INTRODUCTION

With an area of more than 1,648 thousand sq. kms (The 16th largest country in the world), Iran is situated in the eastern part of the northern hemisphere, in south-west of Asia. Geographically, Iran is located between 44° 05′ and 63° 18′ east longitude and 25° 03′ and 39° 47′ north latitude. The elevation ranges from below sea level to more than 5,000 meters above sea level. The temperature fluctuates between –30°C to 50°C and annual precipitation varies from about 25 mm in the Central Plateau to over 2,000 mm in the Caspian Coastal Plain with an average of 250 mm. Approximately 90% of the country is arid and semi-arid.

Central Iran is a steppe-like plateau with hostile climate, surrounded by desert and mountains (Zagros on the western border and Alborz to the north). Underground water irrigates the oases where a wide variety of grains and fruit trees are cultivated. The shores of the Caspian Sea have a humid climate and are suited to tropical and subtropical crops (citrus, cotton, rice and tea). The annual evaporation loss is high, ranging from about 700 mm along the Caspian Sea shores to over 4,000 mm in the Central Plateau and southern part of the Khuzestan and Southern Coastal Plains in southwest, amounting to 16 times the annual average rainfall (250 mm) (Moameni, 2000).

Currently, the total area of cultivated lands in the country is about 15.5 million ha, of which 7 m ha (45%) are under irrigated agriculture (including fallow) with an average holding size of 2.9 ha, and 8.5 mha (55%) are under dry farming with an average holding size of 6.4 ha (Figure 1). About 90% of the irrigated lands are under annual crops (including fallow) and the remaining 10% are used for production of perennial crops (mostly orchards). In rainfed areas, the annual crops constitute about 98% of the total production (Moameni, 2000).

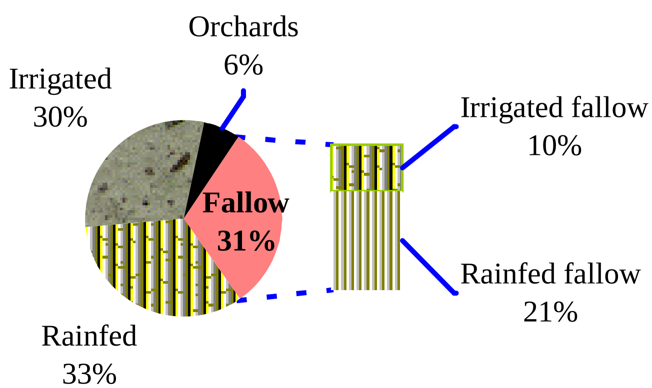

Fig. 1- Distribution of major kinds of agricultural land use in Iran (Moameni, 2000).

Soil survey and land classification studies during the past 50 years reveal that the majority of land resources possess various degrees of limitations (either individually or in combination) related to soil properties, salinity and alkalinity, topography, erosion and drainage, which limit economic and sustainable crop production.

The results of soil survey and land classification activities in Iran (reconnaissance, semi-detailed and detailed, obtained from 1953 to 2000) shown that of a total of 20 mha land areas surveyed from 1953 to 2000 (including the majority of cultivated lands), good-quality lands (class I lands) cover only 1.3 mha (6.5 %). The remaining lands have various degrees of limitations and/ or hazards for irrigation farming.

There exists approximately 4 main soil-order types in Iran. i.e. Entisols, Aridisols, Inceptisols, and Alfisols. According to Dewan and Famouri (1964), the most important soils of plains and slopes consist of alluvial, colluvial, humic-clay and various kinds of salt-affected soil belonging to major classes Aridisol, Entisol, Inseptisol, and Alfiso. Due to their origin, many soils of the country are rich in $CaCO_3$ and classified as calcareous. Plant availability of most nutritional elements, especially micronutrients, is low. The percent of dominant soil types are given in figure 2.

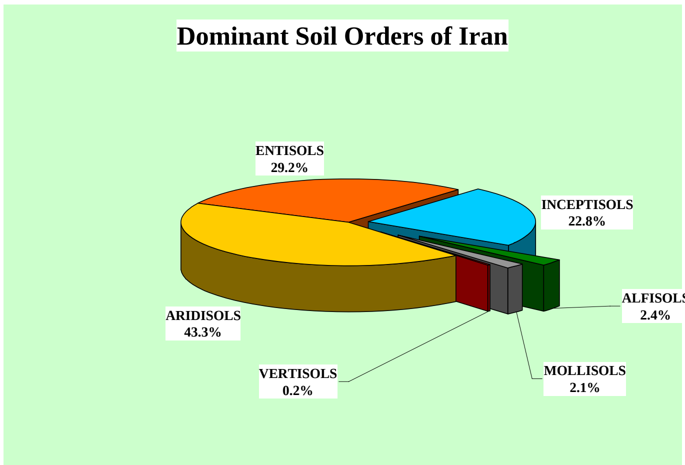

Fig 2. Dominant soil orders of Iran.

