*Food and Agriculture Organization of the United Nations*

# *Economic and Financial Comparison of Organic and Conventional Citrus-growing Systems*

**Study prepared for the Horticultural Products Group,**

**Raw Materials, Tropical and Horticultural Products Service,**

**Commodities and Trade Division, FAO**

***Economic & Financial Comparison of Organic and Conventional Citrus-growing systems***

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**Foreword:**

**This study was conducted for two citrus crops (oranges and mandarins) in the Valencia region, Spain, in the year 2000. The results obtained were of course determined by the agro-ecological and socio-economic context of this country during that period. Consequently, they cannot be used to draw general conclusions on the comparative profitability of organic and conventional farming. Also, one should be cautious when trying to replicate the results in other geographical areas or in other commodities without taking into account the inevitable differences in contexts. However, the methodology presented in this paper is one that can be useful to carry out comparative analyses for citrus as well as other crops in other countries.**

# Introduction

## 1.1. Background

Increased interest in environmental issues has sparked a significant movement in favour of so-called organic or ecological farming. This is because organic farming involves several environmentally friendly growing methods and also responds more effectively to consumers' growing interest in dietary health.

Furthermore, the European Union's new Agricultural Policy, which is being implemented under its "Agenda 2000" action programme, places renewed emphasis on the need for environmentally friendly forms of agriculture as a key component of efforts to support the agricultural sector.

Consequently, agricultural producers in general, and in the European Union in particular, have been demonstrating an interest in such farming systems, on the grounds that such systems meet the demands of modern society more effectively and are also likely to receive strong institutional support.

Compared with the requirements of conventional systems, however, those of organic farming systems are such that the process of conversion to organic farming has not been simple. Nor has the process been helped by the lack of indicators concerning the market for such products.

The term *Organic Agriculture*, as defined by IFOAM (International Federation of Organic Agriculture Movements) refers to the creation of an ecological management system, which includes a transition/conversion period, and which meets the definition of a sustainable agro-ecosystem. Once it has been determined that the system's methods meet regulatory requirements, they must be certified as organic.

Spain is not among those countries of the European Union where this form of agriculture has seen its biggest growth. After all, the surface area defined as organic represents only around 1 percent of all agricultural land. And yet, organic methods are experiencing major growth. The amount of land currently certified as undergoing conversion to organic systems (conversion period of 18 months) now exceeds the amount of land already certified as being devoted to such systems (Table I).

**Table I**

**Total land devoted to organic farming in Spain (Ha) in 1999**

| | Total land certified for organic farming | Total land certified as in transition to organic farming | Total land certified during First Year of Practice | Total land registered as devoted to organic farming |
|---|---|---|---|---|
| Total | 117 856.22 | 124 286.93 | 110 021.08 | 352 164.23 |

Source: Ministry of Agriculture, Fisheries and Food (MAPA), 2000.

Spain is the leading citrus grower in the Mediterranean Basin, having produced more than 6 million tonnes in 1999. More than 80 percent of citrus production is concentrated in the Valencia Region. The region has also seen growth in "organic agriculture," even though that growth is very minor, in relative terms, since organic agriculture account for less than 1 percent of total land (Ministry of Agriculture, Fisheries and Food (MAPA: *Ministerio de Agricultura, Pesca y Alimentación*), 2000). And yet, integrated farming systems already account for around 5 percent of total farmland, having developed their own regulations at the regional level. Such systems also have also brought advances in terms of environmental protection, since they employ more rational, less aggressive plant-protection methods, but without meeting the requirements of organic agriculture.[1]

[1] Decree 121/1995 of 19 June, of the Government of Valencia, on the assessment of agricultural products grown with (DOGV of 4 July 1995).
Order of 23 May 1997, of the Department of Agriculture, Fisheries and Food, on the regulation of products grown with integrated farming methods and the authorization standards of monitoring and certification agencies (DOGV of 4 June 1997).
Resolution of 31 July 1997, of the Director of Research, Technological Development, and Plant Health, establishing regulations for the integrated farming of citrus in the Valencia Region (DOGV 28 August 1997).

It is reasonable to expect that over the next few years, the total surface area devoted to organic farming will increase significantly and that integrated citrus production will grow even more strongly if the economic results of these forms of farming are accompanied by prices that make conversion viable, or by an increase in public subsidies for environmentally friendly practices.

In this regard, organic agriculture has benefited from a regulatory framework defined by the European Union (Regulation (EC) No. 2078/1992), setting up an incentive system, co-funded by the European Agricultural Guidance and Guarantee Fund (EAGGF) and Member States. In the Autonomous Valencia Region, the proportion of Community funding has risen to 75 percent, with the remaining 25 percent of funds shared equally between the Ministry (at the national level) and the Department (at the level of the Autonomous Region). In the Valencia Region, the subsidy programme was developed under the Order of 22 April 1998, of the Department of Agriculture, Fisheries and Food (Annex III), and set a maximum citrus subsidy of €360,61/Ha, with a minimum growing surface of 0.5 Ha. Nevertheless, the subsidy amount was gradually reduced over the five years in which it was granted (Table II).

**Table II**

**Proportion of aid granted for production of organic citrus**

| | Percentage |
|---|---|
| First year | 100% |
| Second year | 80% |
| Third to fifth years | 60% |

Source: Official Journal, Autonomous Government of Valencia, 1998

The subsidy in question is rather a long way from the maximum sum that may be subsidized under the premium set out in the Community Regulation, and which, for citrus, is €1 000/Ha.

At present, by Order of 23 December 1999 (Annex III) of the Department of Agriculture, Fisheries and Food, no more requests are being invited for financial aid regarding the aforementioned agro-environmental programme, since

European Council Regulation (EC) No. 1.257/1999, of 17 May 1999, on EAGGF assistance for rural development, repeals Regulation (CE) 2.078/1992, among others, preventing its application, with effect from 1 January 2000. Thus, until the new Rural Development Programme for the period 2000-2006 is approved, it will not be possible to establish regulations, either at the national level or the level of the autonomous region, regarding application of the aid prescribed for the use of organic production methods.

## 1.2. Objectives

As with any other agricultural product, development of an organic agriculture system for citrus inevitably requires consideration of its economic viability. It should be noted that little research has thus far been done in this area.

The objective of the present report is to try to ascertain, to some degree, the economic and financial viability of organic growing systems, compared with conventional systems. The methodology employed must take into account the fact that these are perennial crops which, in virtually every case, are not new plantings, since, in accordance with the specifications, they are conversions from conventional to organic farming, which must conform to the so-called minimum conversion period (2 years for this growing system).

This requires dynamic financial evaluation methods which consider the value of money over time since, as mentioned above, these are economic activities with a time horizon of more than one year.

Our first concern will be to estimate the costs of organic farming compared with conventional farming. Our second step will then be to set up a scenario of anticipated yields and prices. In doing so, we shall refer to the data provided by the farms addressed in our study and also compare them against prices given by other market sources (Michelsen J., et al, 1999).

We shall also calculate viability indicators, once we have made the necessary general and specific assumptions. The indicators in question are Net Current Value (NCV), Internal Rate of Return (IRR) and Recovery Period (RP).

Lastly, our results will be subjected to sensitivity analysis, with a view to predicting the evolution of the aforementioned indicators under various price scenarios.

## 2. Methodology

### 2.1. Technical and economic aspects of the study

Our first step is to define the elements making up the technical and economic parameters used to define the farms studied. We shall then subject those elements to the evaluation methodology outline below, and this will enable us to achieve our declared objectives.

The farms used as samples to obtain our initial data are farms that, both because of their structure and their agro-climatic characteristics, may be regarded as typical of citrus growing in the Valencia Region.

Thus, these farms are typical of the smallholdings found in the Valencia region, with a surface area of less than 1 Ha, traditional or locally specific irrigation systems, and agronomic characteristics that are not significantly different from those of most citrus farms in the region (Annex II).

We took data from farm plots belonging to members of two cooperative organizations that have been selling organic citrus over recent years (Table III), and whose growing methods, structurally speaking, were typical of citrus growing in this region, with the sole difference that they were organic farming methods, in contrast with conventional methods (Labrador J., et al, 1999).

