The Evaluation of Economic Investments' Efficiency in the Context of a Green Economy. A Case Study for Apple Trees Plantation

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Abstract. Specific for the investment project in agriculture, as well as in other areas of activity is the fact that all the efforts and economic effects are not registered in the same period of time. As it is known, from the moment of beginning the financing and realizing the investments, even in the agriculture projects, the projected requires huge amounts of material, human and financial resources. This is the reason why, for a better substantiation of the investment projects, it appears the necessity of bringing up to date calculations (carried out by dynamic indicators of the economic efficiency of investments). In this context it is necessary to point out the whole aspects that characterize the use of bringing up to date calculations in evaluating the economic efficiency of the investment projects in agriculture.

Keywords: investments, economic efficiency, investment plan, actualized income

INTRODUCTION

In this paper the main purpose is the realization of an economic analysis about the evaluation of the economical efficiency of a process of investment concerning the setting up and the exploitation of an apple trees plantation, in the general context for a functional market economy. Numerous studies made, such as Subić (2009) or Vasiljević (2006) relieve the importance of efficiency analysis made in case of investments projects, especially in agricultural projects where the risk is much more than in the others, in general context of capitalizing the economic potential.

This analysis concerns about the economical opportunity and the economical efficiency of investments by comparing the required effort for the fulfilment of these investments and the acquisition of production with the economical effects which are to be obtained in the case of their comparability through bringing up to date calculations. Using the economical analysis it might be established the profitableness of the project variant at the level of the national economy. This is the reason why a complex system of efficiency indicators which have a lot of advantages is used, among which that of assuring the evaluation of economic efficiency both of the microeconomics level and macroeconomics level. The agricultural investment presents some particularities as it was relieved in many studies as Cicea et al. (2008), Subic (1999) or Burja and Burja (2009). In this context for determination of the main indicators of economic efficiency it was used mainly the BIRD methodology.
MATERIALS AND METHODS

The general context of this papers is the setting up an apple trees plantation on a surface of 10 ha having the duration of the execution (realization) of the economical objective about four years \( (d = 4) \), and the efficient duration of the exploitation 20 years \( (D_e = 20) \). The early investments and the annual interest are recorded at the end of every year (the December 31). For the realization of this project, there is an investment effort of \( I_i = 66.544 \) € (made up as it comes: \( I_j = 5.458 \), \( I_2 = 27.021 \), \( I_3 = 295 \) and \( I_4 = 498 \)). As the agricultural exploitation can support just a part from total value, meaning 33.272 € (50% from the whole value) the rest of 33.272 € (50% from the value) represents attracted (gained) financial sources. Also the Serbian Agricultural Bank, where the loan is taken, requires the following condition to be accomplished: the volume of the bank loan, expressed in EURO is 33272 €. The loans are received at the beginning of the third and the fourth years, meaning \( C_{i3} = 12.392 \) € and \( C_{i4} = 20.880 \) €, the interest rate is 12 %, the repayment is made annually (on December, 31 of each year) and has a period of 3 years and the period of grace for the loan is 2 years for the third year, and a year for the loan in the fourth year.

In these conditions, the calculation of the bank returning sum requires the following calculus (Romanu and Vasilescu, 2007, Cicea et al., 2008):

\[
S_{ht} = O_b \times \frac{(1 + r_d)^n \times r_d}{(1 + r_d)^n - 1} \quad \text{where the} \quad O_b = \sum_{h=1}^{n} C_{bh} \times (1 + r_d)^{t+1-h}
\]

By replacing the known data in the relation above, we obtain:

\[
O_b = 12.392 \times (1 + 0.12)^2 + 20.880 \times (1 + 0.12)^1 = 33.272 \text{ €}
\]

It comes that the annual amount which has to be paid to the bank is:

\[
S_{ht} = 33.272 \times \frac{(1 + 0.12)^4 \times 0.12}{(1 + 0.12)^3 - 1} = 33.272 \times \frac{1.404928 \times 0.12}{1.404928 - 1} = 16.208 \text{ €}
\]

