Fertilizer use by crop in Egypt

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Land and Plant Nutrition Management Service
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Abstract

The population of Egypt is estimated at 70 million people, inhabiting less than five percent of the national territory. Approximately 17 percent of the Egyptian population lives in Upper Egypt. The rest is distributed between Lower and Middle Egypt. The Egyptian rural population represents about 51 percent of the total population.

The total area of agricultural land in Egypt amounts to around 3.5 million ha, accounting for almost 3.3 percent of the total area. At present only 5.4 percent of the land resources in Egypt is qualified as excellent, while about 40 percent is of either poor or of low quality, due mainly to salinity, water logging and sodicity problems.

The total area cropped annually increased from 4.7 million ha in 1982 to 6.5 million ha in 2003 due to increased cropping intensity, which reached about 180 percent. This was made possible by the introduction of earlier maturing varieties of various crops, which permit up to three harvests per year.

The study describes the background to fertilizer use on crops in Egypt, including the fertility status of Egyptian soils and the production, imports, exports and consumption of fertilizers. Egypt currently consumes 1.25 million tonnes of fertilizer nutrients with an $N:P_2O_5:K_2O$ ratio of 1:0.12:0.05.

Information is provided on the agro-ecological zones and farming systems, particularly as regards to agricultural suitability. The agricultural production systems are described, as are the fertilizer requirements and crop needs. Rates of fertilizer use recommended on the main crops in Egypt are given. The role of organic manure as a source of nutrients and as a soil amendment is covered.

In addition, the report summarizes results of the studies which had been carried out in Egypt to determine the most suitable time and proper method of fertilizer application on various crops. It describes the situation concerning fertilizer storage and distribution, pricing and trade.

The study ends with the following proposals for improving soil fertility management:

1. A more extensive use of soil and plant tissue analysis.
2. Assessment of the fertilizing value of fertilizers that have been marketed without proper testing.
3. Study of the direct and residual effects of biofertilizers and organic manures.
4. Preparation of fertilizer recommendations for new crop varieties.
5. Development of new types of complex fertilizers suitable for drip and sprinkler irrigation systems.
6. Study of the role of fertilizers in improving the nutritive value and cooking quality of food crops.
7. Assessment of the residual as well as the direct effect of different sources of phosphorus.
8. Preparation of nitrogen balance sheets for the main field crops.

Preface

This study, commissioned by the Food and Agriculture Organization of the United Nations (FAO), is one of a series of publications on fertilizer use on crops in different countries.

The aim of the series is to examine the agro-ecological conditions, the structure of farming, cropping patterns, the availability and use of mineral and organic plant nutrients, the economics of fertilizers, research and advisory requirements and other factors that have led to present fertilizer usage. The reports examine, country by country, the factors that will or should determine the future development of plant nutrition.

During the past two decades, increasing attention has been paid to the adverse environmental impact of both the under use and the over use of plant nutrients. The efficient use of plant nutrients, whether from mineral fertilizers or from other sources, involves the shared responsibility of many segments of society, including international organizations, governments, the fertilizer industry, agricultural research and advisory bodies, traders and farmers. The publications in the series are addressed to all these parties.

Fertilizer use is not an end in itself. Rather it is a means of achieving increased food and fibre production. Increased agricultural production and food availability can, in turn, be seen as an objective for the agricultural sector in the context of contributing to the broader macroeconomic objectives of society. A review of the options available to policy-makers is given in the FAO/International Fertilizer Industry Association (IFA) 1999 publication entitled "*Fertilizer Strategies*".

The contents of the series studies differ considerably from country to country, in view of their different structures, histories and food situation. But in each case, the aim is to arrive at a better understanding of the nutrition of crops in the country concerned.

Abbreviations and symbols

amm.	ammonium
ARC	Agriculture Research Center
BCM	billion cubic metres
CAPMAS	Central Agency for Public Mobilization and Statistics
d.a.t.	days after transplanting
DTPA	di-ethylene triamine-penta-acetate
EC	exchangeable cations
FAO	Food and Agriculture Organization of the United Nations
Feddan	0.42 ha
FFS	Farmers' Field Schools
FYM	farm yard manure
GDP	gross domestic product
ha	hectare
IPM	Integrated Pest Management
ISNM	Integrated Soil and Nutrition Management
kentar	44.9 kg
LE	Egyptian pound
MALR	Ministry of Agriculture and Land Reclamation
PBDAC	Principal Bank for Development and Agricultural Credit
p.i.	panicle initiation
ppm	parts per million
RRTC	Rice Research & Training Center

N:	Nitrogen
P_2O_5 or P:	Phosphate*
K_2O or K:	Potash*

* Phosphate and potash may be expressed as their elemental forms P and K or as their oxide forms P_2O_5 and K_2O. Nitrogen is expressed as N. In this study phosphate and potash are expressed in their oxide forms.

Chapter 1
Introduction

The Egyptian economy has traditionally relied heavily on the agricultural sector for food, fibre and other products. The agricultural sector provides the livelihood for about 55 percent of the inhabitants and accounts for almost 34 percent of the total employment and labour force. Agriculture contributes nearly 20 percent of the gross domestic product (GDP) and about 20 percent of the total exports and foreign exchange earnings.

The population of Egypt is estimated at 70 million people occupying only about five percent of the national territory. The population density varies among the governorates. Approximately 17 percent of the Egyptian population lives in Upper Egypt. The rest is distributed between Lower and Middle Egypt. Egypt is an arid to semi-arid region and can be divided into five main physiographic units, the Western Desert, Nile Valley, Nile Delta, Eastern Desert and the Sinai Peninsula.

LAND AND SOIL RESOURCES

Egypt has an area of about one million square kilometres or 238 million feddans (one feddan = 0.42 ha). The total agricultural land in Egypt amounts to nearly 8.4 million feddans (3.5 million ha) and accounts for around 3.5 percent of the total area.

One million ha in the irrigated areas suffer from salinization problems, water logging and sodicity. The majority of salt-affected soils are located in the northern-central part of the Nile Delta and on its eastern and western sides. Increased attention is being given to the improvement of salt-affected soils, since they are potentially productive and require less investment, effort, and time for restoring their productivity, than the reclamation of new land.

Based on the World Reference Base for Soil Resources, the main Egyptian soil groups are: Arenosols (AR), Calcisols (CL) associated with

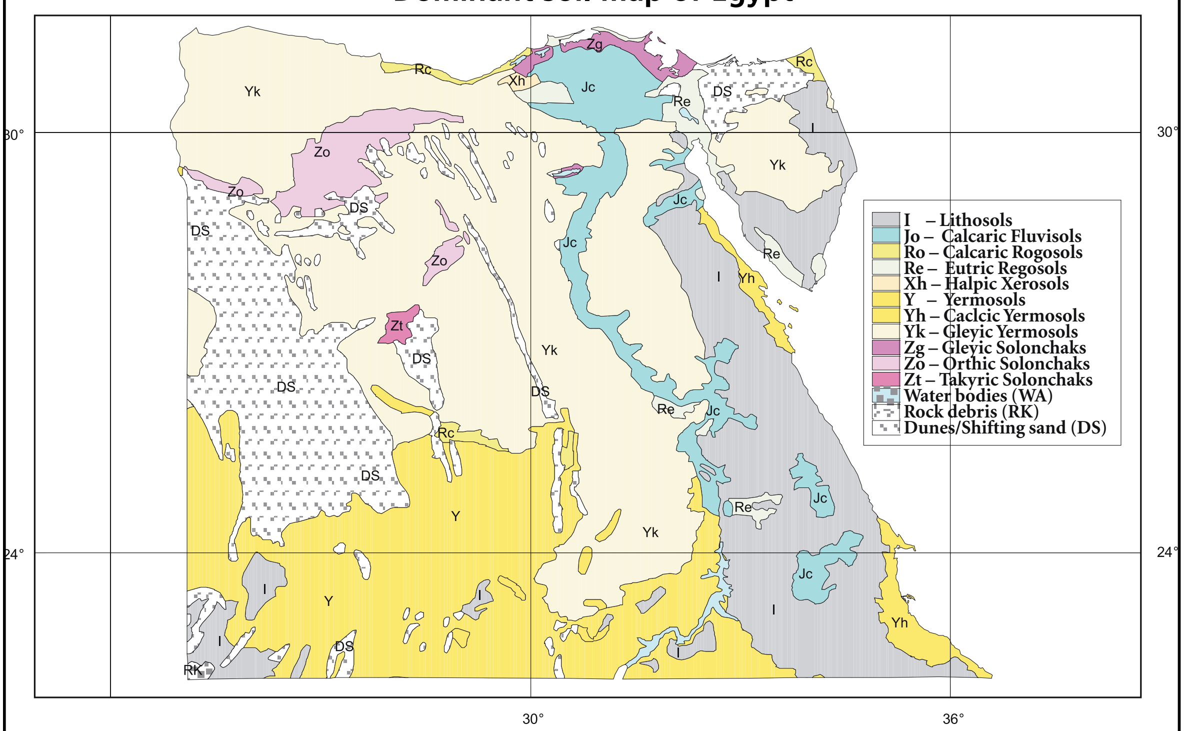
TABLE 1
Major soil groups and land cover in Egypt

Soil groups/land cover	Percentage of total
Arenosols (AR)	25.80
Calcisols (CL), associated with Gypsisols (GY)	0.37
Calcisols (CL)	9.12
Fluvisols (FL)	0.80
Leptosols (LP)	24.87
Water Bodies	15.44
Regosols (RG)	8.68
Solonchaks (SC)	0.48
Vertisols (VR)	4.85
Soils outside the area surveyed	9.59

Source: FAO, 1998.

Gypsisols (GY), Calcisols (CL), Fluvisols (FL), Leptosols (LP), Regosols (RG), Solonchaks (SC) and Vertisols (VR) – see Table 1 and Figure 1.

FIGURE 1
Dominant soil map of Egypt



Original scale: 1:5 million
Source: DSMW-FAO-UNESCO.

Fertility status of Egyptian soils

Most cultivated soils in Egypt are clayey to loamy in texture. About 420 thousand ha are sandy and calcareous. The average results of physical and chemical analyses of soils, sampled at various locations to represent the various types of soils, are presented in Table 2. The results obtained indicate a wide range of physical and chemical characteristics. The organic matter content is low and so, accordingly, is the concentration of total nitrogen.

