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THE TECHNOLOGY OF THE MAIN AGRICULTURAL PRODUCTS ORGANICALLY GROWN IN THE REPUBLIC OF IRAQ

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Abstract

Agriculture in Iraq represents a vital component of the country's economy. Prior to the development of the petroleum industry, agriculture was the primary economic activity in Iraq. Nowadays, there is a strong debate about which direction should Iraqi agriculture take, for its revival and for contributing to national wellbeing, taking also into account the growing competition for water and the challenges due to climate change. This study will be divided into four main sections, which is an introduction in which the literature will also be reviewed, the second main section will be dedicated to technology of agriculture in the present context, the third to organic agriculture the main products grown in Iraq. The last two important sections will be dedicated to the results, which will contain tables of statistical data followed by a discussion in which data will be interpreted, and it will end with the conclusions and recommendations.

Key words**:** *technology of agriculture, organic agriculture in Iraq, main agricultural products*

INTRODUCTION

The present research is situated in the field of agriculture, focusing on evaluating the technology of the main agricultural products grown organically in Iraq

1. What is the availability of technology of agriculture in Iraq?
2. What are the prospects of organic agriculture in Iraq?
4. What are the main agricultural products grown organically in Iraq?

Most analysts agree that Iraq has the potential for substantial agricultural growth, though currently the area of cultivatable land in Iraq is estimated to be around 12 million hectares, and currently, only about 50% of the total is actually cultivated.

In 1995, a national strategy for agricultural research and technology transfer was adopted, and researchers from the different institutions started participating in research planning and evaluation, holding joint field days, seminars, and writing joint publications. Working relationships with farmers, the extension services, and developmental agencies were highly improved. Adaptive research, in farmers' fields, is being conducted not only by extension agents, but also by faculty members. Iraq can be competitive in modern production technology, with the development of temperature controlled supply chains.

MATERIALS AND METHODS

This study involves the use of theory and statistical data. The theory may or may not be made explicit in the design of the research, although it will usually be made explicit in presentation of the findings and conclusions. In the paper the fallowing indicators have been used: arithmetic mean, coefficient of variation, average annual growth rate, ecologic indicators and statistical indicators.

The formulas used for to calculate these indicators, are:

$For\ the\ arithmetic\ mean = \bar{x} = \frac{\sum xi}{n}$,

where $\bar{x}$ = the arithmetical mean, xi= the average production values for a number of years (i); n= number of years taken into account

The average annual rate of growth [1] = r1990-1999 (and respectively r2000 – 20014)= $\sqrt{\prod\left(\frac{p1}{p0}\right) - 1;}$ where r1990-1999, and respectively r2000 – 20014= average

annual growth rate; $\prod\left(\frac{p1}{p0}\right)$ = entagled growth indicators

The research method followed the following steps, beginning with scientific databases research of the relevant articles concerning organic agriculture in Iraq and technology of the main agricultural products grown organically in Iraq, followed by an analysis and selection of the relevant data and the last step was extraction and summarization of the results based on interpretation and evaluation of data.

Data sources used are the USDA-PSD database, the FAO FAOSTAT database, and data provided from the ministry of Agriculture, Iraq.

RESULTS AND DISCUSSIONS

The main agricultural products in Iraq.

In Table 1, during 2000-2012, it appears that the arable land has decreased, and has an average of 9.9 %. The mean for forest area was 1.9 % of land, while the territory of permanent farmland was of 0.5 percent, showing an increase from 2000 to 2012. The territory of arable land showed a mean of 4,313.6 ha during this period.

