# Analytical Study of the Impact of Utilizing Fertilizer Alternatives on Increasing Olives Productivity in Latakia Governorate Olive Mill Waste Water as an Example

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***Abstract***

*The research aims at surveying the real status of utilizing olive mill wastewater (OMWW) (water resulting from pressing olive fruit) in Latakia Governorate, and how to optimally benefit from the wastes resulting therefrom, as well as surveying the economic efficiency of using (OMWW) in olive trees fertilization, where the research sample included /300/ farmers in LatakiaGovernorate, which comprises four regions (Latakia- Jableh- Al Qardaha- Al Haffah) depending upon the descriptive analytic method. Research results revealed that the olive mill wastewater fertilized areas in Latakia governorate take the first place in Latakia region. When economic indicators were applied, the results indicated that fertilizing olive trees with olive mill wastewateris of high productive profitability, where it realizes net profit of (16785) SYPs/dunum/year; whereas total profit margin mounted to about (44774) SYPs, and profitability coefficient relative to production costs is about (19.38%) , and total economic efficiency is (1.2).Research conclusions recommend necessity of encouraging olive farmers in Latakia governorate to use olive mill wastewater as fertilizer irrigation for their lands after it has been revealed the extent to which olive mill wastewater is effective in increasing unit area , as well as instructing olive oil milling machines owners to build an impermeable basin capable of holding the olive oil mill work for a full week according to the productive capacity of each olive oil mill.*

**Key words:** *economic efficiency, olive mill wastewater, olives, fertilization*

## I. INTRODUCTION

Olive tree is known for its rigidness and high capability of enduring difficult and rough climatic and environmental circumstances, which enabled it to live and continue up to our present time.Olive tree surely dates back to over 12 thousand years, and its original cradle is not precisely known, owing to this tree's continuous propagation commensurate with continuity of successive civilizations. However, most studies indicate that the original cradle of olive tree is the East Mediterranean region, particularly Syria, Palestine and Turkey; while Pelletier De Condole stresses that Syria and Turkey are the original home for olive tree; other points of view confirm that Palestine is the olive land (Burbandy, 2004)

The current outburst which Syria witnesses in olive cultivation affirms its economic efficiency in terms of its multiple uses, particularly followingevidence of the economic feasibility of this tree, as well as with the growth in the investment of olive tree planted areas, which noticeably doubled the number of olive oil mills and their non-organized spread, the matter which exacerbated wastes emanating from those olive oil mills (Wazzani et al, 2007).

Olive mill wastewater (OMWW) : is the liquid by-product resultant from olive fruit pressing process. The quantity resulting from pressing 1 ton of fruit ranges between (640-1100) liters (Paraskeva and Diamadopoulous, 2006,.DI Giovacchino et al., 2002 ). Transforming olive fruit to oil produces two extra materials, which are olive mill waste water and pyrene. Here we refer note that pyrene is the solid material produced from extracting oil mechanically, and its wastes are used as thermal source especially in heating.

It is known that olive oil mills spread in Syria are of two different distinctive types , the first is that of traditional olive oil mills with old presses , where oil production therefrom is around 20% of the olive quantity produced, and 4% solid wastes , whereas the polluted industrial water (olive oil waste water) is circa 40% and are of good productive capacity of 1.5 to 2 ton oil per day. The other type, on the other hand, is that of modern olive oil mills , similar to their antecedents, but

of higher capacity, where their productive capacity ranges between 6 and 7 tons of olive/day . The resultant olive oil waste paper is similar to that of conventional mills.

Here, we have to mention that there are olive oil mills built on the principle of centrifugation in the final processing stage of separating oil from olive oil wastewater, which leads to a rise of the resultant olive oil wastewater ration, knowing that the productive capacity of this techniqueranges between 25-30 tons per day of processed olives (Al Bitar, 2002).

## II. RESEARCH PROBLEM

The research problem lies in that there is no proper utilization of the flowing water resultant from olive oil extraction process (olive mill wastewater (OMWW), moreover, disposing of this material is deemed a great problem for the mills in production areas, hence, the multiple studies and methodologies for dealing with utilizing olive mill waste water have not been satisfactory for mills owners, since purification of olive pressing water is economically expensive on the one hand, and it has a negative impact on the environment on the other; and in view of the high prices of chemical and organic fertilizers , whether macro elements NPK or micro element Mo, Cu, Fe , Br.. etc., therefore, it was inevitable thinking of using alternative fertilizers with the possibility of utilizing them in irrigating and fertilizing agricultural crops ,discarding them safely and protecting the environment on the other hand, and benefiting of the organic and mineral compounds they have, which decreases use of chemical fertilizers .