As regards the alluvial soils (clayey and loamy clay), available phosphorous determined by Olsen's method is generally moderate. The results indicate that available (soluble and exchangeable) potassium extracted with a neutral solution of ammonium acetate is high, and this is characteristic of most Egyptian alluvial soils. Micronutrients are above the critical limits, as determined by the DTPA method. Levels of available phosphorus, potassium and micronutrients are fairly low on calcareous and sandy soils.

TABLE 2
Physical and chemical analysis of various soil types

Item	North Delta	South Delta	Middle & Upper Egypt	East Delta	West Delta
Soil texture	**Clayey**	**Clayey**	**Loamy clay**	**Sandy**	**Calcareous**
pH (1:2.5)	7.9-8.5	7.8-8.2	7.7-8.0	7.6-7.9	7.7-8.1
Percent total soluble salts	0.2-0.5	0.2-0.4	0.1-0.5	0.1-0.6	0.2-0.6
Percent calcium carbonate	2.6-4.4	2.0-3.1	2.6-5.3	1.0-5.1	11.0-30.0
Percent organic matter	1.9-2.6	1.8-2.8	1.5-2.7	0.35-0.8	0.7-1.5
Total soluble N (ppm)	25-50	30-60	15-40	10-20	10-30
ppm available P (Olsen)	5.4 -10	3.5-15.0	2.5-16	2-5.0	1.5-10.5
ppm available K (amm. acetate)	250-500	300-550	280-700	105-350	100-300
Available Zn (DTPA) (ppm)	0.5-4.0	0.6-6.0	0.5-3.9	0.6-1.2	0.5-1.2
Available Fe (DTPA) (ppm)	20.8-63.4	19.0-27.4	12.4-40.8	6.7-16.4	12-18
Available Mn (DTPA) (ppm)	13.1-45	11.2-37.2	8.2-51.6	3-16.7	10-20

Source: Taha, 2000.

Land management

Unsatisfactory management of the land is the main limiting factor to agricultural productivity. The following land and water management practices are necessary in order to extract the optimum benefits from using fertilizers:

- Control of salinity, water logging and deterioration of soil structure.
- Prevention and control of soil degradation.
- Proper use of reclaimable land, based on land capability.
- Concentration of intensification efforts on the best land.
- Recycling of organic matter for use as fertilizer.
- Identification of areas where soil regeneration should be given high priority.
- The construction of open drainage systems and the installation of shallow tile drains.
- Promotion of land leveling to increase water use efficiency in transition and fresh water zones.
- Development of land use plans for reclaimable areas.
- Use of reclaimable land in sweet water areas to grow ecologically appropriate crops.
- Promotion of the most efficient crop husbandry practices.
- Integrated crop and livestock systems.

Chapter 2
Agro-ecological zones and farming systems

Soils in the Nile River and Delta are silt-clay mixtures of good quality, deposited during thousands of years of Nile flooding. The total cropped area is estimated at approximately 5.8 million ha with a cropping intensity of 180 percent. Most of the newly reclaimed desert areas use modern irrigation practices such as drip and sprinkler systems.

An estimated 3.5 million farmers cultivate holdings of about two feddans (one feddan = 0.42 ha). Production is intensive and yields are relatively high compared with world standards in countries with similar agroclimatic conditions.

AGRO-ECOLOGICAL ZONES

Based on soil characteristics and water resources, four agro-ecological zones can be identified as follows:

Old land

This land is located in the Nile Valley and Delta Regions. It covers a total area of 2.25 million ha and is characterized by alluvial soils (clay to loamy). The Nile is the main source of water for irrigation.

New land

This land is located mainly on both the east and west sides of the Delta and scattered over various areas in the country. It covers 1.05 million ha. Reclamation of this land was started in the early 1950s and is continuing. Nile water is the main source of irrigation water but in some desert areas underground water is the only source of irrigation water. Sprinkler and drip irrigation regimes are practiced.

Oases

Oases are characterized by alluvial, sandy and calcareous soils. They cover a total area of 40 000 ha. Underground water is the main source for irrigation.

Rainfed areas

These include approximately 0.17 million ha of land located in the north coastal areas, where rainfall fluctuates between 100 and 200 mm annually.

Traditional soil fertility management can lead to the mining of nutrients from the soil due to an insufficient application of nutrients, to nutrient imbalances and to environmental contamination through the over-application of fertilizers.

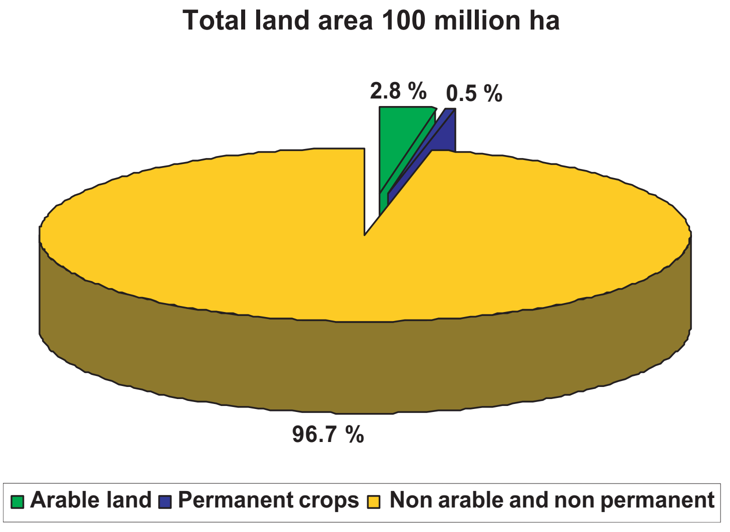
LAND USE AND FARMING SYSTEMS

The present distribution of land use in Egypt is principally the result of long-term historical processes, resulting from the interaction between socio-economic, political and environmental factors. These factors have influenced land ownership and tenure, population growth and urban-industrial development. Figure 2 shows that around 3.3 percent of the land is used for agriculture.

The most significant change in land use is increasing intensification, resulting from the progress of mechanization and the application of fertilizers and agrochemicals.

The aim of land use planning in Egypt is to change the pattern of land use in such a way

FIGURE 2
Land use in Egypt



Source: Ministry of Agriculture and Land Reclamation (MALR), 2002.

that crops are cultivated on relatively large areas, reducing waste in the use of land resources, minimizing and organizing pest control, improving the use of water for irrigation and mechanization practices.

AGRICULTURAL DEVELOPMENT

Three main factors limiting the growth of the agriculture sector are:

1. Water quantity and quality
2. Land resources
3. Human resources

   1. Water resources:
      - ➢Limited water resources
      - ➢Inefficient utilization of water
      - ➢Rapidly deteriorating quality of water due to pollution and salinization
   2. Land resources:
      - ➢Population pressure
      - ➢Urban encroachment
      - ➢Implementation of legal and regulatory systems
      - ➢Land degradation
   3. Human resources:
      - ➢Coordination
      - ➢Information transfer
      - ➢Lack of adequate credit

WATER SUPPLY

There is no effective rainfall in Egypt except on the narrow band along the north coast and Egypt's agriculture is almost totally dependent on irrigation. The total water resources currently available in Egypt are estimated at 73.8 billion cubic meters (BCM) per annum including the natural and non-traditional resources. Table 3 shows that at present approximately 62.6 BCM of water are used annually. Table 4 shows the distribution of water consumption between the various sectors. The agricultural sector consumes about 81 percent of the total water available. The total torrent water is estimated at 1.5 BCM annually. The Nile is the major source of water in Egypt and agricultural development is closely linked to the Nile River and its management.

TABLE 3
Availability and current use of water

Source	Availability BCM/annum	Percent	Current use BCM/annum	Percent
Nile	55.5	75.2	51.7	82.6
Underground	11.3	15.3	5.2	8.3
Agriculture*	5.0	6.8	3.7	5.9
Waste water	1.5	2.03	1.5	2.4
Rainfall	0.5	0.67	0.5	0.8
Total	73.8	100	62.6	100

* Re-use of drainage water
Source: FAO, 2003.

TABLE 4
Distribution of water use by sector

Sector	Consumption BCM/annum	Percent
Agriculture	50.8	81.1
Industrial and municipal	8.8	14.1
Electricity	2.0	3.2
Navigation & winter closure	1.0	1.6
Total	62.6	100

Source: FAO, 2003.

A major component of the strategy for agricultural development is improvement of the efficiency of use of Nile water, increasing the productivity per unit of water.

Total water consumption in the year 1995 was approximately 49 BCM. Water consumption for the proposed cropping pattern for year 2017 should amount to around 67 BCM for the cultivation of about 9.2 million ha. The additional water is expected to result from reducing the area under rice to 420 000 ha and the cultivation of new varieties with a shorter growth duration and lower water consumption. This should reduce the consumption of irrigation water for rice cultivation by four BCM. A saving in the consumption of water on sugar cane of almost 0.5 BCM should be achieved due to the improvement of water use efficiency and land leveling by laser of about 42 000 ha. A further saving is expected to result from improving the use of drainage water and the use of non-conventional water resources.

Irrigated farming systems

Large-scale irrigation schemes in Egypt have been linked primarily to perennial surface water. Patterns of water use vary greatly. Water is not used efficiently and there have been significant economic and environmental impacts from an excessive drawdown of non-recharged aquifers, excessive irrigation that has led to rising groundwater tables and resulted in soil salinization and sodication.

Small-scale irrigated systems have been developed along small perennial streams and at oases, or where flood and spate irrigation is feasible, as well as around boreholes.

In many cases, irrigated cropping is combined with animal husbandry. It is possible to distinguish between full and partial water control. Intense local competition for limited water resources between livestock owners and farmers is becoming increasingly evident. Crop failure is generally not a problem but livelihoods are vulnerable to water shortages, scheme breakdowns and deteriorating input/output price ratios.

