS ($r = .245$), implying that the larger the farm, the greater the number of goats raised.

16. A negative correlation between SIZOFARM and CHEFHA ($r = -.223$), showing that the larger the farm, the smaller the amount of chemical fertilizer used per hectare.

17. A negative correlation between SIZOFARM and FAINPHA ($r = -.262$), implying that the larger the farm, the smaller the income per hectare.

18. A negative relationship between ARALGRIN and ARALPCP ($r = -.160$), showing that the greater the area of a farm allocated to grain, the smaller the area allocated to fruit.

19. A strong positive correlation between ARALGRIN and ARALFGRZ ($r = .891$), implying that the greater the area allocated

to grain per farm, the greater the area used for grazing and animal husbandry.

20. A positive correlation between ARALGRIN and NUMSHP ($r = .618$), indicating that the greater the area cultivated in grain per farm, the greater the number of sheep.

21. A positive correlation between ARALGRIN and NUMGTS ($r = .336$), implying that the greater the area cultivated in grain per farm, the greater the number of goats.

22. A weak positive relationship between ARALGRIN and NUMOA ($r = .164$), indicating that the greater the area cultivated in grain per farm, the greater the number of other animals.

23. A negative correlation between ARALGRIN and CHEFHA ($r = -.221$), implying that the greater the area cultivated in grain per farm, the smaller the amount of chemical fertilizer used per hectare.

24. A negative correlation between ARALGRIN and FAINPHA ($r = -.258$), implying that the greater the area cultivated in grain per farm, the smaller the income per hectare.

25. A strong positive relationship between ARALVEG and IRRAREA ($r = .821$), implying that the greater the area cultivated in vegetables per farm, the larger the area under irrigation.

26. A positive correlation between ARALVEG and CHFERT ($r = .350$), indicating that the greater the area cultivated in vegetables per farm, the larger the amount of chemical fertilizers used.

27. A positive correlation between ARALVEG and INCOMFAR ($r = .424$), implying that the greater the area of land allocated to vegetables per farm, the greater the income of the farm.

28. A positive correlation between ARALPCP and IRRAREA ($r = .538$), showing that the greater the size of the area cultivated in fruits per farm, the larger the area under irrigation.

29. A negative correlation between ARALPCP and ARALFGRZ ($r = -.190$), indicating that the greater the area allocated to fruit per farm, the smaller the grazing area.

30. A positive correlation between ARALFGRZ and NUMSHP ($r = .707$), implying that the greater the land allocated to grazing per farm, the greater the number of sheep.

31. A positive correlation between ARALFGRZ and NUMGTS ($r = .335$), indicating that the greater the land allocated to grazing per farm, the greater the number of goats.

32. A negative correlation between ARALFGRZ and CHEFHA ($r = -.259$), implying that the greater the grazing area per farm, the smaller the amount of chemical fertilizer used per hectare.

33. A negative correlation between ARALFGRZ and FAINPHA ($r = -.318$), implying that the greater the grazing area per farm, the smaller the farm income per hectare.

34. A positive correlation between IRRAREA and CHFERT ($r = .360$), implying that the greater the irrigated area per farm, the larger the amount of chemical fertilizers used.

35. A positive correlation between IRRAREA and INCOMFAR ($r = .426$), implying that the greater the irrigated area per farm, the larger the income.

36. A positive correlation between CHFERT and INCOMFAR ($r = .580$), indicating that the larger the amount of chemical fertilizer used per farm, the greater the income.

37. A positive correlation between NUMSHP and NUMGTS ($r = .469$), implying that the greater the number of sheep per farm, the greater the number of goats.

38. A positive correlation between CHFERT and FAINPHA ($r = .477$), indicating that the larger the amount of chemical fertilizer applied per hectare on a farm, the greater the income per hectare.

Farm Location Relative to the Benghazi Market

In this section, the effect of farm location relative to the Benghazi market on the types of agriculture practiced is discussed. Farm location was defined as the distance in kilometers between the farm and the market. For the purpose of the analysis, this distance was divided into seven categories: (1) less than 10 km, (2) 10 to 20 km, (3) 21 to 30 km, (4) 31 to 40 km, (5) 41 to 50 km, (6) 51 to 60 km, and (7) more than 60 km.

The types of agricultural land-use variables included were the following: (1) the area allocated for cultivation of grains per farm in hectares, (2) the area allocated for cultivation of vegetables per farm in hectares, (3) the land allocated for fruits per farm in

hectares, (4) the area left for grazing and animal husbandry per farm in hectares, (5) the number of sheep per farm, (6) the number of goats per farm, (7) the number of cattle per farm, and (8) the number of other animals per farm.

One-way analysis of variance was used in this section. The results are presented in Table 5.2. Frequency distributions were also employed.

Area Allocated to Cultivation of Grain

The results of the one-way analysis of variance showed that the amount of land allocated to grain per farm in Benghazi was affected by the distance of the farm from the market. The average grain land per farm (grand mean) in the study area was 29.61 hectares. On farms located more than 31 km from Benghazi, more than the average number of hectares was devoted to grain cultivation, whereas on farms located less than 31 km from Benghazi, less than the average amount of land was allocated to cultivation of grains. More specifically, within 10 km of the market, the average grain area per farm was 0.86 ha, whereas for farms located more than 60 km away, the average was 79 ha. The test results indicated that there were significant variations in the averages of the areas allocated to grains per farm at different distances from the Benghazi market. With 6 degrees of freedom, the result was significant at the .001 level; the F-ratio was 9.01 (see Table 5.2).

Table 5.2.--Analysis of variance for types of agricultural land use by distance of farms studied from the Benghazi market.

Distance From Benghazi (in km)	Grain Area in Ha.	Vegetable Area in Ha.	Fruit Area in Ha.	Grazing Land in Ha.	No. of Sheep Per Farm	No. of Goats Per Farm	No. of Cattle Per Farm	No. of Other Animals Per Farm
	$\bar{X}$ 29.61	$\bar{X}$ 4.36	$\bar{X}$ 2.15	$\bar{X}$ 30.54	$\bar{X}$ 150.81	$\bar{X}$ 20.35	$\bar{X}$ 4.83	$\bar{X}$ 2.83
<10	0.86	6.86	2.43	3.80	18.00	5.40	2.40	0.40
10-20	3.47	4.32	2.87	5.56	80.47	12.50	5.57	0.63
21-30	21.58	6.35	2.18	27.68	165.53	11.13	8.27	0.27
31-40	32.98	6.87	2.24	33.22	162.97	20.36	5.03	0.53
41-50	33.71	2.34	2.57	27.62	124.97	14.66	3.62	2.59
51-60	41.95	2.04	1.90	34.32	142.97	26.35	3.30	1.89
>60	79.00	1.04	0.09	73.60	297.50	46.80	3.40	16.80
F-ratio	9.01	4.99	1.33	7.23	5.34	2.99	1.28	6.36
df	6	6	6	6	6	6	6	6
Signif.	.001	.0001	.2432	.001	.001	.0082	.2689	.001

Area Allocated to Cultivation of Vegetables

As shown by the Pearson correlation analysis, there was a negative relationship between the distance from the Benghazi market and the area allocated to vegetables on each farm. This means that the greater the distance from Benghazi, the smaller the area per farm devoted to vegetable cultivation. The results of the one-way analysis of variance showed that the grand mean of area allocated to vegetables per farm was 4.36 hectares. The average area of vegetable land for farms located less than 10 km from Benghazi market was 6.86 hectares; on farms located more than 60 km away, only 1.04 hectares were devoted to vegetables. The test results indicated that there were significant variations in the average areas allocated to vegetables per farm at different proximities to the Benghazi market. With 6 degrees of freedom, the result was significant at the .0001 level; the F-ratio was 4.99.

Area Allocated to Cultivation of Fruit

In general, the fruit land per farm in the Benghazi area was limited and mixed with vegetables. The 1974 agricultural census showed that the total area devoted to vegetables was 141,686 hectares, whereas the area for fruit cultivation was only 2,099 hectares.

The Pearson correlation analysis showed a weak negative relationship between distance from Benghazi and area allocated to fruits per farm ($r = -.156$). The one-way analysis of variance resulted in

an F-ratio of 1.33. The F-probability was .2432, which was not significant at any level.

Area Allocated to Grazing

The Pearson correlation matrix indicated a positive relationship between the distance from the Benghazi market and the grazing area per farm ($r = .378$). The average grazing area per farm in Benghazi was 30.54 hectares. The average grazing area of farms located within 10 km of the Benghazi market was 3.80 hectares. The average for farms located more than 60 km from the city was 70.6 hectares.

The result of the one-way analysis of variance was an F-ratio of 7.23; the F-probability was significant at the .001 level. This result indicated that, in relation to many other factors, both physical and nonphysical, distance from the market played a considerable role in the amount of grazing land per farm in the Benghazi area.

Number of Sheep

Sheep are the most important animals not only in Benghazi but also in Libya in general. They are used for meat, milk, butter, wool, and hides. Because of their importance, sheep were found in all 21 districts under consideration.

The frequency distribution of sheep in the study area showed that only 23 farmers (12 percent of all farmers questioned) did not raise sheep. The minimum number of sheep per farm was 3 and the maximum was 650; the average was 150.81. (See Table 5.3.) The Pearson correlation analysis showed a positive relation between the

Table 5.3.--Frequency distributions of sheep per farm.

Number of Sheep/Farm	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
3	1	1	13
4	1	1	13
7	1	1	14
8	1	1	14
10	3	2	16
12	1	1	17
13	1	1	17
15	5	3	20
17	1	1	20
20	8	4	25
23	1	1	25
25	2	1	26
30	8	4	30
35	3	2	32
37	1	1	33
40	6	3	36
45	1	1	36
50	10	5	42
55	1	1	42
60	3	2	44
70	4	2	46
75	1	1	47
80	3	2	48
85	1	1	49
100	16	9	57
120	3	2	59

Table 5.3.--Continued.

Number of Sheep/Farm	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
150	9	5	64
175	1	1	64
180	1	1	65
200	14	7	72
205	1	1	73
211	1	1	73
250	4	2	75
270	2	1	76
300	17	9	86
310	1	1	86
330	1	1	87
350	3	2	88
353	1	1	89
400	7	4	93
450	2	1	94
500	7	4	97
503	1	1	98
600	3	2	99
650	1	1	100

Mean: 150.87
 Valid cases: 187
 Standard deviation: 157.897
 Sum: 28,201
 Minimum: 3
 Maximum: 650

distance of the farm from the Benghazi market and the number of sheep raised per farm ($r = .303$).

With respect to distance, the results of the one-way analysis of variance showed that there was a variation in means of number of sheep per farms in different locations. For example, farms located less than 10 km from the market had an average of 18 sheep, whereas farms located more than 60 km had an average of 297.5 sheep. The test also showed that these variations in means were significant at the .001 level; the F-ratio was 5.34.

Number of Goats

In contrast to sheep, goats are not important in Benghazi, despite the fact that they were found on 52 percent of the 250 farms surveyed in 1980. This is due to the fact that goats are harmful to forests, especially to fruit trees.

The frequency distribution of goats in the study area showed that 89 farmers had no goats. The minimum number of goats per farm was 2 and the maximum was 200; the mean was 20.348. (See Table 5.4.) However, the Pearson correlation routine showed a positive relation between the number of goats per farm and distance of the farm from Benghazi market ($r = .269$). This meant that the greater the distance from the market, the greater was the number of goats per farm.

The analysis-of-variance test produced the same result by giving a difference in averages of goats on farms in different locations. It showed that farms located less than 10 km from the market

Table 5.4.--Frequency distributions of goats per farm.

Number of Goats/Farm	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
2	3	2	49
3	4	2	51
4	2	1	52
5	4	2	55
6	2	1	56
7	2	1	57
10	14	7	64
12	5	3	67
13	1	1	67
15	5	3	70
17	1	1	71
20	9	5	75
25	3	2	77
30	10	5	82
40	1	1	83
50	8	4	87
60	2	1	88
70	5	3	91
80	1	1	91
90	1	1	92
100	9	5	97
113	1	1	97
120	1	1	98
130	2	1	99
200	2	1	100

Mean: 20.348
 Valid cases: 187
 Standard deviation: 35.912
 Sum: 3,805
 Minimum: 2
 Maximum: 200

had an average of 5.4 goats, whereas farms located more than 60 km from the market had an average of 46.8 goats. The results of the test indicated that the F-probability was significant at the .05 level; the F-ratio was 2.99.

Number of Cattle

The number of cattle was analyzed in relation to distance of the farms from the market. The results showed that the average number of cattle per farm was 4.83; the maximum was 70; the minimum was one. (See Table 5.5.) Although the Pearson correlation coefficient showed a very weak association between distance of the farm from the market and number of cattle ($r = .150$), the analysis-of-variance test showed no significant difference in means. The F-ratio was 1.28; the F-probability was .2689, which was not significant at any level.

Number of Other Animals

The number of other animals (mainly camels) was analyzed in relation to the distance from Benghazi market. The results of the analysis of variance showed that farms close to Benghazi had only 0.04 head, whereas farms located more than 60 km had an average of 16.80 head. The F-ratio was 6.36; the F-probability was significant at the .001 level. This stems from the fact that farmers far away from the market still use camels as an important mode of transportation, especially in districts where paved roads are not available.

Table 5.5.--Frequency distributions of cattle per farm.

Number of Cattle/Farm	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
1	13	7	42
2	16	9	51
3	19	10	61
4	13	7	68
5	11	6	74
6	3	2	75
7	11	6	81
8	5	3	84
10	8	4	88
12	3	2	90
14	2	1	91
15	5	3	94
16	1	1	94
17	2	1	95
18	1	1	96
20	3	2	97
22	1	1	98
25	2	1	99
70	2	1	100

Mean: 4.829
 Valid cases: 187
 Standard deviation: 8.669
 Sum: 903
 Minimum: 1
 Maximum: 70

The Land-Tenure Systems

The present land-tenure systems are the outcome of an historical process. They have been determined by complex economic, cultural, social, legal, and political factors. From the strictly formal viewpoint, every land-tenure system is essentially a defined judicial framework. However, this does not fully explain the policies adopted in the use of land as a factor of production. These policies can be understood only against the broader background of a country's economic, social, and technological development. Nonetheless, the legal expression of ownership and the character of property rights are the keys to the classification of each system. This is also true in a society in which property rights are dictated by a tribal chief or local leader.¹

Land tenure, as Morgan pointed out, "is an important question at several levels."² In the less-developed countries, land tenure exists in different forms, several of which have been seen as obstacles to agricultural change and economic growth. They have become objects of government policies that have frequently focused on land tenure as a key constraint in agricultural-development programs. Hence, at the national level, there has arisen a strong interest in tenure, especially in recent changes in tenure, prospects for further change, and their relationship to holding size and agricultural investment and practice. This interest has been reinforced by the

¹Samuel Pohoryles, Land Tenure in Africa and Its Effect on Economic Growth, Paper No. 3 (Jerusalem: Land Use Research Institute, April 1973), p. 1.

