

## **Control System of Management for Intensive Cultivation Activity in Tomato Production: Spanish Case**

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### **ABSTRACT**

This study presents a detailed analysis of cost management for intensive cultivation activity in terms of tomato production. The main objective was to provide qualitative and quantitative costs obtained in the intensive cultivation of tomato. This methodology was structured by activity costs (soil preparation and planting, crop monitoring, harvesting, selling, etc.) through a study in greenhouses in Almería, Spain. According to the results, this kind of management provides a cost analysis of the products, with extensive information on variable costs, produces measures that are used for cost management and operational performance evaluation; helps in the identification and the evolution of costs; identifies the main activities and tasks carried out during the growing season; and quantifies the cost margin, which enables the farmers to position their products strategically in the market with competitors.

**Keywords:** Agricultural costs, Costs drivers, Workforce.

### **INTRODUCTION**

For its perfect location, one advantage of Spanish agriculture is that it is positioned as a leader in the sector (Spain), based on its environmental conditions. Another advantage is the extensive business experience in distribution and marketing of fruits and vegetables.

In the past years, the results of agricultural activities but nowadays they are being drastically reduced, giving losses in some periods of the year when the demand is high, strengthening more pressure from the Big Distribution (concentration of demand), and increasing the number of competitors other countries (especially Morocco), and even more in the future, when these competitors will be able to be stronger due to their enhanced relations with the European Union countries.

The production costs have considerably increased due to the workforce, Technological processes have focused on the

structure of greenhouses. An important issue is that, in times of crisis, farmers do not have purchasing power to change the structure of their cost.

Nowadays, a decision of relocation can be risky with incredibly high costs. For this reason, the purpose of this study was to develop a comprehensive field study about the costs system of tomato crop, giving references to various activities that are carried out in the process. This way can allow achieving a greater efficiency in terms of costs.

Entrepreneurial activities from other tomato-producing provinces, such as Murcia, have been done with strategies to reduce costs by relocation in nearby places (e.g. Morocco).

For Almería, the alternative would be to optimize the costs system, or relocate their production, considering that the technology in the greenhouse structure is expensive, and it is difficult to obtain loans/funds to carry out their investments.

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According to a study prepared by Associations of Consumers and Users of Al-Andalus, FACUA, and UCA-UCE in collaboration with the Ministry of Agriculture and Marine Affairs of the Junta de Andalusia (Secretaría General Técnica. Junta de Andalucía, 2010), the lack of knowledge by firms about management, production, and local prices could lead to consideration of the needs for a thorough reflection, and a comprehensive study of factors that are influencing the market chain management in order to consider that Consumer Organizations could give an opinion of the current situation, they highlight the lack of knowledge by firms about management, production.

The comments of these three federations of Consumers are supported by some observations made on the tomato value chain, in regards to a study carried out by the Junta de Andalusia, and the Ministry of Environment, Rural and Marine Affairs.

The reason why the analysis was based on data from farms in Almeria is because this province is the leading producer and exporter of fresh tomato in Europe. There are several very interesting articles about the model of agricultural development in Almería. Among them, we highlight the following: Martínez Sierra (1979), Palomar Oviedo (1982), González Olivares and González Rodríguez (1983), Molina Herrera (1991), Fernández Gallego (1992), De Pablo Valenciano (1996), and Galdeano and De Pablo (1999).

## MATERIALS AND METHODS

### Traditional Cost Management

In recent years, the traditional cost model is no longer valid, since production efficiency is not only based on maximizing production and minimizing costs (Figure 1).

The model of cost calculation plays a major role, since it determines the viability in business and the degree of productivity to use the resources efficiently. A cost model cannot rely on allocating costs in a particular activity, because it may be insignificant or unrepresentative of what it actually represents.

