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Improved livelihoods of smallholder farmers in Iraq through integrated pest management and use of organic fertilizer

Socioeconomic and Agricultural Policy Report

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Caption for the photo:
Project team of specialists visited farmers date palm field to assess the major pest problems and to develop proper IPM control program

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Executive Summary

This working paper summarizes the findings of the socioeconomic component of the research project *Improved livelihoods of small-scale farmers in Iraq through integrated pest management and use of organic fertilizer,* that was managed by ICARDA and funded by the International Fund for Agricultural Development (IFAD) and the Ministry of Agriculture in Iraq between (2009-2012). The research focused on two of Iraq's key farming systems – the rainfed wheat/legume systems in the north and the irrigated date palm systems in central and southern Iraq. Its aim was to promote environmentally friendly methods to control diseases and insect pests and encourage the more effective use of organic fertilizer.

The project was put into action in real-life situations, on the lands of small-scale farmers, and reflects the positive impact of some modern techniques used in farming systems. The governorates of Mosul, Erbil, Baghdad, Diwaniyah were selected for this investigation of the impacts of new farming techniques. Mosul and Erbil represented the wheat base cropping system; Baghdad and Diwaniyah the date palm cultivation zones.

The ex ante impact assessments of using an environmentally friendly bio-pesticide to control Dubas bug and using organic fertilizers on date palm indicate that these technologies have positive effects for profitability, production, health, and the environment. The potential increase in profitability achieved in this research will help improve the livelihoods of Iraqi palm producers. However, it should be noted that the potential increase is influenced by the level of adoption of these technologies. An active national program to disseminate these technologies among farmers is needed to spread the project's benefits on a broad scale.

Policy recommendations

Project results suggest that sustainable increases in the productivity of date palm and cereal/food/legume-based production systems can be achieved – and the environment better protected – if farmers can be encouraged to adopt the improved technology packages such as those tested in this research on integrated pest management and organic fertilizer use. The presence of an enabling policy environment is a critical success factor to ensure the widespread use of these approaches. Policies need to be adopted which reduce the use of the chemical pesticides and fertilizers and shift to organic sources, using an integrated pest management approach. Suggested enabling and alternative policy options include:

- **Reduce subsidies on chemical pesticides and fertilizers** to help reduce the amount of chemicals applied by farmers. The current agricultural policy provides substantial input subsidies, especially for fertilizers and pesticides. Current subsidies are as high as 50%. Subsidy reductions will encourage farmers to look for alternatives, such as integrated pest management and organic fertilizer. The money saved by reducing the subsidies for chemical inputs can be directed to subsidizing the inputs needed for applying the bio-pesticide pest control methods and organics.
- **Create a new price policy that gives higher prices for organic agricultural products.** The current agricultural price policy does not differentiate between organic products and non-organic products.
  - **Policy makers should consider cost, access, and availability of organic pesticides when promoting their application by farmers.** Organic pest control needs inputs and facilities which might not be available to farmers.
  - **Create an agricultural extension system that has good knowledge of IPM and the use of organic fertilizers.** This is a key factor if the government is to be successful in changing farmers' attitudes and practices.
    - **Raise awareness on the concepts of IPM and organic fertilizer use among farmers and decision makers** in the Ministry of Agriculture and related ministries and agencies.
    - **Provide technical and financial support to the National Center for Organic Agriculture** to widen its scope and intensify its activities a farm level for IPM and use of organic fertilizers across Iraq.
    - **Create a 'National Center for Agricultural Policy' as a part of current institutional reforms.** We suggest that this can be within the Ministry of Agriculture. Such a center's mandate will be to address the policy and institutional issues at the national and provincial levels.
    - **Ensure that the national agricultural extension system is fully qualified** to disseminate clean farming and organic agricultural practices to producers and consumers.

1.Introduction

Agriculture plays an important role in declines in productivity. Today, Iraq faces a food deficit; local production only partially meets demand and it is estimated that the country will need to import USD 3.5 billion worth of food during the next decade.

1.1 Baseline Study - Socioeconomic characterization of the target communities

A random sample of 125 farmers, representing 62 wheat farmers from Erbil and 63 from Mosul were included in the baseline study. Another random sample of 126 date palm farmers, 60 from Diwaniyah, Qadisiya province, and 66 from Baghdad was also covered by the study. Farmers were interviewed by the specialist and completed a prepared questionnaire which addressed the main socio-economic issues.

The results of the analysis of the survey of the rainfed wheat farmers indicated that the average family size is 10.8 members, of which 4.7 members are working on the farm. Most of the farmers surveyed had an average educational level, ranging from being able to read and write to some years of secondary school education. Wheat ranked first in the cultivated area, followed by barley, lentils, and chickpeas. The dominant wheat varieties, which are preferred and cultivated by the farmers, are Cham 6 and Cimito. Wheat is mainly cultivated under rainfed conditions in both Mosul and Erbil provinces. The productivity of wheat averages 1472 kg/ha, that of barley 1004 kg/ha, that of, chickpeas 700 kg/ha, and that of lentils 492 kg/ha. The rates of application of seed and fertilizer being followed by the farmers are within research recommendations. Using chemical herbicides to control weeds is the common practice of 53% of the respondents. Selling seed to the government is the main marketing activity. Women's contributions to the total household incomes ranged between 0 and 53%. The high cost of fuel, access to inputs, and shortage of water are the major problems encounter by the farmers.

The results of the survey of the date palm farmers showed that the respondents' ages ranged between 31 and 90 years, with an average of 56 years. The majority of the household members have elementary and middle school levels of education. The Zahidi variety of date gave the highest productivity, followed by Khastawi. Small-scale farmers do not apply the required inputs to the date palms. Selling the product to the government is the main marketing windows for date palm farmers. Some of the produce is kept for family consumption or for extracting the date juice. The dates for export are handled, processed, and packed to get higher prices. Two-thirds of the respondents stated that they do not understand the phrase integrated pest management (IPM) and 80.6% do not know how to apply IPM. Only 8.3% of respondents had access to loans. The whole sample was willing to continue working in agriculture and to be involved in future projects. The major problems encountered by the date palm farmers surveyed are access to agricultural loans and poor agricultural extension.

1.2 Agriculture policies related to IPM and the use of organic fertilizers

A review of Iraq's agricultural policies indicated that many ministries, committees, and institutions are involved in drawing up the agricultural policies of the country. These include the Agriculture Committee in the parliament, Council of Ministers, Ministry of Agriculture, Ministry of Water Resources, Ministry of Environment, and some non-governmental organizations (NGOs). The most important agriculture-related policies that have recently been adopted in Iraq are:

- Adoption of the five-year plan (2010-2014) for the development of Iraqi agriculture by the Ministry of Agriculture. The plan has allocated USD 9.5 billion to implement its provisions. The plan targets strategic projects in the fields of water resources and land reclamation and provides

the input requirements for agricultural production, including using environmentally friendly approaches to pest control and modern irrigation techniques, in addition to providing seeds of new varieties which are resistant to salinity and drought

- Agricultural initiative. The agricultural initiative was launched by the Iraq Council of Ministers in 2008. It included creating several projects and activities to help the agricultural sector reduce desertification and to provide farmers with agricultural machines and suitable water for irrigation. The initiative provides farmers with improved seeds, chemical fertilizers, pesticides, and assistance in land reclamation. It also guarantees the purchase of agricultural production by the state at market prices. Additionally, the initiative launched financial loans for small farmers for date palm, development of modern irrigation techniques, improving livestock, and supporting strategic projects
- The Ministry of Agriculture allowed 10 years for the country to reach a state of self-sufficiency in strategic crops through the application of the agricultural initiative
- The national strategy for the protection of the environment in Iraq and the executive work plan for the period of 2012-2017 were prepared by Ministry of Environment.

To increase total agricultural production by improving the productivity of major crops has been the major objective of Iraq's agricultural policies. This is expected to be achieved by providing farmers with all the inputs required, including chemical fertilizers and pesticides. This policy is influenced by the large food gap resulting from the shortage in wheat production – just 30% of self-sufficiency. Therefore, agricultural policymakers have tried to reduce that gap by subsidizing inputs to encourage farmers to apply them and so increase the yield of wheat and other food crops. Available data indicate that subsidies for seeds represent about 30% of the total support for the strategic crops (wheat, barley, rice, maize). The subsidy for chemical fertilizers is 50% and that for chemical pesticides is 50% when these items are used for wheat. These subsidies rise to 100% when the products are used to control pests on date palm. The degree of support provided to modern irrigation systems reaches 50%.

The agricultural policy has some positive environmental indicators. In addition to the national strategy for the protection of the environment, in 2008 the Ministry of Agriculture initiated the National Center for Organic Agriculture, which is a research, extension, and development center which seeks to improve and shift traditional Iraqi agricultural practices to modern ones, which are clean and safe for human health and the environment.

Agricultural policies in Iraq, have not addressed directly the operations of fertilizing date palms. The Ministry of Agriculture, through the National Center for Organic Agriculture, does provide OF from palm residues to palm producers for use in their palm orchards.

The Ministry of Agriculture in Iraq usually controls infestations of Dubas bug and lesser date moth (Humaira) through the General Authority for Plant Protection.

Integrated management to control the pests on palm trees has been receiving more attention from the government in recent years. Several projects have started to address IPM for date palm by targeting the most serious pests. Moreover, the General Authority for Plant Protection has adopted the use of plant extracts, such as neem, to control them. However, no clear agricultural policy is in place regarding IPM or the use of OF.

The success of IPM depends not only on good technology and farmers' skills and knowledge, but, to a large extent, on the overall policy environment. A crop protection policy is part of the larger agricultural

and environmental policy framework. Organic farming and IPM are often mentioned in national policy documents and the statements of politicians. In contradiction to this advocacy for organic farming, chemical pesticides are still receiving direct and indirect support, which hinders the effective dissemination of IPM.

Adopting IPM methods and approaches to control agricultural pests and using OF instead of chemical sources of fertilizers are considered key factors in moving toward clean and sustainable farming. To this end, the Ministry of Agriculture in Iraq initiated a collaborative project, implemented by ICARDA together with the Ministry of Agriculture and other national institutions, and with financial support from IFAD – the IPM/OF project. The purpose of the project is to increase the productivity of date palm and cereal/food/legume-based production systems by having farmers adopt improved technology packages based on IPM and the use of OF. The project was implemented between 2009 and 2012 to achieve the set objectives and outputs. The project focused its work on introducing IPM approaches and practices to control three major insects that attack date palm and reduce the yield and quality of the dates. The insects of concern are stem borers, lesser date moth, and Dubas bug. The project also composted the residues of palm trees for use as OF for date palms. In the rainfed cereal/food/legume-based production systems, the project addressed the major problems facing this system, including having farmers adopt improved technology packages based on IPM. The project also addressed the issue of controlling the major pests of wheat and chickpeas.

It is expected that the results of this project will influence the decisions of policymakers to adjust the current agricultural policy, which supports the application of chemicals as a major input for pest control and as fertilizers, toward applying biological pest control and organic sources of fertilizer. Such a shift will maintain the higher yields, reduce costs, protect the environment, and increase farmers' profits.

1.3 Economic feasibility of IPM and using organic fertilizers

The economic feasibility analysis of using IPM on palm trees to control Dubas bug was done using partial budgeting analysis. This compares adoption of the biological pest control methods with the common practices of using chemical pesticides or no pest control. Research results of the IPM/OF project indicated that using neem (1% Azadarchtine), which is a plant extract, alone or in combination with summer oil, proved to be an ideal alternative to the use of chemical insecticides for controlling Dubas bug. The efficacy of neem is not the only advantage; as a plant extract it is not injurious to health or the environment. Based on this result, in this feasibility analysis the Dubas bug is controlled using an application of neem with summer oil. The analysis showed that using bio-pesticides to control the Dubas bug pest increased date palm yields by 480 kg/dunum (Iraqi dunum = 2500 m^2), the cost of bio-pesticide was less than that for chemical pest control by IQD 3125 per dunum (USD 1 = IQD 1200), and the net benefit increased by IQD 483,125 per dunum (equivalent to USD 403). These figures show that from a purely economic point of view, using the bio-pesticide pest control technology is more profitable and can increase the household incomes of date palm farmers and, hence, is recommended.

Likewise, the same approach has been followed to compare the two soil fertilizing techniques; applying compost as an OF source to palm trees compared to the use of chemical fertilizer, which is the common practice. The analysis took into consideration the different sources of compost (compost purchased from the market versus compost made on the farm). Given the imperfections of the compost market, the purchase and sales prices are different. The analysis indicated that using OF can lead, on average, to an additional yield of 786 kg/dunum (27% more than if chemical fertilizer is used). Applying purchased

compost, as against using chemical fertilizer, will increase the costs by about IQD 269,250 per dunum (equivalent to USD 224). Applying compost prepared on the farm will increase costs by about IQD 89,250 per dunum (equivalent to USD 74). If the compost was prepared on the farm, the profitability is IQD 264,450 per dunum (equivalent to USD 220) as against using chemical fertilizer. If the compost was purchased, the profitability is decreased by IQD 89,250 per dunum (equivalent to USD 74). The corresponding rates of return were 296% and 31% respectively. The minimum increase in date yield which is needed to cover the costs of shifting from applying chemical fertilizer to OF (the breakeven point) is 15 kg/tree if the compost is purchased and 5 kg/ha if it is made on the farm.

The sensitively analysis for changes in the price of dates indicated that the above two scenarios will still remain profitable even if the selling price declined to IQD 300 per /kg; the net benefit as well as the rate of return become less and the breakeven point is increased, but is still less than the potential yield increase.

In conclusion, the economic feasibility analysis indicated that when both bio-pesticide pest control and OF technologies are used on date palm they are more profitable than using chemical pesticides and chemical fertilizers and increase household incomes. The technological shift is also expected to have additional environmental and health benefits. Therefore, it is recommended that the technologies be popularized among palm farmers.

1.4 Impact of adopting Integrated Pest Management and organic fertilizers

Like any other venture, investment in agricultural research and extension needs to be justified. It is important to document the potential returns that will accrue from the research investment. Based on the available data, it was possible to estimate the potential impact of the adoption of the bio-pesticide method using neem with summer oil for controlling the Dubas bug instead of using chemical pesticides. The analysis indicates that it is possible to increase farmers' incomes by USD 37.6 million if all palm producers in Iraq shifted from the use of chemical methods of controlling the Dubas bug insect to bio-pesticide methods of control when the date price is IQD 600,000 per tonne.

Several date prices were used in the analysis. If the selling price for dates is IQD 500,000 per tonne the increase is USD 30.8 million and if the selling price is IQD 450,000 per tonne then the increase is USD 28.6 million. If the selling price drops to IQD 300,000 per tonne then the increases is expected to be USD 19.6 million. When the new technology is compared with the no control method, which some farmers opt to follow, then the corresponding benefit figure for farmers will be about USD 75 million when the selling price for dates is IQD 600,000 per tonne. If the price of dates is IQD 500,000 per tonne then the benefit figure will be USD 62 million. When the price is IQD 450,000 per tonne the benefit is USD 55.5 million, and if the price is IQD 300,000 per tonne, the benefit is US$ 36 million. This substantial increase in profitability under the different selling price scenarios will certainly help to improve the livelihoods of Iraqi date palm farmers.

Likewise, the impact of the adoption of OF for palm tree plantations is estimated. Profitability and productivity indicators were used to measure the impact under several possible adoption level scenarios. The results show that if 50% of palm producers adopt organic instead of chemical fertilizers, it is possible to increase farmers' incomes in Iraq by USD 25 million if the selling price of dates is IQD 600,000 per tonne and the compost is purchased from the market. The corresponding figure is USD 48 million if the compost is made on the farm and the selling price is the same. If the selling price is IQD 450,000 per tonne the financial impact will be USD 10.5 million in the case when compost is purchased and USD 33 million when the compost is made on the farm. These figures will decline to USD 5.6 and 2.4

million, respectively, if the selling price of dates is IQD 400,000 per tonne. There is no financial impact if the selling price is IQD 300,000 per tonne and the compost is purchased, but the impact will be USD 17.2 million if the compost is made on the farm.

The *ex ante* impact assessment related to using environmentally friendly pest control methods and OF indicated that these technologies have positive effects in terms of profitability, production, health, and the environment. The potential increase in profitability certainly will help to improve the livelihoods of Iraqi date palm producers; however, the potential increase is influenced essentially by the level of adoption of these technologies. An active national program to disseminate these technologies among farmers at the national level is needed to harvest the outcomes of this project.

2. Baseline socioeconomic survey

2.1 Baseline survey objective

A baseline study gathers key information early in an activity so that later judgments can be made about the quality and development results achieved by the project. It is an early element in the monitoring and evaluation plan and provides the basis for subsequent assessments of how efficiently the activity is being implemented and the eventual results achieved.

The current survey of the project specifically targets the access of small-scale farmers to farming techniques (OF and IPM for date palm). It has the specific objectives of highlighting the households' interest in joining the project activities and in identifying the socioeconomic indicators of the respondent households. This was achieved by implementing a questionnaire and a comprehensive survey including socioeconomic indicators.

