"An Economic Study of the Agricultural Productivity in El Fayom Governorate"

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Dedication:

To my Mother and my Husband, with lots of love.

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CHAPTER 1

THE RATIONAL OF THE STUDY AND THE PROBLEM LITERATURE

1.1 Introduction

El Fayom Governorate is one of the Middle Egypt Governorates, in the Arab Republic of Egypt. It is located to the West of Giza and Beni Smeif Governorates, and to the South West of Cairo, which lies one hundred kilometers far away. El Fayom Governorate comprises five administrative districts, Ebshiwai, Etsa, Sinoris, Tamia and El Fayom. The economic structure of El Fayom is characterized by a greater agricultural sector in comparison with other economic sectors, therefore the main income of the most inhabitants of this governorate depends on the income which has been obtained from agricultural activity which is about 166 thousand Egyptian pound, it constitutes about 4.33% of the total agricultural income in Egypt (1979/1980 figures)[1].

The importance of the agricultural sector and its role in any society, in general and in developing countries in particular, is demonstrated by the fact that, it provides the population with their needs of food and others agricultural products. Also it provides the industrial sector with those raw materials, necessary for production and manufacture. In Egypt, agriculture is the most important source of national income, despite the degree of progress achieved in industry, the agricultural national income, still constitutes at least, one-third of the total national income, for example, in 1979/80, the net agricultural income, in the Republic equals about 3671 million E. Pound,[2] this income is distributed on the agricultural inhabitants which is about 4097.5 thousand person, representing about 4% of the total labour force in Egypt in 1980.[3]

The agriculture, also has an effective rate in the Egyptian foreign trade, so that in the period (1975-1980)[4], the total exports of agricultural sector was 253.5 million E. pound, representing about 25.7% of the total exports in the republic, which is about 985.4 million E. pound for the previous period. In addition to that, there is a net capital flow from the

agricultural sector to the other sectors in the last years, since the contribution of the agricultural payments to other economic sectors is higher than the agricultural revenues delivered from those sectors.

Also, the agricultural sector serves as a market for numerous industrial products, because the agricultural development creates new market for agricultural tractors, agricultural tools, chemical fertilizers, and pesticides, all these requirements generate the markets of industrial commodities.

From the previous paragraphs, we can deduce that, the agricultural development in developing countries is very important in achieving the objectives of economic development, because it constitutes a corner stone in increase the domestic product in general, and the agricultural income, in particular, which in turn, results an increase in the average of per capita income, as well as higher standard level of living.

Usually the agricultural development is centred on two basic pillars, the first is the horizontal agricultural development, i.e. increase the cultivation area, while the second is the vertical development, i.e. increase the productivity of land unit, however there are many problems facing agricultural development which need urgent solutions to achieve the improvement in agricultural sector, so that, enable it to take its role in social and economic development.

Finally, I would like to refer that, most of agricultural sector problems are representing in the process of improvement and increase the agricultural productivity. Thus, without doing any efforts to increase the productivity - which means the ability of using the production inputs economically - the economic development will exhibit a slow progress, in the meantime, the growth rate of population is increasing rapidly (see Table 1 in the appendix). This situation will lead to enlargement the gap between the reality and the objective targets. Also this situation results in a reduction of the domestic income level and consequently, it affects negatively both the per capita income and living standard.

1.2 The Research Problem:

The agricultural sector in El Fayom Governorate, stands as a basic entity in the economic structure, however there is an important problem

related to this sector, which can be represented in the following two dimensions:

(1) The productivity of the most important field crops and vegetables fluctuates over time in such a way that does not appropriate either to the importance of this sector or to the high rate of population growth.

(2) The area under cultivation of some important crops is decreasing over time, therefore it is necessary to study the productivity of land unit for the most important field and vegetable crops because the productivity of land is the major factor likely to influence the total output and there is no analytical study that has dealt with this subject - in El Fayom Governorate - by details.

1.3 The Research Objectives:

The research mainly aims to study the evolution of the agricultural productivity per Feddan [5] for Wheat, Onion and Nile Maize because they are the most important field crops in El Fayom Governorate, and tomatoes out of the vegetable crops during the period (1966 - 1982). In addition to attempt to throw the light on the causes of the productivity fluctuates over time with respect to the various districts in El Fayom as well as the Governorate as a whole.

Underlying this general aim, there are fundamental aims that need to be examined, such as:

(1) The availability and distribution of agricultural resources

(2) The changes in cultivation area.

(3) The economic analysis of the production function and resources combination.

(4) Measuring of profitability in order to know to which extent, the agricultural policy is successful and its effect on the agricultural productivity.

1.4 The Methodology and Sources of Data

In this study, the researcher will adopt, the quantitative and descriptive economic analysis methods, with using the statistical and mathematical relations to explain the different aspects of the phenomenon under

study, in addition to using the time trend equations in analyse the data, with establish all different relations which in turn, will be examined by the correlation coefficients, the adjusted coefficient of determination, and testing of significancy.

The study relied upon data published by several national institutions particularly Agricultural Economics Research Institute of the Ministry of Agriculture, Central Agency for Public Mobilization and Statistics, in addition to unpublished data from soil survey department, Ministry of Agriculture A.R.E., and the documents of Ministry of Irrigation in El Fayom Governorate.

1.5 The Hypothesis:

The hypothesis on which the study is based are that:

(1) The natural and the distribution of the available agricultural resources had a negative effect - in some cases - on the Feddan productivity. For example the fragmentation of holding area was an obstacle to apply the mechanization also it led to weakening the management efficiency.

(2) The Feddan productivity fluctuated among the different districts of El Fayom Govnorate according to the relative advantage of one district rather than the other in producing specific crop, in addition to the distribution of economic resources between these districts.

(3) There is a positive relationship between the Feddan productivity and the efficient use of all production inputs according to their magnitude and their combination ratio.

(4) Farmers respond significantly and positively - with respect to the cultivation area - to the high profitability for the different crops under study.

1.6 The Research Organization

This research undertakes the study of the agricultural productivity for the most important field crops and vegetables in El Fayom Governorate during the period 1966 to 1982. To achieve the objectives of the study, the research will divide to five chapters: Chapter I is mainly a theoretical

one, since it will deal with the rational of the study with a revision to international and national literature which is relevant to the subject of the study. Chapter II will be devoted to study the agricultural economic resources which are available in El Fayom. Chapter III will investigate and study the economic analysis of Feddan productivity with comparison between various districts, in addition to throw the light on the area under cultivation. Chapter IV will largely be devoted to an analytical study of the production functions concerning the most important field crops and vegetables, and finally, Chapter IV is devoted to study the comparison and analysis of profitability for the crops under study. The research will end with a conclusion of the study, in addition to an appendix and selected bibliography.

1.7 International Literature

There are great differences in agricultural productivity among nations, the existence of this differences among countries over time are because of:

(1) The differences in resource endowments and relative factor prices among countries, as well as,

(2) The level of biological and mechanical technology, e.g., the technical inputs include the mechanical devices and the biological and chemical materials purchased from the industrial sector and

(3) Human capital which is broadly conceived to include the education, skill, knowledge, and capacity embodied in a country's population, therefore, the study will expose some of the international literature, it may be possible to benefit from the previous countries experiences.

Referring to Y. Hayami and V. Ruttan's[6] book, they have studied the agricultural productivity gap among countries for Wheat in 1960, by using the cross-section data for 43 countries (DC & LDCs). This study was concluded in three points:

(1) With respect to the intercountry comparisons (1960) they have concluded that there are great international differences in agricultural productivity for Wheat, measured in terms of either output per worker

or output per hectare. For example the agricultural output per hectare ranged from 0.04 (Libya) to 10.24 (Taiwan), and the output per male worker ranged from 2.1 (India) to 141.8 (New Zealand). The Egyptian land productivity was 6.9 while the labour productivity was 4.4

(2) With respect to the changes in productivity (1955 to 1965). The great differences in agricultural productivity between developed and less developed countries increased during this decade, the output per male worker in thirteen developed countries (DC) increased at an annual 4.7 percent, whereas the rate of growth of eleven less developed countries (LDCS) was only 1.4 percent. The growth rates of output per hectare were of approximately equal magnitudes. The Egyptian change in land productivity ranged from 5.56 in (1955) to 7.75 in (1965), while the Egyptian change in labour productivity ranged from 3.7 in (1955) to 4.6 in (1965).

(3) With respect to the affect of industrialization on agricultural productivity, they have mentioned that growth in agricultural productivity is essentially a process of adaptation by the agricultural sector to new opportunities created by the advances in technology and the progress of interindustry division of labour which has accompanied industrialization.[7]

Industrialization can affect agriculture in many ways. Growth of the non-agricultural sector increases the demand for farm products. More favourable factor-product price ratio increase the demand for both mechanical and biological inputs by agricultural producers. The impact of industrialization on factor markets is perhaps even more significant than the product market impact. Industrial development increases the demand for labour in the non-agricultural sector. The effect of increasing returns resulting from the progressive specialization of industry and division of labour and from the application of new knowledge is to reduce the cost of modern agricultural inputs, such as fertilizer, chemicals, and machinery, produced by the industrial sector.

However, we must not forget Stewart's[8] conclusions about the affect of technology - in poor countries - on productivity. She explained that - in most cases - poor countries are recipients of technology developed in rich

countries, while rich countries, as a block, generate their own technology. The characteristics of a technology are conditioned by the environment in the economy for which it is developed, these characteristics may be unsuitable to the different conditions in poor countries of the third world, however, there are different alternative techniques with an appropriate characteristics. But because so little systematic attention has been devoted to other alternative appropriate techniques, there are many areas where such techniques are not available, therefore the critical point to rise the productivity of technology - is the correct choice of the appropriate technique on the basis of its price, objectives, and all different constraints in poor countries.

Referring to Y. Kato's[9] article, I shall summarize the elements which have affected the agricultural productivity in Japan during the period 1950 to 1962 in the next two points:

(1) The impact of the rapid growth of the non-agricultural sector which has affected the agricultural product markets and factor markets. Changes in the market for agricultural products were brought about by the change in the consumption pattern for food, due to the increase in per capita national income. Demand for energy foods, such as, Wheat, Rice, and Barley, did not increase, or even decrease in some cases, while demand for protective foods, such as, meat, eggs, and fruit, increased very much. Selective expansion of agricultural production was required. Among the change in factor markets, the rate of increase of wages and of the price of land was remarkable, the price of capital goods was almost stationary due to the increase of industrial productivity.

(2) Technical innovations in agricultural production: The significant technical innovations in Japanese agriculture may conveniently be classified into:

(a) Techniques for raising and stabilizing production in agriculture.

The improvement of varieties (seeds, heavy application of fertilizers, new kinds of insecticides and pesticides, and land improvement were the factors contributing most to raising productivity in agriculture. Although mechanization increased much, these types of technical improvement is still dominant.

Land improvement projects, mainly irrigation and drainage, the condition of the soil was improved by the addition of new soil and of iron, and by deep ploughing. By these improvements, fertilizer loss was decreased, the absorption of nutrients by the roots of plants was improved, and the potential productivity of the soil was utilized.

(b) Labour-saving techniques:
Machinery was introduced only in the processes of irrigation, threshing and husking in the pre-war period, the use of power cultivators increased very rapidly in the post-war period. Nowadays complete mechanization, where seeds are sown by drill or helicopter. The use of herbicides, insecticides, and pesticides, accompanied by power spraying and power dusting have very much decreased labour requirements.

(c) Techniques for raising livestock and for managing orchards:
Nowadays large-scale livestock raising systems have been adopted in order to raise the productivity of land, labour, and capital and to strengthen the farmers' ability to withstand fluctuations in the prices of livestock products. Farm management techniques for the raising of livestock improved much as the scale of operations increased.

In the case of orchards, improvement in soil management by sod culture and by grass or straw mulch protected orchards from erosion and less of fertilizer. Slopes were utilized for growing fruit-trees by this improvement.

The study by Bruce F. and E. Philip[10] has explained how it can be obtained the same land productivity by less costs in California, this study concluded that, the relationship between farm size and production costs - for the same yield indicated that relatively modest sized farms - e.g. farms of 100-320 acres[11] can achieve a major portion of the possible cost savings associated with size. The evidence shows that the long-run average cost curve is relatively flat after initially declining rapidly. The costs in the highly mechanized crops generally continue to decline slowly throughout the entire range of surveyed farm sizes, but in vegetable and fruit crops, costs do not appear to decline substantially after the initial phase of rapid decline.

The study also has examined the sources of declining production costs and concluded that, factors other than labour-saving technology are even more important, such as, management, resource quality, and the overall institutional structure.

1.8 The National Literature

There are a lot of studies which has dealt with the agricultural productivity in the national level (Egypt) or the governorates level, in the coming part I shall mention very briefly the results of some of them.

There is an economic study by El Kake[12] comprised on a study for the productivity of Egyptian Millet, its consumption quantity, and its income, this study was concluded that the output quantity has affected - after the second world war - by the productivity of land unit than its affects by the cultivated area, this means that any policy for development aims to increase the output of Egyptian Millet must depend on the technique improvements for the Millet especially that the cultivated area of Millet has a competitive relationship with the other field crops.

The study of Mostafa[13] for Tomatoes marketing in Cairo town, has dealt with the tomatoes production in A.R.E. and its production costs. Also this study aimed to discover the elements which create fluctuation of tomatoes quantity deliveries to vegetables and fruits market in Cairo. Mostafa has concluded that agriculture of tomatoes are concentrated on lower Egypt governorates, where their cultivated area are about 60% of the total cultivated area in Egypt, however, the average of production per Feddan in these governorates is lower than its corresponding average in Middle Egypt governorates (notice that El Fayom Governorate which we are studying is located among Middle Egypt Governorate).

The analytical research by Ali[14] for economic of wheat production in Egypt has studied the production and consumption of this crop in Egypt. This study explained that the most important elements which affect the Feddan productivity of wheat are representing in achieving the productive efficiency by using the optimum combination of production resources, moreover the estimation of production functions are considered an indicator for knowing to which extent the productive efficiency is achieved. The research was also concluded that, it is possible to classify the Egyptian districts

according to their Feddan productivity of wheat during the period 1974-1978 to two groups: the first one comprises of 67 districts which has yielded higher average of production per feddan of wheat than its corresponding national average. The second group comprises the remainder of Egyptian districts (about 64) which has yielded lower average of production per Feddan of wheat. El Fayom districts are considered in the second group because their Feddan productivity were lower than the national average.

Finally, there is an analytical economic study by Saleh[15] for wheat crop in El Dakhlia governorate, which has dealt with the evolution of costs and production of wheat in El Dakhlia, in addition to that, he has studied the evolution of the foodstuff gap between the production and consumption of wheat and the danger which will result from this gap. The solution according to Saleh was: (1) knowing the real problems of farmers; (2) the agricultural integration between plants and animals production, and (3) the specialization in production on the basis of the optimum exploitation of the available endowment resources in every governorate, in other words, the benefit from the relative advantage in every governorate.

Footnotes - Chapter 1

(1) Central Agency for Public Mobilization and Statistics ©CAPMAS°, National Income From Agricultural Estimates Bulletin, 1980, Reference No. 71-52421/82, May 1982.

(2) Ibid.

(3) Central Agency for Public Mobilization and Statistics ©CAPMAS°, Agricultural labour Force Estimates by Sampling in A.R.E., May Cycle Results, Reference No. 71-12525/81, December 1981.

(4) ©CAPMAS°, The Statistical Yearbook, 1952. 1980, July 1981.

(5) One Feddan = 0.42 hectare.

(6) Y. Hayami & V. Ruttan, Agricultural Development. An International Perspective, John Hopkins, 1971.

(7) Industrialization is measured by the ratio of the number of male workers in the non-agricultural sector to the total number of male workers.

(8) F. Stewart, Technology and Underdevelopment, Macmillan, 1977.

(9) Yuzure Kato, Factors contributing to the Recent Increase of Productivity in Japanese Agriculture, Journal of Development Studies, Vol. 2, October 1965.

(10) Bruce F. and E. Phillip, Farm Size and Economic Efficiency: The Case of California, American Journal of Agricultural Economics, Vol. 60, November 1978II.

(11) One Acre = 4 thousand square meters.

(12) El Kake, A.A. The Ability of Productivity, economic, consumption and marketing for Egyptian Millet, Master Thesis, Dept. of Agricultural Economics, Faculty of Agriculture, Alexandria University 1971.

(13) Mostafa, A.M., Marketing of Tomatoes in Cairo Town, Master thesis, Dept. of Agric. Economics, faculty of Agriculture, Cairo University, 1973.

(14) Ali, M.A. Economics of Wheat Production in Egypt, Master thesis, Dept. of Agric. Economics, Faculty of Agriculture, Aim Shams, University, 1979.

(15) Saleh, A.A. An Analytic Economic Study for Wheat Crop in El Dakhlia Governorate, Master thesis, Dept. of Agric. Economics, Faculty of Agriculture, El Mansoura, University, 1982.

CHAPTER II

THE AGRICULTURAL ECONOMIC RESOURCES IN EL FAYOM

2.1 Preface

In this chapter, an attempt will be made to study the agricultural economic resources which are available in El Fayom, such as, the human resources, the agricultural land resources, the irrigation resources, the management element, the capital resources, the animal resources, and the agricultural investments. The study will concentrate mainly on the economic aspects of the available resources which might be exploited economically in a certain time, keeping in mind, the fact that, the income of the society depends on the production factors utilized in the economic structure. However, it can be argued that, the availability of some - or all - elements of production, in a certain degree of abundance, is not proof of increase the level of real income in the society. For example, the available lands may be poor and infertile or it may yield very low productivity with very high costs.

Also, we can say that, the availability of elements of production (quantitatively and qualitatively), does not serve as sufficient evidence for the improvement of the real income of the society, however, we must care for the harmony and proportionality between various elements of production in certain degree to achieve the maximum productivity from the available resources.[1]

Finally, the researcher concerned with studying these resources to help in throwing the light on the productivity of the most important field crops and vegetables in El Farom Governorate.

2.2 The Human Resource:

No doubt, that all economic activities are directed towards man, since his needs are considered the motive power for the supply side in any economic activity, however, from demand side the satisfaction of these needs is the final objective for this economic activity. The men intellects

and,muscles energy are considered the most important element in the production process, therefore we must study the population growth because it is the only source of labour force in any society.

2.2.1 The Total Population in El Fayom:

According to the data in (Table 2.1), it is clear that, the total number of population in El Fayom Governorate is about 1.361 million, which have been distributed between urban and rural areas by the following percentages 24%, 76% in 1982 respectively. The percentages of El Fayom population were about 3.5%, 3.2%, 3.1%, 3.1%, 3.02% and 3.04% of the total population for the country as a whole, however, the rates of population growth in El Fayom Governorate were lower than the corresponding rates for the republic in all years in the table except 1982.

2.2.2 The Human Force in El Fayom:

The human force is defined as that portion of population which can contribute in the economic activities. It comprises all the population with the exemption of children less than 6 years, aged persons (more than 65 years) and disabled people, who are considered unproductive and called outside human force. The human force falls into two parts: the first one is those people inside the labour force, e.g. all people more than 6 years, either economically active in producing goods and services or those who are able to work and looking for work but they are unemployed. The second is these persons who are considered outside the labour force so that, they are able to work, but they do not look for productive work, for many reasons: (1) They might be indulged in the process of preparation and qualification for work, (2) Maybe because of personal or family reasons, (3) they might be lacking the interest of work.

Table 2.2 indicates that the average number of human force in El Fayom during the period 1980-1982 was about 1.0193 million, representing about 77.4% of the total population. It is also clear from (Table 2 in the Appendix) that the human force numbers are increased during the period 1980-1982, however, their ratio to the total population numbers have decreased,

it means that the ratio of outside human force (children, aged persons and disabled people) have increased.

Table 2.1 Number of the Population in the Republic and El Fayom According to Their Classification to Urban and Rural Area by (Thousand Person)

	The Republic				El Fayom Governorate						
Year	Total Number of the Population	The Annual Growth Rate %	Urban	Rural	Total No. of the Popul.	The Annual Growth Rate %	% of the Republic Population	Urban	The Annual Growth Rate %	% of the Republic Urban	Rural
1947	18967	-	6363	12604	669	-	3.5	109	-	1.7	560
1960	25984	2.8	9864	16120	839	1.9	3.2	162	3.7	1.6	677
1966	30083	2.6	12394	17690	940	2	3.1	203	4.2	1.6	737
1976	36511	2.1	15935	20576	1142	2.1	3.1	275	3.5	1.7	867
1980	42289	3.9	18696	23593	1280	3.02	3.02	311	3.27	1.66	969
1982	44673	2.8	19826	24847	1361	3.16	3.04	441	3.21	1.67	1030

Source: Royal Egyptian Population Census, Census and Statistics Department, Ministry of Finance and Economics, Cairo, 1952.

Central Agency for Public Mobilization and Statistics (CAPMAS), the Statistical Yearbook, A.R.E., various issues.

Table 2.2 The Average Number of Population, Human Force, Labour Force in El Fayom Governorate During the Period 1980-1982 (In Hundreds)

	HUMAN FORCE								OUTSIDE HUMAN FORCE			
	Labour Force					Outside Labour Force						
	Employed 6 to less than 12 years	(12-64 Years) Employed	Unemployed	Employed 65 Years or more	Total	6- less than 12 Years	12 less than 65 years	Total Human Force	Less than 6 Years	Unemployed 65 Years or More	Disabled People	Total N Popul
ın	37	793	63	58	951	411	1188	2550	490	98.6	68	3
ıl	374	2507	49	234	3164	1332	3147	7643	1876	240	201	9
ıL	411	3300	112	292	4115	1743	4335	10193	2366	338.6	269	131

ce: Derived from Table 2 in the Appendix

The human force in El Fayom is distributed between rural area and urban areas as follows 75%, 25% of the total human force in the governorate during the above mentioned area (See Table 2.2). Moreover, we can notice from (Table 2 in the Appendix) that the ratio of human urban force to the total is increased over time, this fact serves as an evidence for the reduction of human rural force ratio with respect to the total.

2.2.3 The Labour Force in El Fayom:

It is observed from (Table 2.2) also that the average number of employed workers[2] in El Fayom during the period 1980-1982 was about 400.3 thousand representing about 97.3% of the total labour force in El Fayom and about 39.3% of the total human force, finally it is representing about 30.4% of the total number of El Fayom population.

In the coming part of this chapter, we shall summarize some points related to labour force in El Fayom, especially the educational status and the classification of labour force according to the economic activities.

2.2.3.1 The Educational Status for the Labour Force in El Fayom:

The educational status for the labour in El Fayom Governorate has a high rate of illiteracy. It is clear from table 2.3 that the percentage of illiteracy during the period 1980-1982 was about 73.8% of the total labour force (between 12-64 years). Also we can notice from the same table that the rate of illiteracy in the rural area is higher than that in the urban area during the same period.

The average ratios of workers who were holders of certificates lower than the intermediate or the intermediate one, or the higher than intermediate were about 2.36%, 8.57%, 1.6% of the total labour force during 1980-1982 respectively, while those who were holders of University certificates were about 2.07% of the total.

2.2.3.2 The Classification of Labour Force According to the Economic Activities and Sex

The 1980, 1981 agricultural census estimated the labour force classification according to the economic activities and sex in El fayom, it is obvious from (Table 2.4) that most of the labour force are involved in agricultural activities, where about 71.2%, 62% of the total labour force are working in agriculture field in the previous two years respectively. Moreover, the percentages of the rural labour force who are working in that field were about 86%, 78.5% of the total rural labour force, however, the ratios of females who are working in agricultural activity are considered very small, where they were about 1.9% and 0.9% respectively. The labour force in services sector, commercial activity, and manufacture sector were about 14.6%, 6.9%, 5.8% of the total labour force in 1981 Census. By studying the same table we can deduce that the proportion of the labour force in the agricultural activity to the total labour force in the governorate is decreased in 1981 than 1980, while this proportion is increased from 1980 to 1981 in services sector, commercial activity, and manufacture sector, this indicates that part of labour force engaged in agricultural activity has turned to the non-agricultural sectors.

2.3 The Agricultural Land Resources:

This part is concerned with studying the land resources according to two major points of view as follows:

(1) The economic classification of land resources according to its productive capacity in El Fayom Governorate as well as the different districts, individually.

(2) The farm size and the evolution of holding area in El Fayom Governorate.

Table 2.3 The Average Number of Labour Force (12-64 Years) According to Their Educational Status in El Fayom Governorate During the Period 1980-1982 (In Hundreds)

Educational Status	Urban	%	Rural	%	TOTAL	% For Urban	% For Rural	%
Illiteracy	369.7	43.2	2147.7	84.03	2517.4	14.7	85.3	73.8
Read & Write	157	18.3	237	9.27	394	40	60	11.55
Certificates Lower than the Intermediate	53	6.2	27.7	1.08	80.7	65.7	34.3	2.36
The Intermediate Certificate	179	20.91	113.3	4.43	292.3	61	39	8.57
Certificates Higher than the Intermediate	38.7	4.52	16.7	0.65	55.4	70	30	1.6
University Certificates	58	6.8	12.6	0.50	70.6	82	18	2.07
NOT AVAILABLE	0.6	0.07	1.0	0.04	1.6	37.5	62.5	0.05
T O T A L	856	100	2556	100	3412	25	75	100

Source: Derived from Table 3 in the Appendix

Table 2.4 The Classification of Labour Force (12-64 Year) According to the Economic Activities and Sex in EL FAYOM GOVERNORATE in 1980 (in Hundreds)

Kinds of Economic Activities	URBAN			RURAL			TOTAL			The Relative Importance
	Male	Female	Total	Male	Female	Total	Male	Female	Total	
Agriculture, Forestry & Hunting	194	3	197	2214	44	2258	2408	47	2455	71.2
Manufacturing	91	12	103	51	5	56	142	17	159	4.6
Electricity & Gas	9	0	9	3	0	3	12	0	12	0.3
Construction	42	0	42	26	0	26	68	0	68	2.0
Commerce	89	15	104	40	5	45	129	20	149	4.3
Transport, Communication & Storage	67	8	75	14	0	14	81	8	89	2.5
Financing & Insurance	13	4	17	3	0	3	16	4	20	0.6
Services	161	57	218	129	14	143	290	71	361	10.5
Not Available	39	24	63	49	25	74	88	49	137	4.0
Total	705	123	828	2529	93	2622	3234	216	3450	100

Table 2.4 (Continued) The Classification of Labour Force (12-64) According to the Economic Activities and Sex in EL FAYOM GOVERNORATE in 1981 (In Hundreds)

Kinds of Economic Activities	URBAN			RURAL			Total			The Relative Importanc
	Male	Female	Total	Male	Female	Total	Male	Felame	Total	
Agriculture, Forestry & Hunting	146	9	151	1957	11	1968	2103	20	2123	62
Manufacturing	110	7	117	81	0	81	191	7	198	5.8
Electricity & Gas	8	0	8	0	0	0	8	0	8	0.2
Construction	23	0	23	32	0	32	55	0	55	1.6
Commerce	117	9	126	97	12	109	214	21	235	6.9
Transport, Communication & Storage	79	1	80	21	0	21	100	1	101	3.0
Financing & Insurance	9	3	12	0	0	0	9	3	12	0.3
Services	165	83	248	236	19	255	401	102	503	14.6
Not Available	47	39	86	85	23	108	132	62	194	5.6
Total	704	151	855	2509	65	2574	3213	216	3429	100

Source: Central Agency for Public Mobilization and Statistics (CAPMAS), Agricultural Labour Force Estimates by Sampling in A.R.E. 1981

2.3.1 The Classification of Land Resources According to its Productive Capacity in El Fayom Governorate.

Land registration department in the Ministry of Agriculture has compiled studies on soil classification, and land distribution in El fayom districts during the year 1978/79, its study has divided the land into six scales according to its productive capacity. This division was depended on three considerations: 1. physical and natural characteristics of the soil, 2. the productivity status of the soil and the extent of its arability for field crops, vegetables and fruit production, and; 3. soil preparation costs in addition to production costs. The following portion will define the different six scales, ad expose the divergence between these classes and its percentage in El Fayom Governorate.

2.3.1.1 First Class lands:

The first class lands is known as the best cultivated land and it is arable land for all agricultural crops (field, vegetables, and fruits), it also yields a high average output per Feddan with minimum costs, the irrigation and drainage processes are very good, it has got a deep soil profile and a medium consistency, and finally the percentage of the total soluble salts in this soil does not exceed 0.2% approximately. From (Table 2.5) it is clear that the total area of first class land in El fayom Governorate is about 0.588 thousand Feddan, representing about 0.14% of the total holding area and about 0.18% of the total cultivated area. This kind of land is available only in the Ebshiwai district.

2.3.1.2 Second Class Lands:

It is defined as a cultivated lands, it can produce most of the crops with low costs, the irrigation and drainage processes are good, it has got a deep soil profile and a heavy consistency, and the percentage of the total soluble salts fluctuates between 0.2% and 0.5% approximately. From (Table 2.5) it is obvious that the total area of second class lands in the governorate is about 83 thousand Feddan, representing about 20% of the total holding area and about 25.7% of the total cultivated area.

2.3.1.3 Third Class Lands:

It is defined as cultivated lands, it is useful for producing the field crops, however, the vegetables and fruit crops are not good to cultivate in this type of land, it produces medium yield equal to the corresponding yield in the Arab Republic of Egypt, its production costs are also medium, the irrigation and drainage processes are medium, it has got a deep and (or) medium profile and very heavy or heavy light consistency, and the percentage of the total soluble salts is between 0.5% and 1% approximately. We can notice from (Table 2.5) that the total area of this class in El Fayom Governorate is about 179.8 thousand Feddan representing about 43.24% of the total holding area, and about 55.53% of the total cultivated area.

Table 2.5 Soil Productivity Classification of EL FAYOM Governorate in 1978/1979

District	Land Class Orders				The Total Cultivated Area (Feddan)	Lands of Fith and Sixth Classes				Tota Tenur Area
	First	Second	Third	Fourth		Waste (Feddan)	Submerged by Water (Feddan)	Non Arable Lands (Feddan)	Land for Public Utility (Feddan)	
EBSHIWAI	588	15683	39344	18781	74396	5274	2063	13745	5789	10126
%	0.58	15.49	38.85	18.55	73.47	5.21	2.04	13.57	5.71	100
ETSA	-	23078	44760	13483	81321	15775	327	6248	4360	10803
%		21.36	41.44	12.48	75.28	14.6	0.30	5.78	4.04	100
SINORIS	-	16813	27553	5828	50194	3226	1458	65	3858	58801
%		28.59	46.86	9.91	85.36	5.49	2.48	0.11	6.56	100
TAMIA	-	7988	37482	12710	58180	8128	155	543	5407	72413
%		11.03	51.76	17.55	80.34	11.22	0.22	0.75	7.47	100
EL FAYOM	-	19601	30652	9417	59670	6244	70	1604	7718	75306
%		26.03	40.70	12.50	79.23	8.29	0.09	2.13	10.26	100
Total	588	83163	179791	60219	323761	38647	4073	22205	27132	41581
%	0.14	20.0	43.24	14.48	77.86	9.29	0.98	5.35	6.52	100

Source: Soils Classification Survey and Land Classification in El Fayom Districts, Soil Survey Department, Ministry of Agriculture, A.R.E.

2.3.1.4 Fourth Class Lands:

The fourth class lands is considered as cultivated lands with limited production, also it can be argued that this kind of land can produce under certain conditions, cotton, rice, barley and clover which are considered the best yielded by the fourth class lands, it needs high or medium costs for services and preparation of soil, and its irrigation and drainage processes are medium or bad. It is clear from the previous table that the total area of this class in El Fayom Governorate is about 60.2 thousand Feddan, representing about 14.48% of the total holding area in the governorate and about 18.6% of the total cultivated area.

2.3.1.5 Fifth Class Lands:

It is defined as waste lands under reclamation and it is submerged by water. Table 2.5 indicates that the area of this class in El Fayom is about 42.7 thousand Feddan, representing about 10.27% of the total holding area in El Fayom Governorate.

