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Investment appraisal of a plantation establishment for intensive apple production

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Summary: For fruits, establishing intensive apple-orchards requires the highest amount of investment cost, while the returns depend on many factors. Based on farm and bibliography data we appraised an investment in a model in some variations that are the most used in practice (100% owner's capital and 55% owner's capital + 45% subsidies). The profitability of the investment has been analysed using the methods of NPV (Net Present Value) and DPP (Dynamic Payback Period). The essence of our analysis is a sensitivity analysis with the optimistic, pessimistic and realistic combinations of the yield and the market price. Plantation establishment financed by only own (corporate's) sources turns into profitable over 7–10 years in average and favourable cases, but the opposite is the case in unfavourable circumstances. By subsidy of 45% for investments, it is highly possible to return by the fifth or sixth year after the year of establishment, but it can return by the twelfth year even in unfavourable case.

Key words: apple plantation, investment appraisal, NPV, DPP, return, profitability

Introduction

Investment of a plantation is for 15–18 years, which refers to a long-run activity that can not be appraised by only one-year's economic data from the point of view of efficiency. Apart from the risks and distortions coming out of choosing the year of such analysis, this one-year approach does not refer to the characteristics of an investment such as long run and money intensive when being treated and producing. At the same time, it demands a vast sum of money right in the year of establishment (*Buzás*, 2001), and the beginning years do not provide sales with us and profitability varies in wide intervals in the years coming next. Moreover, failure to identify relevant costs and benefits relating to an investment could lead to bad decisions being made (*Atrill & McLaney*, 2005).

The objective of this paper is to show – based on data from apple producing farms – the net present value of net cash flows generated over the production lifetime of the plantation, and the potential time period that it takes to be returned, as well as the sensitivity of these figures dependent on changing prices and yields.

Materials and methods

"Research shows that there are basically four methods used in practice by businesses throughout the world to evaluate investment opportunities" (*Atrill & McLaney*, 2005). Out of dynamic investment appraisals we used only two, namely NPV (Net Present Value) and DPP (Dynamic Payback Period). NPV shows how much more income derives from the specific investment compared to the opportunity to invest. This opportunity, in general, is to fund in government security (gilt) or some bank deposit. It is discount rate which expresses the benefit relative to the capital invested. The payback time shows us the time period over which enough cash has been generated to recover the initial investment (*Warren*, 1992). DPP as payback period provides us with the point of time (usually expressed in terms of year) by when the investment will have been recovered that is the year when the initial outlay has been repaid out of the cumulative discounted values of yearly benefits (present values) over the years of operation (*Illés*, 2002).

For the costs of the investment and the revenues and expenses in our study, we took the features of an intensive plantation with spacing 4,0 × 1,0 meter.

The discount rate was 7% in our calculation, which was equal with the interest rate for stocks issued by the state at the time of the analysis.

Results

Cost of investment of an intensive apple plantation

The cost of investment of an intensive apple plantation derives from five main activities *(Table 1.)* such as soil preparation, construction of support to produce, graft planting, irrigation system establishment, and other completing jobs.

Costs in table 1. are for a plantation with spacing 4,0 × 1,0 m (equals with 2500 trees per hectare density). It is clear that those figures above can vary depending on many factors,

Table 1. Cost of investment of an intensive apple plantation per hectare

Denomination	Cost *(thousand HUF/ha)*	Percentage ratio *(%)*
Soil preparation	250	8
Construction of support to produce	600	19
Graft planting	1 200	39
Irrigation system establishment	750	24
Other cost	300	10
Total cost of investment:	3 100	100

Source: own calculation

thus they vary by +/– 20% in practice, but can be acceptable as average figures to describe the situation.

Cash flows of intensive apple plantations over the lifetime

Efficiency of this investment is determined – over the costs of establishment – by revenues and expenses generated over the lifetime of the orchard *(Table 2.)*.

Based on data from the relevant literature and farm businesses, intensive apple plantations are characterised by no yield in the first year and 4,0–6,0 t/ha yield in the second year, then 10,0–14,0 t/ha yield in the third year in average. We can expect an increase in yields in the fourth and fifth years, giving 30–40 t/ha average yields from the sixth year of its lifetime that are produced over 8–10 years of its normal production period, of which some 90% is with quality suitable for fresh consumption.