Traditionally, economists have supported the analysis of variable costs (marginal), but in the end the conclusions were not clear to whether or not to produce focusing on setting prices. Furthermore, fixed costs and other costs should be disregarded. However, Cooper...The fixed costs are set in the short term as overhead costs, but after certain length of time, the costs fluctuate depending on which activities are effective (Cooper and Kaplan, 1988a; Cooper and Kaplan, 1988b; Cooper and Kaplan, 1991; Horngren *et al.*, 2000; Ozpinar and Ozpinar, 2011).

According to the draft of the financial accounting information of some corporations, the analysis of costs are the primary source of management information. (Garrison and Noreen, 2000). However, as Johnson and Kaplan (1987), observed,

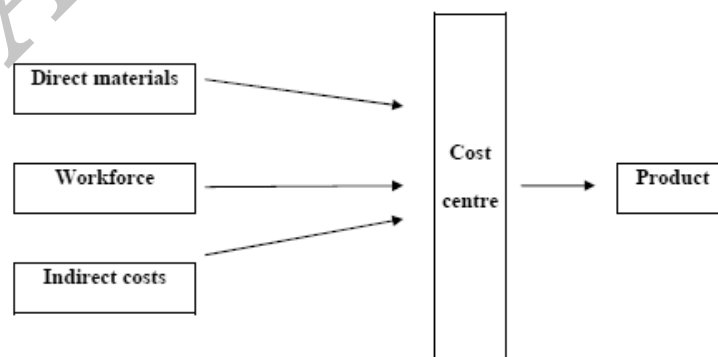


Figure 1. Traditional cost management.

"Today management accounting information is formulated too late, and the added values are too distorted to be relevant to managers." It means that the use of generally accepted accounting principles are not useful in the management plan, control, ABM system, implementation, and management activities to provide information about the effectiveness of every activity. (Qayoumi, 1996).

### Costs of Activities in Intensive Cultivation of Tomato

#### Cost Management by Activity in Fruit and Vegetable Companies

In management control systems, developments have been limited in farm businesses justified by the characteristics of the industry and business environment.

A management control system in agricultural activity should lead to an acceptable management, knowledge, and a cost allocation in the environment where farming operates (Hosseini and Springs, 2009). No expansionist trends in policies can prevail and remain because the objectives of minimizing costs and maximizing quality are the competitive advantages of developed country farmers (Juliá and Server, 1999).

The global environment of horticultural

sector requires to know the relevant and accurate information on how costs can affect the production process as a way to achieve a competitive advantage in an increasingly saturated and less differentiated markets (Server and Mateos, 2002).

The same methodology has been used in the activity-based costing and through its structured phases and costs. Now, we discuss the cost survey of the tomato cropping by using the information collected in different farms in the province of Almeria representing a total sample of 128.50 hectares. In addition, to serve as an example in the cost analysis, we have opted for choosing the cost analysis on tomato by relevant activities. (Table 1)

The type of greenhouse studied was *raspa* activities (the most used in the province of Almeria).

The traditional greenhouses are not prepared for evacuating rainwater. Furthermore, with high precipitation, the structure can be severely damaged. To avoid this, greenhouses have different slopes, called "scraping" slopes. They are held in place by galvanized pipes and wires. Their lower part is known as "feinting" slopes, which join the structure by iron brackets, resulting in channels that can allow rainwater flows to the soil. The typical Almeria greenhouse's success relies on its simplicity and low costs (García-Martínez *et*

**Table 1.** Relevant activities of the production process in the tomato crop long cycle.

Intensive phase of tomato crop	
Phase 1: Soil Preparation and planting	
A) Soil preparation	
B) Planting	
Phase 2: Crop monitoring	
A) Earthing	
B) Trellising (Arrangement of hangers, tie hangers in the main stem, stapling, remove hanger ...)	
C) Treatments	
D) Formation of branches	
E) Cut setms and leaves	
F) Cleaning (Sweeping of leaves and stems and transportation of garbage)	
G) Others tasks (Review of the plant, separation plant, review of work ...)	
Phase 3: Collection	
A) Collection	



al, 2010; and www.Infoagro.com)

### Definition of Activity Map

This step identifies the cost-drivers (inductor cost or generating resources) is “a factor used to measure how a cost is incurred and/or how to impute,” such as costs of activities (Hicks, 1997).

