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The actual application by wheat farmers of scientific recommendations concerning the processes of fertilization and agricultural pest control and its future implications for human and food safety

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Abstract:

The current research was aimed at identifying the actual application by wheat farmers of scientific recommendations concerning the processes of fertilization and agricultural pest control for the wheat crop in Baghdad, Iraq, and its future implications for human health and safety of their food. To achieve the goals of research, the authors developed a measure of the application consisting of 22 items

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distributed into the processes of fertilization and pest control, with a scale of 0-44 degrees. The research covered wheat farmers from the regions of Yusufiya, Al-Nasser and Al-Salam in the province of Baghdad. The results showed that the actual application by wheat farmers can be assessed as medium and tilting to lower, which in turn translates to a negative impact on food safety and thus on human health. The Iraqi Government should pay attention to wheat farmers – especially young people – by working towards an increase in the financial and material support to them. Agricultural extension should also assume its role as regards education among rural population – especially wheat farmers – through various activities and outreach programs.

Key words: Food security; fertilizer use; pesticide use; Iraqi wheat farmers.

INTRODUCTION TO THE RESEARCH AND THE MAIN PROBLEMS

The world today is facing many challenges such as the increasing population expected to reach 9.4 billion by 2050 (WHO, 2015). Climate change as well as rising global food prices, conflicts, wars and others are imposed on countries that seek to provide sufficient and healthy food at every time and place for their citizens (FAO, 2001; Al-Atabi and Al-Zubaidi, 2009; El-Ghamaz, 2013). Humans, however, have developed agricultural methods to increase production per unit area of quantity and quality (Swanson, 2010) – one of these methods is the use of chemicals.

There is no doubt that chemicals have played a significant role in the development of human communities through their use across all scientific, industrial, agricultural, therapeutic, and other activities (Mahmoud et al, 2010). A good example of how chemical fertilizers and pesticides can be

applied is when a farmer gives up the old farming system which involved leaving some part of the land and soil unaltered in order to recover part of it for utilization. Farms relied on additive chemical fertilizers for the soil to maintain fertility (Sheba, 2004), pesticide use on weeds, insects and bacteria in order to avoid the harmful effects of these pests on the quality and quantity of the product yield (Hyati, 2001; Najem, 2011; El-Ghamaz, 2013). But it was considered a double-edged sword, although at that time also a tool to improve and increase the productivity of cultivated land in terms of quantity and quality. It also posed a risk to human life, environment, plants and soil when used excessively, as well as increased the costs of agricultural production (Mahmoud et al, 2010).

Therefore, that enhancing of agricultural production and increase in productivity came at a price. They have generated a number of problems mainly represented in the degradation of natural resources, agricultural land and water as well as damage to the environment and human health. Their contribution was mainly in the methods used to increase agricultural production. They built on the intensive use and irrational to those resources as well as a heavy dependence on chemical inputs manufactured as fertilizers, pesticides and hormones (Hyati, 2001; Al-Atabi and Al-Zubaidi, 2009). These inputs are occurring in the form of harmful side effects and are still present in the environment as a result of their expanded use, in particular the use of chemical pesticides in agricultural pest control (Al-Subaiee, 2006; Al-Atabi and Al-Zubaidi, 2009).

For more than two decades the world has been witnessing an increase in activities aimed at reducing the use of chemical fertilizers and pesticides, as health and environmental pollutants. This has been possible owing to the organization of scientific conferences and symposia, implementation of environmental programs such as the programs carried out by both the United Nations and Food and Agricultural

Organization and Agriculture (FAO) World Health Organization and the Arab Organization for Agricultural Development (Pep, 1999). The results of these activities are to emphasize the proper and rational use of fertilizers and agricultural pesticides which are effective means of reducing the risks as well as making optimal use of them (FAO, 2003).

