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# Partial Budgeting of the Production of Salt-Tolerant Forages in Azraq and Al-Khaldia Sites in Jordan

*Masnat Al-Hairy*

National Center for Agricultural Research and Extension (NCARE), Jordan

**Abstract:** The goal of this study is to evaluate the production of salt-tolerant forages in Al-Azraq and Al-Khaldia sites in Jordan through the estimation of costs and returns of salt-tolerant forages production, estimation of costs and returns of making relatively small changes in the existing farm business of the production of salt-tolerant forages and evaluation of the newly adopted forages crops introduced by "Saving Freshwater Resources with Salt-Tolerant Forage Production Systems in Marginal Areas of West Asia and North Africa (WANA) Region" project. A Socio-economic survey was done to elicit basic numerical data on plant activities, inputs and expenditures. 50 questionnaires have been collected and analyzed. Enterprise budget was used to represent estimates of costs and returns associated with the production of some forage crops. The study used also partial budget to work out the cost and returns of making relatively small changes in the existing farm business. Garrett Ranking was also applied to rank a set of factors in adopting the new forage verities. Major crops planted in the communities' area were barley, wheat and forage crops. Most of the crop land is allocated for barley production and 56% of farmers plant barley as a source of livestock feeding, about 20% of farmers plant wheat and 12% of them plant maize fodder. About 12% of farmers plant pearl millet and 4% plant alfalfa. The study recommended planting maize fodder to attain the proposed net profit which is estimated at US $1119 /ha.

**Key words:** Enterprise budget · Partial budget · Forage crops · Salt-tolerant forages · Garrett Ranking

## INTRODUCTION

Jordan is part of Mediterranean and Arid zone climate. Mediterranean climate dominate in north and west regions, while arid climate dominates in the rest part of Jordan [1]. Jordan is about 100 km from the south-eastern coast of the Mediterranean Sea, between latitudes 29° - 33° N and longitudes 35°- 39° E and has a land area of about 89 200 $km^2$, of which arable land is less than five percent. The population is 5 000 000 (the World Factbook 2006 est. was 5,906,760); with a high annual growth rate of 3.5 percent (World Factbook 2006 est. was 2.49%) [2]. About 30 percent of the population lives in rural areas and roughly 45 percent are below 15 years of age [3]. More than 90 per cent of the country's area is classified as arid and receives less than 200 mm annual rainfall [4].

Jordan is extremely water-scarce with just 167 $m^3$ per capita per year to meet domestic, industrial, agricultural, tourism and environmental demands. The heavy exploitation of water resources has contributed to declines in the levels of aquifers and the Dead Sea. The agricultural sector has begun to respond by improving irrigation efficiency and increasing the use of recycled water [5].

Poor irrigation techniques have resulted in salinization, alkalinization and nutrient depletion in large areas. The area of irrigated land that is salinized by irrigation is estimated to be 3.5% in Jordan [6]. The semi humid climate is dominated in the selected sites (Azraq and Al-Khaldia) and the rainfall ranged between 300-500 mm whereas the production system varies, with severe resource degradation specially water, soil, crops and irrigation systems. This is resulted from mismanagement of the resources by the users and insufficient water.

The production of Jordan from all types of feeds ranges from 597 to 765 thousand tons of dry matter and it provides about half million tons of units of food, while the consumption of animals from the material feed

**Corresponding Author:** Masnat AL-HAIRY, National Center for Agricultural Research and Extension (NCARE), Jordan. Tel/Fax: +962 6 5371807, Cell: +962 777 99 84 54.

in Jordan is estimated at more than two million tons per year, which calls for resorting to import about a million and a half tons from this main material for the animal sector [7]. There is a bad need to meet demand for forage production and to save fresh water resources. Affected areas by salinity in Jordan can be potentially productive with appropriate crops and farming systems. Forage production systems are highly appropriate for salt-affected environments.

Many studies showed that salt-tolerant forages-based diets could be used advantageously as alternative feeds to replace totally or partially common feedstuffs, thus to alleviate feeding cost. Results obtained in many regions worldwide support that feeding salt-tolerant plants could promote livestock production systems, increase farmers' incomes and improve environmental conditions in the saline areas [8]. Alternative practices and collective management strategies are desirable in order to conserve the resource base to become more productive. Therefore, analyses, interpretations and a clear approach of management are needed on different management options towards a balanced resource management in the selected sites, by taking into account; efficiency in resources utilization and environmental sustainability. This study represents a description of the main forage crops planted in Azraq and Al-Khaldia sites in Jordan and their enterprises budget and profit.