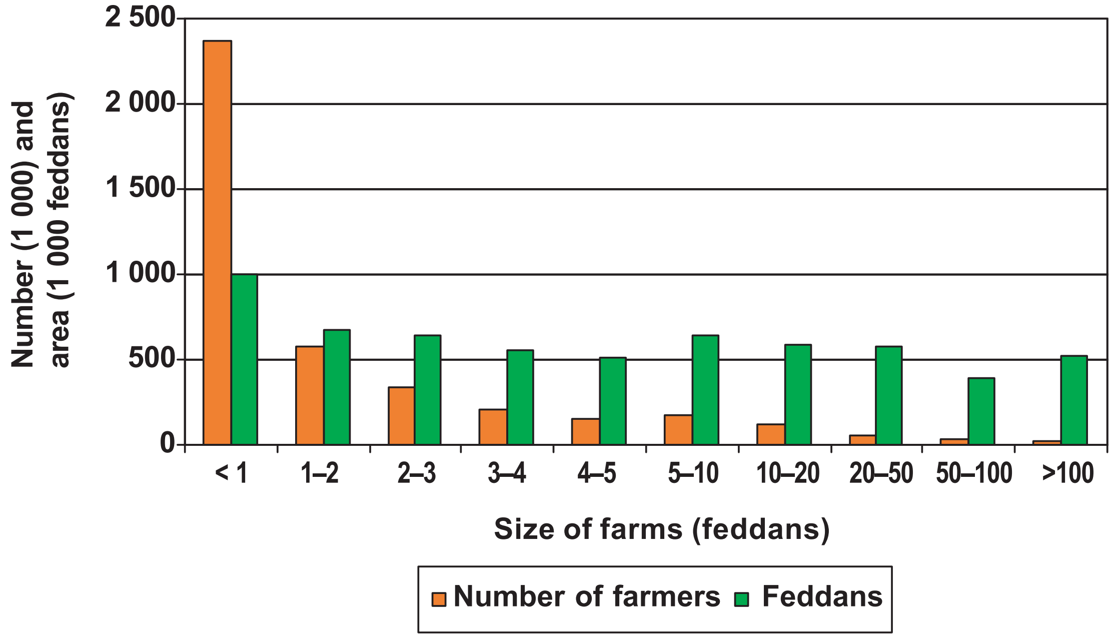
The following policy options are proposed to improve the efficiency of water use in agriculture:

- Improvement of farm water management through laser land levelling programmes and improved irrigation practices.
- Water saving policies according to the different water management zones.
- Restriction of the areas of rice and sugar cane.
- Move towards demand driven water management and an entailed volumetric system, by the middle of the twenty-first century.
- Balancing engineering solutions in the Nile basin with cooperative social approaches at the mesqa (private canal) and distribution level.
- Move toward decentralization of water management responsibilities to effective water user associations.
- Mechanisms for cost sharing to meet the full costs of operation and maintenance.

Land tenure

The Agrarian Reform laws limit the maximum farm size to 50 feddans for an individual or 100 feddans for a family. However, farms of this size are

FIGURE 3
Ownership of agricultural land in 2000



Source: MALR, 2002.

not common in Egypt. The large estates, with thousands of feddans, were expropriated in various ways in the 1952 and 1961 land reforms. About 81 percent of farms do not exceed three feddans while 9 percent have between 3 and 5 feddans. The average farm size is about 1.5 feddans. Figure 3 shows the distribution of agricultural landownership in the year 2000.

The general system is one of individual land tenure. Transfers of title take place through inheritance and the market. The operative farm unit is the holding, defined currently as: land owned plus land legally “rented in” minus land legally “rented out”. Most often, the land that was “rented in” occupied between one-third and one-half of the holding. After the 1961 land reform, this holding was recorded at the cooperative and was the basis for dealings between the cooperative and the landholder.

The annual rent per feddan was about LE30 during the 1950s and at present is about LE2 000 per feddan. There is also substantial unofficial rental, at much higher prices, reflecting market conditions. This is not recorded officially.

Egypt tenant farmers are struggling to come to terms with the new land laws introduced in an attempt to liberalize food supplies. After a five-year grace period, Egypt's 904 000 tenant farmers became subject to a 1992 law allowing landowners to charge market level rents and denying tenants the right to pass rented land on to their children.

There is a slight trend towards concentration of landownership, especially in the new lands, but it is less significant than the concentration of ownership of agricultural machinery or the ability of the larger farmers to take advantage of new market opportunities. Any trend towards concentration of landownership is still inhibited by the agrarian reform rules that limit the size of holdings.

There are many "landless" people in the rural areas. Though some work as labourers, not all are involved in the agrarian sector: many have other occupations – civil servants, merchants, commuting factory workers.

Chapter 3
Agricultural production systems

POPULATION

The rapid increase of the population in Egypt together with a limited cultivated area result in an acute need for additional production of various crops.

During the past century, Egypt's population has increased more than sixfold, from 11 million in 1907 to almost 70 million at the beginning of the year 2004, while the area of cultivated land has increased from 2.25 million ha to around 3.5 million ha during the same period. The area of land per capita has fallen from 0.2 ha in 1907 to 0.05 ha at the beginning of the year 2004.

Table 5 summarizes the situation. As can be seen, the area of land per capita and the availability of water per capita are steadily declining. The situation has reached crisis proportions and it has many serious consequences.

Efforts are being focused on measures that lead to a significant increase in crop production. Among the many factors involved in achieving this aim are the balanced fertilization of different crops and the adoption of suitable fertilizer use practices.

TABLE 5
Population, land and water per capita

Year	Population millions	Land per capita ha	Water per capita m^3
1800	2.0	0.42	n.a.
1850	4.6	0.36	n.a.
1897	9.7	0.21	5 084
1947	19.0	0.13	2 604
1990	55.0	0.05	1 034

Source: Hamdan (1983); Central Agency for Public Mobilization and Statistics (CAPMAS, 1989).

CROP PRODUCTION SYSTEMS

The successful implementation of two agricultural strategies in the 1980s and the 1990s had a positive economic impact at both macro and sector levels. Farmers are very responsive to technology transfer, extension activities and price incentives.

The total cropped (cultivated) area increased from 4.7 million ha in 1982 to 6.5 million ha in 2003 due to an increase in cropping intensity to 180 percent. This was made possible by the cultivation of earlier maturing varieties of various crops, permitting the possibility of harvesting three crops a year. The aim is to reach a cropping intensity of 220 percent within the next 20 years. This target requires new varieties that combine earliness with higher yields.

Agricultural production can be divided into four systems, which are complementary and interrelated. They are as follows:

- Field crops
- Vegetables and fruits
- Forest trees (lumber wood trees)
- Medicinal, aromatic and ornamental plant crops

In Egypt, the major field crops are cotton, rice and maize in the summer rotation and wheat, berseem clover, and faba bean in the winter rotation.

Plant production contributes about 65.8 percent of the total value of agricultural GDP. The value of field crops in 1997 is estimated at about LE23.8 billion representing 38.8 percent of the total plant production value. The value of vegetables and fruits is estimated at about LE7.4 and 8.7 billion, representing 12.1 percent and 14.2 percent, respectively, of the total plant production value. The value of medicinal and aromatic plants is estimated at about LE0.44 billion representing 0.7 percent of the total value of plant production.

Cereal crops represent about 50 percent of the value of field crops, occupying about 2.72 million ha out of the total 6.5 million ha of cropped area. Wheat occupies approximately 1.05, maize 0.88, rice 0.59, sorghum 0.15 and barley 0.19 million ha (Table 6). In 1982, the total area occupied by cereal crops was estimated at about 2.03 million ha, producing 8.5 million tonnes.

TABLE 6
Field crops: areas, yields and returns, 2002/03

Crop	Area ('000 ha)	Yield (kg/ha)	Revenue (LE/ha)	Cost (LE/ha)	Net return (LE/ha)
Cotton	297	462	1 221	866	355
Wheat	1 053	1 147	1 147	720	427
Rice	650	1 659	1 152	739	413
Maize	770	1 373	968	622	346

Source: National Agricultural Income, 2002; Agricultural Statistics, 2003.

Total cereal production amounted to 20.1 tonnes in 2000. Wheat production increased from 2 million tonnes in 1982 to 6.8 million tonnes in 2003 as a result of the cultivation of high yielding, long spike varieties in the context of the National Campaign for Wheat Improvement and the price incentives offered by the State to wheat growers. Maize production increased from 3.35 million tonnes in 1982 to 6 million tonnes in 2002 due to the cultivation of maize hybrids that now cover almost 70 percent of the area grown to maize. Rice production increased from 2.4 million tonnes in 1982 to 6.1 million tonnes in 2002 because of the cultivation of short duration, high yielding varieties, which are sown on almost 60 percent of the area grown to rice, in the context of the National Campaign for Rice Improvement. The increase in cereal production has had a significant impact on cereal imports and exports.

Fibre crops occupy 315 000 ha (cotton 298 200 and flax 15 750 ha). In 1993, lint cotton achieved the highest ever average yield of 19.4 kentars per ha (871 kg/ha). The production of seed cotton from 352 800 ha was similar to that produced from 0.84 million ha in the 1950s. The cotton acreage in 2003 amounted to 296 692 ha and seed cotton production was estimated at 4.9 million kentars (220 000 tonnes). The decrease in the cotton acreage, which is accompanied by an increase in the yield, has permitted an increase in the wheat acreage from 0.63 million ha in 1951 to 1.01 million ha at present.

Sugar crops occupy 147 336 ha (sugar cane 126 336 and sugar beet 21 000 ha). The average yield of sugar cane has increased from 84.7 tonnes/ha in 1982 to 121 tonnes/ha in 2001 and that of sugar beet from 31.5 tonnes/ha in 1982 to 51 tonnes/ha in 2002. The area under sugar beet is increasing rapidly on the newly reclaimed land; it reached 630 ha in 2002 producing 188 thousand tonnes with an average yield of 35.1 tonnes/ha.

Grain legumes are grown on 156 324 ha (faba bean 123 480, lentil 4 620, and chickpeas 6 300 ha).

Oilseed crops occupy approximately 113 358 ha (soybeans 26 040 ha, sunflower 31 080 ha, sesame 30 240 and groundnut 44 520 ha).

Forage crops, which represent 18 percent of the total value of field crops, are grown on about 1.11 million ha (catch or long season berseem clover on 0.71 million ha, catch or short season berseem clover on 0.26 million ha, and alfalfa on 0.11 million ha).

Horticultural crops (vegetables and fruits) are produced in sufficient quantities to meet domestic demand and to provide some surplus for export. Vegetables are grown on about 560 000 ha and contribute 10.5 percent of the total value of horticultural crops. The main vegetable crops are potatoes, tomatoes, watermelons, beans, peas, onions, melons, garlic, peppers, cucumbers, sweet potatoes, cabbage, and leaf vegetable crops.

