

## Original Research Article

# Characterization of the Socioeconomic Conditions, Full Package, and Adoption of New Technologies of Wheat Crop at Irbid Governorate, Jordan

## ABSTRACT

The study explored socio economic conditions of wheat farmers to evaluate the impacts of the introduction of the full package which contains zero tillage, new varieties of wheat seed, adding fertilizer, using the combine, and using herbicides. Partial budget was used to work out the cost and returns of adopting the full package.

Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was also used to provide a framework for potential solutions (opportunities) and threats, and analysis of the FP. Garrett ranking was applied to rank a set of factors in adopting the FP as perceived by the sample respondents based on certain criteria.

A socio-economic questionnaire was designed to elicit basic numerical data. About 50 farmers were personally interviewed in Irbid governorate.

Farmers were characterized by large number of family members and good education. The percentage of the male to female was nearly the same. Results showed that 48% of farmers have finished high school, and 34% have higher education.

During 2012-2013 seasons, the participation of farmers in full package was very high. This is because adoption of improved crop management substantially increased farmer income. In other hands, the adoption of zero tillage is shown to increase steadily. Farmers started to gain awareness on the role of this system in achieving stability and higher profitability of wheat production. However, the adoption of this system could be further increased with the increase in availability of special driller's equipment and farmer learning. There is about 32% of the sample adopted the full package, and 22% adopted the new varieties of seeds.

Garrett ranking showed that there are new techniques have been adopted by the farmers through the full package. Using seeders is one of the main newly adopted techniques as mentioned by 90% of farmers. Regarding to the use of improved variety, there were about 84% of farmers mentioned that they have planted the improved variety.

Key words: Full Package, Zero Tillage, Wheat Production, New Varieties, GARRETT Ranking

## I. INTRODUCTION:

Jordan encourages wheat production through a price subsidy to producers. The amount of the subsidy is fixed each year prior to the cropping season. Nevertheless, farmers of rainfed are sequential decision-makers; they wait until they know the amount of rainfall between October 15th and the end of December to take a decision to plant wheat. Domestic wheat production has a very high degree of variability (Al-Karablieh, *et al.*, 2002). This instability of production makes it essential to introduce new techniques to enhance planting wheat.

The Project "Enhancing Food Security in Arab Countries" comes to enhance food security and focuses primarily on improving wheat production and yield in wheat-based agricultural systems. It introduced full package which contains zero tillage, new varieties of wheat seed, adding fertilizer, using the combine, and using herbicides.

It is important to demonstrate to farmers that the technical and agronomic aspects are directly related to the management and economic ones and, therefore, any technical and agronomic improvement obtained by using the full package need to be quantified in monetary and economic terms.

The determinants of new technology adoption are the benefits received by the user and the costs of adoption. In many cases these benefits are simply the difference in profits when a firm shifts from an older technology to a newer. In the case of farmers, of course, the benefits are the increased utility from the new technology.

This research comes for the purpose of socioeconomic characterization of the selected communities and to assess the adoption of the full package.

## II. METHODOLOGY:

A socio-economic survey was conducted to characterize the livelihood of farmers in term of their assets and opportunities. The study also explored socio economic conditions of farmers to evaluate the impacts of the full package. From the selected sites, 50 farmers were personally interviewed in Irbid governorate, namely in two districts, they are Bani kenanah, and Qasabet Irbid.

Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was also used to provide a framework for potential solutions (opportunities) and threats, and analysis of the full package (FP).

Garrett ranking was applied to rank a set of factors in adopting the FP as perceived by the sample respondents based on certain criteria. The order of the merit assigned by the respondents is converted into scores by using the formula given by Garrett and wood worth (1977). (Palanisami, et.al., 1999)

$$\text{Per cent position} = \frac{100 (\text{Rij} - 0.5)}{N_j}$$

Where,

Rij = Rank given for Ith factor by j th individual

Nj = Number of factors ranked by ith individual

## III. RESULTS AND DISCUSSION:

### 3.1 Community Characterization:

#### 3.1.1 Climate:

Jordan is part of Mediterranean and Arid zone climate. Mediterranean climate dominate in north and west regions, while arid climate dominate in the rest part of Jordan, whereas the semi humid climate is dominate in the selected areas and the rainfall ranged between 300-500 mm.