## III. RESEARCH IMPORTANCE AND OBJECTIVES

Owing to the urgent need for providing other substitutes for the chemical and organic fertilizers whose prices have lately risen causing noticeable rise in production costs, it has been economically worthier to study the efficiency of utilizing olive pressing water in fertilizing olive trees as alternative to the fertilizers generally used , in a way which is positively reflected in production, income, and the benefit occurring from this product with its broad uses , the matter which is considered a significant economic, agricultural and environmental objective, which contributes to developing the areas utilized for olive tree cultivation, which lends importance to profound importance to this survey , whereupon this survey purposes to achieve the following two objectives:

1- Studying the current status of using olive mill waste water (OMWW) in Latakia governorate,, and ways for optimal benefit from the wastes produces therefrom in fertilizing.

2- Studying the economic efficiency of olive mill wastewater utilized in fertilizing olive trees in Latakia governorate.

## IV. MATERIALS AND METHODS

**A**-The research was performed in Latakia , which comprises four regions (Latakia- Jableh- Al Qardaha – Al Haffah) . Latakia is located within a natural peninsula on the Eastern Mediterranean cost in northwest Syria. The Mediterranean Sea borders the city in the west and north, too, a group of villages and farming plains border it in the south, while the high Latakia mountains series border it in the east. The city enjoys a moderate Mediterranean climate and the soil is characterized with its fertility , cultivability and richness with organic matter and nutrient elements . The city is (0-60 meters a.s.l .

**B**-The descriptive analytical method was adopted in accomplishing this research, whereupon a research form has been prepared for the farmers who used olive mill waste water whose number totaled about 1226 farmers ( according to the statistic of the Directorate of Agriculture - Olive Department in Latakia , 2017) .300 forms were distributed , applied to farmers who utilized olive mill waste water in fertilizing olive trees, in accordance with sample volume tables at 95% certainty level, where the necessary data were taken by field surveying and economically analyzed.

**C**-Resorting to relevant scientific resources, researches and studies, as well as to the information available with Directorate of Agriculture (Olives Department) in Latakia.

**D**-Utilizing the economic analysis indicators appropriate for the study purpose.

**E**-Making field trips to the mills located in Latakia governorate whose number totals nearly 113 olive mills distributed as per the table (1).

**Table(1) : Distribution of Olive Mills in Latakia governorate in 2017.**

| Region | Olive Mills in Operation | | Total |
|---|---|---|---|
| | Centrifugal | Presses | |
| Latakia | 15 | 10 | 25 |
| Jableh | 20 | 45 | 65 |
| Al Qardaha | 11 | 1 | 12 |
| Al Haffah | 10 | 1 | 11 |
| **Total :** | 56 | 57 | 113 |

Directorate of Agriculture in Latakia (Olives Department).

**F**-Following collecting statistical data through preliminary study of the farmers' use of olive mill wastewater; we carried out the proper economic

analysis and economic indexes calculation according to the following stages:

- Total economic costs = variable costs + fixed costs.
- Total return= basic return + fixed costs.
- Net costs = total costs – secondary returns.
- Net farm income = total return – total costs (excluding family labor and return on(capital).
- Total margin= total return – variable costs.
- Economic profit= value of economic return – total costs.
- Variable capital coefficient = total return value/total costs.
- Variable assets cycling time = 365/variable capital coefficient.
- Economic Efficiency= total return value – total costs value.
- General economic efficiency=total product ÷ total production costs (Al-Ilaywi, Abdullatif, 2002).
- Gross annual product = mean product quantity x mean kilogram (Khaddam, 2000).
- Attained annual profit= Gross annual product – total annual costs (Ibid.)
- Cost per one kg. = total annual costs ÷ production quantity (Ibid.)

**Research Technique :** it has been depended upon techniques of field survey and personal interview with the persons concerned in the olive mills distributed in the four regions of the governorate , together with the electronic search technique (International Information Network) , besides using the economic analysis indexes suitable for the research purpose.