**Table III**

**Number of plots in the sample**

| | Oranges | Mandarins |
|---|---|---|
| Conventional production | 1 225 | 2 275 |
| Organic production | 11 | 14 |

Source: Authors' figures

They are therefore farms whose production figures, which will be used to determine their cost structure, may be considered representative. Moreover, their figures are, in the case of conventional farming for which data are available, similar to figures published in other studies.

With regard to prices, note that it is hard to pretend that they have great significance, given the considerable price swings observed with organic agriculture. Those swings have indeed been noted in some studies (Michelsen J. et al., 1999). Consequently, the evaluation methodology must include a sensitivity analysis able to give us a very broad price scenario, and is without doubt the most critical aspect of our study.

The expected trend in organic-citrus prices - which, in the opinion of the experts consulted (Anecoop, Coopego, Valfruit), will certainly be upward - requires that demand growth be synchronized with that of supply, and that suitable distribution channels be created. Some studies (e.g. Michelsen J. et al., 1999) make it clear that, despite price differences that are very often markedly in favour of organic products, a very high percentage of such products are, paradoxically, marketed as conventional products.

## 2.2. Evaluation methodology

### Traditional assumptions

Given the objectives of the present study, since we are attempting to compare the economic and financial efficiency of organic citrus farming systems and conventional systems, and this requires analysis of investments with a time horizon of more than one year, the methodology used must necessarily include reference to discount values – that is, as we have already mentioned, criteria that consider the value of money over time (Juliá J. F. and Server R. J., 1996).

Traditionally, this type of evaluation, which is known as economic/financial evaluation, and whose main indicators are Net Current Value, Internal Rate of Return, and Recovery Period, is formulated on the basis of an initial series of generally accepted assumptions, designed to simplify the process of evaluation (Romero C., 1998).

Those assumptions are:

- Receipts and payments for each year are recorded at the same point, at the end of each year. In this way, we can prepare updated figures on an annual basis. Under normal inflationary conditions, in developed countries, this does not impose any significant limitations.

- We know the value of money - or rather the cost of capital, which is the same thing. This value will be used as an interest rate for the purposes of calculation. While accepting that this value is not entirely certain in some economies (as in the case of Spain's economy, since it joined the European Monetary Union), it does enable us to assume a certain stability in the value of money, which is officially expressed by the central monetary authority of the European Union, in this case the European Central Bank.

- In principle, no consideration is given to monetary variations due to inflation. This is among those assumptions that are generally accepted. It is the equivalent, either of not taking inflation into account at all, or of supposing that its existence has such a great influence on the flow of receipts and payments, as well as the value of money, that it does not produce any variation. And yet, when it comes to investments in the agricultural sector, the reality can be different, since growth in prices and expenditures have in fact produced declines in farm incomes. Thus, we shall only initially accept, and thereafter establish, a differentiated hypothesis of inflation rates of receipts and payments if they include monetary variations.

- We are working within a context of certainty, or determinism, which means accepting that the technical and economic variables that will ultimately define the economic parameters of the investment that we are going to evaluate, are certainly known. This is undoubtedly the most restrictive assumption used in evaluating the profitability of any farming asset, and especially of the asset that concerns us in this study. If there is anything that defines farming activity in general, and citrus farming in particular, it is the necessity to assume risk, with respect both to one's own production (agronomic risk) and the prices one is able to charge (market risk). In this particular case, however, the situation is even more critical, since the methodology might contemplate the change from a context of certainty, characterized by known fixed values, to a context of probability which, in the absence of data sufficiently representative of market prices in organic farming, makes it advisable, from the outset, to consider the assumption of risk and establish a sensitivity analysis, including thresholds of anticipated prices.

**Specific assumptions**

Furthermore, we must also design a series of specific assumptions, since we are concerned with a few sample farms and a few determined agricultural models, which might in some cases be different. These assumptions are basically of a technical nature.

- In the case of already established crops, conversion to organic farming occurs in the tenth year, as is becoming common on farms changing to this growing system in the region under consideration in this study, with a two-year conversion period, fixed by current regulations.
- In the case of new plantings, note that another option to be borne in mind is to use conventional farming methods during the training period and perform the conversion during the first two years of the productive period. This is not the case in the present study, since most farms currently using organic farming methods have performed the conversion according to the method outlined above.
- The time horizon, or useful life, of the investment, equivalent to the farm's estimated period of positive yields, has been set, both for the organic system and the conventional system, at 25 years. Although this is a very conservative period, it is to be recommended, since varietal reconversion is presently occurring at a brisk pace, and that which, from the point of view of production, might make it possible to establish longer horizons, is counselled by the reality of the market.

- Farming machinery is rented, because these are small farms, divided into small plots, and so renting is the customary practice.

- The irrigation system is a specific local system, which is mostly found in new farms and is increasingly being installed in all of them.

- The planting frame is 6 x 4, since this is the frame that is becoming most popular for citrus production in the region addressed by this study.

- Two productive periods are used, covering the life of the farm: the so-called training period, and the full-production period, in which we estimate a constant average annual sold product (productive yield).

- The first period lasts for 5 years; the second for 20 years. This gives the 25-year time horizon for the investment indicated above.

**The indicators and how they are formulated**

- **Net Current Value** (NCV) is the difference between the cost of investment, which comprises both the cost of the planting proper and the discounted payments of the so-called training period, and the discounted cash flows, which represent the difference between receipts and payments. The formula used to obtain this value is the following:

  - For conventional farming:

$$NCV_c = -K_0 - \sum_{j=1}^{3} \frac{P_j}{(1+i)^j} + \sum_{j=4}^{25} \frac{q_j p_j - P_j}{(1+i)^j}$$

where: $K_0$ = cost of investment.
$P_j$ = payments made throughout the life of the investment.
$q_j$ = production achieved.
$p_j$ = price.
i = discount rate.

- For organic farming:

$$NCV_o = -K_0 - \sum_{j=1}^{3} \frac{P_j}{(1+i)^j} + \sum_{j=4}^{9} \frac{q_j p_j - P_j}{(1+i)^j} + \sum_{j=10}^{11} \frac{q_{0j} p_j - P_{oj}}{(1+i)^j} + \sum_{j=12}^{25} \frac{q_{0j} p_{oj} - P_{oj}}{(1+i)^j}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made with conventional growing system.

$q_j$ = production achieved with conventional growing system.

$p_j$ = price of product marketed as conventional.

$P_{oj}$ = payments made with organic growing system.

$q_{oj}$ = production achieved when growing system is organic.

$p_{oj}$ = price of product marketed as organic.

i = discount rate.

- **Internal Rate of Return** (IRR), which is defined as the interest rate that, as a discount rate, would give an NCV of zero.

  - For conventional farming:

$$0 = -K_0 - \sum_{j=1}^{3} \frac{P_j}{(1+i)^j} + \sum_{j=4}^{25} \frac{q_j p_j - P_j}{(1+IRR)^j}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made throughout the life of the investment.

$q_j$ = production obtained.

$p_j$ = price.

IRR = internal rate of return.

  - For organic farming:

$$0 = -K_0 - \sum_{j=1}^{3} \frac{P_j}{(1+i)^j} + \sum_{j=4}^{9} \frac{q_j p_j - P_j}{(1+IRR)^j} + \sum_{j=10}^{11} \frac{q_{0j} p_j - P_{oj}}{(1+IRR)^j} + \sum_{j=12}^{25} \frac{q_{0j} p_{oj} - P_{oj}}{(1+IRR)^j}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made with conventional growing system.

$q_j$ = production obtained with conventional growing system.

$p_j$ = price of product marketed as conventional.

$P_{oj}$ = payments made with organic growing system.

$q_{oj}$ = production obtained with organic growing system.

$p_{oj}$ = price of product marketed as organic.

IRR = Internal Rate of Return.

- **Recovery Period** (RP), which is defined as the time needed to recover the cost of the investment.

  - For conventional farming:

$$RP = H \;\; where \;\; K_0 = \sum_{j=1}^{3} \frac{P_j}{(1+i)^j} + \sum_{j=4}^{H} \frac{q_j p_j - P_j}{(1+i)^5}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made throughout the life of the investment.