²William Basil Morgan, Agriculture in the Third World (Boulder, Colorado: Westview Press, 1978), p. 138.

fact that in most developing countries, land accounts for a much higher proportion of total wealth than in more-developed countries.

The frequency distributions of land tenure in the Benghazi area indicated the presence of five major land-tenure systems. Of the 250 farms surveyed in the summer of 1980, there were squatter's rights (47 farms), inheritance (117 farms), purchase (53 farms) sharecropping (23 farms), and several other types of land tenure, such as combinations of the above types, rented land, or gifts of land from friends or relatives. This last category accounted only for seven farms. Land tenure in the Benghazi area has been affected to a great extent by the cultural and institutional aspects of the people. It is a part of the people's belief that the farmer inherits only if he is a legal heir as defined by Islamic Law. He is allowed to give only a small part of his land to a relative who is not one of his legal heirs. Otherwise, he can give all his property for religious purposes--the waqf (see Chapter II).

It was found that 47 percent of the farms surveyed were inherited from fathers or relatives. Twenty-one percent of the farms were purchased, representing the second-largest group. Most of the farms in this category were purchased between 1965 and 1980. This type of ownership illustrated the impact of oil revenues, which increased incomes and encouraged the landless farmers to buy land.

Squatter's rights is a type of land tenure well known not only in the Benghazi area but also in most of Libya and North Africa. This system accounted for 19 percent of the farms surveyed, most of them located in districts far away from Benghazi, such as Gaminis,

Suluq, and al-Khadra. Because squatters have no legal title of ownership, they usually do not invest heavily in their farms. Instead, the squatter cultivates only seasonal crops, such as wheat and barley, or leaves the land for grazing and animal husbandry.

Sharecropping farmers represented less than 10 percent of the surveyed farms. It was found that most of them were foreigners: Egyptians, Sudanese, Palestinians, or Tunisians. They cultivated their farms only temporarily for cash crops (mainly vegetables).

The following analysis is focused only on the effect of the above-mentioned land-tenure systems on the agricultural land-use patterns in the Benghazi area. To determine the relationships between land-use and tenure systems, one-way analysis of variance was used. The variables used were the following: (1) the area allocated for cultivation of grains per farm in hectares, (2) the area allocated for cultivation of vegetables per farm in hectares, (3) the area left for grazing and animal husbandry per farm in hectares, (4) the number of sheep per farm, (5) the number of goats per farm, (6) the number of cattle per farm, (7) the farm size in hectares, (8) the annual use of chemical fertilizers per farm in kilograms, (9) the irrigated land per farm in hectares, and (10) annual income per farm in dollars. These variables were analyzed in relation to the five major types of land-tenure systems: squatter's rights, inheritance, purchase, sharecropping, and other means of land tenure. (See Table 5.6.)

With respect to grain area, the results of the one-way analysis of variance showed a grand mean of 29.61 hectares per farm allocated to cultivation of grains. Only the squatter's rights system was above

Table 5.6.--Analysis of variance for types of agricultural land use by types of farm ownership.

Type of Land Tenure	Grain Area in ha. $\bar{X}$ 29.61	Vegetable Area in ha. $\bar{X}$ 4.36	Grazing Area in ha. $\bar{X}$ 30.54	Number of Sheep $\bar{X}$ 150.81	Number of Goats $\bar{X}$ 20.35	Number of Cattle $\bar{X}$ 4.83	Farm Size in ha. $\bar{X}$ 36.63	Chemical Fertilizers in kg $\bar{X}$ 75.05	Irrigated Land in ha. $\bar{X}$ 7.90	Farm Income in Dollars $\bar{X}$ 12,295.93
Squatter's Rights	68.06	0.60	62.23	247.65	33.53	1.60	68.94	4,266.67	7.50	9,010.71
Inheritance	27.94	4.28	27.76	136.65	20.51	5.83	33.62	6,459.10	6.83	9,116.73
Purchase	17.31	6.22	20.19	125.22	10.54	7.22	29.10	7,165.22	8.71	14,985.21
Share-cropping	4.63	7.73	7.15	102.00	17.74	3.89	18.37	9,680.77	10.40	26,823.54
Other means	2.22	3.11	4.00	35.00	2.00	1.14	8.33	9,250.00	5.22	5,677.78
F-ratio	12.59	8.39	10.69	6.19	2.61	2.85	9.31	1.24	1.50	9.41
df	4	4	4	4	4	4	4	4	4	4
Signif.	.001	.001	.001	.0001	.0373	.0252	.001	.2992	.2036	.001

average; inheritance, purchase, sharecropping, and other means of land tenure were below average. Squatter's rights, with an average of 68.06 hectares, contributed in large part to the differences in averages. The result of the analysis was significant at the .001 level; the F-ratio was 12.59.

The results showed a grand mean of 4.36 hectares per farm cultivated in vegetables. Sharecropping and purchase were above average, whereas squatter's rights and other means of land tenure were below average. Inheritance, however, with an average area allocated to vegetables of 4.28 hectares, was close to the grand mean. The result also indicated a significant difference in average areas allocated to vegetables in relation to land-tenure systems. The F-ratio was 8.39; it was significant at the .001 level.

With respect to grazing land per farm in relation to land-tenure systems, the one-way analysis of variance indicated a grand mean of 30.54 hectares. Only the farms owned by squatter's rights had a grazing area above average, whereas farms owned by inheritance, purchase, sharecropping, and other means of land tenure had grazing areas that were smaller than average. The result was significant at the .001 level; the F-ratio was 10.69.

The average number of sheep per farm in the Benghazi area was 150.81. The squatter's-rights farms had an above-average number of sheep. It was found that squatter's-rights farms had more grazing land than did farms owned by any other type of land tenure. Therefore, squatter's-rights farms were more likely to have more animals than farms in the other types of land-tenure systems. The result of

the test showed that there were significant differences in the averages of the number of sheep per farm for each type of land-tenure system: squatter's rights with 247.65 sheep, inheritance with 136.65 sheep, purchase with 125.22 sheep, sharecropping with 102 sheep, and other means of tenure with 35 sheep. The F-ratio was 6.190; it was significant at the .0001 level.

The average number of goats per farm, as shown by the one-way analysis of variance, was 20.35. Squatter's-rights and inherited farms had an above-average number of goats, whereas farms obtained by purchase, sharecropping, and other types of land tenure had below-average numbers of goats. The result seemed similar to that for sheep, with a variation in the average for all types of tenure being significant at the .05 level. The F-ratio was 2.61; the F-probability was .0373.

The number of cattle per farm in relation to type of land ownership was different from the number of sheep and goats. The average number of cattle for all farms was 4.83. Purchased and inherited farms had above-average numbers of cattle, whereas squatter's rights, sharecropping, and other types of ownership had below-average numbers of cattle. The only obvious reason for this was that many purchased farms in the Benghazi area were used only for raising imported cattle to supply the Benghazi market with meat and milk. The result of the one-way analysis of variance was significant, showing an important variation in the average number of cattle for different types of land tenure. The F-ratio was 2.85; the F-probability was .0252.

Farm size in the Benghazi area appeared to be affected by the type of land tenure. The one-way analysis of variance showed that squatter's-rights farms had an average size of 68.94 hectares, whereas sharecropping farms had only 18.37 hectares. The result showed that there were significant variations between farm-size averages in different types of land tenure. The F-ratio was 9.31; it was significant at the .001 level. The relation of the amount of chemical fertilizers used and area of irrigated land per farm to farm size did not appear to be significant. This meant that there were no significant variations between averages of amounts of chemical fertilizers used and areas of irrigated land in different types of land tenure. The F-ratios were 1.24 and 1.50. The F-probabilities were .2992 and .2036; neither was significant at any level.

Farm income was also tested in relation to types of land tenure in the Benghazi area to see if there was any significant relationship. The analysis showed that the average income of all farms was \$12,295.93. Purchased and sharecropped farms had incomes above average; farms in other land-tenure systems had incomes below average. Sharecropped farms had the highest average income. In general, the result showed significant variations between average farm incomes for different types of tenure. The F-ratio was 9.41; it was significant at the .001 level.

Government Agricultural Assistance

Considerable assistance is given to the farmers in the Benghazi area through the Libyan National Agricultural Bank. This assistance takes a number of forms, including the following:

Subsidization of Farm Machinery

The government subsidizes 25 percent of the market price of farm machinery and equipment if it is purchased by an individual and 50 percent if it is purchased by a farming cooperative.

Interest-Free Loans

There are four different types of agricultural loans that are interest-free. They are as follows:

Seasonal loans (crop loans). Loans in this category are used by farmers to support themselves until farm production is underway. These loans last for one year and range from 50 to 300 Libyan dinars (LD) (US\$ 150-9,000). Most of these loans are spent on seeds, pesticides, and fertilizer at the beginning of the planting season.

Medium-term loans. These loans range from 3,000 to 4,000 LD (US\$ 9,000-12,000) and are given to farmers who prefer to purchase farm machinery, usually in the form of sprinkler-irrigation systems, water pumps, tractors, and plowing and harvesting machinery.

Long-term loans (of more than 15 years). These loans are for constructing, reclaiming, or building new farms. A loan of this type is given to the farmer at various time intervals, depending on the kind of farm or project he proposes. The loans range from 1,000 LD (US\$ 3,000) up.

Subsidization of Farm Inputs

The government subsidizes 50 percent of the market price of chemical fertilizers, pesticides, seeds, fodder, and hay. Another type of assistance is the government purchase of olive oil, wheat, barley, peanuts, and almonds from the farmer in the harvesting season at higher-than-market prices. The government then markets the products domestically or exports them.³

Government assistance was examined to ascertain if there was a significant relationship between the number of hectares allocated to each crop on farms in the Benghazi area and the types of assistance received by farmers. In this study, farmers were asked to list the types of government assistance they received in 1980. Then the types of assistance were grouped into five categories based on these responses: (1) machinery and equipment; (2) interest-free loans; (3) subsidization of farm inputs (excluding machinery and equipment); (4) subsidization of farm inputs (fertilizers, seeds, pesticide, and so on) and interest-free loans; and (5) machinery and equipment, subsidization of farm inputs, and interest-free loans. Land-use variables were the same as those used in the analysis of land-tenure systems. The only variables not used in this analysis were number of cattle, number of other animals, and amount of chemical fertilizer. A one-way analysis of variance was used to test significant variations in averages between the types of assistance and the allocation of resources for different agricultural land uses on each farm. Farm

³S. M. Sherif, "The Future of Mechanization in Libya" (Master's thesis, Michigan State University, 1972), pp. 32-35.

size in hectares, numbers of sheep and goats per farm, and income derived from each farm were also tested in relation to types of assistance received by the farmer. (See Table 5.7.)

The results of the analysis showed that the only agricultural land-use variables affected by assistance were the area per farm allocated to grain, number of sheep per farm, and farm size in hectares. The analysis of grain area in relation to assistance showed a significant difference in averages. Farmers who received machinery and equipment at reduced prices allocated an average of 151 hectares to grain cultivation, whereas farmers who received subsidization of farm inputs, machinery, and interest-free loans devoted an average of only 11 hectares to grain cultivation. The F-ratio was 6.66, and the F-probability was .0002. This result was expected because farmers in the study area used more machinery in grain cultivation than they had a decade before.

The number of sheep per farm in the study area was influenced by government assistance. The one-way analysis of variance showed that the average number of sheep per farm on those farms receiving assistance was 127.34. Only farms receiving machinery and farms receiving subsidization and interest-free loans were above average in number of sheep, with 160 and 270.60, respectively. Hence, the result revealed significant variations in averages. The F-ratio was 4.20; the F-probability was .0105. This result is reasonable because most sheep are found in grain-producing areas where plowing and harvesting machines are available. Also, the subsidization of

Table 5.7.--Analysis of variance for types of agricultural land use by types of government assistance.

Type of Assistance	Grain Area (in hectares)	Vegetable Area (in hectares)	Fruit Area (in hectares)	Grazing Area (in hectares)
	$\bar{X}$ 62.40	$\bar{X}$ 6.38	$\bar{X}$ 3.32	$\bar{X}$ 25.49
Machinery and equipment	151.00	0.50	1.50	76.50
Interest-free loans	31.43	3.57	0.00	23.80
Subsidization	18.78	7.04	3.89	19.95
Subsidization and loans	101.20	6.00	3.80	60.20
Subsidization, machinery, and loans	11.00	10.00	2.00	20.00
F-ratio	6.66	.522	.796	2.31
df	4	4	4	4
Significance	.0002	.7196	.5326	.0721

Table 5.7.--Continued.

Type of Assistance	Number of Sheep Per Farm	Number of Goats Per Farm	Farm Size (in hectares)	Irrigated Land (in hectares)	Farm Income (in dollars)
	$\bar{X}$ 127.34	$\bar{X}$ 20.36	$\bar{X}$ 39.58	$\bar{X}$ 10.70	$\bar{X}$ 16,085.10
Machinery and equipment	165.00	52.00	80.00	2.00	8,500.00
Interest-free loans	42.00	29.00	35.43	6.20	21,034.17
Subsidization	117.74	16.03	31.04	10.79	15,171.67
Subsidization and loans	270.60	32.00	108.00	25.00	20,950.00
Subsidization, machinery, and loans	0.00	0.00	30.00	10.00	15,600.00
F-ratio	4.20	.937	4.47	1.25	.350
df	3	4	4	4	4
Significance	.0105	.4306	.0034	.3064	.8431

farm inputs and interest-free loans makes it possible to raise sheep to supply the Benghazi market with lamb meat.

Government assistance is also associated with farm size. The analysis indicated that the average farm size in the study area was 39.58 hectares. Farms receiving machinery, and subsidization and interest-free loans were, on the average, larger, whereas farms receiving only interest-free loans and subsidization were below average. The results also showed significant variations in averages between farms receiving different types of government agricultural assistance. The F-ratio was 4.47; the F-probability was .0034.