In Iraq, for example, certain studies such as those by Alani and Algadri (1997), Awad (2000), Fayyadh (2002) and Mahmoud et al (2010) indicated the presence of random and excessive use of chemical fertilizers and agricultural pesticides by farmers, including wheat farmers in Iraq. In general, this reduction of the adverse effects of the use of fertilizers and pesticides is largely dependent on the extent to which a farmer applies scientific recommendations regarding their proper use. This is because the farmer acts as a "safety valve" able to prevent these negative effects. Therefore, the aim of the study, i.e. to identify the actual application by wheat farmers of scientific recommendations concerning the processes of fertilization and agricultural pest control of crop in Baghdad, Iraq, is in addition to identifying its future effects on food safety as well as the relationship between the actual application by the wheat farmers and each of the following variables: age, level of education, the area cultivated with wheat, the type of tenure for the land cultivated with wheat, the years of practice of planting the wheat crop and contributing to annual income. Achieving the objectives of this study will help staff in ensuring that the development of programs and educational activities is continued with a view to raising the awareness of farmers and reduce the risk posed by the use of chemical fertilizers and pesticides.

MATERIALS AND METHODS

In conducting the study, the researchers adopted a descriptive approach, as it is commensurate with the nature of the study goals. Al-Nasser and Al-Salam area (in Abu Ghraib) and Yousfiya area (in Mahmudiyah) in the west and south of Baghdad province have been selected as the region to conduct the study, because they are renowned for the cultivation of wheat crop.

The study population consisted of all wheat farmers in two areas with a total population of 3485 farmers (1556 farmers in Al-Nasser and Al-Salam area and 1929 farmers in Yousfiya) (Directorate, 2010). A stratified random sample of 2.7% of them was used. Al-Gadri (2009) said that the size of the two communities can be best demonstrated by taking a stratified random sample of relativity of them. Thus, the study sample comprised 94 farmers (42 farmers from the Al-Nasser and Al-Salam areas and 52 farmers from the Yousfiya area).

The research tool: After we reviewed the scientific literature, research, and extension publications which relate to the two processes of fertilization and control of pests for the wheat crop, professor specialists from the College of Agriculture / University of Baghdad were consulted on the subject. A measure was developed to assess the actual application by the wheat farmers, consisting of 22 areas allocated as follows:

***The process of fertilization*:** the process of fertilization of the crop was measured in terms of nine aspects: (i) the use of organic fertilizers instead of chemical fertilizers to the maximum possible extent to reduce the risks stemming from the use of the latter; (ii) the addition of a decaying fertilizer at approx 20 tons/ha; (iii) the addition of chemical fertilizers to the crop where needed; (iv) the addition of a chemical fertilizer compound to the soil directly at 200 kg/ha; (v) the addition of a urea fertilizer at about 200 kg/ha and in two stages (the first

directly to the soil before sowing and the second when offshoots appear); (vi) the addition of a fertilizer after dew evaporates from plants; (vii) the crop is watered after adding the fertilizer directly and the watering should be gradual; (viii) the amount of manure applied is in line with scientific recommendations; and (ix) safety measures (protective clothing, etc.). The final grade of the process ranges from 0 to 18 degrees.

The pest control process: the fight against agricultural pests on crop was measured in terms of 13 aspects: (i) the land is watered before the tillage process to dispose of weeds; (ii) only seeds pure and free of impurities are selected; (iii) if there are impurities, they should be cleaned; (iv) seeds are appropriate for pesticide fogging; (v) the weeds emerging with the crop are combated with pesticides; (vi) pesticides are mixed together, which is useful for combating weeds and decreasing the economic cost over a short period of time; (vii) insects and diseases that affect the crop are opposing agricultural pesticides; (viii) insect or disease problems are diagnosed by prevention experts; (ix) the pesticide is described by prevention experts; (x) the amount of pesticide is scheduled scientifically and must be adhered to, in line with the instructions on the package; (xi) pest control is carried out after the removal of dew drops from plant leaves; (xii) safety measures (before and during pest control – clothing protecting against pesticides, etc.); (xiii) safety measures (after pest control – washing the tools, etc.). The final grade for the process ranged from 0 to 26.