Class I lands do not possess hazards of limitations of soil, salinity, topography or drainage, for irrigation farming under existing conditions and are capable of producing sustained high yields of a wide variety of climatically adapted crops, at reasonable costs under good management. Owing to the absence of apparent hazards or limitations at present, these lands are considered highly sustainable for irrigation farming and have a high income potential under normal conditions of soil and water management. However, in the semi-arid conditions of the country their productive capacities are threatened by mismanagement. If a sustainable crop production is to be practiced, changes in their quality under irrigation farming must be monitored through long-term studies.

Lands having slight to moderate hazards and/or limitations of soil, salinity, topography or drainage, for irrigation farming (class II + class III lands) cover about 9.5 Mha (about 48% of the total land areas surveyed). Moderately suitable lands for irrigation (class II lands) are either adapted to a somewhat narrower range of crops than for class I land or are more costly to prepare for irrigation (drainage, leveling, etc). At the present conditions these lands are expected to give lower yields, compared with class I lands. Marginally sustainable lands for irrigation (class III lands) either have restricted crop adaptability or are expected to give lower yields than those of class II lands, or demand more costly land improvement and land preparation works or more costly management practices. The problematic lands (class IV+class V+ class VI lands) cover about 8 Mha (40.5% of the surveyed area) and undifferentiated lands (complexes) 1.0 Mha (5%). The annual rainfall in the past two decades is shown in table 1 and figure 3. The agriculture sector in Iran depends on rainfall in many places.

Table 1. Average rainfall in the country in the last two decades

Year	Average Rainfall (mm)	Year	Average Rainfall(mm)	Year	Average Rainfall (mm)	Year	Average Rainfall(mm)
84-85	192	89-90	223	94-95	282	99-00	148
85-86	238	90-91	238	95-96	331	00-01	182
86-87	261	91-92	314	96-97	205	01-02	254
87-88	282	92-93	339	97-98	314	02-03	247
88-89	176	93-94	202	98-99	195	03-04	243

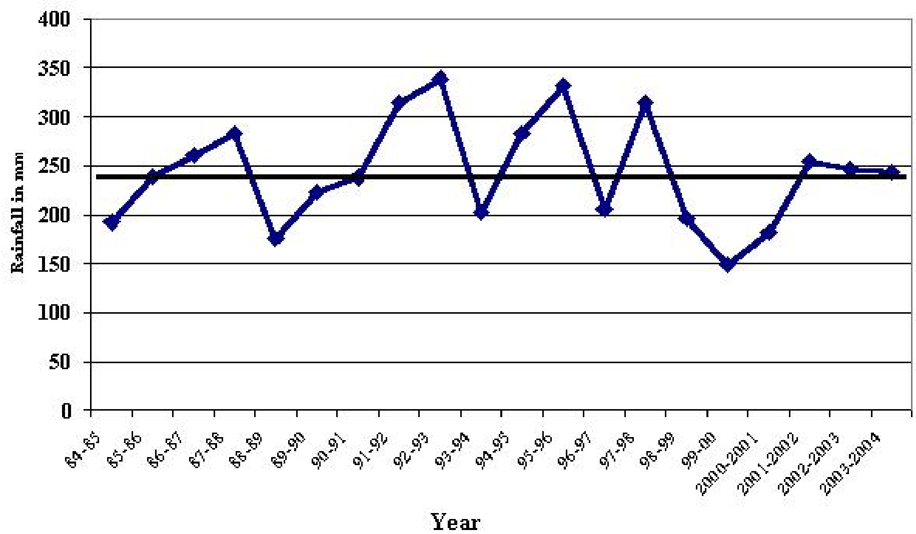

Fig 3. Trends of average rainfall changes in the past two decades (1984-2004).