2.3.1.6 Sixth Class Lands:

The sixth and last class lands is considered not arable lands for cultivation such as rocky lands, sand dune areas, lands which are difficult to irrigate and has got no source for irrigation, lands for public utility, e.g. town cities, factories, rivers, gauges and channels, this class also comprises railway lines, land roads, lakes and others. It can be noticed from table 2.5 that the area of this land in El Fayom Governorate is about 49.3 thousand Feddan, representing about 11.87% of the total holding area in the governorate as a whole.

2.3.1.7 The Classification of Ebshiwai District According to its Productive Capacity

The total holding area in Ebshiwai district is about 101 thousand Feddan, representing about 24.35% of the total holding area in the governorate. The total cultivated agricultural area[3] is about 74 thousand

Feddan representing about 73.5% of the total holding area in this district, while the total area of waste lands, the permanent swamps lands and the public utility lands e.g. the area which is not arable lands for cultivation[4] are about 27 thousand Feddan, representing about 26.5% of the total holding in the district. It can be noticed that Ebshiwai district is the only district which comprises lands of the first class in El Fayom, this area is about 0.588 thousand Feddan, representing 0.79% of the total agricultural area, and about 0.58% of the total holding area in the governorate, however, it is representing 100% of the first class land in the governorate, while the area of the second, third and fourth classes lands in this district were about 21%, 52.9% and 25.2% of the total agricultural area in Eb Shiwai district respectively (see Table 2.5).

2.3.1.8 The Classification of Etsa District According to its Productive Capacity:

From (Table 2.5) it is obvious that Etsa district is the largest district in the governorate in terms of spaciousness its holding area, since it is about 108 thousand Feddan, representing about 26% of the total holding area in the governorate, while the total cultivated area in this district is about 81 thousand Feddan, representing about 75.3% of the total holding area of that district, and about a quarter of the total cultivated area in El Fayom Governorate. The superficial area of the fifth and sixth classes in this district were about 24.7% of its total holding area. also it is clear from the same table that there is no first class lands in Etsa district, while the area of second, third and fourth classes lands were about 28.4%, 55%, 16.6% of the total cultivated area in this district respectively.

2.3.1.9 The Classification of Sinoris District According to its Productive Capacity:

This district is considered the smallest one in El Fayom in terms of its holding area, it is about 58.8% thousand Feddan, representing 14.14% of the total holding area in the governorate, while the total cultivated area in this district is about 50 thousand Feddan, representing about 85.3% of its total, this percentage is considered the highest one in relation to the

corresponding figures for the other districts, thus the waste land area, the submerged lands by water, lands for public utility and the area which is not arable are considered relatively small since, they were about 14.64% of its total holding area. From (Table 2.5) it is clear that Sinoris district has not any first class lands, while the total of second, third and fourth classes lands were about 33.5%, 54.9%, 11.6% of the total cultivated area in this district respectively.

2.3.1.10 The Classification of Tamia District According to its Productive Capacity

The total holding area in Tamia district is about 72.4 thousand Feddan, representing about 17.4% of the total holding area in the governorate, however, the total cultivated area is about 58 thousand Feddan representing about 80.34% of the total holding area in Tamia district, on the basis of this account the total area of fifth and sixth classes lands were about 19.65% of the total cultivated area in this district. From (Table 2.5) it is clear that Tamia district has got no first class lands in addition to that this district is the smallest one which has got the second class lands, since it is about 13.73% of its total cultivated area, while the third and fourth class lands were representing about 64.4% and 21.8% of the total cultivated area in this district respectively.

2.3.1.11 The Classification of El Fayom District According to its Productive Capacity:

It is clear from the previous table also that the total holding area in that district is about 75.3 thousand Feddan representing about 18.1% of the total holding area in the governorate, the cultivated area in this district was about 79.23% of its holding area, however, the total of fifth and sixth classes land were representing about 20.77% of the total holding area in this district. Finally we can notice from (Table 2.5) that the second, third and fourth class lands in El Fayom district were about 2.8%, 51.4% and 15.8 of its total cultivated area respectively.

2.3.2 The Farm Sizes in El Fayom Governorate:

The farm sizes diverge from economy to other and within the same economy. The optimum farm size is defined as total size which leads to provide that all other factors of production are constant - decreasing the average costs per unit of production to its minimum level, which in turn is reflected by the average costs function in the long run, e.g. it is the production size which achieves the perfect utilization of economies of scale if this production unit is used according to the optimum rate of production.[5]

By studying the evolution of holdings number in El Fayom governorate, we can notice from (Table 2.6 and 2.7) that agricultural land is largely organized on small holdings, however, the number of holdings have doubled two and half times from 1950 to 1975. The medium size holding, which is perhaps more indicative of the general size of holding than the mean size in the agricultural census years 1950, 1961, 1965 and 1975 were about 2.52, 2.24, 2.03, 1.8 Feddan respectively, however these media for the Arab Republic of Egypt were about 2.24, 2.03, 1.86, 1.52 Feddan in the above mentioned years respectively (see tables 4 and 5 in the Appendix). On the basis of this account, it is clear that the media in El Fayom were bigger than the corresponding media for the country as a whole, although the medium for farm distribution of El Fayom Governorate in 1975 has decreased remarkably. It reflects the narrowness of the farm spaciousness in the last recent years.

Tables 2.6 and 2.7 illustrate that the declaration of the agrarian reform law and the limitation on land ownership lead to the disappearance of the categories who owns more than fifty Feddan in El Fayom Governorate since 1975, while it was 2% of the total size holdings in 1950.

Table 2.6 The Number of Holdings and Holding Areas by Feddan According to Sets of Tenure in El Fayom Governorate for Years - 1950, 1961

Sets of Holdings Size	1950				1961			
	No. of Holdings	%	The Holding Area Feddan	%	No. of Holdings	%	The Holding Area Feddan	%
Less than one Feddan	8410	18	4851	2	20417	25	9411	3
1 - 2 Feddan	11179	24	15213	4	17073	21	22517	6
2 - 3 Feddan	7818	17	18238	5	14409	18	32812	9
3 - 4 Feddan	4787	10	15942	5	10160	12	33054	9
4 - 5 Feddan	3337	7	14445	4	5645	7	24129	7
5 - 10 Feddan	6242	13	42807	12	9066	11	58767	17
10 - 20 Feddan	2861	6	39700	11	2824	3	37646	10
20 - 50 Feddan	1600	3	48793	14	1430	2	41989	12
50 - 100 Feddan	612	1	43316	12	417	0.5	27722	8
More than 100	459	1	108851	31	328	0.5	65586	19
Total	47305	100	352156	100	81769	100	353633	100
Medium			2.52 Feddan				2.24 Feddan	

Source: Agricultural Census, Ministry of Agriculture, Part I, 1950, 1961.

Table 2.7 The Numbers of Holdings and Holding Areas by Feddan According to Sets of Tenure in El Fayom Governorate for Years 1965 - 1975

Sets of Holdings Size	1965[1]				1975[2]			
	No. of Holdings	%	The Holding Area Feddan	%	No. of Holdings	%	The Holding Area Feddan	%
Less than one Feddan	24346	29	13586	4	42086	34.82	29312	9.11
1 - 3 Feddan	33372	40	57680	19	43279	35.86	83859	25.77
3 - 5 Feddan	11527	14	43453	14	21383	17.72	73248	22.51
5 - 10 Feddan	8069	10	54813	18	9389	7.78	60103	18.57
10 - 50 Feddan	5354	6.5	109954	36	4535	3.76	78840	24.23
More than 50 Feddan	422	0.5	28809	9	-	-	-	-
Total	83090	100	308295	100	120672	100	325362	100
Medium			2.03 Feddan				1.8 Feddan	

Source: (1) Central Agency for Public Mobilization and Statistics, Land Tenure Bulletin, Fayom Governorate, 1965, Reference No. 1250 A/74, December 1973.

(2) Agricultural Economics Bulletin, 1979, Agricultural Economics Research Institute, Ministry of Agriculture.

By studying the evolution of the number of holdings and the holdings area according to its farm spaciousness[6] in El Fayom Governorate, it is clear from (Table 2.8) that the numbers of petit farms have doubled three times since 1950 to 1975, also the holdings area for the petit farms have increased remarkably during the previous period, from 11% to 34.8% of the total holdings area in the governorate. Similarly, the holdings numbers for family farms have doubled from 1950 to 1975, while the total holdings area have increased in the same period from 21% to 41% of the total holding area. finally the numbers of commercial farms in El Fayom have decreased, while the total holdings area have decreased also to one-third during the last mentioned period, since they have changed from 68% to 24.2% of the total. These figures serve as an evidence to the fragmentation of agricultural holdings and the narrowness of the farms sizes in El Fayom governorate which can be considered an important obstacle to apply the mechanization as we referred in our hypothesis.

2.4 The Irrigation Resources:

El Fayom governorate has a very elaborate system for the distribution of water, which is called flush irrigation. In this system the land is irrigated via waterfalls where the land steepness of slope from the south to the north helped to use the flush irrigation system and create the waterwheels on watercourse. The Nile irrigation canals are considered the only source for the agricultural production irrigation in El Fayom Governorate.

The irrigation water enter to El Fayom via Youssef canal which takes its water from El Ebrahemia canal at barrages Deirout, the Youssef canal ramifys at El Lahon Barrage before its entering to El Fayom Governorate directly to two main canals: Wast El Lahon (Youssef Canal) and Hassan Wassef Canal, these two canals irrigate all lands in El Fayom so that Sinoris and Tamia district lands are irrigated by Wast El Lahon canal, however Etsa district lands is irrigated by Hassen Wassef water, while Ebshiwai and El fayom districts are irrigated from both canals (Youssef and Hassen Wassef).

Table 2.8 The Evolution of Farm Sizes in El Fayom Governorate for Years 1950, 1961, 1965, 1975

Years	Farm Size	No. of Holdings	%	The Holdings Area Feddan	%
1950	Less than 3 Feddan	27407	59	38302	11
	3 - 10 Feddan	14366	30	73194	21
	More than 10	5532	11	240660	68
	Total	47305	100	352156	100
1961	Less than 3 Feddan	51899	64	64740	18
	3 - 10 Feddan	24871	30	115950	33
	More than 10	4999	6	172943	49
	Total	81769	100	353633	100
1965	Less than 3 Feddan	57718	69	71266	23
	3 - 10 Feddan	19596	24	98266	32
	More than 10	5776	7	138763	45
	Total	83090	100	308295	100
1975	Less than 3 Feddan	85365	70.7	113171	34.8
	3 - 10 Feddan	30772	25.5	133351	41
	More than 10	4535	3.8	78840	24.2
	Total	120672	100	325362	100

Source: Calculated from Tables 6 and 7

Table 2.9 Average of Irrigation Water Deliveries to El Fayom Governorate Per Month According to the Main Canals During the Period 1978-1982

The Months / Name of Canal	January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.	December
Hassen Wassef Canal	30.6	57.1	68.9	67.4	69.1	74.3	91.7	94	77.5	67.5	67.1	61.7
Wast El Lahon (Youssef Canal)	37.1	99.0	129.8	130.0	135.8	140.8	155.5	161.7	133.4	130.0	122.8	105.5
The Total of the Governorate	67.7	156.1	198.7	197.4	204.9	215.1	247.2	255.7	210.9	197.5	189.9	167.2

Source: Calculated from Table 6 in the Appendix

The irrigation water is available every day of the whole year in El Fayon Governorate, unlike all the other governorates in Arab Republic of Egypt which have open and close system for irrigation.

Table 2.9 shows that the average of irrigation water delivers to El Fayom Governorate per month during the period 1978-1982 ranged between its maximum volumes in July and August which equal to 247.2, 255.7 million cubic meters respectively, and its minimum volume which was about 67.7 million cubic meters in January because of winter closure, however, the average of total irrigation water deliveries to El Fayom Governorate per year during the same period were about 2308.3 cubic meters.

From (Table 2.10) it is clear that the average of 'Feddan Share of Water"[7] in El Fayom Governorate is at its maximum volume in August where it was about 666.5 cubic meters, and at its minimum volume in January where it was about 176.5 cubic meters during the period 1978-1982. Also we can notice from the same table that the Feddan Share in Hassen Wassef lands is higher than its corresponding share in Wast El Lahon lands, although the delivery of water to El Fayom Governorate via Wast El Lahon Canal is higher than that via Hassen Wassef Canal. This is so, because that the irrigated area via Wast El Lahon Canal is approximately double the irrigated area via Hassen Wassef Canal. The following part will expose the available irrigation water resources in the administrative districts of El Fayom Governorate.

2.4.1 The Available Irrigation Resources in Different Districts:

This part concerns with the distribution of all available irrigation water in El Fayom Governorate between its different districts as follows:

2.4.1.1 Ebshiwai:

The lands of this district are irrigated by six branched canals, two of them receive their irrigation water from Hassen Wassef Canal and the other four receive water from Youssef canal. It means that Ebshiwai district is irrigated by both main canals, therefore the Feddan Share of Water in this district is equal to the Feddan Share of Water for the governorate as a whole.[8] (See table 2.10 last column)

The average of irrigation water delivers every month to that district during the period 1978-1982 ranged between 49.6 million cubic meters as a maximum volume in August, to about 13.1 million cubic meters as a minimum volume in January (see table 2.11).

2.4.1.2 Etsa:

The lands of this district are irrigated by four branched canals, all of them receive their water from Hassen Wassef Canal, therefore the "Feddan Share of Water" of Etsa district is represented by that one of Hassen Wassef lands (See table 2-10). The average of irrigation water delivers every month to Etsa district during the period 1978-1982 ranged between 63.7 million cubic meters as a maximum volume in August to about 20.7 million cubic meters as a minimum volume in January (see table 2.11).

Table 2.10 Averages of Feddan Share of Water Per Month in El Fayom Governorate During the Period 1978-1982

Months	Hassen Wassef Canal		Wast El Lahon (Youssef Canal)		El Fayom Governorate	
	Average of Water Deliveries (Million Cubic Meters)	The Feddan Share of Water[1] (Cubic Meters)	Averages of Water Deliveries (Million Cubic Meters)	The Feddan Share of Water[2] (Cubic Meter)	Average of Water Deliveries (Million Cubic Meter)	The Feddan Share of Water[3] (Cubic Meter
January	30.6	255	37.1	140.7	67.7	176.5
February	57.1	476	99	375.4	156.1	406.9
March	68.9	574.4	129.8	492.2	198.7	518
April	67.4	561.9	130	493	197.4	514.5
May	69.1	576	135.8	515	204.9	534.1
June	74.3	619.4	140.8	534	215.1	560.7
July	91.7	764.4	155.5	589.7	247.2	644.3
August	94.0	783.6	161.7	613.2	255.7	666.5
September	77.5	646	133.4	505.9	210.9	549.7
October	67.5	562.7	130	493	197.5	514.8
November	67.1	559.4	122.8	465.7	189.9	495
December	61.7	514.3	105.5	400.1	167.2	435.8

Source: Calculated from Table 2.9.

(1) Calculated according to the tenure area which is about 11 99 56 Feddans

(2) Calculated according to the tenure area which is about 26 36 92 Feddans

(3) Calculated according to the tenure area which is about 38 36 48 Feddans

Table 2.11 Averages of Irrigation Water Deliveries to El Fayom Governorate Per Month According to its Main Districts During the Period 1978-1982 (In Million Cubic Meters)

District / Months	Ebshiwai	Etsa	Simoris	Tamia	El Fayom
January	13.1	20.7	7.1	8.2	10.5
February	30.3	38.7	18.8	21.2	24.3
March	38.5	46.7	24.7	28.6	30.9
April	38.3	45.7	24.7	28.7	30.7
May	39.7	46.8	25.8	30.0	31.9
June	41.7	50.4	26.8	31.1	33.5
July	48.0	62.2	29.6	34.3	38.4
August	49.6	63.7	30.8	35.7	39.8
September	41.9	52.5	25.4	29.4	32.8
October	38.3	45.8	24.7	28.7	30.7
November	36.8	45.5	23.4	27.1	29.5
December	32.4	41.8	20.1	23.3	26.0

Source: Derived from Tables 2.5 and 2.10.

2.4.1.3 Sinoris:

The lands of this district are irrigated by seven branched canals, all of the receive their water from Wast El Lahon (Youssef Canal), therefore the Feddan share of Water in this district is represented by that of Wast El Lahon lands (see table 2.10). The average of irrigation water delivers every month to Sinoris district during the period 1978-1982 ranged between 30.8 and 7.1 million cubic meters as a maximum volume in August and a minimum volume in January respectively. (Table 2.11)

2.4.1.4 Tamia:

This district is irrigated by Wast El Lahon canal only, therefore its Feddan Share of Water is represented by the Feddan Share of Water for Wast El Lahon Lands (see table 2.10). While the monthly average of irrigtaion water which flowed to Tamia district during the above mentioned period ranged between 35.7 and 8.2 million cubic meters as a maximum volume in August and a minimum volume in January respectively (see table 2.11).

2.4.1.5 El Fayom:

The lands of this district are irrigated by eleven branched canals, five of them are receiving their water from Hassen Wassef Canal and the other six are receiving their water from Youssef Canal, therefore the Feddan Share of Water in this district is equal to that one of the governorate as a whole. (See table 2.10). The monthly average of irrigtion water which flowed to El Fayom district during the period 1978-1982 ranged between 39.8 and 10.5 million cubic meters as a maximum volume in August and a minimum volume in January respectively. (See table 2.11)

Finally, from the previous part, we can notice that all El fayom districts have received a relatively high rate of water in July and August months because of the Nile River flood in this period.

2.5 The Management Resources:

The management element is considered one of the most important factors of the agricultural production process because it contributes in any agricultural firm by an effective role in achieving raise in its productivity, also it undertakes the responsibility for formulating and following up the implementation of production plan, therefore we can say that, the private and public economic plans are depending on the success of management ability.

Under Egyptian agricultural conditions, it is difficult to separate the management element and the labour element because the agricultural holdings - as we have seen in 2.3.2 (Farm Size) - are very small, and there is no work specialization, it follows that, most of te landlords are peasants and managers at the same time, it leads to weakening of agricultural management efficiency (It proves our first hypothesis) because most of the farmers do not respond to the instruction methods and they are ignorant to the different requirements of management, moreover there is too much lack of qualified sets, technical persons and agricultural supervisors with the weakness of their efficiency level.

It can be argued that, the management element is very difficult to measure, because it depends on the individual opinion, in other words, it cannot objectively measure because it is a subjective element, however, there are some reserchers which attempted to measure the management efficiency with respect to random agricultural sample, these researchers have measured the regression relationships between the input value as an independant variable and the output value as a dependant variable, in addition to estimate the confidence intervals, in such a manner that, the farms which within the confidence - intervals, have medium management efficiency with respect to the sample farms, while the farms which above the confidence - intervals, have high management efficiency, and finally the farms which, below the confidence intervals have relatively low management efficiency, in other words the criterion of the management efficiency is considered a relative criterion between the value of outputs and the value of inputs, so that, if this ratio has increased, it is a good evidence that these farms have high management efficiency and vice versa.[9]

The needs of management element have increased in the recent past years because of the industrial progress, the technical specialization, the

development of communications, and the increase of production scale, therefore the improvement of farms management is very necessary and reasonable for increasing the exploitation of agricultural scarce resources and raise the production average of the farm unit. It can be achieved via the benefit from large scale advatnages, regulate agricultural rotations, integration of management and providing the farmers with different informations.

2.6 The Capital Resources:

The agricultural sector is considered one of the most needful sectors for the farm capital. In the agricultural field, the capital is rovided from four different sources such as:

(1) The inheritance which is considered acquired capital
(2) The saving which is the main element in providing capital especially on domestic level in view of the farmer return from agricultural process is very low, therefore the farm capital may be obtained from saving outside agricultural sector.
(3) In regard to the limitation of inheritance and saving, the credits became one of the most important sources for small farmers because their income from the agricultural process is seasonal.
(4) Finally, the different forms of rent are considered as a source for farm capital.[10]

We can classify the agricultural capital resources to: fixed capital resources and circulating capital resources (current inputs). The following part will expose the component parts for both forms of capital and their availability in El Fayom Governorate.

2.6.1 The Fixed Capital Resources:

The value of capital asset was estimated in the agrarian reform cooperations and agricultural credit cooperations during the period 1978-1980. These estimations are considered as an indicator of the fixed capital

resources which are defined as that capital which can be used in the production process more than one time without any change in their form, such as: buildings, furniture, agricultural tools and cattle, etc.

From Table 2.12 it is clear that the average value of fixed asset in the cooperations of El Fayom Governorate during the period 1978-1980 was about 466 thousand Egyptian pound. This value is distributed between the agrarian reform cooperations and agricultural credit cooperations by the following percentages 66% and 34% respectively.

The distribution of these fixed capital asset according to their different types can be noticed from (Table 2.13). It is clear that the average of the total value of fixed captal asset (in agrarian reform and agricultural credit cooperations) during the period 1978-1980 were about 466.257 thousand Egyptian pound, distributed as follows: The highest share is devoted to machines and equipments, since their values were about 79.2% of the total asset, then consecutively the values of buildings, miscellaneous, trees, cattle, and furniture which were about 11%, 5.5%, 2.3%, 1.2% and 0.8% of the total asset during the above mentioned period.

From table 2.14 it is obvius that the average of total medium - run loans[11] which were delivered by the cooperative organizations in El Fayom during the period 1978-1981 were about 9% of the total loans value in El Fayom Governorate, while it is representing 3.7% of total medium-run loans in the national level.

Table 2.12 The Value of Fixed Assets in the Cooperative Organization in El Fayom Governorate During the Period 1978-1980

Years	Agarian Reform Cooperations	Agricultural Credit Cooperations	Total
1978	2833386	166669	450055
1979	290826	178362	469188
1980	352454	127074	479528
Total	926666	472105	1398771
average	308888.6	157368.3	466257
% of the total	66%	34%	100%

Source: Central Agency for Mobilization and Statistics (CAPMAS) Annual Bulletin of Cooperation Activities in Agricultural Sector, various issues.

Table 2.13 The Distribution of the Value of Fixed Capital Asset in the Cooperative Organizations in El Fayom Governorate According to Their Different Types. During the Period 1978 - 1980 (In Thousand E. Pound)

Asset Type	Agrarian Reform Cooperations	Agricultural Credit Cooperations	Agrarian Reform Cooperations	Agricultural Credit Cooperations	Agrarian Reform Cooperations	Agricultural Credit Cooperations	Agrarian Reform Cooperations	Agricultural Credit Cooperations
	1978		1979		1980		Average of the Period 1978-1980	
Buildings	22652	2614	26935	50175	26998	22091	25528.3	24960
Machines & Equipment	220184	162997	222560	127254	271050	104349	237931.3	131533.3
Trees	-	-	16445	-	16419	-	10954.6	-
Furniture	2812	1058	2955	933	3211	634	2992.6	875
Cattle	16484	-	-	-	-	-	5494.6	-
Miscellaneous	21254	-	21931	-	34776	-	25987	-
T O T A L	283386	166669	290826	178362	352454	127074	308888.4	157368.3

Source: (CAPMAS) Annual Bulletin of Cooperation Activities in Agricultural Sector, Various Issues.

2.6.2 The Circulating Capital Resources:

The circulating capital reosurces are defined as this resource which enters the production process one time only and are exhausted in that time, such as: seeds, fertilizers and pesticids, etc. all these capital resources are involved in short-run loans[12] which are delivered by the cooperations organization in El Fayom Governorate.

Also, we can notice from (Table 2.14) that the average of total value for short-run loans during the period 1978-1981 were about 91% of the total loans delivered in El Fayom and representing about 4.1% of the total short run loans in the national level.

The average of total loans for the animal development in the period 1978-1981 was about 40.6% of the total short-run loans in El Fayom, however, the average of agricultural loans was about 59.2% of the total short-run loans, and finally the average of other miscellaneous loans was very small, i.e. about 0.2% of the total. From last figures we can deduce that the loans for agricultural processes have the highest share of the total short-run loans in El Fayom Governorate during the above mentioned period. (See Table 2.15)

2.7 The Animal Resources:

The animal resources play an important role in the agricultural production process, however, that role has too many variations from country to country, and within the same country, in the most developed countries the importance of this role is relatively low with respect to the developing countries. In Egypt, in general, and in El Fayom in particular, the traditional agricultural methods are prevalent, therefore the peasants use the animals in cultivation, transport, and as a source of organic fertilizer etc. As can be seen from figures in (Table 2.16) the total number of these resources is relatively low, however, the cows and donkey are representing the higher percentages, 30.6%, 24.4% of the total, during the period 1976-1980 respectively, while the buffalo percentage is relatively low.

Table 2.14 The Total of Short and Medium Run Credit Received by The Cooperational Organizations in El Fayom Governorate and in National Level During (1978-1981)

	The Country as a Whole			El Fayom Governorate		
Years	Short-run Credit	Medium-run Credit	Total	Short-run Credit	Medium-run Credit	Total
1978	166047	6673	172721	7797	617	8414
1979	193645	17739	211384	7601	412	8013
1980	280892	91340	372232	11686	3255	14941
1981	419569	-	419569	16557	-	16557
Average of the period	265039	28938	293976.5	10910	1071	11981
% of the governorate to national level	100	100	100	4.1	3.7	4.0

Source: (CAPMAS), Annual Bulletin of Cooperation Activities in Agricultural Sector, various issues.

Table 2.15 The Distribution of Short-run Credit According to the Economic Activity in El Fayom Governorate During the Period 1978-1981 (In thousand pound)

Years	The Distribution of Short-run Credit			
	For Animal Resource Development	For Agricultural Sector	Other Kinds	Total
1978	2859	4913	25	7797
1979	2395	5156	50	7601
1980	5114	6545	27	11686
1981	7330	9220	7	16557
Average	4424.5	6458.5	27	10910
% of the Total	40.6	59.2	0.2	100

Source: (CAPMAS), Annual Bulletin of Cooperation Activities in Agricultural Sector 1979, Reference No. 71 - 12421/82, September 1982.

Table 2.16 The Estimation of Cattle and Animal Numbers in El Fayom Governorate During 1976-1980

Years	Cows	Buffalo	Sheep	Goat	Camels	Swine	Horses	Mule	Donkey	Total
1976	883	517	432	302	23	3	5	1	680	2846
1977	878	526	419	308	22	2	4	1	605	2765
1978	869	534	404	314	21	2	4	=	710	2858
1979	859	541	387	320	20	2	3	=	725	2857
1980	846	549	368	325	19	2	2	=	740	2851
Average	867	533.4	402	314	21	2.2	3.6	=	692	2835
% of the Total	30.6	18.8	14.2	11.0	0.74	0.08	0.13	0.05	24.4	100

Source: (CAPMAS), The Number of Cattle and Animals Estimates Bulletin for El Fayom Governorate various issues.

= less than 50

2.8 The Agricultural Investment:

The agricultural investment in cultivation, irrigation and drainage projects in El Fayom Governorate is increased rapidly in the recent yeras. As we can see from the table below, that the total investments in 1978/1979 were about 0.8 million Egyptian pound representing about 8.2% of the total investments in the governorate, while this percentage has increased in 1980/1981 to 34.4% of the total investments.

Table 2.17 The Agricultural Investments in El Fayom Governorate (Million Egyptian Pound)

Years	Agricultural Investment In El Fayom	Total Investments in El Fayom	% of the Total
1978/1979	0.8	9.76	8.2
1979/1980	3.8	15.32	22.2
1980/1981	5.5	16.0	34.4

Source: Ministry of Planning, unpublished data.

From the last exposition for the available agricultural resources in El Fayom Governorate, and their distribution among the different districts of this governorate, we shall study in the coming chapters the present state of the agricultural productivity - in the various districts as well as the governorate - as a whole - by using these resources and how we can improve this productivity.

Notes - Chapter 2

(1) Khalifa, A.F. Abdel Hakim, An Analytical Study for the Agricultural productivity in U.A.R. and its Relation by Agricultural Development, PH.D., Thesis, Agricultural Economic Department, Faculty of Agriculture, Cairo University, 1969.

(2) The employed workers comprise (persons have 6 years to less than 12 old) and (persons have 12 yeras to less than 64 old) and (people who are employed and have more than 65 years).

(3) The agricultural area is the total of first, second, third and fourth classes lands.

(4) The area which is not arable lands for cultivation is the total of fifth and sixth classes.

(5) Karkor, EL.W. An Analysis Study of the Optimal Crop Composition in El Fayom Governorate, Master thesis, Agricultural Economic Department, Faculty of Agriculture, Ain Shams University, 1978.

(6) The farms are classified according to its size to, Petit farms, family farms and commercial farms. The petit farms are defined as that farms which have less than 3 feddans, while the family farms are that farms which have between 3-10 feddans and involve all labour of the family who owns that kind of farms, however, the commercial farms are that which have more than 10 feddans. (See El Eodemy, M.S. (Doctor)): Farm Works Management, Faculty of Agriculture, Ain Shams University, 1977.

(7) "The Feddan Share of Water" is defined as the volume of irrigation water deliveries to specific region related to the tenure area in this region.

(8) Notice that the "Feddan Share of Water" for the governorate as a whole $\neq$ the Feddan Share of Water for Hasen Wassef + that one of Youssef canal, because every Feddan Share is weighted by its tenure area.

(9) Khalifa, A.F. An Analytical Study for the Agricultural Productivity in U.A.R. and its Relation by Agricultural Economic Development, op.cit.

(10) Emarah R. El-Sayed, An Analytical Study for Agricultural Productivity in El Garbia Governorate, Master Thesis, Agricultural Economic Department, Faculty of Agriculture, Cairo University, 1977.

(11) The period of these loans must not be more than 10 years and they are used for buying the agricultural machines, cattle, and trees, etc.

(12) The period of these loans must not be more than 14 months and they are used for buying seeds, fertilizers, and pesticides etc., also these loans can be used in financing the agricultural process, the animals resources, etc. (See The Annual Bulletin of Agricultural Activity).

CHAPTER III

THE ECONOMIC ANALYSIS OF THE FEDDAN PRODUCTIVITY FOR THE MOST IMPORTANT FIELD AND VEGETABLE CROPS

3.1 Preface

The productivity is considered an important indicator for economic growth, because it indicates to what extent the production units are successful in using their available resources. The productivity is usually defined as number of units of product per unit of input,[1] measured either in physical term, i.e. the quantity of output per unit of input or in monetary term, i.e. the value of the output related to its cost. From that definition, it is clear that the productivity can be measured for all different factors of production. For example, we can measure the productivity of capital, the productivity of land and the productivity of workers. This research undertakes the study of productivity of land in El Fayom Governorate for many reasons.

(1) Land is the basic factor of production associated with almost all agricultural production, moreover it is the critical factor of production, especially in the short term, since it is difficult to increase the economic supply of this factor rapidly.
(2) The reclamation projects take a long time and need very high costs in addition to the limitation of irrigation water in some new places.
(3) the rapid growth in the population leads to loss of good agricultural land to non-agricultural uses such as increase the construction for living on the expense of agricultural land.

The productivity of land is the major factor likely to influence output of crop products, since the quantity of any total output is the product of its cultivated area and the feddan productivity, therefore, to increase the total output, it is necessary to increase either its cultivated

area (horizontal increase) or improve its productivity per feddan of land (vertical increase), since I referred above to some difficulties which face the horizontal development, the research will concentrate onthe Feddan productivity for the most important field and vegetable crops.

3.2 The Theoretical Framework:

The rate at which productivity per Feddan for any crop can be increased influences the total production of that crop. In fact, if productivity increases are sufficiently rapid it would be possible for the area of land under cultivation to fall while output still increased to meet the population demand.[2] Progress in achieving higher productivity per Feddan is dependent on a number of factors such as the direct inputs of fertilizers, better quality seeds, pesticides, the effetiveness of use of the irrigation water and improved drainage, energy and machinery but also on the technological progress that is made through research and development and on the management skills and farm structures that are used for applying this technology as well as some other uncontrollable factors such as climatic changes.