$q_j$ = production achieved.

$p_j$ = price.

H = recovery period.

i = discount rate.

  - For organic farming:

$$RP = H \;\; where \;\; K_0 = \sum_{j=1}^{3} \frac{P_j}{(1+i)^j} + \sum_{j=4}^{H} \frac{q_j p_j - P_j}{(1+i)^j} + \sum_{j=10}^{H} \frac{q_{0j} p_j - P_{oj}}{(1+i)^j} + \sum_{j=12}^{H} \frac{q_{0j} p_{oj} - P_{oj}}{(1+i)^j}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made with conventional growing system.

$q_j$ = production obtained with conventional growing system.

$p_j$ = price of product marketed as conventional.

$P_{oj}$ = payments made with organic growing system.

$q_{oj}$ = production achieved with organic growing system.

$p_{oj}$ = price of product marketed as organic.

H = recuperation period.

i = discount rate.

## 3. Parameters

### 3.1. Production costs as reference

Regardless of the fact that the evaluation methodology to be employed is based on analysis of the financial flows generated by this productive activity during the period of time addressed by the said investment, the determination of production costs is an indispensable reference.

Traditionally, an initial analysis of the viability of a crop has been conducted by calculating its production costs per hectare, and by estimating its annual yield. This makes it possible to calculate so-called profitability thresholds, which are defined according to the cost structure used. Thus, if, within the said structure, we consider the so-called opportunity costs of the businessman (income from land, interest on invested capital, etc.), this threshold will be the price above which the businessman covers all his production costs, and thus can earn a profit through his business activity proper (Cabalero P., et al, 1992).

However, in order to be able to determine the flow of receipts and payments further out in time, and especially payments stemming from this productive activity, both initially and annually, we can use the cost structure, namely the so-called variable costs, as a reference for calculating them.

The cost system that we shall use (Caballero et al., 1992) is among the most widely accepted systems. With very slight differences, it is used in other highly respected studies of fruit crops (Caballero and De Miguel, 1988; Buxton and Del Campo, 1994), and corresponds to a structure of variable and fixed costs, classified by type (Tables IV and V).

## Table IV

## Costs of growing oranges (€/Ha)

| | Conventional production | Organic production |
|---|---|---|
| **A. Variable costs of factors of production** | | |
| A.1. Raw materials | | |
| A.1.1. Irrigation water | 961.62 | 911.13 |
| A.1.2. Fertilizers | 449.83 | 991.67 |
| A.1.3. Insecticides, fungicides, herbicides,… | 814.01 | 77.43 |
| A.1.4. Other inputs | 48.08 | 48.08 |
| A.2. Labour (includes irrigation, pruning, treatments, labour and machinery rental) | 1 038.49 | 2 604.86 |
| **Total variable costs of factors of production** | 3 312.03 | 4 633.17 |
| **B. Interest on working capital** (annual, taking into account duration of average period) | 96.60 | 115.83 |
| **C. Fixed costs** | | |
| C.1. Amortization of planting | 100.97 | 100.97 |
| C.2. Interest on planting | 63.11 | 63.11 |
| C.3. Amortization of capital for equipment | 360.61 | 360.61 |
| C.4. Interest on capital for equipment | 90.15 | 90.15 |
| C.5. Costs of replacing trees and maintaining equipment | 60.10 | 60.10 |
| C.6. Income from land | 480.81 | 480.81 |
| C.7. Taxes and insurance | 240.40 | 240.40 |
| C.8. Certification | | 6.01 |
| **Total fixed costs** | 1 396.15 | 1 402.16 |
| **D. Total costs (2 + 3 + 4 + 5)** | 4 804.79 | 6 151.16 |

Source: Authors, based on Caballero P., De Miguel M. D., Juliá J. F., 1992.

**Table V**

**Costs of growing mandarins (€/Ha)**

| | Conventional production | Organic production |
|---|---|---|
| **A. Variable costs of factors of production** | | |
| A.1. Inputs | | |
| A.1.1. Irrigation water | 961.62 | 911.13 |
| A.1.2. Fertilizers | 449.83 | 991.67 |
| A.1.3. Insecticides, fungicides, herbicides,… | 1 098.91 | 104.53 |
| A.1.4. Other inputs | 48.08 | 48.08 |
| A.2. Labour (includes irrigation, pruning, treatments, labour and machinery rental) | 1 225.42 | 3 073.73 |
| **Total variable costs of factors of production** | 3 783.86 | 5 129.15 |
| **B. Interest on working capital** (annual, taking into account duration of average period) | 94.59 | 128.23 |
| **C. Fixed costs** | | |
| C.1. Amortization of planting | 111.07 | 111.07 |
| C.2. Interest on planting | 69.42 | 69.42 |
| C.3. Amortization of capital for equipment | 360.61 | 360.61 |
| C.4. Interest on capital for equipment | 90.15 | 90.15 |
| C.5. Costs of replacing trees and maintaining equipment | 10 400 | 10 400 |
| C.6. Income from land | 62.51 | 62.51 |
| C.7. Taxes and insurance | 480.81 | 480.81 |
| C.8. Certification | | 6.01 |
| **Total fixed costs** | 1 430.59 | 1 436.60 |
| **D. Total costs (2 + 3 + 4 + 5)** | 5 309.05 | 6.693.97 |

Source: Authors, based on Caballero P., De Miguel M.D., Juliá J.F., 1992.

The following is a description of all categories listed in the cost tables:

A. *Variable costs of factors of production:* This represents all variable factors of production. For the sake of greater clarity, it has been broken down into different subcategories.

   *A.1. Inputs*: This category represents the costs generated by inputs – that is, the value of all inputs immobilized during the productive process.

   *A.2. Labour:* Includes total costs of the labour required during the production cycle to perform farming tasks. Also included is the cost of renting machinery, since this is the traditional practice whenever the work to be performed is hired out in this manner.

B. *Interest on working capital*: This is an opportunity cost. Working capital comprises the combined costs generated by factors of production invested during the production period, and which are used up in a single process. Since this is a form of capital, it generates certain costs in the form of interest, which naturally depend on the interest rate applied and the time that the investments of each factor remain immobilized during the production period - that is, the time taken to recover the capital invested in each factor, through the sale of the product obtained.

With regard to the interest rate, the base generally used is the price of money, as per bank and savings banks loans, which we shall set at 5 percent.

The immobilization time is defined as the average or maturity period of the production process, and is calculated as the average of the product of each capital invested in the factors used and the time taken to recover the said capital, weighted with the sum of the invested capital. We shall use 7 months for oranges and 6 months for mandarins.

C. *Fixed costs*: This category includes all costs related to fixed factors of production. For the sake of greater clarity and ease of understanding, we have broken down these costs into different subcategories.

*C.1. Amortization of planting and C.2. Interest on planting:* These categories reflect the fact that, since wood crops are regarded as an investment, their cost is attributable throughout the entire life of that investment.

In order to calculate the amortization cost, as a way to account for the depreciation of the planting, any of the familiar methods may be applied, the most commonly used being the "constant quotas" method, which amounts to nothing more than dividing the quoted value by the number of years of the investment.

The interest, as an opportunity cost, will be calculated by applying the rate considered at half the value of the planting, with a view to distributing it evenly through the years.

*C.3. Amortization of capital for equipment and C.4. Interest on capital for equipment:* This is similar to the case of planting, but it must be remembered that the value of the equipment is not that of its components, but that of the components plus the costs of their installation and start-up.

*C.5. Costs of replacing trees and maintaining equipment*: This is a fixed cost, as it is regarded as necessary for the proper conservation of the farm.

*C.6. Income from land*: This category is regarded as an opportunity cost to the businessman. It is given by the most common market rental values for rural property.

*C.7. Taxes and insurance:* This includes taxes, insurance and expenses made to paid to local authorities and other administrative bodies (Property Tax, Social Security,…).

*C.8. Certification:* This is the cost incurred by the farmer to have his or her land certified as organic by the Organic Farming Board, which is the agency responsible for inspecting land and verifying the nature of the growing method used.