The analysis of the remaining variables in relation to types of government assistance showed no significant differences in averages. This indicated that there were no relationships between these variables and government agricultural assistance.

Characteristics of Farmers

Tests were made to determine if there were any significant relationships between land-use-related variables and characteristics of farmers such as age, family size, level of education, length of time spent in agriculture, and occupations. Land-use variables chosen for the analysis were area cultivated in grain per farm in hectares (ARALGRIN), area cultivated in vegetables per farm (ARALVEG), area allocated to fruit per farm (ARALPCP), area specified for grazing per farm (ARALFGRZ), number of sheep per farm (NUMSHP), number of goats per farm (NUMGTS), number of cattle per farm (NUMCTL), farm size in hectares (SIZOFARM), amount of chemical fertilizers used

annually per farm in kilograms (CHFERT), size of irrigated land per farm in hectares (IRRAREA), and annual income per farm in dollars (INCOMFAR). To determine the association between land use and farmers' characteristics, the chi-square test was conducted.

Farmer's Age

Respondents were asked to give or estimate their ages. Their answers were divided into four categories: (1) less than 20 years old, (2) from 20 to 40 years old, (3) from 41 to 60 years old, (4) older than 60 years. Of the 247 farmers who responded to the question, 1 was less than 20 years old, 68 were between 20 and 40 years, 108 were between 41 and 60 years, and 70 were over 60 years old.

The chi-square analysis of land-use variables by farmer's age is shown in Table 5.8. It appears that the result was not significant. The only two variables that indicated a positive relationship were area allocated to vegetables and amount of chemical fertilizers used per farm. The test results showed that at an alpha level of .05 with 4 degrees of freedom, the chi-square value required for significance was 9.49. The raw chi-square of 18.36 was above the significance level, so a significant positive relationship existed between area allocated to vegetables and farmers' ages.

The same held true when the amount of chemical fertilizer used was compared with farmer's age. In this analysis, the raw chi-square obtained was 31.09 at an alpha level of .05 with 10 degrees of freedom. The chi-square value required for significance was 18.31. This indicated that a significant relationship existed between

amount of chemical fertilizers used per farm and farmers' ages. The raw chi-square values for all the remaining land-use variables were insignificant. Hence, no significant relationship between these variables and farmers' ages could be established.

Table 5.8.--Chi-square analysis for types of agricultural land use by farmers' ages.

Land-Use Variables ^a	Raw Chi-Square	df	Probability Level	Significant Value at .05	Significance of Chi-Square
ARALGRIN	7.03	4	.1344	9.49	NS
ARALVEG	18.36	4	.0010	9.49	S
ARALPCP	4.81	4	.3079	9.49	NS
ARALFGRZ	5.76	6	.4510	12.59	NS
NUMSHP	5.74	6	.4531	12.59	NS
NUMGTS	6.40	6	.3794	12.59	NS
NUMCTL	2.23	2	.3279	5.99	NS
SIZOFARM	8.90	10	.5418	18.31	NS
CHFERT	31.09	10	.0006	18.31	S
IRRAREA	10.63	6	.1004	12.59	NS
INCOMFAR	2.12	8	.9772	15.51	NS

S = Significant
NS = Not significant

^aSee page 129 for explanation of land-use variables.

Although two of the land-use variables, ARALVEG and CHFERT, showed significant relationships to farmers' ages, the results generally indicated that farmers' ages were not an important dimension in the types of agriculture practiced in the Benghazi area. Two

reasons for this conclusion can be given. First, most of the farmers depend on hired laborers or members of their families for farm cultivation; second, no important variations were found among farmers' ages. It has already been mentioned that 44 percent of the farmers were between 41 and 60 years of age, which is considered one category in the chi-square analysis.

Family Size

To determine if there were any relationships between family size and land-use patterns, data concerning family members were gathered by direct interviews with farmers in the study area. The frequency distribution of family size based on the farmers' responses is shown in Table 5.9. It appears that 70 percent of the respondents had a family of between 4 and 12 persons. The mean was 8.82; the minimum was 2 persons, and the maximum was 26 persons. For purposes of analysis, family size was categorized into three groups: fewer than 5 persons (42 families), between 5 and 10 persons (135 families), and more than 10 persons (70 families).

Chi-square results of agricultural land-use-related variables by family size indicated no significant relationships. However, the test showed that area allocated to fruit per farm was significant compared to family size. At an alpha value of .05 and with 4 degrees of freedom, the chi-square value required for significance was 9.49. The raw chi-square value was 9.70, which was greater than the required value for significance (see Table 5.10). Hence there was a positive relationship between farm area allocated to fruit and the family size.

Table 5.9.--Frequency distribution of family size in the Benghazi area.

Family Size	Absolute Frequency	Relative Frequency (Percent)	Cumulative Frequency (Percent)
2	7	3	6
3	11	4	10
4	15	6	16
5	20	8	24
6	17	7	31
7	21	9	40
8	32	13	53
9	25	10	63
10	21	9	72
11	8	3	75
12	19	8	83
13	8	3	86
14	7	3	89
15	10	4	93
16	2	1	93
17	3	1	95
18	4	2	96
19	2	1	97
20	4	2	99
23	1	0	99
25	1	0	100
26	1	0	100

Mean: 8.817
 Valid cases: 246
 Standard deviation: 4.548
 Sum: 2,169
 Minimum: 1
 Maximum: 26

Table 5.10.--Chi-square analysis for types of agricultural land use by family size of farmers.

Land-Use Variables ^a	Raw Chi-Square	df	Probability Level	Significant Value at .05	Significance of Chi-Square
ARALGRIN	4.59	4	.3326	9.49	NS
ARALVEG	3.34	6	.7653	12.59	NS
ARALPCP	9.70	4	.0459	9.49	S
ARALFGRZ	1.46	6	.9620	12.59	NS
NUMSHP	7.83	6	.2509	12.59	NS
NUMGTS	0.91	3	.8235	7.81	NS
NUMCTL	1.52	2	.4668	5.99	NS
SIZOFARM	11.61	10	.3118	18.31	NS
CHFERT	7.12	10	.7139	18.31	NS
IRRAREA	4.53	6	.6056	12.59	NS
INCOMFAR	9.19	8	.3267	15.51	NS

S = Significant
NS = Not significant

^aSee page 129 for explanation of land-use variables.

This result occurred because farmers usually count all of their family members, even those who are not engaged in farm business. Another reason was that a large family usually has more access to government assistance than a small family; thus farmers tend to exaggerate their family size in order to reap the benefits of governmental assistance.

Levels of Education of Farmers

Respondents were asked to give their levels of education. Their answers were then categorized into three groups: elementary,

secondary (including middle school), and university levels. Of 250 respondents, 106 (43 percent) had some education. There were 66 farmers who had elementary-level education (62 percent), 32 farmers who had secondary-level education (30 percent), and 8 farmers who had university-level education (8 percent).

To determine relationships between the agricultural land-use variables and levels of education, a chi-square test was used. The result of the analysis was not significant. It appeared that most of the raw chi-square values were lower than the required values for significance. However, the amount of chemical fertilizer per farm was significant. The chi-square result indicated that at an alpha level of .05 with 10 degrees of freedom, the chi-square required for significance was 18.31. The raw chi-square of 20.78 was above the required value for significance (see Table 5.11); thus a significant relationship existed between amount of chemical fertilizer used per farm and level of education of the farmer. Most of the farmers with any education tended to use chemical fertilizers more often than those with no education. Furthermore, most of the educated farmers are located closer to Benghazi, where chemical fertilizers are intensively used.

Length of Time Farmer Has Spent in Agriculture

Length of time spent in agriculture was measured by the number of years the farmer had spent in a farm business. Respondents were asked to give an estimate of how long they had been operating their farms. Of the 250 farmers, 246 responded to the question. The

Table 5.11.--Chi-square analysis for types of agricultural land use by levels of education of farmers.

Land-Use Variables ^a	Raw Chi-Square	df	Probability Level	Significant Value at .05	Significance of Chi-Square
ARALGRIN	7.79	6	.2542	12.59	NS
ARALVEG	4.99	4	.2886	9.49	NS
ARALPCP	12.02	6	.0615	12.59	NS
ARALFGRZ	10.84	12	.5428	21.03	NS
NUMSHP	5.30	6	.5056	12.59	NS
NUMGTS	3.52	4	.4754	9.49	NS
NUMCTL	0.05	2	.9733	5.99	NS
SIZOFARM	15.94	10	.1014	18.31	NS
CHFERT	20.78	10	.0227	18.31	S
IRRAREA	4.53	6	.6056	12.59	NS
INCOMFAR	12.02	12	.4438	21.03	NS

S = Significant
NS = Not significant

^aSee page 129 for explanation of land-use variables.

responses were categorized into five groups: (1) less than 5 years (44 farmers), (2) 5 to 10 years (63 farmers), (3) 11 to 15 years (32 farmers), (4) 16 to 20 years (39 farmers), and (5) more than 20 years (68 farmers).

To determine if there was any significant relationship between land-use variables and time in agriculture, a chi-square analysis was used. Results of the test indicated significant relationships between some of the land-use variables in relation to time in agriculture. Area allocated to vegetables per farm, for example, was significantly

related to the length of time the farmer had spent in agriculture. The chi-square with 8 degrees of freedom and an alpha level of .05 required a value of 15.51 for significance. The raw chi-square value of ARALVEG was 26.61. This value exceeded the value required for significance, so there was a relationship between area allocated to vegetables and the length of time the farmer had spent in agriculture. The same held true when CHFERT, IRRAREA, and INCOMFAR were compared with the length of time the farmer had spent in agriculture. Respectively, the raw chi-squares obtained were 35.61, 25.73, and 24.77 at an alpha level of .05 with 16, 9, and 12 degrees of freedom. The chi-square values required for significance were 26.30, 16.92, and 210.3. (See Table 5.12.) This indicated that significant relationships existed between amount of chemical fertilizers used per farm, irrigated area per farm, and income per farm and length of time the farmer had spent in agriculture.

Occupations of Farmers

It was noted in Chapter II that farms in the Benghazi area represent a symbolic rather than a real source of income. Thus, respondents were asked two questions concerning their occupations. First, the respondent was asked if he was a full-time or part-time farmer ("part-time" indicating that he had a job besides farming). The respondent was also asked to identify his primary job.

It was found that of 250 respondents, 99 farmers (40 percent) had jobs in addition to farming. Respondents who were part-time farmers and had off-farm jobs were categorized into three groups:

Table 5.12.--Chi-square analysis for types of agricultural land use by length of time farmer had spent in agriculture.

Land-Use Variables ^a	Raw Chi-Square	df	Probability Level	Significant Value at .05	Significance of Chi-Square
ARALGRIN	8.98	8	.3442	15.51	NS
ARALVEG	26.61	8	.0008	15.51	S
ARALPCP	14.00	8	.0819	15.51	NS
ARALFGRZ	28.24	24	.2502	36.42	NS
NUMSHP	20.33	12	.0611	21.03	NS
NUMGTS	6.76	8	.5625	15.51	NS
NUMCTL	1.15	4	.8859	9.49	NS
SIZOFARM	16.65	10	.0826	18.31	NS
CHFERT	35.61	16	.0033	26.30	S
IRRAREA	25.73	9	.0023	16.92	S
INCOMFAR	24.77	12	.0159	21.03	S

S = Significant
NS = Not significant

^aSee page 129 for explanation of land-use variables.

school teachers in villages or towns nearby (14 farmers), government employees (60 farmers), and private-enterprise workers (16 farmers).

To determine if there was any relationship between farmers' occupations and agricultural land use in the Benghazi area, the chi-square analysis was used. The results indicated that only two variables were related significantly and positively to farmers' occupations: number of goats per farm and irrigated area per farm. The raw chi-squares, respectively, were 6.03 and 13.41 with 2 and 6 degrees of freedom at an alpha level of .05. The chi-squares required for

significance were 5.99 and 12.59. (See Table 5.13.) Since the raw chi-squares were higher than the required significance, there were relationships between number of goats and irrigated area per farm and farmers' occupations.

Table 5.13.--Chi-square analysis for types of agricultural land use by farmers' occupations.

Land-Use Variables ^a	Raw Chi-Square	df	Probability Level	Significant Value at .05	Significance of Chi-Square
ARALGRIN	6.26	6	.3951	12.59	NS
ARALVEG	8.93	4	.0629	9.49	NS
ARALPCP	5.05	3	.1682	7.81	NS
ARALFGRZ	8.65	6	.1939	12.59	NS
NUMSHP	8.51	6	.2030	12.59	NS
NUMGTS	6.03	2	.0490	5.99	S
NUMCTL	Chi-square invalid; table has one row				
SIZOFARM	10.05	6	.1244	12.59	NS
CHFERT	10.31	8	.2437	15.51	NS
IRRAREA	13.41	6	.0370	12.59	S
INCOMFAR	19.05	12	.0873	21.03	NS

S = Significant
NS = Not significant

^aSee page 129 for explanation of land-use variables.

In summary, four cultural and institutional factors were analyzed in relation to different types of agricultural land use in the Benghazi area. The methods of analysis included the Pearson correlation routine, the one-way analysis of variance, and the

chi-square. The results indicated that a farm's location relative to the Benghazi market and the land-tenure system had major effects on the types of agricultural landscape and on the intensity of cultivation in the Benghazi area. However, the results of the analysis also indicated that the government agricultural assistance and farmers' characteristics had no significant correlation with the types of agriculture practiced and the intensity of land use.

CHAPTER VI

MAJOR RESEARCH FINDINGS

In this chapter, tests of the research hypotheses are presented. These hypotheses were tested by analyzing responses of the farmers to related questions. Following a statement of each hypothesis, the results of analyses performed on the data gathered to test that hypothesis are given. The data were analyzed by Pearson correlation coefficients, by one-way analysis of variance, and by chi-square techniques. The reactions of the farmers to major obstacles affecting agricultural development in the Benghazi area were also examined. Finally, the existing crop-livestock patterns, which were determined by analysis of the data, were compared with agricultural land-use zones hypothesized by the von Thunen model.

Tests of the Research Hypotheses

Hypothesis I

There is a direct relationship between a farm's size and its distance from Benghazi, the central market of the study area; that is, the greater the distance from the city, the greater the size of the farm.

The analysis of this hypothesis was based on responses related to farm size in hectares and distance between the farm and Benghazi in kilometers. Two statistical analyses were undertaken to test the hypothesis: the Pearson correlation coefficient and one-way

analysis of variance. The result of the Pearson routine indicated a positive relationship between farm size and distance from Benghazi, with $r = .376$, which was significant at the .001 level. This supported the hypothesis and implied that, as the distance of the farm from Benghazi increased, the size of the farm increased.