Once the blocks of relevant activities that are carried out in each one are identified, then, one could arrange defining the map of activity. This process of allocating costs for activities, identified in previous steps, is first of all making a deal with costs, because you can share them by identified activities in the process (Torkamani and Abdolahi, 2001). As previously reported in the literature, the classification of costs by activities represents a substantial change in the classical conception of costs accounting, because they are collected by the cost-drivers and they aggregate and give value throughout

production.

The allocation of greenhouse activities cost centers are shown in Table 2, differentiating the main blocks of activity.

As explained above, the farm gives rise to a bunch of companies in order to offer their services to those operations. (auxiliary industry). The basic types of companies which make up this business services network to agricultural activities are the following (Langreo, 2002):

- Business consulting and administration companies, business and/or technique.
- Global Management Business exploitation.
- Companies specialized in mechanized tasks.
- Companies specializing in the application of inputs.
- Companies specializing in a specific cropping activity.
- Handcraft companies.

Examination of the basic structure of horticultural cropping production includes

**Table 2.** Allocation of cost-drivers to activities.

	Stage	Activities	Cost-drivers
Primary activities	Soil preparation and planting	Soil preparation	Workforce hours
		Planting	Workforce hours + numbers of seeds
	Crop monitoring	Earthing	Workforce hours
		Trellising	Workforce hours
		Treatments	Workforce hours+litres of phytosanitary
		Formation of branches	Workforce hours
Secondary activities	Collection	Cut stems and leaves	Workforce hours
		Cleaning	Workforce hours
		Others tasks	Workforce hours
		Collection	Workforce hours
	Sale	Transportation to the manipulation centre	Workforce hours
Infrastructure	Greenhouse	Not assignable <sup>a</sup>	
	Plastic (Painted white)		
Services	Irrigation system		
	Irrigation pond		
		Others (Insurance, water, electricity, communications)	

<sup>a</sup>These costs are distributed in the entire crop through the amortization.

the followings: before greenhouse cultivation, tomatoes must go through a handling or manipulating activity to store them (with or without refrigeration). These activities consist of selection, washing, sizing or selection, packaging, weighing, and quality control. According to the Institute of Studies of Cajamar (2004), in the distribution of value, added services is 62% weighted throughout production and its ancillary activities, 29% belongs to handling and marketing; and finally, the remaining percentages belong to transportation activities (Figure 2).

## RESULTS AND DISCUSSION

This study has focused on achieving a major goal: to provide qualitative and quantitative costs obtained by the intensive cultivation of tomato. The methodology used consisted of determining the costs of activities (soil preparation and planting, monitoring, collection, sale and others) to increase the progress in techniques of business management for horticulture companies and growers.

Among the advantages of setting up a cost-based activity in the company is that it facilitates the cost analysis of products, and clearly indicates the variable costs. Production measures that are useful for cost management and the assessment of

operational performance are made with the intention of helping the identification and understanding of cost behavior. The limitations of cost management system can improve the corporate profitability, but these results need to be checked and contrasted because of the consequences in human resources; besides, the information obtained is historical.

From a financial perspective, the cost of an activity is "the total cost of all chargeable inputs assigned to perform an activity" (Brimson, 1995).

This sequential processing is performed through four basic steps:

Determine the cost elements.

Allocate costs to activities.