The status of food production in Iran:

As an important sign of sustainable development, each country should be able to prepare enough food for its people. An approximation of relative share of food in Iran’s national economy is quite revealing. A recent estimate showed that the food sector roughly accounted for 40% of Iran’s Gross National Product (GNP) in 1993 and 40% added value in the national economy in the same year. It is also interesting to note that the food sector was 1.8 times the size of agriculture, 89 times that of mines, twice the size of industries and five times that of the oil industry. These figures clearly show the extent to which our national economy is food-dependent. Also, they clearly explain the fact that food security has a high position on our national development agenda (Malakouti, 1996). The agriculture sector has a prominent place in social and economic development in Iran. It accounts for 17 % of Gross Domestic Product (GDP) (at fixed price in 1991), 20% of non-oil exports, 25% of employment opportunities, over 80% of food supply, and 90% of raw materials needed for industrial use (Center for Agricultural Planning and Economic Studies, 2003). The agriculture sector consists of four subsectors including farming, livestock, forestry and fisheries. The farming subsector, with a 57 % share in added value in agriculture, is the largest (Ministry of Agriculture, 1996). Since the country has a long history of agriculture, its in habitants have already occupied almost all fertile lands. In the more recent past, however, there had been slight increase in the total area under cultivation, achieved through bringing under cultivation the barren lands and natural resources lands with marginal agricultural potentials (gravelly lands, salt-affected lands, rangelands). By comparing the 1973 and 1998 agricultural censuses, it became clear that in a quarter of a century only 483,000 ha (2.8%) of new land areas were brought under cultivation (Moameni, 2000). On the other hand, the negative water balance implies that (1) no more new land can be brought under cultivation and (2) the country is already facing a critical situation regarding the management of water resources and sustainable food production in existing cultivated lands (Moameni, 2000). As it is clear from above-mentioned information, we cannot focus on increasing the area of cultivated lands. Instead, we should emphasize crop intensification to achieve our goals. The agricultural production situation has been further aggravated by land degradation caused by water and wind erosion, salinization and soil fertility decline. Therefore, intensification of crop production is needed to compensate for land and water scarcity.

It is clear that different factors are involved in agricultural production, e.g., water, pest management, soil fertility, etc. But s*oil fertility is widely acknowledged as a key element in the development of global food security and sustainable agricultural systems (*Balali *et al.*, 2003*)*. In addition, FAO findings indicate soil enrichment, through adding fertilizers, was responsible for over 55% of the growth in the agricultural outputs during the last three decades (Hamdallah, 2000). As it is evident, several factors are involved in fertilization, which include consumption, production, recommendation, methods of application of fertilizers and as a goal, integrated nutrient management. These are further explained as follow:

Our main policies in agricultural production are: determination of production capacity of soil and water resources; increasing water and fertilizer use efficiency; improving yield and total production of agricultural crops, with due attention to environmental issues; enrichment of agricultural products for improving food quality in accordance with known human health principles; and monitoring changes in the quality of soil and water resources under intensive farming.

Soil fertility is a key element in food security for the country. In the past three decades, fertilizer consumption has increased but without a balanced supply of nutrients. Lack of balance has been one of the reasons for low yields. Since 1995, however, by applying integrated nutrient management in the country led to increase in crop yield. Since 1995, we have vigorously pursued the objectives of balanced fertilization to improve the quality and yield of major crops, curb environmental pollution caused by the indiscriminate use of mineral fertilizers, protect of natural resources, and enhance the nation's health and nutritional standards.

The improvements in fertilizer usage for the country are recorded in table 2. As may be seen, the fertilizer use ratio of nitrogen (N), phosphorus (P_2O_5), potassium (K_2O), and micronutrients based on our data has improved from 100-76-00+0% in 1991 to 100-44-15+1% in 1999 and should improve to 100-50-30+4.0% in 2010 provided that the materials are available for application in time (Malakouti, 1996; Bybordi *et al.*, 2000; Malakouti, *et al.*, 2001; Malakouti, *et al.*, 2004).

Table 2. Fertilizer usage trends in Iran for different years and as predicted for 2004 (in thousand tons)

Type of fertilizer	1991		1995		1999		2004	
Urea	920	44.5%	932	48.2%	1,372	55.4%	1,727	45.6%
Ammonium nitrate	120	5.7 %	140	7.2%	158	6.5%	175	4.6%
Ammonium sulfate	12	0.5%	6	0.3%	28	1.2%	150	4.0%
Ammonium phosphate	1,020	49.3%	820	42.4%	371	14.9%	413	10.9%
Triple super phosphate	-	-	27	1.4%	324	13.3%	350	9.3%
Potassium sulfate	-	-	10	0.5%	128	5.1%	150	4.0%
Potassium chloride	-	-	-	-	85	3.4%	100	2.7%
Sulfur coated urea	-	-	-	-	4	0.1%	20	0.5%
Ammonium phosphate sulfate	-	-	-	-	-	-	300	7.9%
Single super phosphate	-	-	-	-	-	-	80	2.1%
Microbial phosphate fertilizer	-	-	-	-	-	-	10	0.3%
Golden bio-phosphate	-	-	-	-	-	-	10	0.3%
Complete macro-fertilizer*	-	-	-	-	4	0.1%	200	5.3%
Sulfur fertilizer	-	-	-	-	-		15	0.4%
Organic granulated sulfur	-	-	-	-	-		50	1.3%
Zinc sulfate and other fertilizers	-	-	-	-	-		30	0.8%
Total	2,072	100%	1,935	100%	2,470	100%	3,780	100%
$N:P_2O_5:K_2O$+ micronutrient	100-76-00+0%		100-63-01+0%		100-44-15+0.8%		100-50-15+1.5%	