The result of the one-way analysis of variance of farm size in relation to distance of the farm from Benghazi showed that there was a significant difference in averages of farm sizes. Those farms located less than 10 km from Benghazi averaged 10.79 hectares, whereas farms situated more than 60 km away averaged 80.13 hectares. With 6 degrees of freedom, the F-ratio was 8.41, which was significant at the .001 level. (See Table 6.1.) Thus a positive relationship existed between farm size and distance from Benghazi.

Table 6.1.--One-way analysis of variance of farm size by distance of farm from Benghazi.

Distance from Benghazi (in kilometers)	Farm Size (in hectares) $\bar{X}$ 36.63
<10	10.79
10-20	12.30
21-30	27.28
41-50	44.37
51-60	46.48
>60	80.13
F-ratio	8.41
df	6
Significance	.001

The research hypothesis was not rejected on the bases:

(1) a positive Pearson correlation coefficient r , (2) a one-way analysis of variance showing the significant variations in average farm sizes, and (3) a distribution map of farm sizes indicating that farms located close to Benghazi average 10 hectares and farms located farther away from the city average more than 50 hectares.

Hypothesis II

As distance from the city increases, a smaller percentage of a farm's acreage is used for vegetables and fruits and a greater percentage is used for grain cultivation.

The analysis of this hypothesis was based on responses related specifically to area cultivated in vegetables per farm in hectares, area per farm planted in fruits in hectares, area cultivated in grain on each farm in hectares, and distance of farm from the Benghazi market in kilometers. The statistical methods used to test this hypothesis were the Pearson correlation and one-way analysis of variance.

The results of the Pearson correlation routine indicated a positive association between area allocated to grain per farm and distance of farm from Benghazi ($r = .418$). The analysis, however, gave a negative relationship between area allocated to vegetables and land planted in fruits per farm in relation to distance from the city ($r = -.259$ and $-.156$, respectively).

The one-way analysis of variance test showed significant variations in averages of grain area and vegetable area per farm in relation to distance from Benghazi. The F-ratios were 9.01 and 4.99, respectively, both of which were significant at the .001 level. The

result of the test also indicated that variations in averages of fruit area per farm were insignificant. The F-ratio was 1.33; the F-probability was .2432, which was not significant at any level. Thus, the second research hypothesis was not rejected on the basis that only the area planted in fruits in relation to distance of the farm from Benghazi showed a weak relationship.

Hypothesis III

Other factors being equal, such as water availability, soil fertility, and transportation facilities, the intensity of cultivation is inversely related to the distance of a farm from Benghazi; that is, the greater the distance from the city, the less intensively and more extensively a farm is cultivated.

Intensity of cultivation in the Benghazi area is rarely determined by a single factor. Rather, a variety of physical, cultural, and institutional considerations interact causally to affect the degree of agricultural intensity. Generally, water availability, soil fertility, and market attraction exert the strongest influences upon intensity of agricultural land use. In order to test the hypothesis, these factors were assumed to be equal.

The respondents were asked three questions related to the cultivation of their farms dealing with the amount of chemical fertilizer they used, the amount of irrigated land on the farm, and their annual income. These three factors were analyzed in relation to the distance of the farm from Benghazi. Statistical methods used to test the hypothesis were the Pearson correlation analysis, one-way analysis of variance, and frequency distributions.

The frequency distribution of chemical fertilizers showed that the average amount of fertilizer used per farm was 7505 kg, with a minimum of 300 kg and a maximum of 30,000 kg. (See Table 6.2.) Neither the Pearson correlation coefficients nor the one-way analysis of variance indicated significant relationships between the amount of chemical fertilizer used per farm and the distance of the farm from market. The r value was $-.152$; the F-ratio was 1.03 ; and the F-probability was $.409$, which was not significant at any level. (See Table 6.3.) However, the Pearson routine indicated a negative correlation between the amount of chemical fertilizer used per hectare and distance of the farm from the market ($r = -.281$, which was significant at the $.001$ level).

Although it has been found that chemical fertilizers were used by 90 percent of the farmers whose farms were located within 10 km of Benghazi, the inadequacy of agricultural guidance and extension services caused uncertainties among farmers about how much fertilizer per hectare could be used effectively. The farmers also did not know when fertilizer could be applied without harming the fields. Consequently, despite the fact that the government subsidizes the market price of fertilizer, of 250 farms surveyed in 1980, on only 100 of them (40 percent) were chemical fertilizers used.

The irrigated-farming system was discussed in Chapter IV. The analysis here was limited to tests of Hypothesis III. Thus, the area under irrigation per farm was analyzed in relation to distance from Benghazi. The frequency distribution of the responses showed that, of 250 farmers surveyed, 168 (67.2 percent) had irrigated land

Table 6.2.--Frequency distribution: Amount of chemical fertilizers used annually per farm, in kilograms.

Chemical Fertilizers (in kilograms)	Absolute Frequency	Relative Frequency	Cumulative Frequency
300	2	2	3
400	1	1	4
500	4	4	8
700	1	1	9
800	1	1	10
1,000	1	1	11
1,500	4	4	15
2,000	11	11	26
2,200	1	1	27
2,500	7	7	34
3,000	1	1	35
3,500	1	1	36
4,000	1	1	37
4,500	1	1	38
5,000	13	13	51
5,500	1	1	52
6,000	3	3	55
6,500	1	1	56
7,000	2	2	58
7,500	1	1	59
8,000	7	7	66
9,000	1	1	67
10,000	11	11	78
11,000	1	1	79
12,000	5	5	84
12,500	1	1	85
15,000	3	3	88
17,000	1	1	89
17,300	1	1	90
20,000	5	5	95
23,000	1	1	96
25,000	3	3	99
30,000	1	1	100

Mean: 7,505.00
 Valid cases: 100
 Standard deviation: 6,654.039
 Sum: 750,500.00
 Minimum: 300.00
 Maximum: 30,000.00

Table 6.3.--One-way analysis of variance of amount of chemical fertilizers, irrigated land, and farm income by distance from Benghazi.

Distance from Benghazi (in kilometers)	Chemical Fertilizers (in kilograms)	Irrigated Land Per Farm (in hectares)	Income Per Farm (in dollars)
	$\bar{X}$ 7,505.00	$\bar{X}$ 7.90	$\bar{X}$ 12,295.93
<10	10,850.00	9.54	29,502.14
10-20	6,762.07	5.65	8,471.43
21-30	7,063.64	8.84	11,310.41
31-40	8,941.18	11.74	13,465.00
41-50	6,555.55	7.00	8,138.13
51-60	7,500.00	5.88	13,687.95
>60	1,833.33	6.75	11,678.57
F-ratio	1.03	2.40	4.10
df	6	6	6
Significance	.4091	.0301	.0160

on their farms. The average amount of irrigated land per farm in the study area was 7.89 hectares, with a minimum of 1 hectare and a maximum of 55 hectares. (See Table 6.4.)

Although the Pearson correlation analysis showed no significant relationship between area under irrigation per farm and distance from Benghazi ($r = -.067$), the one-way analysis of variance showed a significant difference in average land area under irrigation per farm and distance from Benghazi. The F-ratio was 12.40; the F-probability was .0301, which was significant. (See Table 6.3.)

Table 6.4.--Frequency distribution: Area of irrigated land per farm, in hectares.

Irrigated Land (in hectares)	Absolute Frequency	Relative Frequency (percent)	Cumulative Frequency (percent)
1	6	4	4
2	31	18	22
3	14	8	30
4	18	11	41
5	23	14	55
6	11	7	61
7	5	3	64
8	9	5	70
9	1	1	70
10	21	13	83
11	1	1	83
12	4	2	86
13	2	1	87
14	1	1	88
15	2	1	89
20	6	4	92
23	2	1	93
25	2	1	95
28	1	1	95
30	7	4	99
55	1	1	100

Mean: 7.899
 Valid cases: 168
 Standard deviation: 7.942
 Sum: 1,327.00
 Minimum: 1.00
 Maximum: 55.00

It has been assumed that farms located close to the Benghazi market were intensively cultivated. Thus, they would generate more income than those located farther away. To investigate this assumption, farmers were asked to estimate annual income derived only from farming. Of 250 farmers, 226 responded to the question. The frequency distribution of their incomes, based only on their estimations, is

given in Table 6.5. As shown in this table, the average income per farm for all respondents was \$12,295, with a minimum of \$150 and a maximum of \$95,600. Furthermore, 59 percent of the respondents earned less than \$10,000 from their farms annually, but only 3 percent earned more than \$50,000.

Table 6.5.--Frequency distribution: Annual income per farm, in dollars.

Annual Income (in dollars)	Absolute Frequency	Relative Frequency (percent)	Cumulative Frequency (percent)
150	1	0	0
600	2	1	1
670	4	2	3
1,000	5	2	5
1,005	1	0	6
1,050	5	2	8
1,200	3	1	9
1,300	1	0	10
1,500	9	4	14
1,560	2	1	15
1,570	2	1	15
1,575	1	0	16
1,600	1	0	16
1,630	1	0	17
1,675	2	1	18
1,700	2	1	19
1,950	1	0	19
2,000	5	2	21
2,100	1	0	22
2,160	1	0	22
2,170	1	0	23
2,400	2	1	23
2,470	1	0	24
2,600	1	0	24
3,000	1	0	25
3,350	1	0	25
3,400	1	0	26
3,500	7	3	29
3,900	1	0	29
4,000	1	0	30
4,020	1	0	30
4,100	1	0	31

Table 6.5.--Continued.

Annual Income (in dollars)	Absolute Frequency	Relative Frequency (percent)	Cumulative Frequency (percent)
4,200	1	0	31
4,500	10	4	35
4,560	2	1	36
4,570	1	0	37
4,700	1	0	37
4,780	1	0	38
5,025	1	0	38
5,400	1	0	38
5,600	2	1	39
5,670	1	0	40
6,000	4	2	42
6,700	16	7	49
7,000	2	1	50
7,500	10	4	54
7,705	1	0	55
7,800	1	0	55
8,100	1	0	56
8,375	1	0	56
10,000	5	2	59
10,050	10	4	63
10,500	6	3	66
10,750	1	0	66
11,500	1	0	67
11,700	1	0	67
12,000	3	1	69
12,300	1	0	69
12,400	1	0	69
12,500	2	1	70
12,600	2	1	71
12,700	1	0	72
13,100	1	0	72
13,400	2	1	73
13,600	1	0	73
14,000	1	0	74
15,000	2	1	75
15,075	1	0	75
15,600	3	1	77
15,700	2	1	77
16,000	4	2	79
16,700	2	1	80
16,730	1	0	81
17,000	1	0	81
17,600	1	0	81
18,000	2	1	82
18,700	1	0	83

Table 6.5.--Continued.

Annual Income (in dollars)	Absolute Frequency	Relative Frequency (percent)	Cumulative Frequency (percent)
19,500	1	0	83
21,000	4	2	85
21,700	1	0	85
21,900	1	0	86
22,000	1	0	86
23,000	1	0	87
23,100	1	0	87
23,430	1	0	88
23,450	1	0	88
23,500	2	1	89
23,600	1	0	89
24,000	1	0	90
25,000	1	0	90
25,660	1	0	91
26,800	1	0	91
30,690	1	0	92
32,500	1	0	92
37,000	1	0	92
37,800	1	0	93
40,200	1	0	93
42,000	1	0	94
42,500	1	0	94
45,000	2	1	95
45,670	1	0	96
47,000	1	0	96
48,000	1	0	96
53,000	1	0	97
57,700	1	0	97
65,000	1	0	98
70,000	1	0	98
72,000	1	0	99
84,670	1	0	99
90,000	1	0	100
95,600	1	0	100

Mean: 12,295

Valid cases: 226

Standard deviation: 15,542.568

Sum: 2,778,880.00

Minimum: 150.00

Maximum: 95,600.00

Despite the fact that the Pearson correlation routine showed no significant association between farm income and distance of farm from the Benghazi market ($r = .072$), there was a significant negative correlation between annual farm income per hectare and distance from the Benghazi market ($r = -.300$, which was significant at the .001 level). This result was due to the previously discussed fact that farm size increased with distance from Benghazi.

One-way analysis of variance results showed a significant difference between average annual income per farm in relation to distance from the market. It was found that the average income for farms located less than 10 km from Benghazi was \$29,502.14, whereas those located more than 60 km away had an average income of \$11,678.57. The F-ratio was 4.10; the F-probability was .0160, which was significant at the .05 level. Thus, the research hypothesis was not rejected on the following bases: (1) the Pearson correlation analysis showed significant negative relationships between annual amount of chemical fertilizer used per hectare and distance of farm from Benghazi, and (2) the one-way analysis of variance results indicated a significant difference in mean values of land under irrigation and of farm income in relation to distance of farm from the city. Both conclusions supported the research hypothesis.

Hypothesis IV

Farms in the marginal area of the study are more likely to be devoted to grazing and animal husbandry.

To test this hypothesis, the Pearson correlation routine and a one-way analysis of variance were used. The former was used to

determine the direction and strength of relationships between the variables, and the latter was used to see if there were any significant variations among averages. Variables used for the analysis were area per farm allocated to grazing in hectares, number of sheep per farm, number of goats per farm, number of cattle per farm, and number of other animals per farm. These variables were analyzed in relation to the distance between each farm and the Benghazi market.

The results of the Pearson correlation analysis showed a positive relationship between distance from Benghazi and area allocated to grazing per farm ($r = .378$), implying that the greater the distance from the city, the greater the area of grazing. The results of the test also indicated a positive correlation between the number of sheep, goats, and other animals per farm in relation to distance from the market. The r values were .303, .269, and .321, respectively. The number of cattle per farm, however, showed a negative correlation with distance from Benghazi ($r = -.143$).

The results of the one-way analysis of variance for the same variables indicated significant variations in averages of grazing area in relation to distance of farm from Benghazi. The F-ratio was 7.23; the F-probability was significant at the .001 level. The results also showed a significant variation in average numbers of sheep, goats, and other animals per farm in relation to distance from the city. The F-ratios were 5.34, 2.99, and 6.36, respectively, which were significant at the .001 level. The number of cattle, however, in relation to distance of farm from Benghazi, was not important in the one-way analysis of variance. The F-ratio was 1.28; the

F-probability was .2689, which was not significant at any level.