#### 3.1.2 Crop Production:

The major planted crops in the selected sites were barley, wheat, vetch, in addition to olive trees. Results shows that about 42% of the sample planted barley in addition to wheat, the average planted area is 6.6 ha, and 20% planted vetch crop in addition to wheat, the average planted area is 3.5 ha. Only 8% of farmers planted lentils in addition to wheat, the average planted area is 1.7 ha.

#### 3.1.3 Wheat Variety:

Farmers mentioned that they used to plant Hourani variety from early ago until nowadays because it is tolerant to drought as 23% of farmers mentioned, and it is available in the Jordanian Cooperative Corporation. About 32% mentioned that they plant this variety because it gives high production of seed and hay. About 57% of farmers plant Sham variety because it gives high production of seed and hay.

Extension agents of the National Center for Agricultural Research and Extension (NCARE) provide farmers with improved varieties such as ACSAD, Dir-Alla, and they started to plant these varieties and they are now aware that these varieties give high productivity of seed and hay. About 74% plant ACSAD because it gives high production of seed and hay. About 67% of farmers plant Um-Qais because it gives high production of seed and hay. About 50% of farmers plant Dir-Alla because it is suitable to this area.

ACSAD variety gives the highest productivity of seed, and Hourani variety gives the highest productivity of hay.

#### 3.1.4 Seeds Sources and Seed Rate:

The seed rate is different between farmers; some farmers add 120 kg/ha of seeds as recommended by researchers and extension agents of NCARE, but the majority prefer to add 150-200 kg/ha as their grand fathers did. The range was between 100-250 kg/ha, the average quantity of seeds was 160 kg/ha.

About 90% of farmers depend on the Jordanian Cooperative Corporation (JCC) to get seed, which costs 400 JD/ton, because it provides farmers with improved quality and guaranteed seeds as mentioned by 40% of farmers, and they purchase some local seed varieties from the other farmers as mentioned by 2% of farmers because it is tested. About 20% of farmers leave part of their production for seed purposes after succession in one season, and they also store a few amount of wheat production for home consumption.

## **3.2. LIVELIHOOD CHARACTERIZATION:**

### **3.2.1 Family Member:**

The average number of family was 9 members which indicated that it is a large family, and farmers like to increase the number of family members in order to help them in plant and livestock activities. Farmer's age ranged from 30 years to 84 years with an average of 56 years old. About 78% of farmers are less than 70 years old, and 36% are from 30 years to 49 years old.

### **3.2.2 Educational Level:**

Regarding to farmer's educational level, results showed that 48% of farmers have finished high school, and 34% have higher education.

Regarding to son's educational level, results showed that 48% of males and 50% of females have finished higher education (Diploma, BsC, High education).

### **3.2.3 Number of male and female working in the farm:**

The farm activities were done mainly by men, about 74% of farmers mentioned that there is at least one male of the family members is working in the farm. Only about 26% of farmers mentioned that sons don't help in plant production, and about 64% of farmers mentioned that daughters don't help in plant production. The reason is because they are educated and they are not willing to work in agricultural activities or they are working in other jobs outside agricultural activities.

### **3.2.4 Role of Women in agriculture:**

Regarding to women participation, results showed that about 28% of women participated in plant activities, and 24% of them participated in milking and dairy processing activities.

## **3.3 LAND TENURE:**

### **3.3.1 Land Ownership:**

Privately owned, rented, and partner land tenure were found in the surveyed community. Results showed that 76% of the respondents own land, the owned area is between 0.3 ha and 22 ha.

About 48% of the respondents rent land, the rented area is between 1.5 ha and 100 ha. About 8% of the respondents share land, the shared area is between 1 ha and 10 ha with an average of 4.0 ha.

### **3.3.2 Crop Rotation:**

About 70% of respondents mentioned that they follow a double crop rotation, and 24% mentioned that they follow a triple crop rotation.

### **3.3.3 The previous crop before wheat:**

About 44% of farmers leave their lands without planting for one year before planting wheat, and 44% mentioned that they plant summer crops before planting wheat.

## **3.4 FARMER'S INCOME SOURCES:**

The percentage of farmers who are depending on plant production source between (1-25 %) was 48%, and 44% are depending mainly on the off-farm income.