Fruits crop and trees for timber are grown on approximately 0.4 million ha. The main fruit crops are citrus, grapes, mangoes, dates, bananas, olives and deciduous and evergreen trees.

Medicinal, aromatic and ornamental crops represent a rapidly growing farm business of importance for both domestic and external markets.

Egypt now ranks first, by international standards, in the yields of rice (9.2 tonnes/ha), sugar cane (121 tonnes/ha) and sorghum (4.6 tonnes/ha).

CROPPING PATTERNS

Several different crop rotations are followed in the Nile Valley and Delta areas, depending on the soil type and crops.

In the ear1y 1960s, the government of Egypt regulated the area and production of many crops including cotton, wheat, rice sugar cane and onions. Ministerial decree No. 34 issued in 1968 refers. In addition, the farmer was obliged to deliver all or part of his production to the government at a fixed price, which was lower than the free market price. The government handled marketing and processing. The justification of this measure was that the agricultural sector is interrelated with other sectors of the economy. For example, a shortage in the supply of cotton would lead to considerable losses in the industrial sector. A "basic cropping pattern" was prepared by the cooperatives in each village for the agricultural year (November 1 to October 31). The system also specified the quantity, crop variety and the quantity and type of fertilizers and pesticides to be supplied to farmers for each season. The Principal Bank for Development and Agricultural Credit (PBDAC) provided all agricultural inputs. Farmers were subject to monetary penalties for violations of the cropping pattern.

These policies had negative effects on the performance of the agricultural sector. There were large transfers from the agricultural sector to other sectors.

In 1980, a significant reform of these agricultural policies was introduced in the framework of the agricultural sector strategy for the 1980s. By 1986/87 the Ministry of Agriculture had pioneered an economic reform programme, concerning prices and marketing control, delivery quotas for the main crops and reduced subsidies for inputs. It encouraged private sector investment in crop marketing and the supply of inputs. By 1993, the agricultural sector had been completely liberalized i.e.:

- Governmental control of farm and output prices, crop areas and procurement quotas was removed.
- Governmental control of the private sector as regards the imports, exports and distribution of inputs as well as the import and export of agricultural crops, was removed.
- Subsidies on farm inputs were eliminated.
- The role of the PBDAC was diverted to the provision of financial services.
- Governmental ownership of land was limited.
- "New land" was sold to the private sector.
- The role of the Ministry of Agriculture was confined to agricultural research, extension, legislation and economic policies.
- The land tenancy system was modified.

These reforms, especially those involving the removal of governmental controls on areas planted, prices, procurement and domestic marketing, had a positive impact on crop production. They improved the value and profitability of the crop rotation, resulting in an increase of the more profitable crops at the expense of crops with lower profitability.

The aim of the present development strategy is to optimize the cropping pattern and the use of agricultural and water resources. By 2017 it is planned that the cropping pattern should involve:

- A gradual increase in the area under wheat from about 1 million ha in 1997 to about 1.4 million ha in 2017. The aim is to raise wheat production to about nine million tonnes annually by the year 2017, in order to meet the increasing national demand resulting from the growing population.
- The area under cotton would be kept at about 420 000 ha to meet the demand for local consumption and to conserve foreign markets.
- An increase in the areas under green fodder in the summer season, improvement of natural pastures in rainfed areas and increasing the yields of these crops.
- A decrease in the area under berseem, thus increasing the area available for cereals.
- A decrease in the area under rice to 420 000 ha annually, compared with 650 000 ha in 1997. A total production of paddy rice of about four million tonnes annually should increase to five million tonnes annually by the year 2017, by planting the whole area with short duration, high yielding varieties, which have lower water requirements. MALR has new varieties that require only 120 days from planting to harvest, giving an average yield of 9.5 to 13.1 tonnes/ha, compared with 8.3 tonnes/ha from old varieties. The water consumption / evapotranspiration of the new varieties should be around 14 000 m^3/ha, compared with 21 000 to 24 000 m^3/ha for the old varieties.

The productivity of “old land” is relatively high but additional yield gains could be achieved with improved seed quality, more mechanization, strengthened extension support and better land and soil management. The performance of the newly reclaimed areas has been below expectation.

The area under cultivation should increase from 3.3 million ha in the year 1997 to about 4.7 million ha by the year 2017 i.e. an increase of 1.4 million ha, according the objectives of the agricultural strategy (FAO, 2003).

Chapter 4
Fertilizer sector

Egypt has a long tradition of using mineral fertilizers, its first use of Chilean nitrates dating back to 1902. For over thirty years, all mineral fertilizers were imported, until the local production of phosphate fertilizers started in 1936. The production of nitrogen fertilizers began in 1951. No potash fertilizers are produced in Egypt due to the lack of resources, although it was reported recently that some local potash deposits had been found.

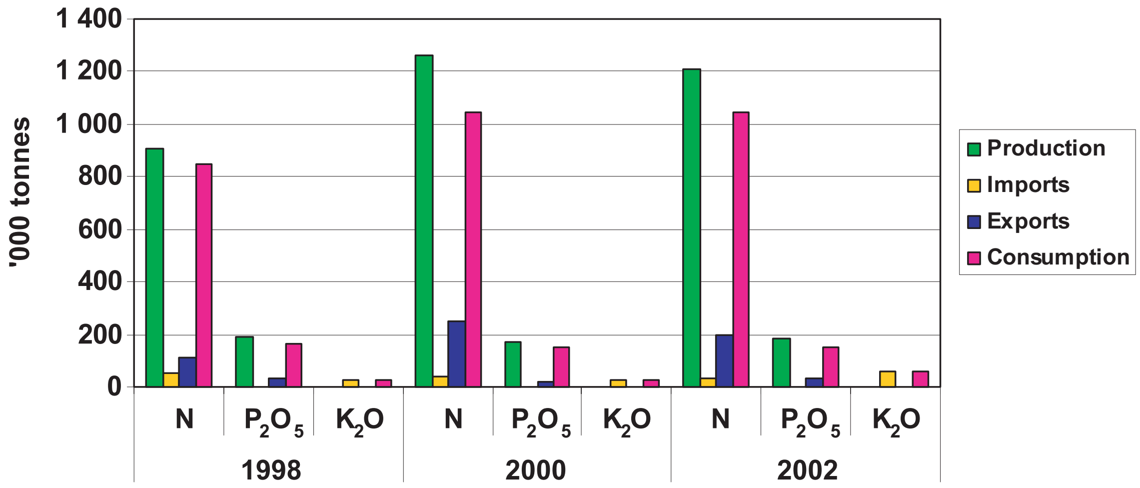
The demand for food and other agricultural commodities is increasing in Egypt due to the increase in the population and improvements in living standards. Efforts continue to improve crop productivity and quality. The breeding of new high yielding varieties and the development of better agricultural practices are some of the measures aimed at increasing agricultural production to meet the increase in demand.

Appropriate fertilization is one of the most important agricultural practices for achieving the objectives. Evaluation of the best source of nutrients, optimum rates of fertilization, suitable timing and proper fertilizer placement are necessary for efficient fertilizer management.

In Egypt, there are several traditional practices that are commonly implemented and which play a major role in restoring and maintaining soil fertility. Among these practices are:

- Planting berseem clover as a winter fodder crop before the cotton crop, providing a green manure by ploughing in after taking one or two cuts.
- Incorporating farm yard manure (FYM) into the soil during seedbed preparation. This is usually done before an important cash crop such as cotton is planted.
- Including in the crop rotation a legume crop such as: faba bean, clover and soybean, which have a positive effect on soil fertility and provide part of the nitrogen requirement.

FIGURE 4
Production, imports, exports and consumption of fertilizers



Source: MALR, 2003.

Efforts are being made to increase the composting of agricultural residues as a source of plant nutrients, as a contribution to improvement of the physical properties of the soil and protection of the environment.

PRODUCTION, IMPORTS, EXPORTS AND CONSUMPTION OF FERTILIZERS

Improvements in product quality and production efficiency, either already achieved or planned, permit the domestic industry to compete successfully with most fertilizer imports. Figure 4 provides details of the production, imports, exports and consumption of fertilizers in the period between 1998 and 2002.

Urea is produced domestically and part of this production is exported. For example, in 2002 total domestic production of urea was five million tonnes of which 23 percent was for export and 77 percent for the domestic market.

The main types of fertilizers used are:

Nitrogen

- urea (46.5 percent N)
- ammonium nitrate (33.5 percent N)
- ammonium sulphate (20.6 percent N)
- calcium nitrate (15.5 percent N)

Phosphate

- ➢ single superphosphate (15 percent P_2O_5)
- ➢ concentrated superphosphate (37 percent P_2O_5)

Potassium

- ➢ potassium sulphate (48 to 50 percent K_2O)
- ➢ potassium chloride (50 to 60 percent K_2O)

Mixed and compound fertilizers containing N, P, K, Fe, Mn, Zn and/or Cu in different formulations for either soil or foliar application. The micronutrient may be in either mineral or chelate form.

Chapter 5
Fertilizer requirements and crop needs

Fertilizer use recommendations are based on experiments carried out by the Ministry of Agriculture. The rates recommended by the Ministry of Agriculture are averages, not tailored to specific crop needs in a specific area. In practice, neighbouring farmers use different rates of fertilizers for the same crop.