Thus, the research hypothesis was not rejected on the basis of only the number of cattle per farm in relation to distance of farm from Benghazi was negative in the Pearson correlation analysis and not significant in the one-way analysis of variance.

Hypothesis V

The land-tenure systems affect the types of crops cultivated. For example, sharecroppers are more likely to concentrate on cash crops such as vegetables, whereas farmers who have squatter's rights and inherited farms are more likely to use large parts of their farms to cultivate grain and to graze animals.

To test this hypothesis, six agricultural land-use variables were chosen for analysis: area allocated for grain per farm in hectares, area cultivated in vegetables per farm in hectares, grazing area per farm in hectares, number of sheep per farm, number of goats per farm, and number of cattle per farm. These variables were analyzed in relation to the five major land-tenure systems in the Benghazi area: squatter's rights, inheritance, purchase, sharecropping, and other types of tenure. The only statistical method used for the analysis was one-way analysis of variance.

The results of the test showed significant variations in averages when agricultural land-use variables were related to types of land-tenure systems. On squatter's-rights farms, more land was allocated to grain cultivation ($\bar{X} = 68.61$ hectares). On inherited farms, which had the second-highest average area of grain cultivation, the average was 7.94 hectares. Other types of land tenure such as rented farms, with an average of 2.22 hectares, had the lowest average

of grain-cultivation areas. The F-ratio was 12.59; the F-probability was significant at the .001 level.

The test also indicated a significant variation in average area allocated to vegetables per farm in relation to land-tenure systems. On squatter's-rights farms, less area was allocated to vegetables than on sharecropped farms. The F-ratio was 8.39; the F-probability was significant at the .001 level. The results also showed a significant variation in the average grazing area, number of sheep, number of goats, and number of cattle per farm. On squatter's-rights farms there were larger grazing areas and more sheep and goats raised than on sharecropped farms. Thus, the hypothesis was not rejected.

Hypothesis VI

Government-assistance programs have a great effect on the variation of agricultural land use in the Benghazi area. For example, farmers who receive agricultural machinery and interest-free loans are more likely to cultivate a larger part of their farms with grain than those who receive only interest-free loans.

The analysis of this hypothesis was based on the relation of agricultural land-use variables to types of government assistance received by the farmers. The land variables used in the analysis were area allocated to grain cultivation per farm in hectares, area allocated for vegetables per farm in hectares, area planted in fruits in hectares, area allocated for grazing per farm in hectares, number of sheep, and number of goats per farm. The types of government assistance were divided into five categories based on the farmers' responses: (1) machinery; (2) interest-free loans; (3) subsidization

Of farm inputs; (4) subsidization of farm inputs and interest-free loans; and (5) subsidization of farm inputs, machinery, and interest-free loans. One-way analysis of variance was used in the analysis.

The results of the test gave significant variations in the average areas allocated for grain and the number of sheep per farm in relation to types of government assistance. The F-ratio for grain area per farm was 6.66; the F-probability was .0002, which was significant. The F-ratio for the number of sheep per farm was 4.20; the F-probability was .0105. The research hypothesis was rejected on the basis that only area allocated for grain per farm and number of sheep per farm indicated significant relationships with types of government assistance.

Hypothesis VII

Significant relationships exist between farmers' characteristics (age, family size, level of education, length of time in farming, and occupation) and the types of agriculture practiced in the Benghazi area.

To test this hypothesis, characteristics of farmers were related to agricultural land-use variables. The variables representing characteristics of farmers were age, family size, level of education, length of time spent in agriculture, and additional occupations. These variables were analyzed in relation to grain area per farm in hectares, vegetable area per farm in hectares, area planted in fruits per farm in hectares, grazing area per farm in hectares, number of sheep per farm, number of goats per farm, farm size in hectares, annual amount of chemical fertilizer used per farm in kilograms,

irrigated area per farm in hectares, and annual income per farm in dollars. The chi-square test was used for this analysis.

In general, the results of the analysis indicated that the relationships between most of the farmers' characteristics and types of agricultural land use were not significant. However, significant correlations existed between some land-use variables and farmers' characteristics. The results of the test showed that age, for example, was positively related to the amount of land allocated to vegetables per farm and amount of chemical fertilizer used per farm. Significant relationships were found between family size and area planted in fruits. This relationship indicated that the greater the family size, the larger the amount of land devoted to cultivation of fruits per farm. Level of education did not appear to be an important factor determining land use. The only variable significantly related to level of education was the amount of chemical fertilizer used per farm. The results of the test also gave significant relationships between length of time spent in agriculture and the amount of land devoted to vegetables per farm, amount of chemical fertilizers, irrigated area per farm, and annual income derived from each farm. Finally, additional occupations was significantly related only to number of sheep per farm and to amount of irrigated land per farm. The hypothesis was rejected because farmers' characteristics were significantly related only to a few agricultural land-use variables and had no effect on agricultural land-use patterns in the Benghazi area.

Farmers' Reactions to Major Difficulties Facing
Agricultural Development in the Benghazi Area

This section discusses spatial variations in farmers' reactions toward some difficulties affecting agricultural land use in the Benghazi area. This discussion, which is based only on the farmers' responses to related questions, will help the agriculturalists as well as government agencies and institutions to develop sound future agricultural plans in the study area.

The farmers' responses to an open-ended question were categorized as follows: (1) shortage of suitable water for agriculture (WATAVA), (2) weak agricultural extension services (EXTSERV), (3) contradictory agricultural policies of government agencies and institutions (CONGOVPOL), (4) delays in distributing seeds during plowing season (DELSEED), (5) lack of agricultural assistance (LACAGAS), (6) shortage of spare parts for agricultural machinery (SHSPAMAC), (7) lack of paved roads (LACPAROAD), and (8) other difficulties (OTHDIFF). The two methods of analysis used were frequency distribution and cross-tabulation. The former was undertaken to give descriptive data, such as means, standard deviations, and percentages, and the latter was conducted to show the relationship between major difficulties facing agricultural development in the area and the location of farmers' land.

Water Shortage

The shortage of water suitable for agriculture is a primary crop-production handicap in the Benghazi area.¹ Table 6.6, which depicts the frequency distribution of 250 respondents, indicates that 104 farmers (46 percent) complained about water shortage. The most complaints were made by farmers in the districts of al-Faakat, al-Kuwaifia, Attaria, Benina, Bu Atni, Deriana, Gaminis, and Sidi Khalifa. (See Table 6.7.) Most of these districts are located close to Benghazi City, where farms are intensively cultivated. Since most of the irrigated farms are located close to Benghazi, this indicates that most of the water complaints came from farmers practicing irrigation.

Table 6.6.--Responses of the farmers to difficulties facing agricultural development in the Benghazi region--1980.

Difficulties ^a	Yes		No	
	No. of Farmers	Percent	No. of Farmers	Percent
WATAVA	104	46	121	54
EXTSERV	70	31	155	69
CONGOVPOL	32	14	193	86
DELSEED	107	48	118	52
LACAGAS	147	65	78	35
SHSPAMAC	135	60	90	40
LACPAROAD	88	39	137	61
OTHDIFF	211	94	14	6

^aSee page 158 for explanation of the difficulties variables.

¹"Water" here refers to underground water as well as rainfall.

Table 6.7. --Percentage of farmers complaining about agricultural difficulties by districts.^a

District	WATAVA	EXTSERV	CONGOVPOL	DELSEED	LACAGAS	SHSPAMAC	LACPAROAD	OTHDIFF
al-Faakat	100.0	100.0	12.5	50.0	75.0	75.0	87.5	100.0
al-Kuwaifia	54.0	81.8	18.2	54.0	63.0	90.9	81.8	100.0
al-Mabni	14.3	57.1	14.3	85.7	71.4	42.9	85.7	100.0
al-Qawarisha	50.0	90.0	--	60.0	60.0	50.0	50.0	90.0
Annawwagia	5.6	50.0	11.1	38.9	66.7	61.1	50.0	88.9
Attaria	50.0	--	--	66.7	83.3	83.3	33.3	100.0
Benina	66.7	22.2	11.1	22.2	55.6	66.7	44.4	77.8
Bersis	25.0	25.0	--	62.5	100.0	100.0	62.5	100.0
Bu Atni	75.0	25.0	25.0	50.0	50.0	50.0	50.0	100.0
Bu Jarrar	50.0	--	--	75.0	75.0	100.0	--	100.0
Dar al-Araibat	28.6	28.6	--	57.1	71.4	42.9	57.1	100.0
Deriana	63.2	36.8	--	26.3	68.4	31.6	63.2	100.0
Ganfuda-Gar Yunis	--	33.3	--	33.3	100.0	66.7	66.7	100.0
al-Khadra	32.1	--	80.3	50.0	33.9	33.6	16.7	91.0
Gaminis	76.2	47.6	--	28.6	76.2	57.1	38.1	95.1
Sawani Tika	33.3	--	--	50.0	83.3	83.3	33.3	83.3
Sidi Bu Fakhra	--	25.0	--	50.0	75.0	75.0	--	100.0
Sidi Khalifa	69.2	--	--	46.2	61.5	53.8	15.4	100.0
Sidi Suwaker	20.0	--	--	20.0	80.0	80.0	--	100.0
Suluq	43.2	2.7	51.4	48.6	40.5	48.6	10.8	86.5
al-Aguria-Irdano	38.5	30.8	30.8	76.9	82.3	84.6	23.1	92.3

^aSee page 158 for explanation of the difficulties variables.

Weak Agricultural Extension Services

In Libya in general and in the Benghazi area in particular, the Secretariat of Agrarian Reform and Land Development provides all extension services for farmers.² These services were viewed as poor and unorganized by the respondents. Of 250 farmers surveyed, 70 of them (31 percent) had complaints about extension services, especially agricultural guidance. Most of the complaints came from farmers in the districts of al-Faakat, al-Kuwaifia, al-Mabni, al-Qawarisha, and Annawwagia.

Contradictory Agricultural Policies

There are many government agencies and institutions that carry out different agricultural-development strategies in the Benghazi area. The Secretariat of Agrarian Reform and Land Development and its affiliated authorities sponsor many new agricultural and land-reclamation projects, while the Secretariat of Planning also engages in agricultural-development planning. These redundant agencies and authorities sometimes contradict each other, and consequently farmers receive different orientations and orders. In the fall of 1980, for example, the Jabal al-Akhdar Agricultural Authority fenced large areas in southwest Benghazi and asked the farmers not to plow, but two weeks later the Secretariat of Agrarian Reform and Land Development gave permission for the farmers to start plowing. In another

²The primary tasks of the agricultural extension services are to provide technical orientation and guidance to crop-livestock producers and to emphasize extension training for both government technicians and farmers.

example, the General Water Authority (Benghazi branch) drew a line from north of Annawwagia to south of Suluq and refused to give any farmer permission to drill new wells east of this line. However, permission was given from other agencies even east of the line.

It was found that 32 farmers (14 percent) had complaints about contradictory agricultural policies. Most of the complaints came from farmers in the districts of Suluq, al-Khadra, and al-Aguria.

Delays in Seed Distribution

Seeds (mainly wheat and barley) are usually distributed at the beginning of plowing season (late September and early October) by different government agencies and agricultural cooperatives. Because of unorganized channels of supply, the availability of seeds is sometimes delayed several weeks at the beginning of plowing season.

An average of 48 percent of the farmers in the Benghazi area complained about delays in seed distribution, but the highest percentages were 85 percent in the district of al-Mabni, 66 percent in the district of Attaria, 75 percent in the district of Bu Jarrar, and 76 percent in the district of al-Aguria-Irdano. Most of these districts are located in the grain-production zone, which is discussed in Chapter IV.

Lack of Agricultural Assistance

Agricultural assistance was previously analyzed in relation to agricultural land-use variables (see Chapter V). No significant relationships appeared, primarily because the assistance is not organized and only a few farmers have access to it.

It was found that 65 percent of the farmers surveyed had complaints about the lack of government agricultural assistance. The most complaints were found in the districts of Bersis, Ganfuda-Gar Yunis, and al-Aguria-Irdano.

Shortage of Spare Parts for Machinery

Most agricultural equipment in Libya is imported, except for some hand tools. All of the farm power machinery is imported. Even though there were 12 dealers in the late 1960s importing machines from various countries, only three main repair workshops had been established in the entire country, none of them in the Benghazi area. Then in 1974 the government became a major importer of agricultural machinery through the Libyan National Agricultural Bank. This move by the government was to control machinery prices, provide maintenance for the machines, and provide good service to the farmers. The problem of a lack of skilled operators, mechanics, and maintenance shops persisted, however.

The chief complaints of the farmers surveyed in 1980 were about the lack of maintenance in general and a shortage of spare parts for their machinery in particular. Table 6.6 indicates that 135 farmers complained about this, most of them in the districts of Bersis, Bu Jarrar, al-Kuwaifia, Attaria, Sidi Bu Fakhra, and Sidi-Suwaker.

Lack of Paved Roads

Transportation facilities are some of the most important factors in agricultural development, especially where agricultural machinery and equipment are used heavily. The study area is served by a total of 725 km of roads; the road most accessible to Benghazi City is the Coastal Highway. Although there are many short roads connecting some remote areas to Benghazi, such as the Benghazi-Annawwagia-Suluq road, many farms and agricultural areas are served with paths and poor, unpaved roads, and the farmers encounter difficulties taking their produce to the market.

It was found that 88 farmers (39 percent) of those surveyed complained about the lack of paved roads. Table 6.7 shows that most of the complaints came from farms located in the districts of al-Faakat, al-Kuwaifia, al-Mabni, Dar al-Araibat, Ganfuda-Gar Yunis, and Deriana.

The table also indicates that 211 farmers (94 percent) in all districts complained about other difficulties, such as lack of pesticides, shortage of animal vaccines, or lack of training programs.

Von Thunen Model and the Actual Land-Use Patterns in the Benghazi Area

An attempt was made to see if there were similarities between the actual land-use zones in the Benghazi area as determined by this research and those identified by the von Thunen model. This study did yield agricultural land-use patterns that could be compared with the zonal pattern shown by the model (see Chapter III).

Generally, the Benghazi area's physical and cultural characteristics appear similar to those projected by the model. This makes a comparison of its actual agricultural land-use pattern and a von Thunen-type model worthwhile. To make this comparison, three basic steps are necessary. First, the von Thunen assumptions for applying his model should be investigated for the physical and cultural conditions of the Benghazi area. Second, the similarities between the actual and theoretical land-use patterns should be determined. And finally, deviations from the model should be explained.

