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VALUE ANALYSIS ON OLIVE SORTING METHODS

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Abstract: *A preliminary step to the development of any olive sorting devices [1] is the analysis of value. The value analysis aims to see if, from an economic point of view, it is worth developing a new sorting system or if the current olive sorting methods are economic efficiency. This economic study was carried out on all current sorting methods that are currently applied in the northern part of Greece on a sample of 125 olive groves.*

Key words: *Value analysis, sorting, olive, economic.*

1. INTRODUCTION

Greece was chosen as the research location, primarily due to the fact that it is one of the most important olive growers and producers in the world, having production based mainly on the traditional style [1].

The chosen regions are regions with a rich tradition in olive cultivation, being an area with many olive groves.

The study of orchards is important because it gives us information about their size, which implicitly shows us how to harvest and the sorting method applied [1,2].

The study on cultivated olive varieties is carried out to determine their final destination: processing in oil, with dual purpose (oil-consumption) or only for consumption [1,3].

An analysis was performed on a number of 125 olive groves and over 85 olive collection-sorting-processing centers, covering the northern part of Greece, Figure 1 [1].

During this stage of the research, the aim was to identify the current methods of sorting, as well as to go through the entire technological process of olives, from harvesting from the tree to packaging (whether it is olives for consumption or for obtaining oil) to better understand the needs of the sorting system [1, 4-6].

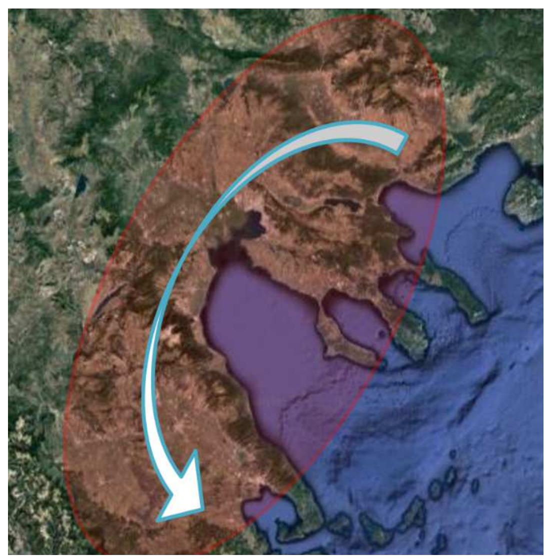

Fig. 1. Location of experimental study.

Each olive grove was followed by the olive variety, the sorting method and whether there is an influence between them.

The results of this analysis show that in this area, the olive variety for consumption (fruit is larger) predominates, followed by the other hybrid varieties, hybrids being generically called dual-purpose olives (for oil and for consumption). Thus, the consumption and hybrid varieties represent a total of 77% of the orchard capacity, while only a percentage of

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23% is represented by olives destined for oil, Table 1 and Table 2 [1].

Table 1

Olive sorting methods analysis

Orchard	Dimension Sq m	Sort mode	Sorting methods	Olive variety
1	5443	At warehouse	Manual	Oil
2	24011	At warehouse	Semiautomatic	Consumption
3	1312	At orchard	Manual	Consumption
4	19968	At warehouse	Manual	Dual use
5	15185	At warehouse	Manual	Dual use
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
125	18585	At warehouse	Manual	Dual use

Table 2

Average value of olive sorting methods

	Average	
Dimension Sq	12637.552	
Sort mode	At warehouse	109
	At orchard	13
	It doesn't require	3
Sorting methods	Manual	99
	Semiautomatic	23
	It doesn't require	3
Olive variety	Oil	29
	Dual use	42
	Consumption	54

This research has shown that regardless of the variety of olives, in order to obtain high quality products that provide competitiveness in the consumer market, it is necessary to introduce the olive sorting phase in the continuation of the technological process [1,4,5].

2. EXPERIMENTAL WORK

The value analysis was applied, in part, to all current sorting methods encountered in Greece, namely:

- Manual sorting directly from the tree;
- Manual sorting from the ground;
- Manual sorting in the warehouse; Sortarea semiautomată de pe benzi transportoare.

For this analysis, the average of the centralized data in Table 2 was used, namely the production given by an olive grove with an area of 1.2 ha, with a number of 500 olive trees would have average annual production of 30,000 kg of olives [1,7-9].