*** The formula for complete macro-fertilizer is 15-10-15+1% Zn**

With respect to fertilizer recommendations, supplying and distribution of the materials as well as their applications; the main problem is with the untimely supply and distribution despite many efforts that have been made in making fertilizer recommendations on the basis of scientific findings. However, a national resolve to apply the process of balanced fertilization starting from recommendations to usage seems necessary. The following steps are therefore recommended:

- Legislation of a comprehensive fertilizer law.
- Using subsidies intelligently by informing the Ministry of the requirement.
- Finalization of a comprehensive plan to carry out soil testing on a national basis (by giving support to private labs; monitoring of natural resources) through the Management and Plan Organization which could be the most important government guarantee of the program of balanced fertilization in the country

History of fertilizer use in Iran:

Before 1945, there was no farmer who had either used or even seen chemical fertilizers. It was in that year that its production started in the country in a small factory near the city of Karaj and within 10 years it had reached a production potential of around 60 tons. The main products where Single Super Phosphate, Thermophosphate, Bone powder and Potassium nitrate. It was in 1955 that 176 tons of Chemical fertilizers were imported in the country by the government for the first time. Along with this import the private sector too purchased 305 tons of chemical fertilizer. Later the Sugar factory too started imports on its own. These imports and subsequent imports were met by warm reception by the farmers. In the sixties there were more than 17 different types of chemical fertilizers in the country including 5 different N-fertilizer, 4 P-fertilizers, 3 types of K-fertilizers and more than 5 varieties of mixed fertilizers.

In the seventies the govt. banned imports by the private sector and with the establishment of Razi Petro-chemical industries, production started inside the country. This company mainly produced Triple superphosphate, Diammonium Phosphate and Ammonium sulfate.

In the eighties due to subsidies on price of fertilizer by the govt., vast and varied amount of fertilizer was imported into the country. Out of the total of 14.8 million tons imported 37% was urea, 60% was Diammonium phosphate and only 3%

were other fertilizers. In the past decade or so the trend for fertilizer use and supply has been changing slowly towards more realistic ones with more Triple phosphate and micronutrients being used and the ratios of nutrients approaching international levels.

Table 3. Trends of fertilizer use and fertilizer use ratio during the past 4 – decade

Years	**Average amount fertilizer used per year (1000 tons)**	**Ratio ($N:P_2O_5:K_2O$)**
1961-1969	110	100:68:07
1970-1979	630	100:75:01
1980-1989	1500	100:83:01
1990-1999	2200	100:70:08
2000-2005	3000	100:55:18

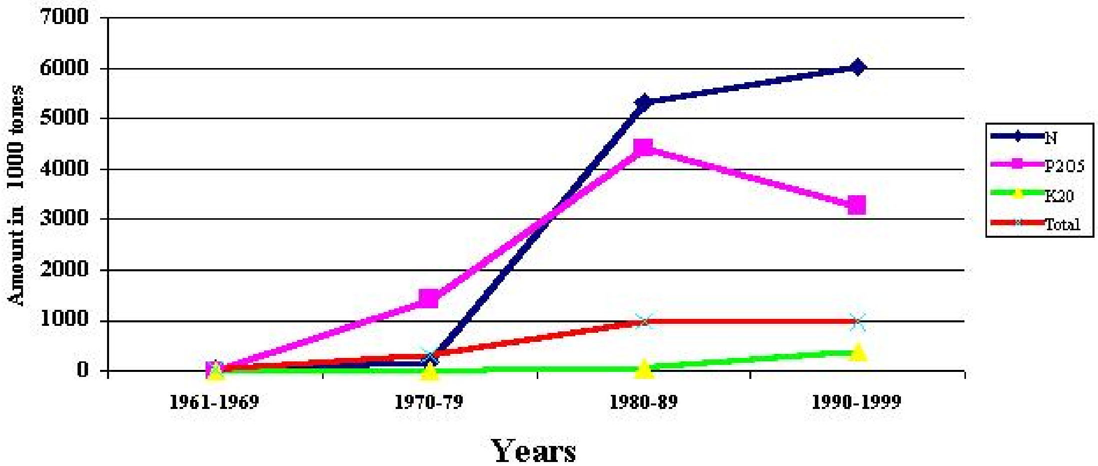

Fig 4. Trends in fertilizer consumption changes during the past 4 - decade.