**Objectives:** The goal of this study is to evaluate the production of salt-tolerant forages in Al-Azraq and Al-Khaldia region in Jordan.

**The Objectives to Achieve the Setup Goal Are To:**

- Estimate the costs and returns of salt-tolerant forages production of the selected communities.
- Estimate the cost and returns of making relatively small changes in the existing farm business of the production of salt-tolerant forages in these sites.
- Evaluate the newly adopted forages crops introduced by "Saving Freshwater Resources with Salt-Tolerant Forage Production Systems in Marginal Areas of West Asia and North Africa (WANA) Region" project to the selected sites.

**Tools and Techniques:** A Socio-economic survey was done to elicit basic numerical data on plant activities, inputs and expenditures. Data were collected through a well-structured questionnaire and personal interviews.

An Enterprise budget used to represent estimates of income, costs and profits associated with the production of some forage crops.

The study used also partial budget to work out the cost and returns of making relatively small changes in the existing farm business, i.e. it evaluates just a segment of a whole farm plan.

Garrett Ranking was applied also to rank a set of factors in adopting a particular technology 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 [9].

$$\text{Percent position} = \frac{100(R_{ij}-0.5)}{N_j}$$

Where,

$R_{ij}$ = Rank given for $i^{th}$ factor by $j^{th}$ individual
Nj = Number of factors ranked by $i^{th}$ individual

By referring the Garrett table the PP estimated was converted in to scores. Then for each factor the scores of various respondents were added.

## RESULTS AND DISCUSSION

**Water Salinity:** About 55% of farmers have tested water and 30% of farmers found water salinity and they check for water salinity by taste. Water salinity results are the death of plant, lack of resistance of diseases and decrease the productivity. Farmers suggested that water salinity problem could be eliminated through increasing wells depth and planting salinity tolerant plants. About 67% of soil was sandy soil. Results showed that soil salinity was about 15 ds/m and the water salinity was 4 ds/m in AL-Khaldieh community.

**Farming System in the Selected Sites:** The dominant production system in the selected communities is an integral part of crop-livestock production system. The main characteristics of the farming system are low productivity (barley, forage and red meat) and irregular rainfall.

Results indicated that farmers plant barley, wheat in addition to some forage crops such as forage maize, Soybean and alfalfa. About 56% of farmer's plant barley and 20% plant wheat, but these areas are not suitable

Table 1: Productivity of the Introduced Forage Crops

| Crops | Productivity (ton/ha) | Price $US | Percentage of Adopters (%) |
|---|---|---|---|
| 1- Barley | 3 | 324 | 56 |
| 2- Maize fodder | 30 | 282 | 12 |
| 3- Alfalfa | 15 | 352 | 4 |
| 4- Sesbania (Colutea ) | 40 | 113 | 4 |
| 5- Pearl Millet (Dokhon) | 1.5 (seeds) | 352 | |
| | 60 (biomass) | 169 | 12 |
| 6- Fodder Brassica /Mustard | 50 | 141 | 8 |
| 8- Fodder beet | 70 (tuber) | 197 | |
| | 60(green vegetation) | 197 | 4 |

Source: Field survey

for planting these crops. It is a low rainfall area which resulted in low productivity unless they were planted under an irrigation system which has a high cost.

The introduced forage crops don't need much water as indicated by 20% of farmers. 14% of farmers pointed out that these crops have a high nutrition value for their sheep and cows. Table 1 below shows productivity, prices and percentage of adapters of different kinds of forage crops.

Most of the land is allocated for barley plantation and 56%of farmers plant barley as a source of livestock feeding, the productivity was 3 ton/ha. Barley is a cereal grain derived from the annual grass *Hordeum vulgare*. Barley serves as a major animal feed crop and in health food. In 2007 ranking of cereal crops in the world, barley was fourth both in terms of quantity produced (136 million tons) and in area of cultivation (566,000 km²) [10].

About 12% of farmers plant Maize Fodder as a source of livestock feeding, the productivity was 30 ton/ha. Maize makes a greater quantity of epigeous mass than other cereal plants, so it can be used for fodder. Digestibility and palatability are higher when ensiled and fermented, rather than dried [11].