2.1.1 Methodology

A random sample of 125 farmers, representing wheat farmers in two provinces – 62 from Erbil and 63 from Mosul – were included in the survey. Another random sample of 126 dates palm farmers – 60 farmers from Diwaniyah, Qadisiya province and 66 farmers from Baghdad – was also covered by the survey. Farmers were interviewed by the specialists and completed a questionnaire which addressed the main socioeconomics issues.
The survey was conducted during the 2010/11 growing season.

The data and information collected were entered in an Excel spreadsheet, compiled, and analyzed using the software package SPSS.

2.2 Results and Discussion

2.2.1 Status of wheat production in Erbil and Mosul governorates

A total of 125 farmers were interviewed from three different rainfed zones (Table 2.1). About 70% of the sample was collected from the high rainfall zone.

Table 2.1: Sample distribution of farmers by governorate and rainfed zone

Governorate	High rain	Medium rain	Dry	Total
Erbil	53	9	-	62
Mosul	35	20	8	63
Total	88	29	8	125

2.2.2 Socioeconomic characteristics

The results in Table 1.2 indicate that the average family size is 10.8 members, of which 4.7 members are working in farm.

Table 2.2: Certain social and socioeconomic indicators

Indicator	Number of respondents	Average	Standard deviation
Total family members	123	10.81	7.066
Female residents less than 7 years	125	0.97	1.356
Female residents 8-15 years	125	1.41	1.828
Female residents 16-60 years	125	2.45	2.19
Female residents more than 60 years	125	0.26	0.983
Male residents less than 7 years	125	0.86	1.410
Male residents 8-15 years	125	1.62	2.630
Male residents 16-60 years	125	2.62	2.439
Male residents more than 60 years	125	0.20	0.508
Number of male workers	80	3.19	2.687
Number of female workers	74	1.54	1.761

Women play a vital role in farming work. Table 2.3 shows that the average number of female workers is close to the average number of male workers in both governorates.

Table 2.3: Number of farm workers by gender

Province		Number of male workers on the farm	Number of female workers on the farm
Erbil	Mean	2.83	2.69
	Std. deviation	2.26	2.46
Mosul	Mean	3.34	1.98
	Std. deviation	2.80	1.42
Total	Mean	3.23	2.15
	Std. deviation	2.80	1.74

Most of the farmers surveyed had an average educational level ranging from being able to read and write to several years of secondary school. Only 19 households had a family member with a university degree.

Figures 1.1a and 1.1b show that more than 50% of the household income is generated from selling wheat. This is followed by selling live animals in Erbil goveronarate and by selling legumes in Mosul.

Figure 2.1: Sources of household income

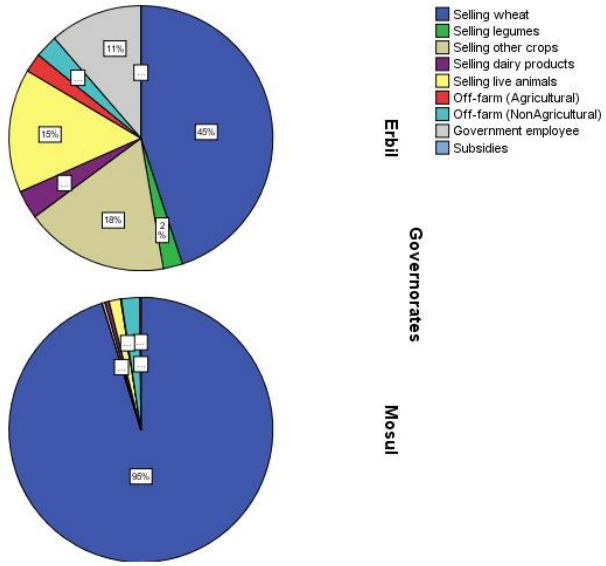


Figure 2.1a Sources of household income Erbil governorate

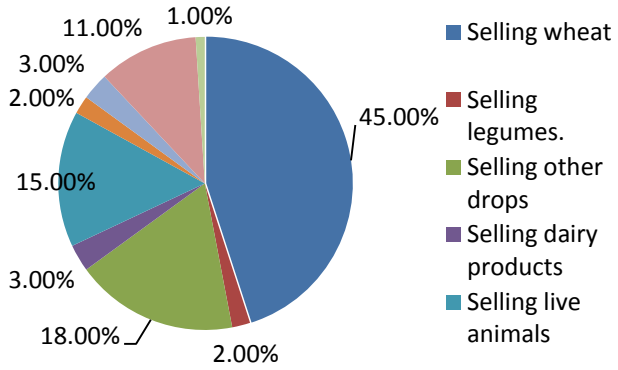
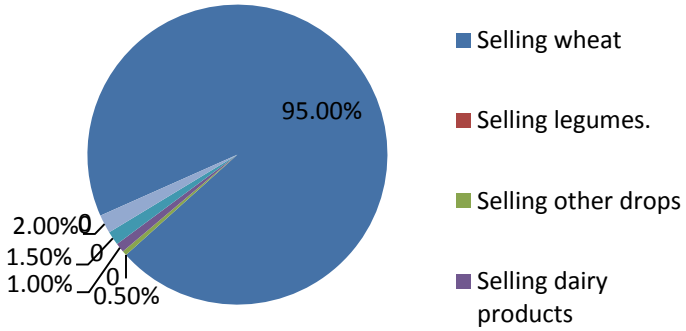


Figure 2.1b Sources of household income Mosul governorate



2.2.3 Cropping pattern and land use

Figures 1.2a and 1.2b show that wheat occupied the largest area of cultivated land, followed by barley, lentils, chickpeas, potatoes, and vegetables. In Erbil, some households are planting olives trees and others keep part of their land fallow.

Figure 2.2: Land use in Erbil and Mosul governorates

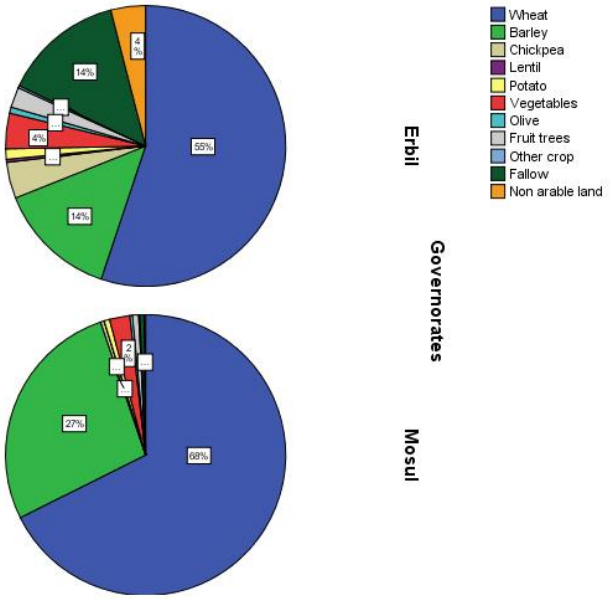


Figure 2.2a: Land use in Erbil governorate

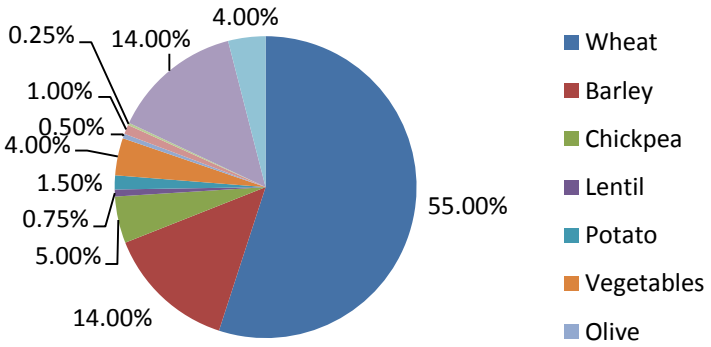
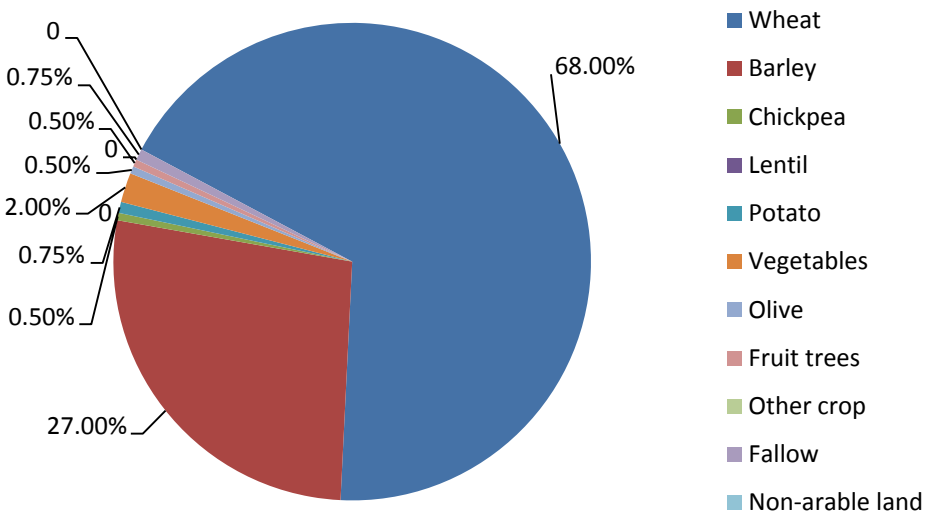


Figure 2.2b: Land use in Mosul governorate



2.2.4 Wheat varieties used by farmers

The dominant wheat varieties are listed in Table 2.4. Cham 6 is the main variety used by farmers in Mosul whereas it is Cimito in Erbil.

Table 2.4: Proportion of farmers using different wheat varieties in Mosul and Erbil governorates

Variety	Erbil governorate	Mosul governorate	Total
	Proportion of farmers using (%)	Proportion of farmers using (%)	
Iba'a 99		7.9	4.1
Om Rabi		19.0	9.8
Cham 6	5.1	34.9	20.5
Abou Ghrib	-	17.5	9.0
Cimito	45.8	3.2	23.8
ACSAD	15.3		7.4
Cham	8.5	3.2	5.7
Sardar	6.8		3.3
Other varieties	18.6	14.3	16.4
Total	100	100	100

2.2.5 Productivity

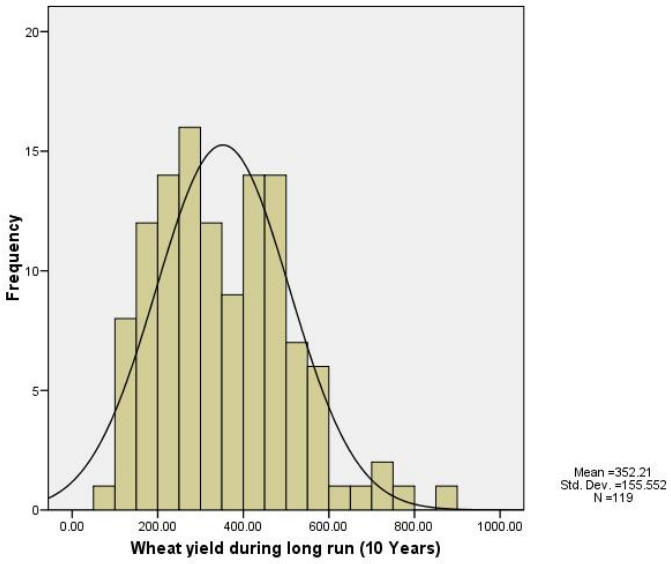
Table 1.5 summarizes the average yields (productivity) of the major field crops cultivated in Erbil and Mosul governorates. In comparison to the average, all field crops registered a drop in their productivity during the 2010/11 season. The average productivities (in kg/ha) were wheat 1472, barley 1004, chickpea 700, and lentil 492.

Table 2.5 Average yields (kg/ha) of some crops cultivated in Erbil and Mosul governorates

Crop	Number of respondents	Crop productivity		
		Minimum	Maximum	Mean
Wheat	122	100	4000	1472
Barley	51	120	2000	1004
Chickpeas	18	140	2500	700
Lentils	4	320	560	492

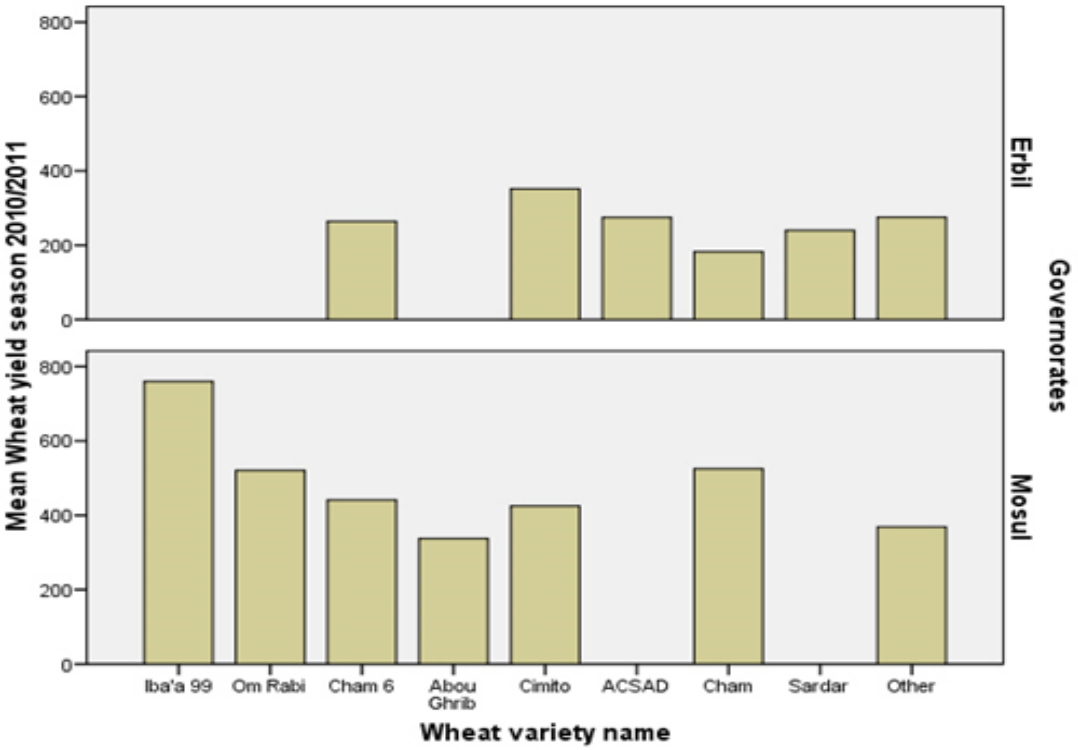
Over a ten-year period wheat productivity for most farmers was less than 1400 kg/ha. However, wheat productivity under irrigated conditions was about 2400 kg/ha. (Figure 1.3).

Figure 2.3: Distribution of average wheat productivity over 10-years



The wheat variety is a key factor in productivity. This is evidenced by the variety IPA 99 which gave the highest yields in Mosul governorate under an irrigation system. The variety Cimito gave the highest yield in Erbil where the rainfed system dominates (Figure 2.4).

Figure 2.4: Average wheat grain productivity (kg/ha) for the 2010/11 season by variety



2.2.6 Input use by farmers for wheat

Although most farmers are using their own experience to determine the quantity and dates for adding agricultural inputs, the seed and fertilizer rates used by the farmers are relatively within the research recommendations. Table 1.6 shows that the farmers added 136 kg/ha of wheat seed in addition to 44 kg/ha of manure, 128 kg/ha of compound fertilizer, 25 kg/ha of superphosphate, and 100 kg/ha of urea. However, the OF (manures) are applied at a rate which is less than the research recommendations. Only 18% of the farmers are using OF at an average application of 44 m^3/ha. There are no significant differences between the amounts of seed and fertilizer used in the two governorates. The agricultural policies adopted by the Ministry of Agriculture have made these fertilizers available to farmers, particularly for the strategic crops, such as wheat.

Table 2.6: Seed and fertilizer application rates for wheat as used by the farmers interviewed

	Wheat seeding rate (kg/dunum)	Manure (m^3/ha)	Compound fertilizer (kg/ha)	Superphosphate (kg/ha)	Urea (46%) (kg/ha)
Sample size	121	80	296	80	268
Mean	136	44	128	100	100

2.2.7 Irrigation

Wheat is mainly cultivated under rainfed condition in both Mosul and Erbil governorates. Only 36% of respondents are using irrigation systems. Such irrigation systems are available on Tigris river in Mosul, and from different sources in Erbil. Table 2.7 shows that wells are the main sources for irrigation In Erbil, followed by canals.

Table 2.7: Irrigation sources in Erbil

Irrigation source	Proportion of farmers using (%)
Well	69.1
Canal	17.6
Other	13.2
Total	100.0

Most of the respondents indicated that they irrigate their wheat crop once as there is adequate rainfall (usually exceeding 300 mm) in the northern part of the country. The dominant irrigation method is surface irrigation.