So, the annual amount which has to be paid to the bank is 16.208 €, where 15.352 € (respectively: 48.624 €-33.272 €) is the interest which has to be paid for the bank loan. The main technical-economic indices which characterize the investment project are presented in the Table no.1. The income tax \((im_p)\) is 20%, from which the agricultural exploitation is absolved in those years when a big loss is registered or the annual profit is under 4.674 €, having in view the whole period of functioning of the apple trees plantation \((d + D_e)\).
The floods of inns and outs, concerning the apple trees plantation (a 10 ha)

<table>
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<th>Values</th>
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<td>1. The value of the investment during the period of execution, where:</td>
<td>€</td>
<td>€ 66544.0000</td>
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<tr>
<td>a) Proper capital, where:</td>
<td>€</td>
<td>€ 33272.0000</td>
</tr>
<tr>
<td>year 1</td>
<td>€</td>
<td>5458.0000</td>
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<tr>
<td>year 2</td>
<td>€</td>
<td>27021.0000</td>
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<tr>
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<td>€</td>
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<td>€</td>
<td>498.0000</td>
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<td>b) Borrowed capital (credit), where:</td>
<td>€</td>
<td>€ 33272.0000</td>
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<tr>
<td>year 1</td>
<td>€</td>
<td>0.0000</td>
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<tr>
<td>year 2</td>
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<tr>
<td>year 3</td>
<td>€</td>
<td>12392.0000</td>
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<td>year 4</td>
<td>€</td>
<td>20880.0000</td>
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<tr>
<td>2. Annual costs (average) of production during the period of the execution, where:</td>
<td>€</td>
<td>€ 4388.0000</td>
</tr>
<tr>
<td>year 3</td>
<td>€</td>
<td>2322.0000</td>
</tr>
<tr>
<td>year 4</td>
<td>€</td>
<td>6454.0000</td>
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<td>3. Annual income (average) during the period of the execution, where:</td>
<td>€</td>
<td>€ 11766.0000</td>
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<tr>
<td>year 3</td>
<td>€</td>
<td>6724.0000</td>
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<td>€</td>
<td>16808.0000</td>
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<td>€</td>
<td>€ 41884.0000</td>
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<td>€</td>
<td>€ 81016.0000</td>
</tr>
<tr>
<td>a) Capacity of production ($q_h = constant$)</td>
<td>kg</td>
<td>260000.0000</td>
</tr>
<tr>
<td>b) unit price ($p_h = constant$)</td>
<td>€/kg</td>
<td>0.3116</td>
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<td>B. The existent crop before planting (Lucerne)</td>
<td>€</td>
<td>€ 4511.0000</td>
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<tr>
<td>1. Annual costs of production ($C_h = constant$)</td>
<td>€</td>
<td>€ 4511.0000</td>
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<tr>
<td>2. Annual income ($V_h = constant$):</td>
<td>€</td>
<td>€ 7819.0000</td>
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<tr>
<td>a) Capacity of production ($q_h = constant$)</td>
<td>kg</td>
<td>94700.0000</td>
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<tr>
<td>b) unit price ($p_h = constant$)</td>
<td>€/kg</td>
<td>0.0826</td>
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<td>C. Interlaid crop (potatoes) – the tilled surface is 5 ha</td>
<td>€</td>
<td>€ 10956.0000</td>
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<tr>
<td>1. Annual costs of production during the period of execution ($C_h = constant$)</td>
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<td>€ 10956.0000</td>
</tr>
<tr>
<td>2. Annual income of production during the period of execution ($V_h = constant$):</td>
<td>€</td>
<td>€ 17204.0000</td>
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<tr>
<td>a) Capacity of production ($q_h = constant$)</td>
<td>kg</td>
<td>115000.0000</td>
</tr>
<tr>
<td>b) unit price ($p_h = constant$)</td>
<td>€/kg</td>
<td>0.1496</td>
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RESULTS AND DISCUSSION

Using the general calculus formulas describes in the literature (Andrić, 2005; Romanu and Vasilescu, 1997; Jitea, 2009; Gittinger, 1972) it was realized an economic analysis regarding the investment efficiency for a apple tree plantation. For confidential reasons the place and the name of the investment project remained undisclosed.