In this context, note that, although the established cost, as set out in Tables IV and V, is €6/Ha, registration with the Organic Farming Board requires a single payment of €90.15, regardless of the surface area registered for organic farming.

D. *Total costs*: Shows the sum of all the aforementioned costs.

## 3.2. Investment receipts and costs

Using the technical elements employed in defining the farms addressed in this study, and in accordance with the assumptions made, we can determine the economic parameters defining the investment.

First, we determined the so-called investment cost, or the outlay needed to set the investment in motion. In our case, this payment is limited to the cost of the seedlings and the labour required to plant them, as well as irrigation equipment (Table VI). This investment cost, which is based on the assumption that the conventional growing system will be used until the ninth growing year, will not vary if the investment analysis is carried out with the conventional growing system and the organic growing system.

**Table VI**

**Investment cost (€/Ha)**

| | Orange | Mandarin |
|---|---|---|
| **Planting** | 2 524.25 | 2 776.68 |
| **Installation** | 3 606.07 | 3 606.07 |
| **Investment cost** | **6 130.32** | **6 382.75** |

Source: Authors, based on consultations with experts.

The flow of receipts and payments generated by the investment during the investment's life will give the so-called cash flows. In this regard, it should be mentioned that in addition to ordinary receipts and payments, extraordinary receipts and payments, stemming from the renovation of equipment during the life of the investment, will also be taken into account.

To determine receipts, we began with the data provided by the farms analysed, and compared that data with figures provided in other studies (Caballero P. et al, 1992, and Roselló J., Domínguez A., and Gascón A., 2000). We did not observe any significant differences. We followed the same procedure with regard to prices (Tables VII, VIII, IX and X), taking the average prices earned in the field by the farms studied, and comparing them with those published by the Organic Farming Board of the Valencia Region, for some of its registered farmers. Although we did find a few slight differences, they are scarcely worthy of mention (Annex IV). Thus, for the present study, we shall use sensitivity analysis, with variation intervals, having also noted that they undergo a greater variation, both by season and market.

With respect to production yields, although a slight reduction in yields was observed for organic crops, in the farms studied, the experts consulted (Agricultural College of the Autonomous Government of Valencia) say that in a favourable agro-environmental context, and with appropriate management and technology, that fall in production would occur between the first three and four years after conversion, with the yield recovering thereafter.

Nevertheless, it should be noted that a favourable environment is found with plots of a certain size, which allows a certain degree of isolation of the crop in terms of the effects of conventional agriculture of surrounding plots of land since, on small farms located in production zones where most farmers practise conventional agriculture, it is hard to imagine that a favourable ecosystem can be created.

In the light of all these factors, we shall assume that yields will fall over the first four years after conversion, but will then rise to levels close (ninety percent) to those earned with the conventional growing system.

**Table VII**

**Normal receipts of growing oranges using the conventional system**

| | Years 1–3 | Year 4 | Year 5 | Years 6–25 |
|---|---|---|---|---|
| **Production (Kg/Ha)** | --- | 10 000 | 20 000 | 36 000 |
| **Price (€/Kg)** | 0.21 | 0.21 | 0.21 | 0.21 |
| **Receipts (€/Ha)** | --- | 2 100 | 4 200 | 7 560 |

Source: Authors, based on data provided by the farms consulted.

**Table VIII**

**Normal receipts of growing oranges using the organic system**

| | Years 1–3 | Year 4 | Year 5 | Years 6–9 | Years 10–11 | Years 12–13 | Years 14–25 |
|---|---|---|---|---|---|---|---|
| **Production (Kg/Ha)** | --- | 10 000 | 20 000 | 36 000 | 29 000 | 29 000 | 32 500 |
| **Price (€/Kg)** | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.27 | 0.27 |
| **Receipts (€/Ha)** | --- | 2 100 | 4 200 | 7 560 | 6 090 | 7 830 | 8 775 |

Source: Authors, based on data provided by the farms consulted.

**Table IX**

**Normal receipts of growing mandarins under the conventional system**

| | Years 1-3 | Year 4 | Year 5 | Years 6-25 |
|---|---|---|---|---|
| **Production (Kg/Ha)** | --- | 14 000 | 22 000 | 28 000 |
| **Price (€/Kg)** | 0.38 | 0.38 | 0.38 | 0.38 |
| **Receipts (€/Ha)** | --- | 5 320 | 8 360 | 10 640 |

Source: Authors, based on data provided by the farms consulted.

**Table X**

**Normal receipts of growing mandarins under the organic system**

| | Years 1-3 | Year 4 | Year 5 | Years 6-9 | Years 10-11 | Years 12-13 | Years 14-25 |
|---|---|---|---|---|---|---|---|
| **Production (Kg/Ha)** | --- | 14 000 | 22 000 | 28 000 | 22 500 | 22 500 | 25 000 |
| **Price (€/Kg)** | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.50 | 0.50 |
| **Receipts (€/Ha)** | --- | 5 320 | 8 360 | 10 640 | 8 550 | 11 250 | 12 500 |

Source: Authors, based on data provided by the farms consulted.

With regard to the costs of citrus farming, it should be noted that they do not match total estimated costs, since some fixed costs are not shown as such. The cash criterion used in this methodology does not match that of accrued interest. Thus, instead, we consider the initial cost of investment and of extraordinary receipts and payments, which includes equipment renovation (Tables XI, XII, XIII and XIV).

**Table XI**

**Normal costs of growing oranges using the conventional system (€/Ha)**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Years 6-25 |
|---|---|---|---|---|---|---|
| **Inputs** | | | | | | |
| **Irrigation water** | 95.17 | 201.16 | 380.68 | 666.22 | 857.04 | 961.62 |
| **Fertilizers** | 191.12 | 221.65 | 280.97 | 368.24 | 421.09 | 449.83 |
| **Insecticides, fungicides, herbicides,…** | 115.10 | 115.10 | 504.59 | 664.69 | 664.69 | 814.01 |
| **Other inputs** | 33.06 | 36.06 | 39.07 | 42.07 | 45.08 | 48.08 |
| **Labour [1]** | 735.64 | 786.36 | 846.32 | 912.70 | 975.74 | 1 038.49 |
| **Rep. trees/M. instal.** | 36.06 | 48.08 | 60.10 | 60.10 | 60.10 | 60.10 |
| **Taxes and insurance** | 240.40 | 240.40 | 240.40 | 240.40 | 240.40 | 240.40 |
| **Total payments** | **1 446.55** | **1 648.81** | **2 352.13** | **2 954.42** | **3 264.14** | **3 612.53** |

[1] (includes irrigation, pruning, treatments, labour and machinery rental)

Source: Authors, based on data provided by the farms consulted.

**Table XII**

**Normal costs [1] of growing oranges under the organic system (€/Ha)**

| | Year 10 | Years 11-25 |
|---|---|---|
| **Inputs** | | |
| **Irrigation water** | 911.13 | 911.13 |
| **Fertilizers** | 991.67 | 991.67 |
| **Insecticides, fungicides, herbicides,…** | 77.43 | 77.43 |
| **Other inputs** | 48.08 | 48.08 |
| **Labour [2]** | 2 604.86 | 2 604.86 |
| **Rep. trees/M. instal.** | 60.10 | 60.10 |
| **Taxes and insurance** | 240.40 | 240.40 |
| **Certification** | 96.16 | 6.01 |
| **Total costs** | **5 029.83** | **4 939.68** |

[1] Payments for years 1-9 match those of the conventional growing system, under the hypothesis with which we are working.

[2] (includes irrigation, pruning, treatments, labour and machinery rental)

Source: Authors, based on data provided by the farms consulted.