2.2.8 Pest control

More than two-third of the respondents are using pest control as one of their crop management practices (Table 2.8).

Table 2.8: Pest control for wheat

Using pest control	Number of respondents	Proportion (%)
Yes	82	65.6
No	43	34.4
Total	125	100.0

2.2.9 Weeding

Weeding is an important crop management activity. The results show that 48% of respondents do not remove the weeds from their fields. Herbicides are being used by 53% of the farmers interviewed to control weeds. An alternative is mechanical weeding (Table 2.9). Most farmers generally weed once. The herbicides that are mostly commonly used by wheat farmers are Grandstar and Topac (Table 2.10).

Table 2.9: Weed control methods used by the farmers interviewed

Weeding method	Number	Proportion (%)
Chemical	53	42
Mechanical	7	6
Chemical and mechanical	17	14
No weeding	48	38
Total	77	100

Table 2.10: Type of herbicide used by wheat farmers

Type of herbicide	Number	Proportion (%)
Topac	8	11
Grandstar	19	26
Topac and Grandstar	30	41
Other	16	22
Total	73	100

2.2.10 Wheat disease

Of 65 respondents, 15 stated that they are aware of wheat leaf pesticides. Such data are necessary for the baseline studies and for a database for further research (Table 2.11).

The use of a spraying machine was limited to eight respondents because of the high cost. Similarly, when using pesticides, the labor and machinery costs for pest control will increase product costs and the financial investment of the farmer.

Table 2.11: Method and number of applications of wheat pesticides used by respondents

	Number of respondents	Proportion (%)
Number of sprayings		
1	4	50
2	3	37.5
4	1	12.5
Cost of a onetime use of a machine (IQD/ha)		
800	1	25
1,400	1	25
4,000	1	25
32,,000	1	25
Cost of a single application of wheat pesticide (IQD/ha)		
40,000	1	50
100,000	1	50
Cost of wheat workers (IQD/ha)		
600	1	50
4,000	1	50
Awareness on wheat leaf pesticides		
Yes	15	23
No	50	77
Cost of wheat leaf pesticide (IQD/ha)		
500	5	33.3
1,000	3	20
1,250	1	6.7
4,000	1	6.7
5,000	4	26.6
8,000	1	6.7

2.2.11 Harvesting

Seed drills and combine harvesters are available and commonly used; they are either rented or owned. The majority of farmers (84%) are using combine harvesters (Table 2.12).

Table 2.12: Methods of harvesting wheat

Method	Frequency	Proportion (%)
Mechanical	105	84.0
Manual	13	10.4
Missing data	7	5.6
Total	125	100

2.2.12 Marketing

The households either keep some of the produce to be used as next year's seeds, or sell it in the local markets. Prices are determined by the open market; however, the price mainly depends on supply and demand.

The government, represented by Ministry of Agriculture, fixes wheat prices, maintaining certain margins of revenue for the farmers. Table 2.13 shows that retaining for selling to the government and in the market are the main marketing channels.

Table 2.13: Wheat marketing channels

Marketing channel	Number of respondents	Amount retained (ton)			Std. deviation
		Minimum	Maximum	Mean	
Seed stock	84	0.2	50.0	5.9	9.8
Sold in the market	33	1.0	80.0	11.5	16.7
Sold to the government	75	2.0	200.0	33.0	38.0
Home consumption	48	0.25	64.0	2.8	9.2
Paid for in cash	10	0.25	5.0	1.9	1.6
Paid as Zakat	65	0.1	8	1.3	1.5
Other uses	3	0.02	0.5	0.2	0.2

2.2.13 Agricultural information

Some 48% of respondents depend on their own sources of information. Agricultural extension is the information source for 25% of farmers (Table 2.14).

Table 2.14: Sources of the agricultural information

Source	Number using	Proportion (%)
Self-information	60	48
Agricultural extension	31	25
Relatives	2	2
Extension and relatives	2	2
No response	30	23
Total	125	100

2.2.14 Women's contributions

Women share in most of the agricultural activities with the men. The women's contributions to plant and animal production range between 22 and 53% of the total. The maximum contributions of the women are in animal production rather than in plant production (Table 2.15).

Table 2.15: Role of women in farming

Women's contribution	Number of respondents	(%)		Mean	Std. deviation
		Minimum	Maximum		
Wheat production	29	1	75	22	21
Legume production	5	40	70	52	11
Other crops production	15	5	95	46	31
Selling dairy production	13	30	100	53	16
Animal rearing	7	10	80	43	23

2.2.15 Problems faced by farmers

The high cost of fuel ranked first in the list of problems faced by the farmers. This is followed by access to inputs and the shortage of water (Table 2.16).

Table 2.16: Problems faced by farmers in the wheat-based farming system

Problems	Number of respondents
Seeds availability	9
High cost of fuel	50
Pesticides	3
Marketing	24
Harsh climatic conditions	5
Shoring	10
Access to inputs	31
Costs of inputs	20
Shoring loan	4
Extension weaknesses	3
Shortages of water and rainfall	25
Pest scattering	5
No response	41

2.4 Status of date palm production in Baghdad and Al-Diwaniyah

Iraq used to be one of the leading countries in the production and export of dates. Although the war destroyed large areas of date orchards, there were more than 30 million trees producing about 932,000 tonne of dates. Now, farmers seem to have abandoned date palm production and are giving insufficient care to the palm trees. This has contributed significantly to the low productivity and the poor incomes generated from date palm production.

Some farmers grow date palms intercropped with fruit trees and/or vegetable. There are many different palm varieties, which make date palm orchards in Iraq a unique source of genetic variability (Figure 2.5). The socioeconomic survey targeted date palm growers in the two governorates of Baghdad and Diwaniyah, Qadisiya as representing the main production area in the country.

2.4.1 Socioeconomic characteristics

The respondents' ages ranged from 31 to 90 years with an average age of 56 years. Table 2.17 shows that 18.5%, of the household members have an elementary school level of education while 17.4% have a middle stage educational level. About 12% of respondents were illiterate and 9.5% held a university degree.

Table 2.17: Educational level of date palm growers

Educational level	No. of households	Minimum number of household members in the this category	Maximum number of household members in the this category	Mean	Std. deviation
Illiterate	64	1	12	3.52	2.9
Read and write	93	1	20	5.25	3.8
Elementary	99	1	12	3.97	2.7
Middle stage	93	1	7	2.03	1.2
Preparatory	71	1	5	1.85	1.0
High school	43	1	3	1.51	.7
B.Sc	48	1	6	1.98	1.2
M.Sc	2	1	1	1.00	.0
Ph.D	1	1	1	1.00	.
Other	21	1	19	3.95	4.2

Both the males and females of the family are on the farm, but the contribution of the males, as measured by the number of family laborers, is higher than that of the females (Table 2.18). On average, about three family members work as laborers on the farm.

Table 2.18: Types of family labor in agriculture

Type of family labor	Number	Minimum number of household members in this category	Maximum number of household members in this category	Mean	Std. deviation
Male less than 15 years	126	0	13	2.47	2.3
Female less than 15 years	126	0	17	2.70	2.7
Male above 15 years	126	0	23	4.18	3.3
Female above 15 years	126	0	15	3.78	2.8
Family laborers	126	0	16	2.89	4.2

2.4.2 Household assets Natural

The average holding size in Diwaniyah governorate is 40 ha and in Baghdad governorate it is 13 ha. About 80% of the holdings are privately held.

Physical Dairy cattle are owned by 89 farmers. Smaller numbers of farmers own small ruminants (sheep and goat) and poultry. The number of poultry owned by farmers (on average 183) is higher that the number of sheep, which is higher than the number of goats. Date palm farmers do keep some farm animals on their land (Table 2.19).

Table 2.19: Numbers of livestock owned by date palm farmers

	Number of farmers	Minimum number of this livestock held	Maximum number of this livestock held	Mean	Std. deviation
Number of sheep	31	7	400	78	99.5
Number of goats	3	15	50	28	18.9
Number of cows	82	1	40	8	8.9
Number of buffalo	7	2	5	3	1.2
Number of poultry	31	4	5,000	183	894

Financial Capital is one of the important inputs for agricultural activities, especially for small-scale farmers. Results of the analysis indicated that most of the respondents (77%) do not have access to credit. About 23% have access to an agricultural bank for funding their farm activities.

2.4.3 Date palm trees

There are many different varieties of palm tree each having a different taste, shape, size, and date of ripening. These varieties normally have different marketing clients. Table 1.20 and Figure 1.5 show that the dominant varieties are Zahidi, Khastawi, and Omrani. Some farmers grow fruit trees under the palm trees to increase their incomes.

Table 2.20: Main date palm varieties cultivated and other trees grown

Tree type	Proportion of farmers growing these (%)	Minimum number of these types grown	Maximum number of these types grown	Mean	Std. deviation
Date palm - Zahidi	30.2	7	1,700	217	238.4
Date palm - Omrani	7.9	2	300	35	57.3
Date palm - Khastawi	19.8	2	450	77	82.7
Other date palm varieties	20.1	3	550	80	110.1
Citrus	13.8	6	3,000	533	641.2
Other	8.2	10	600	131	130.8
Total number of trees	100	15	3,500	583	645.4

Figure 2.5 Proportion of varieties by governorate

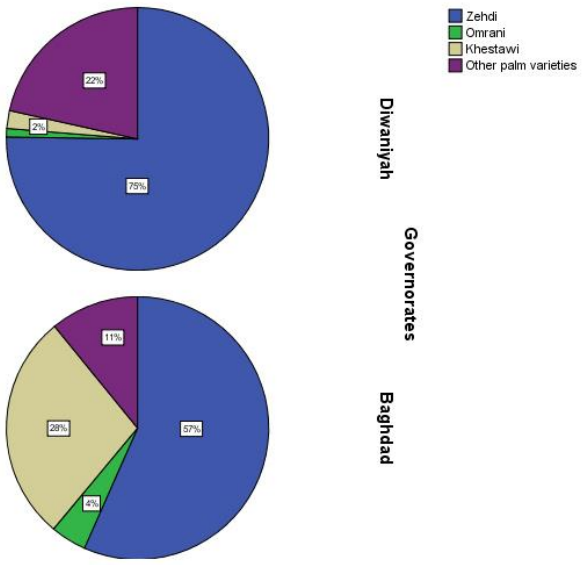
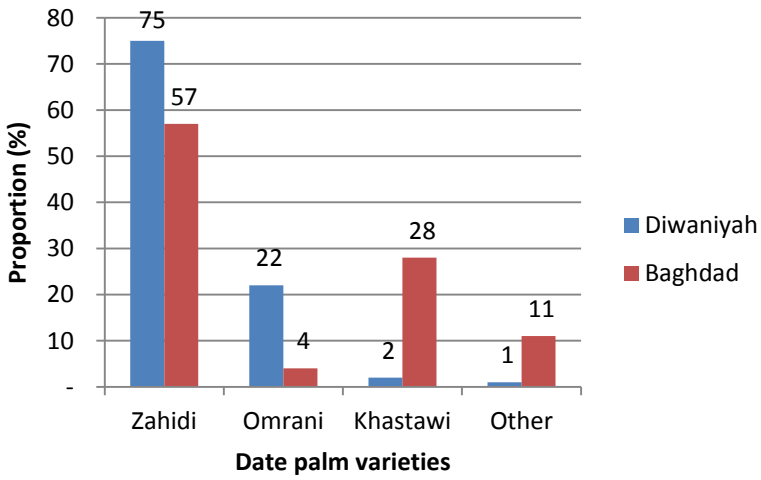


Figure 2.5 Proportion of varieties by governorate



2.4.4 Date palm productivity

Productivity of the date palm tree depends on the variety and field management at the farm. Table 2.21 shows that the Zahidi variety ranked first in productivity, followed by Khastawi, and Omrani.

Table 2.21: Estimated palm productivity per tree by variety (kg/tree)

Variety	Number	Minimum productivity	Maximum productivity	Mean productivity	Std. deviation
Zahidi	108	5	162	51	37
Omrani	22	4	100	38	24
Khastawi	64	3	167	43	30
Other varieties	63	2	100	33	25

2.4.5 Date palm inputs

Although the requirements of date palm trees for agricultural inputs are low, small-scale farmers do not satisfy these requirements. Most of the field work undertaken by the farmer for the trees is at the time of pollination and harvesting. Manure, as fertilizer, is also not added in sufficient quantities. The results of the analysis indicate that one-third of the farmers surveyed used manure on their date palm trees. Table 2.22 shows that manure, urea, and phosphate are the main fertilizers used. About 58% of the respondents do not add fertilizer to palm trees.

Table 2.22: Fertilizer type and the proportion of farmers using it

Fertilizer type	Proportion of farmers using (%)
Manure	32.5
Urea	6.3
Phosphate	3.2

Table 2.23 shows that fertilizer was added to about 18% of the palm trees grown in Diwaniyah governorate and to about 65% of the palm trees in Baghdad governorate. Similarly, fertilizer was used by 17% of respondents in Diwaniyah governorate compared to 71% of respondents in Baghdad governorate. The farmers surveyed indicated that chemical fertilizers are easier to handle than manure.

Table 2.23: Number of fertilized palm trees

Province	No. of fertilized trees in the sample	Total no. of trees in the sample	Proportion of trees fertilized (%)	Proportion of respondents (%)
Diwaniyah	3,476	19,377	18	17
Baghdad	12,931	19,887	65	71
Total	16,407	39,264	42	46

2.4.6 Irrigation

Most of the palm farms are located near main rivers in the central and southern region of the country. These rivers provide them with adequate irrigation sources. Figure 1.6 shows that palm farms in the target governorates depend on different water resources. The traditional irrigation method is the most common. This system is based on water pumps driven directly by fossil fuel engines or by fossil fuel powered generators producing electricity to run them. No other irrigation techniques are used.

Figure 2.6: Irrigated area of palm lands

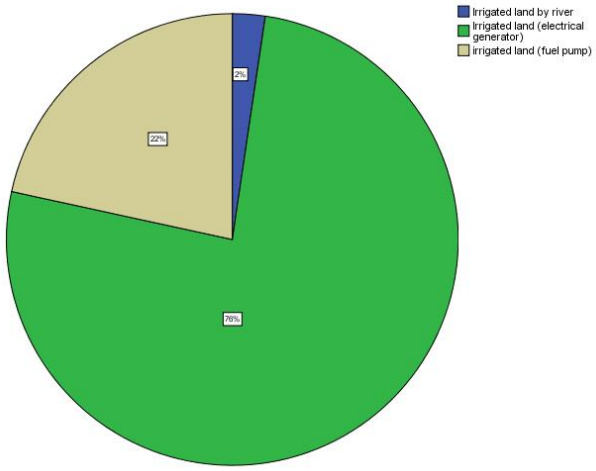
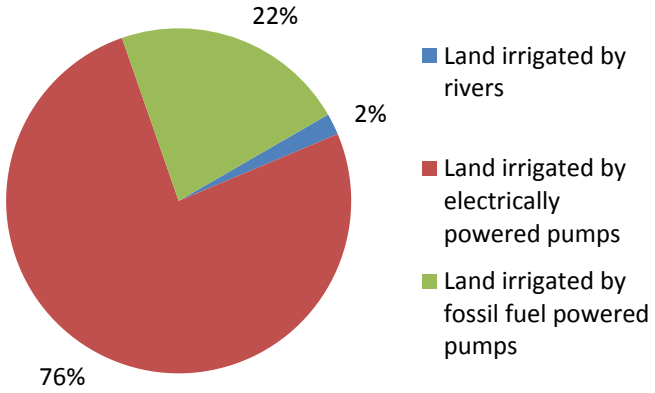


Figure 2.6: Proportion of the land irrigated by the different irrigation methods



2.4.7 Pests affecting palm trees

Palm trees are affected by serious pests in Iraq. The lesser date moth (Humaira), Dubas bug, and borers are the main pests mentioned by the farmers interviewed. Table 1.24 shows that the lesser date moth is considered by 68.3% of respondents as the most important pest, Dubas bug by is rated the most serious by 65.9% and borers are rated the most serious pest by 31.7%.

Table 2.24: Most important pests affecting palm trees

Disease	Proportion of respondents rating as most serious (%)
Lesser date moth (Humaira)	68.3
Dubas bug	65.9
Borers	31.7

2.4.8 Pest control

The majority of farmers (95%) encounter problems in controlling pests. About one-third of the sample is using chemical pest controls and only 2.4% are using organic pest control (Table 2.25).

Table 2.25: Proportion of respondents having a pest on the date palm and the pest control measures used

Item	Proportion of respondents (%)
Having pest problem on palm	95
Using organic pest control	2.4
Using chemical pest control	32.5

The respondents stated that the government is the main source of pesticides. Other sources include the open market. Although organic pest control is relatively safe from the health and environmental viewpoints, it is not commonly used by the respondents. Pest control may need certain inputs and facilities, which are not available. Cost, access, and availability of the pesticides are issues that need to be well understood. Farmers differ in the way they control various pests in their orchards.