The research undertakes the study of Wheat, Onion, and Nile Maize out of the field crops becaue the average of their cultivated area in El Fayom Governorate during the period 1966-1982 is about 40% of the total cultivated area of field crops in El Fayom, and tomatoes (winter tomato, summer tomato and nile tomato) out of the vegetable crops, because the average of its total cultivated area in the three seasons during the last period is about 83% of the total cultivated area by vegetables.[3]

As a matter of fact, nothing is good or bad but by comparison, this chapter therefore attempts to study and compare the Feddan Productivity of the crops under study between the various districts in the governorate during the period 1966-1982, since the data referred to very high fluctuations of the productivity between and within the districts. The purpose of this comparison is showing the district which has highest productivity, in other words, the relative advantage for the various districts in producing one crop rather than the other. The comparison was done in three different ways:

(1) The first is the simplest way which involves the percentage of change in the productivity as a ratio between the last and the first year of our time series, in addition to calculate the percentage of annual change assuming constant change of the basic year, 1966.

(2) The second way is more sophisticated, since it takes into account the whole observations and the evolution of the productivity over time by using the time trend equations, as well as the calculation of percentage of annual change of the average for the total period (1966-1982).

(3) The third method comes to the light, the distinguish between the average productivity of different districts over the period by using the analysis of variance and F test to see whether there is a significant difference between the means of the districts productivity during the above mentioned period or not? In case of the existence a significant difference, the researcher has done the simultaneous confidence intervals to obtain the answer of the quetion, how much are the districts different? i.e. what is the least significant difference between them? (L.S.D.)

This chapter also concerns with discovering the causes of the productivity behaviour and fluctations among the different districts, as well as throwing light on the importance of every district and its effect on total production by taking into account the area under cultivation and its changes as a ratio between the last and the first year in addition to calculate the average of the whole period.

3.3 The Analysis of Productivity Between Districts with Throwing the Light On Cultivation Area:

In this part the analysis has been done according to the arrangement of the three methods of comparisons mentioned above for every crop alone, using for simplicity - the following symbols P_1, P_2, P_3, P_4, P_5, to express this productivity per feddan for the next districts, Ebshiwai, Etsa, Sinoris, Tamia, and El Fayom district repectively, and P_6 for the productivity of the governorate as a whole. Also the symbols A_1 A_2, A_3, A_4, and

A_5, has been used to express the cultivated area of the previous districts respectively.

3.3.1 Wheat

Wheat is considered one of the most important cereals in the world because it has many uses, such as producing bread, macaroni and sweetmeats, in addition to use it in manufacture foodstuff and alcohol. Wheat has this special importance because it exceeds others cereals in protein, carbohydrate, calcium, and vitamin (C). It is worth to refer that straw is the by product of wheat which is used as food for animals and - as will be pointed out in Chapter V - it influences the profitability of wheat.

From Table 3.1 it is clear that - by using the first way of comparison between the productivity of the districts in El Fayom - Tamia District has the highest percentage of annual increae, however, all other districts has a positive change, i.e. increase in their productivity in 1982 rather than 1966. The rate of change in productivity of the governorate as a whole is the result of changes in the all fifth districts, where it was 1.421% of the basic year.

It has been calculated in the second way of comparison the first degree equations of time trends for the Feddan productivity of weat during the period 1966 - 1982 for the various districts as well as, the governorate as a whole respectively, as follows:

$$* \quad \hat{P}_{i1} = 6.77 + \underset{(0.0378)}{0.138}\ t_i \qquad (3.1)$$

$$R^2 = 0.47 \qquad \bar{R}^2 = 0.44$$

$$* \quad \hat{P}_{i2} = 6.72 + 0.152\, t_i \qquad (3.2)$$
$$(0.0362)$$
$$R^2 = 0.54 \qquad R^{-2} = 0.51$$

$$* \quad \hat{P}_{i3} = 7.11 + 0.157\, t_i \qquad (3.3)$$
$$(0.0381)$$
$$R^2 = 0.53 \qquad R^{-2} = 0.49$$

$$* \quad \hat{P}_{i4} = 5.889 + 0.190\, t_i \qquad (3.4)$$
$$(0.0256)$$
$$R^2 = 0.79 \qquad R^{-2} = 0.77$$

$$* \quad \hat{P}_{i5} = 7.085 + 0.177\, t_i \qquad (3.5)$$
$$(0.037)$$
$$R^2 = 0.60 \qquad R^{-2} = 0.58$$

$$* \quad \hat{P}_{iG} = 6.60 + 0.166\, t_i \qquad (3.6)$$
$$(0.029)$$
$$R^2 = 0.69 \qquad R^{-2} = 0.667$$

Where $\hat{P}_{ij}$ are the estimated values of feddan productivity of Wheat, and i = 1, 2 ..... 17, j = 1, 2 ... 5,

T_i = the time variable by year,
R^2 = the determination coefficient (the square of correlation coefficient)
R^{-2} = the adjusted coefficient of determination.

Table 3.1 The Simplest Method of Comparison Between the Feddan Productivity of Wheat For Various Districts

Name of District	Productivity per Feddan in 1966	Productivity per Feddan in 1982	% Total Change	% Annual Change
EbShiwai	7.54	8.81	16.84%	0.99%
Etsa	7.61	9.55	25.5 %	1.5 %
Sinoris	7.71	8.77	13.75%	0.81%
Tamia	6.98	9.43	35.1 %	2.1 %
El Fayom	7.44	9.51	27.82%	1.64%
The Governorate	7.45	9.25	24.16%	1.421%

Source: Derived from Table 7 in the Appendix

Table 3.2 Differences in Average of Wheat Productivity by Using The Analysis of Variance and 95% Simultaneous Confidence Confidence Intervals (Data from table 7 in the Appendix)

	P_1	P_2	P_3	P_4	P_5
P_1	0	-0.1	-0.5	0.39	-0.69
P_2	0.1	0	-0.43	0.49	-0.59
P_3	0.53	0.43	0	0.92	-0.16
P_4	-0.39	-0.49	-0.92	0	-1.08
P_5	0.69	0.59	0.16	1.08	0

The Differences between all averages are significant on 5%

The sign of the parameters in all previous equations refer to increase the productivities of all El Fayom districts, the annual rates of their increase are satistically significant at the 1 percent level of probability, by about 0.138, 0.152, 0.157 0.190, 0.177, 0.166 Ardeb^{4} for all districts as well as the governorate as a whole respectively. The annual percentages of these rates were 1.73%, 1.88%, 1.84%, 2.50%, 2.04%, 2.05% of the average of the period under study (Figure 3.1 shows the evolution of wheat productivity of the governorate as a whole).

From the previous analysis it can be argued that Tamia district has the highest percentage of annual growth (2.5%) of its average and the highest coefficient of determination which means that 79% of the variance in the feddan productivity is associated with the time variable during the period under study.

The study has concluded by the third way of comparison that there is a significant difference between the means of wheat productivity for the various districts during the period under study (see Table 3.2). The positive differences in row P_5 indicate how much El Fayom district is significantly high in its mean than other districts, however, the negative differences in row P_4 indicate that Tamia district has the lowest mean during the period under study.

The results of the previous analysis of the three ways of comparison can be summarized in the following table using ranks from 1, 2 ... 5 referring to the downward arrangement of the different districts.

Table 3.3 Rank Between El Fayom Districts According to the Three Approaches of Comparison for Wheat Crop

Name of District	First Method	Second Method	Third Method
EbShiwai	4	5	4
Etsa	3	3	3
Sinoris	5	4	2
Tamia	1	1	5
El Fayom	2	2	1

It is clear from the table above that Tamia district has the highest productivity in two different ways, however, the third way refers that the mean of this district was very low during the period under study. In the future we can expect for Tamia district higher productivity since it has the highest percentage of annual growth of the basic year (represented by first method) and the highest percentage of annual growth of the average of the total period (represented by second method). It can be argued that El Fayom district follows Tamia district, and its mean during the period 1966-1982 was very high, therefore, it comes to the light that Tamia and El Fayom districts have a relative advantage in producing wheat rather than the three other districts.

The question now arises, why those districts have a relatively high productivity per Feddan? We may be attributed that to the fertility of their soil or more precisely because of the conveniency of their lands to wheat cultivation, in addition to increase the peasants advertency than other districts, where they concern with the opposition of wheat diseases which is the major factor likely to influence the wheat productivity, however, the answer of this question depends also on study the quantity of different inputs used in producing wheat and their combination ratio in the various districts. Unfortunately there is no detailed data for the quantity of inputs or their costs on the level of districts, the only available data is for the governorate as a whole.

Figure 3.1 The Evolution of Feddan Productivity of Wheat in El Fayom Governorate During the Period 1966-1982

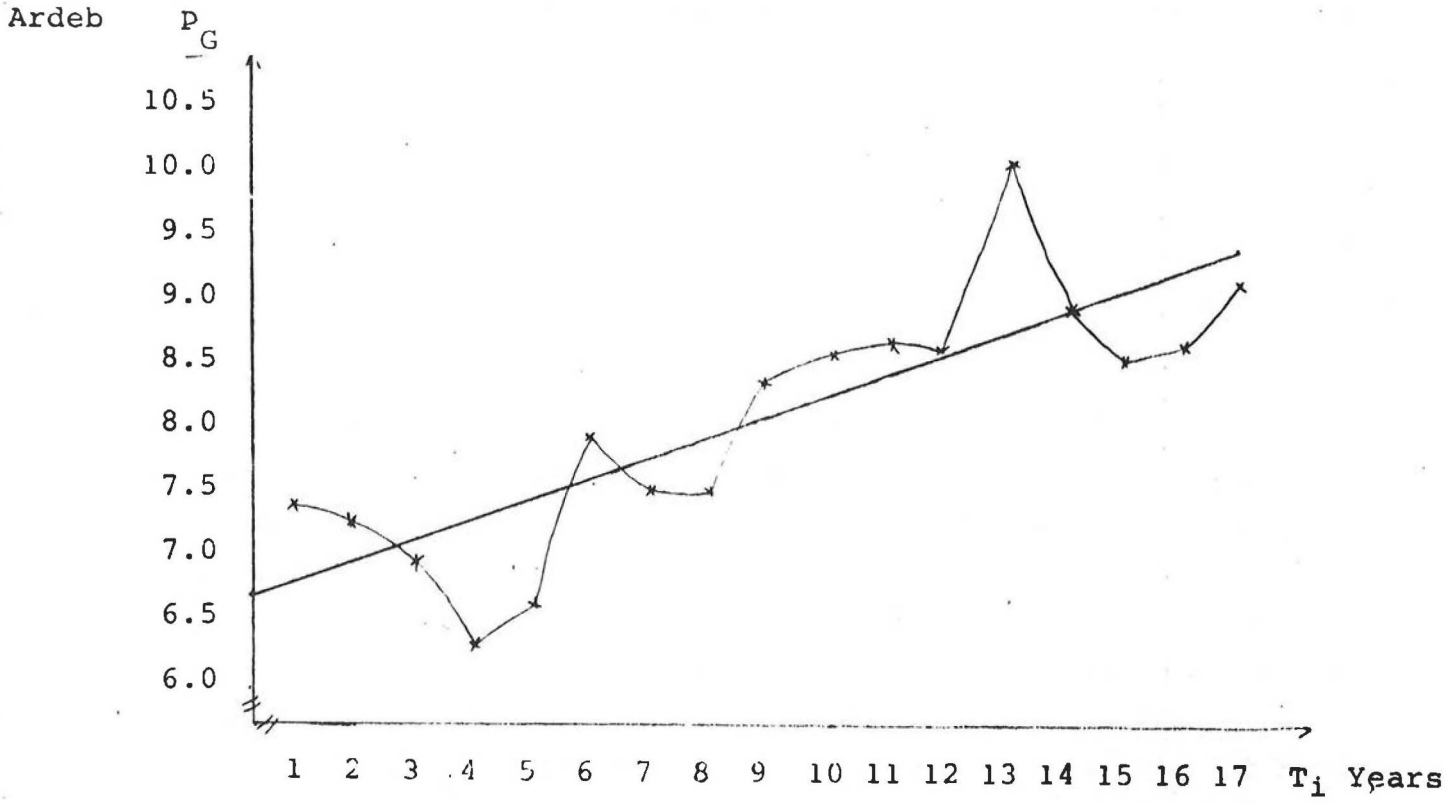


Table 3.4 The Changes in Cultivation Area of Wheat for El Fayom Districts and Their Percentage of the Governorate

Name of District	Area in 1966 Feddan	Area in 1982 Feddan	% Change	Mean of 66-1982	% of the Total
EbShiwai	19499	12845	-34%	15461	20.1%
Etsa	19622	15745	-19.7%	18789	24.4%
Sinoris	13865	10893	-21.4%	12299	16.1%
Tamia	17060	14972	-12.2%	15422	20.1%
El Fayom	15978	13132	-17.8%	14786	19.3%
Total Governorate	86024	67587	-21%	76757	100%

Source: Table 8 in the Appendix

As will be pointed out in the next chapter, the study will use these data to give a clear description for the magnitude and the combination ratio of inputs by estimate the production functions for the crops under study.

The area under cultivation by wheat influences by some economic factors such as: the price of wheat in the last year and - as we shall see in Chapter V - its profitability as well as the competitive cros profitability, in addition affection that area by the governorate policy and the agricultural rotations conditions to achieve - to a large extent - the food security. The cultivation area of wheat has direct and temporary sensitivity for wars. (Notice the increase in the cultivation area in both years 1968 and 1974 for various districts as well as the governorate as a whole. Table 8 in the Appendix).

As we can see from (Table 3.4) the cultivation area of wheat in all different districts and, in turn, the total governorate has decreased during the period 1966-1982 since wheat has some competitive crops in the winter season such as onion, barley and flax, however, Ebshiwai district has a remarkable decline about 34.1% of the basic year 1966. The means of the period under study are lower than all values in 1966, the percentages of the means with respect to the total governorate are more or less equal, Tamia and El Fayom districts are representing about 40% of the total wheat area in the governorate, it means that the improvement in their productivity will affect about 40% of the total product.

3.3.2 Wheat Straw

All agricultural production includes joint products in some form which are produced through a single production process; wheat and straw are joint products in fixed proportions, nevertheless mutton and wool are joint products with competitive range.[5]

The cost of production for wheat feddan yields wheat corns as the main product and straw as the by product, therefore it is necessary to take into consideration the Feddan productivity of straw and its importance for the peasants, since in some cases, the revenue of by product is the stimulator for producing the main product. The study concerns with the evolution of straw productivity over time during the period understudy in El Fayom

Governorate as a whole only because - as mentioned above - the relation between wheat and straw is in fixed porportions i.e. the higher productivity of wheat, the higher productivity of straw, consequently, the districts which have relative advantage in the productivity of wheat have also the same advantage in the productivity of straw and vice versa.

It has been calculated the linear time trend equation for the Feddan productivity of straw during the period 1966-1982 as follows:

$$* \quad \hat{P}_i = 5.99 + \underset{(0.0371)}{0.0958}\, t_i \qquad (3.7)$$

$$R^2 = 0.649 \qquad R^{-2} = 0.625$$

Where $\hat{P}_i$ is the estimted value of Feddan Productivity of straw, and i = 1, 2, ... 17. t_i = the time variable by year, R^2, R^{-2} as defined before.

From equation (3.7) it is clear that, the Feddan Productivity of straw increases by an annual rate statistically significant at the 5 percent level of probability about 0.0958 Heml.[6] The annual percentage of that rate was about 1.4% of the average of the period under study. We can see also from (figure 3.2) the growth of straw productivity in El Fayom Governorate, and from table 9 in the Appendix it is obvious that this productivity has flactuated during 1966-1982, ranged between 5.5 units as a minimum quantity in 1977 to about 9.1 units as a maximum quantity in 1982.

Figure 3.2 Evolution of Feddan Productivity of Wheat Straw in El Fayom Governorate During the Period 1966-1982

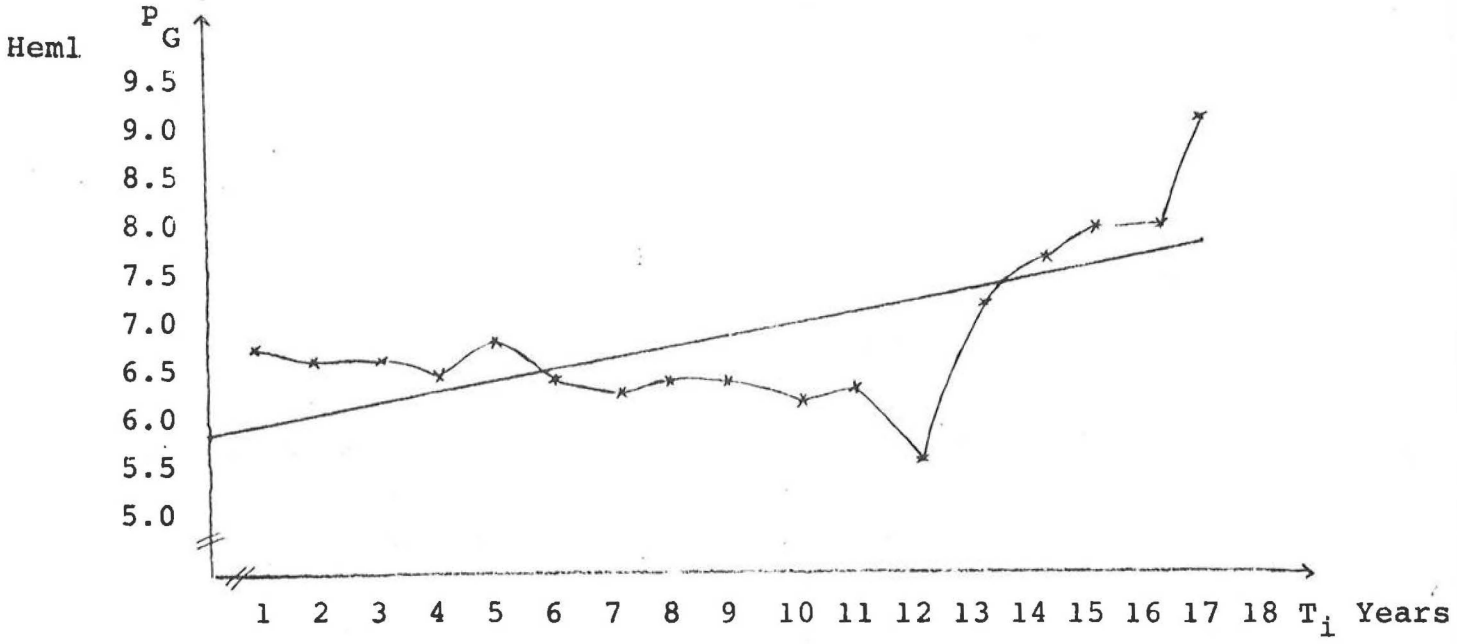
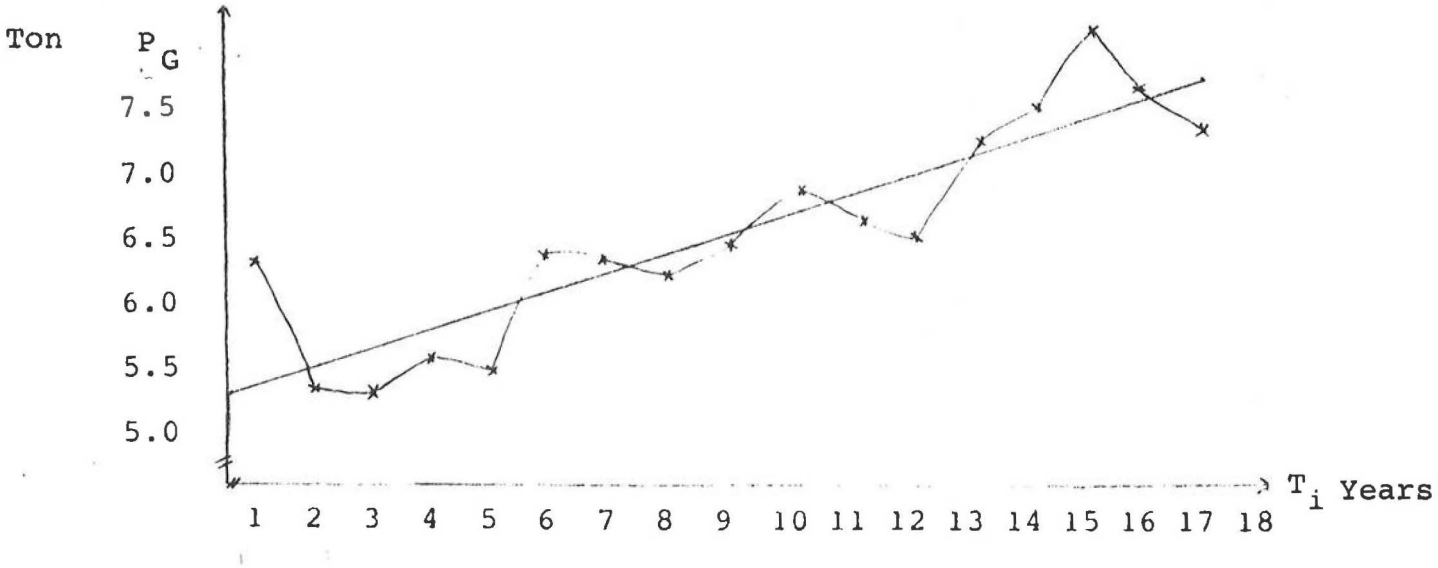


Figure 3.3 The Evolution of Feddan Productivity of Onion in El Fayom Governorate During the Period 1966-1982



3.3.3 Onion

Onion is one of the main agricultural production activities, it is a necessary foodstuff which has not good substitutional commodities. In Egypt Onion can be cultivated in Winter, Summer and Nile seasons, however, in El Fayom Governorate the cultivation of Onion is concentrated in winter season in addition to a very small quantity in other two seasons, therefore the study will concentrate on the productivity of Winter Onion in El Fayom Governorate during the period 1966-1982.

By following the previous manner of comparison analysis between the different districts in El Fayom, we can see from (Table 3.5) that Ebshiwai district has the highest percentage of annual increase however Tamia and El Fayom districts has a negative chang, i.e. their productivity has decreased in 1982 rather than 1966. The rate of change in the governorate as a whole was about 0.83% of the basic year.

In the econd method of comparison, we have calculated the linear time trends equations for the Feddan Productivity of Onion during the period under study as follows:

$$* \quad \hat{P}_{i1} = 5.27 + \underset{(0.0195)}{0.145}\ t_i \qquad (3.8)$$

$R^2 = 0.79 \quad R^{-2} = 0.77$

$$* \quad \hat{P}_{i2} = 5.45 + \underset{(0.0183)}{0.0779}\ t_i \qquad (3.9)$$

$R^2 = 0.41 \quad R^{-2} = 0.37$

$$* \quad \hat{P}_{i3} = 5.93 + \underset{(0.0215)}{0.0697}\ t_i \qquad (3.10)$$

$R^2 = 0.55 \quad R^{-2} = 0.52$

$$* \quad \hat{P}_{i4} = 6.228 - \underset{(0.026)}{0.019}\ t_i \qquad (3.11)$$

$R^2 = 0.57 \quad R^{-2} = 0.53$

$$* \quad \hat{P}_{i5} = 7.201 - \underset{(0.0518)}{0.0942}\, t_i \qquad (3.12)$$

$R^2 = 0.36 \quad R^{-2} = 0.31$

$$* \quad \hat{P}_{iG} = 5.38 + \underset{(0.0179)}{0.132}\, t_i \qquad (3.13)$$

$R^2 = 0.719 \quad R^{-2} = 0.699$

Where $\hat{P}_{ij}$ are the estimated values of Feddan Productivity of Onion, and $i = 1, 2, \ldots 17$, $j = 1, 2, \ldots 5$, T_i is the time variable by year. R^2, R^{-2} as defined before.

The sign of the parameters in equations (3.8), (3.9) and (3.10) referes to the increase in Onion Productivity for EbShiwai, Etsa, and Sinoris districts, the annual rates of their increase are statistically significant at the 1 percent level of probability, by about 0.145, 0.0779, 0.0697 Ton respectively. The annual percentage of these rates were about 2.21%, 1.28%, 1.05% of their averages during the period 1966-1982. However equations (3.11) and (3.12) refer to decrease the productivity of Onion Feddan in Tamia and El Fayom districts, the annual rates of that reduction were statistically not significant. The annual percentage of these rates were -0.31%, -1.48% respectively.

From equation (3.13) it is clear that the productivity of Onion in El Fayom Governorate as a whole has increased by annual rate about 0.132 ton which is statistically significant at the 5 percent level of probability. The annual percentage of that rate was about 2.02% of the average which was 6.57 ton during the abovementioned period. The evolution of this productivity has been drawn in (figure 3.3). It is clear from using this method of analysis that Ebshiwai ditrict has the highest percentage of annual growth (2.21%) of its average and the highest correlation coefficient. The study has concluded by the third method of comparison tat there is a significant difference between the means of Onion Productivity for the various districts during the period under study. (Table 3.6) Summarize the evaluation of all districts by examining their row:

Table 3.5 The Simplest Method of Comparison Between the Feddan Productivity of Onion for Various Districts

Name of District	Productivity per Feddan in 1966	Productivity per Feddan in 1982	% Total Change	% Annual Change
Ebshiwai	6.39	7.34	21.9%	1.29%
Etsa	6.165	6.78	9.98%	0.59%
Sinoris	6.615	7.73	16.9%	0.99%
Tamia	6.345	6.28	-1.02%	-0.06%
El Fayom	6.615	5.05	-23.6%	-1.4%
The Governorate	6.345	7.352	14.25%	0.838%

Source: Derived from Table 10 in the Appendix

Table 3.6 Differences in Averages of Onion Productivity by Using The Analysis of Variance and 95% Simultaneous Confidence Intervals (Data from Table 10 in Appendix)

	P_1	P_2	P_3	P_4	P_5
P_1	0	0.49	-0.07	0.46	0.22
P_2	-0.49	0	-0.56	-0.03	-0.27
P_3	0.07	0.56	0	0.53	0.29
P_4	-0.46	0.03	-0.53	0	-0.24
P_5	-0.22	0.27	-0.29	0.24	0

Differences between all averages are significant at 5%

Thus the positive differences in row P_3 indicates that Sinoris district has the highest mean, while values in row P_1 refers that Ebshiwai district comes after Sinoris district directly.

The results of the previus analysis of the three methods of comparison can be summarized in the following table using ranks from 1, 2 ... 5 as before.

Table 3.7 Rank Between El Fayom Districts According to the Three Approaches of Comparison for Onion Crop

Name of District	First Method	Second Method	Third Method
Ebshiwai	1	1	2
Etsa	3	2	5
Sinoris	2	3	1
Tamia	4	4	4
El Fayom	5	5	3

It is clear from the table above that Ebshiwai district has the highest productivity by different two ways. Sinoris and Etsa districts come after Ebshiwai respectively, however, Tamia and El Fayom districts come later, since as we have seen before their productivity has decreased during the period under study, therefore it comes to the light importance of Ebshiwai district in producing Onion. It may be attributed because of the fact that Onion is a very sensitive crop to the quality of land and the percentage of the soluble salts on it. As we can notice from Chapter II, Ebshiwai district is the only one that has the first class lands.

As mentioned in case of wheat, the area under cultivation of onion influences by some economic factors, moreover the study has concluded from (Table 3.8) that there is a positive relationship between the changes in the cultivation area by Onion and the changes in the Feddan productivity of Onion (compare the sign of changes in productivity in tables 3.5 and in the

equations from (3.8) to (3.12) with the sign of changes in the cultivation area Table 3.8). In this specific case, it can be argued that the peasants response positively to the increase in the productivityby cultivating more area. From the same table it is clear also that the mean of the cultivation area in Ebshiwai district is represnting about 83.3% of the area meanof the total governorate, however, the mean of cultivation area in Sinoris district has a low percentage of the total mean comparatively with its productivity, where it comes in the second level after Ebshiwai district, and it has the highest percentage of the second class lands, (see table 2.5) therefore it is necessary to increase the area under cultivation by onion in that district to improve the total product of Onion in El Fayom Governorate as a whole.

3.3.4 Nile Maize

Nile Maize is also one of the important cereals, the productivity of this crop affects - to a large extent - by the availability of water in addition to the number of seeds per feddan, where the optimal quantity is about 17 to 20 thousands, moreover the cultivation of that crop after vegetables and herbs in the same soil yields high productivity than that in case of its cultivation after grass.

By study the first method of comparison can be deduced from table 3.9, that Etsa district has the highest percentge of annual increase with respect to the basic year 1966. Tamia district and Sinoris districts follow Etsa respectively, the productivity of remainder districts has decrased in 1982 rather than 1966. The rate of change in the governorate a whole has increased due to the high annual increase of Etsa district.

It has been calculated in the second method of comparison the first degree equations of time trends for the Feddan productivity of Nile Maize during the period under study for all the various districts as well as, the governorate respectively, as follows on page 81.

Table 3.8 The Changes in Cultivation Area of Onion for El Fayom Districts and Their Percentage of the Governorate

Name of District	Area in 1966 Feddan	Area in 1982 Feddan	% Change	Mean of 66-1982	% of the Total
EbShiwai	837	3367	302%	2202	83.3%
Etsa	60	62	3.3%	184.6	7.0%
Sinoris	119	234	96.6%	62	2.3%
Tamia	295	47	-84%	153	5.8%
El Fayom	165	13	-92%	41.4	1.6%
Total Governorate	1476	3713	151.5%	2643	100%

Source: Derived from Table 11 in the Appendix

Table 3.9 The Simplest Method of Comparison Between the Feddan Productivity of Nile Maize for Various Districts

Name of Districts	Productivity per Feddan in 1966	Productivity per Feddan in 1982	% Total Change	% Annual Change
Ebshiwai	7.14	7.00	-1.96%	-0.12%
Etsa	5.51	7.46	35.4%	2.08%
Sinoris	7.96	8.9	11.8%	0.69%
Tamia	5.42	6.47	19.37%	1.14%
El Fayom	7.85	7.3	-7%	-0.41%
The Governorate	6.83	7.4	8.34%	0.49%

Source: Derived from Table 12 in the Appendix

$$* \quad \hat{P}_{i1} = 7.32 - 0.045\ t_i \qquad (3.14)$$
$$(0.0279)$$
$$R^2 = 0.35 \qquad R^{-2} = 0.31$$

$$* \quad \hat{P}_{i2} = 6.034 + 0.1138\ t_i \qquad (3.15)$$
$$(0.0279)$$
$$R^2 = 0.64 \qquad R^{-2} = 0.62$$

$$* \quad \hat{P}_{i3} = 7.977 - 0.0199\ t_i \qquad (3.16)$$
$$(0.0549)$$
$$R^2 = 0.53 \qquad R^{-2} = 0.49$$

$$* \quad \hat{P}_{i4} = 5.9157 - 0.0036\ t_i \qquad (3.17)$$
$$(0.0276)$$
$$R^2 = 0.21 \qquad R^{-2} = 0.16$$

$$* \quad \hat{P}_{i5} = 7.669 - 0.0287\ t_i \qquad (3.18)$$
$$(0.0362)$$
$$R^2 = 0.40 \qquad R^{-2} = 0.27$$

$$* \quad \hat{P}_{iG} = 6.805 + 0.026\ t_i \qquad (3.19)$$
$$(0.0247)$$
$$R^2 = 0.51 \qquad R^{-2} = 0.48$$

Where $\hat{P}_{ij}$ are the estimated values of Feddan Productivity of Nile Maize, and $i = 1, 2, \ldots 17$, $j = 1, 2, \ldots 5$. T_i is the time variable by year. R^2, R^{-2}, as defined before.