**Table XIII**

**Normal costs of growing mandarins under the conventional system (€/Ha)**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Years 6-25 |
|---|---|---|---|---|---|---|
| **Inputs** | | | | | | |
| **Irrigation water** | 95.17 | 201.16 | 380.68 | 666.22 | 857.04 | 961.62 |
| **Fertilizers** | 191.12 | 221.65 | 280.97 | 368.24 | 421.09 | 449.83 |
| **Insecticides, fungicides, herbicides,…** | 137.33 | 145.02 | 635.79 | 837.51 | 837.51 | 1 098.91 |
| **Other inputs** | 37.26 | 39.07 | 43.27 | 44.47 | 46.88 | 48.08 |
| **Labour** [1] | 845.98 | 934.37 | 973.26 | 1 049.60 | 1 122.10 | 1 225.42 |
| **Rep. trees/M. instal.** | 36.06 | 49.28 | 62.51 | 62.51 | 62.51 | 62.51 |
| **Taxes and insurance** | 256.03 | 265.03 | 256.03 | 256.03 | 256.03 | 256.03 |
| **Total costs** | **1 598.96** | **1 846.59** | **2 632.51** | **3 284.59** | **3 603.16** | **4 102.40** |

[1] (includes irrigation, pruning, treatments, labour and machinery rental)

Source: Authors, based on data provided by the farms consulted.

**Table XIV**

**Normal costs [1] of growing mandarins under the organic system (€/Ha)**

| | Year 10 | Years 11-25 |
|---|---|---|
| **Inputs** | | |
| **Irrigation water** | 911.13 | 911.13 |
| **Fertilizers** | 991.67 | 991.67 |
| **Insecticides, fungicides, herbicides,…** | 104.53 | 104.53 |
| **Other inputs** | 48.08 | 48.08 |
| **Labour** [2] | 3 073.73 | 3 073.73 |
| **Rep. trees/M. instal.** | 62.51 | 62.51 |
| **Taxes and insurance** | 256.03 | 256.03 |
| **Certification** | 96.16 | 6.01 |
| **Total payments** | **5 543.84** | **5 453.69** |

[1] Payments for years 1-9 match those of the conventional growing system, under the hypothesis with which we are working.

[2] (includes irrigation, pruning, treatments, labour and machinery rental)

Source: Authors, based on data provided by the farms consulted.

The extraordinary receipts and payments generated by the investment consist of those stemming from the renovation of equipment, produced over the life of the investment. In this case, therefore, they will be determined by the renovation of the irrigation system, which has a useful life of 10 years, which will require two renovations, with a residual value of 10 percent for the first two renovations, and 60 percent at the end of the investment's life (Table XV).

The subsidy that may be granted to organic farmers could constitute an additional extraordinary receipt to be considered during the years in which it's granted. It should be noted, however, that since the aforementioned subsidy is suspended (as noted in the first part of our report), it has been decided not to include it in our analysis, although everything points to the approval of further aid in the future. Annex I shows the economic and financial evaluation incorporating the subsidy level that has been granted in the past.

**Table XV**

**Extraordinary receipts and payments (€/Ha)**

| | Year 10 | Year 20 | Year 25 |
|---|---|---|---|
| Receipts | 360.61 | 360.61 | 2 163.64 |
| Payments | 3 606.07 | 3 606.07 | |

Source: Authors.

# 4. Results

## 4.1. Financial comparison of conventional and organic systems

In accordance with the methodology used and the economic parameters established on the basis of the general and specific assumptions, and the technical and economic elements of the project, we shall now proceed to determine the selected indicators. In the case of the NCV and the Recovery Period, it is necessary to define the interest rate.

Moreover, we should bear in mind that because of the evolution in prices, due to inflation, on the one hand, and market imbalances between supply and demand, on the other, it is difficult to accept our initial decision not to include monetary variations in the flow of receipts and payments generated by the project.

With regard to organic farming methods, it cannot be denied that this form of agriculture is profiting from a series of subsidies which represent an extraordinary receipt that affects financial profitability, and thus the viability, of this option. Also, there is no reason to suppose that these subsidies will be eliminated, at least over the medium term, as it is quite clear that the reform of Community Agricultural Policy under the "Agenda 2000" action programme, manifestly implies the commitment to greater integration with environment policy (Piccinini A., 1998). This suggests continued support for a form of agriculture such as organic farming, whose methods imply greater respect for the environment.

The selected profitability indicators were determined according to two working hypotheses:

- Hypothesis A: Hypothesis of non-inflationary markets.
- Hypothesis B: Hypothesis of saturated conventional markets.

These hypotheses will be developed using, as a calculation formula for the NCV, the effect of growth rates for receipts and payments, combined with a general inflation rate for the economy (Table XVI).

**Table XVI**

**Inflation rate and growth rates of receipts and payments considered**

| | Percentage |
|---|---|
| Inflation rate | 2.5 |
| Receipts growth rate | 0 |
| Payments growth rate | 1 |

This hypothesis of saturated conventional markets allows us to establish a zero growth rate for receipts, assuming that supply meets demand sufficiently and assuming no growth in market prices for these products. This seems quite clear, moreover, if we look at the average price index earned by citrus farmers in Spain which, over the past four years, gives an average that is even slightly negative (1996: +13.4%, 1997: -23.48%, 1998: -10.16%, 1999: +8.08%)[2].

We assume a payments growth rate of 1 percent. Even if this is lower than the overall increase in prices, or inflation rate, it is no less certain that essentially, the evolution of farming methods, and especially the introduction of new technologies, allows us to make this assumption. It also matches the average price indices for prices paid by farmers over the past four years, which gives a slightly positive average rate of growth (1996: +4%, 1997: +2.28%, 1998: -1.16%; 1999: -1.33%)[2].

With regard to the inflation rate assumed, we established an average value of 2.5 percent, which is in line with the objectives set by the European Economic and Monetary Union, and is practically the same as the average inflation rate over the past four years (1996: 3.3%, 1997: 2.0%, 1998: 1.4%, 1999: 2.9%)[3].

- For conventional farming:

$$VAN_c = -K_0 - \sum_{j=1}^{3} \frac{P_j (1+\nu)^j}{(1+i)^j (1+g)^j} + \sum_{j=4}^{25} \frac{q_j p_j (1+\mu)^j - P_j (1+\nu)^j}{(1+i)^5 (1+g)^j}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made throughout the life of the investment.

$q_j$ = production achieved.

$p_j$ = price.

i = discount rate.

g = general inflation rate of the economy.

$\mu$ = receipts growth rate.

[2] Source: Authors' own figures, based on Monthly Statistical Bulletins of the Ministry of Agriculture, Fisheries and Food.

v = payments growth rate.

- For organic farming:

$$VAN_o = -K_0 - \sum_{j=1}^{3} \frac{P_j}{(1+i)^j (1+g)^j} + \sum_{j=4}^{9} \frac{q_j p_j (1+\nu)^j - P_j (1+\mu)^j}{(1+i)^5 (1+g)^j} +$$
$$+ \sum_{j=10}^{11} \frac{q_{0j} p_j (1+\nu)^j - P_{oj} (1+\mu)^j}{(1+i)^j (1+g)^j} + \sum_{j=12}^{25} \frac{q_{0j} p_{oj} (1+\nu)^j - P_{oj} (1+\mu)^j}{(1+i)^j (1+g)^j}$$

where: $K_0$ = cost of investment.

$P_j$ = payments made with conventional growing system.

$q_j$ = production achieved with conventional growing system.

$p_j$ = price of product marketed as conventional.

$P_{oj}$ = payments made with organic growing system.

$q_{oj}$ = production achieved with organic growing system.

$p_{oj}$ = price of product marketed as organic.

i = discount rate.

g = general inflation rate of the economy.

$\mu$ = receipts growth rate.

v = payments growth rate.

For both mandarins and oranges, results achieved under Hypothesis A show scarcely any differences between conventional and organic farming (Tables XVII and XVIII). Although in both cases the profitability rates may seem rather high, it should not be forgotten that we are working under the hypothesis of the non-inflationary market and of the non-existence of the risk, by accepting the general assumption of a context of certainty.

[3] Source: Authors' own figures, based on data provided by the National Institute of Statistics.