Table 1. Evolution of how land use in Iraq during 2000-2012

Indicator	MU	2000	2006	2007	2011	2012	Average (2000-2012)	Stdev	C%	Growth annual
Arable land	Th. ha	4,100	4,800	4,950	4,000	3,427	4,313.6	514.6	11.93	-1.48
Arable land	%	9.4	11.0	11.3	9.2	7.9	9.9	1.2	11.70	-1.43
Territory permanent farmland	%	0.46	0.43	0.43	0.48	0.53	0.5	0.0	6.55	1.23
Forest area	Th. ha	818	825	825	825	825	823.4	2.5	0.30	0.07
	%vs2000		100.9	100.9	100.9	100.9	x	x	x	x
Forest area (% of land)	%	1.87	1.89	1.89	1.90	1.90	1.9	0.0	0.54	0.13
Average rainfall per year	mm	…	…	216	…	216	x	x	x	x

Data processed by:FAOSTAT Database 2000-2012

In Table 2, during 2000-2012, the arable land per person shows a decrease from 0.172 ha in 2000 to 0.105 in 2012, with a mean of 0.156 for this period. The annual growth was a negative one, -4.03. The land used for grain production, shows also a decrease from 2,490.4 in 2000 to 2,015.8 in 2012, with a mean of 2,594.9 for this period, while the cereal production, measured I kg/ha, shows an increase from 363.2 in 2000 to 1,742.9 in 2012, with an average mean of 1,286.3.

Table 2. Evolution of agricultural potential in Iraq during 2000-2012

Indicator	Mu	2000	2004	2007	2011	2012	Average (2000-2012)	St.dev	C%	Growth annual
Arable land per person	ha	0.172	0.169	0.172	0.126	0.105	0.156	0.028	17.95	-4.03
Land used for grain production	000 ha	2,490.4	2,783.6	2,966.8	2,374.3	2,015.8	2,594.9	646.5	24.91	-1.75
Cereal production	kg/ha	363.2	1,191.6	1,264.8	1,798.5	1,742.9	1,286.3	430.9	33.50	13.96
Value added in agriculture until 2005. constant worker	$ US	4,968.3	5,356.1	5,653.0	6,487.9	6,734.5	5,867.2	959.4	16.35	2.57
	%vs2000		107.8	113.8	130.6	135.5	x	x	x	x

Data processed by: FAOSTAT Database 2000-2012

According to Table 3, regarding the evolution of agricultural potential in Iraq, during 2000-2012, the annual growth of rural population decreased from 2.86% in 2000 to 2.32 % in 2012, with an average of 2.32 in 2012. The average was 2.5%. Improved water source access of rural population increased from 28.9 in 2000 to 68.5 in 2012, with a mean of 58.7 and a positive annual growth of 2.85. The poverty gap in the rural poverty line was 9.5, in 2007, that being the highest peak.

Table 3. Evolution of the main indicators of rural areas in Iraq for the period 2000-2012

Indicator	MU	2000	2004	2007	2008	2012	Average (2000-2012)	Stdev	C%	Growth annual
Rural population	Th. Pers.	7,498.3	8,345.6	8,946.1	9,144.7	10,042.2	8,754.5	815.3	9.3	2.46
	% vs 2000		111.2	119.3	121.9	133.9	x	x	x	x
Rural population growth annual	%	2.86	2.57	2.23	2.22	2.32	2.5	0.2	9.0	-1.72
Rural Population of total population	%	31.50	31.29	31.13	31.07	30.83	31.2	0.2	0.7	-0.18
	% vs 2000		99.31	98.80	98.63	97.84	x	x	x	x
Improved water source. rural of rural population with access	%	48.9	55.5	60.3	62	68.5	58.7	6.3	10.8	2.85
	% vs 2000		113.50	123.31	126.79	140.08	x	x	x	x
The poverty gap in rural poverty line	%			9.5		7.6	x	x	x	x
Report of the poor under the national poverty line of rural population	%			39		30.6	x	x	x	x
Employment in agriculture of total employment	%		17	15.1	23.4		x	x	x	x

Data processed by: FAOSTAT Database 2000-2012

In Table 4, regarding the evolution of the main indicators of rural areas in Iraq for the period 2000-2012, the annual growth of rural population showed an average of 2.5%. Employment in agriculture of total employment had the highest peak in 2007, 17%.

During 2000-2012 the Crop production index shows a mean of 102.8, with an increase from 2000, from 91.6 to 111.6 in 2012. It also shows an increase of food production index, from 100.8 in 2000, to 114.7 in 2012. The livestock production shows a mean of 110.7, with an increase as well from 123.1 to 110.7.

The main agriculture products grown in Iraq are wheat, barley, rice, vegetables, dates, cotton and cattle (FAOSTAT database).