Figure 3.4 The Evolution of Feddan Productivity of Nile Maize in El Fayom Governorate During the Period 1966-1982

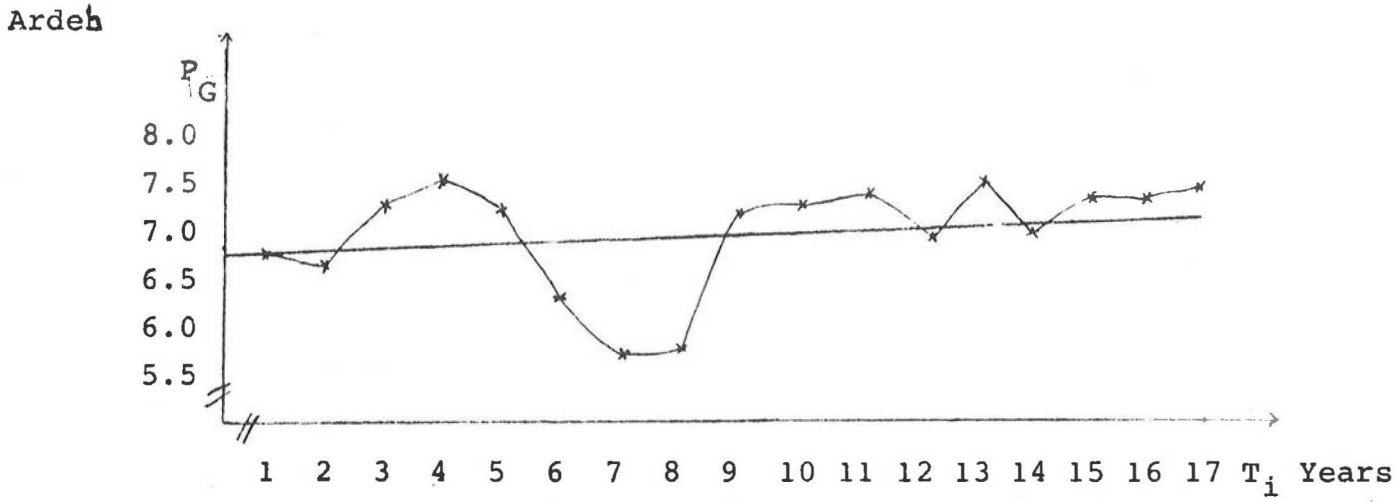
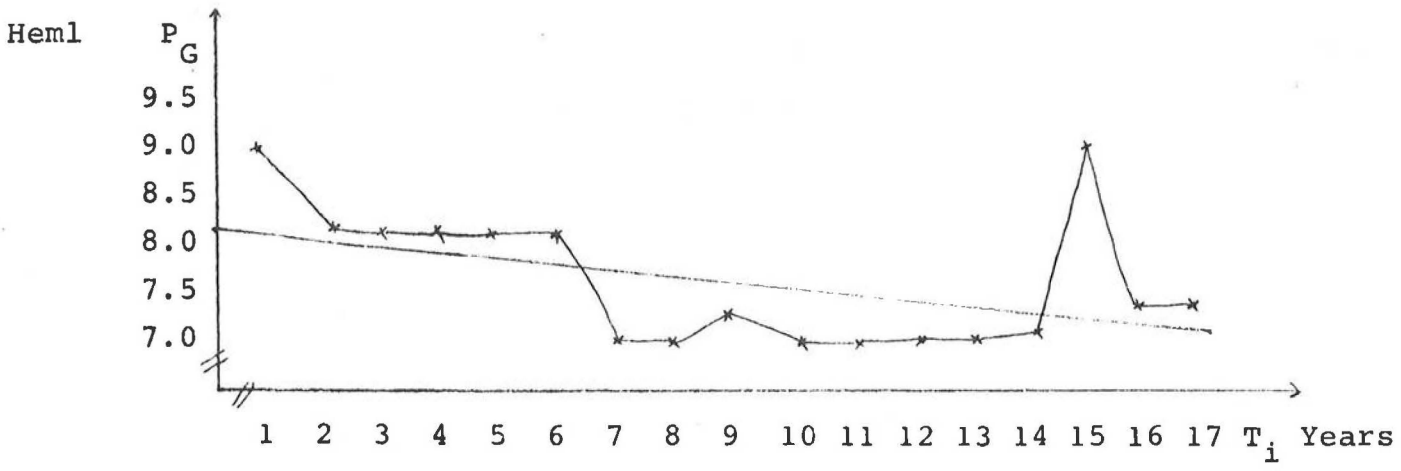


Figure 3.5 The Evolution of Feddan Productivity of Maize Stalks in El Fayom Governorate During the Period 1966-1982



The sign of the parameters in equations (3.14), (3.16), (3.17), and (3.18) refer to decrease in the Nile Maize productivity for Ebshiwai, Sinoris, Tamia and El Fayom districts, the annual rates of their decreae are not statistically significant. The annual percentage of these rates were almost -0.645%, -0.256%, -0.0609%, -0.388% of their averages during the period 1966-1982 respectively. However, equation (3.15) refers to increase the productivity of the Nile Maize Feddan in Etsa ditrict, the annual rate of that increase is statistically significant at the 1 percent level of probability by about 0.1138 Ardeb. The annual percentage of that rate were about 1.61% of the average during the period under study which was about 7.06 Ardeb.

From equation (3.19) it is clear that the productivity of Nile Maize in El Fayom Governorate has increased by annual rate about 0.026 Ardeb which is not statistically significant. The annual percentage of that rate was about 0.37% of the average which was about 7.04 Ardeb during the above mentioned period. (Notice that the average of Etsa district is more or less equal to the average of the governorate as a whole). The evolution of the governorate productivity is represented by Figure 3.4). Finally, it is reasonable to say that this method of analysis leads to the fact that the productivity of Nile Maize Feddan in Etsa is the only one which has increased over time during the above mentioned years.

The study has deduced by the third method of comparison that there is a significant difference between the means of Nile Maize productivity for the various districts during the period under study. (Table 3.10) shows by how much the means of these districts are different. From rows P_3 it is clear that Sinoris district has the positive differences, nevertheless El Fayom and Etsa districts come after Sinoris districts with respect to their mean during the study period.

Table 3.10 Differnces in Averages of Nile Maize Productivity by Using the Analysis of Variance and 99% Simultaneous Confidence Intervals (Data from Table 12 in the Appendix)

	P_1	P_2	P_3	P_4	P_5
P_1	0	-0.19	-0.93	0.97	-0.51
P_2	0.19	0	-0.74	1.16	-0.32
P_3	0.93	0.74	0	1.9	0.42
P_4	-0.97	-1.16	-1.9	0	-1.48
P_5	0.51	0.32	-0.42	1.48	0

The differences between all averages are significant at 1%

Table 3.12 The Changes in Cultivation Area of Nile Maize for El Fayom Districts and their Percentage of the Governorate

Name of District	Area in 1966 Feddan	Area in 1982 Feddan	% Change	Mean of 66-82	% of the total
EbShiwai	21151	15679	-25.9	17928.2	20.67
Etsa	36453	26825	-26.4	28773.1	33.18
Sinoris	12506	10756	-13.9	9853.0	11.36
Tamia	16246	10769	-33.7	12715.5	14.66
El Fayom	26009	14644	-43.7	17460.2	20.13
Total Governorate	112365	78673	-30%	86730	100%

Source: Derived from Table 13 in the Appendix

The results of the previous analysis can be summarized in the following table using rank from 1, 2, ... referring to the downward arrangement of the different districts.

Table 3.11 Rank Between El Fayom Districts According to the Three Approaches of Comparison for Nile Maize Crop

Name of District	First Method	Second Method	Third Method
Ebshiwai	4	5	4
Etsa	1	1	3
Sinoris	3	3	1
Tamia	2	2	5
El Fayom	5	4	2

It is obvious from the table above that Etsa district has the highest productivity by two different ways. Tamia and Sinoris districts come after Etsa resectively, however Tamia district has the lowest mean during the period under study as we can see from using the third way of comparison. The superiority of Etsa district attribute to the availability of irrigation water, where it is clear from Chapter II that this district has the highest flow of water since it receives its irrigation water from Hassen Wassef canal which has higher Feddan share of water than Wast El Lahon Canal. (See Tables 2•10, 2•11).

As we can see from (Tabe 3.12) the cultivation area of Nile Maize in all different districts and, in turn, the total governorate has decreased during the period under study, since Nile Maize has some competitive crops in the Nile season such as rice and millet, however, there is a big variance in this reduction among districts, where Sinoris district has the lowest percentage of reduction. The means of cultivation area in the period under study are lower than all values in 1966, the percentages of these means with respect to the total refer that Etsa district is the highest one followed by

Ebshiwai and El Fayom district. As we have seen before the productivity of Tamia and Sinorio districts come before Ehshiwai and El Fayom districts, therefore it is necessary to take in the consideration the redistribution of the cultivation area by Nile Maize.

3.3.5 Maize Stalks

As mentioned in case of wheat, maize and stalks are joint products in fixed proportions, therefore the study has been calculated the time trend equation for the Feddan productivity of stalks in El Fayom governorate during the period 1966-1982 as follow:

$$* \quad \hat{P}_i = 8.113 - \underset{(0.0312)}{0.0569}\, t_i \qquad (3.20)$$

$$R^2 = 0.27 \qquad R^{-2} = 0.22$$

Where $\hat{P}_i$ is the estimated value of Feddan Productivity of stalks, and $i = 1, 2, \ldots 17$, T_i = the time variable by year, R^2, R^{-2} as defined before.

From equation (3.20) it is clear that, the Feddan productivity of Stalks decreased by an annual rate about 0.0569 Heml, however, that rate is not statistically significant. The annual percentage of that rate was about -0.75% of its average which was about 7.6 Heml. We can see also from (figure 3.5) the reduction of stalks productivity in El Fayom Governate, and from table 9 in the appendix it is obvious that this productivity more or less fixed between 7 and 8 unit during the period of study.

3.3.6 Tomatoes

Tomatoes is one of the main consumption vegetables because of its importance as a good foodstuff, where it has vitamins (A), (B), (B1) and (B2) as well as calcium, protein riboflavin, and niacin.[7]

Tomatoes is one of the famous multiple cropping,[8] since it can be cultivated three times per year in the following three seasons, winter, summer and Nile.[9] The productivity of vegetables in general, and tomatoes

in particular is very sensitive to climatic changes such as lighting and temperature in addition to other economic factors as the direct inputs of fertilizers and seeds however in some cases - it is difficult to separte the effectiveness of the climatic factor from the economic factor because of the strong interrelationships that occur between themselves.

In the following part the study will deal with the analysis of comparison between the different districts for winter tomato, summer tomato, and nile tomatoe, by using the same manner followed before.

3.3.6.1 Winter Tomato

By using the first way of comparison between the productivity of winter tomato in all El Fayom district, we can deduce from (Table 3.13) that Etsa district has the highest percentage of annual increase with respect to the basic year 1966. Tamia and Sinoris district came after Etsa directly, however, the productivity of Ebshiwai district is the only one which is constant in both years 1966, 1982. The rate of change in the governorate as a whole was about 0.74% per year.

In the second method of comparison, we have calculated the time trends equations for the evolution of the Feddan Productivity of winter tomato over time during the period under study as follows:

$$* \quad \hat{P}_{i1} = 6.6 - \underset{(0.0819)}{0.0017}\, t_i \qquad (3.21)$$

$R^2 = 0.27 \quad R^{-2} = 0.22$

$$* \quad \hat{P}_{i2} = 4.154 + \underset{(0.056)}{0.164}\, T_i \qquad (3.22)$$

$R^2 = 0.63 \quad R^{-2} = 0.61$

$$* \quad \hat{P}_{i3} = 5.068 + \underset{(0.059)}{0.105}\, t_i \qquad (3.23)$$

$R^2 = 0.36 \quad R^{-2} = 0.319$

$$* \quad \hat{P}_{i4} = 4.44 + \underset{(0.064)}{0.138}\, T_i \qquad (3.24)$$

$R^2 = 0.23 \quad R^{-2} = 0.18$

$$* \quad \hat{P}_{i5} = 5.62 + 0.072\ T_i \qquad (3.25)$$
$$(0.0752)$$
$$R^2 = 0.35 \qquad R^{-2} = 0.31$$

$$* \quad \hat{P}_{iG} = 4.84 + 0.168\ T_i \qquad (3.26)$$
$$(0.0718)$$
$$R^2 = 0.57 \qquad R^{-2} = 0.53$$

Where $\hat{P}_{ij}$ are the estimated values of Feddan Productivity of winter tomato, and $i = 1, 2, \ldots 17$, $j = 1, 2, \ldots 5$ T_i is the variable time by year. R^2 R^{-2} as before.

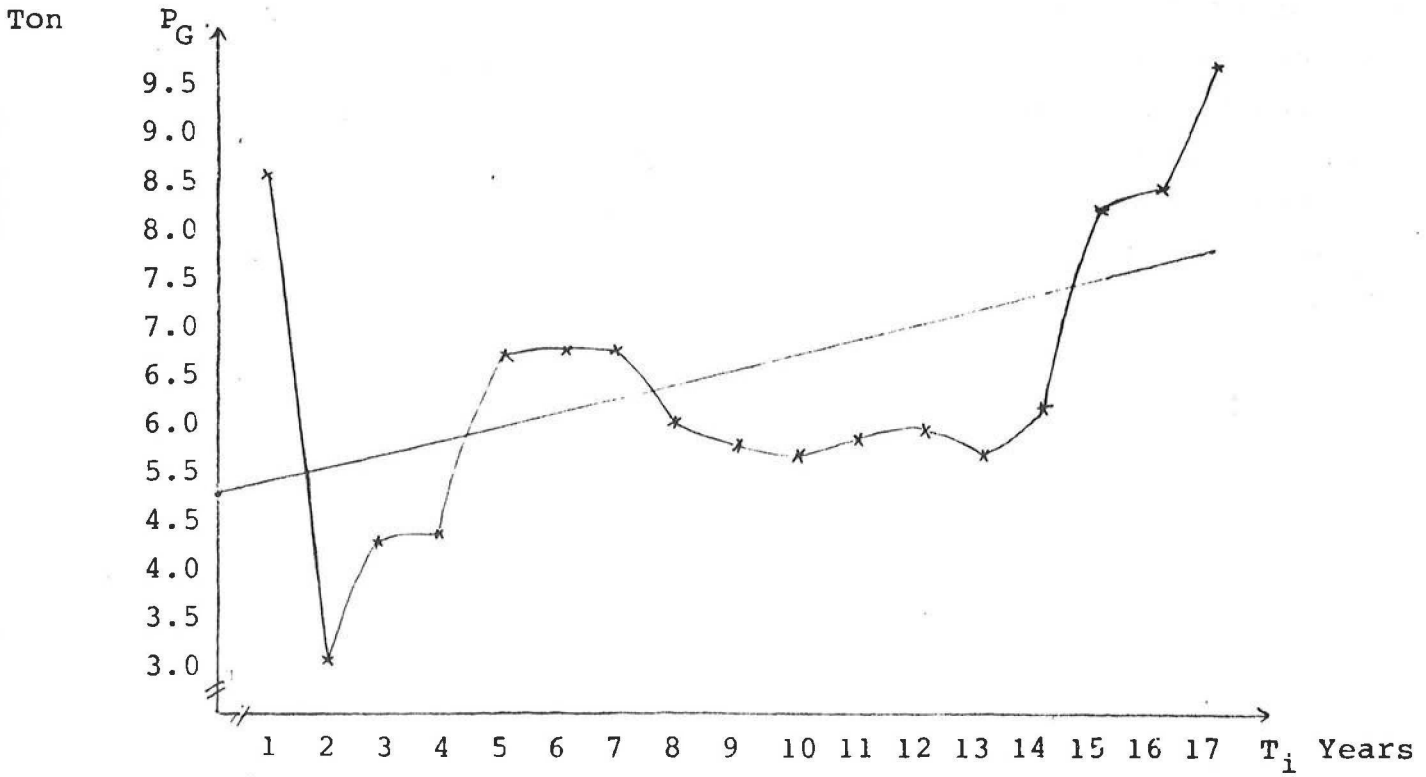
The sign of equation (3.21) refer to decrease the winter tomato productivity in Ebshiwai district, however, the annual rate of this decline is not statistically significant, while the sign of equation (3.23) and (3.25) refer to increase the productivity in Sinoris and El Fayom districts by annual rate about 0.105, 0.072 ton resectively, nevertheless this rate is not statistically significant, finally both equations (3.22) and (3.24) indicate that the Feddan Productivity of winter tomato has increased in Etsa and Tamia districts, the annual rates of their increase are statistically significant at the 5 percent level of probability, by about 0.164, 0.138. The annual percentage of these rates were about 2.81%, 2.36% of their averages which is about 5.83, 5.84 ton during the period under study respectively.

Table 3.13 The Simplest Method of Comparison Between the Feddan Productivity of Winter Tomato for Various Districts

Name of District	Productivity per Feddan in 1966	Productivity per Feddan in 1982	% Total Change	% Annual Change
EbShiwai	10.0	10.0	0	0
Etsa	6.0	9.5	58.3	3.43
Sinoris	7.5	10.0	33.3	1.96
Tamia	7.0	9.5	35.7	2.1
El Fayom	8.5	9.5	11.76	0.69
Total Governorate	8.66	9.75	12.59	0.74

Source: Derived from table 14 in the Appendix.

Figure 3.6 The Evolution of Feddan Productivity of Winter Tomato in El Fayom Governorate During (1960-1982)



From equation (3.26) it is clear that the productivity of winter tomatoe in El Fayom as a whole has increased by annual rate about 0.168 ton which is statistically significant at the 5 percent level of probability. The annual percentage of that rate was about 2.64% of its average which was 6.35 ton. The evolution of this productivity has been drawn in (Figure 3.6). From the previous analysis it can be argued that Etsa district has the highest percentage of annual growth (2.81%) of its average, followed by Tamia district.

In the third method of comparison, the study has deduced that there is no significant difference between the means of winter tomato productivity for the various districts by using the analysis of variance and F test, therefore, it can be argued that all means of El Fayom districts during the period 1966-1982 are very near.

The results of the previous analysis can be summarized in the following table using rank as before.

Table 3.14 Rank Between El Fayom Districts According to the Two Approaches of Comparison for Winter Tomato Crop

Name of District	First Method	Second Method
Ebshiwai	5	5
Etsa	1	1
Sinoris	3	3
Tamia	2	2
El Fayom	4	4

It is very clear from the table above that the arrangement of El Fayom districts according to the higher productivity of winter tomato, is the following: Etsa, Tamia, Sinoris, El Fayom and Ebshiwai districts respectively, however, there is no big difference in their means, it serves as an evidence that, the superiority of Etsa and tamia districts, take place in the last recent years and it may be because of the increasing peasants

advertency in the recent years with respect to the influence of the climatic changes on the productivity in addition to increase the ability of control these factors rather than before.

As we can see from (Table 3.15) the cultivation area of winter tomato in all different districts and, in turn, the total governorate has increased in 1982 rather than 1966, the means of the period under study also assert that fact, where they are higher than all values in 1966. The percentages of the means with respect to the total governorate refer that Ebshiwai district has the highest cultivation area while Etsa and Tamia are approximately equal. On the light of our analysis, we can forecast higher productivity in the future for both Etsa and Tamia district, therefore it is necessary to redistribute the area under cultivation by winter tomatoe in the favour of the above mentioned districts to increase the total product of that crop in El Fayom Governorate.

3.3.6.2 Summer Tomato

It is quite obvious from (Table 3.16) that the Feddan productivity of Summer Tomato has increased in 1982 rather than 1966 in all El Fayom districts and in turn, in the governorate as a whole, nevertheless Ebshiwai district has the highest percentage of annual growth followed by Sinoris district.

By following the second way of comparison, the study has calculated the first degree of time trends equations for the Feddan Productivity of Summer Tomato during the period 1966 - 1982 for various districts as well as the governorate as a whole respectively, as follows:

$$* \quad \hat{P}_{i1} = 7.05 + \underset{(0.0411)}{0.0646}\ T_i \qquad (3.27)$$

$$R^2 = 0.61 \qquad R^{-2} = 0.58$$

$$* \quad \hat{P}_{i2} = 6.42 + \underset{(0.0244)}{0.0424}\ T_i \qquad (3.28)$$

$$R^2 = 0.57 \qquad R^{-2} = 0.54$$

$$* \quad \hat{P}_{i3} = 6.93 + \underset{(0.0321)}{0.0658} \; T_i \qquad (3.29)$$

$R^2 = 0.24 \qquad R^{-2} = 0.19$

$$* \quad \hat{P}_{i4} = 6.87 + \underset{(0.01697)}{0.01417} \; T_i \qquad (3.30)$$

$R^2 = 0.49 \qquad R^{-2} = 0.45$

$$* \quad \hat{P}_{i5} = 7.28 + \underset{(0.0409)}{0.0201} \; T_i \qquad (3.31)$$

$R^2 = 0.35 \qquad R^{-2} = 0.31$

$$* \quad \hat{P}_{iG} = 6.98 + \underset{(0.259)}{0.0339} \; T_i \qquad (3.32)$$

$R^2 = 0.55 \qquad R^{-2} = 0.52$

Where $\hat{P}_{ij}$ are the estimated values of Feddan Productivity of Summer Tomato, and $i = 1, 2 \ldots 17$, $j = 1, 2 \ldots 5$, T_i is the time variable by year. R^2, R^{-2} as defined before.

The sign of the parameters in the equations from (3.27) to (3.31) refer to increase the productivity of Summer Tomato in all El Fayom districts by annual rates were about 0.064, 0.042, 0.065, 0.014, and 0.0201 ton respectively, however all these annual rates are not statistically significant. The annual percentage of these rates were about 0.85%, 0.62%, 0.87%, 0.2% and 0.27% of their averages during the period under study.

From equation (3.32) it is clear that the productivity of summer tomato in El Fayom Governorate as a whole has increased by annual rate about 0.034 ton which is not statistically significant. The annual percentage of that rate was about 0.47% of the average which was about 7.29 ton during the period 1966-1982.

Table 3.15 The Changes in Cultivation Area of Winter Tomato for El Fayom Districts and their Percentage of the Governorate

Name of District	Area in 1966 Feddan	Area in 1982 Feddan	% Change	Mean of 66-1982	% of the total
EbShiwai	2320	9061	290	5146	43.3
Etsa	284	6481	2182	1974	16.7
Sinoris	802	3376	321	1698	14.3
Tamia	749	4572	510	1830	15.4
El Fayom	1092	1610	47	1200	10.2
Total Governorate	5247	25100	378	11848	100

Source: Derived from table 15 in the Appendix

Table 3.16 The Simplest Method of Comparison Between the Feddan Productivity of Summer Tomato for Various Districts

Name of District	Productivity per Feddan in 1966	Productivity per Feddan in 1982	% Total Change	% Annual Change
EbShiwai	7.75	9.5	22.6	1.3
Etsa	6.75	7.6	12.6	0.74
Sinoris	7.0	8.0	14.3	0.84
Tamia	7.0	7.8	7.14	0.42
El Fayom	7.25	7.5	3.45	0.2
Total Governorate	7.18	7.95	10.7	0.63

Source: Derived from Table 16 in the Appendix

The evolution of this productivity has been drawn in (Figure 3.7). It is clear from using this method of analysis that Sinoris district has the highest percentage of annual growth (0.87%) of its average, and the highest correlation coefficient.

By using the third method of analysis it has been deduced that there is a significant difference between the means of Summer Tomatoe productivity for the various districts in El Fayom during the abovementioned period. (Table 3.17) summarizes by how much are they different. It is quite obvious from row P_1 that Ebshiwai district has the highest mean, while values in row P_3 refers that Sinoris district comes after Ebshiwai district directly.

The results of the previous analysis of the three methods of comparison can be summarized in the following table using rank from 1, 2 ... 5 as before.

Table 3.18 Rank Between El Fayom Districts According to the Three Approaches of Comparison for Summer Tomatoe Crop

Name of Districts	First Method	Second Method	Third Method
Ebshiwai	1	2	1
Etsa	3	3	5
Sinoris	2	1	2
Tamia	4	5	4
El Fayom	5	4	3

Figure 3.7 The Evolution of Feddan Productivity of Summer Tomato in El Fayom Governorate During the Period 1966-1982

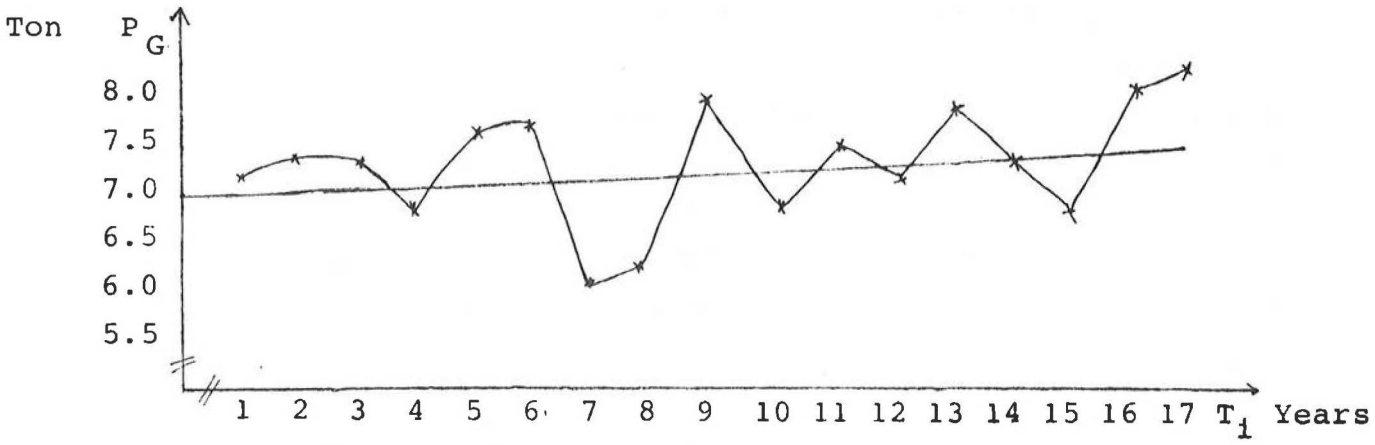


Figure 3.8 The Evolution of Feddan Productivity of Nile Tomato in El Fayom Governorate During the Period 1966-1982

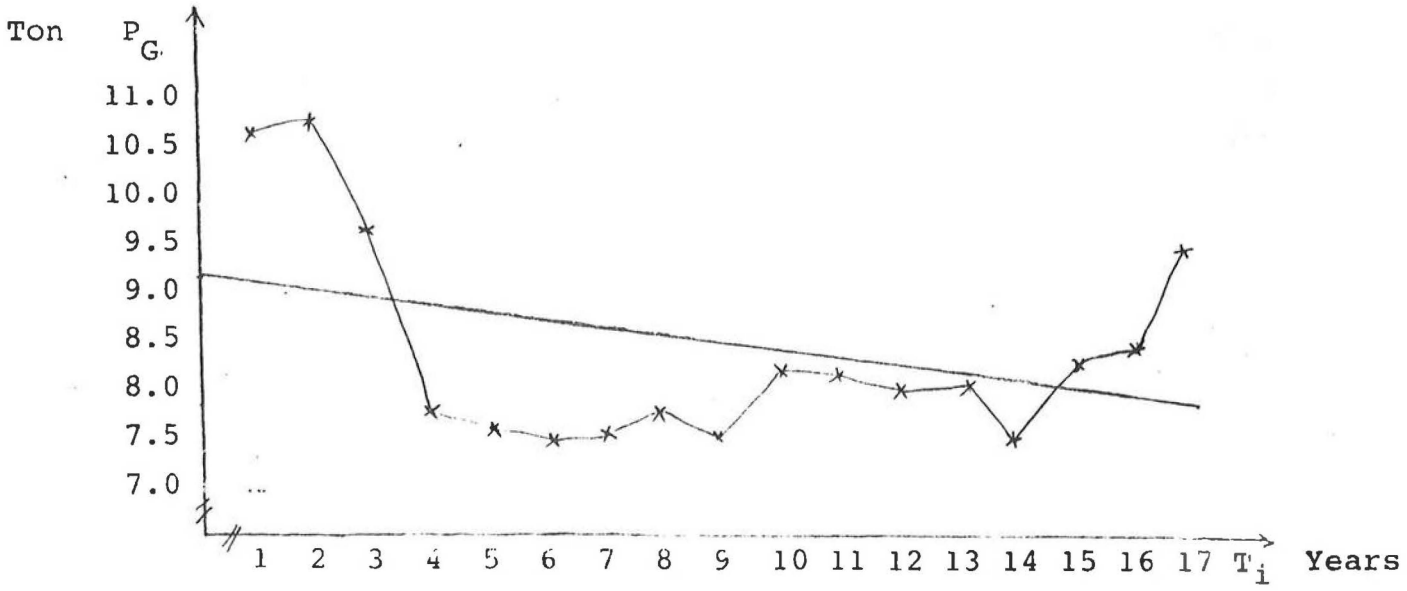


Table 3.17 Differences in Averages of Summer Tomato Productivity by Using the Analysis of Variance and 95% Simultaneous Confidence Intervals (Data from Table 16 in the Appendix)

	P_1	P_2	P_3	P_4	P_5
P_1	0	0.83	0.1	0.63	0.17
P_2	-0.83	0	-0.73	-0.2	-0.66
P_3	-0.1	0.73	0	0.53	0.07
P_4	-0.63	0.2	-0.53	0	-0.46
P_5	-0.17	0.66	-0.07	0.46	0

The differences between all averages are significant at 5%

Table 3.19 The Changes in Cultivation Area of Summer Tomato for El Fayom Districts and their Percentage of the Governorate

Name of District	Area in 1966 Feddan	Area in 1982 Feddan	% Change	Mean of 66-1982	% of the total
EbShiwai	64	173	170	223.4	15
Etsa	76	274	260	382	25.6
Sinoris	235	104	-55.7	272	18.3
Tamia	72	13	-81.9	97	6.5
El Fayom	734	378	-48.5	515.6	34.6
Total Governorate	1181	942	-20	1490	100

Source: Derived from table 17 in the Appendix

From the above table, the evidence refers that, the arrangement of El Fayom districts according to the higher productivity of Winter Tomato is the following: Ebshiwai, Sinoris, Etsa, Tamia, and El Fayom respectively. If we put the analysis study of Winter Tomato in comparison with summer tomato, it is clear that, although we study the same crop, the productivity of the various districts are different. It serves as an evidence that the superiority of one district is not because of the appropriateness of its land to this crop, however it can attribute to the weather changes as well as other inputs such as seeds and fertilizer as we shall see in the next chapter.

The area under cultivation by Summer Tomato has fluctuated from 1966 to 1982, where Ebshiwai and Etsa has a remarkable increase, while the other three districts has decreased. The total cultivation area in the governorate has decreased by 20%, (see Table 3.19). The percentages of the means, indicate that Etsa district represents quarter of the total, however the highest district in producing that crop has only 15%, therefore, it is necessary to increase the area under cultivation in Ebshiwai district to increase the total product from Summer Tomato.

3.3.6.3 Nile Tomato

By studying the first method of comparison, we can deduce from (Table 3.20) that the productivity of all districts, and in turn, the governorate has decreased in 1982, however, there is a big variance in this reduction, where Etsa district has the lowest percentage of annual decrease with respect to the basic year 1966. The rate of reduction in the governorate as a whole was about 0.7% per year.