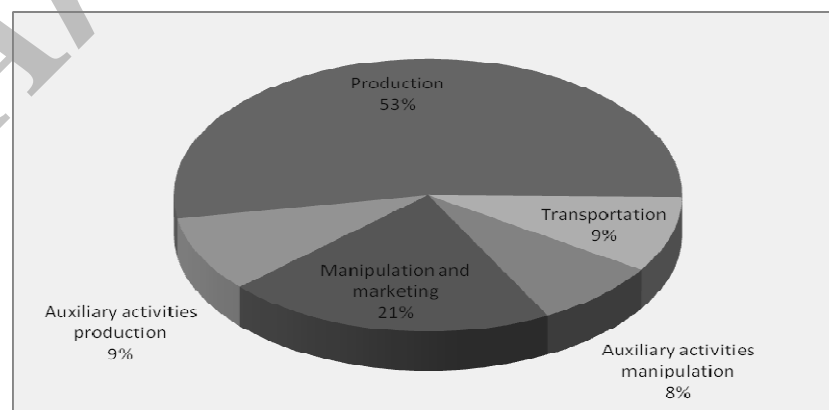
Quantify the output of the activity.

Calculate the cost per unit of activity.

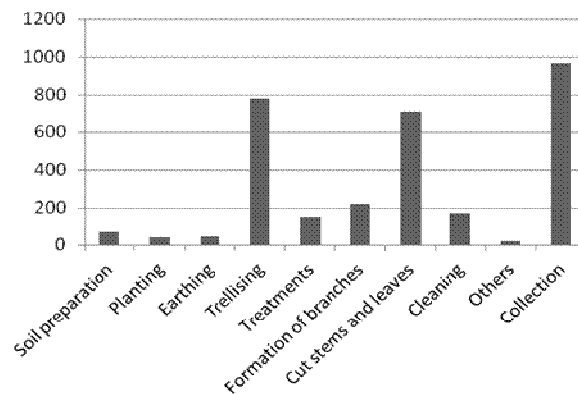
Figure 3 shows the cumulative working hours for each activity, and Figure 4 depicts the total labor activity over the daily crop.

Once the activities are defined and consolidated and all costs have been attributed for each activity, we are able to calculate the cost of the product, adding to the cost of activities the costs directly attributable to them (Molina De Paredes, 2003).

Finally, the attribution of the cost of the activity to cost objectives (tomato) is discussed in Table 3. As concluded by Server and Mateos (2002) in this case, the



**Figure 2.** Distribution of value added services [Source: Own elaboration with information of the Institute of Cajamar (2004)].



**Figure 3.** Share of different activities in total seasonal activity (per cent).

**Table 3.** The unit cost of activities in the intensive cultivation of tomato (euros m<sup>-2</sup>).

Primary activities (I)		
	Soil prepatation	Planting
Total Cost (A)	532.19	4058.52
Cost driver	Hours	Hours+Number seeds <sup>a</sup>
Measuremente of activity (B)	64.94	37.65
Unit cost: (A)/(B)	8.19	107.80

<sup>a</sup> Seed 0.2 € and Nursery 0.05 € by 15,000 plants (approximately one hectare).

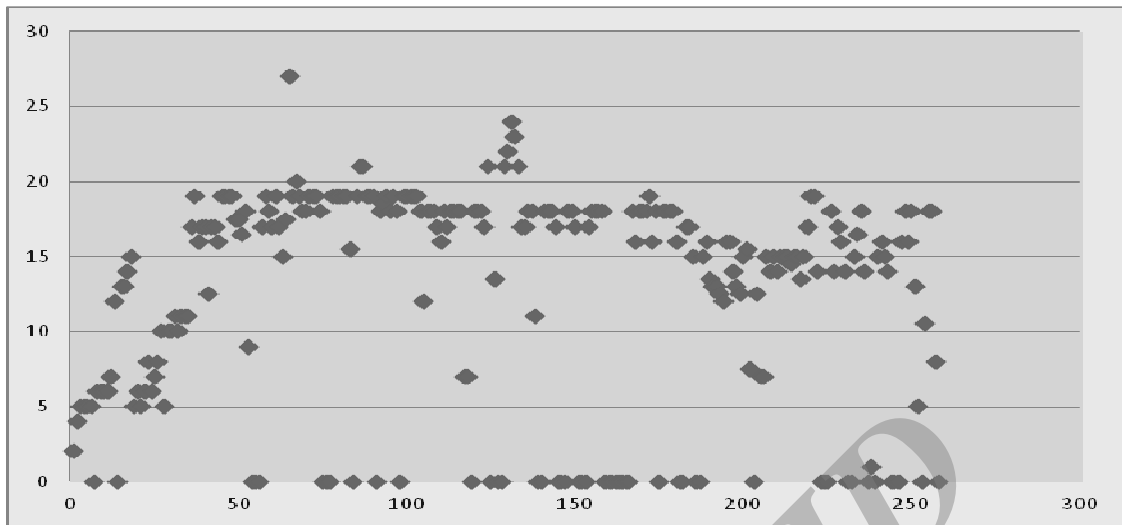
Primary activities (II)							
	Earthing	Trellising	Treatments	Branches	Cut stems and leaves	Cleaning	Others
Total cost (A)	366.36	6023.78	5149.22	1719.98	5495.45	1338.19	661.97
Cost driver	Hours	Hours	Hours+Litres of treatment <sup>b</sup>	Hours	Hours	Hours	Hours
Measuremente of activity (B)	44.71	735.06	140.24	209.88	670.59	163.29	19.76
Unit cost: (A)/(B)	8.19	8.19	36.72	8.19	8.19	8.19	33.49