## V. RESULTS AND DISCUSSION

### *A. Real Status of utilizing olive mills wastewater internationally*

It is estimated that the number of olive trees in the world is circa 750 million olive trees distributed the entire world over, 95% of which are in the Middle East region. Southern Europe is regarded the most olive producing, then Morocco and Moroccan East, where in Spain there is no less than 236 million trees over an estimated area of 2 million hectares i.e. 27% of the olive trees cultivated area in the world.

Spain 's contribution to world olive oil production is 35 %, followed by Italy 27%, Greece 17%, Syria 8% , Tunisia 5%, Turkey 4%, Morocco 3%, Algeria 2%, Portugal 1% , and the Argentine 1%( ACSAD , 2014).

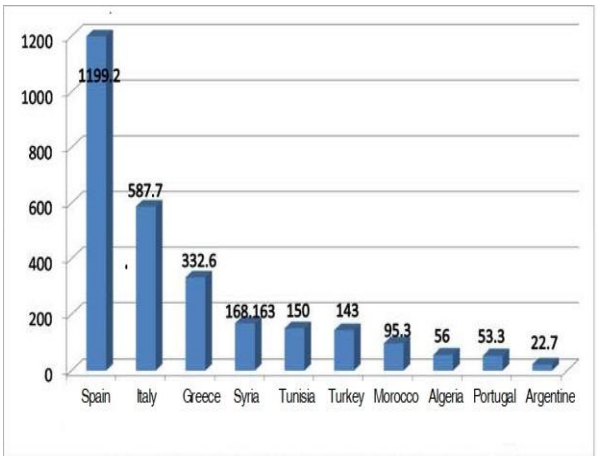


**Figure (1) illustrates quantity of annual olive oil production (thousand tons) for a number of states For 2016.**

Figure (1)'s data show the vast expansion of olive cultivation, as a result of the strikingly increasing international demand on olive oil , hence the accompanying increase in mills which, in addition to olive oil, produce secondary wastes resultant from pressing olive fruit (olive mills waste water (OMWW) . These wastes contain high percentages of organic materials and polyphenol. Olive mills also emanate unpleasant odors ,and olive mills waste water cause changes in water resources characteristics , which are reflected in change of water color, the appearance of an oil layer on its surface, and a decrease in oxygen.

There are international surveys which demonstrated the possibility of transforming such wastes into an economic resource, like utilizing them as biofuel, fertilizer, or as a crude material in the process of extracting value products as antioxidants , enzymes and biogas. To avoid the occurring of any economic or social mistakes, which may lead to a crisis in the olive oil production sector, owing to the high investment cost of treating olive mills waste water , some states resorted to issuing precautionary legislations , criteria and strategic plans to get rid of these wastes. In Italy, olive mills waste water irrigation has been used within certain standards. In Spain, however, the adopted production techniques were changed from presses and three-phased centrifugation to bi-phase centrifugation system, which leads to minimum utilization of olive mills waste water ( Project of Integrated Management resulting from pressing olive fruit, 2012).

Resultant (OMWW) quantity is estimated to be equivalent to (0.5-1) cubic meters per 1 ton of olives according to the followed pressing method ( Paraskevo and Diamadopoulous,2006;Di Giovacchino et al., 2002). Total (OMWW production in Mediterranean countries is estimated to be over 30 million cubic meters of solid and liquid wastes resultant from olive

pressing , of which about 1 million cubic meters are in Syria (Baccari et al.,2003,Capasso et al. 1995). On the whole, quantity and composition of this material differ according to various factors, among which are atmospheric, agricultural and natural conditions,cultivation processes, pesticides and fertilizers utilization, olive species, ripening stage, andolive fruit collection time(Halliwell,1990).

### *B. True status of using olive mill wastewater in Syria, in general and in Latakia governorate, in particular*

Syria occupies a remarkable position in the domain of olive cultivation on both the Arab and international levels, where it ranks first on the Arab level and fourth internationally.Olive cultivated areas on the country level are about (695711) hectares, an area equivalent to 10% of total cultivated area in Syria, and about 65% of total arbored fruit-bearing area . This area also includes over (103536200) trees (81532000) of which are fruit-bearingtrees. Olive mills total about (1100) , 700 of which work on centrifugation system, i.e. equivalent to two-thirds of the country's olive mills (Olive Office Director, 2017).

Olive mill wastewater is disposed of in a randomized and non-organized way, and the local survey performed by the General Commission for Environmental Affairs in collaboration with the United Nations Development Program (UNDP) demonstrated the way olive mill wastewater is disposed of by mills owners in Syria . Table (2) shows the methods followed by mills owners to get rid of olive mill wastewater.