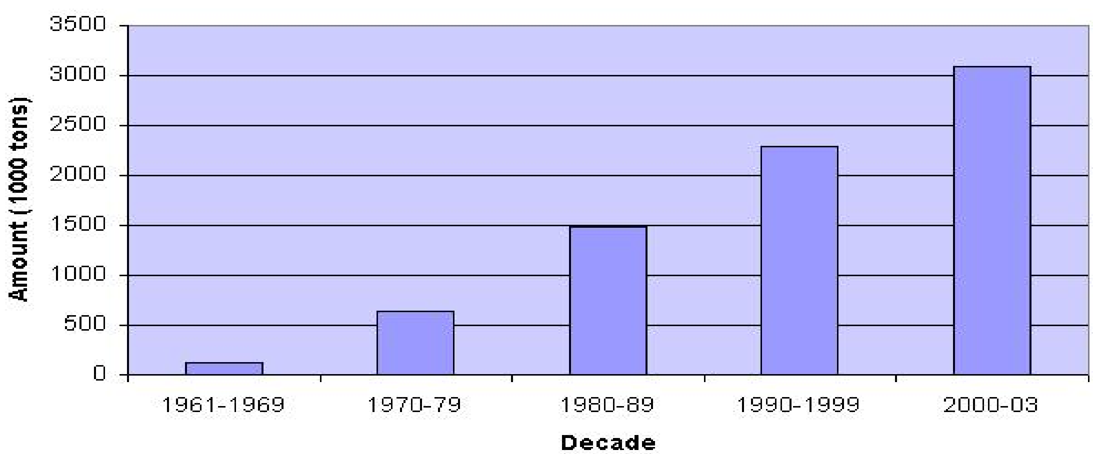

Fig 5. Increasing fertilizer use in Iran during the past 4 - decade.

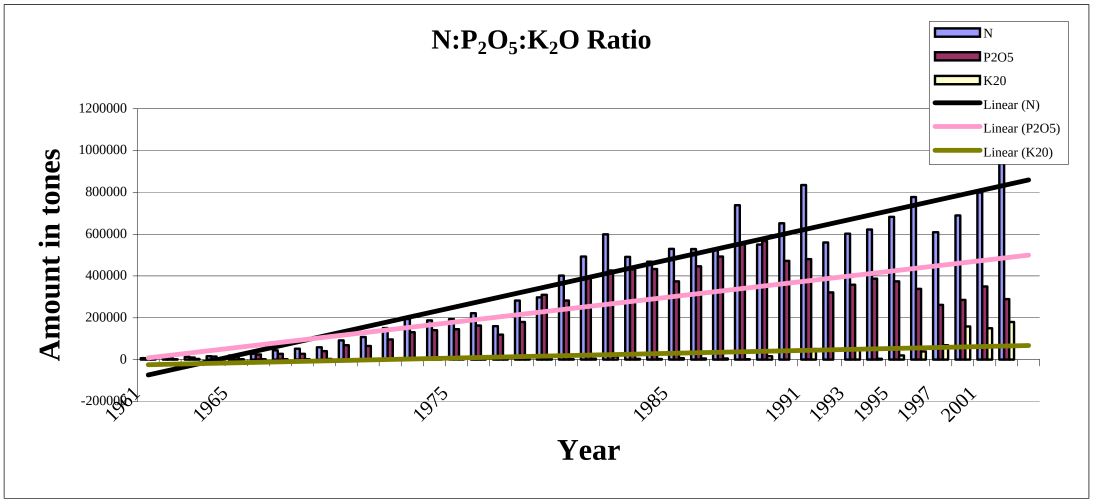

Fig 6. Amount of N, P and K-fertilizers use during the past 4 - decade.

It is assumed that the higher fertilizer use efficiencies (FUE) in some parts of the country is manly due to higher soil organic matter content or the optimal use of organic fertilizers, especially manure. During dry years, about 8 to 12 percent of total production comes from dry-land areas. However, in wet years this figure can rise to 35%. One of the reasons for low FUE is due to the current subsidy for fertilizer in the country, which also contributes to smuggling of fertilizers to neighboring countries (Statistics and Information Technology Office. 2001/2004). It is important to note that the above given major crops covers only the maximum crop land under cultivation of different crops. There are many other crops grown in the provinces, which have not been mentioned.