The equation for sorting time (τ_s) for all production is calculated:

$$\tau_s = \frac{Pr}{E_L * Nr_L} \quad (1)$$

Where:

- Pr – Production. The production is calculated starting from the average area of the studied orchards (table 2) which is 1.2 ha, which means a number of about 500 olive trees. An olive tree can produce, on average, 60 kg of olives, so we have a production of 30,000 kg of olives [10].
- E_L – the efficiency of a day laborer depends on the sorting method and is given per working day;
- Nr_L – number of laborers;

In order to elaborate the generalized calculation model, we conceived from the equation of the cost of sorting (C_s), given by the formula:

$$C_s = \tau_s * Nr_L * C_z + \frac{Eq_a}{Eq_L} \quad (2)$$

Where:

- τ_s – Sorting time, expressed in working days;
- Nr_L – number of laborers;
- C_L – Laborer daily cost = 50 euro (10 working hours / day) [10, 11];
- Eq_a – Auxiliary equipment [11 - 14] (depending on the sorting method);
- Eq_L – Equipment life, expressed in years, expected minimum period [11 - 14].

The efficiency of sorting methods, the average cost of auxiliary materials and the minimum duration of use depending on the sorting method are indicated in Table 3.

Table 3

Efficiency, average cost of auxiliary materials and minimum duration of use depending on the sorting method

Sorting method	Efficiency Kg/h	Auxiliary material cost	Minimum equipment life years
Directly from the tree	10	24	2
From the ground	15	86	3
Deposit manual	20	116	3
Semiautomatic	100	5800	5

From Table 3 the equation of time required for sorting (1) is calculated for each method [1].

Equation of time required to sort directly from the tree:

$$\tau_s = \frac{30.000}{100 * 1} = 300\ days$$

Equation of time required for sorting from the ground:

$$\tau_s = \frac{30.000}{150 * 1} = 200\ days$$

The equation of the time required for manual sorting at the warehouse:

$$\tau_s = \frac{30.000}{200 * 1} = 150\ days$$

The equation of time required for semi-automatic sorting:

$$\tau_s = \frac{30.000}{1000 * 1} = 30\ days$$

From Table 3 the equation of the cost of sorting (2) is calculated for each method separately [1].

The equation of the cost of sorting directly from the tree:

$$C_s = 300 * 1 * 50 + \frac{(2 * 4 + 2 * 8)}{2} = 15.012\ euro$$

The cost per kg is 15012/30000=0,50 euro

The equation of the cost of sorting from the ground:

$$C_s = 200 * 1 * 50 + \frac{(70 + 2 * 8)}{3} = 10.028\ euro$$

The cost per kg is 10028/30000=0,33 euro.

The equation of the cost of manual sorting at the warehouse:

$$C_s = 150 * 1 * 50 + \left(\frac{100 + 2 * 8}{3}\right) = 7.538\ euro$$

The cost per kg is 7538/30000=0,25 euro.

The equation of the cost of semi-automatic sorting:

$$C_s = 30 * 1 * 50 + \frac{5800}{5} = 1500 + 1160 = 2.660\ euro$$

The cost per kg is 2660/30000=0,08 euro.

3. RESULTS AND DISCUSSIONS

Cost comparison between productivity of sorted olives, worker cost and equipment cost according to the sorting methods, and it can be concluded that manual sorting has an insignificant cost of equipment but also has a very low productivity (Table 4).

Table 4

Comparison of equipment costs and productivity by sorting method

Sorting method	Productivity sorted olives / hour [kg]	Cost worker / day of work [€]	Equipment cost [€]
Manual directly from the olive tree	10	50	24
Manual directly from the ground	15	50	86
Manual at the warehouse	20	50	116
Semi-automatic	100	50	5800
Automatic ally	1000	50	Unknow price

A comparison of current sorting methods is presented in Table 5. From which it can be concluded that manual methods are slow but also expensive due to the fact that more staff have to be employed.

Table 5

Comparison of sorting methods

Sorting method	Advantages	Disadvantages
Manual directly from the olive tree	Without losses* Superior quality	Slow Costly
Manual directly from the ground	Superior quality	Slow Costly With losses**
Manual at the warehouse	High quality	Slow Costly With losses**
Semi-automatic	High quality Acceptable productivity	High cost of equipment Requires staff for sorting
Automatically	Acceptable quality Good productivity	Requires additional sorting Still in the research stage

* *Sorting is done directly from the olive tree, take olives that meet the requirements*

** *Sorting is done from olives picked by shaking (there may be leaves, twigs and olives that do not meet the standards imposed by the producer) which requires additional operations*

Automatic sorting has a high productivity but also has a very high cost of the necessary sorting equipment and is still in the research phase.