<sup>b</sup> Litres of phytosanitary and integrate control.

Primary activities (III)	
	Collection
Total Cost (A)	7454.53
Cost driver	Hours
Measuremente of activity (B)	909.65
Unit cost: (A)/(B)	8.19

Secondary activities			
	Sale	Infrastructure	Services
Total Cost (A)	2800	11534.72	11400
Cost driver		Not assignable	
Measuremente of activity (B)			
Unit cost: (A)/(B)			*

\* Moves to the total primary activities from depreciation (total in euro): -Collection: 1,433.42; -Crop monitoring: 14,065.43; -Soil preparation and planting: 7,346.27.



**Figure 4.** Total labor (hours) for each activity throughout the growing season.

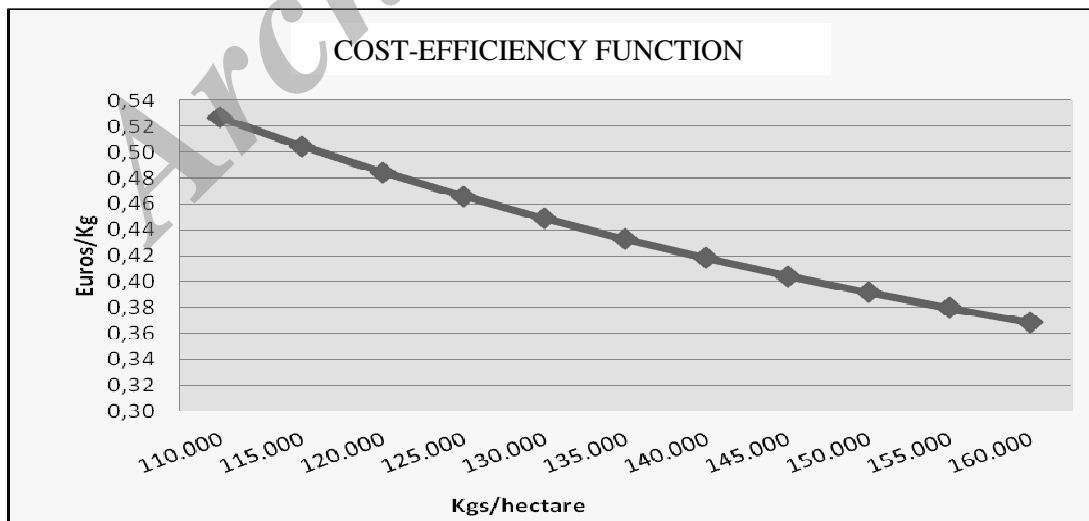
cost objective will consist of calculating the cost of the product. Therefore, we proceed to add the cost of those activities attributed to manufacture them.

Thus, we established the unit cost (euros  $m^{-2}$ ) of each activity in tomato production, based on the total cost of each activity and through different cost in each case.