2.4.9 Marketing

Although date products are available in large quantities, with the different varieties having different flavors, an efficient marketing system for dates is not available. Market research, which considers the attitudes of consumers and traders, is needed. Table 2.26 shows that the government and wholesale markets are the main market windows for date palm growers. The prices of dates in the government market are determined by the Ministry of Agriculture. The prices of better quality dates are decided in the open market. Some of the products are kept for family consumption or for industrial purposes (extracting date juice). Dates to be exported are handled, processed, and packed and as a result they achieve higher prices.

Table 2.26: Market windows for date palm

Market windows	Proportion of respondents using the window (%)
Government	46.8
Market	56.3
Home consumption	80.0
Stock	7.1

2.4.10 Agricultural extension

Agricultural extension plays a vital role in the different aspects of palm cultivation and production. A set of questions were directed to the respondents regarding their knowledge and the availability of these services. Participants were also questioned about their willingness to participate in future activities. Two-third of the respondents stated that they do not know the term IPM and 80.6% of them do not know how to apply IPM (Table 2.27).

Table 2.27: Survey inquires of palm farmers

Question	Yes (%)	No (%)
Do you know the meaning of integrated pest control?	27.5	68.8
Do you know the meaning of manure?	67.9	28.6
Have you applied integrated pest control?	13.9	80.6
Do you apply chemical fertilizers?	51.4	43.2
Are you willing to apply for future projects?	100.0	0
Do you rely on loans for your farms?	8.3	91.7
Will you continue working in agriculture in the future?	100.0	0
Is there a clinic in your village?	25.0	75.0
Are you weeding your land?	1.8	98.2

2.4.11 Difficulties faced by palm farmers

The major problems encountered by the farmers surveyed are listed in Table 2.28. Agricultural loans not being available was cited by the whole sample as the main problem. More than half of the respondents indicated that agricultural extension is poor. Fertilizer is not available according to 67.9% of the respondent and 13.9% indicated that pesticides were not available.

Table 2.28: Problems faced by palm farmers

Problem	Proportion of respondents experiencing the problem (%)
Water shortages	27.5
Fertilizers not available	67.9
Pesticides not available	13.9
Deficiencies in agricultural extension	51.4
Agricultural loans not available	100.0

3.Agricultural policies related to wheat and date production

Iraqi agriculture has entered the twenty-first century, but is still showing a lot of the characteristics and attributes of agriculture in developing countries in the last century. These characteristics and attributes include restrictions and problems which hinder agricultural development. Iraqi agricultural policies tried to deal with these problems, to enhance the contribution of the agricultural sector to the national economy, taking into account the regional and global changes in the economic and political climates and that policy performance varies among the different components of the agricultural sector.

Several institutions are involved in drawing up agricultural policies in Iraq. These include boards, commissions, or high committees developed under special decrees for agro-economic policy formulation. The relevant ministries in the agriculture sector propose and implement the agricultural policies. However, the ministries responsible for the national economy and planning propose general economic policies and review proposed agricultural policies within the framework of these. The same ministry also follows up and evaluates the necessary supporting policies and programs to achieve the policy objectives. Generally, the institutions which are responsible for agricultural policy in Iraq are:

Agriculture Committee of the parliament
Council of Ministers
Ministry of Agriculture
Ministry of Water Resources
NGOs, such as the Association of Agricultural Engineers.

In the following pages a review of the policies related to wheat and date production will be presented. These two crops are strategic crops in Iraqi agriculture. They are the main sources of food for people and provide the population with their needed calories. The production of these crops is being addressed by the IFAD-funded project.

3.1 Agricultural policy related to wheat production in Iraq

3.1.1 Overview

Wheat is the most important food grain crop in Iraq. The contribution of wheat to the average income derived from cereals was 19.4% during the period 1975-1995. On average, wheat occupied 43.4% of the cultivated land in Iraq and 50.1% of the area devoted to cereals. Wheat is mainly grown under rainfed conditions, although some is grown under irrigated conditions in the irrigated areas, or under supplemental irrigation in the rainfed areas.

Iraq still imports large quantities of wheat every year to meet the needs of local consumption. Although Iraq allocated more than 40% of the arable land to growing wheat, production is still far below the country's needs. One major reason for the low production is the low productivity of the wheat that is grown. Some of the causes which contribute to the low productivity include low yielding wheat varieties, severe and frequent droughts in the rainfed areas (a consequence of low and erratic rainfall and the effects of the climate change), low soil fertility, and soil salinity in the irrigated areas.

3.1.2 Wheat production in Iraq

Data published by the Food and Agriculture Organization (FAO) indicates that the average area planted to wheat was about 1.4 million ha during the period 1970-2010 and the average production was about 1.3 million tonne during the same period. The average wheat yield was about 900 kg/ha. Figure 3.1 shows the evolution of the wheat area and wheat production. It is noted that there is a general trend towards an increase in the cultivated area and production, and the rate of increase in production was higher than the rate of increase in the area as a result of the increase in yields, Figure 3.2 shows that some progress has been achieved in improving wheat yields in recent years.

Figure 3.1: Changes in the areas planted to wheat and wheat production (1970-2010)

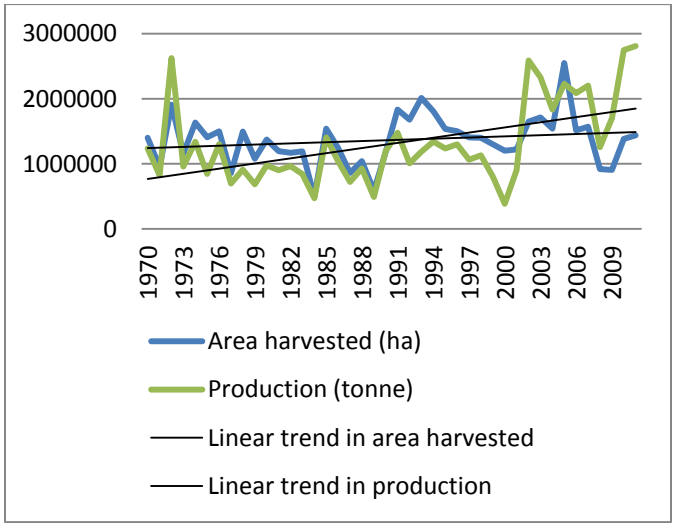
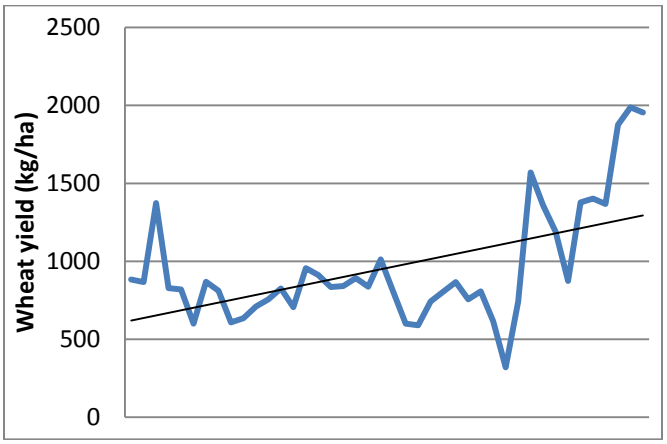


Figure 3.2: Changes in wheat yields in Iraq (1970-2010)

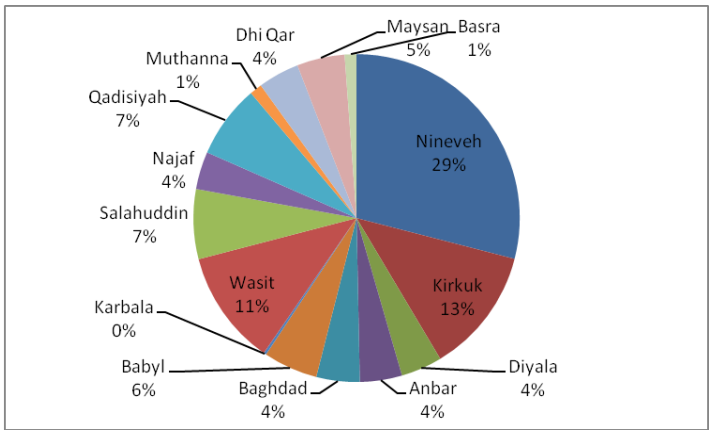


Wheat is grown in all the provinces, but to different extents, as shown in Table 3.1. It is clear from Figure 3.3 that Nineveh (29%), Kirkuk (13%), and Wasit (11%) were the provinces with the highest percentages of area planted to wheat during the period 2008-2012.

Table 3.1: Average area and yield of wheat (2008-2010)

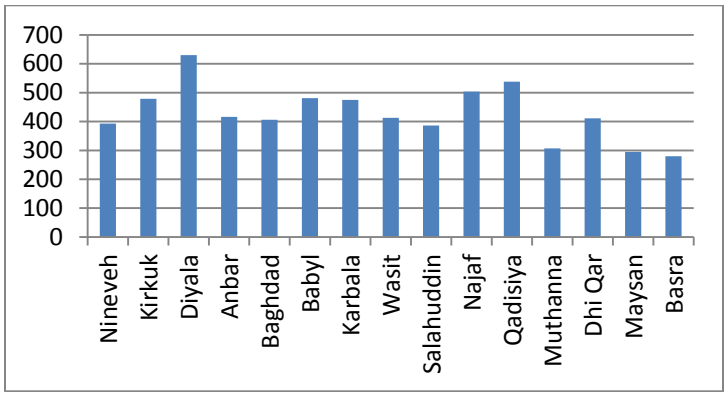
Province	Planted area (dunum)		Average yield (kg/dunum)		Production (tonne)
	Total area	Harvested area	Total area	Harvested area	
Nineveh	1,579,175	675,633	188	393	297,987
Kirkuk	676,410	548,661	397	479	267,569
Diyala	222,121	220,570	628	630	126,824
Anbar	227,429	205,911	382	416	92,064
Baghdad	234,028	234,028	406	406	94,942
Babyl	293,256	279,677	459	481	134,295
Karbala	14,381	13,834	452	475	6,684
Wasit	617,161	612,479	411	413	252,335
Salahuddin	374,768	350,257	363	386	143,368
Najaf	202,311	199,509	497	504	101,247
Qadisiya	393,748	354,960	499	538	192,377
Muthanna	66,522	57,992	273	307	18,959
Dhi Qar	222,174	201,624	380	411	82,122
Maysan	257,796	257,796	295	295	72,859
Basra	63,653	63,653	280	280	17,769
Total	5,444,932	4,276,585	350	436	1,901,402

Figure 3.3: Distribution of the wheat area by province (average 2008-2010



Average wheat yields in Iraq are relatively low; the data indicated that the average yield during the period 2008-2010 was 436 kg/dunum (equivalent to 1740 kg/ha) including both irrigated and rainfed wheat. Diyala province recorded the highest yield at 630 kg/dunum) (Figure 3.4). This is primarily because the wheat in this province is grown under full irrigation conditions.

Figure 3.4: Average wheat yields (kg/dunum) by province



The irrigated wheat area during the 1970s represented about 20% of the total wheat area (Table 2.2), but in the last ten years, the irrigated wheat area was higher than the rainfed area (Figure 2.5). The general trend for the area planted to irrigated wheat increases while that of the rainfed area declines. This has been reflected in the production figures as in recent years the majority of the wheat produced has come from the irrigated areas (Figure 3.6). There is a noticeable variation in wheat yields, under irrigated and rainfed conditions (Figure 3.7). Over the last 30 years, the average irrigated wheat yield is more than twice the rainfed yield (Figure 3.7).

Table 3.2: Area, production, and yield of wheat in Iraq during the period 1971-2002

Year	Irrigated area			Rainfed area		
	Area (000 dunum)	Production (000 tonne)	Yield (kg/dunum)	Area (000 dunum)	Production (000 tonne)	Yield (kg/dunum)
1971	**531**	**255**	**480**	**3,262**	**567**	**174**
1972	**1,072**	**813**	**759**	**6,586**	**1,811**	**275**
1973	**940**	**296**	**316**	**5,775**	**660**	**114**
1974	**927**	**425**	**448**	**5,696**	**923**	**162**
1975	**810**	**262**	**323**	**4,980**	**583**	**117**
1976	**849**	**406**	**479**	**5,220**	**905**	**173**
1977	**752**	**215**	**287**	**4,622**	**480**	**110**
1978	**867**	**281**	**325**	**5,493**	**627**	**114**
1979	**690**	**232**	**337**	**4,238**	**452**	**107**
1980	**644**	**210**	**327**	**5,002**	**765**	**153**
1981	**572**	**182**	**318**	**4,274**	**719**	**168**
1982	**542**	**177**	**328**	**185**	**787**	**188**
1983	**671**	**176**	**263**	**4,454**	**664**	**149**
1984	**758**	**181**	**240**	**4,512**	**289**	**64**
1985	**801**	**207**	**258**	**5,464**	**1,198**	**219**
1986	**701**	**198**	**283**	**4,339**	**837**	**193**
1987	**754**	**200**	**266**	**4,126**	**521**	**126**
1988	**942**	**185**	**179**	**3,439**	**743**	**216**
1989	**782**	**192**	**245**	**2,668**	**299**	**112**
1990	**639**	**195**	**305**	**4,143**	**1,000**	**242**
1991	**2,372**	**597**	**183**	**6,796**	**878**	**129**
1992	**2,536**	**930**	**367**	**2,273**	**380**	**167**
1993	**2,587**	**623**	**241**	**2,155**	**287**	**133**
1994	**2,405**	**254**	**218**	**2,672**	**329**	**123**
1995	**2,728**	**649**	**238**	**2,974**	**441**	**149**
1996	**2,840**	**853**	**300**	**2,728**	**297**	**109**
1997	**3,132**	**702**	**224**	**2,366**	**244**	**103**
1998	**3,054**	**988**	**334**	**2,728**	**486**	**178**
1999	**3,277**	**1,093**	**334**	**2,672**	**82**	**3**
2000	**2,891**	**1,006**	**348**	**1,235**	**33**	**24**
2001	**2,994**	**1,296**	**433**	**2,223**	**923**	**415**
2002	**3,158**	**1,600**	**570**	**3,436**	**989**	**288**

Source: Ministry of Agriculture – Agricultural statistics records

Figure 3.5: Development of the irrigated and rainfed wheat areas in Iraq

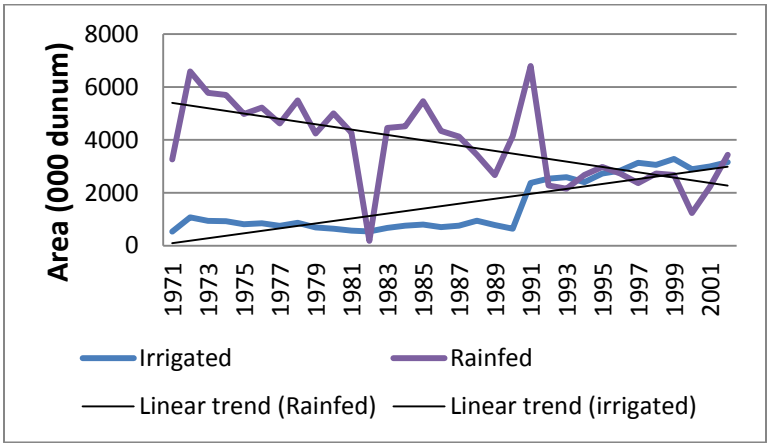


Figure 3.6: Total production of wheat (irrigated and rainfed)in Iraq during the period 1970-2002.