In the second method of comparison, we have calculated the linear time trends equations for the evolution of the Feddan Productivity of Nile Tomatoe over time during the period 1966-1982 as follows:

$$* \quad \hat{P}_{i1} = \underset{(0.0459)}{10.1 - 0.1207\ T_i} \qquad (3.33)$$

$$R^2 = 0.49 \qquad R^{-2} = 0.45$$

$$* \quad \hat{P}_{i2} = 8.76 - 0.0667\ T_i \qquad (3.34)$$
$$(0.0758)$$
$$R^2 = 0.31 \qquad R^{-2} = 0.27$$

$$* \quad \hat{P}_{i3} = 9.79 - 0.114\ T_i \qquad (3.35)$$
$$(0.0442)$$
$$R^2 = 0.307 \qquad R^{-2} = 0.261$$

$$* \quad \hat{P}_{i4} = 9.76 - 0.176\ T_i \qquad (3.36)$$
$$(0.0442)$$
$$R^2 = 0.51 \qquad R^{-2} = 0.48$$

$$* \quad \hat{P}_{i5} = 10.33 - 0.196\ T_i \qquad (3.37)$$
$$(0.033)$$
$$R^2 = 0.71 \qquad R^{-2} = 0.69$$

$$* \quad \hat{P}_{iG} = 9.11 - 0.077\ T_i \qquad (3.38)$$
$$(0.0285)$$
$$R^2 = 0.47 \qquad R^{-2} = 0.43$$

Where $\hat{P}_{ij}$ are the estimated values of Feddan Productivity of Nile Tomato, and $i = 1, 2, \ldots 17$, $j = 1, 2 \ldots 5$. T_i is the time variable by year. R^2, R^{-2} as defined before.

Table 3.20 The Simplest Method of Comparison Between the Feddan Productivity of Nile Tomato for Various Districts

Name of District	Productivity per Feddan in 1966	Productivity per Feddan in 1982	% Total Change	% Annual Change
EbShiwai	10.75	8.5	-20.9	-1.23
Etsa	10.3	10.0	- 2.9	-0.17
Sinoris	10.4	10.0	- 3.8	-0.23
Tamia	10.75	9.0	-16.3	-0.96
El Fayom	10.5	9.0	-14.3	-0.84
The Governorate	10.65	9.42	-11.5	-0.7

Source: Derived from Table 18 in the Appendix

Table 3.21 Differences in Averages in Nile Tomato Productivity by Using the Analysis of Variance and 95% Simultaneous Confidence of Intervals (Data from Table 18 in the Appendix

	P_1	P_2	P_3	P_4	P_5
P_1	0	0.77	0.15	0.82	0.42
P_2	-0.77	0	- 0.62	0.05	- 0.35
P_3	-0.15	0.62	0	0.67	0.27
P_4	-0.82	-0.05	-0.67	0	-0.4
P_5	-0.42	0.35	-0.27	0.4	0

The differencesbetween all averages are significant at 5%

The sign of the parameters in all equations from (3.33) to (3.37) indicates to decrease the Feddan Productivity of Nile Tomato during the period under study. The annual rates of this decline were about 0.1207, 0.0667, 0.114, 0.176, 0.196 ton in the above mentioned equations respectively, these rates are statistically significant at the 5 percent of probability for all previous equations except equation (3.34) which was insignificant. The annual percentage of these rates were about -1.36%, -0.82%, -1.65%, -2.18% and -2.31% of their averages during the period of study.

Equation (3.38) is representing the productivity evolution of Nile Tomato in El Fayom Governorate by a negative sign refers to decrease this productivity over time by an annual rate about 0.077 ton, which was statistically significant at the 5 percent of probability. The annual percentage of that rate was about -0.91% of the average which was about 8.42 ton. The evolution of the governorate productivity is represented by (figure 3.8). The result of this method of analysis indicates that Etsa district has the lowest percentage of annual decline (0.82%) with respect to its average (8.13) ton during the period under study, and it is the only district which has insignificant rate of decline.

The study also has concluded that there is a significant difference between the means of Nile Tomato productivity for the various districts in El Fayom Governorate. (Table 3.21) shows that row P_1 has positive differences, it serves as an evidence that Ebshiwai district has the highest mean in the period 1966-1982. While values in rows P_3 and P_5 refer that Sinoris and El Fayom districts come directly after Ebshiwai.

The following table summarizes the results of the productivity analysis among El Fayom districts with respect to Nile Tomato crop.

Table 3.22 Rank Between El Fayom Districts According to the Three Approaches of Comparison for Nile Tomatoe Crop

Name of District	First Method	Second Method	Third Method
Ebshiwai	5	2	1
Etsa	1	1	4
Sinoris	2	3	2
Tamia	4	4	5
El Fayom	3	5	3

It is clear from the table above that Etsa district has the highest productivity by two different ways, although, the third way of comparison refers that, it has low mean during the period under study. In the future we can forecast higher productivity for Etsa district, where, it has the lowest percentage of annual decline of the basic year 1966 (represented by first method of comparison) and the lowest percentage of annual reduction from its mean (represented by the time trend equation). Sinoris and El Fayom districts came after Etsa with respect to their productivity of Nile Tomato Crop.

As we can see from (Table 3.23) the cultivation area of Nile Tomato in all different districts as well as, the governorate has increased sharply in 1982 rather than 1966. The means of the period indicate that the cultivation area in the basic year was very low comparatively with the remainder of the period under study. The percentages of these means show that Etsa district has about one-third of the cultivation area by Nile Tomato, moreover our analysis indicated that this district has the lowest percentage of feddan productivity decline especially in the recent years, therefore, the improvement of its productivity can be improved 33% of the total production by that crop.

Table 3.23 The Changes in Cultivation Area of Nile Tomato For El Fayom Districts and Their Percentage of The Governorate

Name of District	Area in 1966 Feddan	Area in 1982 Feddan	% Change	Mean of 66-1872	% of the Total
EbShiwai	2654	2755	3.8	2357.4	17.3
Etsa	114	7093	6122	4600.5	33.8
Sinoris	359	3149	777	1923.2	14.1
Tamia	797	3431	330	2013	14.8
El Fayom	1450	4616	218	2713.9	20.0
Total Governorate	5374	21044	292	13608	100

Source: Table 19 in the Appendix

As we have seen in this chapter the productivity of El Fayom districts and in turn, the governorate as a whole has decreased for Nile Tomato, and increased insignificantly for Summer Tomato and Nile Maize, however, it has increased significantly in wheat, onion and winter tomato by a slow rates, although there is still considerable potential in raising these productivities. The question now arises, what determines these productivities? As a matter of fact, the Feddan productivity of any crop depends on the magnitude of all other inputs (capital, labour, etc.) and their combination ratio, therefore the research undertakes - as we shall see in the next chapter - to estimate the production functions of the crops under study in El Fayom Governorate as a whole, because these functions reflect the relation between the different inputs and output, as well as, they indicate to what extent the productive efficiency is achieved from the available agricultural resources.

Notes to Chapter III

(1) Hansen, B. Output-Productivity and Value Added - Productivity, Institute of National Planning, Cairo, Memo No. 163, May 1962.

(2) Report by the Secretary-General, Study of Trends in World Supply and Demand of major Agricultural Commodities, Organization for Economic Cooperation and Development (OECD), Paris 1976.

(3) Agricultural Economics Bulletin, Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E., "Various Issues".

(4) Ardeb 0.15 ton.

(5) Heady, E.O. Economics of Agricultural Production Functions and Resource Use, Prentice-Hall, Inc. U.S.A. Third Printing, 1960.

(6) Heml = 0.25 ton.

(7) Mostafa, A.M. Marketing of Tomatoes in Cairo Town, op.cit.

(8) Multiple cropping is the practice of growing more than one harvested crop on the same area of land within one year.

(9) The period of the Nile River flood in Egypt is called Nile Season.

CHAPTER IV

THE ECONOMIC ANALYSIS OF THE PRODUCTION FUNCTIONS FOR THE MOST IMPORTANT FIELD AND VEGETABLE CROPS IN EL FAYOM

4.1 Preface:

This chapter assesses the analysis of farm production functions for the most important field and vegetable crops in EL Fayom Governorate during the period 1966-1982. The estimation of agricultural production functions and other economic relationships which can be derived from it, are considered as an indicator for knowing to which extent the economic efficiency[1] is achieved from the available agricultural resources, it also helps to know the present state of the combination of production resources and the prevalent technical level in the agricultural sector. The nature of production functions is important in economic development and in determining the extent to which national products can be increased from given resources, therefore, it is considered as decision making guides in formulating and modifying the programmes of agricultural resources exploitation on the basis of raising the agricultural productivity and achieving the productive efficiency, however, a production function taking into account the whole set of hypothesis, relevent to developing countries is very difficult to estimate directly by traditional methods of estimation becaue of the lack of quantitative data and problems related to multicollinearity between explanatory variables, therefore we shall try - to a large extent - to avoid such restrictive assumptions by some adjustments, for examle: labour variable is heterogeneous, with divergent characteristics, the study will use this variable in human equivalent expressed by man/day in addition to weight hours worked by women and children by one-half of man hours.

4.2 The Theoretical Framework

There are numerous algebraic forms can be used in deriving the production functions, therefore the selection of an appropriate algebraic form which appears or is known to be consistent with the phenomena under investigation is considered an important problem, so the researcher has made a lot of plot studies for choice the fit form in which the indeendent variables explain the changes in the dependent variable to a large extent. Finally it was chosen the power function which is known by the Cobb Douglas function for the following reasons:[2]

(1) It has been widely used in production function studies, moreover it is generally the most appropriate form for the agricultural production circumstances, assuming that, it is possible to involve the convienient numbers of production inputs.

(2) It was used mainly because of its ease of manipulation and interpretation, where it is linear in the logarithmic form.

(3) Its coefficients can be interpreted as indicating directly the elasticities of production with respect to inputs.

(4) Assuming that the factors are specified correctly, the coefficients can also be interpreted as indicating the relative importance of each factor as a source of difference in output over time.

(5) It has small errors with normal distribution.

(6) The Cobb-Douglas is relatively an "efficient user" of degrees of freedom, in other words, sufficient degrees of freedom unused to allow for statistical testing.

(7) And, finally, it has the important property that the marginal product of any factor is a given fraction of the average product of the factor.[3]

However, the Cobb-Douglas function form has some shortcoming such as:

1. It has constant elasticity of production not only for the individual factor, but also for all factors of production together.
2. This function cannot be used satisfactorily for data where there are ranges of both increasing and decreasing marginal productivity however, the Egyptian farms are characterized by small holdings, so it is rare to find increasing and decreasing marginal productivity at the same time. at the same time.

The Cobb-Douglas function, in the general form is:

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} \ldots\ldots\ldots X_n^{bn}$$

Where Y is the output, a is constant,

$X_1 \ldots\ldots X_n$ are the different production inputs,

$b_1 \ldots\ldots b_n$ the elasticities of production with respect to inputs.

To estimate the parameters of this function, we have to take its lagarithmic form as follows:

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \ldots\ldots b_n \log X_n$$

The study will estimate two production functions for every crop, the first is a relation between the output per Feddan. (The Feddan Productivity) and its inputs to see how this productivity is influenced by the magnitude of these inputs and their combination ratio. The second is a relation between the total output and its inputs (which as in the first case) in addition to the area under cultivation, to investigate the importance of land on total output.

4.2.1 The Inputs-Outputs of Production Functions

The estimation of production function depends on knowing and measuring the inputs and output as well as the determination of the most appropriate algebraic form of the equation. The coming part will deal with the inputs of the production functions used in this research. In the first case the

researcher has confined the inputs to comprise the following X_1, X_2, X_3, X_4 as the independent variables which influence the productivity per Feddan (P), in the second case the inputs is increased by the cultivation land X_5 which influences the total output (Y).

4.2.1.1 Labour X_1

The need of land unit from labour differ from farm to other according to: the nature of the soil, the manner of production, the agriculture region, and the output quantity. Generally, the labour input is measured in terms of labour man/hour or labour man/day or labour man/month, etc. This study will measure the labour input in terms of labour man/day in human equivalent i.e. according to the days numbers of man work in the agricultural year, assuming that the number of hours per day is about 8 hours, moreover, we must put in the consideration that the utilization ratio of labour is about 80%.

4.2.1.2 Fertilizers X_2

Fertilizers are a major component of crop production and most roductivity - increasing technological developments depend on increased applications of fertilizr, nevertheless - we must keep in mind that - the efficiency of using fertilizer depends on the quantity used and the correct time of putting it during the different stages of plant growth. Both organic and chemical fertilizers are combined as one inut in our production function measured by constant prices, i.e. we have adjusted the value of fertilizer during the period under study by the index numbers of wholesale prices with considering that 1965/1966 is the basic year.

4.2.1.3 Seeds X_3

Seeds also is considered an important element affecting the productivity of any crop by their quantity and quality, where good hybrid seeds can increase significantly the productivity per feddan and, in turn the total output. The seeds input is represented by the constant prices, i.e. (the cost of these seeds in the production process adjusted by the index numbers of wholesale prices).

4.2.1.4 Other Capital and Current Inputs X_4

This input comprises all remaining cost articles, which comprises of: 1. The fixed capital includes the inputs of mechanical power such as, oil, fuel, depreciation, improvements cost and spare parts, etc. however, the fixed capital input does not include the land rent and its improvements and the irrigaion investment in view of estimation difficulty. 2. The current capital inputs includes pesticides, feed livestock, and petty expenses. Also this input is measured in adjusted Egyptian pounds.

The first production functions will take the following algebraic form:

$$P = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4}$$

Where P is the Feddan Productivity, and $X_1 \ldots X_4$ as defined above.

4.2.1.5 Land X_5

There are many studies which have attempted to measure the land factor by different measurments. In year 1944 Girhard[5] used the acre unit as a measurement for land, however, this measurement ignores the variations in the land quality. In the same year Heady[6] measured this element in dollars, he considered that its value includes the value of both land and its improvements. These two types of assets were included as one agent of production since in the enumeration the operator's estimate of land value was undoubtedly affected by the number and condition of the buildings on the

farm. Errors in the evaluation of real estate are probably greater than for any other asset since only a small fraction of the farms are on the market in any one year. However, the use of dollar value as a measure of real estate input has an advantage over the acre measurement in that it allows variations in the productivity of the resource from farm to farm.

In year 1970, Risk and Afer[7] tried to measure land element by taking into consideration its fertility degree and productivity level, they depended on agricultural land tax as indicator to land productivity and they used the following equation to adjust the land area:

$$\text{Adjusted area} = \text{actual area} \quad X \frac{\text{Agriculture land tax of the farm}}{\text{Agriculture land tax of the village}}$$

The using of this measurement reflects that, the more fertile land, the bigger area, however, there are two shortcoming in using that measurement: 1. There is no big variations in the agricultural land tax between different farms in the same village.[8] 2. The agricultural land tax does not reflect the productive efficiency of land because the value of this tax is not imposed according to the economic criteria.[9]

Finally, in view of the difficulty of obtaining good data for land description - as we have seen above - the study used the physical land units expressed by feddan to represent this input.

The second production functions will take the following algebraic form:

$$Y = a\, X_1^{b1}\, X_2^{b2}\, X_3^{b4}\, X_4^{b4}\, X_5^{b5}$$

Where Y is the total output, and X_1 .... X_5 the quantity of previous inputs used in producing this total output.

4.2.1.6 Management

Management has not been included along with other inputs in both cases of our production functions since - as I referred before - there is no objective measure of this productive agent. The results might well have differed, had it been possible to measure the input of this factor for our research, however, the inability to measure management inputs objectively is not, of course, a weakness common only to the type of analysis under consideration in this study.

It is also possible that, had management been included as an input, the sum of elasticities would not have been greater, but the elasticities for the individual production factors shown might have been smaller.[10]

4.2.1.7 The Output

This factor is representing the dependent variable in both cases of our production functions of all crops, measured by physical units such as Ardeborton. In the first case this factor is the output of one Feddan only, while in the second production function it is representing the total product which is equal to the productivity per Feddan X the area under cultivation of the crop under study.

4.2.1.8 The Data Used

It is worthwhile to refer that, the data which have been used in both cases of our production functions is an official data issued by several national institutions such as The Ministry of Agriculture, etc, however, this data may not be suitable to the reality - especially in developing countries - since peasants may or may not use the same quantity of inputs known by the government in their production process.

4.2.2 The Important Economic Relationships Derived from the Production Functions

It is possible to derive some important economic relationships from the production function which can help as decision-making guides in formulating the agricultural policy. The following part will explain these relationships and how it can be derived.

4.2.2.1 Elasticities of Production

Its quantity is of some importance in production function studies, particularly in analyses relating to product imputation. The elasticity of production indicates the change in output relative to the change in input. In other words, it shows approximately the average percentage change in total product which might be forthcoming if the input of any one resource is increased by 1 percent.[11]

If the elasticity of production for any one input is greater than 1.0, it reflects the increasing returns to scale for that input, i.e. the output increases by a greater percentage than input, if this ratio is 1.0, it reflects the constant returns to scale and means that the output increases by the same rate as input, and finally, if it is less than 1.0, it reflects the decreasing returns to scale and means that the output increases by a percentage less than the percentage increase in input.

The elasticity coefficient, E is defined as

$$E = \frac{\partial Y}{\partial X} \cdot \frac{X}{Y}$$

For a single variable resource X, the elasticity is the product of its marginal product and the reciprocal of its average product. Applying this definition for Cobb-Douglas function, we can deduce that the regression coefficients give immediately the elasticities for the individual factors of production.

4.2.2.2 Aggregate Elasticities of Production

The farm production functions may also be computed to determine the magnitude of returns to scale. Scale returns are measured by the ratio, per cent increase in output divided by per cent increase in input, under the condition that all factors be increased by the same proportion. For this measure to be applicable, there must not be ommission of important input categories or any serious aggregation problems.

For the Cobb-Douglas function, the elasticities of the individual factors - as we mentioned above - are their exponents in the production function, the sum of these elasticities determines the scale coefficient, indicating the percentage by which output will be increase if all factors are increased by 1 percent. In our production function, increasing returns to scale hold true if $b_1 + b_2 + b_3 + b_4 > 1.0$, if $\sum_{i=1}^{4} b_i < 1.0$, decreasing returns to scale hold true, while for $\sum_{i=1}^{4} b_i = 1.0$ constant returns to scale hold true..

4.2.2.3 Coefficient of Multiple Determination

The correlation between the n observed values of Y and the corresponding $\hat{Y}$ values is shown by the coefficient of multiple correlation. It is denoted by R. The coefficient of multiple determination, R^2, indicates the percentage of the variation in the n observed Y values that is explained by the fitted regression equation of Cobb-Douglas function. Thus it is a measure of the goodness of fit of the estimated regression equation. When the number of parameters to be estimated is large, or as often happens in production function estimation, the number of observation is small, the study took account of this by calculating the adjusted coefficient of multiple determination R^{-2}.

4.2.2.4 Marginal Productivity

The marginal productivity is considered one of the most important measurements for economic efficiency since it indicates to the efficiency of agricultural resources used and helps the farm managers to redistribute the resource combination in such a way which maximize the farm profit.

The marginal productivity for any one factor of production indicates approximately to the change in output which might be expected on the average from the addition of one unit of this input, provided that, all other factors of production are constant.

The researcher concerned to estimate the marginal productivity in its both terms, physical untis such as Ardeb or Ton and in monetary[12] terms by Egyptian pound, it is estimated at the geometric means and is derived from the elasticities as follows:

$$\frac{\partial Y}{\partial X_r} = ab_r X_r^{b_r - 1} \quad \bar{G}$$

Where X_r is denoted to the input under consideration, a is a constant, b_r is the elasticity coefficient of the same input, while $\bar{G}$ is the geometric mean of the other inputs - included in the production function - raised to their elasticities power.

4.2.2.5 The Ratio Between Marginal Productivity and Opportunity Cost

This ratio can be used as a criterion of efficiency as follows: If this ratio is equal to one, then the quantity used from certain inut is equal to the quantity which achieves the production efficiency, while when this ratio is less than unity then, the quantity used from this element is bigger than the efficient quantity and vice versa. The study is concerned with the ratio between the marginal productivity of land (monetary) and its opportunity cost represented by the geometric mean of annual rent per feddan during the period 1966-1982 to discover whether this important factor of production achieves the economic efficiency or not, ceteris parihus all other inputs are constant at their geometric mean during the period.

4.3 An Analytical Study for the Production Functions of Wheat, Onion, Nile Maize and Winter Tomato Crops in El Fayom Governorate

This part is concerned with the analysis of the wheat, onion, Nile Maize and winter tomato production functions. The parameters of the abovementioned crops have been estimated in El Fayom Governorate during the period 1966-1982 two times for every crop. These estimations will give a clear description for the productive relationships and the present state of the resources combination, it helps to know the correct change which achieves the maximum farm income and profitability.

4.3.1 The Production Functions of Wheat

By using data in Tables 22 and 23 in the Appendix, the study has estimated the production function of the Feddan Productivity as well as the production function of the total output for wheat crop in El Fayom Governorate during the period 1966-1982 as follows:

$$\hat{P} = 3.94\ X_1^{0.1752}\ X_2^{0.1536}\ X_3^{-0.345}\ X_4^{0.1095} \qquad (4.1)$$

$$\hat{Y} = 323.7\ X_1^{0.0382}\ X_2^{0.0808}\ X_3^{-0.326}\ X_4^{0.2607}\ X_5^{0.4372} \qquad (4.2)$$

Where $\hat{P}$ is the estimated feddan productivity, $\hat{Y}$ is the estimated total output, and $X_1 \ldots X_5$ are the inputs used in production as defined before respectively.

The regressions coefficients in the previous two equations have been summarized in Table 4.1. It is obvious from that table that labour elasticity in both cases, reflects decreasing returns to scale, since a 1 percent increase of the quantity used per feddan is associated with an increase in the productivity of that feddan by about 0.1752 percent, while an increase of the total labour used in producing the total production of wheat by 1 percent, leads to increase the total output by 0.0382 percent. The labour elasticities in both cases are statistically significant at the 0.1 level of probability.

The fertilizer elasticity also shows decreasing returns to scale in both cases, where an increase in both fertilizer organic and chemical by 1

percent is associated with an increase of about 0.1536 percent of the feddan productivity and about 0.0808 percent of the total product ceteris paribus all other inputs are constant. The elasticity of fertilizer in both cases is statistically significant at the 0.1 level of probability.

As we can see from the same table, the seeds elasticity is negative, i.e. a 1 percent increase in that input is associated with decrease about 0.345 percent of the feddan productivity and about 0.326 percent of the total product, however, it is hardly conceivable that the feddan productivity or total production of any crop decrease were more of any individual factor employed, therefore, this negative sign can be partly attributed to increasing the quantity used from seeds rather than the optimal quantity per feddan, so that they become crowded and it leads to decline the percentage of their yield, it may also grow out of errors in reporting the original data and limited sample. The elasticity of seeds in btoh cases are not statistically significant.

With respect to the other capital input, it is quite obvious that its elasticity in both cases is statistically significant at the 0.05 level of probability, and indicate to decreasing returns to scale, since 1 percent increase from these capital - in the first case - would result in an increase in the feddan productivity about 0.1095 percent and - in the second case - an increase in the total wheat product by about 0.026 percent.

The production function in the second case for the total wheat production has included the cultivation area by thousand fedan representing the land input. The estimation of this input elasticity is relatively high, where, an increase of the quantity used by 1 percent leads to an increase about 0.4372 percent of the total production from that crop, it is an indicator to the importance of that element and its influence on the output of wheat crop, since the use of area under cultivation by that crop is still in the rational stage of production. The elasticity is statistically significant the 0.05 level of probability.

Table 4.1 The Results of Production Functions Estimation for Wheat Crop in El Fayom Governorate During The Period 1966-1982

Items	First Function for the Feddan Productivity	Second Function for Total Output
Labour Elasticity	0.1752* (0.0923)	0.0382* (0.0206)
Fertilizer Elasticity	0.1536* (0.0843)	0.0808* (0.0418)
Seeds Elasticity	-0.345 (0.319)	-0.326 (0.265)
Other Capital Elasticity	0.1095** (0.0488)	0.02607** (0.0118)
Land Elasticity	-	0.4372** (0.1822)
Aggregate Elasticities	0.0933	0.2563
Multiple Correlation Coefficient R	0.654	0.785
The Coefficient of Multiple Determination R^2	0.428	0.616
The Adjusted Coefficient of Multiple Determination $\bar{R}^2$	0.24	0.441
F Test	3.48**	5.21**

* = Significant at the 0.1 level of probability

** = Significant at the 0.05 level of probability.

The sum of the elasticities are also indicative of returns to scale when all factors of production can be changed by the same proportion. In both cases the aggregate elasticities has reflected decreasing returns to scale, since an increase in the all inputs per feddan by 1 percent would result in an increase in the productivity of that feddan by 0.0933 percent, while an increase in total inputs used in the second production function by 1 percent would result in an increase in the total wheat product by about 0.2563 percent.

From this analysis, we can arrange the importance of the inputs involved in the feddan productivity function for wheat crop according to their affect on this production as follows: labour, fertilizer and other capital, since - as we have seen above - the increase of using their percentages are associated with an increase of the feddan productivity by decreasing percentages respectively, however, the seeds input needs to repeat the study of its economic use. While in the total production function the land input comes on the top whereas its affect on the total output.

Multiple correlation coefficients are presented in table (4.1) also. By comparing them in both production functions, it is clear that this correlation has increased in the second case, since the relation between the total output of wheat and its productive inputs including land is stronger. Both of these multiple correlation coefficients are statistically significant at the 5 percent level of probability. The adjusted coefficients of multiple determination indicate that 0.24 percent of the variance in the feddan productivity is associated with the quantities of resources used, however, 44 percent of the variability of the total wheat product are determined by the independent variables involved in our second production function.

Table 4.2 summarized the estimations of marginal productivities and their values by adjusted Egyptian Pound for the all inputs included in both cases of our production functions. It is clear from this table that the increase of the quantity used - in our first production function - from labour by one unit (man/day) is asociated with an increase in the feddan productivity about 0.0653 Ardeb, while the increase of the quantity used from this input - in the second production function - leads to increase the total output of wheat crop by 0.09559 Ardeb, and so on with respect to the other inputs. The value of these marginal productivities indicate that the

additional unit from labour - as an example - is associated with an increase in the feddan productivity returns by about 0.285 pound, and an increase of the value of total product by 0.418 Egyptian pound and so on.

The ratio between the marginal productivity value of land and its opportunity cost is bigger than one (Notice that the opportunity cost of land used in producing the wheat crop has been represented by the geometric mean of its annual rent[13] during the period under study which was 7.63 adjusted Egyptian pound by the index numbers of whoelsale prices). This ratio is an indicator that the quantity of land used in this crop is smaller than the quantity which achieves the economic efficiency, since it is known that the profit maximization is achieved when the ratio of marginal productivities values and opportunity costs are equal to unity for all inputs, therefore, it is necessary to increase the area under cultivation by this crop to increase the gains from the exploitation of this important input.

4.3.2 The Production Functions of Onion

The following two equations are representing the production functions estimations of the feddan productivity and total product of onion in El Fayom Governorate during the period 1966-1982 respectively, by using the data in tables 24 and 25 in the appendix.

$$\hat{P} = 2.442\ X_1^{0.1748}\ X_2^{-0.0329}\ X_3^{0.06319}\ X_4^{0.1128} \qquad (4.3)$$

$$\hat{Y} = 2.711\ X_1^{0.1456}\ X_2^{-0.0224}\ X_3^{0.05029}\ X_4^{0.1069}\ X_5^{0.7524} \qquad (4.4)$$

Where $\hat{P}$ is the estimated feddan productivity, $\hat{Y}$ is the estimated total output, and $X_1 \ldots\ldots X_n$ are the inputs used in the production as defined before respectively.

Table 4.2 The Marginal Productivities and their Values for the Farm Resources-on their Geometric Means - Used in Producing Wheat Crop in El Fayom Governorate During the Period 66-1982

Items	Measurement Units	First Function for the Feddan Productivity	Second Function for Total Output
The geometric means for			
- Labour	man/day	21.532	1657770
- Fertilizer	pound	7.568	582713
- Seeds	pound	2.561	197178
- Other Capital	pound	5.564	428373
- Land	feddan	-	76410
The Marginal Productivity for			
- Labour	Ardeb/man/day	0.0653	0.09559
- Fertilizer	Ardeb/pound	0.1629	0.575
- Seeds	Ardeb/pound	-1.0817	-6.856
- Other capital	Ardeb/pound	0.158	2.524
- Land	Ardeb/feddan	-	23.729
The Value of Marginal Productivities for			
- Labour	pound/man/day	0.285	0.418
- Fertilizer	pound/pound	0.712	2.513
- Seeds	pound/pound	-4.728	-29.967
- Other Capital	pound/pound	0.691	11.032
- Land	pound/feddan	-	103.719

Source: Derived from the estimations of production functions in Table 4.5

x = The geometric mean of Ardeb Wheat price which is adjusted by the index numbers of wholesale prices = 4.371 E. pound

xx = The value of marginal productivity for every input = its marginal productivity derived from itsproduction function X the geometric mean of adjusted price for one unit (Ardeb) during the period under study.

For simplicity and making the comparison clear between the abovementioned two production functions, the study has summarized the results of regressions coefficients for this crop in Table 4.3. It is quite obvious that the labour elasticity in both cases reflects decreasing returns to scale, however, this elasticity - in both cases - is not statistically significant.

The fertilizer elasticities in both cases are negative, it means that both of feddan productivity and total output of Onion will decrease by using more units of fertilizer. In my view, this negative sign is not because that the quantity used of this input has reached to the third stage of production (the irrational area) but because of the inefficient use of this input, where the peasants hear about the importance of fertilizer, but they do not use it in the correct way due to the lack of their knowledge and - as we have seen in Chapter II - the fragmentation of holdings area is an obstacle of existence a special manager for the farm, nevertheless the landlords are peasants and managers at the same time. The fertilizer elasticities in both cases are statistically significant at the 0.1 level of probability.

Both seeds and other capital inputs in our two production functions have reflected decreasing returns to scale with positive sign, moreover the seeds elasticity is statistically, significant at the 0.1 level of probability in both cases, while the other capital elasticity is significant at 0.05 level as probability in both cases also.

From the second equation of onion, we can see that the elasticity of land is relatively high, where an increase of the land under cultivation by onion by 1 percent leads to an increase about 0.7524 percent of the total production. It has a high level of significance at the 0.01 level of probability.

The aggregate elasticities in the first case has reflected decreasing returns to scale since an increase in the all inputs per feddan by 1 percent would result in an increase in the productivity by 0.3179 percent, while the production function in the second case has denoted increasing returns to scale, i.e. the increase of the inputs of our production function incuding land by one percent, is associated with an increase of the total output by 1.03 percent.

Table 4.3 The Results of Production Functions Estimation for Onion Crop in El Fayom Governorate During the Period 1966-1982

Items	First Function for the Feddan Productivity	Second Function for Total Output
Labour Elasticity	0.1748 (0.1501)	0.1456 (0.155)
Fertilizer Elasticity	-0.0329* (0.0179)	-0.0224* (0.01182)
Seeds Elasticity	0.06319* (0.0325)	0.05029* (0.0253)
Other Capital Elasticity	0.1128** (0.0434)	0.1069** (0.0445)
Land Elasticity	-	0.7524*** (0.1452)
Aggregate Elasticities	0.3179	1.0327
Multiple Correlation Coefficient R	0.894	0.9967
The Coefficient of Multiple Determination R^2	0.7999	0.9933
The Adjusted Coefficient of Multiple Determination R^2	0.733	0.9903
F Test	11.993***	328.518***

* Significant at the 0.1 level of probability
** Significant at the 0.05 level of probability
*** Significant at the 0.01 level of probability

From that analysis, we can arrange the importance of the inputs involved in the feddan productivity function for onion crop according to their affect on this productivity as follows: labour, other capital, and seeds, since the increase of using their percentages are associated with an increase of the feddan productivity by decreasing percentages respectively, nevertheless, it is necessary to organize some instruction programmes for using the fertilizer input with respect to this crop.

From the same table we can notice also that the multiple correlation coefficient has increased in the production function involved the land element, where it is about 0.99. Moreover both of multiple correlation coefficients are statistical significant at the 0.01 level of probability. The adjusted coefficients of multiple determination indicate that 0.73 percent of the variance in the feddan productivity is associated with the quantities of resources used, however, 99 percent of the variability of the total onion product are determined by the independent variables including land input.