The scope of the application of respondent farms has been determined through sum of which it gets from degrees of determine the reality of the paragraphs relating to the application of fertilization and pest control processes for the wheat crop, according to the following equation: the degree of the actual application per respondent is a total score obtained from the application of paragraphs to the processes of fertilization and pest control for wheat crops). Using standard

grade (Z-Score), respondents were divided according to their scores to three levels: low (less than -1), middle (from +1 to -1), and high (more than +1).

Genuineness of the scale. For the purpose of achieving the intended results from the research execution has been prepared administering a questionnaire, which includes many questions that aim to obtain data on the actual application of scientific recommendations by wheat farmers, relevant for the processes of fertilization and pest control for the wheat crop. After the initial wording of the questionnaire was completed, it was presented to a number of professors specializing in field crops and agricultural development at the College of Agriculture / University of Baghdad (Prof. Dr. Khudhair Abbas Jadoa, Dr. Makiya Kazim, Dr. Mohammad Hazal Al-Baldawi, Dr. Khalil Ibrahim, Dr. Mithal Abdul-latif, d. Raad Muslim, d. Bayan Abdul-Jabbar, Mr. Ahmed Hamdan). The purpose was to verify the authenticity of the content, honesty in compiling the questionnaire and its ability to achieve the objectives of the research. Allam (2009) said about "Ebel" that the best way to measure the honesty is to establish how many experts and specialists are of the opinion that paragraphs reflect the aspects which they are intended to measure.

RESULTS AND DISCUSSION

The actual application of scientific recommendations by wheat farmers concerning the processes of fertilization and pest control for wheat crop.

The results showed that the degree of respondent farmers' application ranged from 17 to 39, with an average of 28.82 degrees on a scale where the highest degree was 44 and the lowest was zero. Furthermore, medium degrees of respondent farmers' application was above the middle of the scale at about

6.82 degrees. In order to avoid measurement problems, all degrees of respondent farmers' application were diverted to the standard grade. This revealed that 63.8% of the respondents assessed the actual level of application as medium and 19.2% as low (Tab. 1).

As can be seen in Table 1, nearly two-thirds of the respondents assessed the actual level of application of scientific recommendations to the processes of fertilization and pest control as average. Such a level of application may be insufficient to reduce the negative effects of excessive and improper use of fertilizers and pesticides to humans and their environment, plants and soil. The proof is that the low level of the application has reached a rate of 19%. The result is due to many reasons such as the possible unawareness or disregard of damage which might be caused by the excessive use of fertilizers and the hazardous effects of pesticides on the environment, plant, soil and humans. Another factor is probably the poor or limited informational assistance provided to wheat farmers by the relevant authorities. Correct and rational methods of use of fertilizers and pesticides in agricultural pest control are required of those actors to exercise their supervision and the extension role and to clarify the collateral damage caused by the excessive and irrational use of fertilizers and pesticides. They are sensitized to that underestimated damage and the risks to the farmers in general, and wheat farmers in particular.

Table 1. The distribution of wheat farmers according to the degrees of their application of fertilization processes and pest control of the crop.

Application categories	Degree standard	No.	%	Average	Notes
Low	less than -1	18	19.2	20.6	Mean = 28.82
Middle	from -1 to +1	60	63.8	29.3	Standard deviation = 5.326
High	more +1	16	17	36.0	
Total		94	100		

Determine the actual application by wheat farmers of scientific recommendations for each of the processes of fertilization and control of the crop.

Fertilizing the crop: the research results have shown that degrees of the actual application of the respondent farmers in the process of fertilizing the crop ranged between 5 and 18 with an average of about 11.88 on a scale of 0-18 degrees. It emerged that at the 68.06 percent ratio, the level of their application can be assessed as average. High and low level was the proportion of each of them for 15% of the respondents (Tab. 2).

Table 2. The distribution of wheat farmers, according to the actual application for each process of fertilization processes and pest control crop.