Tables 4 and 5 below summarize the main crop areas, cropping systems and average yields in the country.

Table 4. Evolution of the main agricultural products in Iraq during 2000-2012

Indicator	MU	2000	2004	2007	2011	2012	Average (2000-2012)	Stdev	C%	Growth annual
Crop production index (2004-2006 = 100)	%	91.6	91.6	102.6	113.9	111.6	102.8	10.84	10.5	0.05
Food production index (2004-2006 = 100)	%	100.8	91.2	103.0	115.3	114.7	105.0	11.1	10.5	1.66
Livestock production index (2004-2006 = 100)	%	123.1	92.6	101.8	121.9	126.0	110.7	15.3	13.8	1.08

Data processed by: FAOSTAT Database 2000-2012

In 2010 and for the first time in Iraq, 37 farmers (Grapes growers) were organically certified and work is ongoing to increase the land organically cultivated and certified farmers.

Table 5. Access to basic agricultural inputs compared to 10 years ago

Region of respondent	More		Similar		Less		Total	
	no	%	no	%	no	%	no	%
South Iraq (n=7)	5	15.6	0	0.0	2	15.4	7	13.7
Central Iraq(n=7)	7	21.9	2	33.3	8	61.5	17	33.3
Kurdistan (n=28)	20	62.5	4	66.7	3	23.1	27	52.9
Total	32	100.0	6	100.0	13	100.0	51	100.0

Data processed by: Journal of International Agricultural Extension Education

Figure 1 shows the harvested wheat areas for different regions within Iraq. The large increase of wheat grown area after 1991 is likely due to a national policy to increase food production in Iraq, possibly induced by international economic sanctions. The average productivity of wheat is shown to rise steadily.

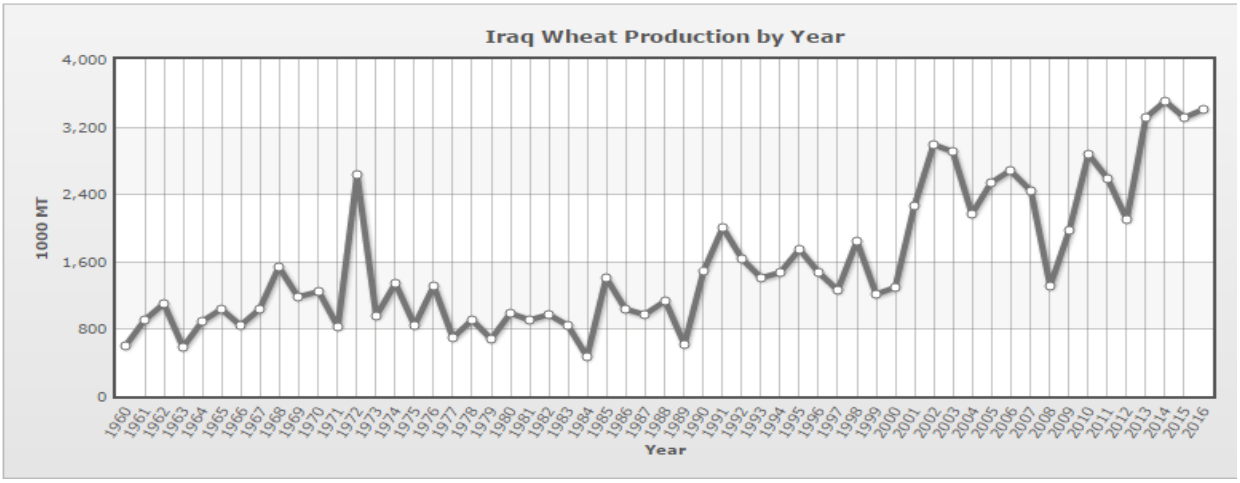

Fig 1. Iraq wheat production by year. (Data processed by:Ministry of Agriculture – GoI and FAOSTAT)