The marginal productivities and their values for all inputs used in both cases of our production functions are presented in table 4.4. As we can see, the increase of the quantity used from labour by one unit (man/day) is associated with - in the first case - an increase in the feddan productivity about 0.029 ton, and an increase - in the second case - in the total output by 0.025 ton, while the additional unit from fertilizer leads to decrease both the feddan productivity and total output of onion. The values of marginal productivities indicate that the additional unit from labour is associated with an increase in the feddan productivity returns by 0.394 E. pounds and an increase of the value of total product about 0.312 E. pound and so on with respect to other inputs.

Table 4.4 The Marginal Productivities and their Values for the Farm Resources-on their Geometric Means - Used in Producing Onion in El Fayom Governorate during the Period 1966-1982

Items	Measurement Units	First Function for the Feddan Productivity	Second Function for total output
The geometric means for			
- Labour	man/day	30.099	95682
- Fertilizer	pound	9.108	20974
- Seeds	pound	13.339	30718
- Other Capital	pound	8.447	19452
- Land	feddan	-	2303
Marginal Productivity for			
- Labour	ton/man/day	0.029	0.023
- Fertilizer	ton/pound	-0.023	-0.016
- Seeds	ton/pound	0.031	0.0246
- Other Capital	ton/pound	0.086	0.083
- Land	ton/feddan	-	4.91
The Value of Marginal Productivity for			
- Labour	pound/man/day	0.394	0.312
- Fertilizer	pound/pound	-0.312	-0.217
- Seeds	pound/pound	0.421	0.334
- Other Capital	pound/pound	1.167	1.127
- Land	pound/feddan	-	66.663

x The geometric mean of ton onion price which is adjusted by the index numbers of wholesale prices = 13.577

xx The value of marginal productivity for every input = its marginal productivity derived from its production function X the geometric mean of adjusted price for one unit (Ton) during the period under study.

SOurce: Derived from the estimations of production function in table 4.3.

The value of marginal productivity of land in our second production function is about 66.663 E. pound, while its opportunity cost represented by the geometric mean of its annual rent during the period of study was 6.895 E. pound, therefore, the ratio between the marginal productivity of land and its opportunity cost is about 9.6, this big ratio is an evidence to the fact that, the quantity used from land is smaller than the correct quantity which achieves the economic efficiency.

4.3.3 The Production Functions of Nile Maize

By using data in tables 26 and 27 in the appendix, the study has estimated the production function of the feddan productivity as well as the production function of the total output for Nile Maize crop in El Fayom Governorate during the period 1966-1982 as follows:

$$\hat{P} = 6.205\ X_1^{0.1691}\ X_2^{0.1894}\ X_3^{0.1504}\ X_4^{-0.0271} \qquad (4.5)$$

$$\hat{Y} = 18.08\ X_1^{0.1432}\ X_2^{0.2067}\ X_3^{0.1592}\ X_4^{-0.0476}\ X_5^{0.7447} \qquad (4.6)$$

Where $\hat{P}$ is the estimated feddan productivity, $\hat{Y}$ is the estimated total output, and $X_1 \ldots\ldots X_n$ are the inputs used in production as defined before respectively.

The regressions coefficients in the previous two equations have been summarized in Table 4.5 for simplicity and comparison illustration between the two cases. it is obvious that the labour elasticity in both cases, reflects decreasing returns to scale. This elasticity - in the first case - is statistically significant at the 0.1 level of probability, however, it is insignificant in the second case.

Both fertilizer (organic and chemical) and seeds inputs in our two production functions have reflected decreasing returns to scale by positive sign, moreover the fertilizer elasticity is statistically significant at the 0.05 level of probability while the seeds elasticity is statistically significant at 0.1 level of probability in both cases.

Table 4.5 The Results of Production Functions Estimation for Nile Maize Crop in El Fayom Governorate During the Period 1966-1982

Items	First Function for the Feddan Productivity	Second Function for Total Output
Labour Elasticity	0.1691*	0.1432
	(0.0871)	(0.0964)
Fertilizer Elasticity	0.1894**	0.2067**
	(0.0845)	(0.0881)
Seeds Elasticity	0.1504*	0.1592*
	(0.0821)	(0.0813)
Other Capital Elasticity	-0.0271	-0.0476
	(0.0507)	(0.0529)
Land Elasticity	-	0.7447***
		(0.1761)
Aggregate Elasticities	0.4818	1.2062
Multiple Correlation Coefficient R	0.52	0.86
The Coefficient of Multiple Determination R^2	0.27	0.74
TheAdjusted Coefficient of Multiple Determination $\bar{R}^2$	0.028	0.62
F Test	3.29**	6.28***

* Significant at the 0.1 level of probability
** Significant at the 0.05 level of probability
*** Significant at the 0.01 level of probability

The elasticity of other capital which comprises all remainder inputs such as fuel, pesticides, animal rent and petty expenses etc, is negative, i.e. a 1 percent increase in this capital is associated with decrease about 0.0271 percent of the feddan productivity and about 0.0476 percent of the total product, however, it is hardly conceivable that the feddan productivity as total production would decrease were more of any individual factor employed, therefore, this negative sign can be partly attributed to variations between years in respect to techniques employed, and weather conditions, it may also grow out of errors in reporting the original data and limited sample. Moreover the elasticity of these capital is not statistically significant in both cases.

The production function in the second case for the total Nile maize Production has included the cultivation area by thousand feddan representing the land input. The estimation of this input elasticity is relatively high where, an increase of the land used by 1 percent leads to an increase about 0.7447 percent of the total production from that crop, it is an indicator to the importance of that element and its influence on the output of Nile maize since the use of area under cultivation by that crop is still in the rational stage of production. The land elasticity also has a high level of significance, on 1 percent of probability.

The sum of the elasticities are also indicative of returns to scale when all factors of production can be changed by the same proportion. In the first case the aggregate elasticities has reflected decreasing returns to scale since an increase in the all inputs per feddan by 1 percent would result in an increase in the productivity of that feddan by 0.4818 percent, while the production function in the second case has denoted increasing returns to scale because of the high elasticity of land which can be attributed to the limited of its exploitation.

From that result, we can arrange the importance of the inputs involved in the feddan productivity function for Nile Maize crop according to their affect on this productivity as follows: fertilizer, labour, seeds, since - as we have seen - the increase of using their percentages are associated with an increase of the feddan productivity by decreasing rates respectively, however, the other capital input needs to repeat the study of its

economic use. While in the total production function the land input comes on the top whereas its affect on the total output.

Multiple correlation coefficients are presented in the same table. By comparing them in both production functions, it is clear that this correlation has increased in the second case, since the relation between the total output of Nile Maize and its productive inputs including land is stronger. The multiple correlation coefficient in case of feddan productivity function is statistically significant at the 5 percent level of probability while it is - in the second case - significant at 1 percent level. The coefficients of multiple determination indicate that 27 percent of the variance in the feddan productivity is associated with quantities of resources used, while 74 percent of the variance in the total output is due to the variance of the independent variables involved in our production functions.

Table 4.6 summarized the estimations of marginal productivities and their values by E. Pound for the all inputs included in both cases of our production functions. It is clear from this table that the increase of the quantity used - in our first production function - from labour by one unit (man/day) is associated with an increase in the feddan productivity about 0.089 Ardeb, while the increase of the quantity used - in the second production function - from this input leads to increase the total output of Nile maize crop by 0.537 Ardeb, and so on with respect to the other inputs. The value of these marginal productivities indicate to the returns which might be expected on the average from the addition of one unit of the various productive agents, for example, the increase of fertilizers by one Egyptian Pound - in the first production function - is associated with an increase in value of the feddan productivity by 1.624 pound while in the second case it leads to increase the value of total product by 11.954 pound and so on.

The value of marginal productivity of land in the second production function is about 365.5 E. Pounds, while its opportunity cost represented by the geometric mean of its annual rent during the period of study was 5.316 adjusted E. Pounds by the index numbers of wholesale prices, therefore, the ratio between the marginal productivity of land and its opportunity cost is greater than one, and it is a reflection to the shortage of using land input in producing Nile Maize Crop.

Table 4.6 The Marginal Productivities and their Values for the Farm Resources - on their Geometric Means - Used in Producing Nile Maize Crop in El Fayom Governorate During 1966-1982

Items	Measurement Units	First Function for the Feddan Productivity	Second Function for Total Output
The geometric means for			
- Labour	man/day	30.245	2459057
- Fertilizer	pound	8.522	730935
- Seeds	pound	0.946	81507
- Other Capital	pound	3.016	259703
- Land	feddan	-	86093
Marginal Productivity for			
- Labour	Ardeb/man/day	0.089	0.537
- Fertilizer	Ardeb/pound	0.3545	2.609
- Seeds	Ardeb/pound	2.535	18.020
- Other Capital	Ardeb/pound	-0.1433	-0.839
- Land	Ardeb/pound	-	79.767
The Value of Marginal Productivity for			
- Labour	pound/man/day	0.408	2.46
- Fertilizer	pound/pound	1.624	11.954
- Seeds	pound/pound	11.615	82.567
- Other Capital	pound/pound	-0.657	-3.844
- Land	pound/feddan	-	365.49

x The geometric means of Ardeb Nile Maize price which is adjusted by the index numbers of wholesale prices = 4.582 pound

xx The value of marginal productivity for every input = itsmarginal productivity derived from its production function X the geometric means of adjusted price for one unit (Ardeb) during the period under study.

Source: Derived from theestimations of production functions in table 4.1.

4.3.4 The Production Functions of Winter Tomato

The study has estimated only the production functions for winter tomato, because of the shortage in data with respect to summer and nile tomatoes. The following two equations are representing the production functions for the feddan productivity and total output of winter tomatoe in El Fayom Governorate during the period under study respectively.

$$\hat{P} = 81.45 \quad X_1^{-0.6307} X_2^{0.1994} X_3^{0.657} X_4^{0.1335} \qquad (4.7)$$

$$\hat{Y} = 87.36 \quad X_1^{-0.6374} X_2^{0.19053} X_3^{0.7421} X_4^{0.11946} X_5^{1.4736} \qquad (4.8)$$

Where $\hat{P}$ is the estimated feddan productivity, $\hat{Y}$ is the estimated total output, and $X_1 \ldots X_n$ are the inputs used in the production as defined before respectively.

Table 4.7, shows the regressions coefficients which indicates that the labour elasticity in both production functions for tomato is negative because the existence of disguised unemployment in rural area with respect to that crop. It means that it is possible to decrease the quantity used of labour, without any reduction in either the feddan productivity or the total output of winter tomato since - as we shall see later - the marginal productivity of labour is negative. The elasticity of labour is statistically significant at the 0.05 level of probability in the first case, while at the 0.1 level of probability in the second case.

Both fertilizer and seeds inputs in our two production functions have reflected decreasing returns to scale with postive sign, moreover the fertilizer elasticity is statistically significant at the 0.05 level of probability in both cases, while the seeds elasticity is significant at 0.1 level in the first case and insignificant in the second case.

Table 4.7 The Results of Production Functions Estimation for Winter Tomato Crop in El Fayom Governorate During the Period 1966-1982

Items	First Function for the Feddan Productivity	Second Function for total Output
Labour Elasticity	-0.6307^{xx} (0.2920)	-0.6374^{x} (0.3062)
Fertilizer Elasticity	0.1994^{xx} (0.0927)	0.19053^{xx} (0.0882)
Seeds Elasticity	0.6570^{x} (0.3367)	0.7421 (0.4755)
Other Capital Elasticity	0.1335 (0.1103)	0.11946 (0.1347)
Land Elasticity	-	1.4736^{xxx} (0.43178)
Aggregate Elasticities	0.3592	1.888
Multiple Correlation Coefficient R	0.658	0.9866
The Coefficient of Multiple determination R^2	0.433	0.9734
The Adjusted Coefficient of Multiple Determinant $\bar{R}^2$	0.244	0.9613
F Test	12.295^{xxx}	80.469^{xxx}

x Significant at the 0.1 level of probability
xx Significant at the 0.05 level of probability
xxx Significant at the 0.01 level of probability

Table 4.8 The Marginal Productivities and Their Values for the Farm Resources - on their Geometric Means - Used in Producing Winter Tomato Crops in El Fayom Governorate During the Period 1966-1982

Items	Measurement Units	First Function for the Feddan Productivity	Second Function for Total Output
The geometric means for			
- Labour	man/day	71.176	719131
- Fertilizer	pound	11.264	113809
- Seeds	pound	2.834	28641
- Other Capital	pound	6.865	69367
- Land	feddan	-	10104
The Marginal Productivity for			
- Labour	ton/man/day	-0.203	-1.742
- Fertilizer	ton/pound	0.407	3.289
- Seeds	ton/pound	0.532	0.592
- Other Capital	ton/pound	0.447	3.385
- Land	ton/feddan	-	2.866
The Value of Marginal Productivities for			
- Labour	pound/man/day	-8.207	-70.43
- Fertilizer	pound/pound	16.455	132.97
- Seeds	pound/pound	21.508	23.93
- Other Capital	pound/pound	18.072	136.85
- Land	pound/feddan	-	115.87

* The geometric mean of ton winter tomato price which is adjusted by the index numbers of wholesale prices = 40.43 E. pound.

** The value of marginal productivity for every input = its marginal productivity derived from its production function X the geometric mean of adjusted price for one unit (ton) during the period under study

The capital elasticity is indicative to decreasing returns to scale, since 1 percent increae in this input is associated with an increae about 0.1335 percent in the feddan productivity and about 0.1195 percent of the total product ceteris paribus all other inputs are fixed. The elasticity of capital input is insignificant in our two production functions.

The land elasticity, refers that, land is the only input which indicates increasing returns to scale, since this elasticity is bigger than one, and is significant at 0.01 level of probability. It is an evidence to the fact, that the quantity used from land in producing winter tomato is still in the first stage of production (The irrational area). Therefore, it is necessary to increae sharply the quantity used from that input till the second stage of production (the rational area) to achieve the economic use from it.

The aggregate elasticities in the first case has reflected decreasing returns to scale, while in the second - it is obvious - that the sum of elasticities is bigger than one, i.e. has reflected increasing returns to scale because of the high elasticity of land which can be attributed to the limited of its exploitation.

From the previous results, we can summarize the importance of inputs involved in the feddan productivity function as follows: seeds, fertilizer and capital, however, it is necessary to decrease the quantity used from labour, to improve the feddan productivity of winter tomato.

The multiple correlation coefficients are 0.66 and 0.986 respectively, and they are statistically significant at the 0.01 level of probability in both cases, while the coefficients of multiple determination indicate that 43,97 percent of the variability of feddan productivity and total output of Winter tomato are determined by the independent variables which are involved in the two production functions respectively.

From Table 4.8 we can see the marginal productivities and their values, it is clear that the additional units from labour are associated with a reduction in both of the feddan productivity and total output of winter tomatoe, while the increase of the quantity used from seeds - for example - by one unit is associated with an increase in the feddan productivity by 0.532 ton, and an increase in the total output by 0.592 ton, and so on. The value of marginal productivity of land was about 115.87, while its opportunity cost represented by the geometric mean of its annual rent

during the period 1966-1982 was about 12.292 adjusted Egyptian Pounds, therefore, the ratio between both - as we must expect from it is elasticity - is greater than one because the irrational use of this input in producing winter tomatoe.

Finally, we can observe that the analysis of this chapter has concluded that the feddan productivity in El Fayom Governorate with respect to the crops under study can be improved by the efficient use of seeds, fertilizer, and capital in cases of wheat, onion and Nile Maize respectively, in addition, to decrease the quantity use of labour in case of winter tomatoe, nevertheless, the total output of the abovementioned crops can be increased sharply, if the lands under cultivation have been enlarged.

Notes to Chapter IV

(1) Economic efficiency is denoted when given resources are used in a manner that they cannot be rearranged to give (a) a greater physical product with the same collection of resources or (b) the same physical product with less of one or more resources. (See Heady, E.O., Economics of Agricultural Production Functions and Resource Use, op.cit.)

(2) Heady, E.O. and J. L. Dillon, Agricultural Production Functions, Iowa State University, Ames, Iowa, 1961.

(3) Hansen, B. Marginal Productivity wage Theory and Subsistence Wage Theory in Egyptian Agriculture, The Journal of Development Studies, Vol. 2, 1965.

(4) Nassar, S. Z., and others. The Agricultural Production Function in Egypt 1960-1976, The Fifth International Conference of Statistics, Ain Shams University, 29 March to 13 April 1980.

(5) Tentnar, G.A. Note on the Drivation of Production Function from Record Data, Econometrica 16: 295-304, 1944.

(6) Heady E.O., Production Functions from a Random Samle of Farms, Journal of Farm Economics, Vol. 28: 989-1004, 1946.

(7) Resk, M. and Afer M., The Production Functions for the Most Important Crops in A.R.E. the Institute of National Planning, memo 1017, Cairo, 1972.

(8) Nassar, S.Z. and others. The Agricultural Production Function in Egypt, 1960-1976, op.cit.

(9) Hodhod, H. The Economic Efficiency of Agricultural Land and its Relation with Land Rent Determined According to Agrarian Reform Law in Egypt, Ph.D. thesis, Agricultural Economic Department, Faculty of Agri. Mansoura University 1981.

(10) Heady, E.O. Production Functions From a Random Samples of Farm, op.cit.

(11) Heady, E.O. and J.L. Dillon, Agricultural Production Functions, op.cit.

(12) The value of marginal productivity (monetary) is equal to the product of physical marginal productivity and the average price of the output.

(13) In Egypt, the agricultural land rental value is determined, according to agrarian reform, at, seven times agricultural tax.

CHAPTER V

THE ANALYSIS OF PROFITABILITY FOR MOST IMPORTANT FIELD AND VEGETABLE CROPS IN EL FAYOM GOVERNORATE

5.1 Preface

Profitabilty, or the ability of a farm to generate profits, is a major consideration for any private enterpreneur to set up a firm, since he determines the production size according to the comparison between the expectation of total revenue on his sales and costs of production.

Profit is considered the net returns which is one of the most important measurements of management efficiency, since a firm can be considered successful to a certain degree, when its revenue is higher than costs of inputs used in the production process, generally the success of any project depends on the ability of achievement, output maximization and cost minimization.[1]

It can be argued that profits on sales are the difference between total costs which have been spent on a certain quantity of production and its total revenue, in other words, we can say that profit is a result of both costs and revenue, therefore, it is necessary to take them into consideration to show their role and influence on profit.

Costs of production are considered one of the important aspects which are playing a main role in determining profit of any crop, it can be defined - strictly speaking - as prices and rents of inputs and services which have contributed in the production process.

We have already observed in the previous discussions that the productivity of some crops has increased during the period under study, however, the increase in productivity does not necessarily indicate to the productivty efficiency of the agricultural resources used, where costs of production process which are representing in the different inputs may be -

in some cases - so high to achieve this productivity, therefore it is necessary for policy makers to put into consideration a fair policy which fulfil low cost per unit of production to realize profit for producers without burden for consumers, such policy can be achieved by shift in making finances more accessible for smaller producers.

Prices also play an important role in production, consumption and allocation fields in both capitalistic and socialistic societies, however, that role has too much variations among these societies, where in capitalistic prices are the most important factor which determines the resource allocation between different uses, while in socialistic states they are not so important, because the planning decisions are also affecting the resource of allocation.

Prices can control the quantity of production, since by assuming that producers are rational, then they will respond positively to the raise in output prices and negatively to the input prices, nevertheless in Egypt, prices have faced many policies which are sometimes not compatible together. For example, there is some contradiction arised from the dissimilarity of appraisal methods, where some commodities are free and their prices determine according to supply and demand, while the prices of other have been determined by the government. This contradiction, in turn, affects the distribution of income and profit between the agricultural producers.

Finally, we can deduce from the previous discussions that profits depend on prices and quantities of inputs which used in the production process in addition to prices and quantitites of outputs. The profitability of other competitive crops - undoubtedly - is an important economic aspect which affects the producers decisions and their preference to certain crop rather than the other.

5.2 The Importance of the Profitability Study

The research undertakes analysis and measuring the profitability for many reasons, some of them are the following:

(1) The study of profitability interprets - to a large extent - why peasants increae the production of one crop on the expense of the

others, since profit is considered one of the most important stimulators for producing specific crop.

(2) The profits are an indicator to which extent the present projects are successful, this in turn helps farmers in formulating the productive plans on the basis of encouragement the high profit projects on one hand and redistribution of the resource allocation with respect to the projects of low profit on the other hand.

(3) The study of profitability helps also to achieve the planned crop composition, via increasing the profit of the important crop by introducing the economic desired modification in the production methodology.

5.3 The Theoretical Framework

The purpose of this chapter is measuring the profit of the crops under study as well as the comparison between their profitability. The study - for simplicity - has divided the time series under study (1966-1982) to four parts, every period is four years approximately, the profit which can be obtained in every period is an average for four years except the first period which is an average for five years.

It can be argued that, there are different point of views in measuring the profitability of any crop. The following part will summarize very briefly, how we can measure the proits according to these different views?

5.3.1 The Feddan Profitability

The profit per feddan, i.e. the profit per unit of land can be calculated by subtraction the total costs (the value of inputs used in the production per one feddan) from the total revenue of feddan productivity. However, we must notice that, in case of joint products such as wheat & straw and Maize & Stalks, the total revenue per feddan equal to the revenue of the main product (which equal to the feddan productivity multiply price per unit of that main product) plus the revenue of the by product (which equal to the feddan productivity of that by product multiply the price of its units).

Generally, we can separate the revenue of joint products, nevertheless, we cannot separate their costs, since they have been produced in one production process, therefore, the costs of production per feddan is representing the costs of both main and by product crops together, however, it is worth to refer that our study has no problems of joint inputs, since most of the crops under study are not consequent crops.

5.3.2 The Feddan Profitability per Month

To compare between the profitability of different crops, it is necessary to take into consideration the feddan profitability/month, i.e. we have to take into account the crop staying period in soil, where - in some cases - it may be there are two crops which have got the same profit per feddan, however, the first stays in land three months only, while the second stays six months. In that case we prefer to cultivate the first crop which stays shorter time on soil, since peasants can use their land again in cultivating another crop, therefore, to make the comparison more precisely, it is necessary to calculate the feddan profitability/month which equal to the profit per feddan divided by the number of months of crop staying period.

5.3.3 The Profit/Cost Ratio per Feddan

To calculate the relative profitability for the different crops under study, we can also examine the profitability of one pound which has spent in the agricultural process in other words the profit/cost ratio per feddan which equal to:

$$\frac{\text{Profit on sales per feddan}}{\text{the total cost of that feddan}}$$

The previous ratio is a good indicator to the relation between profit and costs of the agricultural production process. For example, if we have two crops which have the same profit per feddan, however, their costs of production are different, then the lower ratio is the higher cost, this in

turns leads - with respect to some peasants - to face problem of finance the crop which has high cost, therefore it is not necessarily to expect that peasants will respond positively to the crops which have got higher profitability per feddan because of the problem of finance.

5.3.4 The Profit Cost Ratio/Month

As has been followed in case of the feddan profitability, the research undertakes to measure the profit cost ratio per month to help in comparison between the crops under study, and to take into consideration the period of receiving the net returns of the agricultural process. We can calculate the profit cost ratio/month by dividing the profit cost ratio on the number of months of crop staying period.

5.3.5 The Profitability per Unit

Finally, it is worth to measure the profitability per unit of production, i.e. ton or Ardeb, to reflect the weight of selling that unit which, in turn helps the peasants to restrict the self consumption by their families, from their own production. In other words, the profitability per unit shows to the producers a precise comparison between either selling that unit and receiving its profit or using it for consumption.

The profit per unit can be measured by subtraction the costs of production per unit (which equal to the total cost per feddan divided by the feddan productivity) from its price. However, the following equation refers to an important adjustment which must put into account when we attempt to calculate the cost of one unit in the case of joint products:[2]

$$U_c = \frac{Tc - R}{P}$$

Where U_c is the cost per unit of the main crop

T_c is the total cost per feddan

R is the revenue of by product

P is the productivity per feddan of the main crop.

However, we must take into consideration that the previous formula may be affected by the changes in by products price and in turn their revenue, it leads to give not exactly value for unit cost of the main crop, since it is very difficult to separate costs of joint products.

5.4 The Analysis and Comparison of Profitability

The coming part will attempt to measure the different point of views of profitability for wheat, onion, nile maize, and winter tomato as well as the comparison between them according to the previous framework as follows:

5.4.1 Wheat

The figures listed in Table 5.1 refer to a remarkable increase in Straw prices in comparison with the wheat price. The average of straw price in the first two periods (1966-1970) and (1971-1974) was representing approximately one-third of the average of wheat price in these periods, however, in the recent period (1979-1982) the price of straw became about 104% of wheat price, this in turn, affects the percentage of the by product revenue with respect to the total revenue per feddan, where it was 25%, 20%, 29% in the first three period respectively, and it has increased to 49% in the last period, this fact serves as an evidence to increase the importance of wheat by product, which may stimulate the peasants to produce the main product, since their revenues are more or less equal especially in the past recent years.

As we can see from the same table (columns 10, 12) both, feddan profitability and the feddan profitability per month are increasing over time, this means that the rates of increase prices of wheat and straw are higher than the rate of increase the cost of production per feddan. However, from (Columns 13, 14), it is clear that the profit cost ratio, and in turn the profit cost ratio per month are the highest in period (1971-1974), although in the same period the profitability per feddan was not the highest. This can be attributed to the fact that the profitability per feddan is a difference between revenues and costs, while the profit cost ratio is a ratio between the profitability per feddan and the total cost of

that feddan. Also we can attribute the highest cost ratio per feddan to increase the feddan profitability by a rate higher than that of increase costs of production in that period. Measuring of the profitability per unit (Ardeb) of the main product (wheat) is representing in the last column of the same table to show the peasants, the ability of their own products in the exchange for other commodities.

Finally, the question now arises, whether the different views of the profitability can assert the importance of wheat cultivation, with stimulation of peasants to its production or not? The answer of that question depends to a large extent, on the comparison of profitability of other competitive crops in the same seasons, which is being discussed below in the case of Onion crop.

5.4.2 Onion

The different views of measuring the onion profitability are listed in table 5.2 which indicates that both the profit cost ratio and the profit cost ratio per month are very high in the period 1975-1978, this in turn means that the rate of increase the Feddan profitability in that period is higher than the rate of increase the production costs, also it is remarkable that the profit per unit (ton) of Onion in the same period was exactly 100 percent from its cost, it is of course an indicator to increase the total cost per feddan by a very low rate in comparison with the feddan productivity (Notice that the profit per unit equal to total cost per feddan divided by the feddan productivity).

As a matter of fact, Onion and Wheat are competitory crops on land, since both are cultivated in winter season, therefore, it is necessary to put them in comparison. From tables 5.1 and 5.2 we can notice the following:

Table 5.1 Measuring of: Feddan Profitability, Feddan Profitability/Month Pound Profitability, Pound Profitability/Month, and Unit Profitability (Ardeb) for Wheat Crop in El Fayom Governorate During the Period (1962-1982)

(1) Items Period	(2) Feddan productivity of main crop	(3) Price of unit per (Ardeb)	(4) Revenue of main crop	(5) Feddan Productivity of by Product Crop	(6) Price of its unit (Heml)	(7) Revenue of by product crop	(8) Total Revenue per Feddan	(9) Total cost per Feddan	(10) The Feddan Profitability	(11) The crop Staying Period	(12) Profitability of Feddan/Month	(13) Profit cost ratio	(14) Profit cost ratio per month	(15) The unit cost (Ardeb)	(16) The unit profitabil
	Ardeb	pound	pound	Heml	Pound	Pound	Pound	Pound	Pound	Month	Pound			Pound	Pound
1966-70	6.93	5.10	35.34	6.68	1.85	12.34	47.69	29.55	17.84	six	2.97	0.60	0.1	2.35	2.75
1971-74	7.82	6.00	47.00	6.38	1.94	12.38	59.4	32.6	26.8	months	4.47	0.82	0.136	2.6	3.4
1975-78	9.02	7.63	69.0	6.21	4.5	28.0	97.0	60.12	37.0	in all	6.20	0.61	0.101	3.56	4.07
1979-82	8.89	11.44	101.70	8.18	11.88	97.2	200.0	119.45	80.55	years	13.43	0.674	0.112	2.50	8.94

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

* All values listed in the above table are an average for the abovementioned periods

Table 5.2 Measuring of Feddan Profitability, Feddan Profitability/Month, Pound Profitability, Pound Profitability/Month, and Unit Profitability (Ton) for Onion Crop in El Fayom Governorate During the Period 1966-1982

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Items/ Periods	Feddan Productivity	Price of Unit (Ton)	The Revenue per Feddan	Total Cost per Feddan	The Feddan Profitability	The Crop Staying Period	Profitability of Feddan/mth	Profit Cost Ratio	Profit Cost Ratio per mth	The Unit Cost (Ton)	The Unit Profit-ability
	Ton	Pound	Pound	Pound	Pound	Month	Pound			Pound	Pound
1966-1970	5.69	11.84	67.36	40.69	26.67	Five	5.33	0.66	0.13	7.15	4.69
1971-1974	6.43	16.26	104.6	57.1	47.5	Months	9.5	0.83	0.166	8.88	7.38
1975-1978	6.83	29.44	201.1	100.53	100.6	in all	20.11	1.00	0.2	14.72	14.72
1979-1982	7.55	49.21	371.5	265.1	106.4	Years	21.28	0.401	0.08	35.11	14.1

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

* All value listed in the above table are an average for the above mentioned periods.

(1) Although the costs of production per feddan of wheat is lower than that in the case of onion in all periods under study - the profitability per feddan in case of the first crop is lower than the second, by putting every period in comparison with its corresponding for both crops, we can deduce that the percentages of feddan profitability of wheat are equal, 66.89%, 56.42%, 36.78%, 75.7% of the feddan profitability of onion in the abovementioned periods (compare table 5.1 column 10 with table 5.2 column 6).

(2) The wheat profitability of feddan/month is also lower than that of onion, however, the percentages betwen them were about 55.7%, 47.1%, 30.83%, 63.11% which are different than the previous percentages of feddan proftability. This difference of course attributes to the unequal number of months of both crops staying period (compare table 5.1 column 12 with table 5.2 column 8).

(3) The profit cost ratio in case of wheat is lower than that in case of onion except last period (1979-1982) which indicates that the Egyptian pound used in wheat cultivation has got a higher profit than that one used in Onion, this can be attributed to increase the costs of production of onion by a rate higher than that of increase the profitability per feddan in this period only.

(4) The percentages between the wheat profit cost ratio/month and onion were about 76.9%, 81.9%, 50.5%, 140% respectively. It is clear that in the last period the costs of production per feddan of onion has got a remarkable increase which affected the profit of pound per month.

(5) Finally, from last columns in the previous two tables, it is quite obvious that the profit per unit of onion was higher than that of wheat in all periods under study.

Having the previous comparison, we can deduce that onion crop is more profitable than wheat crop, and that in turn, interprets the phenomenon which we have seen in Chapter III with respect to the changes in cultivation area - during the all period under study 1966 - 1982 - in favour of onion crop, since from (table 3.4) we can notice the reduction of wheat cultivated area in El Fayom Governorate as a whole by 21% of the basic year, while from (Table 3.8) it is obvious that the area under cultivation by onion has increased by 151%.

It is worth to refer that, in spite of the fact that the feddan profitability of onion is higher than the wheat crop, the profitability per pound of Onion in the recent period became lower because of increase its cost, therefore we can expect in the future that the response of increase the cultivation area by onion can continue with respect to a special category (rich groups) of peasants and does not continue for the others who face the problem of finance the crop which has the highest cost.

5.4.3 Nile Maize

From table 5.3 it is clear that the price of stalks is low relative to the maize price, this in turn affects the percentages of this by product revenue with respect to the total revenue per feddan during the periods under study, where they were about 9.45%, 8.9%, 11.1%, and 14.9% respectively, this case is a contrary with the by product of wheat.