Agricultural processes	Application categories according to the degree of the standard	No.	%	Mean of process degree	Standard deviation
Fertilize the crop	Low (less than -1)	15	16	11.88	2.6
	Middle (from -1 to +1)	64	68		
	High (more +1)	15	16		
Pest Control of the crop	Low (less than -1)	17	18	16.83	4.16
	Middle (from -1 to +1)	59	63		
	High (more +1)	18	19		

Pest control: research results have shown that the actual degree of application by respondent farmers in the process of pest control for wheat crop ranged between 6 and 24 degrees, with an average of approx. 16.83 on a scale of 0-26 degrees. It was found that 69.7% respondents assessed their degree of application as average (Tab. 2).

Furthermore, Table 2 shows a percentage rise in the rate of application degrees of farmers in the process of pest control about the percentage rate of their grades in the fertilization process. The slight difference in the results may be due to the fact that the farmers did not attach the same weight to the hazards connected with the excessive and irrational use of fertilizers, compared with the risks of pesticides used in pest

control to humans, the environment, plants and soil. Awareness of the risks arising from excessive use of fertilizers is not less than the risks resulting from the improper use of pesticides in agricultural pest control.

The relationship between the actual application by wheat growers and some independent variables

Age: the results showed that the highest respondent's age was 75 years and the lowest was 21 years, with an average of 44.255 years, which means that the analyzed group of respondents was middle-aged. In order to describe the actual application by farmer respondents according to age, the respondents were divided by age into five categories. It emerged that 31.91% of them were aged between 31-40 years and represented almost one-third of the respondents. Average of their application degrees was 27.15 degrees. It emerged that 53.19% of them were aged 41 years and over, and they are representing more than almost half of the respondents (Tab. 3).

In order to know the correlation between age and the application of the wheat farmer respondents, the simple correlation coefficient (Pearson) was used and valued at 0.273, which indicates the presence of a strong positive correlation between them. For the verification of moral relationship the t. test was used. The calculated value was 2.722, which means it is a moral at the level of probability of 1%, i.e. that young farmers are more likely to apply scientific recommendations in fertilization and pest control processes for the wheat crop. The result is explaining that young farmers are more open and ambitious about progress and building the future. Therefore, they are more receptive to the ideas of modern agriculture than the older generation. This result is consistent with the findings of Al-Saadi (1996).

Table 3. The distribution of wheat farmer respondents according to age.

Age categories/ year	No.	%	Average application degrees	Notes
21-30	14	14.90	24.93	Correlation coefficient 0.273
31-40	30	31.91	27.15	
41-50	21	22.34	29.29	Morale at the level of probability 0.01
51-60	18	19.15	31.95	
More 60	11	11.70	29.55	
Total	94	100		

Educational attainment: in order to describe the actual application by the respondent farmers according to the educational attainment, a division into six categories was introduced (illiterate, reads and writes, primary school, middle school, high school, other). It emerged that 23.4% of the respondents were part of the middle category and average grade application was 29.7 degrees. 22.3% of them were among the primary category, while the other category (after high school) had a proportion of 10.6% (Tab. 4).

In order to know the correlation between educational attainment and application by wheat farmer respondents, the simple correlation coefficient (Pearson) was used with the value of 0.017, indicating that the correlation was very weak. For verification of moral relationship the t. test was used. The calculated value was 0.163, which means it is not significant at the level of 5% probability. This means that educational attainment has no impact on the actual implementation of fertilizing and pest control process by farmers for the wheat crop. This result is consistent with the findings of both Hannoush (2001) and Shehata (2002).