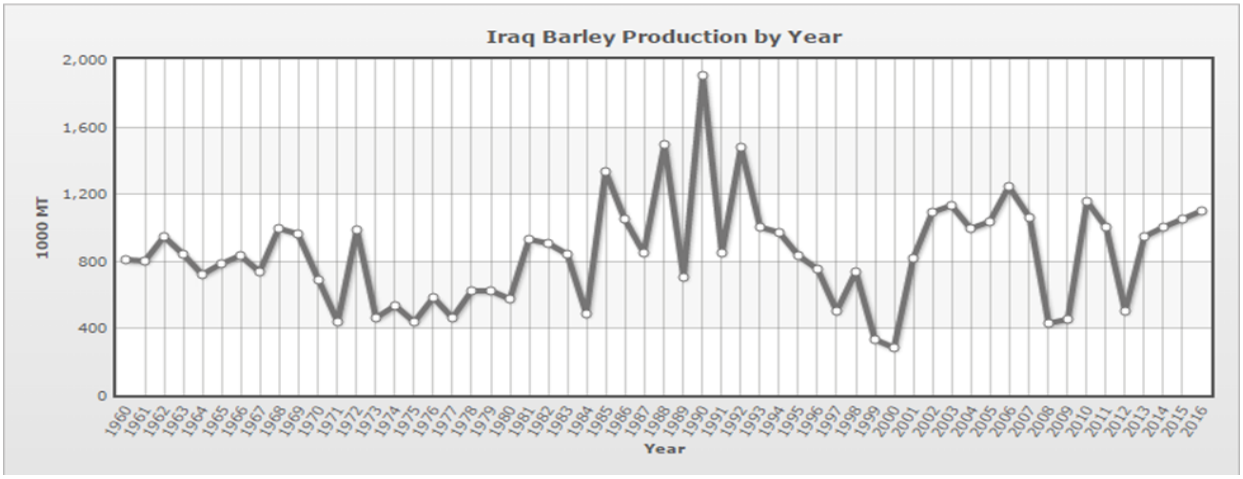

Fig 2. Iraq Barely production by year. (Data processed by:FAOSTAT Database 2000-2012)

The production of barley can be separated into three regions; Northern, Central and Southern Iraq.

According to figure 3, cotton is mentioned as an important crop in Iraq. The FAOSTAT database shows vegetables like cucumber and watermelon, and crops like sunflower in the same magnitude as cotton.

Haj (2010)[6] describes how cotton production was introduced and encouraged during the British Mandate period (1914-1932) as it was considered it would become a main export product, however, it did not become one. The table shows a decrease in production.

In Figure 4, the production of dates shows a large increase between 1994 and 2003, with a large decrease (more than 50%) after 2003. The production data for 2008 according to Williams (2009)[11] are lower than the reported values in FAOSTAT.

According to Figure 5, the production of rice in Iraq is mainly grown in four provinces in central and south Iraq, with a large concentration around Najaf. Rice varieties are long-grain aromatic types, considered in high demand in Iraq. The growing season of rice starts in July and ends in October-November. The productivity for rice during 1993-1999 appears lower than in other years, and corresponds to a period of high production of rice.