The profitability per feddan of that crop in all periods under study is lower than both wheat and onion crops, however, all different views of profitability in the last period became negative because of increase in the costs of production in such a way not appropriate with the increase of its price. For example, if we compare the last two periods (1975-1978) and (1979-1982), we can deduce that the total revenue of that crop has increased by 195%, while the total cost has increased by 267%.

The profitability of feddan/month, the profit cost ratio and the profit cost ratio/month in the first period (1966-1970) only were higher than these of wheat crop, nevertheless they became lower in all the following periods.

As we have seen above, the production of that crop does achieve the productive efficiency especially in the recent period, we also noticed in Chapter IV, that the production function of that crop indicates to the inefficient use of the capital input, therefore, it is necessary to redistribute the resources combination on the basis of achieving their efficient use as well as decrease costs of production instead of increasing its price.

The negative profit in last period can be interpret the following two phenomenon: 1. The reduction of Nile Maize cultivation area by 30% of the

basic year 1966 (see table 3.12), since this crop has an important competitive crop (Nile Rice) which is cultivated in the same season. 2. The disappearance of that crop from the market, since the peasants felt that it is not a profitable crop, and they have preferred to use it as self consumption instead of selling it.

5.4.4 Winter Tomatoe

As we have seen above, the different views of measuring the winter tomatoe profitability are listed in table 5.4 which indicates that both the profit cost ratio, i.e. the profitability of one Egyptian pound used in producing that crop and the profit cost ratio per month are the highest in period (1971-1974), this can be attributed to the low rate of increase costs of production per feddan in that period relative to the rate of increase in the feddan profitability.

If we put all the crops under study in comparison together on the basis of comparing each period to its corresponding in the four crops, we can deduce the following:

(1) The price per unit of winter tomato and costs of production per feddan are the highest in all periods with the exception of the production cost of onion in the recent period (1979-1982).

(2) The five different views of looking to the profitability are indicating that winter tomatoe has got the highest profitability in all periods under study. This of course serves as a good evidence to interpret the remarkable increase of its cultivation area which was about 378 percent of the basic year 1966 (see table 3.15).

(3) According to the previous analysis and comparison of the profitability,it can be argued that the arrangement of the crops under study according to the higher profitability as follows: Winter Tomato, Onion, Wheat, and finally Nile maize. (see Figures 5.1 and 5.2).

Table 5.3 Measuring of: Feddan Profitability, Feddan Profitability/Month, Pound Profitability, Pound Profitability/Month and Unit Profitability (Ardeb) for Nile Maize Crop in El Fayom Governorate During the Period (1966-1982)

(1) Items Periods	(2) Feddan Productivity of Main Crop	(3) Price of Unit per (Ardeb)	(4) Revenue of Main Crop	(5) Feddan Productivity of by Product Crop	(6) Price of its Unit (Heml)	(7) Revenue of by product crop	(8) Total Revenue per Feddan	(9) Total Cost per Feddan	(10) The Feddan Profitability	(11) The Crop Staying Period	(12) Profitability of Feddan/ Month	(13) Profit Cost Ratio	(14) Profit cost Ratio per Month	(15) The Unit Cost (Ardeb)	(16) The Unit Profitability
	Ardeb	Pound	Pound	Heml	Pound	Pound	Pound	Pound	Pound	Month	Pound			Pound	Pound
1966-70	7.2	4.81	34.6	8.2	0.44	3.61	38.21	23.63	14.58	Four	3.65	0.62	0.155	2.78	2.03
1971-74	6.38	5.93	37.8	7.35	0.5	3.7	41.5	27.6	13.9	Month	3.5	0.503	0.126	3.74	2.19
1975-78	7.28	8.11	59.04	7.0	1.05	7.35	66.39	51.8	14.59	in all	3.64	0.28	0.07	6.1	2.01
1979-82	7.25	15.2	110.2	7.7	2.5	19.25	129.45	138.13	- 8.68	years	-2.17	-0.062	-0.015	16.39	-1.19

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

* All values listed in the above table are an average for the above-mentioned periods.

Table 5.4 Measuring of: Feddan Profitability, Feddan Profitability/Month, Pound Profitability, Pound Profitability/Month, and Unit Profitability (Ton) for Winter Tomato Crop in El Fayom Governorate During the Period (1966-1982)

(1) Items Periods	(2) Feddan Productivity Ton	(3) Price of Unit (Ton) Pound	(4) The Revenue per Feddan Pound	(5) Total Cost per Feddan Pound	(6) The Feddan Profitability Pound	(7) The Crop Staying Period Month	(8) Profitability of Feddan Month	(9) Profit Cost Ratio	(10) Profit Cost Ratio per Mth	(11) The Unit Cost (Ton) Pound	(12) The Unit Profitability Pound
1966-1970	5.46	40.59	221.6	54.09	167.51	Four	41.87	3.09	0.773	9.9	30.69
1971-1974	6.22	62.47	388.5	61.75	326.75	Months	81.69	5.29	1.32	9.93	52.54
1975-1978	5.82	87.42	508.78	108.44	400.34	in all	100.08	3.69	0.92	18.63	68.79
1979-1982	8.11	100.45	814.6	222.06	592.54	Years	148.13	2.668	0.667	27.38	73.07

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.
All value listed in the above table are an averages for the abovementioned.

Figure 5.1 Development of Profit Per Feddan Over Time

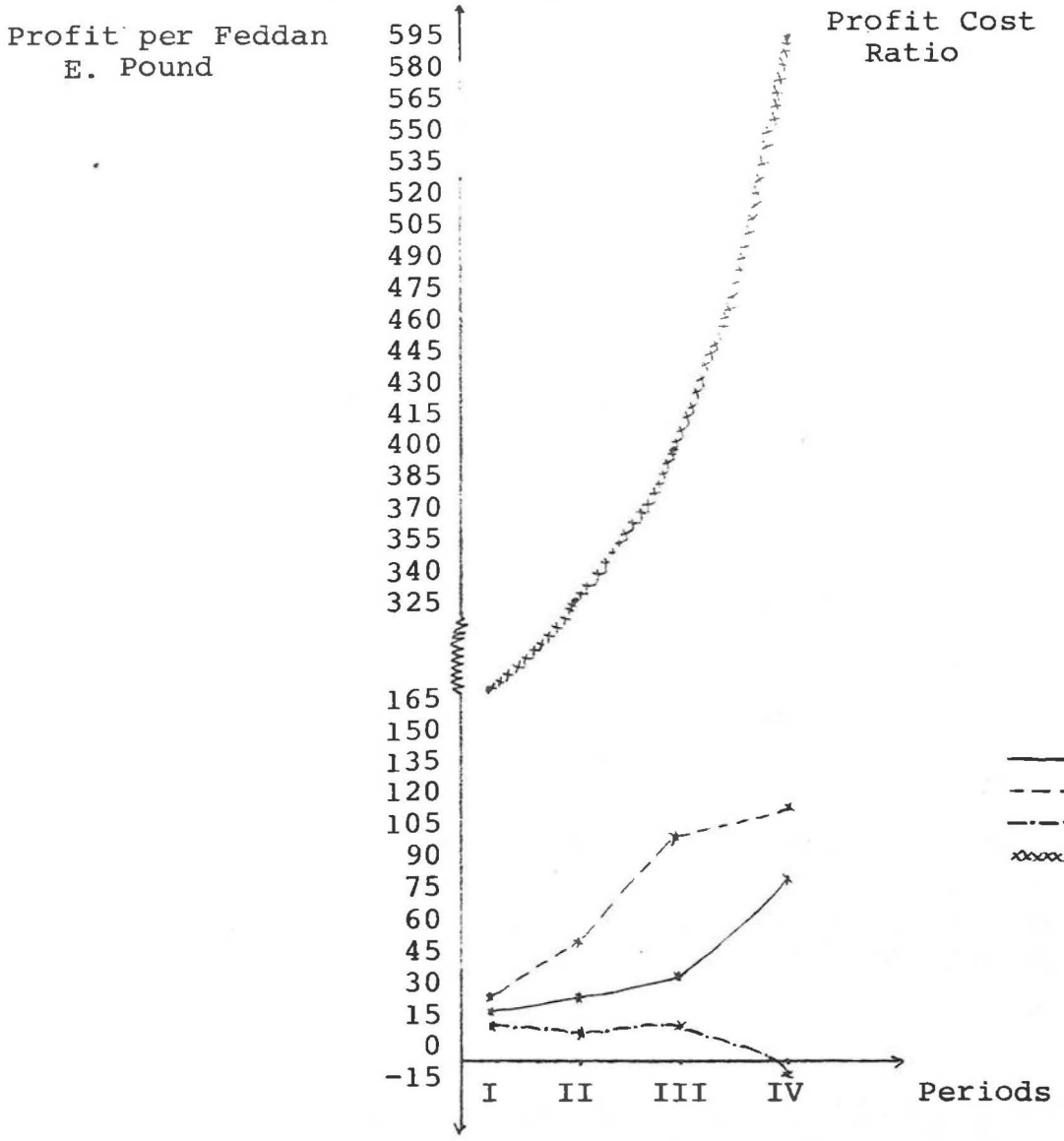
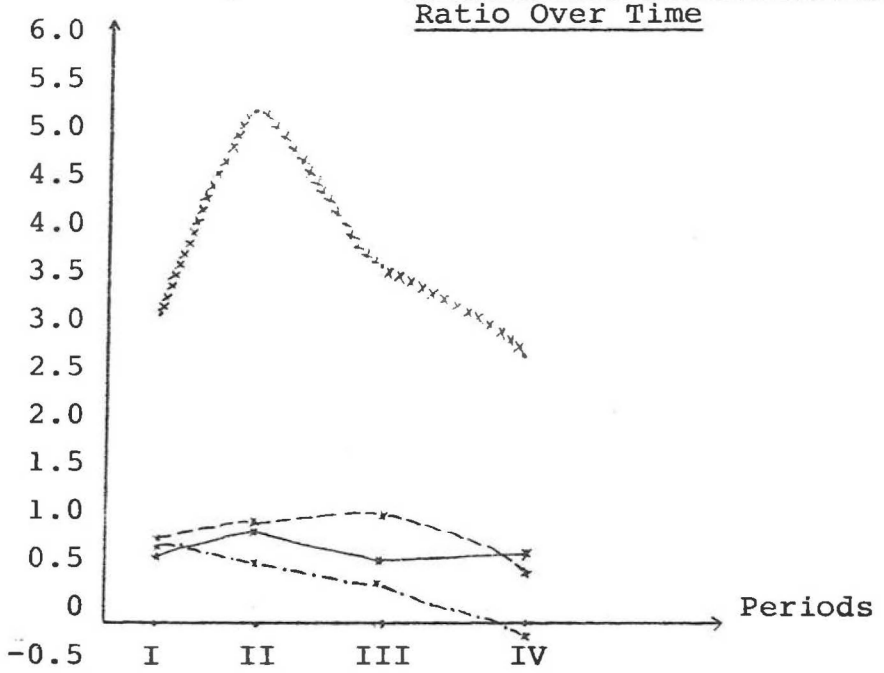


Figure 5.2 Development of Profit Cost Ratio Over Time



——— Wheat
- - - - Onion
—·—·— Nile Maize
×××××× Winter Tomato

I = (1966-1970)
II = (1971-1974)
III = (1975-1978)
IV = (1979-1982)

Generally, the profitability of vegetable crops in El Fayom Governorate is very high relative to the field crops, therefore, most of the peasants prefer to cultivate their lands by vegetable crops with the exception of the four following cases:

1. When the nature of the soil does not appropriate to the vegetables cultivation.
2. When some peasants are facing the problem of finance, since vegetable crops have also high costs of production.
3. When the producers feel that they need the field crops for their self consumption.
4. And finally, in case of existence some restrictions related to the agricultural policy which have been issued by the government to achieve the optimum agricultural rotation as well as the food security.

Notes to Chapter V

(1) Khalifa, A.F. Abdel Hakim, Factors which affect in the crop composition in El Minia Governorate, Master Thesis, Agriculture Economic Department, Faculty of Agriculture, cairo University, 1966.

(2) Nassar, S.Z., An Analytical Study for the Profitability of the Main Field Crops in Egypt as an Average to the Period 1970-1972, Researchs. Magazin and Agricultural Development, Faculty of Agriculture, El Minia University, 1974.

Conclusion

El Fayom is one of the Middle Egypt Governorates, which comprises five administrative districts, Ebshiwai, Etsa, Sinoris, Tamia and El Fayom. Agriculture is playing - and will continue to play - a significant role in El Fayom economy, therefore the agricultural development is of a great importance in achieving the objectives of economic development in this region.

The research aimed at studying problem of fluctuating the productivity of land unit - for the most important field and vegetable crops during (1966-1982) - because it is the major factor likely to influence the total output and in turn, the agricultural income. To deal with this problem the study investigated the available agricultural resources in El Fayom and its distribution between the different districts as we have seen in Chapter II. The main conclusion from this chapter can be summarized as follows:

1. Most of El Fayom population is working in agricultural production, since 75% of total human force is representing the rural area as an average of the period (1980-1982).
2. The educational status for the labour force in El Fayom has a high rate of illiteracy, which is an obstacle to adopt new cultivation techniques.
3. The fragmenttaion of holdings area is an obstacle to apply mechanization and/or achieve the economic efficiency of the available agricultural resources.
4. Ebshiwai district is the only one which has got the first class lands.
5. Etsa district has the highest quantity of irrigation water, since it is receiving its water only from Hassen Wassef canal which has higher "Feddan share of water" than Youssef canal.
6. As a matter of fact, the management skill is an important factor associated with the farm labour force, however, in the small family owned holdings the peasants are managers at the same time, it leads to weakening the management efficiency, as a result of the farmers having little knowledge of anything other than traditional subsistence farming. If

progress is being made on education and training of these farmers, the lack of adequate technical knowledge and management skill will remain a very serious limitation on improvement land productivity.

7. The study has classified the capital resources to: fixed capital such as buildings, tractors, cattle, etc, and circulating capital (current inputs) such as seeds, fertilizers and pesticides, etc, the peasants have been provided with most of this capital from two main cooperations in El Fayom Governorate; a. the Agrarian reform cooperatives and b. the agricultural credit cooperatives.
8. The animal resources play an important role in the agricultural production process in El Fayom Govenorate, since the traditional agricultural methods are prevalent, however, the available quantity of these resources is relatively low with respect to the area under cultivation in El Fayom Governorate.

Chapter three dealt with three different approaches of comparison for the evoluation of the feddan productivity in the various districts as well as the governorate as a whole in addition to discuss the changes in cultivation area during the period 1966-1982.

The chapter presented these approaches related to wheat onion, nile maize out of the field crops and tomatoes (winter, summer, and nile tomatoes) out of the vegetable crops because they are the most important field and vegetable crops in El Fayom Governorate during the abovementioned period. the study concentrated only on the land productivity for some reasons as sited in section 3.1.

By applying the different approaches, the chapter concluded the following:

a. Wheat: Tamia district has the highest productivity by different two ways during the period under study, this can attribute to the fertility of its soil or more precisely because of the conveniency of Tamia lands to wheat cultivation. The time trend of wheat productivity per feddan in the governorate as a whole was increasing, but at a slow pace (see figure 3.1). The cultivation area by that crop has been distributed

approximately by equality between the five districts, since Tamia district has got 20% of the total, however, the total area under cultivation by wheat crop has decreased during the period under study.

b. Onion: Ebshiwai district has the highest productivity, since - as we have mentioned in Chapter II - this district is the only one which has got the first class lands. The time trend of onion productivity per feddan in the governorate was increasing during the period under study. The study also concluded that there is a positive relationship between the changes in feddan productivity of onion and the cultivation area. In this specific case, it can be argued that the farmers did respond positively to the increase in the productivity by cultivating more area, where the land under cultivation in Ebshiwai district has increased till it became 83% of the total area of onion, moreover, the total area in the governorate has increased by 151% of the basic year 1966.

c. Nile Maize: Etsa district has the highest productivity by different two ways of comparison, this can be attributed to the availability of irrigation water in that district. The time trend of feddan productivity was increasing insignificantly with respect to the governorate as a whole. The total cultivation area has decreased during the period under study. Therefore, the study suggested to redistribute the area under cultivation in the favor of Etsa district and against Ebshiwai and El Fayom districts since their productivity has decreased over time.

d. Winter Tomato: Etsa district has the highest productivity of that crop, this may be attributed to increase the peasants advertency in that district to the influence of the climatic chanes on the productivity, since vegetables in general, are affecting - to a large extent - by the climatic changes. The evolution of the feddan productivity in El Fayom Governorate has increased over time (see figure 3.6). The cultivation area by that crop has increased, however, the area under cultivation in Etsa district was about 16% of the total, therefore, it is necessary to redistribute that area in the favor of Etsa district.

e. Summer Tomato: Ebshiwai district has the highest productivity of that crop, however, the time trend of feddan productivity for the governorate

as a whole was increasing insignificantly during the period under study. The total area under cultivation by summer tomato has decreased by 20% of the basic year 1966. The percentages of the governorate mean, indicated that Ebshiwai district - which is the first district in producing that crop - has got only 15% of the total area, therefore, it is necessary to redistribute the area under cultivation by that crop in the favor of Ebshiwai district.

f. Nile Tomato: The time trend equations of the different districts as well as the governorate as a whole were decreasing over time, however, Etsa district has the lowest percentage of annual decline. The area under cultivation in Etsa district is representing about one-third of the total, therefore the improvement of its productivity can be improved about 33% of the total production by that crop.

On the basis of these conclusions, it is clear that the productivity per feddan has decreaed for some crops, or increased insignificantly for the other, and finally has increased at a slow pace for the rest of crops under study, however, there is still considerable potential increase in this roductivity, therefore the study discussed and analyzed the production functions which determine these productivities in chapter four during the period 1966-1982.

The study investigated in chapter IV two production functions for the cros under study (wheat, onion, nile maize and winter tomato only because of the shortage in data with respect to summer tomato and nile tomato. The first is a relation between the productivity per feddan and its inputs representing by labour, seeds, fertilizer and other capitl, while the second is a relation between total output and its inputs which as the first case in addition to the cultivation area. The study used the Cobb-Douglas form for some reasons which exhaustively discussed in this chapter. The Ordinary Least Squares techniques were applied in each case to estimte the relationship between the dependent variables and the postulated independent variables, and tests of significance were based on multiple regression analysis.

The results indicated that, with respect to wheat crop, the elasticities of labour, fertilizer and capital in the two cases of our

production functions are reflecting decreasing returns to scale with positive sign, while seeds elasticity had a negative sign, however, it is hardly conceivable that the feddan productivity or total production of any crop decrease were more of any individual factor employed, therefore, this negative sign can be partly attributed to increase the quantity used from seeds rather than the optimal quantity per feddan, so that they became crowded and it leads to decline the percentage of their yield, it may also grow out of errors in reporting the original data and limited sample.

In case of Onion, the elasticities of labour, seeds and capital inputs - in both production functions - showed decreasing returns to scale, nevertheless, the fertilizer elasticity was negative. In my view, this negative sign is not because that the quantity used of this input has reached to the third stage of production (the irrational area) but because of the inefficient use of this input, where the farmers hear about the importance of fertilizer, but they do not use it by the correctional way due to the lack of their own knowledge.

With respect to Nile Maize crop, the results referred to a negative sign for other capital input which comprises all remainder inputs such as fuel, pesticides, animal rent, petty expenses, etc. This negative sign may be attributed to variations between years in respect to techniques employed, it may also attribute to limitation of reliability of the official data.

The winter tomato crop has a negative sign with respect to labour elasticity because of the existence of disguised unemployment in rural area. It means that it is possible to decrease the quantity used of labour without any reduction in either the feddan productivity or total output of winter tomato.

In this chapter also, we can summarize two conclusions which are common in all crops under study as follows:

(1) The elasticity of land is the highest coefficient with positive sign, in comparison with other inputs coefficients, it serves on an evidence to the importance of land input and its influence on the total output, however, all land elasticities was reflecting decreasing returns to scale except in case of winter tomato which indicated to increasing returns to scale.

(2) The ratio between the value of marginal productivity of land and its opportunity cost (representing by the geometric mean of its annual rent during the period under study) was always bigger than unity, this in turn means that the quantity of land used in the production process of the crops under study is smaller than the quantity which achieves the economic efficiency, since it is known that the profit maximization is achieved when the ratio of marginal productivity values and opportunity costs are equal to unity for all inputs.

If we put our two production functions in comparison together, we can deduce the following:

(1) The regressions coefficients for all inputs, indicate to the same sign and approximately the same magnitude in both cases.

(2) The sum of the aggregate elasticities in the first production function is indicating decreasing returns to scale while in the second case it indicates to increasing returns to scale - with respect to all crops except Wheat - because of the high elasticity of land which can be attributed to the limited of its exploitation.

(3) The multiple correlation coefficient and the coefficient of multiple determination in the second production function are always higher than those in the first production function because the relation between any agricultural product (output) and its inputs including land is stronger.

Finally, we can observe that the feddan productivity in El Fayom Governorate with respect to the crops under study can be improved by the efficient use of seeds, fertilizer, and capital in cases of wheat, onion, and nile maize respectively, in addition to decrease the quantity used of labour in case of winter tomatoe, nevertheless the total output of the abvementioned crops can be increaed sharply, if the lands under cultivation have been enlarged.

The study analyzed the profitability for crops under study, from different points of view, the results indicated to the following:

(1) In case of joint products such as wheat and straw, the price of the by product has increaed sharply and led to increae the profitability of that crop.

(2) Both wheat and onion are competitive crops on resource use in the same season, however, onion has higher productivity that wheat during the

period undr study, therefore the cultivation area by wheat has decrased, while the cultivation area by onion has increased. (See chapter III).

(3) The profitability of nile maize in the recent period (1979-1982) was negative, it led to decrease the cultivation area by that crop, therefore it is necessary to redistribute the resources combination of that crop and/or making finances more accessible for the smaller producers by shift in government policy.

(4) Winter tomato has the highest profitability with respect to all other crops under study, moreover the area under cultivation by that crop has increased sharply.

From the previous points, it is quite obvious that during the period under study farmers did respond positively to higher profitability and the other way around when profits are reduced.

Our general conclusion, is that this analysis, verifies to some extent all the hypothesis with which we started this research and set up in Chapter I, however, limitations are inherent in such an analysis. The discussions, however, may be intriguing for those who intend to do further research in this field.

APPENDICES

Table 1 The Estimation of Population Number and Growth Rate in A.R.E.

Years	Total Population (Thousand)	The Annual Growth Rate	The Index Number
1965	29389	-	100
1966	30203	2.77	102
1967	30892	2.28	105
1968	31596	2.28	108
1969	32316	2.28	110
1970	33053	2.28	112
1971	33807	2.28	115
1972	34578	2.28	118
1973	35366	2.28	120
1974	36172	2.28	123
1975	36997	2.28	126
1976	37841	2.28	129
1977	38794	2.52	132
1978	39819	2.64	135
1979	40983	2.92	139
1980	42289	3.18	144
1981	43465	2.76	148
1982	44673	2.78	152

Source: Central Agency for Public Mobilization and Statistics (CAPMAS), The Statistical Yearbook, 1952-1980, July 1981

Table 2 Estimation of Population, Human Force, and Labour Force in EL FAYOM governorate in 1980, 1981 and 1982 (In hundreds)

TYPE	HUMAN FORCE								OUTSIDE HUMAN FORCE				YEAR
	Labour Force					Outside Labour Force							
	employed 6 to less than 12 years	(12-64 years) employed	(12-64 years) unemployed	employed 65 years or more	Total	6-less than 12 years	12-less than 65 years	Total Human Force	Less than 6 years	Unemployed 65 or more	Disabled people	Total number of population	
Urban	40	776	52	68	936	392	1134	2462	501	80	77	3120	1980
Rural	378	2585	37	218	3218	1280	3060	7558	1763	188	171	9680	
Total	418	3361	89	286	4154	1672	4194	10020	2264	268	248	12800	
Urban	32	779	76	64	951	435	1160	2546	482	106	76	3210	1981
Rural	402	2506	68	303	3279	1271	3123	7673	1922	154	221	9970	
Total	434	3285	144	367	4230	1706	4283	10219	2404	260	297	13180	
Urban	38	824	61	43	966	406	1270	2642	486	110	52	3290	1982
Rural	343	2429	43	182	2997	1445	3257	7699	1942	378	211	10230	
Total	381	3253	104	225	3963	1851	4527	10341	2428	488	263	13520	

SOURCE: Year 1980: Central Agency for Public Mobilization and Statistics (CAPMAS), Agricultural Labour Force Estimates by Sampling in A.R.E., May Cycle results, reference no. 71-12525/81, December 1981.
Year 1981: Central Agency for Public Mobilization and Statistics (CAPMAS), Agricultural Labour Force Estimates by Sampling in A.R.E., May Cycle results, reference no. 71-12525/82 September, 1982.
Year 1982: Central Agency for Public Mobilization and Statistics (CAPMAS), unpublished data.

Table 3 The Estimation of Labour Force (12-64 years) according to their Educational Status in EL FAYOM governorate in 1980, 1981, and 1982 (in hundreds)

Educational Status	URBAN	%	RURAL	%	TOTAL	% for URBAN	% for RURAL	%	YEAR
- Illiteracy	399	48	2302	87.8	2701	15	85	78	1980
- Read and Write	148	18	217	8.3	365	40.5	59.5	11	
- Certificates lower than the intermediate	56	7	26	1.0	82	68.3	31.7	2.3	
- The intermediate certificates	152	18.4	48	1.8	200	76	24	5.8	
- Certificates higher than the interme-diate	27	3.2	12	0.5	39	69	31	1.1	
- University certificates	44	5.2	14	0.5	58	76	24	1.7	
- Not available	2	0.2	3	0.1	5	40	60	0.1	
TOTAL	828	100	2622	100	3450	24	76	100	

Educational Status	URBAN	%	RURAL	%	TOTAL	% for URBAN	% for RURAL	%	YEAR
- Illiteracy	327	38.2	2045	79.4	2372	14	86	69	1981
- Read and Write	176	20.5	303	12	479	37	63	14	
- Certificates lower than the intermediate	64	7.5	33	1.3	97	66	34	3	
- The intermediate certificates	182	21.3	149	5.8	331	55	45	9.6	
- Certificates higher than the interme-date	48	5.6	20	0.7	68	70.5	29.5	2.0	
- University certificates	58	6.8	24	0.9	82	71	29	2.4	
- Not available	0	0	0	0	0	0	0	0	
TOTAL	855	100	2574	100	3429	25	75	100	

Educational Status	URBAN	%	RURAL	%	TOTAL	% for URBAN	% for RURAL	%	YEAR
- Illiteracy	383	43.3	2096	84.8	2479	15	85	73.84	1982
- Read and Write	147	16.6	191	7.7	338	43.5	56.5	10.1	
- Certificates lower than the intermediate	39	4.4	24	0.97	63	62	38	1.88	
- The intermediate certificates	204	23.1	143	5.8	347	58.8	41.2	10.32	
- Certificates higher than the interme-diate	41	4.6	18	0.73	59	69.5	30.5	1.76	
- University certificates	71	8.0	0	0	71	100	0	2.1	
- Not available	0	0	0	0	0	0	0	0	
TOTAL	885	100	2472	100	3357	26.4	73.6	100	

Source: 1980, 1981: Ibid, CAPMAS. 1982: Ibid, CAPMAS (unpublished data).

Table 4 The Number of Holdings and Holding areas by Feddan according to sets of tenure in Egypt for the years 1950, 1961.

Sets of holdings size	1950				1961			
	number of holdings	%	the holding area feddan	%	number of holdings	%	the holding area feddan	%
Less than one Feddan	214334	21	111774	2	434219	26.4	211155	4
1- 2 Feddan	248336	25	335694	6	385901	23.5	505325	8
2- 3 Feddan	161658	16	373951	6	286804	17.5	647912	10
3- 4 Feddan	99132	10	328708	5	174595	11	566407	9
4- 5 Feddan	63330	6	272687	4	99722	6	423622	7
5- 10 Feddan	122356	12	818382	13	170019	10.4	1100669	18
10- 20 Feddan	52517	5	705331	12	56705	3	742619	12
20- 50 Feddan	26468	3	792082	13	23811	1.5	689367	11
50-100 Feddan	8372	1	57053	9	6424	0.4	429952	7
more than 100	6520	1	2826259	30	3960	0.3	905911	14
TOTAL	1003023	100	6143924	100	1642160	100	6222939	100
MEDIUM	2.24 Feddan				2.03 Feddan			

Source: Agricultural Census, Ministry of Agriculture, Part I, 1950, 1961.

le 5 The Number of Holdings and Holding Areas by Feddan according to Sets of Tenure in Egypt for the years 1965, 1975.

Set of holdings size	1965[1]				1975[2]			
	number of holdings	%	the holding area		number of holdings	%	the holding area	
			feddan	%			feddan	%
Less than one Feddan	571105	32	307684	6	1124286	39.4	739028	12
1- 3 Feddan	756746	42	1271070	24	1160147	41.4	2023456	34
3- 5 Feddan	238522	13.2	877581	17	354841	12	1185581	20
5-10 Feddan	145615	8	959587	18	148459	5	944411	16
10-50 Feddan	81642	4.5	1553345	29	65059	2.2	985508	16
More than 50	4548	0.3	318569	6	131	0.004	105684	2
TOTAL	1798178	100	5287836	100	2852923	100	5983668	100
MEDIUM	1.86 Feddan				1.52 Feddan			

Source: 1) Central Agency for Public Mobilization and Statistics, Land Tenure Bulletin, reference no. 1171A/74, July 1974.

2) Agricultural Economics Bulletin, Agricultural Economic Research Institute, Ministry of Agriculture, A.R.E., 1979.

Table 6 The Irrigation Water Deliveries to El Fayom Governorate per Month according to the Main Canals in 1978, 1979, 1980, 1981 and 1982

the months / name of the canal	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
Hassen Wassef Canal	33.7	60.6	70.4	68.5	68.6	73.8	88.8	93.3	81.2	71.4	68.5	61.4	1978
Wast El Lahon (Youssef Canal)	39.8	103.3	126.7	127.9	132.3	137.3	156.3	166.3	145.8	140.2	122.3	110.5	
The total of the governorate	73.5	163.9	197.1	196.4	200.9	211.1	245.1	259.6	227.0	211.6	190.8	171.9	
Hassen Wassef Canal	29.2	57.6	71.1	69.0	71.8	77.1	95.0	96.7	84.9	73.0	69.1	63.2	1979
Wast El Lahon (Youssef Canal)	38.1	99.18	134.0	134.2	141.4	146.0	148.6	167.6	145.9	133.2	128.9	74.0	
The total of the governorate	67.3	156.78	205.1	203.2	213.2	223.1	243.6	264.3	230.8	206.2	198.0	137.2	
Hassen Wassef Canal	31.4	59.0	68.1	65.9	68.3	74.2	93.6	90.4	74.2	65.4	67.0	64.7	1980
Wast El Lahon (Youssef Canal)	36.8	91.2	128.9	129.8	130.1	139.9	156.3	160.3	140.5	124.4	119.3	124.5	
The total of the governorate	68.2	150.2	197.0	195.7	203.4	214.1	249.9	250.7	214.7	189.8	187.3	189.2	
Hassen Wassef Canal	29.8	57.6	67.3	67.5	68.1	72.8	88.7	89.9	72.2	61.5	65.1	56.4	1981
Wast El Lahon (Youssef Canal)	35.7	108.6	130.6	131.1	137.1	141.2	158.9	161.0	97.1	124.2	118.9	107.9	
The total of the governorate	65.5	166.2	197.9	198.6	205.2	214.0	247.6	250.9	169.3	185.7	184.0	164.3	
Hassen Wassef Canal	29.1	50.7	67.5	66.2	68.7	73.4	92.3	99.4	74.8	66.1	65.9	63.0	1982
Wadt El Lahon (Youssef Canal)	35.1	92.9	128.6	126.9	133.2	139.5	157.3	153.5	137.8	127.8	124.6	110.4	
The total of the governorate	64.2	143.6	196.1	193.1	201.9	213.1	249.6	252.9	211.6	193.9	190.5	173.4	

Source: Main canals discharge estimates records, Fayom Irrigation Dept., Ministry of Irrigation, unpublished data.