Farm gate selling prices are very hectic from year to year in the apple industry in Hungary. This fact – and prices themselves are difficult to predict within a specific year too– makes planning difficult. Based on current prices and average conditions presumed, we took prices 65 HUF/kg and 15 HUF/kg for apple for fresh consumption and processing, respectively. We did not expect significant increase in prices in the future, because it seems unrealistic to expect a rising tendency.

Production costs (expenses) rise from the relative low value of treatment costs in the beginning years up to the value of 1 200 000 HUF a year by the productive years have come. Time of planting is taken as year zero in farm management.

Table 2. Cash flows over the lifetime

Age *(year)*	Yield			Selling price		Revenue *(thousand HUF/ha)*	Expense *(thousand HUF/ha)*
	For fresh consumption *(t/ha)*	For processing *(t/ha)*	Total *(t/ha)*	For fresh consumption *(t/ha)*	For processing *(t/ha)*		
0.							3 100.0
1.	0.00	0.00	0.0	65.0	15.0	0.0	270.0
2.	4.50	0.50	5.0	65.0	15.0	285.4	280.0
3.	11.25	1.25	12.5	65.0	15.0	713.4	400.0
4.	20.25	2.25	22.5	65.0	15.0	1 284.2	701.3
5.	27.90	3.10	31.0	65.0	15.0	1 769.3	1 039.5
6.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
7.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
8.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
9.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
10.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
11.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
12.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
13.	31.50	3.50	35.0	65.0	15.0	1 997.6	1 189.5
14.	27.90	3.10	31.0	65.0	15.0	1 769.3	1 171.5
15.	24.30	2.70	27.0	65.0	15.0	1 541.0	1 153.5

Source: own calculation

Investment appraisal of intensive apple plantations

For investment appraisal it is advisable to consider more financing variations, since way of financing is the most decisive to the return of an investment, thus we followed that way in our analysis. We took two cases such as financing by 100% own source (corporate's money) and another way of financing by 55% own source completed by 45% subsidy. The importance of subsidy is to reduce the own money needed, while improving the efficiency.

An investment appraisal is a calculation for the future. Unfortunately factors influenced agricultural production are not predictable precisely in time, thus – mainly in the long run – evaluations always include a certain degree of error. To avoid the unreasonable degree of error we conducted sensitivity analysis of some combinations of budgeted yields and market prices, predicting each version by the ways of optimistic, realistic and pessimistic approach. Other factors were not taken into the sensitivity analysis, since there are no such uncertainties for costs and discounted rate relative to yields and market prices.

For the realistic version we took yields and prices that were the most likely to occur. The optimistic version was made up of more favourable figures, while the pessimistic version including much unfavourable figures than those of the realistic version. In our case it refers to realistic figures of 65 HUF/kg of apple for fresh consumption and the yield of 35 t/ha, optimistic figures of 75 HUF/kg of apple for fresh consumption and the yield of 40 t/ha, and to pessimistic figures of 55 HUF/kg of apple for fresh consumption and the yield of 30 t/ha.

Investment financed by 100% own source

As it has mentioned before, we evaluate the investment using NPV and DPP. Calculation of NPV (only for realistic case) is shown in *Table 3*. Nevertheless, we used a simplified way of DPP calculation: the payback was finished in that year when NPV firstly turning into positive.

NPV is the figure we calculate by taking the difference between the summed discounted present values of all the annual net cash flows and the initial layout.