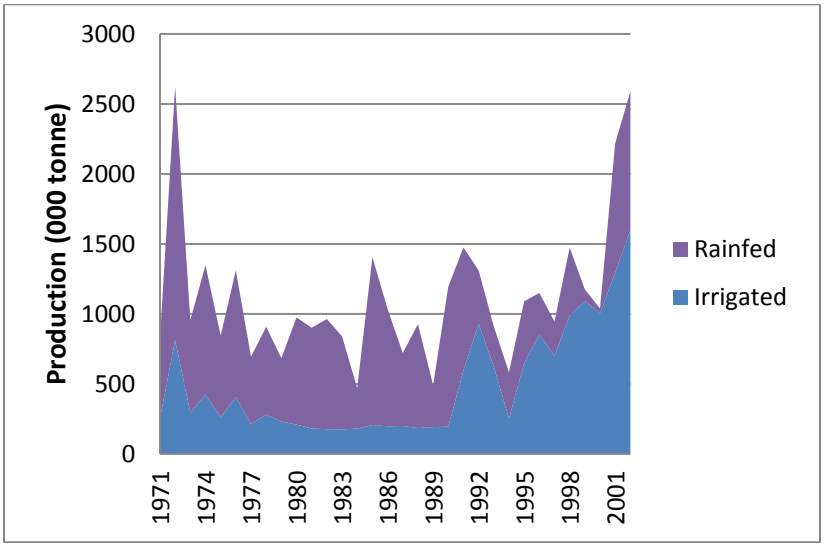
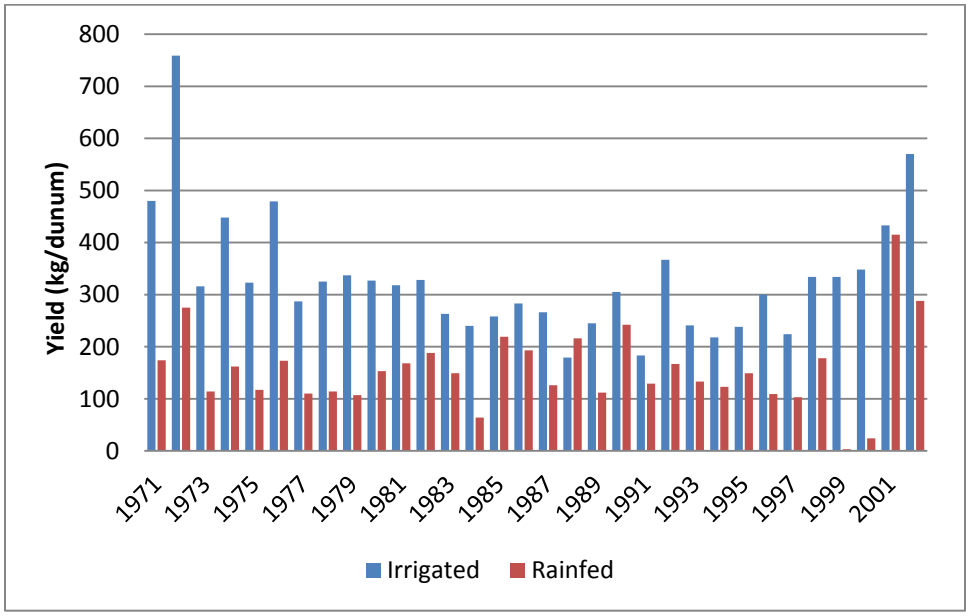


Figure 3.7: Irrigated and rainfed wheat yields (kg/dunum)



3.1.3 Wheat self-sufficiency

It is estimated that Iraq need around 4.5 million tonne of wheat for domestic consumption and it is importing more than 3 million tonne, equivalent to about 60 to 70% of the actual need. If we take into account that local production is approximately 1.5 million tonne annually, the gap between consumption and production is very large. This situation needs policy decisions which can be categorized in three options:

- First, simply accept the consequences of the influence of free trade, including the distribution of income and efficiency
- Second, even if the price, in the case of free trade, was too high for consumers, implement a direct price policy to reduce food prices and improve the nutritional status and the distribution of incomes of urban residents in the short term
- Third, protect domestic producers from foreign competition by raising the level of farm prices for the commodity concerned. This may provide the necessary incentives to increase production and may also lead to an improved income distribution between urban and rural areas.

It is clear that the wheat crop has both food and economic importance; many studies referred to that and their findings can be summarized as:

- Wheat is the main source of wages in the community. A study indicated that 19% of the total amount spent on food per capita is spent on wheat
- It is an important source of farm income. In this regard, a study pointed out that income from wheat was about IQD 2,352 million for the period 1975-1995. This represented 19.4% of the average income derived from grain production
- Wheat and its products, such as flour, influence the state budget, which reflects that importance through the support price policy applied by the government. One of the studies indicated that the support policy had some negative economic effects; including changes in state revenue

caused by consumer protection, which means that the state loses some revenue as a result of consumer protection at the expense of the producers in most years

- A study carried out by the World Bank and others in 2003, related to circumstances of unsustainable food security, indicated that the food aid program in Iraq (until the date of preparation of this report) was costing the country more than USD 2 billion annually, creating a market compensatory affect for agricultural production.

3.1.4 Iraq's price policies for wheat

One of the most important factors influencing agricultural production is the price policies which are an integral part of the general economic policy of the country. The large amount of support directed to agricultural inputs was a major problem impeding the desired progress and creating significant economic distortions. A large proportion of the fertilizers, pesticides, and seeds which were distributed to farmers were then smuggled out of the country. The pricing policy and marketing system passed through various stages. During the 1970s and 1980s, marketing was mandatory to the public sector at prices fixed by the state. In the 1990s, the prices of strategic crops, including wheat, were fixed and the state was ready to receive all the production at the specified price. Farmers were able to sell their production to the public sector or in the local market. After 2003, a better price was fixed by the state for wheat to encourage production and increase the wheat areas.

The Iraqi government applied a subsidy policy to stabilize the prices of locally produced cereals and raise the purchasing power of people, especially those with limited incomes. In order to resist the phenomenon of inflation and its negative effects on the economy and society, a policy was adopted to support cereal prices in Iraq using different methods which were consistent with the goals to achieve the economic policies. However, the Ministry of Agriculture has been using productivity as a function when calculating the production costs per tonne and when calculating prices. An example of this is presented in Table 2.3, which shows the price policy for 2008.

Table 3.3: Wheat prices in 2008 (USD)

Crop	Current price	Proposed price	Current world price
Wheat	540	625	458
Barley	282	400	-
Rice	900	900	452
Maize	300	300	257

3.1.5 Policies related to IPM for wheat production

The success of IPM depends not only on good technology and the skills and knowledge of the farmers, but, to a large extent, on the overall policy environment. A crop protection policy is part of the larger agricultural and environmental policy framework. IPM is often mentioned in national agricultural policy documents and the statements of politicians. In contrast to these, chemical crop protection methods often still receive direct and indirect support and hinder the effective dissemination of IPM. It is important to identify the role of government in the different crop protection systems.

In 2008, the Iraqi Ministry of Agriculture opened a new center called the National Center for Organic Agriculture, which is one of the research, extension, and development centers. One of the objectives of the center is to improve traditional Iraqi agriculture; to make agriculture modern, clean, and safe for human health and to preserve the environment. The goal of the center is to promote the use of methods in agriculture which maintain human health and the environment. This is to be achieved by

using technology and scientific agricultural recommendations and through the application and implementation of a range of applied projects for achieving an increase in wheat production and for raising the yield per unit area. The most important projects which the center is implementing are:

- Natural pest control in agriculture
- OF and mushroom production
- Development of medicinal plants and herbal spices
- IPM and agricultural rehabilitation
- Improved livelihoods for small-scale farmers in Iraq through IPM and the use of organic fertilizer (in collaboration with IFAD and ICARDA).

There is no clear agricultural policy regarding the use of IPM for the wheat. Sunn pest control has not been applied during the past five years because damage from this pest had not reached an economic threshold. Agricultural aviation was used to control this insect during the 1970s, but the air embargo, which was for a long time imposed on Iraq, prevented the Ministry of Agriculture from controlling Sunn pest by aerial spraying. The report prepared by the World Food Program and others in 2003 indicated that Iraq's needs for insecticides and herbicides may be reduced with an accelerated IPM program, but until now imports of these chemicals are reaching 6000 t/year.

3.1.6 New agricultural policies for improving wheat production in Iraq

In Iraq, particularly in recent years, agricultural policies concerning cereals in general and wheat in particular have been designed to promote yield increases as well as increasing the area planted to wheat. The Ministry of Agriculture developed a long-term plan to achieve food security and a long-term goal to achieve self-sufficiency. The action plan of the Ministry of Agriculture for the years 2011-2014 seeks to raise the coverage ratio of the domestic consumption of wheat from 41% (base year 2011) to 70% in 2014 (Table 3.4). The plan has been prepared in the light of key indicators, such as the availability of water resources and the priority of vertical expansion; horizontal expansion is only applied when organizing sprinkler and drip irrigation systems. The plan has adopted the following indicators:

- Annually add 375,000 dunum of new irrigation systems
- 100% growth in wheat yields using sprinkler irrigation systems
- 5.5% annual increase in the irrigated wheat area
- Achieve a 42% growth in irrigated wheat yields during the years of the plan.

The concentrated focus of these new policies for wheat production by different cultivation methods depends on the availability of water sources. There are three options:

- Irrigate wheat using sprinkler systems. This represents the most significant development for increasing wheat production. It is estimated that such a move will increase wheat production by 1.725 million tonne during the period of the plan
- Increase the production of irrigated wheat by 882,000 tonne by limited horizontal expansion. The primary effort will be to focus on vertical expansion using fertilizers according to the needs of the wheat crop, use full mechanization, and provide improved seeds in the recommended quantities
- The rainfed wheat area and yields will remain unchanged.

Table 3.4: Summary plan for the years 2011-2014 for wheat

Total wheat	Base line: 2008 and 2009	Year 2011	Year 2014	Growth from base line to 2014	
				Quantity	Proportion (%)
Area (000 dunum)	5,080	5,380	6,728	1,648	32
Yield (kg/ha)	346	449	649	303	88
Production (000 tonne)	1,759	2,415	4367	2,608	148
Gap (000 tonne)	2,716	2,490	992	1,724	63
Coverage (%)	41.3		69.5		28.2

3.1.7 Water resources development policies

The agricultural policies related to water are designed to reduce water wastage in the irrigation networks by lining the irrigation channels, using pipelines to transfer water, and to exploit the topography to raise water levels in the rivers without leaking water into the Arabian Gulf. The policy also focused on using renewable groundwater as well as agricultural drainage water and gives priority to the coverage of fertile lands with sprinkler and drip systems in order to minimize losses.

The Ministry of Agriculture has adopted a fodder cultivation project which applies modern irrigation techniques. The project will provide wheat farmers with pivoting irrigation systems; where 20 thousand systems were allocated and each system will cover an area of 120 dunum, and other system will cover an area of 40 dunum where 15 thousand were allocated. These irrigation systems will be subsidized and made available to farmers at 50% of the cost, the balance being payable over several years. The project is designed to:

- Reduce the wastage of water by between 30 and 40%
- Increase productivity to 1 t/dunum
- Move Iraq to self-sufficiency. The project will provide 3 million tonne of wheat to cover the deficit in the demand. Iraq needs to import wheat as current wheat production is between 1.7 million and2 million t/year and the actual need is for 5 million t/year. Successfully completing this project means that Iraq can achieve self-sufficiency in wheat.

3.1.8 Wheat marketing

There is no clear agricultural policy regarding the marketing of wheat; the process in Iraq is a free market system. A farmer can sell his wheat production in the domestic market or to the state at prices which have been set by government institutions and which are higher than local market prices. It has been observed that some producers prefer to sell their wheat in the market for several reasons. These include receiving payment for the wheat directly from the buyers and not having to wait to be paid by the state, which usually takes some time. Other farmers have just a small amount of wheat and prefer to sell in the local market.

The Iraqi Ministry of Trade has implemented a strategic project which includes the construction of eight large silos in various provinces. The project is part of the development plan adopted by the ministry for the next three years and is scheduled to deliver a combined silo storage capacity of 240,000 tonne (eight silos of 30,000 tonne). The project is scheduled to be completed in 2014. Iraq currently has 38 silos and its storage capacity is between 10,000 and 20,000 tonne. There are some agricultural policies, which are still operational which prevent the export of domestic wheat. But the current policies allow local traders

to import and trade in wheat and its products. It should be noted that the economic policies allocate a food quota for every citizen, including 9 kg of flour per month.

3.1.9 Credit policies

The Agricultural Bank and other commercial banks give short-term loans to farmers, at interest rates of from 18 to 21%, to purchase production requirements or to implement agricultural projects. But the high interest rate and inadequate lending procedures do not help the development of the agricultural sector. After 2003, a fund was established to lend to farmers. The fund has a capital of IQD 25 billion to contribute to the provision of concessional financing in accordance with the appropriate guarantees. Then, in 2008, came the Prime Minister's agricultural initiative to establish six specialized funds for lending. These funds provide interest-free loans to farmers for horticulture, date palm production, for introducing mechanization and technology in the wheat sector, livestock development, and major agricultural development projects. The funds were allocated USD 240 million in 2008 and similar amounts in 2009, 2010, and 2011.

3.1.10 The impact of current agricultural policies on wheat production

There are some positive effects resulting from the agricultural policies addressing wheat production currently being applied in Iraq:

The policy of supporting production requirements (seeds, mechanization, fertilizers, pesticides etc.) for wheat – which can be up to 100% in some cases. This is a policy which has been pursued in Iraq for decades up to the present day, despite the reduction in support allocations during the recent years. This policy is positive in some respects because it creates a semblance of stability in providing inputs to farmers at reasonable prices

The pricing policy adopted by the government for buying wheat from producers has helped to increase the area planted to wheat. The price is adequate and may sometimes exceed the international price for wheat in order to encourage wheat cultivation

Other policies pursued by the state to promote the cultivation of wheat, especially in recent years, include introducing new technologies, such as the provision of sprinkler and drip irrigation systems. This is an attempt to increase the area planted to wheat and to conserve water used for irrigation. The system tends to reduce salinity. However, this policy is still in its early stages

The state has adopted new agricultural policies in recent years, such as the provision of specialized agricultural lending funds. These funds provide interest-free money to farmers to increase the planted area and achieve higher productivity

Despite the positives of the current agricultural policies, there are some negatives which have had an impact on wheat production. For example, farmers rely heavily on the inputs provided by the government, but these may be insufficient to achieve the anticipated high production and productivity of wheat. Or some farmers may sell these subsidized inputs at higher prices instead of using them in the production process.

3.2 Agricultural policy related to palm cultivation and date production

3.2.1 Introduction

Iraq used to be the main date producing and exporting country in the world. It occupied an advanced rank in the global market for dates. But the number of palm trees declined dramatically as a result of external and internal challenges, as well as damage to a large numbers of trees by disease, pests, and insects. Additionally, the low prices for dates were not commensurate with the costs of production. In 2005 Iraq ranked as the fifth largest producer of dates n the world. By 2010 it had slipped to seventh place in the global ranking for date production. The contribution of Iraqi dates to the global date trade decreased by 6% in the same period. The total production of Iraqi dates was 650,000 tonne in 2005 and accounted for 9.7% of the total world production of 6,671,000 tonne.

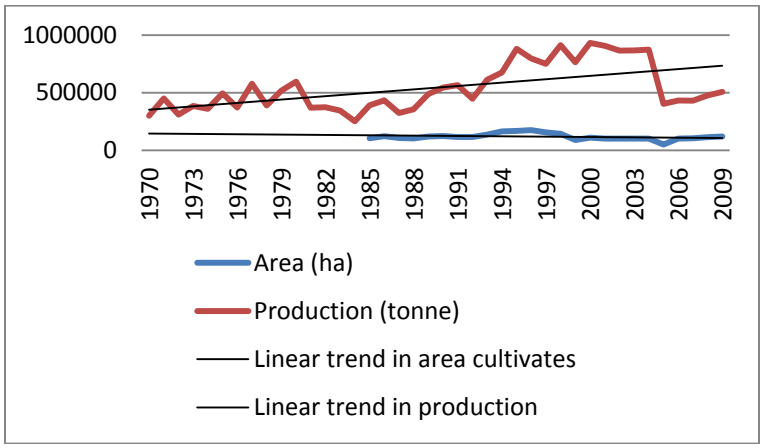
3.2.2 Status of date palms in Iraq

Table 3.5 and Figure 3.8 show the production and productivity of date palm and the area given over to date palm cultivation in Iraq from 1970 until 2009, according to FAO statistics.

Table3.5: Area, production and yield of date palms in Iraq

Year	Area (ha)	Production (tonne)	Yield (kg/ha)
1985	105,000	390,200	3,716
1986	122,130	434,210	3,555
1987	107,970	323,540	2,997
1988	103,370	356,330	3,447
1989	119,970	488,390	4,071
1990	123,510	544,930	4,412
1991	115,670	566,220	4,895
1992	116,000	447,840	3,861
1993	136,000	612,580	4,504
1994	165,000	675,820	4,096
1995	168,000	881,020	5,244
1996	176,000	797,450	4,531
1997	156,000	750,000	4,808
1998	144,000	913,000	6,340
1999	90,000	764,000	8,489
2000	110,000	932,000	8,473
2001	101,500	907,000	8,936
2002	101,500	866,000	8,532
2003	101,500	868,000	8,552
2004	101,500	875,000	8,621
2005	50,000	404,000	8,080
2006	101,500	432,000	4,256
2007	105,000	430,861	4,103
2008	115,000	476,318	4,142
2009	120,000	507,002	4,225

Figure 3.8: Area and production of date palm in Iraq



Date palm is grown on a large scale in the central and southern regions of Iraq. Data indicate that the economic cultivation of date palm is recognized in 13 provinces. In 2009, the number of palms was about 12 million, covering an area of 500,000 dunum (equivalent to 125,000 ha), and producing 507,000 tonne – an average productivity of 61 kg/tree.

Baghdad, Diyala, Karbala, Babyl, and Basra are the most important palm growing provinces in Iraq (Table 3.6). These provinces have nearly two-thirds of the palm trees and date production (Figures 3.9 and 3.10).