The total actualized income. Using the general form of the index which express the total volume of the revenues obtained during the whole period of functioning of the investment objective. They are made up especially by the value of the merchandise production. In the case of the apple trees plantation, the formula for the total internal income is:

$$\Delta V_{ta} = \sum_{h=1}^{d+D_f} \Delta V_h \times \frac{1}{(1+a)^h}$$
Where the $\Delta V_{at}$ represents the increase from the total actualized income, $\Delta V_h$ is the increase obtained in the year \( h \), $V_h^\Delta$ is the annual loss, realized in the period \( (d+D_e) \), -the annual income of the interlaid cultures, obtained during the period of execution \( (d) \) and the $\Delta V_{at}$ is the annual income of small fruit, obtained during the period of execution \( (d') \).

The calculation of the total actualized income, leads to the following result:

$$\Delta V_{at} = 273.161 \text{€}$$

**The total actualized costs.** This index reflects the total effort made by the investor, which includes both the costs of the investments and the costs of production. There must be said that the costs of production do not include the decrement. The calculation of the total actualized costs, in the case of the apple trees plantation is:

$$\Delta C_{at} = \sum_{h=1}^{d+D_e} (I_h + \Delta C_h) \times \frac{1}{(1+a)^h} \Rightarrow \Delta C_{at} = \sum_{h=1}^{d+D_e} \Delta C_{ih} \times \frac{1}{(1+a)^h}$$

Where the $\Delta C_{at}$ represents the increment of total actualized costs, $I_h$ is the annual investments, $\Delta C_h$ is the increment of the total production costs, calculated using the formula: $\Delta C_h = (C_h + \Delta C_h + \Delta C_{ih}) - C_h$, where: $C_h$ define the annual costs of production for the previous crop, realized in the period \( (d+D_e) \), $\Delta C_h$ represents the annual costs of production for the interlaid cultures, pointing out to the period of execution \( (d) \), $\Delta C_{ih}$ is annual costs of production for the small fruit, concerning the period of execution \( (d') \) and the $\Delta C_{ih}$ is the increment of total annual costs.

We underline the fact that, the investment project has an efficient cost and it is acceptable if the value of the total actualized costs is inferior to the value of the total internal income \( C_{at} < V_{at} \). After making the calculation of the actualized costs, it appears that: $\Delta C_{at} = 200.082$ €

**The ratio between the total actualized incomes and total actualized costs.** Also known under the name of the analysis „incomes/costs” or „benefits/costs”, (Cicea et al.2008) the indicator expresses the total actualized incomes (gross) which are obtained at a monetary unit, total effort with the studied investment and actualized production. In the case of the investment project the ratio between the total actualized incomes and the total actualized costs is established using the formula:

$$R = \frac{\sum_{h=1}^{d+D_e} \Delta V_h \times \frac{1}{(1+a)^h}}{\sum_{h=1}^{d+D_e} (I_h + \Delta C_h) \times \frac{1}{(1+a)^h}} \quad \text{or} \quad R = \frac{\Delta V_{at}}{\Delta C_{at}}.$$ 

In this context the “$R$” represents the ration between total actualized incomes and costs. The value of the indicator, established using the incomes and the costs, is the following:
The condition $R > 1$ was accomplished, we believe that this project variant is efficient because we obtain better incomes as compared to the efforts (the investment and the costs of the production).

**The cash flow.** It is an index which expresses the daily situation, meaning which is the income or the loss for each year of calculation. It is established that the difference between annual incomes and the total annual costs made up in the realization of the project of investment. The formula for the cash flow, for the apple trees plantation, is the following

$$F_h = \Delta V_h - (I_h + \Delta C_h),$$

In our case the actual values of the cash flow are:

\[
\begin{align*}
CF_{1a} &= -2.190 \; \text{€;} \\
CF_{2a} &= -18.208 \; \text{€;} \\
CF_{3a} &= -3.514 \; \text{€;} \\
CF_{4a} &= -6.077 \; \text{€;} \\
CF_{5a} &= 2.940 \; \text{€;} \\
CF_{6a} &= 1.731 \; \text{€;} \\
CF_{7a} &= 2.903 \; \text{€;} \\
CF_{8a} &= 7.324 \; \text{€;} \\
CF_{9a} &= 10.590 \; \text{€;} \\
CF_{10a} &= 13.024 \; \text{€;} \\
CF_{(11-16)a} &= 49.283 \; \text{€;} \\
CF_{(17-20)a} &= 11.366 \; \text{€;} \\
CF_{(21-24)a} &= 3.907 \; \text{€}.
\end{align*}
\]