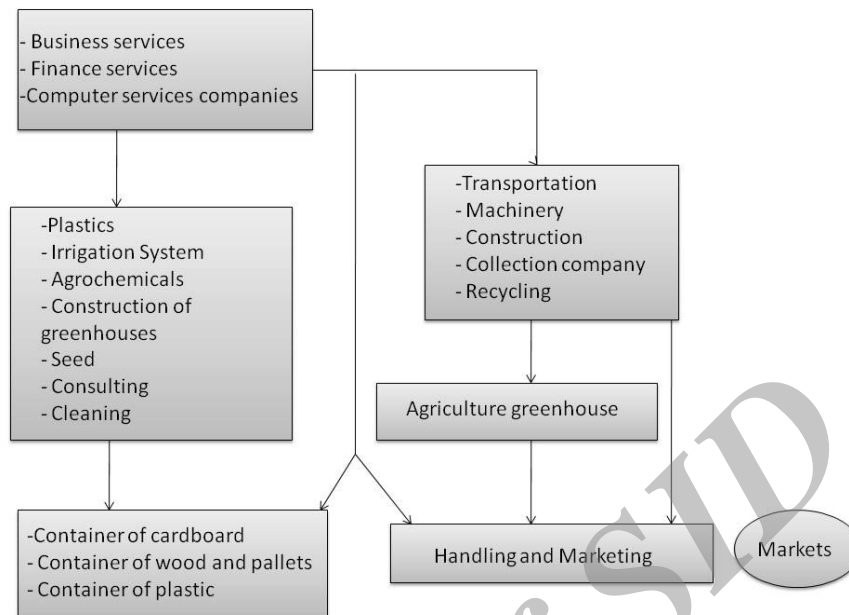
With data available, and as a complementary analysis, we obtained a cost function depending on the output obtained by the cropping activity (Figure 5).

This function of price-performance ratio points out how the cost per kilogram is related with the obtained kilograms per hectare (yield) obtained in a medium crop. Thus, the entrepreneur could know more accurately the break-even point (price at which the profit and loss would be equal) and its margin, in each case.

Also, it is important to know the handling cost. In agriculture, sub-sectors can be classified according to whether or not they could offer their products or services to



**Figure 5.** Performance cost function for the intensive cultivation of tomato.



**Figure 6.** Cluster model of agriculture of Almeria (Source: Own elaboration with information of the Institute of Cajamar, (2004).

other economic sectors such as seeds, Plastics, Agrochemicals, and fustigation systems, seed, agricultural machinery, construction greenhouses, Media, Environmental Control Systems, Waste Treatment, among others. De Pablo *et al.* (2009) article analyzes the sector of assistant business agriculture in Almeria, a diverse conglomerate of companies that amalgamate important differences between them in terms of human resources at a technological level and, therefore, with different provisions of capital. In line with the review explained by Cajamar Studies Institute (2004), this activity carried out a cluster of agricultural model in Almeria, as shown in Figure 6.

Moreover, according to the surveyed companies in average terms (handling costs

are showed in Table 4); it can bring together all the information in order to get the production costs of intensive cultivation plus handling cost per kilo of tomato (Table 5). Notably, the average productivity of one hectare ranged between 110,000 and 140,000 kg of tomatoes, and it was generally a variety of smooth tomato.

In line with activities, this managerial methodology provide some contributions and conclusions as listed below:

- Identification of the main activities and tasks that correspond to each one performed in intensive cultivation. This analysis of cropping process facilitates the monitoring of the company's actions, and also controls the process of production. In this particular case study (tomato), which is increasing its

**Table 4.** Average cost of handling the tomato.<sup>a</sup>

Costs	Unit (euros Kg <sup>-1</sup> )
Direct labor	0.09 – 0.10
Structure (Depreciation, electricity and others)	0.045 – 0.06
Insumos	0.09 – 0.115
Total	0.225 – 0.275



