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Dynamic economic analysis of greenhouse pepper production on rockwool on a family farm

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Summary: The major part of the pepper growing farms in Hungary operate as family enterprises with areas varying between 1,000 and 3,000 m^2. As a result of the small size, their profitability is greatly dependant on the technological level and market circumstances. Most of these farms are characteristically affected by the lack of capital, therefore, they are unable to implement any further developments with their own forces. Greenhouse pepper production on rockwool had already been subjected to analysis earlier in our research, however, those calculations were directed solely at the profitability and efficiency of production. Based on the data from 2004 in 2005 yet another and more profound analysis was set as the objective. Besides the methods already applied before, several dynamic indicators have been introduced which could also be useful for practical applications. The graphs can permit growers to monitor the temporal distribution of the costs incurred and revenues earned during production. Thereb,y it is easier to plan the costs and more simple to distribute them more rationally over the production period. Our experiences suggest that this sort of analytical method is applicable only in cases where a very careful and precise collection of data is ensured and the results obtained can not be generalised as being valid only for the single farm analysed. Experiences and results, however, make us consider the dynamic economic analysis as being very useful both for beginners and practicing horticulturists.

Key words: dynamic economic analysis, pepper, rockwool

Introduction

Pepper is the most important one of the greenhouse-grown vegetable crops in Hungary, accounting for 50% of thetotal production value. Currently, greenhouse-grown pepper take up an area of approximately 2,000–2,500 hectares. Due to the high labour requirements, production is mainly carried out by small enterprises and on family farms (*Tégla,* 2003). The size of the majority of the profitable farms ranges between 1,000 and 3,000 m^2.

Pepper consumption is rapidly growing in the European Union and this tendency is unlikely to change over the next few years. In 2002, consumption was as high as 1.6 million tons. Hungary's contribution however was as low as 1%. Among the member states Holland and Spain are net exporters, i.e. their pepper exports exceed the purchases (*Deme,* 2003).

The appearance of globalisation and new consumption habits has generated significant demands on the markets of the EU also for products, such as waxy pepper that formerly played a role only on East-European markets.

It is of great significance that vegetable production is not subject to quotas in the European Union, therefore the waxy pepper with its 'hungaricum'-like particular appearance and quality can take a greater share of the exports. This fact has special importance in the competition with other major exporting countries, such as Spain where 80% of the 8,500 hectare pepper in Almeria is grown for export purposes (*Rimóczi,* 2004). The increase of the exports, however, requires an adequate background of producers, quality assurance and inventive marketing activities.

The structure of production will also undergo changes. As heating costs are high, very early and early production will lose ground or only those more powerful growers already existing (e.g. Árpád Agrár Share Company) will be able to go on utilising this production technology. Sustaining high heating levels seems feasible mainly there where it will be possible to use cheap natural energy sources (e.g. thermal water) as well. Soil based production is also losing ground due to the increasing level of soil infection and the consequent decreases in yield levels. As a result, rockwool media will keep on spreading over a larger and larger growing area. New technologies and growing competition will set further tasks to Hungarian horticulturists. They will have to make decisions that will determine the course of production for many years (*Kiss* et al., 2003).

Due to the changes mentioned above, out of the smaller or bigger family farms carrying out production mainly in soil, only those ones will be able to keep on producing profitably that will be capable of meeting the new qualitative and quantitative requirements and on the other hand, will be ready to cooperate and collaborate with other growers in order to be successful both on the national and international markets.

Greenhouse pepper production on rockwool had already been subjected to analysis earlier in our research, those calculations, however, were directed solely at the profitability and efficiency of production. Based on the data from 2004 in 2005, yet another and more profound analysis was planned.

Material and method

Besides the methods already applied earlier, several so-called dynamic indicators have been introduced which could also be useful for practical applications. The graphs can permit growers to monitor the temporal distribution of costs and revenues during production. Thereby it is easier to plan the costs and more simple to distribute them more rationally over the production period.

For the purposes of modelling a family farm, similarly to the former investigations, a modern greenhouse block has been taken as the basis, comprising an area of 3,500 m^2, provided with automatic ventilation, of new construction and covered with a double plastic layer and where tasks are carried out by two adults of a four member family and three physical workers. Transplanting date was early January. Transplants are bought from a company specialised in this activity. Crop is planned to be cleared by the end of September. The variety grown was Hó F_1, a very common variety in production on rockwool and having excellent yield potential. Plants are pruned to a double stem, so 3.6 plants per square meter were transplanted (*Terbe & Gyúrós,* 1999).