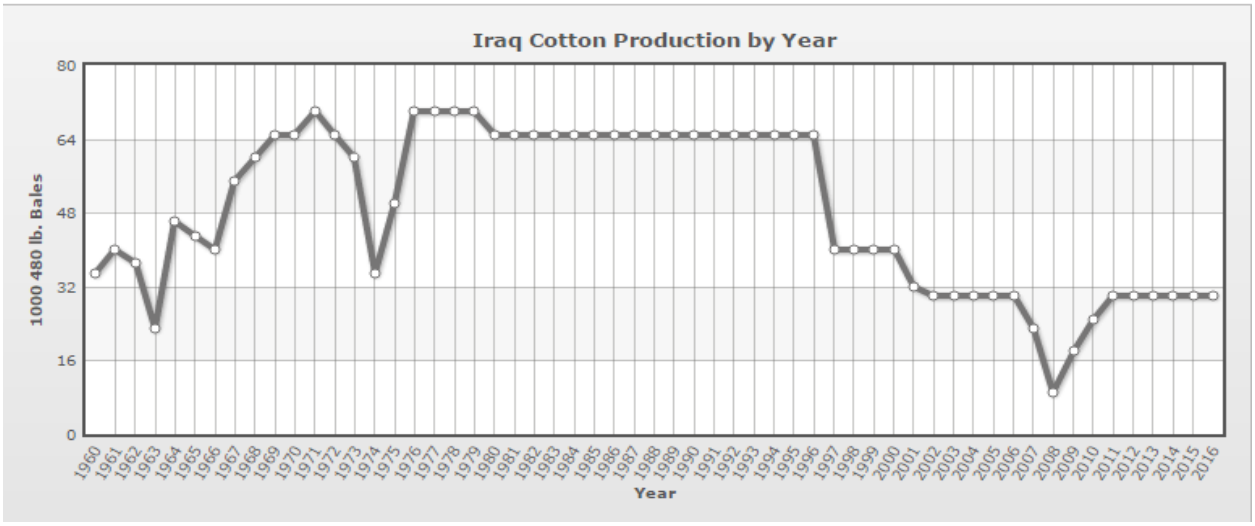

Fig 3. Iraq cotton production by year (Data processed by:FAOSTAT Database 2000-2012)

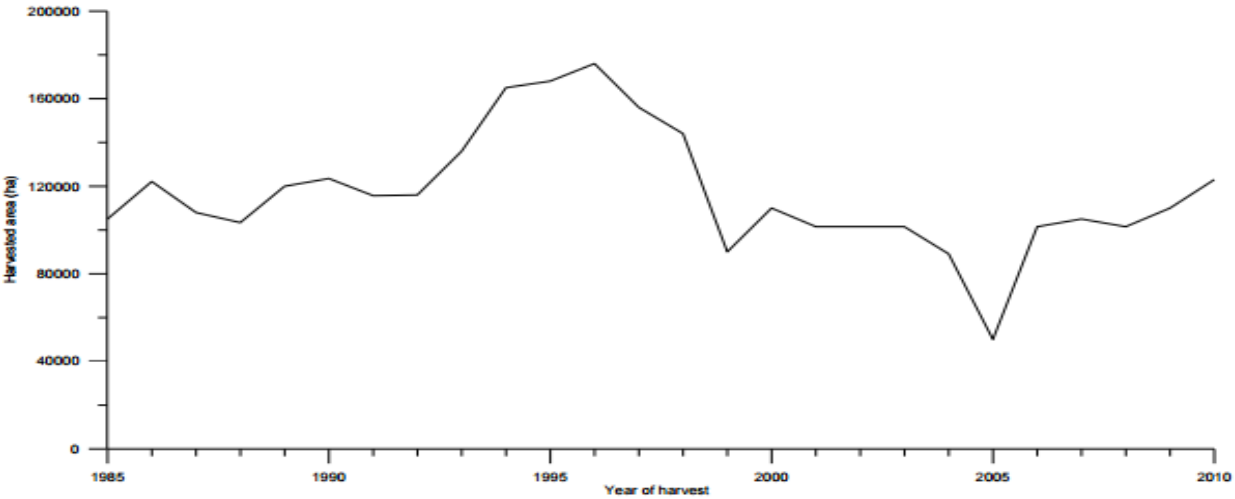

Fig 4. Cultivated area of dates in Iraq. (Data processed by: FAOSTAT Database 2000-2012)