**Table (2) Illustrates ways for getting rid of olive mill wastewater by Syrian mills owners.**

| Olive mill wastewater elimination methods | Number of mills | Percentage |
|---|---|---|
| Discharge to sewage system | 400 | 36.37 |
| Discharge to surface water | 89 | 8.1 |
| Throwing on the ground | 60 | 5.45 |
| Storage in catchments | 301 | 27.37 |
| Collection in artificial permeable holes | 10 | 0.9 |
| Transporting it to other places. | 215 | 19.56 |
| Utilizing it in trees irrigation | 25 | 2.3 |
| **Total :** | 1100 | 100 |

**Source: Olive Office Directorate 2017.**

Olive mill wastewater (OMWW) is considered among the most prominent products of olive pressing process for its important uses for irrigation purposes, particularly olive trees irrigation, where the results of field survey of a sample of olive tree farmers in Latakia governorate showed that the farmers had a positive effect from utilizing olive mill wastewater , after they had had a misconception that olive mill wastewater is not good for irrigation, but even negatively affects agricultural crops. It has become known that olive mill wastewater has no toxic effect, but may lead to causing a temporary pollution in the milieu where it is propagated if it is dispersed in large quantities at an inappropriate time (Kbeibo, 2010).

Field survey demonstrated that the amount of dispersed olive mill wastewater were concentrated in four main regions: Latakia district – Jableh district- Al Qardaha district, - Al Haffah district. Table (3) illustrates theolive mill wastewater fertilized areas, distributed amounts and number of farmers for (2017) season.

**Table (3) olive mill wastewater fertilized areas, distributed amounts and number of farmers for (2017) season**

| Region | Amount of distributed Olive mill wastewater ($m^3$) | Percentage | Area upon which it is distributed (dunum) | Percentage | No. of farmers |
|---|---|---|---|---|---|
| Latakia | 21966 | 59.81 | 3290 | 51 | 561 |
| Al Haffah | 4218 | 11.5 | 557 | 8.65 | 135 |
| Al Qardaha | 3432 | 9.34 | 840 | 13 | 225 |
| Jableh | 7107 | 19.35 | 1764 | 27.35 | 305 |
| **Total** | 36723 | 100 | 64.51 | 100 | 1226 |

(Directorate of Agriculture in Latakia- Olives Department, 2016)

From table (2) we notice that the largest distributed percentage of olive mill wastewater was in Latakia region, and the least was in Al Haffah region, and that the largest percentage in term of the area over which olive mill wastewater was distributed, was Latakia district, too; and the least was Al Haffah district.

### *C. Calculating costs of the Agricultural processes required for Olive oil Production per Dunum*

Through field investigation, costs of agricultural processes required for olive oil production per dunum using olive mill wastewater, as before, where utilizing olive mill wastewater minimizes costs of farming processes (organic and chemical fertilization) decreases

agricultural materials costs (organic and chemical fertilizers and control materials). Table (4) shows total costs for olive oil production in Latakia governorate per dunum.

**Table (4) Total Costs of Olive Oil Production in Latakia Governorate per Dunum SYP.**

| Expense Nature | Costs Items per Dunum | Year 2017 |
|---|---|---|
| **Agricultural Processes** | Tillage 2 | 3000 |
| | Combing and Hoeing | 1600 |
| | Husbandry and Pruning | 6000 |
| | Controlling Weeds and Diseases | 2550 |
| | Organic & Chemical Fertilization | 1761 |
| | Fertilizing with Olive Mill wastewater | 700 |
| | Collection and Sorting | 25000 |
| | Loading and Transport | 2800 |
| **1** | **Total Agricultural Processes Wages** | 43411 |
| **Production Requisites** | Organic Fertilizers Value | 1375 |
| | Chemical Fertilizers Value | 3600 |
| | Control Materials Value | 2500 |
| | Refills Value | 4340 |
| **2** | **Total Agricultural Materials Value** | 11815 |
| **3** | Petty Expenses 5% of 1+2 Totals | 2761 |
| **4** | 1+2+3 | 57987 |
| **5** | Capital Interest 9% of Total 4 | 5219 |
| **6** | Total 4+5 | 63206 |
| **7** | Total Costs of Pre-investment Years | 19443 |
| **8** | Investment Year 's share of Setup Costs | 607 |
| **9** | Total 6+8 | 63813 |
| **10** | Land 's return | 22770 |
| | **Total Preliminary Costs** | **86583** |