Benghazi as an Isolated State

To apply his model, von Thunen made seven assumptions:

(1) completely rational economic behavior, (2) an isolated state, (3) a single central city, (4) a village type of settlement away from the central city and an ethnically homogeneous population, (5) uniform topography, (6) uniform soil fertility and climatic conditions, and (7) a relatively primitive transportation system.³ Each of these assumptions must be applied to the Benghazi area landscape to determine its degree of applicability. Griffin mentioned, however, that several of these strictly defined limiting concepts were later modified by von Thunen and others to permit a closer approximation of the real world.⁴

The farmers in the Benghazi area are not totally rational in economic behavior. Yet within the limits of their information and

³Peter Hall, ed., Von Thunen's Isolated State (Oxford: Pergamon Press, Ltd., 1966), p. 72.

⁴Griffin, p. 199.

investment opportunities, it can be said that they are reasonably rational. It was found that farmers close to the Benghazi market intensively cultivated their fields, a result that supports the above-mentioned conclusion that farmers in the study area are economically rational.

The Benghazi area is a good example of an isolated economic unit. The area is bordered on the northeast and east by the Jabal al-Akhdar Region and on the northwest and west by the Mediterranean Sea, both acting as the wilderness outlined in the model. To the south is the al-Khalej Region, one of the less developed and more isolated regions in the whole country. Furthermore, no major urban centers have developed closer to the study area to attract agricultural products away from the Benghazi central market. So despite the fact that the area is not totally isolated, it is well suited to an isolated economic state.

Benghazi City, with its growing population, is not only the major urban center but also the largest city in the region (see Chapter II). It is also the market for the vast majority of all surplus agricultural products destined for domestic consumption. The city, however, is not centrally located, which violates the central-city assumption of the model.

The rural Benghazi area is sparsely populated, with only about 4 percent of the population residing in rural areas. The most common form of settlement is the small town of 10,000 inhabitants or less. This is represented by Gaminis, Suluq, al-Aguria, and Deriana. Smaller villages are widespread. As a generalization, one could characterize

the rural-settlement pattern as a village type. Furthermore, the cultural traits of the population in the Benghazi area are generally homogeneous.

Topographically, the area is relatively featureless. It is dominated by undulating plains of slight local relief, with only two landform regions varying from the general pattern: the coastal plain and the Benina Platform.⁵ Because of the Benghazi area's small size and similarity of landforms, the climate and soil fertility (discussed in Chapter II) are relatively uniform. These characteristics meet the basic criteria set forth by von Thunen.

The last simplifying condition is that of a primitive and uniform transportation network. The Benghazi area, as mentioned, is served by only one access road, the Coastal Highway, which extends from north to south. In addition, there are some narrow one-way paved roads connecting many towns and villages with Benghazi City or with the Coastal Highway. In this sense, the area has fairly uniform transportation linkages, especially along the coastal plain (see Figure 6.1).

In general terms, the Benghazi area embodies many of the essential characteristics of the "Isolated State." Its farmers react in a fairly rational manner in their economic behavior, the agricultural output is almost entirely consumed locally, and Benghazi acts as the marketing center for a large percentage of surplus farm production. The settlement pattern and population composition are

⁵For more details, see Chapter II.

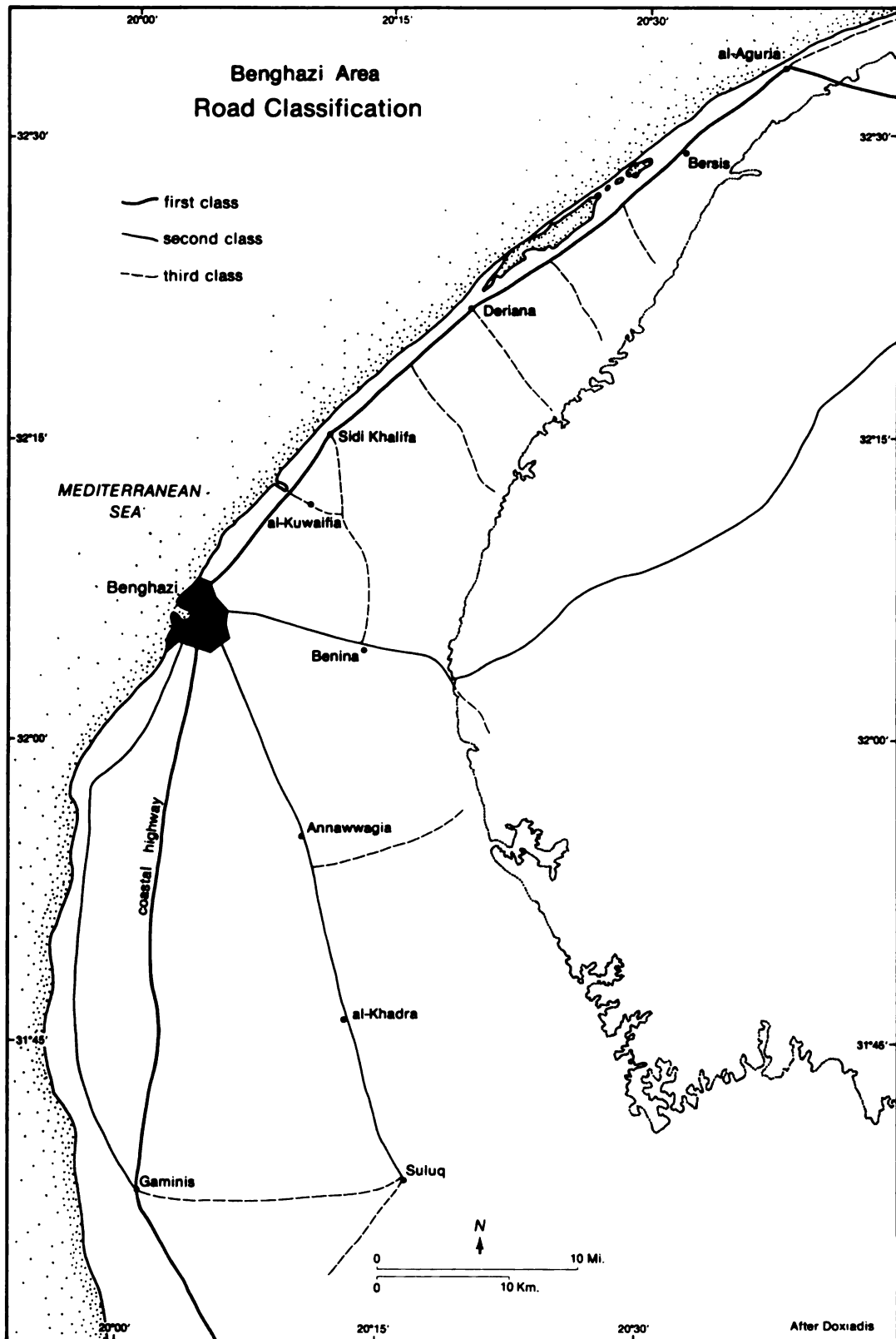


Figure 6.1

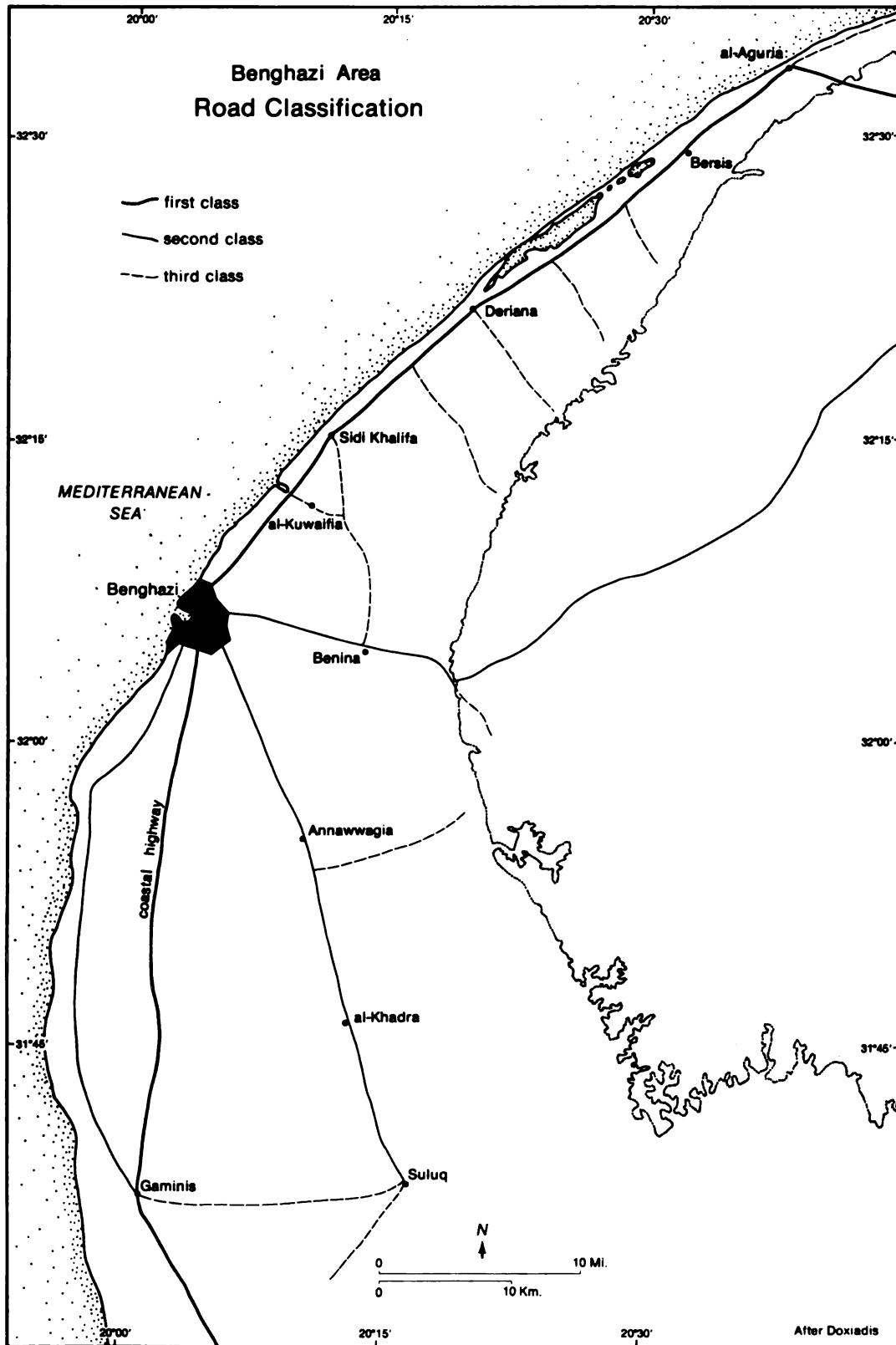


Figure 6.1

relatively similar to those hypothesized by the model. Topographic, climatic, and soil-fertility conditions are quite uniform.

However, some rigid assumptions implied in the theory should be relaxed if the comparison between the model and the actual land-use patterns is to become valid. von Thunen envisioned a centrally located city around which concentric rings of agricultural land uses would develop, each decreasing in intensity as the distance from the city increased. Although Benghazi is not centrally located, it is the largest city not only in the study area but also in the whole eastern region. Furthermore, it represents a major commercial, financial, and industrial center, emphasizing its importance as the area's central market.

Although the transportation network in the study area is not as primitive as that of the theory, it is still inefficient in connecting all parts of the area. The districts of Suluq, al-Khadra, and a large part of Deriana, for example, are not well connected with Benghazi City.

The model is well suited if the study area is a circle with the market in the center. Although the Benghazi area is triangular and the city is not in the center, it is found that Benghazi, with its location, acts as a central market and the triangular shape of the area is acceptable for demonstrating the model.

Similarities and Differences Between the Model and the Actual Land-Use Zones

A comparison of actual land-use patterns and the von Thunen model for the Benghazi area should provide useful insights into the

theory's relevance for understanding agricultural land-use distribution. To estimate the extent of agreement between the model and reality, it becomes necessary to analyze the similarities and differences between theoretical and actual land-use conditions.

Based on the previous analysis and on agricultural land-use distribution maps, theoretical land-use zones were simplified and grouped into three classes for comparison purposes: (1) horticulture and market gardening, (2) grain production, and (3) livestock raising. These three theoretical classes were then compared with the actual land-use patterns already determined (see Chapter IV).

To determine the similarities and differences between the model and the actual land-use distributions, two maps were constructed. Figure 6.2 shows the hypothetical distribution of agricultural land-use zones under the model's rigid conditions. Figure 6.3 indicates actual land-use zones based on results of the land-use distribution maps, previous analysis of the interview schedules, the soil-classification map, and the writer's personal observations.

From the model, one can develop a useful overall impression of how the land-use intensity varies spatially in the study area. First, there is an intensive zone of horticulture and market gardening (mainly vegetables) surrounding Benghazi, as suggested in the model. Second, there is a zone of grain production that is less intensive, which occupies large areas in the south and east. Third, an extensive zone of livestock raising occupies most of the southern districts with a narrow strip following the Ar-Rajma Escarpment to the north.