Regarding to credits, results showed that there are only 10% of farmers took loan from different sources. The average amount of the loan was 1500 JD.

## 3.5 FARMERS' PRACTICES:

### 3.5.1 Kind of Participation in the Project:

The adoption of zero tillage improved soil fertility by reversing decades of soil degradation (IFPRI, 2009). Zero tillage is an innovation package contains: management practices, herbicide, equipment (i.e., no-till drills and air seeder), and crop varieties, so the project introduced the full package to increase the income of farmers to enhance their livelihood.

Zero tillage innovation was introduced as an alternative to traditional tillage to combat soil degradation and to promote agricultural sustainability. The slow and lack of adoption of sustainable practices, especially in developing countries, call for additional research to better understand the local constraints to innovation adoption and to modify practices to better suit local conditions. In the case of zero tillage adoption, superior economic conditions, and social interactions allowed this technology to spread on the world (Awada, 2013) but only 4% of targeted farmers adopted zero tillage

There is about 32% of the sample adopted the full package, and 22% adopted the new varieties. The rest are not participating in the project.

### 3.5.2 Farming Method:

About 84% of farmers mentioned that they use seed driller for planting wheat, but 16% of farmers are still broadcasting their land by hand.

About 80% of farmers mentioned that they plow their fields before planting wheat, but 20% of farmers mentioned that they use zero tillage.

Regarding to sowing date, farmers mentioned that they plant wheat during November and December each year after the first rainfall.

### 3.5.3 Labor:

About 48% of farmers mentioned that they hired labor, but 52% mentioned that they don't hire labor because there is at least one member of the family is working in the farm.

### 3.5.4 Fertilizers:

Farmers don't do soil analysis before adding fertilizers, 90% of farmers used to add manure and chemical fertilizer. Previous studies showed that fertilizer use can have substantial returns, even in the absence of any changes in other farming practices (Duflo, 2008).

Only 4% of farmers added manure (organic) fertilizer and 70% of farmers added chemical fertilizers before agriculture as complex fertilizer in different ranges. And 14% of farmers added both organic and chemical fertilizers.

### 3.5.5 Weed Control:

The application of herbicides was done by 74% of farmers, and 26% of farmers mentioned that they don't apply herbicides because of the high cost of herbicides or because there are no weeds noticed in their fields.

## 3.6 GARRETT RANKING:

Garrett ranking showed that there are new techniques have been adopted by the farmers. 90% of farmers mentioned that using seeders is one of the main newly adopted techniques for these reasons: good distribution of seed, profit increase with the increase in production, reduced seed rate, and saving in time and money (less number of workers).

Zero tillage is also one of the main newly adopted techniques as mentioned by 24% of farmers for these reasons: good distribution of seed, profit increase, and saving time and money (less number of workers).

86% of farmers mentioned that they add fertilizer for these reasons: profit increase, and it enhances the growth of the plant.

And 70% of farmers mentioned that they use herbicides for these reasons: profit increase, increase in the productivity, and weed reduction.

Regarding to seeding rate, there are about 80% of farmers mentioned that they have reduced the seeding rate for these reasons: profit increase, and increase in the productivity.

76% of farmers mentioned that they adopted the use of fertilizer schedule for these reasons: profit increase, time and money saving, and increase in the growth of the plant.

Regarding to the use of improved variety, there are about 84% of farmers mentioned that they have planted the improved variety for these reasons: profit increase, increase in the productivity, and tolerant to water stress.

Only 14% of farmers used combine because it saves time and money, and increases the profit but it is not available at the requested time.

Garrett Ranking was applied also to rank the technologies according to its importance. Accordingly, the top priority was given by the respondents for seeder use, followed by others which are: adding fertilizer and fertilizer schedule, the using of herbicides, the use of improved variety, seed rate, combine, and the use of no-till seeder.

The use of the different techniques is easy and available according to farmers, but Ministry of Agriculture (MoA) and NCARE should enhance their role regarding to the awareness of farmers regarding the full package and its benefit.

### 3.7 SWOT ANALYSIS:

The new adopted techniques save time as mentioned by all farmers, 92% of farmers pointed out that the new techniques allowed for planting earlier, and 90% of farmers mentioned that it reduced weed in their farms, 80% of farmers mentioned that the new techniques reduced the labor cost. About 49% of farmers mentioned that these techniques increased the production as well as the profit, and 56% of farmers increased the planting areas after launching the project.