In table 4 total cultivated area (irrigated and rainfed), total fertilizer use (irrigated and rainfed) and total agricultural products (irrigated and rainfed) in different agroecological zones in 2001-2002 is shown. Approximately 44 percent of the cultivated crops are rainfed and they produce only 12% of the total crops (in wheat up to 35 percent) but, 90% of the orchards are irrigated (Agricultural Support Service Company. 2004 and Agronomy Department, 2004; Malakouti *et al.*, 2004).

Table 4. Total cultivated area, total fertilizer use and total agricultural production in different agroecological zones in 2001-2002

Zone No.	Agroecological zones	Cultivated area* (1000 ha)			Total fertilizer use (1000tons)			Total agricultural production (1000 tons)		
		Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total
1	Central Zone	881.4	269.1	**1150.5**	239.0	60.9	**299.9**	7,444.9	188.4	**7,633.3**
2	Caspian Coastal Plain Zone	840.1	640.3	**1,480.4**	262.0	107.0	**369**	4,598.3	3,109.9	**7,708.2**
3	North Western Zone	1828.6	2356.9	**4,185.5**	263.8	182.7	**446.5**	9,655.3	1,929.6	**11,584.9**
4	Central Zagros Zone	691.2	1621.8	**2,313.0**	322.6	101.3	**423.9**	5,332.6	188.4	**5,521.0**
5	Khuzestan Zone	623.1	357.9	**981.0**	228.3	77.6	**305.9**	7,723.0	438.3	**8,161.3**
6	Arid Central Zone	517.6	96.7	**614.3**	238.7	62.8	**301.5**	4,807.0	125.9	**4,932.9**
7	Southern Zagros Zone	929.3	423.5	**1,352.8**	352.7	108.0	**460.7**	8,650.3	597.2	**9,247.5**
8	Southern Coastal Plain Zone	196.6	182.8	**379.4**	40.7	10.1	**50.8**	2,129.8	101.6	**2,231.4**
9	Arid Southern Zone	715.6	13.7	**729.3**	211.3	44.4	**255.7**	4,598.1	24.9	**4,623.0**
10	Khorasan Zone	1042.5	530.6	**1,573.1**	277.9	83.8	**361.7**	7,610.0	353.8	**7,963.8**
	Total	**8,266**	**6,493**	**14,759**	**2,437**	**839**	**3,276**	**62,549**	**7, 058**	**69,607**

Agricultural Support Service Company. 2004 and AgronomyDepartment, 2004

Fertilizer Strategies:

Currently unavailability of certain essential fertilizers is a bigger impediment than the cost of the materials for improving crop yields. Considering crop yield targets of the Fourth National Development Plan (2005-2009), promoting soil testing on a national scale as well as balanced application of fertilizers is of primary importance, rather than fertilizer subsidies which have only served as a serious disincentive for soil testing and for careful and scientific fertilizer usages and should be discontinued. Instead the subsidies for high quality strategic crops should be increased or the money saved by discontinued fertilizer subsidies should be appropriated for improving organic matter status of our soils. The government of Iran has subsidized all the chemical fertilizers for the past three decades. The subsidized amount until two years back where the total production was less that three million tons was 70 million dollars. This amount was exclusive of the production by the Iranian petro-chemical industry, which was asked to produce and sell fertilizers at reduced prices. Due to increase in the amount of fertilizer used i.e. 3,276 and 3,700 million tons in the years 2002 and 2004 respectively and the increased cost of fertilizers, the fertilizer subsidy given by government has been around and more than 200 million dollars. This subsidy is a big obstacle implementation of the correct utilization of fertilizer and the practice of balanced fertilization in the country. No exact figures are available for the production or use of manure in the country. Unofficial sources put the total amount of cattle and poultry manure produced at 31 million tons, where 30% or so of this amount is burnt as fuel by the poor farmers who cannot afford other types of fuel. Out of the remaining 70% a part is just buried without use and the rest is used as fertilizer in the field. Currently there are some private companies, which are involved in the production of bio-fertilizers and compost. The municipal cooperation of major cities too are involved in the production of compost and vermi-compost directly. But there again is no record of their production and sales. Regarding our objectives to increase the yields of food crops by promoting balanced application of fertilizers, production and application of biological fertilizers have been launched during the last four years in the country, improving yields of field crops and fruit products. Only in the past year several plants with good capacities for the production of biological fertilizers have started operating. Fertilizer subsidies have worked against the practice of balanced use of fertilizers because of poor management in production and distribution of nutrient materials.