Investment costs are summarized in *Table 1.*

Table 1 Investment costs of the pepper production system on rockwool for a 3.500 m^2 greenhouse area (2004)

Components	Gross price (1000 HUF)
Greenhouse block (frame and fittings)	19 250
Plastic layer	1 840
Construction costs	6 125
Heating system	3 500
Humidifying systems	300
Automatic fertigation control	2 500
Drip irrigation system	1 024
Support system	145
Performance of skilled tasks	437
Thermal fogger	350
Cold fogger	76
Manual tools	100
Small lorry	2 500
Total	38 147

In the investigations, it was considered necessary to utilise not only the indications from the literature but also the information, data and experiences gathered from the growers in order to get as detailed a picture as possible for the economic analysis. Besides, the calculations also utilised the data from the pepper production trials on rockwool carried out at the experimental farm of the Department of Vegetable and Mushroom Growing, Faculty of Horticultural Science, Corvinus University of Budapest.

Information gathered this way has been summarised in tables and graphs, thereby, a clear picture has been provided on the extent and pattern of the different cost categories, as well as on their temporal distribution.

Amortisation costs have been calculated in accordance with the calculation method of constant annual amortisation figures (*Bacskay,* 1984) ignoring interests. It means that the value of a given implement or machine decreases from year to year by the same percentage of the original gross value (*Table 2*).

The costs incurred and revenues earned during the growing season have been illustrated not only in an aggregate form, but also in function of time, outlining a sharp picture on which moment the above mentioned indicators occur during the growing season. Special attention has been given to manual labour, being one of the major cost factors. Data recorded preliminarily have been illustrated on graphs having a two-week scale. Each single expense has been indicated at the time of its occurrence, except for the amortisation, the costs of the 'other' category and the overheads which have been distributed evenly over the whole year. The growing season is calculated to start from October as at this moment preparations for planting the crop will already begin.

Table 2 Breakdown of amortisation costs for a 3.500 m^2 greenhouse area (2004)

Denomination	Gross price (1000 Ft)	Length of amortisation (years)	Annual amortisation (1000 HUF)
Greenhouse block (frame and fittings)	19 250	15	1 283
Plastic layer	1 840	5	368
Construction costs	205	3	68
Automatic fertigation control	2 500	10	250
Drip irrigation system	1 023	3	341
Heating system	3 000	10	300
Thermal fogger	75	5	15
Cold fogger	350	5	70
Manual tools	100	5	20
Support system	150	10	15
Small lorry	2 500	5	500
Total	30 993		3 230

Results

Profitability of production

It is advisable to break down production costs into components, thereby, material costs, ancillary services, manual labour, amortisation, overheads and other costs (non classifiable) are separated. Over the growing season gross production cost is 14.024.500 HUF for 3.500 m^2, that is 4.007 HUF per m^2, which is composed as follows (*Table 3*).

Pepper price figures and their changes in the year 2004 are illustrated in *Figure 3.* Harvested yield is 24.2 kg/ m^2, which can be considered fairly good in Hungary. For a really profitable production, it is indispensable to realise yields over 20 kg/ m^2 at this technological level, since yield figures inferior to this level will fail to guarantee that the technology is economical.

Table 3 Costs of pepper production on rockwool at the holding observed (2004)

Category	HUF/m^2	HUF/3.500 m^2
Material costs	1.143.3	4.001.550
Costs of ancillary services	1.088.0	3.808.000
Wages and related contributions	656.3	2.297.050
Amortisation	922.9	3.230.150
Overheads(electricity. fuel etc.)	152.9	535.150
Other costs (e.g. professional advice)	43.6	152.600
Production costs	4.007	14.024.500

Profit totalled 1,776.7 HUF per square meter in 2004, equivalent to 6.218.450 relative to the total area (*Table 4*). That means an income of 512.204 HUF for the family besides their wages. With a smaller area, profitability will decrease and the farm will become gradually less viable. By further developments and investments, however, profits can still be increased resulting in a more competitive farm that is less vulnerable to the risks inherent to production.

Table 4 Projected yield and production value for a 3.500 m^2 greenhouse area (2004)

Yield	24.2 kg/m^2	84.7 t
Production costs	4.007 HUF/ m^2	14.024.500 HUF
Income from sales	5.783.7 HUF/ m^2	20.242,.950 HUF
Profit	1.776.7 HUF/ m^2	6.218.450 HUF

Dynamic economic indicators

Once it has been concluded that production is profitable under the given circumstances, it is worth analysing the temporal distribution of the costs incurred and revenues earned. *Figure 1* is an illustration of the costs incurred during production, while the income figures are illustrated in *Figure 2*. Based on these illustrations it can be seen that a very high proportion of the costs tend to occur prior to the beginning of production or immediately afterwards. This is the period when the grower has to buy the necessary materials and implements, such as transplants, chemicals, plastic mulching, rockwool slabs etc., and prepare himself for the following growing cycle. With the start of the crop, further substantial costs will occur, such as heating, manual labour. By observing the pattern of the incomes it can be seen that sales can be expected to earn substantial incomes only after the first two pickings in April and May. Yields are not yet too high in this period, but the market prices of pepper are still very high (*Table 3*). Later on, incomes will decrease with the sharp decline of pepper prices and not even the growth in yields will be able to counterbalance it.