About 4% of farmers plant Alfalfa as a source of livestock feeding, the productivity was 15 ton/ha. Alfalfa (*Medicago sativa*) is a flowering plant in the pea family Fabaceae cultivated as an important forage crop. It resembles clover with clusters of small purple flowers. When used as feed for dairy cattle alfalfa is often made into haylage by a process known as ensiling. Rather than drying it to make dry hay, the alfalfa is chopped finely and fermented in silos, trenches, or bags, anywhere where the oxygen supply can be limited to promote fermentation. The anaerobic fermentation of alfalfa allows it to retain high nutrient levels similar to those of fresh forage and is also more palatable to dairy cattle than dry hay. In many cases, alfalfa silage is inoculated with different strains of microorganisms to improve the fermentation quality and aerobic stability of the silage [12].

About 4% of farmers plant Sesbania as a source of livestock feeding, the productivity was 40 ton/ha. *Sesbania* is a genus of flowering plants in the pea family, Fabaceae. Notable species include the Rattlebox (*Sesbania drummondii*), Spiny Sesbania (*Sesbania bispinosa*) and *Sesbania sesban*, which is used in cooking. Plants of this genus, some of which are aquatic, can be used in alley cropping to increase the soil's nitrogen content [13].

About 12% of farmers plant Pearl millet as a source of livestock feeding, the productivity was 1.5 ton/ha for seeds and 60 ton/ha for biomass. Pearl millet (*Pennisetum glaucum*) is the most widely grown type of millet. Pearl millet is well adapted to production systems characterized by drought, low soil fertility and high temperature. It performs well in soils with high salinity or low pH. Because of its tolerance to difficult growing conditions, it can be grown in areas where other cereal crops, such as maize or wheat, would not survive [11].

About 8% of farmers plant Brassica as a source of livestock feeding, the productivity was 50 ton/ha. *Brassica* is a genus of plants in the mustard family (Brassicaceae). The members of the genus may be collectively known either as cabbages, or as mustards. Crops from this genus are sometimes called *cole crops*, which is derived from the Latin *caulis*, meaning *stem or cabbage* [14].

About 4% of farmers plant beet as a source of livestock feeding, the productivity was 70 ton/ha from tuber an 60 ton/ha from green vegetation. The beet (*Beta vulgaris*) is a plant in the amaranth family. It is best known in its numerous cultivated varieties, the best known of which is probably the red root vegetable known as the beetroot or garden beet. However, other cultivated varieties include the leaf vegetables chard and spinach beet, as well as the root vegetables sugar beet, which is important in the production of table sugar and mangelwurzel, which is a fodder crop [15].

Table 2: Revenues of Introduced Forage Crops

| Crops | | | | | |
|---|---|---|---|---|---|
| Return (US $/ha) | Alfalfa | Soybean | Maize Fodder | Wheat | Barley |
| Total Return | 987 | 1016 | 1763 | 705 | 783 |
| Total Variable Cost | 355 | 355 | 355 | 374 | 372 |
| Fixed Cost | 289 | 289 | 289 | 289 | 289 |
| Total Cost | 644 | 644 | 644 | 663 | 663 |
| Net Return | 343 | 372 | 1119 | 42 | 120 |

Source: Calculated from the Field survey

**Enterprise Budget for the Selected Communities:** The following section represents a description of costs and returns of the main crops planted in the communities' area (Table 2).

The net return for alfalfa is estimated at US$ 343/ha, the variable costs are estimated at US$ 355/ ha with fixed costs at 289 JD/ ha. The total cost of alfalfa is estimated at US$ 644/ ha and the total return is estimated at US$ 987/ha.

The net return for Soybean enterprise is estimated at US$ 372 / ha, the variable costs are estimated at US$ 355/ ha with fixed costs at US$ 289 /ha. The total cost of Soya been is estimated at US$ 644/ ha and the total return is estimated at US$ 1016/ ha.

The net return for maize fodder enterprise is estimated at US$ 1119/ ha, the variable costs are estimated at 355 JD/ ha with fixed costs at US$ 289 / ha. The total cost of maize fodder is estimated at US$ 645/ ha and the total return is estimated at US$ 1763/ ha.