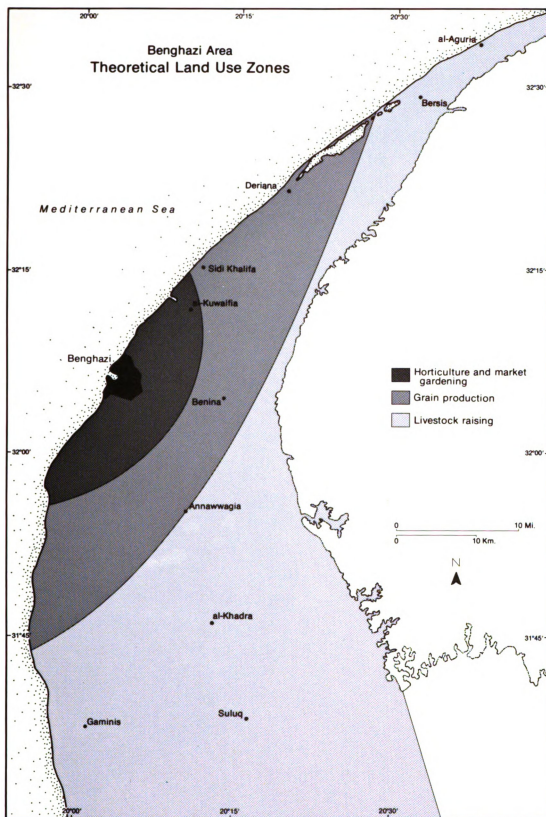
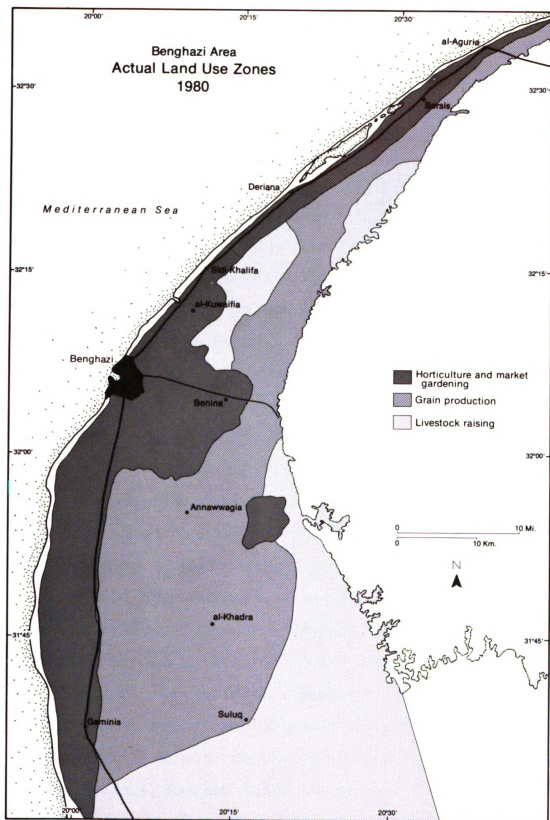


Figure 6.2



See Figure 6.1 for road explanation.

Figure 6.3

At this level of generalization, however, only a simplified area of land-use distribution is presented.

The actual land-use distributions in the Benghazi area reflect the complexities of the real world, although simplifications are being made here to show the similarities and differences between the model and reality. Intensity of agricultural land use was measured here only in terms of application of chemical fertilizers, area under irrigation per farm, and income derived from each farm. Given these factors, it was found that the intensity of agricultural land use was related to distance from Benghazi and the Coastal Highway. First there is an intensive zone of vegetable production surrounding Benghazi and extending along the highway to the north and south. Second, the less intensive grain-production zone was found mainly between Annawwagia, Suluq, and the Coastal Highway. This zone extends to the north along the Ar-Rajma Escarpment. Third, a livestock-raising zone occupies the area south of the Suluq-Gaminis axis, with some areas north and northeast of Benghazi City (see Figure 6-2). When analyzing the location of these individual zones compared to the model, some accord exists between intensity of land use and distance from Benghazi. The horticulture and market-gardening zone, for example, although extending to the south and north, surrounds the urban market. The grain-production zone is somewhat more distant, much as the theory predicts. The location of the livestock-raising zone, although far south of Benghazi, does not violate the sequence of the theory. Therefore, the general sequence of land use in these three patterns corresponds well to what might be expected theoretically.

Despite the considerable agreement between actual land-use patterns and the von Thunen model at a general level, there are some differences. The horticulture and market-gardening zone, for example, although surrounding the city in three directions, extends north and south along the Coastal Highway, and the grain-production zone extends north and south without surrounding the market. Furthermore, the livestock-raising pattern is concentrated only in the southern part of the study area.

In conclusion, the following findings were reached, based on testing the research hypotheses, on analysis of the farmers' reactions to the major difficulties facing agricultural development, and on comparison of the theoretical land-use zones, hypothesized by von Thunen, with the actual land-use distribution in the Benghazi area:

1. The first research hypothesis was formulated to ascertain any possible relationship between farm size in acreage and distance from the Benghazi market. The results of the analysis indicated that a significant association existed between size of farms and distance from the market. That is, as distance from the market increased the size of farms increased.

2. The purpose of the second hypothesis was to ascertain if there was any relationship between a farm's location relative to the Benghazi market and areas per farm allocated to vegetables, fruits, and grain. The results of the tests indicated a significant correlation between farm location and areas allocated to vegetables, fruits, and grain. That is, the greater the distance of the farm

from the market, the smaller the area allocated to vegetables and fruits and the more land per farm cultivated in grain.

3. The objective of the third hypothesis was to determine the relationship between distance from the Benghazi market and agricultural land-use intensity in terms of fertilizers, irrigated land, and income derived from each farm. The results of the analysis indicated that more chemical fertilizers were used on farms close to Benghazi. Furthermore, farms located close to the city had more irrigated area and had higher incomes than those farther away. Consequently, the distance from Benghazi affected the intensity of agricultural land use.

4. The fourth hypothesis dealt with the relationship between farm location in the study area and amount of land allocated to grazing and animal husbandry. The results of the tests showed a significant relationship between distance from the Benghazi market and area allocated to grazing and animal husbandry. That is, farms located on the margin of the study area allocated more land to grazing than those located close to the market.

5. The fifth hypothesis was aimed at ascertaining any relationship between agricultural land use and the land-tenure systems. The results of a one-way analysis-of-variance test indicated a significant relationship between agricultural land use and land-tenure systems. That is, squatter's-rights farmers allocated more land to grain and grazing than did sharecroppers, farmers who concentrate more on cash crops.

6. The purpose of the sixth hypothesis was to identify any relationships between the area allocated to each crop in the study area and the type of government agricultural assistance. One-way analysis of variance was used to test the hypothesis. No significant relationship was found between agricultural land use and government agricultural assistance.

7. The purpose of the seventh hypothesis was to see if there was any association between farmers' characteristics, such as age, family size, level of education, time in agriculture, and occupation, and types of agricultural land use. The result of the test indicated no significant relationship between farmers' characteristics and types of agricultural land use practiced.

8. It was found that the primary difficulties that affect agricultural land use in the Benghazi area were water shortage, inadequate extension services, lack of agricultural assistance, shortage of spare parts for agricultural machinery, and lack of paved roads. The results of the analysis of the farmers' responses indicated that most of the complaints about water shortage came from farmers located close to Benghazi, where farms were intensively cultivated. A shortage of spare parts and delays in seed distribution were the major difficulties in the grain-production zone, whereas the other difficulties had no clear spatial distribution.

9. The von Thunen model of agricultural land-use intensity appeared applicable in a modified way to the actual land-use intensity in the Benghazi area. It was found that the intensity of land use decreased outward from Benghazi market and formed three distinct

agricultural zones: a horticulture zone around Benghazi and along the Coastal Highway, a less-intensive grain-cultivation zone, and an extensive grazing zone that was basically located in the southeast of the study area. The existence of these zones resembled the sequences of agricultural zones identified by the von Thunen model under certain conditions.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

Summary

The Benghazi area is one of the most important agricultural areas in Libya. Even taking into account the flow of money from the oil sector, the area's economy is based largely on agriculture and livestock production. A wide variety of vegetables, fruits, and grains can be grown mainly because of the physical environment as well as cultural and institutional factors. Consequently, the Benghazi area is vitally important to Libya as a producer of winter wheat and barley. Sheep grazing has traditionally been the area's chief pursuit, but it has declined in recent years because of the migration of many young farmers from rural areas to the urban center of Benghazi and also because of rising farm-production costs and low market prices. Goats and cattle are less important than sheep because of economic and cultural considerations. Livestock raising, however, is not a separate or alternate system of production but rather a mutually supportive and interdependent part of a single system. Given these conditions, the delimitation of current crop-livestock patterns and preparation of updated agricultural land-use maps was paramount. In turn, the effect on rural land use of cultural factors such as farm location in relation to the Benghazi market, the land-tenure

system, government agricultural policy, and farmers' characteristics was important.

The present study, therefore, constituted a geographic appraisal of current agricultural land-use patterns in the Benghazi area, as well as the effect of selected cultural factors on these patterns. Agricultural land-use obstacles as perceived by the farmers were also studied. The investigation was both descriptive and exploratory in nature. Descriptive portions included the reporting of information obtained through library research and land-use mapping. An overview of the Benghazi area, including physical features, cultural characteristics, the economic base, and a brief review of the related literature, was also given. Reviews of some agricultural land-use and location theories, the method of sampling, the pilot survey, and analysis procedures were discussed in the descriptive portion of the study. The analysis of data obtained from the interview schedule, the testing of research hypotheses, and comparison of the agricultural land-use zones suggested by the von Thunen model with the actual land-use patterns in the Benghazi area constituted the exploratory portion of this research.

Conclusions

A detailed analysis of land-use patterns in the Benghazi area and the major cultural factors affecting the spatial patterns of agricultural activities have been presented in this study. Conclusions drawn from this study are based on the interpretation of descriptive information, including the writer's field-study experience,

maps, published and unpublished materials, and informal discussions and interviews with many administrative officials. These conclusions were also based on the tabulation and analysis of data obtained through administration of an interview schedule conducted in the Benghazi area in the summer of 1980. They include the following:

1. Given the physical characteristics of the Benghazi area, especially the marginal rainfall and soil fertility, and the basic cultural preferences of landholders, agricultural land use will continue to be dominated by grains (mainly wheat and barley) and grazing animals in the foreseeable future.

2. Based on crop combinations and intensity of cultivation, the Benghazi area presents three zones of agricultural land use: (1) an intensive crop-production zone where horticulture and cash crops (mainly vegetables) are grown; (2) a mixed-crop-livestock zone, where grain cultivation and sheep raising are practiced simultaneously; and (3) a grazing zone distinguished by a greater number of sheep and goats.

3. Agriculture and the grazing of animals in the Benghazi area are not separate or alternative productive systems but rather mutually supportive and interdependent parts of a single system. Similarly, no pure grazing is found in the area under consideration, although livestock are found with varying densities in the 21 districts surveyed. Thus, livestock raising is an integral part of the agricultural system, despite the fact that its importance is considerably less than vegetable and grain cultivation.

4. The existence of several distinct crop zones, based generally on distance from Benghazi, supports the concept that spatial patterns exist in the agricultural land use of the area.

5. Distance from Benghazi market and land-tenure systems are important factors affecting agricultural land-use patterns in the area.

6. Government assistance and characteristics of farmers had little influence on increasing farm production and the agricultural landscape.

7. There are several difficulties that affect agricultural development in the Benghazi area. The primary ones are shortage of suitable water for agriculture, inadequate extension services, lack of needed agricultural inputs for individual farmers, shortage of spare parts for agricultural machinery, and lack of paved roads.

8. At a generalized level, the von Thunen model of agricultural land-use distribution is applicable to the actual land-use patterns of the Benghazi area.

Recommendations

It is the writer's belief that more attention to the study of agricultural land use in the Benghazi area will facilitate development of the region. Thus, the following recommendations are made for researchers as well as for government agencies and institutions.

1. The existence of three different crop zones in the study area, based on distance from Benghazi, makes any future agricultural plan more profitable if specialization in crop cultivation is taken

into consideration. Consequently, close to Benghazi first priority should be given to vegetable and fruit cultivation, and, at a greater distance, concentration on grain cultivation should be encouraged. The outer zone of the area is well adapted to grazing animals, especially sheep.

2. The government agricultural policy appears to have little effect on agricultural land use. Thus, types of crop loans and subsidization of farm inputs should be reviewed and new, more effective agricultural policies should be clearly stated. In the new approach, a theory of development should be considered that requires an interest rate on crop loans, a reduction in subsidization of farm inputs, and an increase in extension services and training programs.

3. A new Land Registration Act should be issued to clarify the land-tenure system. In the new act, all squatter's-rights farmers should have titles to their farms, and the relationship between tenants and landlords should be determined. This would encourage the farmer in the Benghazi area to invest more heavily in his farm since he would be certain of his ownership.

4. Agricultural land-use maps and reports prepared by the Secretariat of Planning, Agrarian Reform and Land Development as well as consultant companies should be revised, based on updated production data, to serve as useful long- and short-range planning tools.

5. Cooperation between government agencies and university researchers should be strengthened. This would accelerate information

gathering and acquainting researchers with the specific needs and problems of agricultural land use in the area.

6. Research centers for agricultural development are important not only for producing new high-yield varieties but also for determining the factors affecting agricultural land use. Thus, at least one agricultural research center should be established in the Benghazi region to help in land-use studies.

7. Reliable data on agricultural land use based on clear administrative districts are important for researchers. Data of this kind, however, are not available in the Benghazi area or in Libya in general. This situation usually complicates research efforts and makes scientific conclusions for the study of land use almost impossible. Thus, agricultural data should be gathered and updated annually for the purpose of useful research in agricultural planning.

Further Research

During the course of the study it became apparent that improvements in methodology could be made and that some related topics merit study of a more specific nature. Land-tenure systems, for example, could be studied as a limiting factor in agricultural development over a larger area than the Benghazi region. There should also be research on the competition between urban encroachment and agricultural land use. This research would help planners restrict urban expansion occurring at the expense of agricultural land.

High-cost public agricultural projects in the Benghazi area, such as the Benghazi Plain Agricultural Project, the Wadi Qattara Settlement Project, and the newly planned Southwest Benghazi Project,

appear to be increasing at the expense of private farms. Since agricultural development is for the farmers, the study of their attitudes toward these projects should be explored. A study of this kind would help agricultural planners in modifying these projects to suit the needs of the farmers.

Study of the effect of the changes in farmers' incomes on agricultural land use in the Benghazi area is an important topic, especially since 1965, when the oil revenues became an easy income stream for most of the economic sectors in the whole country. There should also be research on the effect of the population pressure in the urban center of Benghazi on agricultural changes around the city.

This research dealt with the existing agricultural land use-- a point-in-time study. There should be a study that explores the agricultural land-use changes over time. This kind of transitional study would determine the direction and trend of changes in agricultural land use in the study area.