Source: Field Investigation

**And Table (5) shows total costs of olive oil production per dunum in Latakia Governorate**

Table (5) shows total costs of olive oil production per dunum in Latakia Governorate

| Description | Value at 2017 Prices |
|---|---|
| **Variable Costs** | |
| Total Value of Agricultural Processes | 43411 |
| Total Agricultural Requisites Value | 11815 |
| **Total Variable Costs** | 55226 |
| **Fixed Costs** | |
| Land's Revenue | 22770 |
| Capital Interest | 5219 |
| **Total Fixed Costs** | 27989 |
| **Total Productive Costs** | 83215 |

Source: Field Investigation

***1. Economic Return from Olive Oil Production per dunum using Olive mill wastewater***

One dunum yields average production equivalent to 500 kg of olivesi.e. equivalent to about 125 kg olive oil.

**Production Value per dunum Production QuantityDunum**

**Price of 1 kg Olive Oil =** 125 x800=100000 SP.

**Net profit value: Total Net Product – Total Costs**

Total Costs = Variable costs + fixed costs

Variable costs = total value of Agricultural processes value + Agricultural requisites value = 43411+11815=55226 SP.

Fixed costs = Land's revenue + capital interest = 22770 + 5219= 27989 SP.

Hence, total costs = 55226+27989=83215 SP.

Thus, net profit value =100000-83215=16785 SP.

***2. Calculating Economic Analysis for Olive Oil Production Using Olive Mill wastewater***

* Profit per one dunum (SP./dunum/year) = Total Product (SP./dunum/year )= total costs with capital (SP./dunum/year.

= 100000-83215=16785 (SP./dunum/year).

* Variable Assets Re-cycling Average = Gross product /Total Costs

= 100000/55226-1.81

* Total Economic Efficiency = Gross Product/Total Costs

=100000/83215=1.20

* Total Margin (SP./dunum/year)= Gross product (SP./dunum/year)- variable costs (SP./dunum/year)

=100000-55226= 44774 SP.

*Net Farm income per dunum (SP./dunum/year)= Average Gross Product (SP./dunum/year) –

Total costs excluding capital interest = 100000-83215-5219=11566 SP.

*** Profitability Coefficient:**

- Profitability Coefficient in proportion to productive costs=( attained annual profit/preliminary productive costs x 100=(16785/86583) x 100 =19.38%

## VI. CONCLUSIONSAND SUGGESTIONS

### *A. Conclusions*

1- Field investigation has shown the difficulties the farmers face owing to the penalties the governorate impose like taking the action of sealing the mills , the matter which negatively affects farmers, besides lack of impermeable basins and farmers' non-conforming with international standards for olive mill wastewater dispersion.

2- It has been found that utilizing olive mill wastewater in olivetrees fertilization is important in view of the high productive profitability it attains.

3- Fertilization with olive mill wastewater in olive trees cultivation achieves net profit of 16785 SP.per dunum according to the year of study.

4- It has been evidenced via studying economic analysis indexes of utilizing olive mill wastewater for olive trees fertilization,that:

- ✓ Total margin totaled about 44774 SP.
- ✓ Average of variable assets re-cycling per dunum totaled circa 1.81.
- ✓ Total economic efficiency per dunum totaled about 1.20.
- ✓ Profitability coefficient compared to production costs totaled 19.38%.

### *B. Suggestions*

Encouraging olive tree farmers in Latakia governorate to use olive mill wastewater as fertilizer irrigation for their lands after it has been shown the extent to which olive mill wastewater is efficient in increasing production per unit area , in coordination with the Directorate of Education , mills owners and the governorate.

1. Necessity for adherence to international rates for dispersing olive mill wastewater, which is 8$m^3$per dunum if the mill works on three-phased centrifugation system; and 5 $m^3$ per dunum if the mill works on press system.
2. Binding olive mill owners to build an impermeable basin capable of holding the mill's work for a period of one full week in accordance with the productive capacity of each mill.
3. Changing the techniques the governorate follow by implementing penalties on olive mills owners , where the governorate resorts to sealing the olive mills until the violations are removed, since a financial tax should be imposed in lieu of this measure which harms the farmer.

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