The year of initial investment that is the planting year in our case is called year zero, and the coming years refer to the age of the plantation. As it can be seen, we took 15 years of age, so 12 productive years into account. In year zero, there was 3 100 000 HUF expense that was the cost of planting itself. *Table 3.* shows that NPV is negative in the beginning years. Revenues and expenses are almost equal in the second year, and the increasing yields cause that the annual cash

Table 3. Realistic parameters for investment appraisal (100% own source)

Age (year)	Revenue (thousand HUF/ha)	Expense (thousand HUF/ha)	Net Cash Flow (thousand HUF/ha)	Discounted N.C.F. (thousand HUF/ha)	Cumulative D.N.C.F. (thousand HUF/ha)	NPV (thousand HUF/ha)
0.						–3 100.0
1.	0.0	270.0	–270.0	–252.3	–252.3	–3 352.3
2.	285.4	280.0	5.4	4.7	–247.6	–3 347.6
3.	713.4	400.0	313.4	255.9	8.2	–3 091.8
4.	1 284.2	701.3	582.9	444.7	452.9	–2 647.1
5.	1 769.3	1 039.5	729.8	520.4	973.3	–2 126.7
6.	1 997.6	1 189.5	808.1	538.5	1 511.8	–1 588.2
7.	1 997.6	1 189.5	808.1	503.3	2 015.0	–1 085.0
8.	1 997.6	1 189.5	808.1	470.3	2 485.4	–614.6
9.	1 997.6	1 189.5	808.1	439.6	2 924.9	–175.1
10.	1 997.6	1 189.5	808.1	410.8	3 335.8	235.8
11.	1 997.6	1 189.5	808.1	383.9	3 719.7	619.7
12.	1 997.6	1 189.5	808.1	358.8	4 078.5	978.5
13.	1 997.6	1 189.5	808.1	335.3	4 413.8	1 313.8
14.	1 769.3	1 171.5	597.8	231.8	4 645.7	1 545.7
15.	1 541.0	1 153.5	387.5	140.5	4 786.2	1 686.2

Source: own calculation

flows turn into positive, improving the NPV. The NPV turns into positive in the tenth year, which means that the initial capital has been recovered by the end of this year.

The NPV patterns in log term for the three considered cases such as realistic, optimistic, and pessimistic are shown in *Figure 1.* As it can be seen, under normal conditions – that is the realistic case with 65 HUF/kg price for apple for fresh consumption and average yield of 35 t/ha here – NPV turns into positive in the tenth year only, which means that DPP is ten years. The sensitivity analysis resulted in year 7 as turning point into positive in optimistic case with 75 HUF/kg price for apple for fresh consumption and average yield of 40 t/ha, and in pessimistic case with 55 HUF/kg price for apple for fresh consumption and average yield of 30 t/ha there is no such turning point reached in the lifetime.

In the optimistic case, NPV is 5 355 000 HUF by the end of year 15, and NPV is 1 686 000 HUF in the realistic case, which means that this is that sum of money (expressed in present value!) by which we could have generated more relative to the opportunity of initial capital (3 100 000 HUF) tied up at interest rate of 7% at a bank for 15 years. It is the optimistic version that gives an outstanding figure, while figure in the realistic version only being acceptable. In the pessimistic case, the figure is negative and –1 494 000 HUF only, that cannot be acceptable at all.

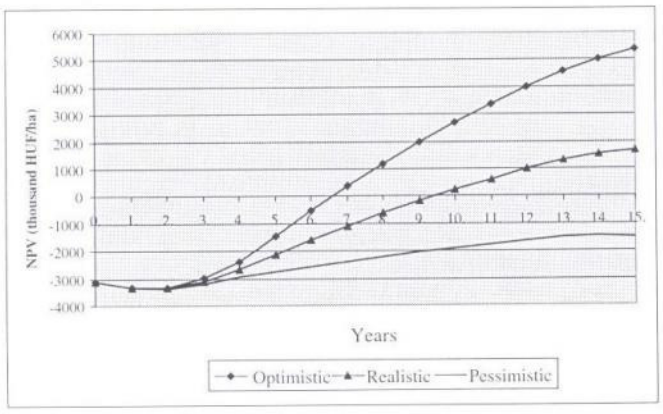

Figure 1. NPVs and paybacks for different cases (financed by 100% own source)

On the whole, it can be stated that investment financed totally by own source demands yields of 35–40 t/ha and prices of 65–75 HUF/kg, providing 90% ratio of the total apple production with quality suitable for fresh consumption, to worth being made. If the conditions are worse than the former ones, the investment is not worthwhile compared with the opportunities to tie up as a long-term bank deposit or to invest government securities.