The ideal would be an automatic sorting with a low cost of the machine and with a high productivity.

From the value analysis performed at the sorting operation, draw up a summary table, Table 6, between the sorting methods and their efficiency (on an annual harvest of 30,000 kg of olives) [10].

These sorting values, in addition to the calculation criteria presented, are also influenced by several factors such as: variety, annual harvest, human operator, cost of harvesting, etc [1]. However, these factors do not significantly change the cost of sorting, Table 6.

Table 6

Centralized table of the analysis of the value of sorting / harvest year

	COST – euro (€)					
	Presorting		Soring			
				Sorting cost**		
Sorting method	Harvest cost*	Auxiliary workers cost	Necessary days / 1 worker	Sorting cost annual / harvest	Sorting cost/Kg	Total cost*** €
Manual directly from the olive	0	0	300	15012	0,50	15012
Manual directly from the ground	0-150	50	200	10028	0,33	10078-10228
Manual at the warehouse	150-100.000	50	150	7538	0,25	7738-107588
Semi-automa	30.000-150.00	50	30	2660	0,08	32660-152660

* *Harvest cost - minimum and maximum possible value*

**Sorting cost calculated with the average value of the auxiliary equipment*

***Total cost = Harvest cost + Auxiliary staff cost + Sorting cost*

4. CONCLUSIONS

The factors that significantly change the value of the sorting process are the factors of the pre-sorting operation, from Table 3 the cost of harvesting plus the auxiliary costs. The most important factor of sorting is the harvesting process, and the cost of the harvesting process increases when harvesting is mechanized or automated (according to the value of the machines) as shown in the comparative diagram between sorting costs and harvesting costs plus sorting cost, Figure 2.

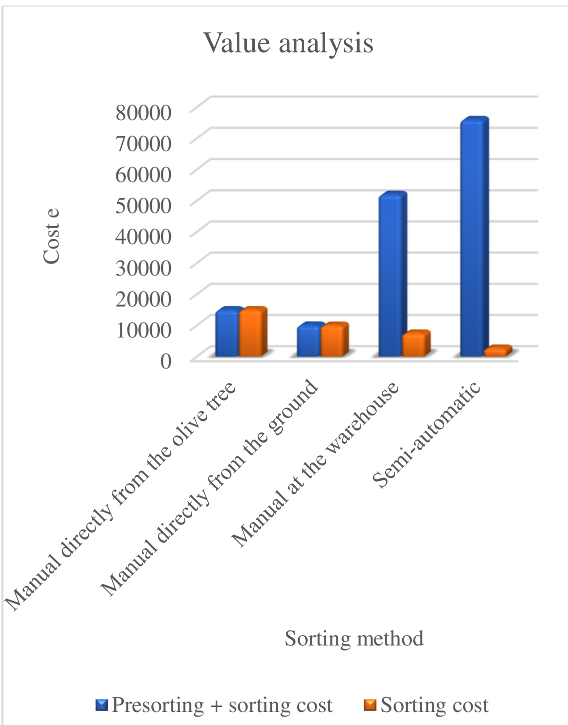

Fig. 2. Comparative diagram of value analysis.

The conclusions of the analysis carried out on the sorting of olives in Greece, Macedonia and Thessaly highlighted the following [1]:

- The vast majority of orchards are small, of the order of 1000-2500 sqm;
- The sorting is done on the spot, in the orchard or inside a warehouse, a warehouse that can serve several orchards (of the same owner or a group of owners);
- The method of manual sorting is most common, immediately after the olives have been harvested, this sorting being done in storage;
- Sorting is performed manually by collectors or other staff;
- After sorting, the process of food recovery of the olives in the respective warehouse begins, and sorting represents the most important stage of this process;
- Sometimes, after sorting, third party companies are involved to deal with the processing of olives;
- Sporadically harvested olives are sold to processors without further sorting.

As a final conclusion it can be said that an efficient sorting system would be an automatic system with high sorting efficiency and with a low price, as presented in other papers by the authors [1,4,5].

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ANALIZA VALORII METODELOR DE SORTARE A MĂSLINELOR

Rezumat: *O etapă premergătoare dezvoltării prototipului de sortare a măslinelor [1] a fost analiza valorii. Analiza valorii are ca scop să vedem dacă, din punct de vedere economic merită să dezvoltăm sisteme noi de sortare sau dacă sunt suficiente sistemele actuale de sortare. Acest studiu economic a fost realizat pe toate metodele de sortare care se aplică în momentul de față în partea de vest a Greciei pe un eșantion de 125 de livezi de măsline*.

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