About 68% of farmers mentioned that they are reluctant to apply the new technologies and methods because of the high cost, and about 60% of farmers mentioned that machines couldn't be available on time, and 66% said that there is difficulty in using these machines in sloppy areas. Only 20% of farmers complained that they don't have the improved variety.

About 23% of farmers mentioned that they would like to apply the new technologies and methods to increase the quantity and quality of production, and about 16% of farmers mentioned that there is opportunity to increase the planted area, and 9% said that using these machines will save time and effort.

About 43% of farmers mentioned that there is no problem in applying the new technologies and methods, but 22% said that they are reluctant to apply the new technologies and methods because machines couldn't be available on time and 9% said that there is difficulty in applying the new technologies and methods because of the raising in input prices (pesticides, fertilizers, seed). Box 1

Box 1: SWOT Analysis for the Full Package

| Strengths                                                                                                                                                                                                                                                                                                                                                     | Weaknesses                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Save time</li> <li>• Increase in production and profit</li> <li>• Reduce seed rate</li> <li>• Reduce the cost</li> <li>• Reduce weed</li> <li>• Reduce the labor cost</li> <li>• Increase planting area</li> <li>• Add fertilizer according to the quantity and type</li> <li>• Planting in suitable time</li> </ul> | <ul style="list-style-type: none"> <li>• Don't found machines at requested time</li> <li>• Don't have the improved variety</li> <li>• Difficulty use in sloppy areas</li> <li>• High prices of some technologies</li> </ul>                                                           |
| Opportunities                                                                                                                                                                                                                                                                                                                                                 | Threats                                                                                                                                                                                                                                                                               |
| <ul style="list-style-type: none"> <li>• National Center for Agricultural Research and Extension</li> <li>• The private sector</li> <li>• Increasing in quantity and quality of production</li> <li>• The provision of manpower</li> </ul>                                                                                                                    | <ul style="list-style-type: none"> <li>• Lack of mechanisms at the appropriate time</li> <li>• Raising input prices ( pesticides, fertilizers, seed)</li> <li>• The high cost of manpower</li> <li>• Cost of pesticides and weed control</li> <li>• Lack of improved seeds</li> </ul> |

|                                                                                                                                                                                                                                                         |                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Increase the area planted</li> <li>• keep up with technology</li> <li>• Cost Reduction</li> <li>• Increased income</li> <li>• The development of improved varieties</li> <li>• Reduce the seed rate</li> </ul> | <ul style="list-style-type: none"> <li>• Higher prices of renting farmland</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|

## 3.8 MARKETING:

Farmers mentioned that they have three marketing options; authorized marketing centers, intermediaries for sale, and personal marketing. About 33% of farmers take the role of marketing their production by themselves, because they can get direct financial benefits, easier for sale, and the farmer can decide the price and save the good quality for the next season. But 6% of farmers depend on Intermediaries for marketing their production because they can get direct financial benefits and easier for sale from their point of view.

About 61% of farmers depend on authorized marketing centers (Ministry of Trade and Industry, Jordanian Cooperative Corporation) for these reasons: easier for sale, and reduces the time and labor. But there are some problems face those farmers: seed examination, late payment for grains, and fluctuating prices.

## 3.9 COSTS AND RETURNS OF WHEAT:

The objective of this section is to estimate the costs and returns of wheat production after applying the full package. Data used for the analysis were collected through a well-structured questionnaire and personal interview on the plant units, costs and revenue items in the farm.

The net return for wheat enterprise is estimated at 557 JD/ha, the increased in farmer income was come not only due to higher yields but also as a result of less inputs costs. The total variable costs are estimated at 595 JD/ha with total fixed cost at 547 JD/ha. The total cost of wheat is estimated at 1142 JD/ ha and the total return is estimated at 1700 JD/ha (Table 1). The highest variable cost was the cost of labor followed by the cost of harvesting by combine. Regarding to the fixed cost, the cost of land rent was the highest followed by the cost of seed.