Investment financed by 55% own source completed with 45% subsidy

Presently, it is the National Development Plan that provides 45% EU subsidy for plantation establishment, by which the farmer can reduce the cost of planting and three year of treatment compared with the 100% own sourced version *(table 4.)*. Subsidies are favourable for the payback of investments, since the farmer does not have to pay for the total cost by his own money put up in his farm business.

NPV functions in figure 2. are based on the same parameters – except the way of finance of course – like functions in figure 1. It can be stated that NPV turns into positive between year 5 and 12, which is the effect of the subsidy.

This is favourable, since it is two and three years after starting productive period in the optimistic and the realistic versions, respectively, when NPV turns into positive (NPV figures =

Table 4. Realistic parameters for investment appraisal (55% own source+45% subsidy)

Age (year)	Revenue (thousand HUF/ha)	Expense (thousand HUF/ha)	Net Cash Flow (thousand HUF/ha)	Discounted N.C.F. (thousand HUF/ha)	Cumulative D.N.C.F. (thousand HUF/ha)	NPV (thousand HUF/ha)
0.						–1 705.0
1.	0.0	148.5	–148.5	–138.8	–138.8	–1843.8
2.	285.4	154.0	131.4	114.7	–24.0	–1729.0
3.	713.4	220.0	493.4	402.8	378.8	–1326.2
4.	1284.2	701.3	582.9	444.7	823.5	–881.5
5.	1769.3	1039.5	729.8	520.4	1343.8	–361.2
6.	1997.6	1189.5	808.1	538.5	1882.3	177.3
7.	1997.6	1189.5	808.1	503.3	2385.6	680.6
8.	1997.6	1189.5	808.1	470.3	2855.9	1150.9
9.	1997.6	1189.5	808.1	439.6	3295.5	1590.5
10.	1997.6	1189.5	808.1	410.8	3706.3	2001.3
11.	1997.6	1189.5	808.1	383.9	4090.2	2385.2
12.	1997.6	1189.5	808.1	358.8	4449.0	2744.0
13.	1997.6	1189.5	808.1	335.3	4784.4	3079.4
14.	1769.3	1171.5	597.8	231.8	5016.2	3311.2
15.	1541.0	1153.5	387.5	140.5	5156.7	3451,7

Source: own calculation

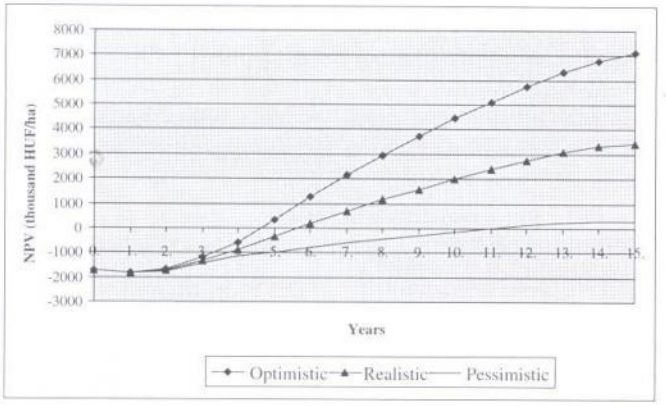

Figure 2. NPVs and paybacks for different cases (55% own source+45% subsidy)

7 121 000 HUF and 3 452 000 HUF). Although NPV is still low (272 000 HUF) by the end of year 15 in the pessimistic case, this is clear that initial layout is paid back in fifteen years even in the worst case, so the investment is worthwhile.

Conclusions

Plantation establishment financed by 100% own source demands 7–10 years to be paid back under normal and favourable conditions, but it is not worthwhile in pessimistic case (under unfavourable conditions). The investment is highly possible to be paid back in 5–6 years if 45% of subsidy is included, but it also occurs in 12 years even if the conditions are unfavourable.

As consequences we have to highlight that plantation establishment is not worthwhile if financed without subsidy, because the payback period will be so long or NPV will not turn into positive over the lifetime of the investment. It is vital for the right figures to gain average yields of 35–40 t/ha and realize at least 65–70 HUF/kg prices, even if the financing is completed by the subsidy of 45% .

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