Table 5. Relationship between average annual rainfall, total fertilizer use, nutrient ratios, and total agricultural production in the past 12-years (1991-2004)

Year	Annual average rainfall (mm)	Total fertilizer use (1000 tons)	Total agricultural production (10^6 tons)	N-P_2O_5-K_2O+ micronutrient-fertilizer ratios	Fertilizer use efficiency (FUE)* (kg/kg fert.)
1989-1990	238	2,114	45.4	100-75-00+0.0%	10.8
1991-1992	314	2,608	62.5	100-70-00+0.0%	12.0
1993-1994	202	1,946	53.3	100-70-03+0.0%	13.9
1994-1995	282	1,933	54.7	100-63-01+0.0%	14.2
1995-1996	231	2,225	55.9	100-54-08+0.2%	12.6
1997-1998	314	1,942	65.0	100-43-06+0.5%	11.8
1998-1999	195	2,400	60.7	100-44-15+1.0%	12.7
1999-2000	148	3,100	57.0	100-50-14+1.2%	9.2
2000-2001	182	3,060	59.1	100-40-18+1.7%	9.7
2001-2002	254	3,275	71.3	100-51-15+1.5%	10.9
2002-2003	247	2,880	76.5	100-39-11+1.0%	13.5
2003-2004	243	3,100	77.2	100-50-15+1.0%	12.5

New achievements and future view of Integrated Nutrient Management:

Land degradation becomes severe when biophysical, socio-economical and ethical aspects of land degradation over lap(figure 7). Sustainable agriculture calls for an integrated approach to reduce the problem. To solve the research problem, a complex method will be used to integrate the degraded biophysical land properties with socio-economic and ethical aspects of land degradation to find the missing link between sustained crop production and land stewardship. The aim is to investigate sustainability of current land use systems and compare it with that of the past land use systems to find ways to improve the present activities through stimulation of land ethics.

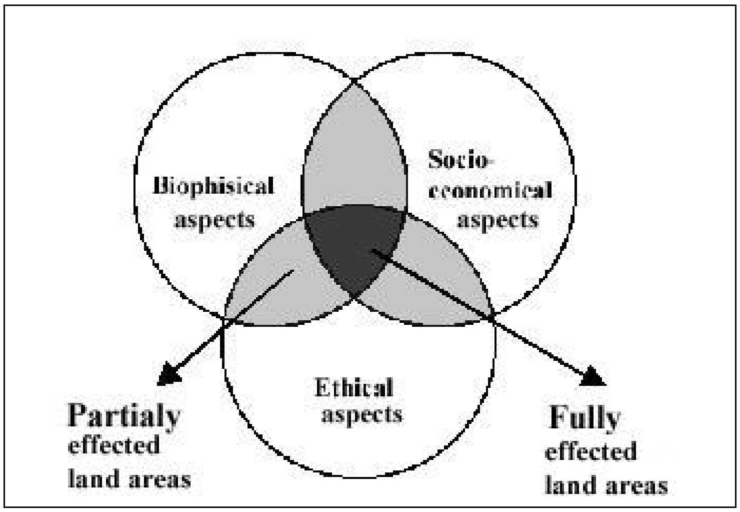

Figure 7. Over lap of three aspects of land degradation.

In Iran, regional experiments were first done and based on the findings, some regional recommendations were prepared. Later on, fertilizer recommendations were introduced by Soil and Water Research Institute (SWRI) based on soil test or leaf analysis to improve soil fertility, so more than 100 private soil testing labs have been established all over the country. The current facilities allow extending soil test and planting analysis over the whole country. To justify the agricultural activities, a committee (The High Council for the Promotion of Biological Materials and Optimal Use of Fertilizers and Pesticides in Agriculture) was established in 1995 in the Ministry of Agriculture, aiming at: reducing the use of chemical pesticides by 40%; promoting the combined use of chemical and organic fertilizer for the purpose of protecting the environment and agricultural resources through maintaining a desirable level of soil fertility; controlling the quality of domestically produced and imported fertilizers particularly for Cd and Pb content; emphasizing on production and consumption of slow-release fertilizers like SCU in areas with high precipitation such as Caspian coastal plain to reduce N-leaching; and allocating government subsidies to newly introduced chemical, organic and biological fertilizers.

In the past seven years, new horizons to balanced fertilization were opened and new achievements were reached in increasing the efficiency of fertilizers as well as water use efficiency, leading to more than 20% yield increase. Also the quality of crops which is important in promotion of human health was increased through enhancing concentration of the most beneficial elements such as Fe, Ca, Mg, and Zn.