## Table XVII

## Results for oranges (Hypothesis A)

| | Orange (conventional system) | | Orange (organic system) | |
|---|---|---|---|---|
| | IRR | 15.93% | IRR | 14.15% |
| Discount rate | NCV | Recovery Period | NCV | Recovery Period |
| 3% | 36 460.60 | 9 | 30 080.84 | 10 |
| 4% | 30 285.50 | 9 | 24 599.48 | 10 |
| 5% | 25 096.10 | 9 | 20 018.84 | 11 |
| 6% | 20 716.18 | 11 | 16 174.41 | 12 |
| 7% | 17 003.89 | 11 | 38 541.58 | 13 |
| 8% | 13 844.55 | 11 | 10 192.05 | 14 |

Source: Authors

## Table XVIII

## Results for mandarins (Hypothesis A)

| | Mandarins (conventional system) | | Mandarins (organic system) | |
|---|---|---|---|---|
| | IRR | 20.35% | IRR | 19.52% |
| Discount rate | NCV | Recovery Period | NCV | Recovery Period |
| 3% | 74 015.93 | 7 | 72 620.58 | 7 |
| 4% | 63 379.42 | 7 | 61 806.22 | 7 |
| 5% | 54 394.95 | 7 | 52 718.45 | 7 |
| 6% | 46 771.04 | 7 | 45 046.82 | 7 |
| 7% | 40 272.56 | 7 | 38 541.58 | 7 |
| 8% | 34 709.03 | 7 | 33 001.08 | 7 |

Source: Authors.

The results under hypothesis B are shown below (Tables XIX and XX).

**Table XIX**

**Results for oranges (Hypothesis B)**

| | Oranges (conventional system) | | Oranges (organic system) | |
|---|---|---|---|---|
| | IRR | 12.40% | IRR | 10.14% |
| Discount rate | NCV | Recovery Period | NCV | Recovery Period |
| 3% | 16 825.96 | 11 | 10 550.57 | 14 |
| 4% | 13 528.70 | 12 | 7 999.60 | 15 |
| 5% | 10 731.26 | 12 | 5 846.52 | 15 |
| 6% | 8 347.97 | 13 | 4 021.50 | 16 |
| 7% | 6 309.41 | 14 | 2 468.18 | 18 |
| 8% | 4 559.01 | 14 | 1 140.84 | 21 |

Source: Authors

**Table XX**

**Results for mandarins (Hypothesis B)**

| | Mandarins (conventional system) | | Mandarins (organic system) | |
|---|---|---|---|---|
| | IRR | 20.94% | IRR | 19.76% |
| Discount rate | NCV | Recovery Period | NCV | Recovery Period |
| 3% | 43 505.09 | 8 | 40 253.62 | 7 |
| 4% | 37 264.20 | 8 | 34 231.00 | 7 |
| 5% | 31 938.73 | 8 | 29 117.89 | 7 |
| 6% | 27 373.88 | 9 | 24 756.97 | 7 |
| 7% | 23 443.85 | 9 | 21 020.89 | 8 |
| 8% | 20 046.01 | 9 | 17 806.11 | 8 |

Source: Authors.

Results according to Hypothesis B also show scarcely any differences, either for mandarins or oranges, although, under this hypothesis, profitability rates do fall slightly in all cases. Although they may still seem somewhat high, we must remember that we are not considering risk, since we accept the context of certainty.

## 4.2. Sensitivity analysis

We need to consider, at least, other possible market scenarios which might determine variations in prices. In this context, at least, we shall abandon our previously established assumption of a context of certainty. The wisest course would be to perform sensitivity analysis. Doing so will enable us to determine clearly the effects that this might have in terms of variations in profitability, and variations in receipts and payments.

Note that the market for organic products is paradoxical in the sense that, although prices of products sold as organic are significantly higher than those of conventional products, a significant proportion of those products are sometimes sold as conventional farming products (among fruits in general, the figure is around 10 percent). As long as organic production continues to grow, that proportion may increase if the appropriate marketing channels are not found.

With this aim in mind, the data obtained under Hypothesis B were subjected to sensitivity analysis, with variation intervals in prices and payments of ±20 percent (Tables XXI and XXII).

## Table XXI

## Sensitivity analysis for oranges

| | % variation IRR | | | % variation IRR | |
|---|---|---|---|---|---|
| % change receipts | Oranges (conventional) | Oranges (organic) | % change payments | Oranges (conventional) | Oranges (organic) |
| -20 | -48.69 | --- | -20 | 30.50 | 44.96 |
| -15 | -33.76 | -58.54 | -15 | 22.60 | 33.64 |
| -10 | -21.37 | -33.91 | -10 | 14.87 | 22.40 |
| -5 | -10.29 | -15.50 | -5 | 7.33 | 11.23 |
| 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 5 | 9.75 | 13.95 | 5 | -7.16 | -11.60 |
| 10 | 19.08 | 26.93 | 10 | -14.23 | -24.23 |
| 15 | 28.04 | 39.19 | 15 | -21.38 | -39.17 |
| 20 | 36.66 | 50.86 | 20 | -28.90 | -58.51 |
| Average elasticity | 2.44 | 3.48 | Average elasticity | -1.45 | -2.90 |

Source: Authors.

## Table XXII

## Sensitivity analysis for mandarins

| | % change IRR | | | % change IRR | |
|---|---|---|---|---|---|
| % change receipts | Conventional mandarin | Organic mandarin | % change payments | Conventional mandarin | Organic mandarin |
| -20 | -30.54 | -35.26 | -20 | 18.34 | 21.32 |
| -15 | -22.22 | -25.49 | -15 | 13.78 | 16.07 |
| -10 | -14.39 | -16.42 | -10 | 9.19 | 10.76 |
| -5 | -6.99 | -7.94 | -5 | 4.59 | 5.40 |
| 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 5 | 6.62 | 7.46 | 5 | -4.58 | -5.43 |
| 10 | 12.89 | 14.49 | 10 | -9.12 | -10.86 |
| 15 | 18.84 | 21.11 | 15 | -13.61 | -16.28 |
| 20 | 24.50 | 27.37 | 20 | -18.04 | -21.67 |
| Average elasticity | 1.43 | 1.66 | Average elasticity | -0.88 | -1.05 |

Source: Authors.

This first analysis shows quite clearly the enormous sensitivity that variations in product prices, and thus variations in receipts, implies in terms of profitability rates, especially in the case of organic orange production, where a 20 percent fall in the price of this product would hit profitability so hard that it would fall to negative levels.

Organic farming of mandarins is also somewhat more sensitive to variations in price than conventional farming, although less so than in the case of oranges, since a fall of 20 percent in receipts would produce a loss in profitability of 39.42 percent, giving an Internal Rate of Return of slightly more than 9.66 percent.

In order to express more clearly the comparison between organic and conventional farming of oranges and mandarins, we have provided, below, the profitability rates according to five different market hypotheses:

- Hypothesis 1: Markets with a very strong preference for organic farming (price differences between organic and conventional farming +40 percent).
- Hypothesis 2: Markets with a strong preference for organic farming (price differences between organic and conventional farming +30 percent).
- Hypothesis 3: Markets with preference for organic farming (between organic and conventional farming +20 percent). This hypothesis is the one initially regarded, for the purposes of this study, as the closest to the present price scenario.
- Hypothesis 4: Markets with slight preference for organic farming (price differences between organic and conventional farming +10 percent).
- Hypothesis 5: Markets without preference for organic farming (no price differences between organic and conventional farming).

**Table XXIII**

**Profitability rates for oranges, by hypothesis**

| | IRR (organic) | IRR (conventional) |
|---|---|---|
| Hypothesis 1: Very strong preference | 15.29 | 12.40 |
| Hypothesis 2: Strong preference | 12.87 | 12.40 |
| Hypothesis 3: Preference | 10.14 | 12.40 |
| Hypothesis 4: Slight preference | 6.70 | 12.40 |
| Hypothesis 5: No preference | Negative | 12.40 |

Source: Authors.

**Table XXIV**

**Profitability rates for mandarins, by hypothesis**

| | Organic IRR | Conventional IRR |
|---|---|---|
| Hypothesis 1: Very strong preference | 25.17 | 20.94 |
| Hypothesis 2: Strong preference | 22.62 | 20.94 |
| Hypothesis 3: Preference | 19.76 | 20.94 |
| Hypothesis 4: Slight preference | 16.52 | 20.94 |
| Hypothesis 5: No preference | 12.79 | 20.94 |

Source: Authors.