FERTILIZER REQUIREMENTS

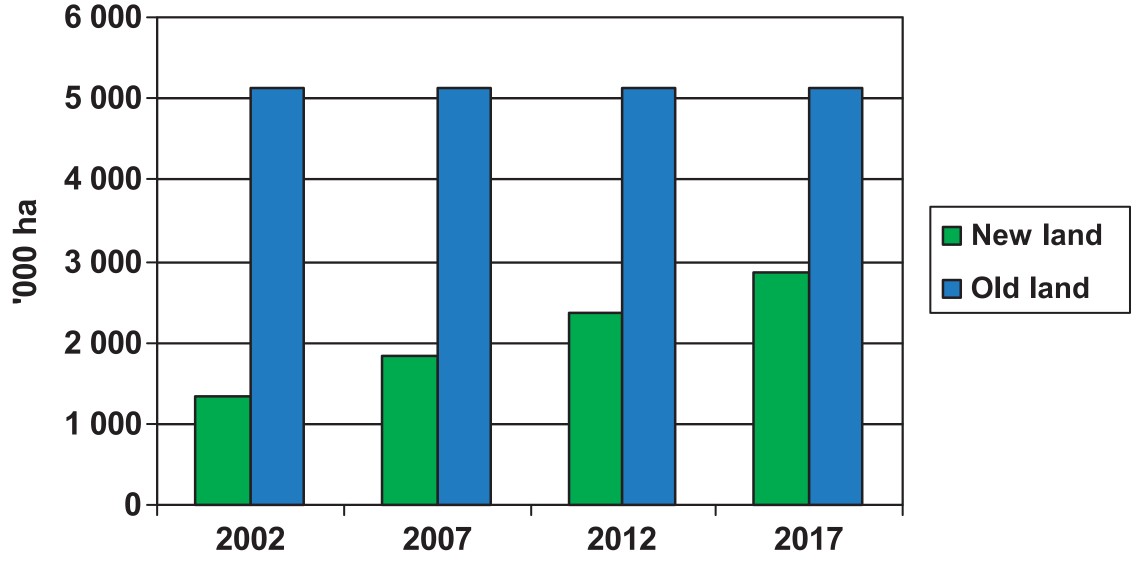
An estimation of the fertilizer requirements of the country is crucial not only for the development of agriculture but also to permit correct investment decisions in the fertilizer manufacturing industry. Incorrect forecasts might result either in shortages for the farmer or in excess capacity and low profits for the producers.

Two main factors are taken as a basis for estimating the fertilizer requirements for the country. The first factor is the “indicative cropping pattern” i.e. the optimum rotation, and the area allocated to each crop. The second is the economic optimum rate of fertilizer for each crop under different agroclimatic conditions. In addition to these two main factors, the following factors are taken into consideration:

1. Expansion of the newly reclaimed area
2. Crop rotations and their impact on crop responses to fertilizers
3. Soil and plant tissue analysis
4. The fertilizing value of the various sources of fertilizers
5. Residual effect of the fertilizers and the organic manures
6. Crop intensification, whether by increasing the number of plants per unit area or by intercropping
7. Nutritional balances for the various crops
8. Improvements in the irrigation and drainage systems

FIGURE 5

Cropped area, 2002 to 2017, new and old land



Source: MALR, 2003.

9. New technology implemented by the fertilizer industry to produce new types of fertilizers with higher efficiency

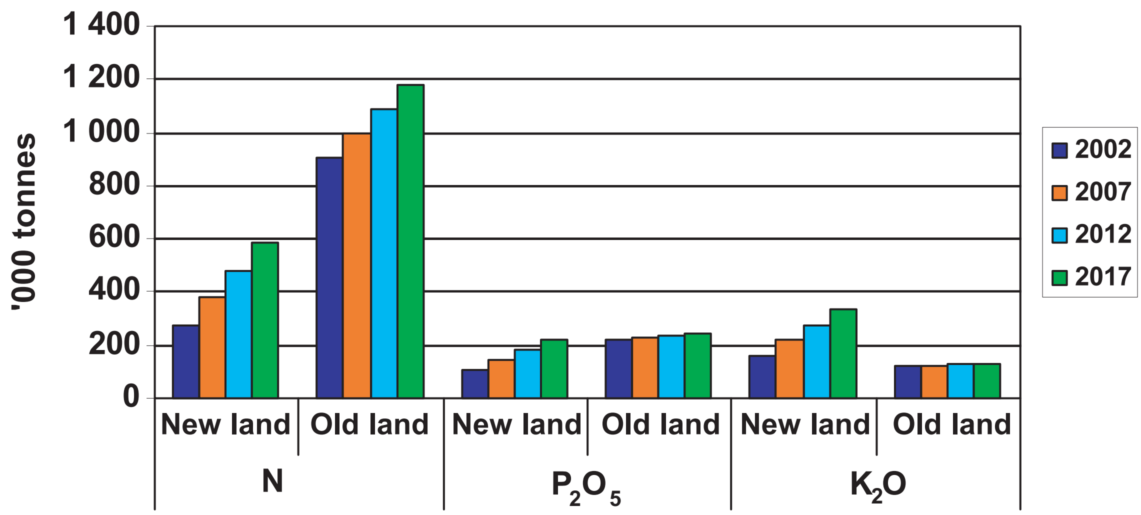
In the agricultural year 2002/03, the crop areas in the old and new lands amounted to 5.1 and 1.4 million ha respectively. According to the "indicative cropping pattern", the area allocated to various crops and the recommended rates of nitrogen and phosphate fertilizers, it is estimated that the country needs 1.1 million tonnes of N and 364 thousand tonnes of P_2O_5.

The status of potash and the micronutrients in most Egyptian soils is different from that of N and P. In consequence, it has been decided to determine requirements for these nutrients by taking the consumption of the previous year and increasing it by about 10 percent. Most farmers have a poor knowledge of potash and micronutrient requirements and it is hoped that, with the help of the extension staff, farmers will recognize their importance. Figures 5 and 6 show the estimates of the areas and fertilizer requirements of "new" and "old" land respectively up to 2017.

NUTRIENT BALANCE

It is necessary to distinguish between two expressions:

FIGURE 6
Estimated fertilizer requirements on new and old land



Source: MALR, 2003.

Removal

Nutrient removal is the amount of a nutrient removed from the field (soil) by a given yield.

Uptake

Nutrient uptake is the maximum amount taken up by a plant during the vegetative period. Normally uptake is higher than the removal.

The nutrient balance has two different aspects, as follows:

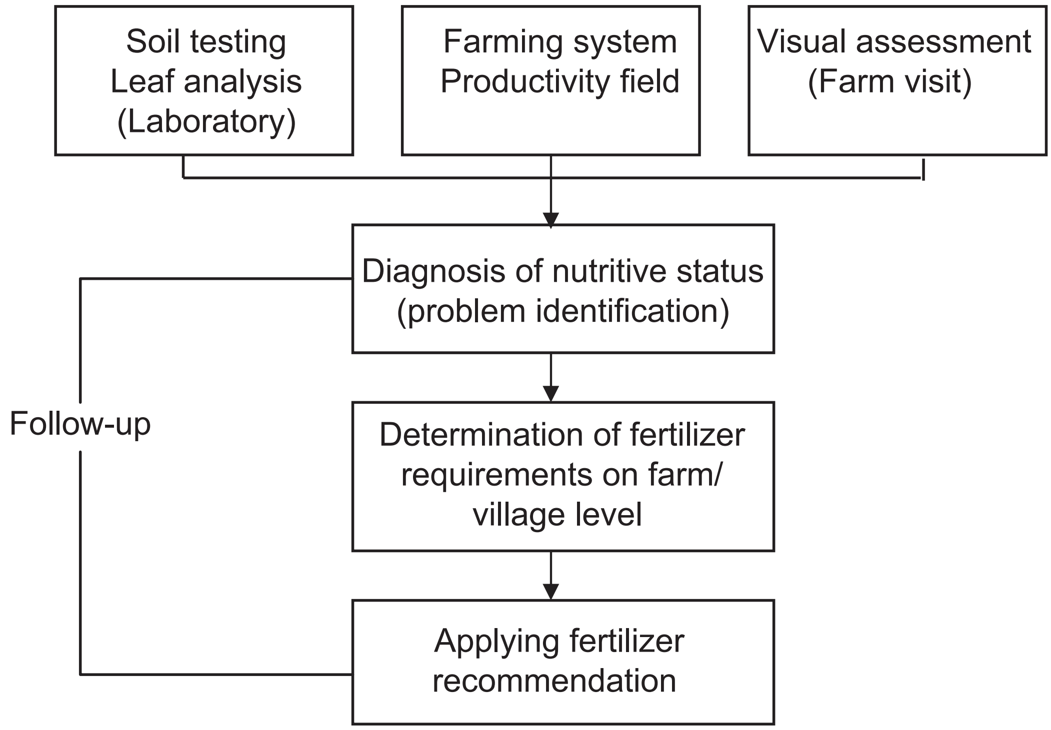
- Output (removal from the field).
- The balance between the nutrient requirement of the crop to be supplied as fertilizers and the availability of the nutrient from all natural sources (El-Fouly, 1998).

Thus, the input of nutrients from different sources, such as soil, air, water and other sources, including organic manures, should be equal to the amount removed or taken up by the crop. If the quantities from these sources are not sufficient for the crop to reach the target yield, the difference should be added as fertilizer. Insufficient amounts of nutrients result in loss of yield. Excessive amounts represent a waste of resources, possibly a decrease of yield and could be an environmental hazard, as in the case of nitrogen, for example (Fawzi, 1992). In this context:

- The fertilizer nutrient requirement = output minus input from natural and organic sources.
- Fertilizer requirement = nutrient requirement adjusted for the nutrient content of the fertilizer.

Figure 7 illustrates the steps to be taken to determine the fertilizer requirements.

FIGURE 7
Systematic determination of fertilizer requirements



Chapter 6

Fertilizer use by crop

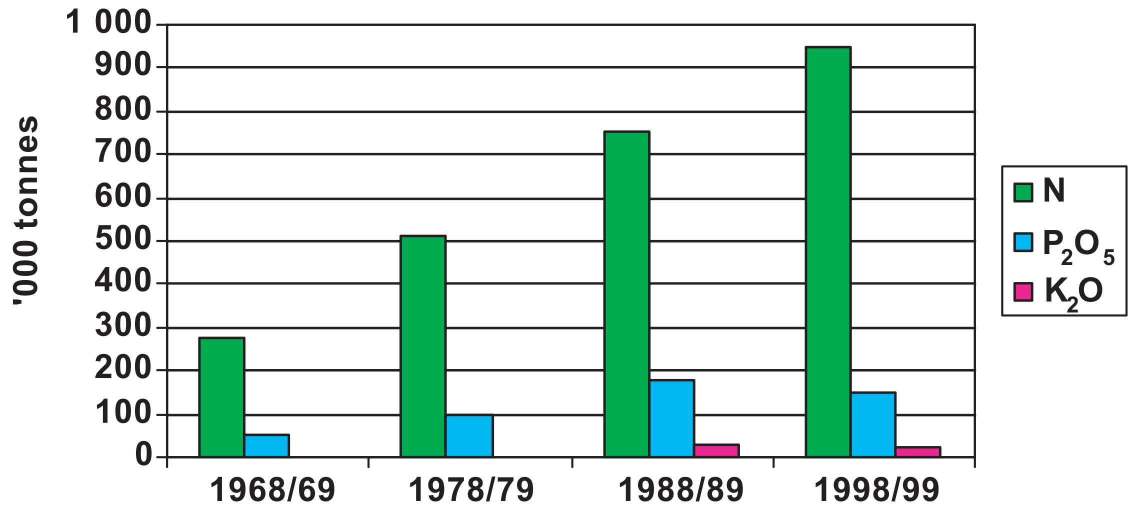
In Egypt, mineral fertilizers, especially nitrogen, phosphate and potash are being applied to an increasing extent. Figure 8 shows that the consumption of nitrogen and phosphate fertilizers has tripled during the last 30 years.