Table 4. The distribution of wheat farmer respondents according to educational attainment.

educational attainment categories	No.	%	Average application degrees	Notes
Illiterate	6	6.4	27.0	Correlation coefficient 0.017 Non moral at the level of probability 0.05
Reads and writes	18	19.2	28.9	
primary school	21	22.3	29.3	
Middle school	22	23.4	29.7	
High school	17	18.1	27.1	
other	10	10.6	29.9	
Total	94	100		

***The area cultivated with wheat*:** the results showed that a higher wheat cultivated area of 67.5 hectares was assumed, and the least area of 0.75 hectares. In order to characterize the actual application by farmer-respondents in accordance with the area cultivated with wheat, a division into six categories was applied. It emerged that 70.2% of them were areas ranging from 0.75 to 5.5 hectares, and the average degree of application for them was 28.8 degrees, which represents nearly two-thirds of the respondents. This means that most of the respondents were from small areas (Tab. 5).

To determine the correlation between the area cultivated with wheat and the actual application by wheat farmer respondents, the simple correlation coefficient (Pearson) was used. The value of -0.073, indicating the existence of a negative correlation, is very weak. To check the moral relationship the t. test was used. The calculated value was -0.702, which means it is not significant at the level of probability of 5%. This means that the area cultivated with wheat, whether large or small, does not have any impact on the actual implementation by farmers of fertilizing and pest control processes for the wheat crop. This result is consistent with the findings of Al-Ajili (2001).

Table 5. The distribution of wheat farmer respondents according to area cultivated with wheat.

area categories / ha	No.	%	Average application degrees	Notes
Less than 3	41	43.6	30.2	Correlation coefficient -0.073 Non moral at the level of probability 0.05
3 – 5.5	25	26.6	27.4	
6 – 8.5	8	8.5	26.4	
9 – 11.5	4	4.3	25.0	
12 – 14.5	4	4.3	29.0	
More 14.5	12	12.7	29.8	
Total	94	100		

Type of tenure for the land cultivated with wheat: for the purpose of description of the actual application of the respondent farmers according to the type of tenure of cultivated land, it was divided into three classes (private property, rent or contract, participation with others). It emerged that 84% of them were within the category of privately owned, absolutely outweighing the other categories. Average grades application was 29.3 degrees. 12.8% of them within the contract category (Tab. 6).

To determine the correlation between the type of tenure for cultivated land with wheat and the actual application by wheat farmer respondents the simple correlation coefficient (Pearson) was used. Its value was 0.213, which indicates the presence of a positive correlation relationship. In order to verify the moral relationship the t. test was used. The calculated value was 2.091, which means it is a moral at the level of 5% probability. This in turn means that there is a significantly positive relationship between the possession of land under cultivation and the actual implementation of fertilization and pest control processes for various wheat crop types. The result can be interpreted that the ownership of land encourages a farmer to apply fertilization and anti-pest processes. The farmer is more stable at his land and has the freedom to use the land as desired as well as the abundance of physical potential.

This result is consistent with the findings of Al-Saadi (1996), but in contrast with the findings of Mahmoud (2009).

Table 6. The distribution of wheat farmer respondents according to type of tenure for land cultivated with wheat.

Type of tenure	No.	%	Average application degrees	Notes
private property	79	84.0	29.3	Correlation coefficient 0.213 Moral at the level of probability 0.05
rent or contract	12	12.8	26.8	
participation with others	3	3.2	24.3	
Total	94	100		

Contribution to annual income: in order to describe the actual application by the respondent farmers according to the contribution of their crop to the income, a division into three classes was introduced (high contribution, medium contribution, low contribution). It turned out that 61.7% of them fall within the medium category, with an average degree of application at 29 degrees. Around 24.5% are located within the category of large contribution to the income. These two groups are representing more than three quarters of all respondents. The result confirms that farmers are dependent for their income on the cultivation of wheat crop by a large margin, and sometimes totally dependent (Tab. 7).

In order to establish the correlation between the contribution of wheat cultivation to the farmer's income and the actual application by wheat farmer respondents, the simple correlation coefficient (Pearson) was used with the value of 0.013. It indicates that the presence of correlation is positive but very weak. To check the moral relationship, the t. test was used. The calculated value was 0.124, which means it is not significant at the probability level of 5%. It further means that contribution to the income has no relation to the actual application of scientific recommendations in the processes of

fertilization and pest control for the wheat crop. This result is consistent with the findings of Fayyadh (2010).