Table 3.6: Number of palm trees and their production, by province, during the period 2007-2009

Governorate	2007		2008		2009		Average 2007-2009	
	Total number of palm	Production (tonne)	Total number of palm	Production (tonne)	Total number of palm	Production (tonne)	Total number of palm	Production (tonne)
Kirkuk	1,548	54	2,167	68	2,729	79	2,148	67
Diyala	1,218,152	51,617	1,374,858	56,813	1,548,022	59,956	1,380,344	56,129
Anbar	655,639	38,849	576,255	39,295	582,317	40,754	604,737	39,633
Baghdad	1,231,174	53,198	1,649,913	63,135	1,929,883	68,562	1,603,657	61,632
Babyl	1,376,643	65,879	1,450,613	84,165	1,502,925	86,422	1,443,394	78,822
Karbala	1,344,993	53,732	1,382,607	43,522	1,405,671	50,108	1,377,757	49,121
Wasit	543,525	32,182	590,391	31,572	619,803	33,047	584,573	32,267
Salahuddin	214,592	9,805	262,039	12,469	295,014	13,895	257,215	12,056
Najaf	522,257	24,291	533,404	22,691	539,480	23,324	531,714	23,435
Qadisiya	426,570	15,546	459,535	24,552	491,634	25,561	459,246	21,886
Muthanna	517,545	13,229	529,961	16,461	581,588	17,577	543,031	15,756
Dhi Qar	584,509	20,199	879,553	27,778	930,726	29,781	798,263	25,919
Maysan	149,682	5,425	162,100	6,411	166,311	6,898	159,364	6,245
Basra	1,091,736	48,354	1,159,255	47,386	1,201,028	51,038	1,150,673	48,926
Total	9,878,565	432,360	11,012,651	476,318	11,797,131	507,002	10,896,116	471,893

Figure 3.9: Distribution of the number of palm trees by province

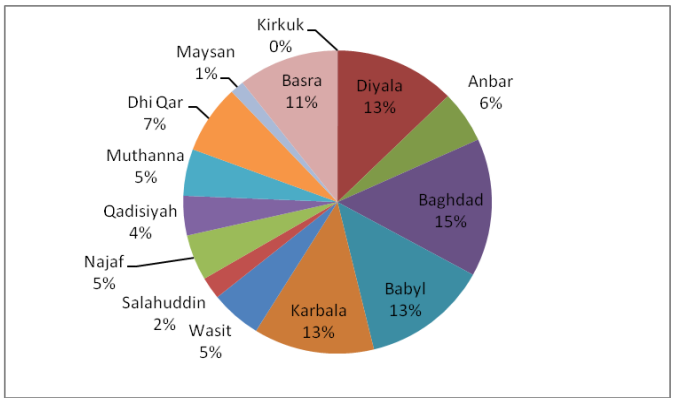
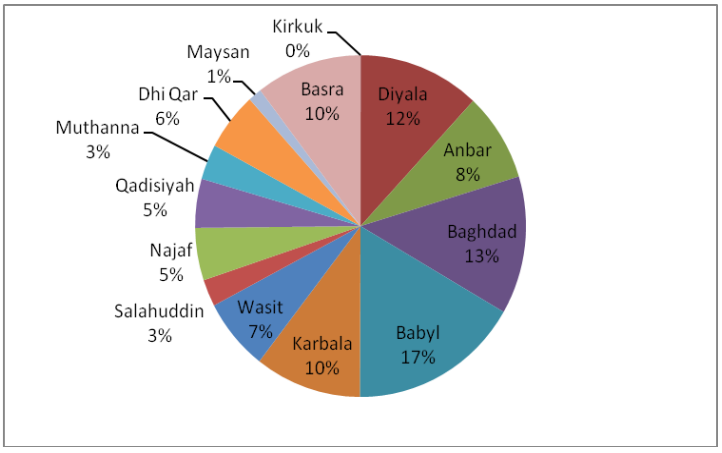


Figure 3.10: Proportion of date palm production by province (average 2007-2009)



Iraq has a wealth of palm tree varieties – more than 600. Twenty varieties of these are widely spread, including six varieties that are commercially recognized. The Zahidi variety makes up 76% of Iraq's production of dates, as shown in the Table 3.7.

Table 3.7: Number and production of palm trees, and average yield by varieties for the year 1997

Rank	Variety	Total number of palm trees (000)	Number of palm trees in the fruiting stage	Yield (kg/tree)	Production (tonne)	Relative importance (%)
1	Zahidi	10,309	9,533	60	575,180	76.7
2	Khastawi	1,285	1,086	47	51,480	6.9
3	Sayre	957	920	30	27,940	3.7
4	Halawi	666	613	29	17,720	2.4
5	Khadrawi	928	811	23	19,080	2.5
6	Derry	289	277	11	3,180	0.4
7	Other varieties	1,573	1,370	40	55,560	7.4
	Total	15,910	14,613	51	750,140	100

Source: General Authority for Date Palm (2007) study on palm status: production and marketing of the dates grown in Iraq and the prospects for development. (Baghdad governorate)

3.2.3 Reasons for the decline in the areas planted to palm trees

- Although Iraq was one of the leading countries in the world for the number of palm trees and volume of dates produced, this situation has changed as a result of the deterioration of the palm sector. The Palm Commission issued a report which presents the major problems facing the date palm sector. These include a lack of proper farm management, such as use of fertilizers, irrigation, pest control, and the weak service operations necessary for the trees (vaccination, ability to react to problems, etc.). This is a result of the lack of skilled labor and the limited resources available to farmers
- Weak economic returns from palm cultivation because of the low market price
- High salinity, especially in the southern regions, in addition to a decrease in the amount of irrigation water
- Disasters resulting from the successive wars, which have led to the destruction of large areas of palm, particularly in the southern areas of Iraq
- Fragmentation of the agricultural holdings resulting in the inability of farmers to adopt modern technologies, particularly in the field of agricultural mechanization.

The data presented show fluctuations in the area and production of palm trees. A noticeable decline in the areas and the productivity of the palms is observed, especially after the 2003 war. However, this situation has started to change slightly following the launch of the agricultural initiative in 2008, which has led to an increase in the cultivated area and production.

3.2.4 Agricultural policies for date palm

Agricultural policies for date palm have changed since the establishment of the Iraq State. In 2005, the Ministry of Agriculture created the General Authority for Palm to be responsible for the development of palm cultivation in various parts of the country using technologies and research recommendations. It would also apply and implement a range of projects to achieve an increase in the production of palm trees in the coming years. These following projects are part of this strategy:

- Creating mother palm stations
- Plantlet nurseries

- Rehabilitation of the palm orchards
- Introducing modern technology for palm cultivation and the marketing of dates
- Cultivation and production of palm plantlets using tissue culture technology
- Rehabilitation of the palm sector:

In addition to this, the Ministry of Agriculture played a major role by having the technical and financial facilities to introduce modern agriculture technologies to improve the productivity, manufacturing, and marketing of dates.

3.2.5 Water policies related to palm trees

Palm trees need a large amount of water for irrigation – about 175 m^3 per palm tree annually. The need for water increases before and during plant growth and fruit development, events which coincide with hot weather. Most of the palm groves, and fruit trees in general, are located adjacent to rivers (river beds). Surface irrigation from the Tigris and Euphrates is the main watering method used. In addition, in some desert areas groundwater artesian wells are used. Drip irrigation has recently been used in limited areas, especially on the state farms.

In order to reduce the wastage of water in palm irrigation and to encourage the adoption of modern irrigation methods, the Ministry of Agriculture provides loans to farmers through the Agricultural Bank for them to install modern irrigation systems in the palm groves. The Palm Development Fund was created as part of the agricultural initiative to spread modern irrigation and other advanced technologies. The initiative encourages establishing palm groves in areas where the main source of water requires that wells be dug. The Fund grants the necessary loans to dig and establish such wells.

3.2.6 Pricing policies for dates palm

Policies which organized trading, marketing, and pricing are changed following changes in the policies and regulations systems. In the 1960s the following marketing bodies were established:

- Trading Company for Iraqi Dates Ltd., in Basra in 1952
- Cooperative Association for Dates Producers, in the central region in 1960
- Department for Iraqi dates, in 1961.

In 1979, the Palm Corporation for Iraqi Dates was established. In 1980, the Marketing Institute for Iraqi Dates was initiated, replacing the Department for Iraqi dates. The Iraqi Company for Dates Manufacturing and Marketing, a mixed stock company, was established in 1988.

Since 2008, the Ministry of Agriculture of Iraq has adopted a marketing campaign for dates because the institutions involved in date marketing have stopped their activities. The ministry receives and markets dates from farmers. The date price is declared in advance before harvesting. In the 2011 season, the purchase price for dates of the Zahidi variety (first class) was IQD 450,000 per tonne and for second class dates it was IQD 350,000 per tonne. This price was higher than the usual price in the local markets.

3.2.7 Date marketing policies

Internal marketing includes agencies which deal with wholesalers, semi-wholesalers, and local merchants while the external marketing of dates is carried out by large merchants who have fixed offices and export licenses. External marketing of Iraqi dates is mainly carried out by brokers located in Dubai. It is through these that the re-export of Iraqi dates to other international markets is made after some marketing functions. Iraqi dates are exported to the Gulf region and to countries such as Turkey, Syria, Jordan, and Morocco.

The activities of collecting dates, marketing, packaging, and storage are facing serious constraints, which affect the productivity and marketing process as a whole. These constraints are discussed in the following.

Date collection, processing, and marketing

- The small area under cultivation and the fragmentation of the palm orchards make it difficult to collect the dates because of differences in the quantities, varieties, qualities, and stages of maturity
- Traditional harvesting methods (manually) in most date production areas are the most common practice
- Significant losses and damage occur during harvesting
- Transportation facilities are limited especially during the peak period of the season, in addition to poor agricultural roads and high transportation costs
- Brokers do not meet marketing quality standards, and therefore can expect low prices
- The role of extension agencies in marketing is limited or does not exist. In addition there is a lack of extension marketing centers.

Date storage

- In general, storage capacity is limited and not properly distributed
- As a result of the *Almaaoma* phenomenon (fruiting exchange between years), annual production fluctuates between years and, therefore, the quantities of dates available for marketing will also fluctuate
- There is no supervision of the storage facilities or the techniques provided to the private sector
- A lack of coherence between the consumption, export, and price policies, and a lack of vision and clarity add to the complications of the marketing issues.

Transportation of dates

- Poor road networks and the absence of connections within palm groves results in large losses and damage
- Packaging and its associated activities are irregular and poorly organized.

3.2.8 Supporting policies for date palm production

The support policies for dates of the past few years focused on programs which encouraged production and productivity improvements. The General Authority for Palm adopted several projects to increase the cultivated area and the development of new palm groves and to multiply the desired palm varieties for global markets through tissue culture and other approaches.

The Ministry of Agriculture provides substantial support to date producers by ensuring the marketing of their dates, and through the provision of funds for palm development. The amounts allocated to the agricultural initiative of the Iraqi government were IQD 22 billion, for the period from 2008 to 2010, and IQD 7 billion for 2011.

3.2.9 Policies related to use of organic fertilizer with palm

Technical reports indicate that annually a palm tree needs approximately 600 g of nitrogen, 420 g of phosphorus, and 225 g of potassium to create fronds and other vegetative parts (except logs and roots); such dosages will give 45 kg of dates. Palm trees have a high response to nitrogen fertilizer.

In the southern region the fertilizer used is generally in the form of animal fertilizer (organic) which is applied once every four to five years at a rate of between 100 and 300 kg/tree in the autumn. In other areas, where intercropping with fruit trees is practiced, both chemical fertilizers and OF are applied every year to the intercropped fruit trees; the palm trees also benefitting from that application.

The new policies adopted by the Ministry of Agriculture through the National Center for Organic Agriculture convert waste palm residues (anguish, fronds, and even trunks) to organic fertilizer by chopping and aerobic and anaerobic fermentation. These products are then delivered to palm producers as a source of fertilizer to be used in their fields instead of them burning the residues. One objective of the project is to build a specialized laboratory for compost production from palm tree residues, which can then be used as a source of OF. This will reduce the cost of production and improve farmers' incomes.

3.2.10 Use of Integrated Pest Management with palm trees

The Iraqi Ministry of Agriculture usually controls the Dubas bug and lesser date moth free of charge. The General Authority for Plant Protection usually conducts a survey to detect infected areas in the provinces and determine the severity of the infestation. The areas identified as needing to be controlled undergo aerial spraying with chemical pesticides.

In recent years, the government has initiated several projects which introduce integrated pest control technologies against serious pests, such as Dubas bug and the lesser date moth. The General Authority for Plant Protection has introduced some of projects at the National Center for Organic Agriculture. Among these is the IPM/OF project where plant extracts, such as neem, are used as a bio-pesticide to control Dubas bug insects. It has also introduced predators and parasitoids as biological controls against some pests. Another new approach which has been introduced is the use of light traps to control borers.

3.2.11 The need for new policies to improve the date palm sector

The General Authority for Palm at the Ministry of Agriculture indicated that the Ministry of Agriculture has a major role to play in the growth and development of the date palm sector – from production to marketing. This role could be achieved by issuing supporting policies to the sector, which would address the followings areas:

- Support producers and farmers through a special system of loans and credits and continue the support to inputs required for palm production
- Launch a strategic plan to re-classify dates and promote cultivars which have economic and commercial value
- Launch an awareness and extension program to encourage farmers to plant the desired varieties which have international markets. Provide farmers with the proper farming practices and services recommended by research programs and train them in the use of these practices especially using fertilizers and pest control
- Assist and support the establishment of cooperatives and associations for producers and marketers of dates to play more constructive roles in the development of the sector
- Encourage investment in establishing refrigerated stores and small factories for date products

- Provide irrigation water, using modern irrigation methods, and establishing irrigation and drainage networks
- The pricing policy should support the final prices. Establish a minimum price which will be attractive to producers and continue announcing purchasing prices annually
- Conduct studies and research as well as expand the ways for the results of scientific research to be applied in the palm fields.

3.3 Agricultural policy options for promoting IPM and the use of OF

As identified in the introduction to Section II, several ministries and institutions are involved in drawing up agricultural policies in Iraq. The most important policies currently adopted in Iraq which are related to the agricultural sector are:

- The five-year plan (2010-2014) for the development of Iraqi agriculture which has been allocated USD 9.5 billion for the implementation of its provisions. The plan targets strategic projects in the fields of water resources and land reclamation as well as providing the inputs required for agricultural production, including pest control
- The agricultural initiative, which was started in 2008 by the Iraqi Council of Ministers, included several projects and various activities to support the agricultural sector and provide farmers with agricultural machines and suitable water for irrigation. The initiative also included providing farmers with improved seeds, chemical fertilizers, pesticides, and assistance in land reclamation., It guaranteed the purchase of agricultural production by the state at market prices, opened financial loans for palm development, and distributed loans to small-scale farmers
- The Ministry of Agriculture set a 10-year time line for achieving self-sufficiency in strategic crops
- A national strategy for the protection of the environment in Iraq and the executive work plan for the period of 2012-2017 were prepared by Ministry of Environment.

Current agricultural policies in Iraq seek to increase total agricultural production by increasing productivity and by providing farmers with needed inputs, including chemical fertilizers and pesticides. This policy is influenced by the large food gap as represented by the shortage of wheat in Iraq. This gap requires that 70% of the wheat needed for consumption be imported annually. Therefore, agricultural policymakers are trying to reduce that gap by using an input subsidies policy to encourage farmers to apply the inputs needed to increase yields. The available data on the amounts of these subsidies indicate that the proportion supporting wheat seeds represents about 30% of the total support value for strategic crops (wheat, barley, rice, maize). The proportion supporting chemical fertilizer is 50%, that for chemical pesticides for wheat is 50%, and that for the chemical pesticides to control palm pests is 100%. The proportion of support provided to modern irrigation systems is 50%.

The agricultural policy has resulted in some positive environmental indicators. In addition to a national strategy for the protection of the environment, in 2008 the Ministry of Agriculture established the National Center for Organic Agriculture to improve traditional Iraqi agriculture and move it to modern agricultural practices which are, clean, and safe for human health and the environment.

Most agricultural policies of recent years did not directly address fertilizer use for date palm, but now. there is the National Center for Organic Agriculture project for producing compost from date palm plant residues.

For the first time during the 2012 season, the plant extract neem was tested by the IFAD IPM/OF project in aerial sprays in specific areas to control the Dubas bug.

Until now, no clear agricultural policy has been available or been applied regarding the implementation of IPM and the use of OF. However, the success of IPM depends not only on good technology and the skills and knowledge of farmers, but also, to a large extent, on the overall policy environment. As indicated in paragraph 2.1.5 Policies related to IPM and political statements supporting organic approaches to farming are not supported by actions.

Serious efforts need to be considered by the policymakers to move Iraqi farming from traditional agriculture, which relies on the extensive use of chemical pesticides, into a 'clean' agriculture. This requires implementation of a series of polices. Adoption of IPM approaches to control agricultural pests and the use of OF are the key factors for a clean and sustainable farming system.