This increase in consumption is due to various factors including:

- The additional cropped area (Figure 9).
- The introduction of new high yielding varieties which need higher rates of fertilizers, as indicated by the increases in recommended rates in Table 7.
- The construction of the High Aswan Dam which reduced the quantity of suspended materials deposited on the soil during floods, which permitted for thousands of years the restoration of the fertility of Egyptian soils.

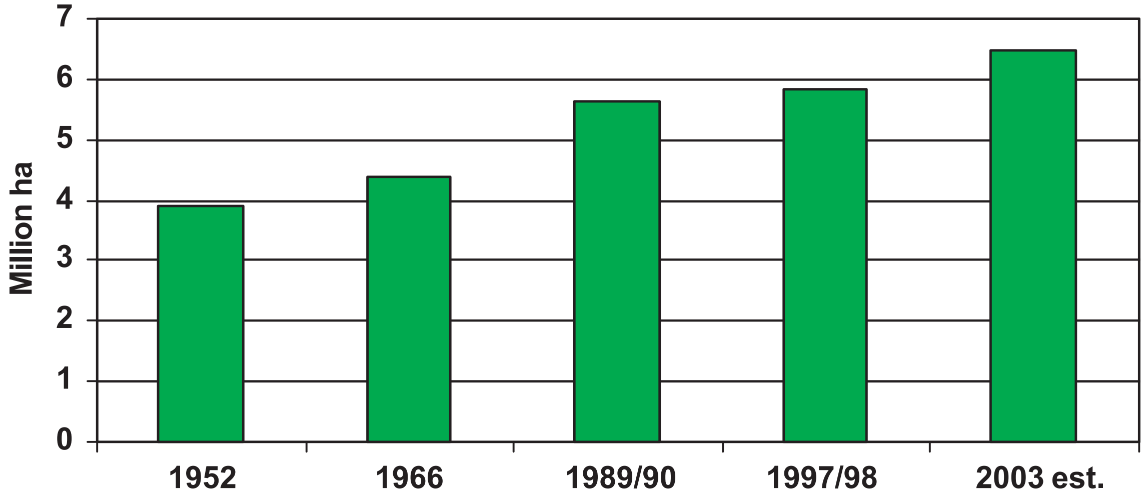
FIGURE 8

Consumption of N, P_2O_5 and K_2O



Source: Taha, 2000.

FIGURE 9
Cropped area



Source: MALR, 2003.

Apart from mineral fertilizers, organic manures are the main source of plant nutrients, especially of nitrogen and micronutrients.

The recommended rates of N, P_2O_5 and K_2O for all the crops, on a national level, are issued by MALR each year through an annual Ministerial decree (Tables 7 to 12). The rates of fertilizers to be applied to the crops evidently differ according to the species and variety, soil type as well as the area allocated to each crop in that year.

TABLE 7
Recommended rates of fertilization, 2003/04 compared with 1979/80

Crop	N (kg/ha)		P_2O_5 (kg/ha)		K_2O (kg/ha)	
	1979/80	2003/04	1970/83	2003/04	1980/83	2003/04
Cotton	90-145	145-170	40	55	0	60
Faba bean	20	40	40	70	0	60
Maize	145-160	215-290	0	55	0	0
Potatoes	215	300	15-30	145	115	115
Rice	70	95-145	40	40	0	0
Sugar cane	140-300	380	40-70	40-110	115	115
Tomatoes	215	300	40-70	110	115	115
Wheat	110-140	160-180	40	40	0	0

Source: MALR, 2003.

TABLE 8
Recommended rates of fertilization for other field crops and pulses

Crop	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Barley	45	15	60
Broad bean	15	70	60
Flax	45	40	0
Green peas	15	70	60
Lentil	15	30	60
Sugar beet	60	80	0

Source: MALR, 2003.

TABLE 9
Recommended rates of fertilization for aromatic and medicinal plants

Crop	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Aniseed	145	70	60
Bardacoch	300	110	60
Coriander	145	70	60
Cumin	145	110	60
Jasmine	430	110	60
Mint	430	110	60
Swallow	215	145	115

Source: MALR, 2003.

TABLE 10
Recommended rates of fertilization for fodder crops

Crop	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Clover, long season	40	40-55	0
Clover, short season	70–110	70	115
Green fodder	430	110	115
Sorghum	300–320	70	0

Source: MALR 2003.

EFFECTIVENESS OF VARIOUS SOURCES OF NUTRIENTS

An important factor influencing the efficient use of fertilizers is the source of the nutrients. In Egypt, studies have been carried out to evaluate the effectiveness of different sources of N, P and K for different field crops.

As regards nitrogen, field experiments carried out on cotton, wheat, maize and rice indicate that calcium nitrate and urea are of nearly equal

TABLE 11
Recommended rates of fertilization for fruit crops

Crop	Age of trees (years)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Apple, pear	1 to 3	60	55	60
	3 to 6	145	70	60
	Over 6	215	70	115
	7 to 10	450	70	60
	Over 10	430	70	115
Apricot, plum	1 to 3	215	55	60
	Over 3	215	110	115
Banana	Permanent	1 070	215	115
	Nursery	300	110	60
Citrus	1 to 3	110	55	60
	3 to 7	170	70	60
	7 to 10	450	70	60
	Over 10	430	70	115
Date palm	1 to 5	400 g/palm	75 g/palm	50 g/palm
	Over 5	850 g/palm	145 g/palm	240 g/palm
Grapes	1 to 3	95	70	60
	Over 3	300	115	110
Mango	1 to 3	95	55	60
	3 to 7	180	70	60
	7 to 10	250	70	60
	Over 10	360	70	115

Source: MALR, 2003.

TABLE 12
Recommended rates of fertilization for vegetable crops

Crop	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Artichoke	110–180	65	60
Beans	130	70	115
Cabbage	130	55	60
Eggplant	250	55	60
Garlic, Lower Egypt	110	40	60
Garlic, Upper Egypt	215	110	115
Kidney beans	40	55	60
Onion, Lower Egypt	145	40	60
Onion, Upper Egypt	370	110	115
Pepper	250	55	60
Squash	130	55	60
Strawberry	550	110	230
Sweet potatoes	70	55	60
Taro	300	55	60

Source: MALR, 2003.

value. On rice, sulphur coated urea and urea super granules were found to be superior to urea and ammonium sulphate, while iso-butidylin di-urea was the least effective (M.R. Hamissa *et al.,* 1997).

The phosphate fixation process in alkaline soils and the presence of calcium carbonate result in a low recovery of added phosphatic fertilizers. A number of field trials have been carried out to study the effectiveness of phosphate sources on clover, wheat, faba bean, alfalfa and maize. The data obtained revealed that phosphate fertilizers containing phosphorous in water soluble form, such as single superphosphate, triple superphosphate and polyphosphate, were the most effective, followed by those containing phosphorous soluble in ammonium citrate or two percent citric acid, such as dicalcium phosphate and basic slag. Rock phosphate was the least effective source.

Regarding micronutrients, studies on some field crops indicated that the foliar application of micronutrients in mineral or chelated forms was more effective than soil application, except in some special cases such as the application of zinc sulphate or zinc oxide on rice.

To assess the effectiveness of organic manures, a series of field trials were conducted in two successive seasons to study the fertilizer value per unit of nitrogen in pigeon refuse, FYM, green manure and two kinds of compost (one prepared from rice straw and the other from faba bean straw). Rice was cultivated in the first year followed by cotton and wheat followed by rice in the second year (Taha, 2000).

The results obtained (Table 13) showed that organic manures increased rice and wheat yields directly. Pigeon refuse gave the highest values, while compost and FYM resulted in the lowest values. As regards the residual

TABLE 13
Direct and residual effect of organic manures

Organic manures	Direct effect		Residual effect	
	Rice (tonnes/ha)	Wheat (tonnes/ha)	Cotton (tonnes/ha)	Rice (tonnes/ha)
Pigeon refuse	1.5	0.4	138	76
FYM	1.3	0.3	134	72
Green manure	1.3	0	142	0
Compost (rice straw)	1.2	0	148	0
Compost (bean straw)	0	0.4	0	74

effect, pigeon refuse, FYM and composted bean straw had almost the same effect on rice, while composted rice straw showed superiority over the others on the cotton crop.

Crop productivity could be increased on both old land and in the newly reclaimed areas by means of improved varieties, optimum cultivation practices, high quality seed and the efficient use of land and water inputs. In addition, with better extension, the gaps between yields obtained by farmers and those obtained by researchers could be narrowed or even closed.

Chapter 7
Time and method of fertilizer application

Studies have been carried out in Egypt to determine the most suitable time and proper method of fertilizer application for various crops. The following are some examples (Taha *et al.*, 1996).

RICE

For broadcast seeded rice, recent work conducted by the Rice Research and Training Center (RRTC) indicated that the most effective treatment is the split application of fertilizer nitrogen in three equal doses: one third applied before planting, incorporated in dry soil; one third at the mid tillering stage and one third at panicle initiation.

For transplanted rice, using N^{15} labeled fertilizer, it was found that, comparing banding in dry soil, placement ten cm deep in the soil, two thirds top dressed 35 days after transplanting and one third at the primordial initiation of the panicle, the treatments gave roughly comparable results. The ten cm placement treatment was found to be the best (Table 14).