**Table 5.** Average cost of a kilo of tomatoes (cultivation costs plus costs of handling).

	Stage			
	Pessimistic		Optimistic	
Productivity (kg ha <sup>-1</sup> )	110000		140000	
Growing cost <sup>a</sup> (euros ha <sup>-1</sup> )	58534.92			
Growing cost (euros kg <sup>-1</sup> )	0.532		0.418	
Manipulation cost (euros kg <sup>-1</sup> )	More efficient	Less efficient	More efficient	Less efficient
	0.225	0.275	0.225	0.275
Total (euros kg <sup>-1</sup> ) <sup>b</sup>	0.757	0.807	0.643	0.693

<sup>a</sup> Based on cost management for activities performed, <sup>b</sup> To complete the cost of the total value chain to this cost would be added margin brokers (market intermediaries) and transport to the consumer, widely varying ways depending on the destination (domestic or foreign).

added value in each stage, implies the knowledge of cost structure.

- The proposal of a cost methodology for identifying activities in greenhouses based on units of activity (cost-drivers). The study of the cost by activities and its formation will allow us to analyze how the labor cost is incurring in its main cost.

- Quantification (general and activities) for all the phases of the agriculture developed in a slope, based on field crops in Almeria (128.50 hectares) in Table 6.

- *Quantifying the margin cost added by the phase of product handling.* According to this study, the costs to be added to the product (per kg) by handling ranged between 0.225, to 0.275 € kg<sup>-1</sup>, representing 52.63% of the total cost, -in average values.

The application of this methodology is useful in the specific case of tomatoes; however, it can be extrapolated to other products in horticultural companies.

The comparison of this measure with competitors enables the farmer to be in a strategically position on the competitive scenario.

Generally, optimizing costs and expenses of the company should be part of the daily management, but it is not "creating future," and, therefore, it will not sustain the business in the long term. On a medium-long-term basis, corporations must necessarily apply new technological procedures to maintain or even to increase the economical margins of the farms.

**Table 6.** Summary activity costs.<sup>a</sup>

Activity	Total cost	Unit cost per activity
Soil	532.19	8.19
Planting	4058.52	107.80
Earthing	366.36	8.19
Trellising	6023.78	8.19
Treatments	5149.22	36.72
Branches	1719.98	8.19
Cut stems and leaves	5495.45	8.19
Cleaning	1338.19	8.19
Others	661.97	33.49
Collection	7454.53	8.19
Marketing	2800.00	
Infrastructure	11534.72	
Services	11400.00	



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## سامانه کنترل مدیریت برای عملیات کاشت فشرده گوجه فرنگی: مطالعه موردی

اسپانیا

ج. دپابلو والنسیانو، و ج. اوریب توریل

### چکیده

این مطالعه جزئیاتی تحلیلی در مورد مدیریت هزینه عملیات کاشت فشرده برای محصول گوجه فرنگی ارائه می دهد. هدف اصلی پژوهش فراهم آوردن داده های هزینه های کمی و کیفی در کاشت فشرده گوجه فرنگی بود. این روش با تهیه هزینه هر عملیات ( شامل تهیه زمین و کاشت، مراقبت از گیاه، برداشت، فروش و غیره ) از طریق مطالعه ای در گلخانه های منطقه المیرا در اسپانیا اجرا شد. بر اساس نتایج، این شیوه مدیریت تحلیلی از هزینه محصولات را به دست می دهد که همراه است با اطلاعات گسترده از متغیر های هزینه و به شناسایی و تکامل هزینه ها کمک می کند. نیز، این روش سنجه هایی برای مدیریت هزینه و تکامل و ارزیابی عملکرد عملیات و شناسایی فعالیت ها و عملیات اصلی که در طی فصل زراعی انجام می شوند فراهم کرده و حاشیه هزینه ها را به صورت کمی به دست می دهد که این مطلب به کشاورز اجازه می دهد تا موقعیت استراتژیک محصول خود را در بازار رقابتی مشخص نماید.