Table 7 The Feddan Productivity of Wheat for all Districts and the Governorate during the Period 1966-1982 by Ardeb.

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	7.54	7.61	7.71	6.98	7.44	7.45
1967	6.73	7.81	7.81	6.51	7.69	7.30
1968	6.87	7.39	6.67	5.94	7.54	6.90
1969	6.35	6.43	6.66	5.79	6.51	6.34
1970	6.57	6.38	6.98	6.48	6.91	6.64
1971	7.85	7.41	8.49	7.58	8.45	7.90
1972	7.02	7.49	7.94	7.06	8.18	7.52
1973	8.38	8.38	8.96	7.87	9.43	7.51
1974	9.12	7.50	9.17	7.19	9.31	8.36
1975	9.16	8.00	9.06	7.63	9.28	8.58
1976	8.23	8.23	9.68	8.27	9.27	8.69
1977	8.68	8.63	8.96	7.83	9.43	8.68
1978	9.82	10.42	10.61	8.98	10.90	10.13
1979	8.42	9.27	9.45	8.03	9.49	8.93
1980	8.49	8.70	9.04	8.31	8.68	8.63
1981	7.79	8.30	8.94	9.30	9.56	8.75
1982	8.81	9.55	8.77	9.43	9.51	9.25
Mean	7.99	8.09	8.52	7.60	8.68	8.09

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 8 The Cultivation Areas of Wheat for all Districts and the Governorate during the Period 1966-1982 by Feddan.

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	19499	19622	13865	17060	15978	86024
1967	17620	20802	13705	17553	17151	86832
1968	19718	21576	14377	18630	17035	91336
1969	16780	19928	14223	17117	14959	83007
1970	16764	18302	14270	17252	15391	81979
1971	16361	20635	12912	16956	15943	82807
1972	15187	17587	12210	14576	14445	74005
1973	15305	17806	12321	14067	14400	73899
1974	15845	20849	12044	15879	15471	80088
1975	15305	19981	12061	14271	15270	76888
1976	13916	18609	11592	14307	15206	73630
1977	14546	16460	11326	13421	12140	67893
1978	13571	17681	10763	14557	13867	70439
1979	13849	17844	10913	13029	13112	68747
1980	11979	17090	10419	13825	13615	66928
1981	13751	18906	11187	14699	14243	72786
1982	12845	15745	10893	14972	13132	67587

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 9 The Evolution of Feddan Productivity for Wheat Straw and Maize Stalks in El Fayom Governorate during the period 1966-1982

Years	Wheat Straw Heml	Maize Stalks Heml
1966	6.75	9.0
1967	6.70	8.0
1968	6.70	8.0
1969	6.50	8.0
1970	6.75	8.0
1971	6.4	8.0
1972	6.3	7.0
1973	6.41	7.0
1974	6.4	7.4
1975	6.08	7.0
1976	6.25	7.0
1977	5.5	7.0
1978	7.0	7.0
1979	7.6	7.1
1980	8.0	9.0
1981	8.0	7.35
1982	9.1	7.35
Mean	6.85	7.6

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 10 The Feddan Productivity of Onion for all Districts and the Governorate during the Period 1966-1982 by Ton

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	6.390	6.165	6.615	6.345	6.615	6.435
1967	5.265	4.860	6.210	5.850	6.570	5.445
1968	5.445	5.040	5.940	5.625	6.660	5.427
1969	5.535	6.670	6.120	5.895	6.975	5.633
1970	5.355	5.625	6.165	6.300	7.020	5.514
1971	6.345	6.120	6.570	6.345	7.560	6.358
1972	6.390	6.210	6.660	6.300	7.605	6.395
1973	6.390	6.210	6.750	6.255	5.985	6.371
1974	6.609	6.377	6.333	6.310	7.095	6.581
1975	6.904	6.258	6.472	5.649	7.000	6.855
1976	6.683	6.362	6.300	5.486	4.000	6.654
1977	6.722	6.368	6.382	5.402	5.044	6.620
1978	7.250	7.100	6.500	5.600	6.000	7.190
1979	7.513	6.066	6.987	6.581	6.250	7.466
1980	8.000	6.130	7.740	5.990	6.500	7.853
1981	7.630	6.005	7.345	7.590	6.065	7.529
1982	7.340	6.780	7.730	6.280	5.050	7.352
Mean	6.570	6.080	6.640	6.110	6.350	6.570

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 11 The Cultivation Areas of Onion for all Districts and the Governorate during the Period 1966-1982 by Feddan

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	837	60	119	295	165	1476
1967	653	123	41	219	66	1102
1968	812	363	37	311	37	1560
1969	2438	854	57	436	50	3835
1970	1099	211	21	113	32	1476
1971	1902	479	48	284	109	2822
1972	1099	137	14	181	36	1467
1973	1164	48	6	66	7	1291
1974	1401	69	15	96	9	1590
1975	1420	31	18	36	1	1506
1976	1597	47	15	22	6	1687
1977	2484	114	17	41	102	2758
1978	4039	115	37	112	12	4315
1979	3797	68	36	67	7	3975
1980	5226	216	177	182	28	5829
1981	4098	147	161	102	24	4532
1982	3367	62	234	47	13	3713

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 12 The Feddan Productivity of Nile Maize for all Districts and the Governorate during the Period 1966-1982 by Ardeb

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	7.14	5.51	7.96	5.42	7.85	6.83
1967	6.66	6.54	6.82	5.82	7.02	6.73
1968	7.02	7.04	10.20	6.99	7.31	7.46
1969	7.54	7.17	8.29	5.97	8.75	7.55
1970	7.59	7.00	8.75	5.88	8.64	7.46
1971	6.84	6.46	6.94	5.03	7.00	6.47
1972	5.93	5.91	5.31	6.90	5.65	5.95
1973	5.97	6.06	6.44	4.80	6.38	5.98
1974	7.18	7.21	7.74	5.83	7.54	7.13
1975	7.36	7.26	8.07	5.85	7.57	7.22
1976	7.75	7.63	7.42	5.83	7.70	7.38
1977	6.92	7.22	7.52	5.58	7.41	7.01
1978	7.03	8.82	7.76	5.78	7.43	7.52
1979	6.07	7.77	7.59	6.00	7.25	7.07
1980	6.38	7.91	8.43	6.05	7.29	7.27
1981	6.47	7.70	8.50	6.16	7.30	7.26
1982	7.00	7.46	8.90	6.47	7.30	7.40
Mean	6.87	7.06	7.80	5.90	7.38	7.04

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 13 The Cultivation Area of Nile Maize for all Districts and the Governorate during the Period 1966-1982 by Feddan

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	21151	36453	12506	16246	26009	112365
1967	19196	31638	11898	14050	22775	99557
1968	20704	29740	11331	13945	19285	95005
1969	20188	30311	11483	13233	19678	94893
1970	15079	30234	10997	14264	17509	88083
1971	20304	30706	9685	15183	18823	94701
1972	18348	27967	9762	14302	19546	89925
1973	22695	29017	11405	12555	18785	94457
1974	23030	26777	7856	11920	18363	87946
1975	17528	25874	7968	11003	14025	76398
1976	16118	29263	9664	11479	13426	79949
1977	14663	28708	10719	11029	13814	78933
1978	15841	25159	7811	14825	15865	79501
1979	16504	29878	7400	10365	15095	79242
1980	14881	27229	7404	10711	16473	76698
1981	12872	23370	8853	10284	12708	68087
1982	15679	26825	10756	10769	14644	78673

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 14 The Feddan Productivity of Winter Tomato for all Districts and the Governorate during the Period 1966-1982 by Ton

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	10.0	6.0	7.5	7.0	8.5	8.66
1967	4.0	3.0	3.0	3.25	3.0	3.16
1968	5.0	4.0	4.0	3.50	4.5	4.42
1969	5.0	4.0	3.93	3.0	4.0	4.50
1970	7.0	5.5	6.0	5.5	7.0	6.60
1971	7.0	5.5	6.5	5.5	7.0	6.67
1972	7.0	6.0	6.5	6.0	6.0	6.67
1973	6.0	5.5	6.0	5.5	6.0	5.90
1974	5.5	5.5	6.0	5.5	6.0	5.69
1975	5.5	5.5	6.0	5.5	6.0	5.66
1976	6.0	5.5	6.0	5.5	6.0	5.88
1977	6.0	5.5	6.0	5.5	6.0	5.92
1978	6.0	5.5	6.0	5.5	6.0	5.82
1979	6.05	5.5	7.0	7.5	6.0	6.33
1980	8.5	8.53	7.8	7.5	8.05	8.145
1981	8.5	8.64	7.5	8.0	8.5	8.23
1982	10.0	9.50	10.0	9.5	9.5	9.75
Mean	6.65	5.83	6.19	5.84	6.36	6.35

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 15 The Cultivation Area of Winter Tomato for all Districts and the Governorate during the Period 1966-1982 by Feddan

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	2320	284	802	749	1092	5247
1967	422	872	902	769	835	3800
1968	2876	1140	863	945	826	6650
1969	4494	710	1084	642	630	7560
1970	4062	484	1057	700	793	7096
1971	4139	633	1009	588	788	7157
1972	3971	687	1086	611	419	6774
1973	4599	866	1384	935	867	8651
1974	4679	1374	1521	988	1481	10043
1975	4790	880	1910	968	1268	9816
1976	5031	1258	1513	1001	976	9779
1977	5371	507	1486	983	676	9023
1978	7139	2840	1572	2307	551	14409
1979	7459	4210	2771	3835	2068	20343
1980	8368	4912	3136	5438	2787	24641
1981	8711	5417	3401	5065	2729	25323
1982	9061	6481	3376	4572	1610	25100

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 16 The Feddan Productivity of Summer Tomato for all Districts and the Governorate during the Period 1966-1982 by Ton

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	7.75	6.75	7.0	7.0	7.25	7.18
1967	7.50	7.50	7.50	7.25	7.5	7.40
1968	7.50	7.0	7.50	7.25	7.5	7.40
1969	7.50	6.0	7.0	7.0	7.07	6.91
1970	8.0	6.25	7.75	7.0	7.75	7.56
1971	8.0	6.0	7.75	7.0	8.0	7.61
1972	6.0	6.0	6.0	6.0	6.0	6.00
1973	6.0	7.0	6.0	7.0	6.0	6.20
1974	8.0	7.0	8.0	7.0	8.0	7.75
1975	7.2	6.3	7.3	6.53	7.45	7.00
1976	8.0	7.0	8.15	7.0	8.3	7.47
1977	7.25	7.0	8.0	7.0	8.5	7.30
1978	7.3	7.0	8.0	7.0	8.5	7.70
1979	7.24	7.0	8.0	7.0	8.0	7.44
1980	8.0	6.7	8.0	7.0	6.0	7.074
1981	9.0	7.5	8.0	7.5	7.5	7.92
1982	9.5	7.6	8.0	7.5	7.5	7.95
Mean	7.63	6.80	7.53	7.00	7.46	7.28

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 17 The Cultivation Area of Summer Tomato for all Districts and the Governorate during the Period 1966-1982 by Feddan

Years	Ebshiwai	Etsa	Sinaris	Tamia	El Fayom	Total Governorate
1966	64	76	235	72	734	1181
1967	61	243	199	71	764	1338
1968	143	243	649	394	782	2211
1969	187	225	414	44	347	1217
1970	217	178	418	49	428	1290
1971	172	193	407	53	567	1392
1972	113	313	343	56	661	1486
1973	283	223	181	74	746	1507
1974	332	261	154	92	584	1423
1975	253	737	445	164	906	2505
1976	241	945	306	86	186	1764
1977	306	936	284	95	105	1726
1978	311	434	106	79	567	1497
1979	312	421	80	48	403	1264
1980	382	520	198	197	306	1603
1981	242	281	94	56	310	983
1982	173	274	104	13	378	942

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 18 The Feddan Productivity of Nile Tomato for all Districts and the Governorate during the Period 1966-1982 by Ton

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	10.75	10.30	10.40	10.75	10.5	10.65
1967	10.75	10.75	10.50	10.75	10.75	10.72
1968	10.50	8.50	10.50	8.50	9.25	9.55
1969	8.00	7.50	7.5	7.5	8.0	7.76
1970	8.25	6.5	8.0	7.5	8.25	7.71
1971	8.25	6.5	8.25	7.5	8.5	7.66
1972	8.25	6.5	8.25	7.5	8.5	7.67
1973	8.50	6.75	8.5	7.75	8.75	7.86
1974	8.50	6.75	8.5	7.75	8.75	7.70
1975	8.50	7.76	8.5	7.72	8.60	8.12
1976	8.70	7.7	8.6	7.80	8.8	8.12
1977	9.91	7.7	7.64	7.91	8.06	8.04
1978	9.90	7.72	7.65	7.50	8.0	8.01
1979	8.29	7.55	8.0	7.0	6.5	7.4
1980	8.00	9.5	9.0	7.5	7.0	8.323
1981	7.75	10.0	9.0	7.5	7.0	8.47
1982	8.50	10.0	10.0	9.0	9.0	9.42
Mean	8.9	8.13	8.75	8.08	8.48	8.42

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 19 The Cultivation Area of Nile Tomato for all Districts and the Governorate during the Period 1966-1982 by by Feddan

Years	Ebshiwai	Etsa	Sinoris	Tamia	El Fayom	Total Governorate
1966	2654	114	359	797	1450	5374
1967	1623	1672	634	557	1366	5852
1968	1393	620	639	856	1296	4804
1969	1437	931	634	931	1301	5234
1970	2024	1531	899	1005	1374	6833
1971	2231	2721	1099	994	1650	8695
1972	4264	3867	1154	1020	1843	12148
1973	2645	3981	1598	1301	2107	11632
1974	2484	7244	2600	2378	2527	17233
1975	2883	7441	2696	2597	3290	18907
1976	1026	5983	3145	3213	2225	15592
1977	1760	5983	2325	3163	2200	15431
1978	2272	7238	2160	2689	4362	18721
1979	2172	7472	3225	2995	4251	20115
1980	3489	7203	3289	3222	5239	22442
1981	2965	7115	3091	3069	5038	21278
1982	2755	7093	3149	3431	4616	21044

Source: Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 20 Index Number of Cost of Living in Rural Areas in Egypt and Average of the Daily Wage per Worker (current and adjusted) during the Period 1966-1982.

(1966/1967=100)

Years	Index numbers of cost of living in rural area	Average of the daily wage per worker	
		current pound	adjusted pound
1966	91.8	0.250	0.272
1967	100	0.250	0.250
1968	101.8	0.240	0.236
1969	105.6	0.250	0.237
1970	113.5	0.260	0.229
1971	117.9	0.240	0.204
1972	117.6	0.265	0.225
1973	131.2	0.285	0.217
1974	149.6	0.350	0.234
1975	167.9	0.465	0.277
1976	187.8	0.615	0.327
1977	206.7	0.760	0.367
1978	234.2	0.890	0.380
1979	248.7	1.06	0.426
1980	311.0	1.37	0.440
1981	353.4	1.81	0.512
1982	402.8	2.35	0.583

Source: Index Numbers:
- Central Agency for Public Mobilization and Statistics (CAPMAS), The Statistical Yearbook, various issues.

Labour Wages:
- Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 21 Index Numbers of Wholesale Prices in Egypt during the Period 1966-1982

(1965/1966=100)

Years	Index Numbers
1966	100
1967	107.8
1968	110.2
1969	112.0
1970	114.6
1971	119.1
1972	120.5
1973	128.8
1974	147.2
1975	158.3
1976	170.7
1977	186.6
1978	214.1
1979	234.6
1980	285.2
1981	308.9
1982	337.7

Source: Central Agency for Public Mobilization and Statistics (CAPMAS), The Statistical Yearbook, various issues.

Table 22 The Production Function of the Feddan Productivity for Wheat Crop in El Fayom Governorate during the Period 1966-1982 by Adjusted Prices

Years	Output per Feddan Ardeb	Labour man/day	Fertilizer E. pound	Seeds E. Pound	Other Capital E. pound
1966	7.45	21.560	8.800	2.400	4.600
1967	7.30	22.920	8.163	2.783	4.861
1968	6.90	22.271	7.985	2.722	4.764
1969	6.34	21.360	7.768	2.678	4.571
1970	6.64	21.846	7.548	2.617	4.773
1971	7.90	23.645	7.263	2.519	4.676
1972	7.52	20.566	7.925	2.987	3.983
1973	7.51	17.421	8.656	2.795	3.738
1974	8.36	17.428	7.574	2.446	3.281
1975	8.58	24.387	8.307	2.843	4.737
1976	8.69	23.431	7.762	2.812	6.005
1977	8.68	28.684	7.636	2.572	5.627
1978	10.13	29.887	6.725	2.242	5.198
1979	8.93	22.452	5.584	2.131	8.738
1980	8.63	19.708	5.189	1.753	9.116
1981	8.75	15.193	6.555	2.913	10.845
1982	9.25	18.404	10.986	2.665	12.289

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 23 The Production Function of Total Output from Wheat in El Fayom Governorate (1966-1982) by Adjusted Prices

Years	Total Output Thousand Ardeb	Labour Thousand man/day	Fertilizer Thousand E.pound	Seeds costs thousand E.pound	Other capital thousand E.pound	Cultivated area Thousand Feddan
1966	641.199	1854.677	757.011	206.458	395.710	86.024
1967	634.236	1990.190	708.833	241.647	422.078	86.832
1968	629.833	2034.129	729.362	248.646	435.131	91.336
1969	525.933	1773.030	644.787	222.340	379.460	83.007
1970	544.691	1790.926	618.777	214.605	391.296	81.979
1971	654.229	1958.040	601.411	208.582	387.267	82.807
1972	556.368	1521.990	586.513	221.094	294.792	74.005
1973	634.355	1287.398	639.731	206.550	276.261	73.899
1974	669.418	1395.819	606.645	195.867	262.789	80.088
1975	659.886	1875.075	638.710	218.570	364.283	76.888
1976	639.991	1725.217	571.528	207.044	442.126	73.630
1977	589.479	1947.457	518.475	174.644	382.035	67.893
1978	713.478	2105.255	473.761	157.920	366.178	70.439
1979	614.065	1543.565	383.881	146.520	600.730	68.747
1980	577.596	1319.019	347.312	117.335	610.143	66.928
1981	636.891	1257.798	542.705	241.202	897.809	72.786
1982	625.246	1243.888	742.516	180.125	830.578	67.587

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 24 The Production Function of the Feddan Productivity for Onion Crop in El Fayom Governorate during the 1966-1982 by Adjusted Prices

Years	Output per Feddan Ton	Labour man/day	Fertilizer E.pound	Seeds E.pound	Other Capital E.pound
1966	6.435	38.260	7.200	11.00	4.770
1967	5.445	30.039	5.472	13.914	2.876
1968	5.427	36.250	8.393	9.075	3.176
1969	5.633	34.32	8.259	9.152	3.839
1970	5.514	37.654	9.791	10.471	8.115
1971	6.358	16.541	13.694	10.075	8.942
1972	6.395	41.773	13.535	9.958	8.008
1973	6.371	38.667	12.663	9.317	7.655
1974	6.581	33.714	11.079	8.152	7.812
1975	6.855	47.892	8.023	13.266	11.326
1976	6.654	45.707	10.252	14.645	12.302
1977	6.620	44.408	7.502	13.397	13.612
1978	7.190	39.708	6.539	11.676	12.667
1979	7.466	51.509	9.451	25.575	14.663
1980	7.853	59.124	8.239	26.297	10.694
1981	7.529	47.983	8.902	24.279	16.834
1982	7.352	42.638	10.512	26.651	15.398

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 25 The Production Function of Total Output from Onion in El Fayom Governorate during the Period 1966-1982 by Adjusted Prices

Years	Total Output Thousand Ton	Labour Thousand Man/day	Fertilizer Thousand E.pound	Seeds Cost Thousand E.pound	Other Capital Thousand E.pound	Cultivated Area Thousand Feddan
1966	9.470	56.472	10.627	16.236	7.041	1.476
1967	6.006	33.104	6.031	15.334	3.169	1.102
1968	8.466	56.550	13.094	14.157	4.955	1.560
1969	21.604	131.617	31.673	35.097	14.724	3.835
1970	8.138	55.577	14.451	15.455	11.978	1.476
1971	17.941	131.341	38.646	28.433	25.235	2.822
1972	9.381	61.282	19.856	14.609	11.748	1.467
1973	8.225	49.919	16.348	12.028	9.883	1.291
1974	10.464	53.606	17.617	12.962	12.422	1.590
1975	10.324	72.126	12.082	19.979	17.058	1.506
1976	11.225	77.108	17.295	24.707	20.754	1.687
1977	18.266	122.477	20.692	36.951	37.542	2.758
1978	31.040	171.339	28.216	50.385	54.658	4.315
1979	29.676	204.750	37.564	101.662	58.286	3.975
1980	45.774	344.634	48.030	153.287	62.337	5.829
1981	34.121	217.461	40.346	110.036	76.291	4.532
1982	27.299	158.316	39.032	98.955	57.174	3.713

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 26 The Production Function of the Feddan Productivity for Nile Maize Crop in El Fayom Governorate during the Period 1966-1982 by Adjusted Prices

Years	Output per feddan Ardeb	Labour man/day	Fertilizer E. pound	Seeds E.pound	Other capital E.pound
1966	6.83	24.360	8.970	1.20	2.340
1967	6.73	23.680	8.813	1.113	2.087
1968	7.46	25.396	8.621	1.089	2.223
1969	7.55	25.360	6.785	0.714	2.232
1970	7.46	24.212	6.632	0.698	2.181
1971	6.47	41.792	9.668	0.756	3.257
1972	5.95	23.132	8.714	0.747	1.950
1973	5.98	20.982	8.152	0.776	2.057
1974	7.13	29.914	7.133	0.679	1.698
1975	7.22	31.441	9.665	0.884	1.421
1976	7.38	32.731	9.666	0.820	2.899
1977	7.01	30.00	10.396	0.750	1.607
1978	7.52	26.910	5.955	0.934	7.379
1979	7.07	39.594	7.383	0.890	8.077
1980	7.27	31.752	7.363	1.403	4.558
1981	7.26	72.348	9.744	1.618	8.714
1982	7.4	35.958	14.332	1.776	7.699

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 27 The Production Function of Total Ouput for Nile Maize in El Fayom Governorate (1966-1982) by Adjusted Prices

Years	Total output thousand Ardeb	Labour thousand man/day	Fertilizer thousand E.pound	Seeds costs thou-sand E.pound	Other capital thousand E.pound	Cultivated area thousand feddan
1966	767.720	2737.211	1007.914	134.838	262.934	112.365
1967	669.602	2357.510	877.358	110.824	207.795	99.557
1968	708.737	2412.731	819.009	103.454	211.218	95.005
1969	715.982	2406.486	643.917	67.781	211.815	94.893
1970	657.472	2132.625	584.146	61.489	192.153	88.083
1971	612.606	3957.713	858.750	71.562	308.514	94.701
1972	535.129	2080.152	783.579	67.164	175.372	89.925
1973	564.901	1981.940	770.030	73.336	194.341	94.457
1974	627.081	2630.842	627.332	59.746	149.365	87.946
1975	551.616	2402.019	738.401	67.566	108.588	76.398
1976	590.196	2616.867	772.793	65.570	231.838	79.949
1977	553.183	2367.990	820.632	59.221	126.902	78.933
1978	597.505	2139.381	473.441	74.265	586.696	79.501
1979	560.126	3137.535	585.026	70.595	640.084	79.242
1980	557.628	2435.301	564.747	107.571	349.605	76.698
1981	494.599	1862.048	663.457	110.201	593.364	68.087
1982	582.172	2828.880	1127.560	139.780	605.715	78.673

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 28 The Production Function of the Feddan Productivity for Winter Tomato Crop in El Fayom Governorate during the Period 1966-1982 by Adjusted Prices

Years	Output per feddan ton	Labour man/day	Fertilizer E.pound	Seeds E.pound	Other capital E.pound
1966	8.66	69.600	11.500	1.800	5.390
1967	3.16	73.800	11.466	2.226	5.167
1968	4.42	77.750	11.297	2.178	4.691
1969	4.50	81.440	12.045	2.142	4.821
1970	6.60	79.385	11.893	2.251	5.253
1971	6.67	85.000	10.915	3.358	6.087
1972	6.67	80.943	12.216	2.987	5.842
1973	5.90	74.070	10.714	2.484	6.211
1974	5.65	73.600	10.108	1.426	4.552
1975	5.66	66.666	9.399	1.326	11.055
1976	5.88	60.813	10.017	3.515	8.934
1977	5.92	68.026	12.915	3.215	9.121
1978	5.82	74.157	12.377	3.363	9.808
1979	6.33	75.235	11.227	3.197	9.249
1980	8.145	55.606	8.906	5.259	10.403
1981	8.23	53.259	11.978	4.855	9.987
1982	9.75	69.978	13.621	7.995	5.922

Source: Computed from data of Archives of Agriculture Economics Research Institute, Ministry of Agriculture, A.R.E.

Table 29 The Production Function of Total Output for Winter Tomato in El Fayom Governorate (1966-1982) by Adjusted Prices

Years	Total output thousand ton	Labour thousand man/day	Fertilizer thousand E.pound	Seeds costs thou-sand E.pound	Other capital thousand E.pound	Cultivated area thousand feddan
1966	45.444	365.191	60.341	9.445	28.281	5.247
1967	12.014	280.440	43.569	8.460	19.634	3.800
1968	29.417	517.038	75.129	14.482	31.198	6.650
1969	34.016	615.687	91.057	16.200	36.450	7.560
1970	46.839	563.313	84.397	15.975	37.276	7.096
1971	47.764	608.345	78.120	24.037	43.567	7.157
1972	45.158	548.311	82.749	20.238	39.576	6.774
1973	51.006	640.781	92.689	21.493	53.733	8.651
1974	56.738	739.165	101.521	14.328	45.712	10.043
1975	55.577	654.400	92.269	13.022	108.515	9.816
1976	57.545	594.690	97.962	34.373	87.364	9.779
1977	53.394	613.801	116.535	29.013	82.299	9.023
1978	83.881	1068.530	178.346	48.456	141.331	14.409
1979	128.850	1530.520	228.404	65.035	188.169	20.343
1980	200.708	1370.180	219.454	129.598	256.346	24.641
1981	208.371	1348.690	303.319	122.967	252.902	25.323
1982	244.669	1756.470	341.901	200.681	148.653	25.100

Source: Computed from data of Archives of Agricultural Economics Research Institute, Ministry of Agriculture, A.R.E.

Selected Bibliography

Ali, M.A. Economic of Wheat Production in Egypt, Master Thesis, Department of Agriculture Economics, Faculty of Agriculture, Aim Shams University, 1979.

Bruce, F. and Philip, E. Farm Size and Economic Efficiency: The Case of California, American Journal of Agricultural Economics, Vol. 60, November 1978, II.

Central Agency for Public Mobilization and Statistics, ©CAPMAS°, Agricultural Labour Force Estimates by Sampling in A.R.E., May Cycle, Reference No. 71-12525/81, December 1981.

-- Annual Bulletin of Agricultural Activity.

-- Annual Bulletin of Cooperation Activities in Agricultural Sector, various issues.

-- Land Tenure Bulletin, Fayom Governorate, 1965, Reference No. 1250A/74, December 1973.

-- National Income From Agricultural Estimates Bulletin, 1980, Reference No. 71-52421/82, May 1982.

-- The Number of Cattle and Animals Estimates Bulletin, for El Fayom Governorate, various issues.

-- The Statistical Yearbook, 1952-1980, July 1981.

-- Unpublished Data.

El Eodemy, M.S., Farm Works Management, Faculty of Agriculture, Ain Shams University, 1977.

El Kake, A.A., The Ability of Productivity, Economic, Consumption and Marketing for Egyptian Millet, Master Thesis, Dept. of Agric. Economics, Faculty of Agriculture, Alexandria University, 1973.

Emarah, R. El-Sayed, An Analytic Study for Agricultural Productivity in El Garbia Governorate, Master Thesis, Cairo University, 1977.

Hansen, B. Marginal Productivity Wage Theory and Subsistence Wage Theory in Egyptian Agriculture, The Journal of Development Studies, Vol. 2, 1965.

-- Output-Productivity and Value Added-Productivity, Institute of National Planning, Cairo, memo No. 163, May 1962.

Hayami, Y. & Ruttan, V. Agricultural Development. An International Perspective, John Hopkins, 1971.

Heady, E.O. and J.L. Dillon, Agricultural Production Functions, Iowa State University, Ames Iowa, 1961.

Heady, E.O., Economics of Agricultural Production Functions and Resource Use, Prentice Hall, Inc. U.S.A. Third Printing, 1960.

-- Production Functions from a Random Samples of Farms, Journal of Farm Economics, Vol. 28: 989-1004, 1946.

Hodhad, H. The Economic Efficiency of Agricultural Land and its Relation with Land Rent Determined According to Agrarian Reform Law in Egypt, PH.D. Thesis, Agricultural Economic Department, Faculty of Agri, Mansoura, University, 1981.

Karkor, El.W. An Analysis Study of the Optimal Crop Composition in El Fayom Governorate, Master Thesis, Agricultural Economic Department, Faculty of Agriculture, Ain Shans University, 1978.

Khalifa, A.F. Abdel Hakim, An Analytical Study for the Agricultural Productivity in U.A.R. and its Relation by Agricultural Economic Development, PH.D. Thesis, Agricultural Economic Department, Faculty of Agri., Cairo University 1969.

-- Factors which Affect in the Crop Composition in El Minia Governorate, Master Thesis, Agriculture Economic Department, Faculty of Agri. Cairo University 1966.

Koutsayianis, A., Theory of Econometrics: An Introductory Exposition of Econometric Methods, The Macmillan Press Ltd., London, Second edition, 1983.

Ministry of Agriculture, Agricultural Census, Part I, 1950, 1961.

-- Agricultural Economics Bulletin, Agricultural Economics Research Institute, A.R.E. "Various Issues".

-- Archives of Agricultural Economics Research Institute, A.R.E.

-- Soils Classification Survey and Land Classification in El Fayom Districts.

Ministry of Finance and Economics, Statistics Department, Cairo, 1952.

Ministry of Irrigation, Main Canals Discharge Estimates Records, Fayom Irrigation Department, Unpublished Data.

Ministry of Planning, Unpublished Data.

Mostafa, A.M. Marketing of Tomatoes in Cairo Town, Master Thesis, Dept., of Agric. Economics, Faculty of Agriculture, Cairo University, 1973.

Nassar, S.Z. An Analytical Study for the Profitability of the Main Field Crops in Egypt as an Average to the Period 1970-1972, Researchs Magazine and Agricultural Development, Faculty of Agriculture, El Minia University, 1974.

-- , and others, The Agricultural Production Function in Egypt 1960-1976, The Fifth International Conference of Statistics, Aim Shans University, 29 March to 13 April 1980.

Organization for Economic Cooperation ©OECO°, Study of Trends in World Supply and Demand of Major Agriculture Commodities, Report by the Secretary General, 1976.

Resk, M. and Afer, M. The Production Functions for the Most Important Crops in A.R.E., The Institute of National Planning, memo no, 1017, Cairo, 1972.

Saleh, A.A. An Analytic Economic Study for Wheat Crop in El Dakhlia Governorate, Master Thesis, Dept. of Agric. Economics, Faculty of Agriculture, El Mansoura University, 1982.

Stewart, F., Technology and Development, Macmillan, 1977.

Tentnar, G.A., Note on the Drivation of Production Function from Record Data, Econometrica 16: 295-304, 1944.

Wonnacott, T.H., Introductory Statistics for Business and Economics, John Wiley, Third Edition, New York, 1984.

Yuzure, K. Factors Contributing to the Recent Increase of Productivity in Japanese Agriculture, Journal of Development Studies, Vol. 2, October 1965.