TABLE 14
Effect of timing and method of N application on paddy

Treatment	Yield (tonnes/ha)
Banded in dry soil	7.5
Broadcast in water before leveling	6.3
Point placement 10 cm deep	7.6
2/3 band+1/3 at panicle initiation (p.i.)	6.6
2/3 top dress 15 d.a.t.+1/3 at p.i.	6.0
2/3 top dress 35 d.a.t.+1/3 at p.i.	7.3
LSD (0.05)	0.9

d.a.t. = days after transplanting.
p.i. = panicle initiation

WHEAT

Studies were carried out to determine the most suitable time of nitrogen application for producing the highest yield of grain and protein. In a coordinated field trial, using N^{15} labeled fertilizer, it was found that splitting the amount of nitrogen into three equal doses to be applied at planting, early tillering and booting stages of growth were more effective than N fertilizer applied in two equal doses at planting and tillering or in one single dose at planting.

MAIZE

Data obtained from a coordinated programme on maize, using N^{15} labeled fertilizer, showed that the split application of N fertilizer in three equal doses applied at planting, at 50 cm plant height and at tasseling was more effective than N fertilizer applied in two equal doses.

COTTON

About 22 field trials were conducted to study the most effective method and the suitable time of nitrogen application. The results indicated that:

- Deep side dressing after thinning was the most effective treatment when compared with topdressing after thinning or banding in the bottom of the ridge.
- Splitting the nitrogen dose into two equal doses, the first before the second watering (after thinning) and the second before the fourth watering was the most efficient treatment.
- Data from different field experiments showed that the application of phosphate fertilizer in one single dose before planting or before the first or second watering were almost equal in their impact on crop production.

FERTIGATION

Conventional fertilization practice involves the application of phosphate, potassium and part of nitrogen requirements before planting and the application of one or two doses of N fertilizer during growth. Manual broadcasting and mechanical spreading or spraying are used.

Fertigation, the application of fertilizers with irrigation water, is used in Egypt on sandy soils and especially for vegetable production where the productivity of crops on these soils is lower than the potential yield of the recommended cultivars. Below optimum productivity is due to poor soil fertility, low water and fertilizer efficiency and unsuitable management practices. Fertigation permits improved efficiency of irrigation and nutrient use and reduces application costs. It improves plant growth and nutrient uptake and limits nutrient losses.

In Egypt, fertigation is practiced on only 13 percent of agricultural land, 87 percent of the fertilizer being applied to the soils. One of the main recommendations adopted at an FAO meeting in the year 2000 concerned the importance of fertigation in both pressurized systems (sprinkler and drip irrigation) and surface irrigation. Fertigation was shown to enhance overall root activity, improve the mobility of nutritive elements and their uptake, as well as reducing the contamination of surface and ground water. The fertigation technique is used mainly with N and K fertilizers (Taha, 1999).

Under Egyptian agricultural conditions, nitrogen is considered to be the most critical factor in crop production. The rate of nitrogen application in Egypt is one of the highest rates in the world. As a result, nitrogen contamination of drainage water reaches an average of 1.5 ppm N in the drains of the Nile Delta area. This results from the heavy application of nitrogenous fertilizers and the leaching out of the easily soluble nitrogen through the uncontrolled surface irrigation practices usually practiced by Egyptian farmers. Such losses of nitrogen are a substantial financial waste and pollution of the environment with nitrate.

Applying fertilizers through the irrigation system has several advantages:

- Nutrients can be applied at any time during the season and according to plant requirements.
- Placement of mobile nutrients such as nitrogen can be regulated in the soil profile by the amount of water applied.
- Applied nutrients are readily available for rapid plant uptake.
- Nutrients are applied uniformly over the field.
- Ground water contamination is likely to be less since nitrogen may be applied at any given time. It is often applied when crop uptake and utilization are at their maximum.
- Crop damage during fertilizer application is minimized.

The disadvantages of fertilizer application through the irrigation system are:

- Uniformity of fertilizer distribution is only as good as the uniformity of water distribution.

- Lower cost fertilizer materials often cannot be used.
- Localized fertilizer placement such as banding cannot be achieved in a sprinkler irrigation system. To a limited extent, it can be achieved with drip irrigation.

Water source contamination can be significant if the injection system is not properly installed or is poorly maintained.

The following are two fertilization programmes, for maize and wheat grown on sandy soil in open fields.

1. Maize

- 330 kg N/ha as ammonium nitrate. Twenty percent applied to the soil before planting and after thinning, the remainder being applied in irrigation water (fertigation).
- 70 kg P_2O_5/ha as single superphosphate applied to the soil in two equal doses before planting and after thinning.
- 130 kg K_2O/ha as potassium sulphate applied in three doses, half applied to the soil before planting, one quarter after thinning and one quarter during the growing season in irrigation water.

2. Wheat

- 285 kg N/ha as ammonium nitrate, ten percent applied to the soil before planting and at tillering, the remainder being applied in irrigation water.
- 70 kg P_2O_5/ha as single superphosphate applied to the soil in two equal doses before planting and at tillering.
- 115 kg K_2O/ha as potassium sulphate applied in three doses (half applied to the soil before planting, one quarter at tillering and one quarter during the growing season in irrigation water).

Yields of maize 7.9 tonnes/ha and wheat 6.4 tonnes/ha indicated that it is possible to increase the crop productivity of sandy soils of low soil fertility with the use of fertigation.

The efficiency of the fertigation technique depends on many factors including:

- Water quality, (pH, exchangeable cations, concentration of soluble cations and anions Na^+, Ca^{++}, Mg^{++}, Cl^-, $SO_4^=$).

- The fertilizers and salts should be completely soluble to avoid problems in solution flow and to improve fertilizer efficiency.
- The timing and concentrations of each type of fertilizer.
- Avoidance of reaction between water and fertilizers leading to precipitation of salts in the irrigation system.
- Cleaning the system by injecting diluted mineral acids periodically in order to dissolve precipitations in the system.

EXTENSION ACTIVITIES

Extension is one of the main activities of the Ministry of Agriculture and Land Reclamation in Egypt. This sector has different "Central Departments", one of which is the Central Department of Soil Fertility and Soil Improvement.

In addition to the extension staff, there are national campaigns for different individual crops, involving research and extension staff and covering issues that include soil fertility and fertilizer application. Research staff at the Agriculture Research Center (ARC) must allocate 30 percent of their time to extension activities.

Recently there was a national campaign for recycling agricultural residues by composting, for use as organic manure.

In addition to the national campaigns, there are other collaborative activities between research and extension staff such as:

- Training programs for agronomists and their assistants.
- Extension meetings and lectures.
- Field days.
- Farmers' Field Sschools (FFS).

Farmer's field schools involve four coordinated projects:

- Egypt-Finland Agriculture Research Project in Ismailia Province (East Delta).
- German Technical Cooperation in some provinces of North and Middle Egypt.
- Integrated Pest Management Project in Fayoum.
- Capacity building in land management and soil productivity/soil productivity improvement through FFS in Fayoum Governorate and Nubariya Region (TCP/EGY/2904, FAO).

The Egyptian/German assisted project started in 1976 with the objective of studying plant nutrition problems in Egypt, especially those related to micronutrients. Subsequently it covered almost all aspects of plant nutrition and foliar fertilization in the context of balanced fertilization and nutrient management. From the outset, the project involved on-farm research with farmers. In 1980, the study of new approaches for transferring the research results to farmers was initiated (Manning, 1980; Fritz, 1980).

This project was and still is primarily concerned with innovations in the field of plant nutrition and fertilizer use and in extension methodologies, all involving collaboration with farmers. It was in fact recognized that all aspects of growing the crop and not only nutrient management should be discussed with farmers. FFS specializing in nutrient management are indicated only in the early stages of developing new technology. Subsequently nutrient management should become a part of the crop FFS.

The Fayoum Integrated Pest Management Project is a Dutch assisted project that began in March 1999 with two cotton FFS on integrated pest management in two villages. In addition to cotton, these FFS cover problems of other crops cultivated by the farmers during the season. In June 1999 a tomato curriculum was introduced.

Rural schools for women were introduced on a pilot basis. Training subjects included integrated pest management, pesticides, processing of the products, basic agricultural practices, household animal husbandry, production of dairy products, literacy, hygiene and child care (EL-Fouly, 2000).

Project TCP/EGY/2904 (A) started in October 2003 and is designed to function at village level. The project aims to improve the productivity and fertility of degraded soils including salt affected soils through ISNM and farmers' involvement through the FFS approach. One of the major objectives is to demonstrate appropriate ISNM methods for optimum sustainable production on selected pilot farms (farmers' fields) in two Governorates (Fayoum and Nubariya).

The planned outputs of the project for enhancing the productivity of salt affected soils in relation to plant nutrition, soil fertility improvement, and fertilizer use include:

- Improved ISNM technologies.
- Integrated agronomic and soil, water and nutrient management practices.
- Training material concerning soil, water, fertility and crop management.
- Guidelines on integrated low cost, low risk techniques.

One of the major achievements, which reveals the importance of the interaction between researchers and extension staff in the area of soil fertility and plant nutrition, is the application of zinc fertilizers in rice fields. Twenty years ago zinc as a fertilizer was unknown to rice farmers in Egypt. Today the application of zinc fertilizers to paddy nurseries is one of the general fertilizer practices in rice cultivation.

Chapter 8
Fertilizer distribution, pricing and trade

Until 1996, all domestic fertilizer production capacity was publicly owned. With planned additions to capacity, the distribution of ownership can change significantly, although "private sector" participation seems to consist of mixed companies that are more than 25 percent owned by government entities. Fertilizer distribution, by contrast, became increasingly dominated by the private sector during the 1991 to 1998 period, despite some important disruptions. The Principal Bank for Development and Agricultural Credit (PBDAC) previously had a monopoly of the distribution of both domestic and imported fertilizers of all types, through a credit linked system of village level branches. In 1992, the subsidy on most fertilizers was removed. Private traders and cooperatives were allowed to purchase fertilizer directly from processing plants and to import nitrogenous and phosphatic fertilizer subject to a 30 percent import duty. By 1994, private traders handled about 70 percent of the market (nutrient basis) (Saad, 2002).

PBDAC, the agricultural cooperatives and the private traders continue to participate in the distribution of mineral fertilizer. The Government determines the share of each participant. There are about 27 large scale distributors who deal directly with fertilizer manufacturers within the limits of the quota fixed for the private sector by the Government. The quota for each distributor is determined according to his past transactions with the manufacturers. A trader who does not observe good storage practices or the selling price range is deleted from the list. The number of private traders is about 6 000. About half of them are licensed, while the other half are unlicensed, generally small retailers located in villages. Wholesalers generally receive their fertilizer from the distributors and sell to retailers. The Egyptian Association of Fertilizer Distributors and Traders has set the rules for its members to ensure appropriate margins and suitable pricing so that the private traders are not accused of improper practices, as was the case in 1995.