According to the expectations, the value of the index during the years the investment is made is negative (1 – 4), and during the rest of the years (5 – 24) is positive and reflects a favourable situation for the studied agricultural exploitation. Considering the actualized calculations, the value of the index is $\Delta V_{\text{NA}} = 73.079 \; \text{€}$. It can be seen a favourable situation for the studied agricultural exploitation which covers all the costs and also offers a good enough profit.

**The Internal Rate of the Investments Profitability.** This indicator (RIRE) is the internal rate to which the agricultural exploitation does not have profit, the total costs (of the investments and exploitation), on a time duration $(d + D_e)$. In this case the increment of the internal net income actualized is zero ($\Delta V_{\text{NA}} = 0$), and the ratio income/costs equals 1 ($R = 1$). In the economic analysis, concerning the case of the fruit trees plantation, the index takes the form of internal rate of economic profitability and is obtained using the formula (Subić 2003):

$$RIRE = a_{\text{min}} + (a_{\text{max}} - a_{\text{min}}) \times \frac{\Delta V_{\text{NA}(+)} \times \Delta V_{\text{NA}(+) + \Delta V_{\text{NA}(-)}}}{\Delta V_{\text{NA}(+) + \Delta V_{\text{NA}(-)}}},$$

In our case, $D_e > 15$ where the internal coefficient corresponding to the ratio of the annual average profit and the total investment and this rate is the calculation limit for the actualized rate. In the case of an apple trees plantation, we will consider $a_{\text{min}} = 30\%$ and $a_{\text{max}} = 35\%$, from here we have the calculated actualized values. Applying the formula above, we have:

$$RIRE = 0.30 + (0.35 - 0.30) \times \frac{3.847}{3.847 + [-2.640]} = 0.33$$

As the actualized rate of economic profitability is bigger than the actualized factor $(RIRE > a$, respectiv $33% > 15\%$), we can see that this variant of the project is profitable.
The Break Even point. When speaking about objectives with a huge capacity of production, the attention is attracted by a „critical point“ under which the degree of using the capacity of the production can’t bring down because the objective could register a great loss and it could not bring back the invested capital (Subić 1999 and Jitea 2009). That is why it’s absolutely necessary a deep analysis in order to establish the minimum degree of using the capacity of the projected production, so it can bring back a minimum profit or for the agricultural exploitation not to work with any loss. Inside the studied project, in order to establish the break even point, during an efficient functioning we will act in the following way. For the project it was considered an annual physical average production \( q_h = 260,000 \) kg/ha and an unit price for selling \( p_h = 0.3116 \) €/kg, so the annual average value of merchandise production will be \( PM = 81,016 \) €. It was also considered that the annual costs of the production \( C_h = 41,884 \) €, where: -35% represents overhead charges \( (CF = 14,659) \) and -65% represents variable expenses \( (CV = 27,225) \). By replacing the known date in the formula we obtain:

\[
PR = \frac{14,659}{81,016 - 27,225} \times 100 = 27.2518\%
\]

This means that the agricultural exploitation has to organize itself so that the capacity of production to be used to be of approximately 22.2518%. If not the plantation registers a loss which leads it to bankruptcy.