The net return for wheat enterprise is estimated at US$ 42/ ha, the variable costs are estimated at US$ 372/ ha with fixed costs at US$ 289/ ha. The total cost of wheat is estimated at US$ 663/ ha and the total return is estimated at US$ 705/ ha.

The net return for barley enterprise is estimated at US$ 120/ ha, the variable costs are estimated at US$ 372/ ha with fixed costs at US$ 289/ ha. The total cost of barley is estimated at US$ 663/ ha and the total return is estimated at US$ 783/ ha.

It was noted that planting wheat and barley in the selected sites didn't attain a high net return because these crops are not tolerant to the salinity and it have low productivity in these areas.

**Change in Forage Use / Using the Partial Budget to Analyze Farm Change:** It was proposed that the cost will be decreased due to the introduction of forage crops instead of wheat and barley because forage crops need less water in addition these crops can be irrigated with low quality water. The selected sites is known by its low rainfall, so it is not appropriate for planting wheat, fruits and vegetable crops, but it can be planted with forage crops, for feeding their animals instead of buying high prices feed. In the next partial budget worksheets we can find the proposed changes from introducing new fodder crops instead of barley and wheat.

| Partial budget worksheet, Partial Budget | | | |
|---|---|---|---|
| Proposed change: | | | |
| It was proposed that the cost will be decreased due to the introduction of forage crops instead of wheat and barley because forage crops need less water in addition these crops can be irrigated with low quality water. | | | |
| Positive effects | Value ($US/ha) | Negative effects | Value ($US/ha) |
| Additional income | | Reduced income | |
| Total additional income | | Total reduced income | |
| Reduced costs | | Additional costs | |
| Less quantity of water | 425.9 | | |
| Less quantity of fodder | 652.5 | | |
| Total reduced costs | 1078 | Total additional costs | |
| Total additional income & reduced costs | 1078 | Total reduced income & additional costs | |
| Change in net income: (total additional income & reduced costs) minus (total reduced income & additional costs) | | | 1078 |

Table 3: Garrett Ranking

| A. Newly adopted crops | Percent (%) |
|---|---|
| 1. Forage maize | 13.6 |
| 2. forage Turuep | 9 |
| 3. Barley Rum 1 | 41 |
| 4. Sugar Beet | 4.5 |
| 5. Dokhon | 4.5 |
| 6. ACSDAD Barley | 23 |
| 7. Mustard | 4.5 |
| B. Is it easy to plant these crops | |
| 1. Yes | 96 |
| 2. No | 4 |
| C. Reasons for adoption | |
| 1. Profitable | 89 |
| 2. Use as feed for sheep | 11 |
| D. Ranking for priorities | |
| 1. Profitable | 40 |
| 2. Doesn't need much water | 20 |
| 3. Potential species | 40 |

Table 4: Garrett Ranking for Priorities

| | | Garrett Ranking | | |
|---|---|---|---|---|
| No. | Benefits | Rank | PP | S |
| 1. | 1. Profitable | I | 17 | 69 |
| 2. | 2. Doesn't need much water | II | 50 | 89.94 |
| 3. | 3. Potential species | III | 50 | 89.94 |

PP = Percent Position

S = Scores

**Garrett Ranking:** The introduction of new forage crops resulted in an increase in the net return to the farmers and 14% of farmers adopted forage maize and about 64% of farmers adopted barley Rum 1 and barley ACSAD due to it's tolerance to the soil and water salinity (Table 3).

Farmers have benefited from the introduction of these forage crops and they have ranked the priorities from planting these crops. They mentioned that the profitability is in the first rank and these crops don't need much water because of its tolerance to salinity.

## CONCLUSION

It was clear from the partial budget worksheet that the introduced forage crops reduce cost through reducing the cost of irrigation water and reducing the feed quantity which resulted in additional net income equals to 1078 $US /ha.

The introduced forage crops don't need much water as indicated by 20% of farmers. At the same time 14% of farmers pointed out that these crops have a high nutrition value for their sheep and cows.

Major crops planted in the communities' area were barley, wheat and forage crops. Most of the crop land is allocated for barley production and 56% of farmers plant barley as a source of livestock feeding, about 20% of farmers plant wheat and 12% of them plant maize fodder. About 12% of farmers plant pearl millet and 4% plant alfalfa. The study recommended planting maize fodder in large scales more than one hectare to attain the proposed net profit which is estimated at $US1119 /ha.

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