Figure 4 is an illustration of the expenditures and revenues and their changes by time. The values are presented in an accumulated form. In the graph it is easy to recognize the dynamic cost increase at the beginning of the growing season and the slow down of the process later on. Revenues

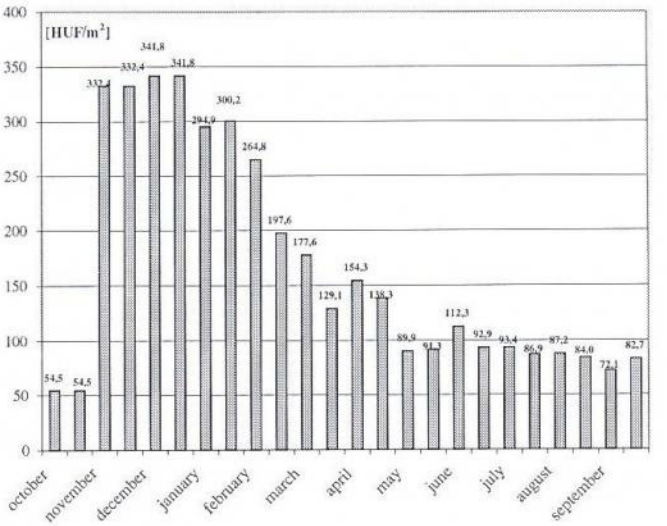

Figure 1 Temporal distribution of the costs during the growing season expressed per square meter for a 3.500 m^2 greenhouse area (2004)

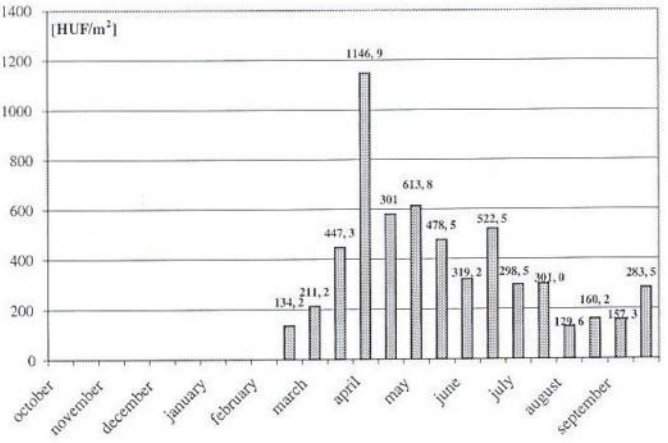

Figure 2 Temporal distribution of the incomes during the growing season expressed per square meter for a 3.500 m^2 greenhouse area (2004)

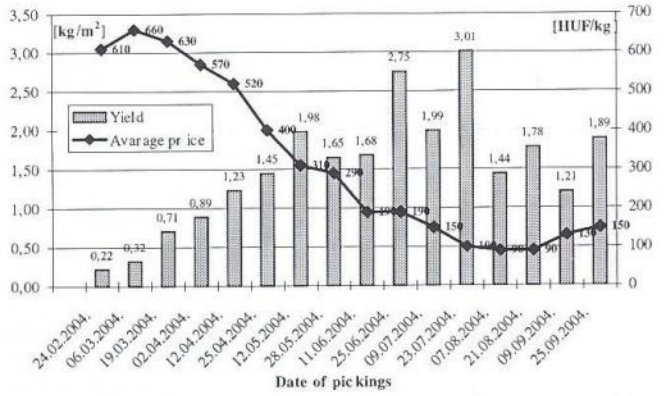

Figure 3 Yields and average prices of pepper expressed at the single pickings during the growing season of the farm tested (2004)

start to flow from the end of February and show a very dynamic increase, by May reaching the break even point and by the end of the growing season exceeding the sum of the costs. Because of average prices being low in the summer this increase slows down from the end of July.