The Sensitivity Analysis of the project investment. For every investment project and during every type of analysis (economic or financial), the BIRD methodology also recommends an analysis which implies the economic risk and incertitude. In other order, it is absolutely necessary that for a correct estimation of the efficiency of an investment of a project to consider and analyze the possible changes that may appear in the evolution of the agricultural exploitation. (Vasiljević 2007 and Subić 2006) This is the reason why the sensitivity analysis is used. By the use of this analysis one can determine how sensitive is the future objective to some changes (especially negative changes), which will appear for sure in its period of functioning. It can be established what is the influence of the change of the selling price of the final product or of the tax for services, the price of some raw material, of the currency, the growth of the production costs, the diminishing of the crops per hectare, per animal, or fruit tree, etc on the studied project. All these changes influence more or less the international rate of profitableness of the investment project. This is the reason why, it is recommended that the investment project to be tested by some simulations in order to determine the influence they have on the project. During the testing it is necessary to calculate the two internal rates of profitableness and especially the internal financial rate of profitableness (RIRF), because here one can see better the influences that may appear on the investor’s side. In the case of the apple trees plantations, we will test the sensitivity of the project in conditions of the rising of the costs of production for 25% starting with the 11th year of the total exploitation (as a result of the growth of wages), as well as the diminishing of the incomes with 15% in the last four years of the total exploitation of the plantation (as a result of the diminishing of the crops per hectare). The actualized calculations, lead us to the following results:

- for the economic analysis:
  
    a) the ratio between the total actualized income and costs
\[
R = \frac{\Delta V_{ua}}{\Delta C_{ua}} = \frac{271.403}{215.698} = 1.26 \text{ € total income to 1€ total costs;}
\]

b) the net actualized income
\[
\Delta V_{NA} = \Delta V_{ua} - \Delta C_{ua} = 271.403 - 215.698 = 55.705 \text{ €;}
\]

c) the internal rate of economic profitableness:

\[
R_{IRE} = a_{\min} + \left( a_{\max} - a_{\min} \right) \times \frac{VNA(+)}{VNA(+)|VNA(-)|} = 0.30 + \left( 0.35 - 0.30 \right) \times \frac{1.113}{1.113 + 4.249} = 0.31
\]

- for the financial analysis:

a) the ratio between the total actualized income and costs
\[
R = \frac{\Delta V_{ua}}{\Delta C_{ua}} = \frac{291.929}{252.229} = 1.16 \text{ € total income to 1 € total costs}
\]

b) the net actualized income
\[
\Delta V_{NA} = \Delta V_{ua} - \Delta C_{ua} = 291.929 - 252.229 = 39.700 \text{ €;}
\]

c) the internal rate of financial profitableness

\[
R_{IRF} = a_{\min} + \left( a_{\max} - a_{\min} \right) \times \frac{VNA(+)}{VNA(+)|VNA(-)|} = 0.30 + \left( 0.35 - 0.30 \right) \times \frac{4.720}{4.720 + 1.537} = 0.29
\]

It can be see that, after making the changes, the actualized rate of economic profitableness (RIRE), which expresses efficiency at microeconomic level, hasn’t changed significantly from the initial variant (31% as against 33%). But, more important is the fact that neither the actualized rate of financial profitableness (RIRF) which reflects the economic efficiency at microeconomic level, hasn’t changed too much (29% as against to 31% for the situation). In addition it can be noticed that, nor the other analyzed indices (the ratio between total actualized incomes and costs, as well as the net actualized income) don’t have significant changes as compared to the initial situation. In these circumstances, the investment project is efficient despite the unpropitious conditions presented.

CONCLUSIONS

Based on the above research, it results that the use of these indices in the BIRD methodology, in analyzing the economic efficiency of the investment projects, creates the necessary conditions for a better evaluation to the level of economic efficiency, as well as the acknowledgement of a minimum limit of economic usage of the capacities of production. However every usage of BIRD methodology must be reconsidered in the specific context of
the agricultural production which is realized and goes to the appearance of incomes from selling. For instance, in the case of fruit and wine growing, beyond all organizational measures for a good production development, the realization of the production is tied with atmosphere conditions (very low temperatures in spring, when the plant blossoms, can attack the crops—the situation can only be partly prevented and its reduced effects by using some networks or foils for protection spread over the plantation, solutions which unfortunately are very expensive and difficult to realize for the agriculturists in Serbia). Also, in summer time very high temperatures and the lack of precipitations can affect the quantity of crops, especially in the situation of some irrigation networks less performing or adversative.

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