Most of the research is concentrated around these fields:

- Innovative approaches to balanced fertilization;
- Identifying critical and optimum levels of nutrient elements in soil and plants;
- Improving health level of the society through fortification of agricultural products;
- Change in the fertilizer recommendation use, types of fertilizers and its common usage in the country;
- Correction of fertilizer application ratios in the country;
- Changing policies of fertilizers to suit the farmer in the country;
- Encouraging and guiding private sectors on production of fertilizers;
- Research on biological fertilizers including: Thiobacillus, Chickpea and Bean Rhizobium, Granulated phosphatic bacterial bio-fertilizers, Azotobacter bacteria, Mycorrhiza fungi, etc.,;
- Producing Vermi-compost out of agricultural residues for improving the situation of agricultural soils of the country;
- Achievement of technical knowledge in production of liquid humus fertilizer;
- Developing the soil fertility maps for the irrigated lands of the country;
- Monitoring changes in the quality of soil and water resources under intensive farming;
- Increasing water and fertilizer use efficiencies (WUE & FUE);
- Developing the computerized fertilizer recommendation for the main agricultural crops;
- Devising and implementing innovative methods for cost effective, systematic studies and land evaluation schemes to facilitate the collection of data adaptive to such advanced techniques as remote sensing (RS) and geographical information system (GIS) for the integration of different data on Iran’s soil resources;
- Improving plant-nutrient uptake by innovative fertilizing practices, including the band application of fertilizers for field crops, localized deep-placement of fertilizers mixed with barnyard manure in orchards, and acidification of irrigation water to reduce the pH in calcareous soils prior to fertilizer application;
- Increasing WUE as well as FUE by practice fertigation, despite salinity and drought problems which we are faced in our country and
- Balanced fertilization of various crops cultivated on the salt-affected soils irrigated with saline water.

Bibliography

- Agricultural Support Service Company. 2004. Fertilizer use data in the Islamic Republic of Iran during 2001-2004. Ministry of Jihad-e-Agriculture, Tehran, Iran.
- Agronomy Department. 2004. Fertilizer use data in the country during 2001-2004. Ministry of Jihad-e-Agriculture, Tehran, Iran.
- Balali, M. R., A. Moameni, M. J. Malakouti and M. Afkhami. 2003. Balanced soil fertilization towards sustainable agriculture and food security in Iran. Congress on Global Food Security and the Role of Sustainable Fertilization, FAO, Rome, Italy.
- Bybordi, M., M. J. Malakouti H. Amirmokri, and M. Nafici. 2000. Production and optimized consumption of chemical fertilizers in Iran towards sustainable agriculture. pp. 282. Ministry of Agriculture. Karaj, Iran

- Dewan, M. L. and J. Famouri. 1964. The soils of Iran. SWRI-FAO, Rome, Italy.
- FAO. 2004. Current world fertilizer trends and outlook to 2008/09. Food and Agriculture Organization of the United Nations, Rome, Italy.
- Hamdallah, G. 2000. Soil fertility management: the need for new concepts in the region. A Paper presented at Regional Workshop on Soil Fertility Management through Farmer Field Schools in the Near East, 2-5 October 2000, Amman, Jordan.
- Malakouti, M. J. 1996. Sustainable agriculture and yield increase through balanced fertilization. Pp. 350. Ministry of Agriculture. Karaj, Iran.
- Malakouti, M. J., N. Nafici, and B Motesharrezadeh. 2001. National effort for production of fertilizers as a step toward self-sufficiency and sustainable agriculture. pp. 420. Ministry of Agriculture. Karaj, Iran.
- Malakouti, M. J., Z. Khoughar, and Z. Khademi. 2004. Innovative approaches to balanced nutrition of wheat-A compilation of papers. pp. 851. Agronomy Department. Ministry of Jihad-e-Agriculture. Sana Pub. Co., Tehran, Iran.
- Moameni, A. 2000. Soil use potentiality map of Iran. Soil and Water Research Institute. Ministry of Agriculture, Tehran, Iran.
- Moameni, A. 2003. An appraisal of land resources of Iran: A contribution to a project on *Framework for Sustainable Agricultural Development Strategy in Iran* under the auspices of FAO. FAO Office, Ministry of Jihad-e-Agriculture, Tehran, Iran.
- Statistics and Information Technology Office. 2004. A statistical glance at agriculture in the Islamic Republic of Iran during 2001-2004. Deputy of Planning and Economy Ministry of Jihad-e-Agriculture, Tehran, Iran.