## 5. Conclusions

Organic agriculture is rapidly gaining in importance within the European Union, even though it still accounts for a small proportion of farm production. Citrus, in particular, is following this pattern. Thus, in Spain (the leading citrus producer in the EU), the amount of land devoted to organic farming accounts for scarcely 1 percent of the total, but has shown significant growth over recent years. There has been further expansion of so-called integrated farming which, without attaining the environmental performance level required for organic farming, also involves the incorporation of more environmentally friendly growing methods and, in some instances, is the precursor to organic farming.

Markets for organic products in the EU do present certain paradoxes and uncertainties. Thus, whereas it seems clear that there is a growing interest in this type of product on the part of consumers, with prices higher than those for the same products produced by conventional farming, it is also apparent that a significant proportion of organic production is marketed as conventional, with this proportion reaching 10 percent in the case of fruits in general (Michelsen J., et al, 1999). The basic reason is that since these products are relatively new to the market, and have a small presence, they do not have good distribution channels. Furthermore, in many EU countries, the major distribution chains are not showing great interest in them.

It should be noted, however, that the new Agricultural Policy implemented under the "Agenda 2000" action programme more than ever implies a greater degree of integration with Environmental Policy. This leads us to suppose that this new form of agriculture enjoys strong institutional support within the framework of the European Community's new Agricultural Policy.

Economic comparison of organic and conventional citrus farming should be performed in light of the fact that citrus is a perennial crop, which means that the most appropriate methodology must take into account the entire useful life of the grove, as well as different market scenarios.

Thus, the methodology used is the so-called economic/financial evaluation, which considers the value of money over time (NCV– IRR analysis), regardless of an initial approximation of its viability through an estimate of growing costs.

Production costs highlight the need for a higher price for the organic product, since the costs are greater (27.9 percent for oranges and 25.9 percent for mandarins) and the yields are lower, especially during the conversion period (19.4 percent for oranges and 19.6 percent for mandarins).

Evaluation of profitability according to the methodology used and the assumptions and the hypotheses established, both the general assumptions, which are habitually used for this type of analysis (Romero C., 1998), and specific assumptions of a technical nature, which reflect the character, or typology of the farms, as well as the market hypotheses (level of prices attainable), reveal higher profitability in conventional farming than in organic farming, as well as the greater sensitivity of organic orange growing to variations in market prices.

Due to the difficulty in predicting the evolution of markets and, in particular, that of the prices that organic products might reach, we had to simulate different price scenarios that would allow us to discern under what conditions the estimated profitability for organic farming would be higher or, at least, comparable.

This was performed under the assumption of a saturated global citrus market, that is, a supply level that matches existing demand (saturated markets hypothesis). Results indicate that only in a context of strong and very strong preference - that is, with prices for organic citrus 30 percent and 40 percent higher than for conventional citrus- can organic farming show higher profitability. In the case of the hypothesis of simple preference (initial hypothesis), which is the present situation, the profitability rates are, as we have already mentioned, in favour of conventional farming. Those differences are, however, small (2.26 percentage points for oranges, and scarcely more than 1 percentage point for mandarins), and that is why many farmers are contemplating this form of production, presuming a change in markets.

If the institutional framework becomes more favourable, and is reflected in the implementation of an agricultural policy that supports these growing systems, if distribution channels are developed for this type of product, and if interest among major operators increases, it seems quite clear that the trend toward this form of production, which is already growing, will grow further. If the price differential becomes somewhat higher than at present, organic citrus will attain higher profitability rates that will make this growth possible.

Organic citrus growing will gain ground over the coming years, although how fast it grows will depend on the evolution of the market, and the practical impact that institutional support has on the citrus-growing industry. In the short term, however, it does not seem that a major shift toward organic farming is justified.

## 6. Bibliography


AGUSTÍ M., 2000. *Citricultura*. Ed. Mundi-Prensa. p. 416.

BUXTON B., DEL CAMPO F.J., 1995. *Constructed costs of producing oranges in selected orange exporting countries*. Readings in Citrus Economy. Publications Department. University of Valencia. pp. 35-43.

CABALLER V., DE MIGUEL M.D., 1988. *La estructura de los costes en el cultivo de cítricos y su evolución*. III Congress of SECH. Tenerife.

CABALLERO P., DE MIGUEL M.D., JULIÁ J.F., 1992. *Costes y precios en hortofruticultura*. Ed. Mundi-Prensa. p. 768.

JULIÁ J.F., SERVER R. J., 1996. *Dirección Contable y Financiera de Empresas Agroalimentarias.* Ed. Pirámide. p. 492.

LABRADOR J., et al, 1999. *Guía de la Agricultura Ecológica en la Comunidad Valenciana. Recursos para agricultores, consumidores y técnicos.* Seminar on Ecological Farming. Autonomous Government of Valencia. p. 186.

MICHELSEN J. et al., 1999. *The European Market for Organic Products: Growth and Development*. Ed. Hohenheim University. Institute for Agricultural Business Management. 410A. p. 199.

PICCININI A., 1998. *Gli agricoltori europei tra quote e mercato*. Ed. FrancoAngeli. p. 539.

ROMERO C., 1998. *Evaluación financiera de inversiones agrarias*. Ed. Mundi-Prensa. p. 78.

ROSELLÓ J., DOMÍNGUEZ A. and GASCÓN A., 2000. *Comparación del balance energético y de los costos económicos en cítricos y hortícolas valenciana en cultivo ecológico y convencional.* IV Congress of the Spanish Society for Ecological Farming. Harmony between Ecology and Economy. Not yet published.

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# ANNEX I

## FINANCIAL EVALUATION AND SENSITIVITY ANALYSIS OF ORGANIC FARMING, INCLUDING SUBSIDIES

As indicated earlier in the report, Annex I shows the results produced when the financial evaluation and sensitivity analysis are based on the assumption that public subsidies are available for farmers who earn their profits through an organic farming system.

The only new factor introduced into our analysis by this consideration is the incorporation of certain extraordinary receipts during the years in which the subsidy is granted to farmers. In accordance with the Order of the Department of Agriculture (Order of 22 April 1998), on the application of the said subsidies, the following Table shows the extraordinary receipts that it would generate.

**Table A**

**Extraordinary receipts generated by subsidies**

| Year of receipt | Subsidies (€/Ha) |
|---|---|
| **Year 10** | 360.61 |
| **Year 11** | 288.49 |
| **Year 12** | 216.36 |
| **Year 13** | 216.36 |
| **Year 14** | 216.36 |

Source: Order of 22 April 1998, of the Department of Agriculture, Fisheries and Food.

Following the procedure described in the fourth part of the present report, although working solely under Hypothesis B of conventional saturated markets, the data in Table A are combined with those in the aforementioned fourth part of the report. The results obtained are shown below.

## Table B

### Results for growing oranges and mandarins with subsidy (Hypothesis B)

| | Organic orange | | Organic mandarin | |
|---|---|---|---|---|
| | IRR | 10.43% | IRR | 19.94% |
| Discount rate | NCV | Recovery Period | NCV | Recovery Period |
| 3% | 11 239.97 | 14 | 40 943.02 | 7 |
| 4% | 8 615.91 | 14 | 34 847.31 | 7 |
| 5% | 6 398.18 | 15 | 29 669.55 | 7 |
| 6% | 4 515.90 | 16 | 25 251.37 | 7 |
| 7% | 2 911.78 | 17 | 21 464.50 | 8 |
| 8% | 1 539.35 | 19 | 18 204.63 | 8 |

Source: Authors

## Table C

### Sensitivity analysis for organic oranges and mandarins, with subsidy

| | % variation IRR | | | % variation IRR | |
|---|---|---|---|---|---|
| % change receipts | Organic orange | Organic mandarin | % change payments | Organic orange | Organic mandarin |
| -20 | -94.00 | -34.78 | -20 | 43.28 | 20.97 |
| -15 | -55.59 | -25.14 | -15 | 32.38 | 15.81 |
| -10 | -32.46 | -16.20 | -10 | 21.56 | 10.59 |
| -5 | -14.91 | -7.84 | -5 | 10.80 | 5.31 |
| 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 5 | 13.48 | 7.36 | 5 | -11.10 | -5.34 |
| 10 | 26.03 | 14.29 | 10 | -23.08 | -10.68 |
| 15 | 37.89 | 20.83 | 15 | -37.05 | -16.01 |
| 20 | 49.18 | 27.01 | 20 | -54.88 | -21.31 |
| Average elasticity | 16.02 | 1.63 | Average elasticity | -2.70 | -1.04 |

Source: Authors.