The purpose of the IPM/OF project is to increase productivity of the date palm and cereal/food/legume-based production systems by having farmers adopt improved technology packages based on IPM and the use of OF. During the years 2009-2012, the project worked to achieve the set objectives and outputs, by introducing IPM approaches to control three major insects which attack date palm trees and fruits and reduce the yield and quality of the product. The project also promoted the use of OF on palm. The results of the project are being reflected in farmers' incomes. The project introduced and demonstrated IPM options to control the three major insects. The project composted the residues of palm trees to be used as an OF on palm rather than using chemical fertilizers. It is expected that the results of this project will influence policymakers to adjust the current agricultural policy, which supports applying chemical agricultural inputs, in favor of applying bio-pesticides and OF, since these technologies can improve yield, profit, and the environment.

Based on the results obtained from the IPM/OF project, with its sustainable increase in productivity of the date palm and cereal/food/legume-based production systems and to protect the environment, we have to encourage farmers to adopt the improved technology packages which are based on IPM and the use of OF.

Agricultural policy can play a vital role in this regard by adopting enabling policies to reduce the use of chemical pesticides and fertilizers in favor of organic sources and to apply the IPM approaches. Some of the suggested enabling and alternative policy options to reach this objective include:

- Reducing or removing the subsidies currently applied to chemical products will help to reduce the amounts of these which are applied by farmers and encourage them to look for alternatives, such as IPM and the use of OF. The money saved by reducing the subsidies for chemical inputs can be directed to subsidize the inputs needed to apply biological pest control methods and use OF
- It is necessary to differentiate between organic and non-organic products and create a new price policy that gives higher prices for organic agricultural products
- Organic pest control needs inputs and facilities which might not be available, have a higher cost, and be difficult to access. Policymakers will need to consider the availability of the organic pesticides when promoting their use by farmers
- Farmers differ in their responses to applying various pest control methods on their farms. A well-trained agricultural extension system with a good knowledge of IPM approaches and the use of OF needs to be established and be effective in changing farmers' attitudes and practices
- Raising the awareness of farmers and decision makers at the Ministry of Agriculture and other related ministries and institutions regarding the concepts of IPM and the use of OF is urgently needed to gain their confidence, support, and understanding

- Technical and financial support to the National Center for Organic Agriculture is essential to widen its scope, and to intensify its activities in the areas of IPM and use of OF at the farm level and to cover the different regions of the country
- Within the framework of institutional reform, we suggest creating a 'National Center for Agricultural Policy' as a national department or division within the Ministry of Agriculture. This center will have the mandate to address policy and institutional issues at the national and provincial levels
- An agricultural extension system has an important role in disseminating clean farming and organic agricultural techniques to producers and consumers. In order to achieve such a goal, the system needs to be qualified for this role.

4. Feasibility of using bio-pesticide and organic fertilizer on date palm

4.1 Introduction

The IPM/OF project conducted many activities and introduced and evaluated several technologies for the purpose of improving the livelihoods of small-scale farmers. This section will focus on the feasibility of two technologies introduced by the project – applying OF to date palm and using a bio-pesticide to control Dubas bug insects on date palm.

Several indicators could be used to measure the feasibility of a technology. These include operational, cultural, political, technical, schedule, economic, and legal feasibilities. Economic feasibility, which is a measurement of the cost effectiveness of a technology, was applied in this research. The return on cost technique was used to assess the economic feasibility of the above technologies by applying partial budgeting. This is a method of organizing data and information about the costs and benefits resulting from some changes in the technologies being used on the farm. It requires less information than a whole farm budget since the purpose is to estimate the differences in benefits or losses which are expected from the application of the technologies. As a result, there is no need to estimate the total income and costs for each of the technologies being considered, but it is necessary to indicate that the benefits quantified in this analysis are not the net returns per unit. However, the partial budget technique is most useful where the new technology consists of an existing technology with but one or two changes.

4.2 Feasibility of applying organic fertilizer to date palm

The technical results of the research on applying organic fertilizer indicate that the date palm responded positively to the application of OF in the form of compost, manure, or mycorrizah. The increase in yield was nearly 30% following the application of 30 kg of compost per tree, 10 to 30% with the application of 15 kg of compost, and 10 to 17% with the application of 25 kg of manure per tree as compared with the unfertilized trees. This variability was associated with the soil (mainly salinity) and management (irrigation, pruning, pollination, and many other issues). The application of OF in the form of compost improved the nutrient balance of the soil by increasing the concentration of NH_4-N by 5 to 47% and NO_3-N by 9 to 58% in the top 60 cm of soil . Composting agricultural waste, including date palm waste, by farmers is a technology adopted by the Center for Organic Farming in the Ministry of Agriculture which is to be disseminated among farmers in the various Iraq governorates.

The economic feasibility study of this technology focused on applying OF in the form of compost to date palm and comparing the results obtained from applying chemical fertilizers. The analysis is based on the following assumptions:

- The palm tree variety is Zahidi, which is the dominate variety in Iraq
- Management of the date palm trees is the same whether organic or chemical fertilizers are applied
- The amount of chemical fertilizers added per tree are 1kg urea and 0.5 kg trisodium phosphate (TSP)
- The amount of OF added per tree is 30 kg of compost
- There are 40 date palm trees planted per dunum
- Urea is priced at IQD 700 per kg and TSP, IQD 1200 per kg

- Purchase price of OF is IQD 250 per kg
- Cost of OF made on the farm is IQD 100 per kg
- Selling price for dates is IQD 450 per kg
- Exchange rate is USD 1 = IQD 1200.

Table 3.1 shows the estimated partial budget for the two soil fertilizing techniques – applying OF and applying chemical fertilizers – in the palm tree plantations. The analysis took into consideration the different sources of compost (compost purchased from the market versus compost made on the farm). Given the imperfections of the compost market, the purchase and sales prices are different.

The analysis indicated that using OF can lead, on average, to an additional yield of 786 kg/dunum (27% more than when chemical fertilizers are used). On the cost side, applying purchased compost will increase costs over applying chemical fertilizer by about IQD 269,250 per dunum (equivalent to USD 224) while applying compost prepared on the farm will increase costs by about IQD 89,250 per dunum (equivalent to USD 74). If the compost was prepared on the farm, the profitability per dunum was increased by IQD 264,450 per dunum (equivalent to USD 220) over the case when chemical fertilizers are used. If the compost is purchased, the profitability is IQD 89,250 per dunum (equivalent to USD 74). The corresponding rates of return were 296% and 31% respectively. The minimum increases in date yield needed to cover the costs of shifting from using chemical fertilizer to OF (the breakeven point) are 15 kg/tree if the compost is purchased and 5 kg/ha if it is made on the farm; the potential increases in yields are higher than these figures.

The analysis concluded that using OF on palm on the form of compost instead of using chemical fertilizers is profitable and can increase the household incomes of palm producers. It is recommended, therefore, that this strategy be adopted by farmers if only from an economic point of view.

Table 5.1: Partial budget for applying organic fertilizer to palm trees in Iraq

	Organic fertilizer	Organic fertilizer	Chemical fertilizer
Variety	Zahidi	Zahidi	Zahidi
Composts source	Purchased from market	Made on the farm	
Yield (kg/tree)	93.8	93.8	74.15
No. of trees per dunum	40	40	40
Yield (kg/dunum)	3,752	3,752	2,966
Dates price (IQD/kg)	450	450	450
Total value of production (IQD/dunum)	1,688,400	1,688,400	1,334,700
Input			
Compost (kg/dunum)	1,200	1,200	
Nitrogen (urea) (kg/dunum)			40
TSP (kg/dunum)			20
Price (IQD/kg)			
Compost (IQD/kg)	250	100	
Nitrogen (urea) (IQD/kg)			700
TSP (IQD/kg)			1,200
Costs that vary (IQD)			
Compost	300,000	120,000	
Labor to add the compost	31,250	31,250	
Urea cost			28,000
TSP cost			24,000
Labor to add chemical fertilizer			10,000
Total costs that vary	331,250	151,250	62,000
Net benefit	1,357,150	1,537,150	1,272,700
Increase over using chemical fertilizer			
Yield increase (kg)	786	786	
Increase in net benefit (IQD)	84,450	264,450	
Increase in costs (IQD)	269,250	89,250	
Rate of return (%)	31	296	
Breakeven point (kg/tree)	15	5	

Iraqi dunum = 2500 m^2 = 0.25 ha

4.3 Feasibility of applying botanical insecticides to dates palm

In Iraq, palm trees are affected by certain serious pests. The lesser date moth, Dubas bug, and borers were the main pests mentioned by farmers in the baseline survey. The analysis will focus on the Dubas bug only since about two-third of the farmers surveyed indicated that the Dubas bug pest is affecting their palm trees, and if they control it they use chemical pesticides.

The results of the research conducted by the project for controlling Dubas bug showed that spraying with a neem-summer oil mix was 96.7% effective, while using neem alone was 96.6% effective. Furthermore, decreasing the amount of neem by more than 66% had no significant effects on its efficacy. Partial replacement of neem with cheaper materials, such as summer oil, reduced the costs by more than 50%. The neem was effective in reducing the nymph population to levels which were 72% lower. There was no indication of population damage during subsequent generations; this is in contrast to the chemically treated orchards. Mixing summer oil with neem did not reduce the efficacy nor did it affect the mode of application. The Ministry of Agriculture in Iraq used a 1% solution of neem to control Dubas bug by aerial spraying 12,000 ha during the 2012 season.

To study the economic feasibility of using environmentally friendly insecticides (botanicals) for controlling Dubas bug on palm trees, an approach similar to that applied for assessing the economic feasibility of using OF was used. The two pest control techniques – applying botanical insecticides and applying chemical insecticides to palm trees – were compared. The analysis is based on the following assumptions:

- The palm tree variety is Zahidi, which is the dominate variety in Iraq
- 40 trees per dunum
- The same date palm management approach is used for both techniques
- Neem pesticide mixed with summer oil is used at a concentration of 2 ml per liter of water
- The selling price for dates is IQD 450 per kg
- Exchange rates is USD 1 = IQD 1200.

The analysis compared the use of a botanical insecticide (neem with summer oil) for controlling Dubas bug with the use of a chemical pesticide control as well as without any control. Table 3.2 shows the estimation of the partial budget for applying the two techniques based on data collected from Baghdad and Diwaniyah provinces in the 2012 season.

The analysis shows that using neem increased the date palm yield by 1040 kg/dunum as compared to the yield achieved without any control treatment. The treatment required an additional cost estimated at IQD 24,250 per dunum (equivalent to USD 20) and the net benefit increased by IQD 443,750 per dunum (equivalent to USD 370). The rate of return was very high – up to 18 times the additional costs for the neem application. The economic feasibility analysis comparing the use of botanical and chemical insecticides on palm trees indicated that the yield increased by 480 kg/dunum, the cost of applying neem was less than that for using the chemical insecticide by IQD 6250 per dunum, and the net benefit increased by IQD 228,500 per dunum (equivalent to USD 190).

The analysis concluded that using a bio-control technology to control Dubas bug is profitable and can increase the household incomes of palm producers. It is recommended that such a strategy be adopted by farmers from economic point of view.

Table 4.2: Partial budget for applying bio-controls and chemical controls on palm trees in Iraq

	Bio-control	Chemical control	No control
Variety	Zahidi	Zahidi	Zahidi
Yield (kg/tree)	51	39	25
Yield (kg/dunum)	2,040	1,560	1,000
Price (IQD/kg)	450	450	450
Total value of production (IQD/dunum)	918,000	702,000	450,000
Costs that vary (IQD/dunum)			
Hired labor	10,000	10,000	
Organic pesticide	5,000	0	
Chemical pesticide	0	11,250	
Sprinkler rental	6,250	6,250	
Fuel for sprayer	875	875	
Painting	625	625	
Other materials and supplies	1,500	1,500	
Total costs that vary	24,250	30,500	0
Net benefit	893,,750	671,500	450,000
Increase compare with no control			
Yield increase (kg/dunum)	1,040	560	
Increase in net benefit (IQD/dunum)	443,750	221,500	
Increase in costs (IQD)	24,250	30,500	
Rate of return (%)	1,830	726	
Breakeven point (kg/tree)	1.4	1.7	
Increase compared with chemical control			
Yield increase (kg/dunum)	480		
Increase in net benefit	222,250		
Increase in costs	-6,250		
Total net benefit increase	228,500		

4.4 Risk analysis for using organic fertilizer and bio-control of pests

When farmers consider a new technology, they are concerned with the risk involved compared to the risk of their present technology. Measuring risk is difficult and of limited value because different farmers look at risk differently.

Risk analysis needs to be kept as simple as possible. Some indications of risk can be obtained from doing a sensitivity analysis on the partial budgets. This approach is used in this study with the focus on the

changes in the selling prices for dates. Sensitivity analyses were carried out for the use of OF and the bio-control of pests on palm trees. Five scenarios were used for the selling price of the dates. The first scenario used the current price of IQD 450 per kg, the second assumed the selling price increased to IQD 600 per kg, and the third one used a selling price of IQD 500 per kg. The fourth and fifth scenarios consider price declines to IQD 400 per kg and IQD 300 per kg.

The use of organic fertilizers: Table 4.3 shows the increase in net benefits, rate of return, and the breakeven points for using OF (compost) compared to using chemical fertilizers. Two sources of composts were used; –compost purchased from the market and compost produced on the farm. The results indicate that this technology will continue to be profitable even when the selling price declines to IQD 400 per kg. However, the amount of net benefit and the rate of return were less and the breakeven point was increased. When the selling price is IQD 300 per kg there is a risk in applying OF if the compost is purchased from the market, but not if it is made on the farm. With this second situation it is still profitable to the farmers and is recommended.

Table 4.3: Sensitivity analysis based on changes in the selling price dates when applying OF

	Organic fertilizer	Organic fertilizer	Chemical fertilizer
Variety	Zahidi	Zahidi	Zahidi
Composts source	Purchased from market	Made on the farm	
Yield (kg/dunum)	3,752	3,752	2,966
Date selling price IQD 600 per kg			
Total value of production (IQD)	2,251,200	2,251,200	1,779,600
Total costs that vary (IQD)	331,250	151,250	62,000
Net benefit (IQD)	1,919,950	2,099,950	1,717,600
Increase in net benefit (IQD)	202,350	382,350	
Increase in costs (IQD)	269,250	89,250	
Rate of return (%)	75	428	
Breakeven point (kg/tree)	14	6	3
Dates selling price IQD 500 per kg			
Total value of production (IQD)	1,876,000	1,876,000	1,483,000
Total costs that vary (IQD)	331,250	151,250	62,000
Net benefit (IQD)	1,544,750	1,724,750	1,421,000
Increase in net benefit (IQD)	123,750	303,750	
Increase in costs (IQD)	269,250	89,250	
Rate of return (%)	46	340	
Breakeven point (kg/tree)	17	8	3
Dates selling price IQD 400 per kg			
Total value of production (IQD)	1,500,800	1,500,800	1,186,400
Total costs that vary (IQD)	331,250	151,250	62,000
Net benefit (IQD)	1,169,550	1,349,550	1,124,400
Increase over using chemical fertilizers			
Increase in net benefit (IQD)	45150	225150	
Increase in costs (IQD)	269250	89250	
Rate of return (%)	17	252	
Breakeven point (kg/tree)	21	9	4
Dates selling price IQD 300 per kg			
Total value of production (IQD)	1,125,600	1,125,600	889,800
Total costs that vary (IQD)	331,250	151,250	62,000
Net benefit (IQD)	794,350	974,350	827,800
Increase over using chemical fertilizers			
Increase in net benefit (IQD)	-33,450	146,550	
Increase in costs (IQD)	269,250	89,250	
Rate of return (%)	-12	164	
Breakeven point (kg/tree)	28	13	5

Table 4.4: Sensitivity analysis based on changes in the selling price of dates when using bio-controls for pests on date palm trees

	Bio-control	Chemical control	No control
Variety	Zahidi	Zahidi	Zahidi
Yield (kg/dunum)	2,040	1,560	1,000
Date selling price IQD 600 per kg			
Total value of production (IQD)	1,224,000	936,000	600,000
Total costs that vary (IQD)	24,250	30,500	0
Net benefit (IQD)	1,199,750	905,500	600,000
Increase over using no control			
Increase Net benefit (IQD)	599,750	305,500	
Increase costs (IQD)	24,250	30,500	
Rate of return (%)	2,473	1,002	
Increase over using chemical control			
Increase in net benefit (IQD)	294,250		
Increase in costs (IQD)	-6,250		
Total net benefit increase (IQD	300,500		
Date selling price IQD 500 per kg			
Total value of production (IQD)	1,020,000	780,000	500,000
Total costs that vary (IQD)	24,250	30,500	
Net benefit (IQD)	995,750	749,500	500,000
Increase in net benefit (IQD)	495,750	249,500	
Increase in costs (IQD))	24,250	30,500	
Rate of return (%)	2044	818	
Increase over using chemical control			
Increase in net benefit (IQD)	246,250		
Increase in costs (IQD)	-6,250		
Total net benefit increase (IQD)	252,500		
Date selling price IQD 400 per kg			
Total value of production (IQD)	816,000	624,000	400,000
Total costs that vary (IQD)	24,250	30,500	
Net benefit (IQD)	791,750	593,500	400,000
Increase over using no control			
Increase in net benefit (IQD)	391,750	193,500	
Increase in costs (IQD)	24,250	30,500	
Rate of return (%)	1615	634	
Increase over using chemical control			

Increase in net benefit (IQD)	198,250		
Increase in costs (IQD)	-6,250		
Total net benefit increase (IQD)	204,500		
Date selling price IQD 300 per kg			
Total value of production (IQD)	612,000	468,000	300,000
Total costs that vary (IQD)	24,250	30,500	
Net benefit	587,750	437,500	300,000

Table 4.4: Sensitivity analysis based on changes in the selling price of dates when using bio-controls for pests on date palm trees (continued)\

Increase over using no control			
Increase in net benefit ((IQD))	287,750	137,500	
Increase in costs ((IQD))	24,250	30,500	
Rate of return (%)	1,187	451	
Increase over using chemical control			
Increase in net benefit (IQD)	150,250		
Increase in costs (IQD)	-6,250		
Total net benefit increase (IQD)	156,500		

4.5 Conclusion

The national team in Iraq gathered data to assess the economic feasibility and cost effectiveness of two technologies under field conditions – applying OF to date palm and using bio-control measures for the Dubas bug insect. Partial budget analysis was applied. The results indicate that using organic fertilizer in the form of compost can lead to an increased yield and increased profitability.