## 3.10 WHEAT CULTIVATION CONSTRAINTS AND SUGGESTIONS:

A question about what are the obstacles and difficulties in wheat cultivation, the answers were varied: limited access to machinery, erratic of rainfall, rising costs of production inputs, high labor wages, and land fragmentation.

Farmers suggested some ideas to solve these problems such as:

- (i) providing agriculture machines at encouraging prices,
- (ii) governmental incentives and support for farmers,
- (iii) providing farmers with improved varieties (tolerant drought),
- (iv) providing seeds at encouraging prices,
- (v) buying yield at encouraging prices,
- (vi) Activation of Agricultural Extension,

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Table 1: Average Net Return and Cost of Production of Wheat for One Hectare

| Activity                     | Unit     | Quantity | Price US\$ | Total  |
|------------------------------|----------|----------|------------|--------|
| Wheat grains                 | Kg       | 2500     | 0.563      | 1408   |
| Straw                        | Kg       | 3500     | 0.282      | 987    |
| Total Return                 | US\$     |          |            | 2395   |
| Variable Cost                |          |          |            | 837.1  |
| Mechanical plowing           | US\$/ ha |          |            | 74     |
| Weeding                      | US\$     |          |            | 14     |
| Herbicides                   | US\$     |          |            | 28     |
| Pesticides                   | US\$     |          |            | 14     |
| Spraying Machine             | US\$     |          |            | 20     |
| Fertilizer                   | Kg       | 100      | 0.98       | 98     |
| Spreading                    | US\$     |          |            | 11.8   |
| Harvesting (by combine)      | US\$     |          |            | 119    |
| Labor for Harvesting         | US\$     |          |            | 94.4   |
| Urea                         | US\$     |          |            | 73.8   |
| Bags                         | no.      | 120      | 0.14       | 16.8   |
| Transportation               | US\$     |          |            | 70     |
| Labor                        | US\$     |          |            | 126.8  |
| Interest on operational cost |          |          |            | 76     |
| Fixed Cost                   | US\$/ ha |          |            | 769.6  |
| Seeds                        | kg       | 169      | 0.56       | 94.6   |
| Depreciation                 | US\$     |          |            | 42     |
| Land Rent                    | US\$/ ha |          |            | 563    |
| Interest on capital cost     | US\$     |          |            | 70     |
| Total Cost                   | US\$     |          |            | 1606.7 |
| Net return                   | US\$     |          |            | 788.3  |

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Source: Calculated by the researcher from the data of research sample

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## 4. CONCLUSIONS AND RECOMMENDATIONS:

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The project disseminated to farmers new agricultural practices, technology, and high yielding varieties.

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The results show that transferring the new technology to all farmers is very important and will be very

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helpful in food security issues. For example, by implementing only the full package of integrated

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cropping practices in farmer's fields, wheat grain yield was raised to more than 76% comparing with

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traditional methods. Not only the yield can be increased by the new technology but also the income of

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the farmers, this was obviously appeared when applying zero tillage.

In some demonstrations farmer income was increased to more than 610 US dollar when applying zero tillage. The project introduces a number of improved varieties to the farmers in the target site. Availability of such varieties with good quantity among farmers will enhance the spread and adoption of these varieties and will add to the efforts of food security in the country.

The net return for wheat enterprise is estimated at US\$ 788/ha, the total variable costs are estimated at US\$ 837.1/ ha with total fixed cost at US\$ 769.6/ ha. The total cost of wheat is estimated at US\$1606.7/ ha and the total return is estimated at US\$ 2395/ ha.

The highest variable cost was the cost of labor followed by the cost of harvesting by combine. Regarding to the fixed cost, the cost of land rent was the highest followed by the cost of seed.

The cost can be reduced through reducing seed rate, using the harvesting combine from the MoA instead of renting high cost private combines, and reducing the labor cost.

The recommended and promising technologies proved to be an appropriate and effective method that can be used in Jordan to increase both wheat yield and farmers income and therefore contribute to food security. Based on this study, it was shown that the farmers need support to continue farming their land successfully. The best way to support them is to provide them with the more practical incentives in the form of: improved varieties seed supply, accesses to machinery especially the zero till seeder, field learning of farming technology including herbicides for weed control. These incentives must be also combined with increasing the public awareness of the improved crop managements and varieties among the farming community and the stakeholders.

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