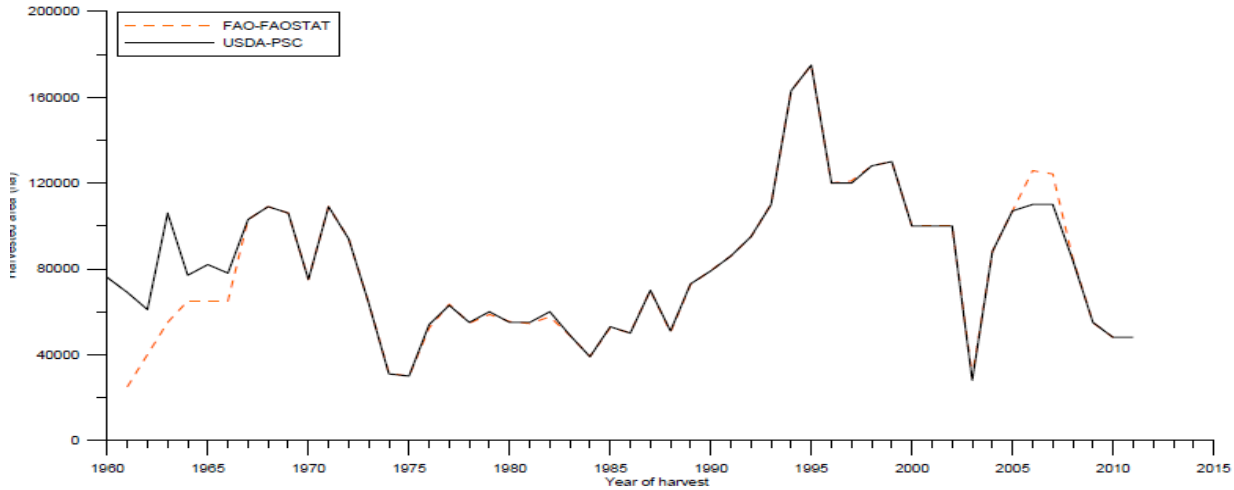

Fig 5. Cultivated area of rice in Iraq.(Data processed by:FAOSTAT Database 2000-2012)

Technology of agriculture. Agricultural technology is among the most revolutionary and impactful areas of modern technology and has a very important role in developing the agricultural industry (Hurst, 1991)[7].

Agricultural technology refers mainly to

machines which are designed for specific stages of the agricultural process, including machines for tilling the soil, planting seeds, irrigating the land, cultivating crops, protection from pests and weeds, harvesting, livestock feeding, and sorting and packaging the products. The most known agricultural technology tools are pumps and other specialized gears used to provide water quickly and in high volumes to large areas of land, fertilizers and pesticides. Some of the farm equipment generally includes: tractors, cultivators, plows, subsoiler, power tiller, harrows. These mostly are used for soil cultivation, but there are machines also used for planting: seed drill, air seeder, precision drill, rice transplanter etc. For harvesting the most used equipment is corn harvester, cotton picker, sickle, swather. Another tool is biotechnology, but biotechnology raises many questions. Fertilizing and pest control also benefit from technological tools, such as fertilizer spreader, manure spreader and sprayer (USAID, 2006)[10].

Technology has many advantages in agriculture, including expediting crop production rate and crop quantity, reducing the costs of production for farmers and food costs for consumers. It can help making crops more nutritious. Also, despite providing so many benefits, biotechnology raises environmental concerns due to the fact that genetic modification can lower the levels of biological diversity. It also raises safety concerns due to the use of chemicals and it can prove to be an expensive tool (Yeoshua,2005).

According to a survey made by Rita Abi-Ghanem et al[1], published in *Journal of International Agricultural Extension Education* results show thatthe flow and availability of agriculturalsupplies and products has become lessrestricted compared to the previous decade.Sixty-three percent of theparticipants indicated greater access toagricultural inputs, such as seed andfertilizer, in 2008 than in 1998. Despite perceiving noticeable improvement overall, 83.6% of the program attendees responded that access to new agricultural technologies and inputs was currently insufficient to successfully promote productive agricultural practices.

According to table 4, most farms in southern Iraq increasingly have timely access to improved equipment. The extensive strife from 2003 to 2008 exacerbated problems in the dispersal of agricultural supplies in the central Iraq region. Agriculture was promoted and well supported with new technologies from both the KRG government (which received autonomy in 1991–1992) and international organizations from 1997 to 2003. However, foreign entities abandoned their programs in 2003, preceding the war.

Southern Iraq, especially in the areas surrounding Basra, possessed advanced vegetable and crop production practices prior to sanctions, which declined after. Earlier reports noted a shortage of equipment in southern Iraq (FAO, 2003)[5] and more than half of the tractors are allegedly at least 15 years old (Ghanem et al, 2013)[1].