APPENDIX

INTERVIEW SCHEDULE

BENGHAZI-AREA FARM SURVEY
Interview Schedule
July-October 1980

District or Mahalla _____

Farm number on the district _____

Farm number on the computer card (ID) _____

Record of visits

	Date	Day of week	Time	Notes
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	_____

Farmer's name (optional) _____

Interviewer's name _____

Comments _____

	<u>Code</u>
1. How large is your farm?	
a. ____ Less than 10 hectares	1
b. ____ From 11 to 20 hectares	2
c. ____ From 21 to 30 hectares	3
d. ____ From 31 to 40 hectares	4
e. ____ From 41 to 50 hectares	5
f. ____ Larger than 50 hectares	6
2. What are the main crops produced on this farm?	
a. ____ Grains	1/0
b. ____ Vegetables	1/0
c. ____ Fruits	1/0
3. Approximately how much land do you allocate for each type of crop per year?	
a. Grains ____ hectares	
b. Vegetables ____ hectares	
c. Fruits ____ hectares	
4. Do you use any kind of fertilizer?	
a. ____ Yes	2
b. ____ No	1
5. If "yes," what kind of fertilizer do you use?	
a. ____ Chemical fertilizer	1
b. ____ Organic fertilizer	2
c. ____ Both kinds	3
6. Approximately how much chemical fertilizer do you use each year?	
a. ____ Less than 2500 kilograms	1
b. ____ From 2500 to 5000 kilograms	2
c. ____ From 5001 to 7500 kilograms	3
d. ____ From 7501 to 10,000 kilograms	4
e. ____ More than 10,000 kilograms	5

	<u>Code</u>
7. Is your farm irrigated, rain-fed (dry), or both?	
a. ____ Irrigated	1
b. ____ Rain-fed (dry)	2
c. ____ Both	3
8. If this is an irrigated farm, what are your water resources?	
a. ____ Wells	1
b. ____ Tanks or containers	2
c. ____ Other resources	3
9. Do you have any problems with water quality or quantity?	
a. ____ Yes	2
b. ____ No	1
10. If "yes," what are the major problems?	
a. ____ Water quality	1
b. ____ Water quantity	2
c. ____ Both	3
11. What source(s) of power do you use for water lifting?	
a. ____ Small fuel pump	1
b. ____ Electric water pump	2
c. ____ Other sources of power	3
12. What methods of irrigation are used on this farm?	
a. ____ Ditching and furrows	1
b. ____ Other methods	2
13. How many hectares of this farm are under irrigation?	
a. ____ Less than 10 hectares	1
b. ____ From 10 to 20 hectares	2
c. ____ From 21 to 30 hectares	3
d. ____ More than 30 hectares	4

	<u>Code</u>
14. Do you sell most of your agricultural products?	
a. ____ Yes	2
b. ____ No	1
15. If "yes," where do you sell the products?	
a. ____ Benghazi	1
b. ____ Other places (specify)	2
16. What mode of transportation do you use to take farm products to the market?	
a. ____ A private pickup car	1
b. ____ A rented pickup car	2
c. ____ Other modes of transportation	3
17. Are there any problems in taking your agricultural products to the market?	
a. ____ Yes	2
b. ____ No	1
18. If "yes," what are they?	
a. _____	1/0
b. _____	1/0
c. _____	1/0
d. _____	1/0
19. Do you use part of your farm for grazing?	
a. ____ Yes	2
b. ____ No	1
20. If "yes," how much land do you use for grazing?	
a. ____ Less than 5 hectares	1
b. ____ From 5 to 10 hectares	2
c. ____ From 11 to 15 hectares	3
d. ____ From 16 to 20 hectares	4
e. ____ From 21 to 25 hectares	5
f. ____ More than 25 hectares	6

	<u>Code</u>
21. What animals do you raise on this farm?	
a. ____ Sheep	0/1
b. ____ Goats	0/1
c. ____ Cattle	0/1
d. ____ Other animals	0/1
22. How many of each kind of animals do you have?	
a. ____ Sheep	
b. ____ Goats	
c. ____ Cattle	
d. ____ Other animals	
23. How far is your farm from Benghazi?	
a. ____ Less than 10 kilometers	1
b. ____ From 10 to 20 kilometers	2
c. ____ From 21 to 30 kilometers	3
d. ____ From 31 to 40 kilometers	4
e. ____ From 41 to 50 kilometers	5
f. ____ From 51 to 60 kilometers	6
g. ____ More than 60 kilometers	7
24. How far is your farm from the closest paved road?	
a. ____ Less than 5 kilometers	1
b. ____ From 5 to 10 kilometers	2
c. ____ More than 10 kilometers	3
25. How far is your farm from the nearest village or town?	
a. ____ Less than 5 kilometers	1
b. ____ From 5 to 10 kilometers	2
c. ____ More than 10 kilometers	3

	<u>Code</u>
26. How long has this farm been in operation?	
a. ____ Less than 10 years	1
b. ____ From 10 to 20 years	2
c. ____ From 21 to 30 years	3
d. ____ More than 30 years	4
27. How long have you been operating this farm?	
a. ____ Less than 5 years	1
b. ____ From 5 to 10 years	2
c. ____ From 11 to 15 years	3
d. ____ From 16 to 20 years	4
e. ____ More than 20 years	5
28. Are you a	
a. ____ Full-time farmer	1
b. ____ Part-time farmer	2
29. If "b" is your answer to question 28, what is your occupation?	
a. ____ Teacher	1
b. ____ Official employee	2
c. ____ Private-enterprise worker	3
30. Do you live on this farm?	
a. ____ Yes	2
b. ____ No	1
31. If "no," where do you live?	
a. ____ Benghazi	1
b. ____ Other places (specify) _____	2
32. How far is your residence from your farm?	
a. ____ Less than 5 kilometers	1
b. ____ From 5 to 10 kilometers	2
c. ____ From 11 to 15 kilometers	3
c. ____ More than 15 kilometers	4

	<u>Code</u>
33. Do you receive any assistance from the Secretariat of Agrarian Reform and Land Development to help increase your production?	
a. ☐ Yes	2
b. ☐ No	1
34. If "yes," what kind of assistance do you receive?	
a. ☐ Agricultural equipment and machinery	1/0
b. ☐ Interest-free loans	1/0
c. ☐ Subsidized farm inputs	1/0
d. ☐ Other assistance	1/0
35. How many members are there in your family?	
a. ☐ Fewer than 5 members	1
b. ☐ From 5 to 10 members	2
c. ☐ More than 10 members	3
36. Do you have any education?	
a. ☐ Yes	2
b. ☐ No	1
37. If "yes," what is your level of education?	
a. ☐ Elementary	1
b. ☐ Secondary	2
c. ☐ University	3
38. Did you have any training experience in operating agricultural machinery?	
a. ☐ Yes	2
b. ☐ No	1
39. What is the approximate net income of this farm?	
a. ☐ Less than \$5,000 per year	1
b. ☐ From \$5,001 to \$10,000 per year	2
c. ☐ From \$10,001 to \$15,000 per year	3
d. ☐ More than \$15,000 per year	4

	<u>Code</u>
40. Is the income of this farm enough to support your family?	
a. ____ Yes	2
b. ____ No	1
41. If "no," do you have any other source of income?	
a. ____ Yes	2
b. ____ No	1
42. How old are you?	
a. ____ Less than 20 years old	1
b. ____ Between 21 and 40 years old	2
c. ____ Between 41 and 60 years old	3
d. ____ More than 60 years old	4
43. Are you a Libyan citizen?	
a. ____ Yes	2
b. ____ No	1
44. If "no," what is your nationality?	
a. ____ Palestinian	1
b. ____ Egyptian	2
c. ____ Sudanese	3
d. ____ Other nationality (specify)	4
45. How did you obtain this farm?	
a. ____ Squatter's rights	1/0
b. ____ Inheritance	1/0
c. ____ Purchase	1/0
d. ____ Sharecropping	1/0
e. ____ Other ways	1/0
46. From your experience in the farm business, are you encouraging your children to become farmers?	
a. ____ Yes	2
b. ____ No	1

Code

47. In your opinion, what are the major difficulties facing agricultural development in this region?

- | | |
|----------|-----|
| a. _____ | 1/0 |
| b. _____ | 1/0 |
| c. _____ | 1/0 |
| d. _____ | 1/0 |
| e. _____ | 1/0 |
| f. _____ | 1/0 |
| g. _____ | 1/0 |
| h. _____ | 1/0 |

48. In your opinion, how can the major agricultural difficulties in the Benghazi area be solved?

- | | |
|----------|-----|
| a. _____ | 1/0 |
| b. _____ | 1/0 |
| c. _____ | 1/0 |
| d. _____ | 1/0 |
| e. _____ | 1/0 |
| f. _____ | 1/0 |

49. Do you have anything to add to your answers?

Thank you.

INTERVIEW SCHEDULE
(ARABIC INTERPRETATION)

جامعة قريونس - فرع البيضاء

كلية التربية

البيضاء

=====

الاستثمار الخاص بدراسة

الحيازات الزراعية (المزرع)

بمنطقة سمل

بنغازي ١٩٨٠م

=====

- ١ -

١ - تيسر كم مكنار مساحة مزرعتك (عيازتك الزراعيه) ؟
مكثار : _____

٢ - شونوع الماصيل اللى تنزع فيها ؟ :

المصـول	المساحة بالمكتـار
أ حـوب	
ب خـضـره	
ج فواكه	

٣ - تستعمل شى فى سجاد فى زراعه منتوجاتك ؟

أ نعم ☐

ب لا ☐ انتقل الى ٦ -

٤ - اذا كانت الـ ايه " بنعم " شونوع السجاد :

☐ كيمـاوى :

☐ عضـوى :

☐ الاثنـين معا :

٥ - اذا كنت تستعمل فى سجاد كيمـاوى تيسر كم عطار تستعمل فى السنه ١٠٠ ؟

عطارا : _____

٦ - تسقى فى مزرعتك والا كلما بعلـى ؟ :

☐ تسقى

☐ بعلـى

☐ الاثنـين معا

- ١ -

١ - تقيس كم مكثارة مساحة مزرعتك (عهازتك الزراعيه) ؟
مكثارة : _____

٢ - شئو نوع المعاصيل اللئ تزرع فيهما / ؟ :

المحصول	المساحة بالمكثارة
أ حبوب	
ب خضره	
ج فواكه	

٣ - تستعمل شئ في سجاد في زراعة متوجباتك ؟

أ نعم ☐

ب لا ☐ انتقل الى ٦ -

٤ - اذا كانت الابه " بنخم " شئو نوع السجاد :

☐ كيمائى :

☐ عضوى :

☐ الا ثنين مما

٥ - اذا كنت تستعمل في سجاد كيمائى تقيس كم غطار تستعمل في السنه ١٠٠ ؟

• غطارا : _____

٦ - تسقى في مزرعتك والا كلما بعلى : ؟

☐ تسقى

☐ بعلى

☐ الا ثنين مما

- ٢ -

٧- ان كان تستق في مزرعتك املين مصدر المياه ؟

☐ بئر☐ تنك☐ مصادر اخرى

٨- عدد ك شي مشكله بالنسبه لنوع المياه وكميتهما ؟

☐ نعم☐ لا انتقل الى - ١٠ -

٩- اذا كانت الابه بنعم - شي المشكله

☐ ١ نوعية المياه☐ ب كمية المياه☐ ج الاثنين معا

١٠- شعور سيلتك في استخراج المياه _____ اه ؟

☐ ١ محرك وتود☐ ب محرك كهربائي☐ ج وسائل اخرى :

- ٣ -

- ١١ - كيف تسقى فى المحاصيل فى مزرعتك ؟
 أ ☐ الساقية
 ب ☐ وسائل أخرى :

- ١٢ - كم مكنار مساحة الجزء الذى تسقى فيه المزرعة ؟
 مكنار : _____
- ١٣ - اصبحت فى منتجاتك الزراعيه ؟
 أ ☐ نعم
 ب ☐ لا
 انتقل الى ١٦
- ١٤ - اذا كانت الاجابه " بنعم " - وين ؟
 أ ☐ بنسازى :
 ب ☐ اماكن اخرى (حدد ما)

- ١٥ - كيف تشيل فيها للمسوق ؟
 أ ☐ سياره خاصه
 ب ☐ سياره مؤجره
 ج ☐ واسطه اخرى

يتبع ص ٢٠٠

— ٤ —

١٦ — فيه شئ صحيفه في تصريف متوجباتك ؟

أ نعم ☐
ب لا ☐

١٧ — اذا كانت هناك صحفات / شعبي ؟

أ _____
ب _____
ج _____
د _____

١٨ — امخصش جزء من زيتك للرعي ؟

أ نعم ☐
ب لا ☐

١٩ — اذا كانت الاجابه " نعم " تميزكم مكنار امخصش للرعي ؟

مكتارا : _____

٢٠ — شعبي الحيوانات التي عـ _____ ذك ؟

العدد	الـ _____
_____	أ اغـ _____
_____	ب ماء _____
_____	ج ابقـ _____
_____	د حيوانات اخـ _____

- ٧ -

- ٣٣ - اذا كانت الاجابه "نعم" لا عدد بين قوسين ؟
 ١ تعليم اولي (ابتدائي) :
 ب تعليم ثانوي :
 ج مؤهل جامعي :
- ٣٤ - ادرت شي على المعدات الزراعيه ؟
 ١ نعم :
 ب لا :
- ٣٥ - شعورك خولك من المزرعه في السنه ؟
 : ديناراً
- ٣٦ - هل هذا الدخول يكفيك انت واسرتك ؟
 ١ نعم : انتقل الى - ٣٨ -
 ب لا :
- ٣٧ - ان كانت الاجابه "لا" من بين تسد في النقص ؟

- ٣٨ - كم عمرك (يتدر العمر في حالة عدم الحصول على اجابه) :
 : سنه

- ٨ -

٣٩ - هل انت ليهبى الجنسية ؟
 ا نعم : ☐ انتقل الى - ٤١ -
 ب لا ☐

٤٠ - اذا كانت الاجابه "بلا" ماهى جنسيتك ؟
 ا فلسطينى : ☐
 ب مصرى : ☐
 ج سودانى : ☐
 د جنسيات اخرى : ☐

٤١ - كيف تعاملت على هذه المزمه ؟
 ا وضع يد : ☐
 ب مبرات جد : ☐
 ج شرا : ☐
 د بالشرك : ☐
 ه وسائل اخرى : ☐

٤٢ - هل تشجع اولادك على ان يكونو مزارعين ؟
 ا نعم : ☐
 ب لا ☐

— ٩ —

٤٤ — تتدر تقولى شئى المشاكل اللى تعاني منها الزماعة / ؟

٤٥ — شئى فى رأيك العاجات اللى تتمنى بالزماعة ؟

٤٦ — عندك شئى حاجة تريد انزيد ؟

((الله ايبارك فيك))

=====

الاسكندرية ٠٠٠٠٠

- ٩ -

٤٤ - تذكر تقولى شئى المشاكل اللى تمنى مما الزاعه / ؟

٤٥ - شئى فى رأيك العاجات اللى تتمنى بالزاعه ؟

٤٦ - عندك شئى حاجه تريد اتزيدم ؟

((الله ايمارك فيك))

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