The study of the economic feasibility of using a botanical insecticide technology for controlling Dubas bug on palm indicated that the yield can be increased and the cost of control is reduced.

Sensitivity analysis on the change in the date selling price indicated that the above two technologies are still profitable even if the date selling price declined to IQD 300 per kg, but the net benefit as well as the rate of return are less and the breakeven point is increased; but it is still under the potential yield increase.

In conclusion, the results of the economic feasibility analysis suggest that both bio-control and OF technologies used on palm are more profitable than using chemical pesticides and chemical fertilizers and can increase household incomes. Therefore, it is recommended that these technologies be popularized among palm farmers. The technological shift is also expected to have additional environmental and health benefits.

5. *Ex ante* impact assessment of using bio-pesticide and organic fertilizer on date palm

Like any other venture, investment in agricultural research needs to be justified. It is important to document the potential returns that will accrue from the research investment. Impact assessment is used for this purpose, since it is a systematized way of measuring the social, economic, environmental, and other benefits, and it also measures the additional costs associated with the changes that happened.

Impact assessment could be either *ex ante* or *ex post*. *Ex ante*, or potential, impact generates projections of outcomes from intervention options, while *ex post*, or actual, impact is a process to determine the actual effects of the interventions often when completed, but can also be during implementation. Several indicators could be used to assess and measure the technology impacts, including economic, technical, health and nutritional, environmental, social, and institutional.

There are several analytical methods which could be used for impact assessment, including descriptive analysis, financial analysis, an econometric approach, and an economic surplus model.

Based on the available data, it was possible to estimate the potential financial impact of the adoption of the botanical method – using neem mixed with summer oil – for controlling the Dubas bug insect instead of using chemical control methods. Profitability and productivity indicators were used to measure the impact under several possible scenarios of adoption. The impact assessment has been carried out at the national and study area (Baghdad and Diwaniyah provinces) levels. The *ex ante* impact assessment is based on the following assumptions:
The total area under palm in Iraq is 300,000 dunum and the study area was 80,000 dunum
From the data of the baseline survey it was estimated that nationally the level of infection by Dubas bug was 50%, and in the study area, 64%
The same changes in yield and net benefit as presented in Tables 3.1 and 3.2 in the feasibility section apply
Exchange rate is USD 1 = IQD 1200.

The adoption rate for both IPM and the use of OF on dates palm is very low because these technologies are still at the test stage and have not been officially released and disseminated on a large scale among farmers. Therefore, this section will estimate the potential financial impact for different levels of adoption assuming that farmers do adopt these technologies. The financial impact is usually influenced by two main factors –the level of adoption and the profitability. Since the profitability is affected by the selling price of the dates, the financial impact assessment in this section is calculated under five scenarios of selling price – IQD 600 per /kg, IQD 500 per kg, IQD 450 per kg, IQD 400 per kg, and IQD 300 per kg.
The first step in this analysis is to determine the impact at the farm level. This requires identifying, quantifying, and valuing the costs and benefits which occur at the farm level. It also includes estimating the level of adoption by farmers, which is a necessary piece of information for assessing the magnitude of the total benefits.
Table 5.1 presents the estimated impact on profitability resulting from the adoption of the botanical insecticide control method against Dubas bug pests under different adoption scenarios and five selling prices. The analysis indicates that it is possible to increase farmers' incomes by USD 37.6 million if all palm producers in Iraq (i.e. 100% level of adoption) shift from using of chemical control methods to

using biological ones for the Dubas bug insect and if the selling price of dates is IQD 600,000 per tonne. The increase drops to USD 30.8 million if the selling price for dates is IQD 500,000 per tonne. When the selling price is IQD 450,000 per tonne the increase in incomes is USD 28.6 million, and if the price is IQD 300,000 per tonne, it is expected to be USD 19.6 million. When the results obtained using the introduced technology are compared with those arising from the no control method, then the corresponding benefit figure for farmers will be about USD 75 million if the ceiling price for dates is IQD 600,000 per tonne. The benefits will be USD 62 million if the price of dates is IQD 500,000 per tonne, USD 55.5 million when the price is IQD 450,000 per tonne, and USD 36 million when the price is IQD 300,000 per tonne. This substantial increase in profitability, under the different selling price scenarios, will certainly help to improve the livelihoods of Iraqi palm producers.

Table 5.1: Effect of the adoption of an environmentally friendly botanical control of pests on palm (USD)

	Botanical vs. chemical insecticide		Botanical vs. no control	
Proportion of farmers adopting	Profitability increase at the national level	Profitability increase in the study area	Profitability increase at the national level	Profitability increase in the study area
				Selling price IQD 600,000 per tone
5%	1,878,125	641,067	3,748,438	1,279,467
10%	3,756,250	1,282,13	7,496,875	2,558,933
15%	5,634,375	1,923,200	11,245,313	3,838,400
20%	7,512,500	2,564,267	14,993,750	5,117,867
25%	9,390,625	3,205,333	18,742,188	6,397,333
30%	11,268,750	3,846,400	22,490,625	7,676,800
40%	15,025,000	5,128,533	29,987,500	10,235,733
50%	18,781,250	6,410,667	37,484,375	12,794,667
60%	22,537,500	7,692,800	44,981,250	15,353,600
80%	30,050,000	10,257,067	59,975,000	20,471,467
100%	37,562,500	12,821,333	74,968,750	25,589,333
				Selling price IQD 500,000 per tone
5%	1,539,063	525,333	3,098,438	1,057,600
10%	3,078,125	1,050,667	6,196,875	2,115,200
15%	4,617,188	1,576,000	9,295,313	3,172,800
20%	6,156,250	2,101,333	12,393,750	4,230,400
25%	7,695,313	2,626,667	15,492,188	5,288,000
30%	9,234,375	3,152,000	18,590,625	6,345,600
40%	12,312,500	4,202,667	24,787,500	8,460,800
50%	15,390,625	5,253,333	30,984,375	10,576,000
60%	18,468,750	6,304,000	37,181,250	12,691,200
80%	24,625,000	8,405,333	49,575,000	16,921,600
100%	30,781,250	10,506,667	61,968,750	21,152,000
				Selling price IQD 450,000 per tone

5%	1,428,125	487,467	2,773,438	946,667
10%	2,856,250	974,933	5,546,875	1,893,333
15%	4,284,375	1,462,400	8,320,313	2,840,000
20%	5,712,500	1,949,867	11,093,750	3,786,667
25%	7,140,625	2,437,333	13,867,188	4,733,333
30%	8,568,750	2,924,800	16,640,625	5,680,000
40%	11,425,000	3,899,733	22,187,500	7,573,333
50%	14,281,250	4,874,667	27,734,375	9,466,667
60%	17,137,500	5,849,600	33,281,250	11,360,000
80%	22,850,000	7,799,467	44,375,000	15,146,667
100%	28,562,500	9,749,333	55,468,750	18,933,333

Table 5.1: Effect of the adoption of an environmentally friendly botanical control of pests on palm (USD) (continued)

Selling price IQD **400,000** per tone				
5%	1,278,125	436,267	2,448,438	835,733
10%	2,556,250	872,533	4,896,875	1,671,467
15%	3,834,375	1,308,800	7,345,313	2,507,200
20%	5,112,500	1,745,067	9,793,750	3,342,933
25%	6,390,625	2,181,333	12,242,188	4,178,667
30%	7,668,750	2,617,600	14,690,625	5,014,400
40%	10,225,000	3,490,133	19,587,500	6,685,867
50%	12,781,250	4,362,667	24,484,375	8,357,333
60%	15,337,500	5,235,200	29,381,250	10,028,800
80%	20,450,000	6,980,267	39,175,000	13,371,733
100%	25,562,500	8,725,333	48,968,750	16,714,667
Selling price IQD **300,000** per tone				
5%	978,125	333,867	1,798,438	613,867
10%	1,956,250	667,733	3,596,875	1,227,733
15%	2,934,375	1,001,600	5,395,313	1,841,600
20%	3,912,500	1,335,467	7,193,750	2,455,467
25%	4,890,625	1,669,333	8,992,188	3,069,333
30%	5,868,750	2,003,200	10,790,625	3,683,200
40%	7,825,000	2,670,933	14,387,500	4,910,933
50%	9,781,250	3,338,667	7,984,375	6,138,667
60%	11,737,500	4,006,400	21,581,250	7,366,400
80%	15,650,000	5,341,867	28,775,000	9,821,867
100%	19,562,500	6,677,333	35,968,750	12,277,333

5.1 Financial impact of adopting the use of OF on date palm

Table 5.2 presents the financial impact of adopting the use of OF, in the form of compost, on date palm relative to that when chemical fertilizers are used. The analysis distinguishes between the sources of the compost, whether it is purchased or made on the farm. Five date selling price scenarios are used and it is assumed that the maximum level of adoption will be 50%.

The results show that if 50% of palm producers adopt organic instead of chemical fertilizers, it is possible to increase farmers' incomes in Iraq by USD 25 million if the selling price of dates is IQD 600,000 per tonne and the compost is purchased from the market. For the same selling price, the corresponding figure is USD 48 million if the compost is made on the farm. If the selling price is IQD 450,000 per tonne, the financial impact will be USD 10.5 million in the case where the compost is purchased and USD 33 million in the case where the compost is made on the farm. These figures will decline to USD 5.6 million and 2.4 million, respectively, if the selling price of dates is IQD 400,000 per tonne. There is no financial impact if the selling price is IQD 300,000 per tonne and the compost is purchased, but the impact will be USD 17.2 million if the compost is made on the farm.

Table 5.2: Financial impact of adopting the use of OF on date palm rather than chemical fertilizer (USD)

Compost source	Purchased from market		Made on the farm	
Proportion of farmers adopting	Profitability increase at the national level	Profitability increase in the study area	Profitability increase at the national level	Profitability increase in the study area
Selling price IQD 600,000 per tonne				
5%	2,529,375	674,500	4,779,375	1,274,500
10%	5,058,750	1,349,000	9,558,750	2,549,000
15%	7,588,125	2,023,500	14,338,125	3,823,500
20%	10,117,500	2,698,000	19,117,500	5,098,000
25%	12,646,875	3,372,500	23,896,875	6,372,500
30%	15,176,250	4,047,000	28,676,250	7,647,000
35%	17,705,625	4,721,500	33,455,625	8,921,500
40%	20,235,000	5,396,000	38,235,000	10,196,000
45%	22,764,375	6,070,500	43,014,375	11,470,500
50%	25,293,750	6,745,000	47,793,750	12,745,000
Selling price IQD 500,000 per tonne				
5%	1,546,875	412,500	3,796,875	1,012,500
10%	3,093,750	825,000	7,593,750	2,025,000
15%	4,640,625	1,237,500	11,390,625	3,037,500
20%	6,187,500	1,650,000	15,187,500	4,050,000
25%	7,734,375	2,062,500	18,984,375	5,062,500
30%	9,281,250	2,475,000	22,781,250	6,075,000
35%	10,828,125	2,887,500	26,578,125	7,087,500
40%	12,375,000	3,300,000	30,375,000	8,100,000
45%	13,921,875	3,712,500	34,171,875	9,112,500
50%	15,468,750	4,125,000	37,968,750	10,125,000

Selling price IQD 450,000 per tonne				
5%	1,055,625	281,500	3,305,625	881,500
10%	2,111,250	563,000	6,611,250	1,763,000
15%	3,166,875	844,500	9,916,875	2,644,500
20%	4,222,500	1,126,000	13,222,500	3,526,000
25%	5,278,125	1,407,500	16,528,125	4,407,500
30%	6,333,750	1,689,000	19,833,750	5,289,000
35%	7,389,375	1,970,500	23,139,375	6,170,500
40%	8,445,000	2,252,000	26,445,000	7,052,000
45%	9,500,625	2,533,500	29,750,625	7,933,500
50%	10,556,250	2,815,000	33,056,250	8,815,000

Table 5.2: Financial impact of adopting the use of OF on date palm rather than chemical fertilizer (USD) (Continued)

Selling price IQD 400,000 per tonne				
5%	564,375	150,500	2,418,750	645,000
10%	1,128,750	301,000	4,837,500	1,290,000
15%	1,693,125	451,500	7,256,250	1,935,000
20%	2,257,500	602,000	9,675,000	2,580,000
25%	2,821,875	752,500	12,093,750	3,225,000
30%	3,386,250	903,000	14,512,500	3,870,000
35%	3,950,625	1,053,500	16,931,250	4,515,000
40%	4,515,000	1,204,000	19,350,000	5,160,000
45%	5,079,375	1,354,500	21,768,750	5,805,000
50%	5,643,750	1,505,000	24,187,500	6,450,000
Selling price IQD 300,000 per tonne				
5%			1,718,750	458,333
10%			3,437,500	916,667
15%			5,156,250	1,375,000
20%			6,875,000	1,833,333
25%			8,593,750	2,291,667
30%			10,312,500	2,750,000
35%			12,031,250	3,208,333
40%			13,750,000	3,666,667
45%			15,468,750	4,125,000
50%			17,187,500	4,583,333

5.2 Impact on date production as a result of adopting a bio-pesticide pest control and OF

The impact on production as a result of adopting environmentally friendly pest control methods on palm was estimated. Date palm production in Iraq can be increased by 72,000 tonne (about 12% of total date production in Iraq) if all farmers shifted from chemical methods of pest control to botanical insecticides (Table 5.3). An similar approach was applied for the adoption of OF, in the form of compost, for date palm. It is expected that date palm production could be increased by 36,000 tonne (6% of total date production) if 50% of farmers adopted the use of OF (compost) (see Table 5.4).

Table 5.3: Impact on productivity as a result of adopting bio-control for palm tree pests (tonne)

Proportion of farmers adopting	Botanical vs. chemical insecticides		Botanical vs. no control	
	Production increased at the national level	Production increased in the study area	Production increased at the national level	Production increased in the study area
5%	3,600	1,229	7,800	2,662
10%	7,200	2,458	15,600	5,325
15%	10,800	3,686	23,400	7,987
20%	14,400	4,915	31,200	10,650
25%	18,000	6,144	39,000	13,312
30%	21,600	7,373	46,800	15,974
40%	28,800	9,830	62,400	21,299
50%	36,000	12,288	78,000	26,624
60%	43,200	14,746	93,600	31,949
80%	57,600	19,661	124,800	42,598
100%	72,000	24,576	156,000	53,248

Table 5.4: Impact on productivity as a result of adopting OF for palm rather than chemical fertilizer (tonne)

Proportion of farmers adopting	Production increased at national level	Production increased in the study area
5%	2,250	120
10%	4,500	241
15%	6,750	361
20%	9,000	481
25%	11,250	602
30%	13,500	722
35%	18,000	963
40%	22,500	1,203
45%	27,000	1,444
50%	36,000	1,925

5.2 Conclusion

The ex ante impact assessments of using an environmentally friendly bio-pesticide to control Dubas bug and using organic fertilizer on date palm indicate that these technologies have positive effects for profitability, production, health, and the environment. The potential increase in profitability certainly will help in improving the livelihoods of Iraqi palm producers; however, the potential increase is influenced essentially by the level of adoption of these technologies. An active national program to disseminate these technologies among farmers at the national level is needed to harvest the outcomes of this project.

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