During the 1995 crisis, PBDAC was instructed to take over and handle all the domestic production. This quota had declined to 10 percent by 1998, with the private traders handling about 70 percent and the cooperatives 20 percent. In February 2002, the PBDAC quota was increased to 30 percent and then to 50 percent in March 2002. This change in policy was due to the increase in the prices of fertilizer sold by the private traders. It was intended to penalize private traders who export fertilizers (due to high international prices) without satisfying local requirements. Investigation of the retail prices of fertilizer at different locations indicated that the prices of the private sales were not much different from those of PBDAC and the cooperatives.

PRICE AND TRADE DISTORTIONS

The manufacturers are free to reduce prices but not increase them. This inability to increase domestic prices, thus retaining adequate supplies for the domestic market, was the direct cause of the 1995 crisis. It is government policy that pricing and foreign trade decisions should be separate, requiring administrative intervention rather than relying on market signals for coordination. Manufacturers who do not reduce their prices are forced to carry high inventories or to export their fertilizer, unless the Government intervenes or the producers reduce their output.

However, at the present time, because the price reductions are selective and not universal, reductions for non storing traders only reduce producers' revenues since supplies on the market during the peak season are limited by the storage policies of PBDAC vis-à-vis private traders. The manufacturers can increase the proportion of their output sold at higher domestic prices during the season of peak demand for fertilizer only by increasing storage capacity.

Table 15 shows the prices of imported fertilizers in the period between 2000 and 2002.

Storage problems occur as long as the weekly production capacity of the plants cannot meet peak weekly demand. In the long run, investment in adequate storage capacity by distributors will require much lower ex-factory prices for fertilizer during the off season, in order to cover the costs of storage until the peak season. If these lower prices are made available to all distributors equally, none will be able to profit by selling immediately, at a high current price, quantities intended for storage. The only way to sell at the high price would be to hold the product until the peak season. Past efforts by the producers to persuade dealers to increase the amounts stored have been ineffective, largely because the discounts intended to cover storage costs have been made available to only a few traders, and have been too small to cover the full cost of storage.

TABLE 15
Prices of imported fertilizers

Year	Fertilizer	Price (US$/tonne)
2000	Ammonium sulphate	58
	Ammonium nitrate	40
	Calcium nitrate	100
	Potassium sulphate	167
2001	Urea	463
	Ammonium sulphate	63
	Calcium nitrate	116
	Potassium sulphate	167
2002	Ammonium sulphate	56
	Calcium nitrate	106
	Potassium sulphate	177

Source: MALR, 2003.

Private dealers are actively weighing up several investment projects that promise to increase competitiveness and quality in local fertilizer production and marketing. Two companies are considering bulk blending operations and one is expanding its extension and training services for dealers in the use of such fertilizers. Some are considering additional investment in storage.

Chapter 9
Future outlook

The entire fertilizer sector faces drastic changes as a result of changing production and trade policies such as the removal of the price controls and subsidies, the production of new types of fertilizers, the increased role of the private sector and the use of modern methods for determining crop fertilizer requirements according to variety, location, and farming system.

PROPOSALS FOR IMPROVING SOIL FERTILITY MANAGEMENT

The efficient and proper use of fertilizers is essential for increasing soil productivity. Soil productivity and soil fertility levels change over time and on-going studies are required. The following are some proposals for helping to improve the use of fertilizers:

Soil and plant tissue analysis

Reliable systems of soil and plant tissue testing need to be developed to complement the results obtained from field trials. Much has been done in this area but there is a need for more work to establish the critical limits of major and micronutrient elements for various soils and crops.

Assessment of the fertilizing value of some fertilizers for soil or foliar application

Many mixed and compound fertilizers have been introduced to the farmer before evaluation of their effectiveness and their suitability under different agroclimatic conditions.

Direct and residual effect of some biofertilizers and organic manures

In Egypt, soils are poor in organic matter, with less than two percent in most soils. However, very few studies have been conducted on the use of organic manures and biofertilizers, in spite of the fact that these organic manures improve the physical, chemical and biological characteristics of the soil, as well as conserving the environment from pollution.

Preparation of fertilizer recommendations for newly released crop varieties

Crop breeders are developing new varieties of various crops, with a high yield potential. Before the introduction of these new varieties to the farmer, high priority should be given to the development of appropriate fertilizer management techniques, to ensure that appropriate fertilizer recommendations are available.

Development of new types of complex fertilizers

NP, NPK, PK, NPK fertilizers plus microelements should be developed that are suitable for drip and sprinkler irrigation systems used especially in the newly reclaimed areas.

Nutritive value of food crops and cooking quality as affected by fertilizer applications

Very few studies have been carried out on the nutritive value and cooking quality. The main objective of this proposal is to improve the nutritive value and the cooking quality of food crops through the efficient use of fertilizers.

Direct and residual effect of different sources of phosphorus

Most studies carried out to evaluate different sources of phosphate have focused on the direct effect of these sources. Very little work has been done to evaluate the residual effect of these sources by means of long-term experiments. The fertilizing value of various sources of phosphate should include both the direct and the residual effect of the different sources under different cropping systems.

Preparation of nitrogen balance sheets for the main field crops in Egypt

The objective of this would be to study the rate of the fertilizer nitrogen applied to the main crops, using different sources of nitrogen and time and method of application, in order to increase the efficiency of fertilizer nitrogen and to reduce nitrogen losses (Hamissa, 2000).

Strengthening of extension service system

The objective of this is to communicate more effectively to the farmer new techniques in fertilizer management and thus to improve the efficiency of their use.

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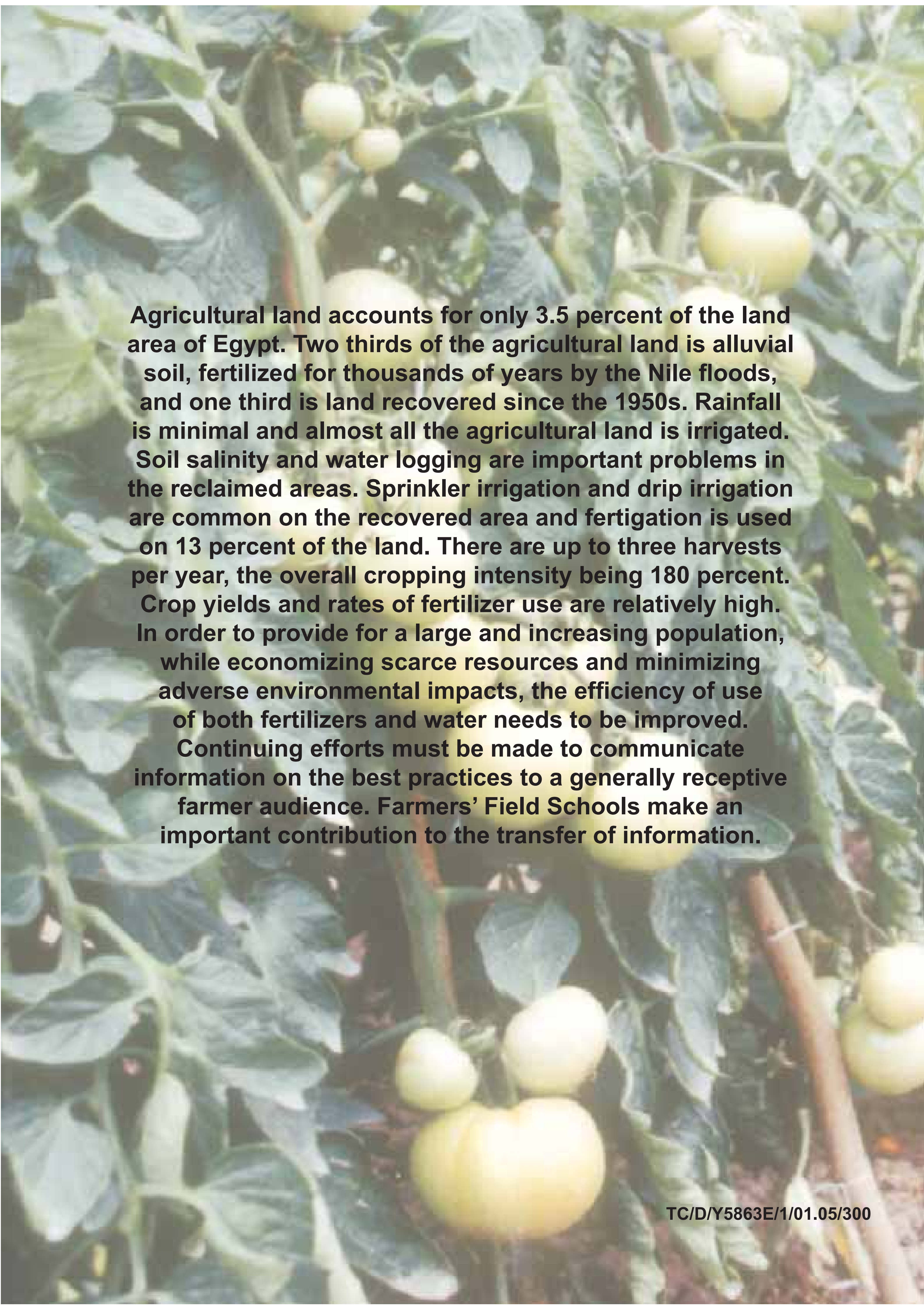

Agricultural land accounts for only 3.5 percent of the land area of Egypt. Two thirds of the agricultural land is alluvial soil, fertilized for thousands of years by the Nile floods, and one third is land recovered since the 1950s. Rainfall is minimal and almost all the agricultural land is irrigated. Soil salinity and water logging are important problems in the reclaimed areas. Sprinkler irrigation and drip irrigation are common on the recovered area and fertigation is used on 13 percent of the land. There are up to three harvests per year, the overall cropping intensity being 180 percent. Crop yields and rates of fertilizer use are relatively high. In order to provide for a large and increasing population, while economizing scarce resources and minimizing adverse environmental impacts, the efficiency of use of both fertilizers and water needs to be improved. Continuing efforts must be made to communicate information on the best practices to a generally receptive farmer audience. Farmers' Field Schools make an important contribution to the transfer of information.

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