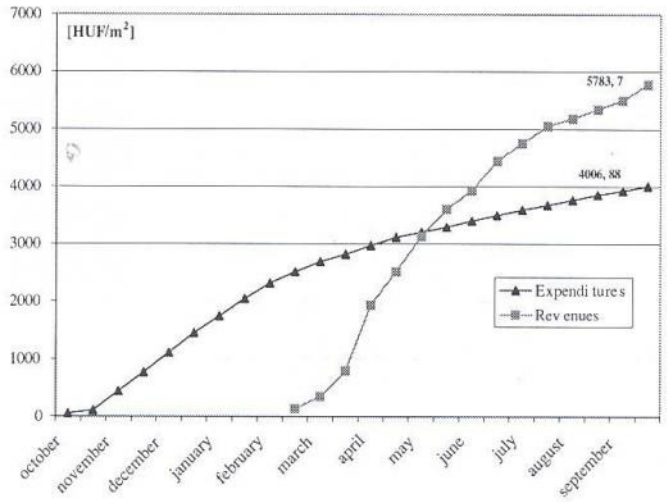

Figure 4 Temporal distribution of accumulated expenditures and revenues expressed per square meter during the growing season on the farm tested (2004)

It is a very hard job for horticulturist engaged in greenhouse pepper production to recruit skilled and reliable workers and keep them, which often may turn out to be not very simple. In our investigation we had to see how changing the actual labour demands were during over the growing season.

It is easy to see from *Figure 5* which periods are particularly affected by labour peaks at the farm tested, therefore, the grower can make preliminary preparations by employing the necessary labour capacities. Such labour peaks can occur in periods of intensive crop growth (pruning) and at harvesting, especially in the period of late spring and early summer. In the figure, it is easy to trace the tendency of increasing labour expenditure in parallel to vegetative crop growth and yield increase. Later on, with the aging of the plants and with the decline of yields manual labour requirements undergo decreases by the end of the growing season.

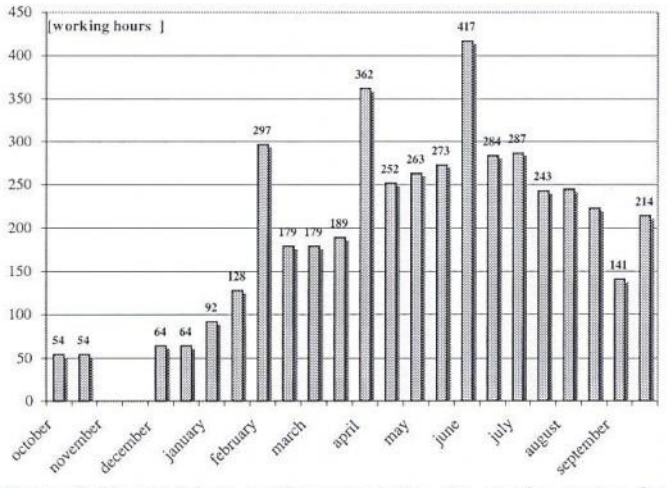

Figure 5 Manual labour requirements during the growing season for 3.500 m^2 greenhouse area concerning the number of working hours (2004)

Conclusions

From the results it can be concluded that the production is profitable at the farm analysed. It provides a living for the whole family all the year round. The amount of profit, however, is insufficient to permit any further developments. This way the family is subject to the whims of the market and trade. The projected increase in energy prices (gas, oil) will present further difficulties for production. Owing to financial problems being more and more frequent, it will be very hard for the grower to conform himself to the current requirements. In the future, the right answer to the challenges may be a technological development, setting up of well organized and efficient systems of marketing, advisory services and financial support.

As it is apparent from the dynamic economic analysis, in our case, the beginning of the growing season is characterized by very high expenditures, therefore, it seems advisable to consider how to elaborate a more rational allocation of costs, as it is almost impossible or much more difficult to schedule the revenues. Dynamic figures similar to those above are very suitable for this purpose. Once they are compiled and analysed it is much simpler to have a broad vision of the operation of a given horticultural enterprise or farm. They will greatly facilitate one to project and sum up both costs and revenues.

Considering the average pepper prices and the distribution of the harvest figures, it is clear that the profitability of production is sharply declining in the late summer period. In this season not even the high level of yields are able to compensate for the low market price of pepper, therefore, efforts should be made to realise as high yields and quality in the early period (February-June) as possible. Dynamic figures are also very suitable for assessing labour requirements. The graph permits to forecast manual labour demands and to make out labour peaks as well. This way, the grower can project in advance, relative to the whole year, when and how many employees are necessary.

Our experiences suggest that this method of analysis is applicable only with very a careful and precise collection of data. The temporal distribution of the different data is particularly difficult. It is also important to note that the results obtained can not be generalised, as they are valid only for the farm analysed, therefore, in the case of different farm size or activity new data collection and calculations are necessary.

On the basis of what had been said above, we suggest that the dynamic economic analyses should be applied to every kind of horticultural activities, specially when horticultural growers do not possess the suitable growing experiences. On the other hand, also the experienced grower can profit from this method. It can provide further information and data for making production even more successful.

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