Table 6. Access to new agricultural technologies compared to 10 years ago

Region of respondent	More		Similar		Less		Total	
	no	%	no	%	no	%	no	%
South Iraq (n=7)	4	22.2	0	0	3	16.7	7	14.9
Central Iraq(n=7)	7	38.9	7	63.6	5	27.8	19	40.4
Kurdistan (n=28)	7	38.9	4	36.4	10	55.6	21	44.7
Total	18	100	11	100	18	100	47	100

Data processed by: Journal of International Agricultural Extension Education

Table 5 and 6. Changes in Access to Basic Agricultural Inputs and New Technologies in Iraq Based on Region Between 1998 and 2008 (n = number of respondents)

In Table 5, Kurdish responses generally suggested a feeling of increased access to agricultural inputs over the last decade (74, 15, and 11% of the Kurdish participants denoted more, similar, and less resource access, respectively). Kurdish representatives more frequently designated that new technologies were exceedingly limited during the period in question. The influx of international aid after KRG autonomy and their subsequent departure could offer an explanation for this disparity (Schnepf, 2003)[9]. While 58% of those at the predominately male session indicated greater availability of new technology, 57% of the all-women's session denoted access has decreased. In central Iraq, conditions remained unstable at the time that the survey was conducted. It was considered unsafe for extension personnel, particularly women, to visit farmers and distribute information in certain locations (Ghanem et al, 2013)[1].

Fertilizers

In Table 7, during 2004-2012, the fertilizer consumption showed an average of 140.9, with an increase from 111.4 to 154.4, from 2004 to 2012 and the fertilizer consumption per hectare of arable land showed an increase as well from 24.4 to 56.6, showing an average of 46.6.

Table 7. Evolution of Iraq using chemical fertilizers in the period 2004-2012

Indicator	MU	2004	2005	2006	2011	2012	Average (2004-2012)	Stdev	C%	Growth annual
Fertilizer consumption of fertilizer production	%	111.4	132.4	132.5	130.5	154.4	140.9	21.05	14.94	4.17
Fertilizer consumption per hectare of arable	kg/ha	24.4	41.6	46.3	46.1	56.6	46.6	13.96	29.96	11.10
	%vs2004		170.8	189.8	189.0	232.1	x	x	x	x

Data processed by:FAOSTAT Database 2000-2012

Pesticides

Pesticides are used to control organisms that are considered to be harmful, but their use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil (Miller, 2004)[8]. In order to protect the public from pesticide misuse, pesticides safety education and pesticide applicator regulation are designed. The most people using pesticides in Iraq, especially the laborers who are in the most contact with pesticides, have likely received minimal or no training in protection of environment.

Below there is a graph that shows the use of pesticides in Iraq during 2000-2007.

According to figure 6, there appears to be an increase in the use of pesticides in Iraq starting especially from 2000.

Prospects of organic agriculture in Iraq

There are many definitions for organic agriculture but all spin around the idea that it is a system that relies on ecosystem management rather than external agricultural inputs: "Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system." (FAO, 1999) [4].

In 1997, the organic agriculture activities started in Iraq through the dissemination of organic agriculture techniques, awareness raising on environment and pesticide hazards, rural extension and training courses for farmers, rural women, agriculture department staff and students.