Table 7. The distribution of wheat farmer respondents according to contributing at annual income.

Contributing to the income	No.	%	Average application degrees	Notes
High	23	24.5	29.0	Correlation coefficient 0.013 Non moral at the level of probability 0.05
Medium	58	61.7	29.0	
Low	13	13.8	28.0	
Total	94	100		

Years of practice of planting the wheat crop: the results showed that the highest number of years spent in the cultivation of the crop was 40 and the lowest was 2. In order to describe the actual respondents farmers' application according to the number of years' experience of planting the crop, the number of years was divided into five categories. It turned out that 63.8% of respondents had between 2 and 16 years of experience. The average degree was 28.5. Only 5.3% of them were in the category of 33 years and over (Tab. 8). To find out the correlation between the number of years' experience in the cultivation of the crop and the actual application by wheat farmer respondents, the simple correlation coefficient (Pearson) was used with the value of -0.018. This indicates the existence of a negative correlation. To investigate the relationship moral, the t. test was used. The calculated value amounted to -0.172, which means it is not significant at the level of the probability of 5%. It further means that the number of years devoted by a farmer to the cultivation of wheat crop has no relation to the actual application of scientific recommendations in the processes of fertilization and pest control for the wheat crop. This result is consistent with the findings of both Al-Ajili (2001) and Fayyadh (2002).

Table 8. The distribution of wheat farmer respondents according to the years of practice of planting the wheat crop.

years of practice/ year	No.	%	Average application degrees	Notes
2 - 8	19	20.2	29.0	Correlation coefficient -0.018 Non moral at the level of probability 0.05
9 – 16	41	43.6	28.0	
17 – 24	15	16.0	30.0	
25 – 32	14	14.9	27.0	
33 – 40	5	5.3	30.0	
Total	94	100		

CONCLUSIONS

1. Although the actual application by wheat farmers was assessed as medium, the average degree declared by the respondents leaned towards the center of the scale, which shows that farmers are not given much attention as regards negative effects that result from the indiscriminate and excessive use of fertilizers and pesticides on humans, animals, plants and the environment.
2. This is manifested in the weakness of the actual application, as with more than two-thirds of the respondents in the application category the median tends to become lower. In the final outcome, the weak application will eventually exert a negative impact on the quality of food. This may be the result of weakness and limitations of the role of extension education which would be influential and persuasive to farmers. It has a potential to encourage them to follow the best modern methods and techniques in the composting process for the wheat crop and to take precautionary measures when inspecting the crop for pests. Other relevant institutions also have an important role to play. Thus encouraging them to provide information and skill support to farmers as well as activating the supervisory role of extension would allow the clarification of

collateral damage of these materials to human and the environment.

3. The research results also revealed slight differences in the average degree of farmers' application in the processes of fertilization and pest control in favor of the pest control process. This means that farms were giving more attention to the dangers of the use of pesticides and disregard for collateral damage of the indiscriminate use of fertilizers.
4. The results also showed the existence of moral positive correlation between the actual application by farmers and the age and type of land tenure.
5. Based on the above we recommend the following: farmers are the first persons responsible for the application of scientific recommendations concerning the processes of fertilization and pest control within an agricultural area. Therefore, the state being a sponsor for these farmers, especially young people, should work towards increasing the financial and material support for them in order to overcome various obstacles that impede the processes of correct fertilization and pest control for the production of wheat crop.
6. We also recommend that agricultural extension takes the lead in the education provided to rural population in general, and wheat farmers in particular, e.g. on how to preserve the environment and protect the man and his family or on the available resources and the methods of their maximum utilization without damaging them, especially in the context of use of chemical fertilizers and pesticides. The development of various programs and extension activities (training courses, clarifications field, etc.) should contribute to raising the level of application of scientific recommendations in this field and urge farmers to abide by them.

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