# ANNEX II

## SOIL & CLIMATE CHARACTERISTICS AND AGROECOLOGICAL SYSTEM

### SOIL

The physical and chemical characteristics of the soil are fundamental to successful citrus growing.

It is hard to define the ideal soil for citrus growing, since it is necessary to combine characteristics of very diverse nature, which sometimes move in opposite directions. Consequently, the optimum state is an intermediary one.

The soil in the Region of Valencia, zones where citrus growing is more developed, such as the zone addressed by our study, share certain characteristics. Soils are generally deep, favouring strong root development, and thus ensuring that trees are well rooted and receive good nutrition. Soil texture ranges from sandy to clayey. The type most commonly found has a low capacity for water retention and a limy consistency (Agustí M, 2000).

The chemical characteristics of the soils vary considerably, and in these contexts depend to a large extent on the fertilization programmes implemented through the soils' cultivation years. It may be said, however, that evidence of deficiencies is often present, especially in micronutrients and Mg; in a low degree of correlation between their content in mineral elements and their folate concentration; and in a close relationship between the potassium content of the soils and the vigour of the trees.

### CLIMATE

Climate is a crucial factor in plant growth. Thus, all factors influencing climate have a decisive effect on the growth and cultivation of citrus.

Citrus grows in the zone between Latitudes 40º North and 40º South. Altitude is another factor to be taken into account when seeking to compare citrus farms located in different zones, since differences have been identified in at least two characteristics - the photoperiod and seasonal temperatures - which undoubtedly affect the growth of the crop, and hence the growing methods employed by the farmer. With respect to the present study, the farms analysed are all located less than 100 metres above sea level.

The most influential variable in terms of plant growth, flowering, and size and quality of fruit, is the temperature. The optimum growing temperature is between 23 and 34 degrees centigrade, although citrus can withstand higher and lower temperatures, depending on the point in the annual cycle at which they occur. In the Region of Valencia, temperatures during the active phase of the tree range between optimum values, while in the phase in which the tree is still, temperatures are much lower (between 5 ºC and 15 ºC), although the effect on the tree is not negative, since this occurs during the tree's vegetative state.

Relative Humidity does affect the quality of the fruit, although in this regard, citrus can adapt to extreme conditions. In the zone considered by this study, the average normal levels for relative humidity range from 40 to 60 percent.

The water need of citrus has been much studied, and is considered to be between 7 500 and 12 000 $m^3$/ha. The influence of this factor on growth is critical, since the water not provided by rain must be supplied by the farmer, and this has a direct effect on the growing system, and thus on production costs. Rainfall in the growing region in question is XXXX mm, although it is distributed unequally, with periods of torrential rains, followed by very dry periods, which means that an irrigation system must be installed.

The Papadakis Classification enables us to establish climatic analogies for regions at the same latitude, and can be used when introducing new varieties or ecotypes, and to improve classification of optimum growing zones.

The results obtained were as follows:

Temperature:

| | Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ELHD** | | 16 | | | | | | | | | | 14 |
| **ELHME** | 6 | | | | | | | | | | | |
| **ELHMI** | | | | 19 | | | | | | | 11 | |

**WINTER:**

Coldest month: January.

Ave. of min. absolute temps. in coldest month: -0.10 ºC.

Ave. of min. temps in coldest month: 5.10 ºC.

Ave. of max. temps. in coldest month: 15.40 ºC.

Winter-type: **Citrus ($C_i$)**.

**SUMMER:**

Average of maximum temperatures in hottest week: 27.35 ºC.

Summer-type: **Gossypium (less hot) (g).**

THERMAL REGIME: **Semi-hot subtropical (Su)**.

**Rainfall:**

| | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PET** | 19.91 | 24.46 | 40.04 | 52.29 | 87.61 | 120.0 | 157.5 | 156.3 | 108.6 | 68.07 | 37.41 | 23.55 |
| **Hi** | 2.154 | 1.586 | 1.000 | 1.000 | 0.299 | 0.174 | 0.158 | 0.083 | 0.594 | 1.361 | 1.790 | 3.039 |

Annual precipitation: 525.9 mm.

Annual PET: 895.9 mm.

Annual humidity index (Hi): 0.586

Washing water (Ln): 139.5 mm. < 20% annual PET.

HUMIDITY REGIME: **Mediterranean Dry (Me).**

**CLIMATE-TYPE**: **MEDITERRANEAN SUBTROPICAL (Me, Su)**.

## PESTS

Pests play a very significant role in citrus growing, both in terms of production levels and fruit quality. This can have a serious impact on the profitability of the fruit, hence the importance of studying them.

In the growing region addressed by this study, the main pests to be found are the following:

- **Mites:**
  - Citrus Red Mite (*Panonychus citri* McGregor): although this mite attacks all species, it is particularly common among varieties of the navel group.
  - Red Spider Mite (*Tetranychus urticae* Koch): found mainly in clementines.
- **White Citrus Fly** (*Aleurothrixus floccosus* Mask): attacks all species and varieties of citrus, showing no preference for any one in particular. The most effective natural enemy of this insect is the hymenopteran *Cales noaki* How.
- **Aphids**: A group of arthropods of the class *Insecta*, order *Hemiptera*, suborder *Aphididae.* Those most frequently found in this growing region are *Aphis spiraecola* Patch, and *Aphis gossypii* Glover. The latter is the most effective vector at transmitting the citrus tristeza virus in Spain. Biotic control of these pests may be achieved with the hymenopteran *Lysiphlebus testaceipes* Gresson.
- **Coccidae**: Belong to the class *Insecta*. The main coccidae affecting the Spanish citrus-growing industry are *Lepidosaphes beckii* Newman, *Parlatoria pergandei* Comstock and *Aonidiella aurantii* Masketll. These

insects have effective natural enemies, including *Rodolia cardinalisk* Muls or *Criptolaemus montrouzieri* Muls.

- **Lepidoptera**:
  - Citrus moth (*Prays citri* Mill).
  - Cacoecia (*Cacoecimorpha pronubana* Hbn.).
  - Leaf miner (*Phyllocnistis citrella* Stainton)
- **Mediterranean fruit fly** (*Ceratitis capitata* Wied). Thus far, biological methods have not generally been successful in combating the Mediterranean fruit fly, although some success has been achieved with the autocide method, which consists of the mass liberation of males created in the laboratory and sterilized by radiation.

## DISEASES

- **Caused by fungi:**
  - Phytophthora spp.
  - White root rot
  - Alternaria
  - Botrytis
  - Rot
  - Anthracnosis
- **Caused by bacteria:**
  - Cancrosis or chancre.
- **Nematodes:**
  - *Tylenchulus semipenetrans* Cobb.
- **Viruses and similar diseases:**
  - Psoriasis.
  - Citrus Tristeza.

## ANNEX III

**Order of 22 April 1998, of the Department of Agriculture, Fisheries and Food**,

*updating the regulations for applying the system of horizontal measures for the promotion of farming methods that are compatible with the requirements of environmental protection and preservation of the natural environment.*

and

**Order of 23 December 1999, of the Department of Agriculture, Fisheries and Food**,

*suspending invitations for new requests for subsidies regarding the agro-environmental programme under Regulation (EC) No. 2.078/1992, in the Region of Valencia.*

## ANNEX IV

## PRICES PAID TO FARMERS IN THE FIELD

**1998–1999**

| | €/Kg [1] |
|---|---|
| **Organic orange** | 0.31 |
| **Organic mandarin** | 0.55 |

Source: Organic Farming Board of the Region of Valencia

[1] Average of 16 commercial operators (internal and external markets)