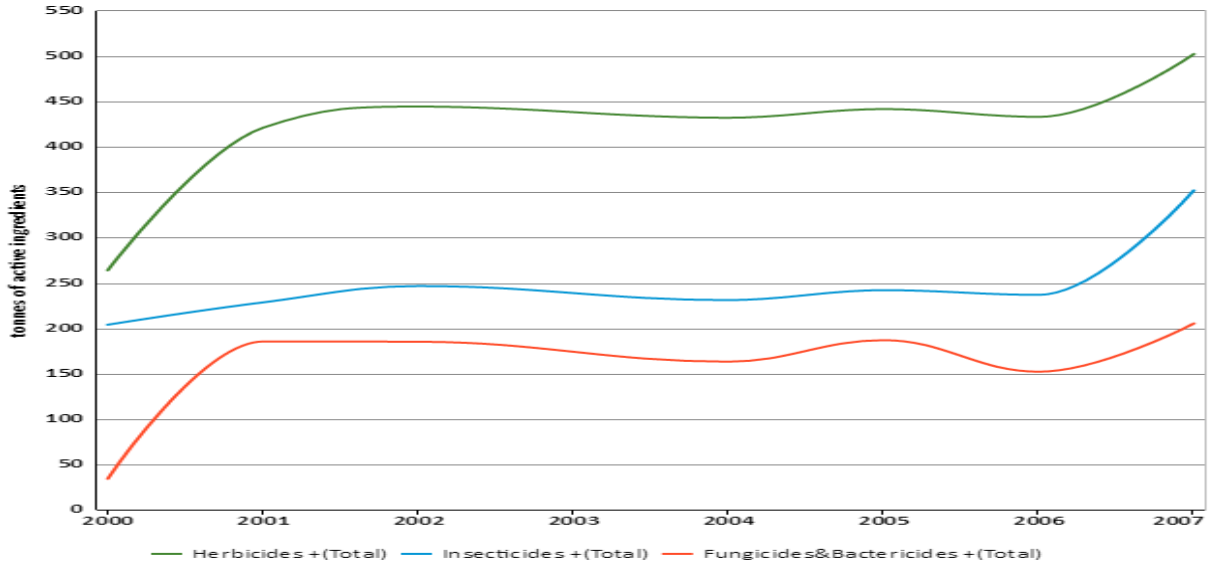

Fig 6. . Use of pesticides in Iraq during 2000-2007(Data processed by: FAOSTAT Database 2000-2012)

At that period, the main goal of the government was to produce food without taking any consideration to the value, health and environmental issues. Also there were problems with the FAO policy in Iraq, as the FAO due to the UN resolution 986 (Oil for Food) was regularly importing a lot of agriculture chemicals and distribute to or oblige farmers to receive these chemical inputs as a condition to receive other equipment (FAO).[5]

In 2009, in the Ministry of agriculture in Iraq the Organic agriculture department was founded which expected to play an important role in dissemination of organic agriculture among farmers, and the following years many conferences and meetings were arranged by universities and Iraqi academics recommended to adopt organic agriculture as a mean to reduce the deterioration in the environment. At the time, extension of agriculture is an important matter of discussion in Iraq and its neighboring countries, since it has a major economic and sociologic impact. According to experts there is a growing awareness about the pollution problems caused by the misuse of chemicals, while the cost of many imported inputs makes them unaffordable for most small farmers (Bashur, 2008)[2]. Organic agriculture is an important option when considering the extension of agriculture so its reality and future prospects require theoretical and applied research, a good administration that would reflect in society's involvement, trough targeted investments, agricultural education, and appropriate legislation.

The role of organic farming is to eliminate the use of fertilizers, pesticides, animal drugs and food additives, I order to improve soil, water and environmental quality. The excess use of nitrogen fertilizers in agriculture can lead to nitrate accumulation into plants which constitute a problem when eaten.

CONCLUSIONS

Today, organic agriculture is studied in colleges of agriculture in the Kurdistan region and Iraq especially by graduate students. The technology of agriculture used for crops is basic but it seems that the agricultural sector is beginning to expand:

-The flow and availability of agricultural supplies and products has become less restricted compared to the previous decade.

-Results show greater access to agricultural inputs, such as seed and fertilizer, and to new technologies

-Most analysts agree that Iraq has the potential for substantial agricultural growth,

-In 1995, a national strategy for agricultural research and technology transfer was adopted, and researchers from the different institutions started participating in research planning and evaluation,

Although these are important achievements that need to be underlined, however there are still many challenges the organic farmers have to face in Iraq:

-Drought and desertification problems

-Lack of law and legislation in Iraq to provide a legal framework for organic production;

-Lack of organic marketing of farmers' products.

There appears to be an increase in the use of pesticides in Iraq starting especially from 2000. In 2009, in the Ministry of agriculture in Iraq the Organic agriculture department was founded which expected to play an important role in dissemination of organic agriculture among farmers, and the following years many conferences and meetings were arranged by universities and Iraqi academics recommended to adopt organic agriculture as a mean to reduce the deterioration in the environment. Technology makes it possible to share and learn.

Organic agriculture is an important option when considering the extension of agriculture so its reality and future prospects require theoretical and applied research, a good administration that would reflect in society's involvement, trough targeted investments, agricultural education, and appropriate legislation.

These challenges can be overcome by procedures and the government's mismanagement of soil and agricultural land, as well as marketing and certification of organic products.

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