

## **CHAPTER 7: ECONOMIC ANALYSIS OF THE AGRICULTURAL OPERATION AND AGRICULTURAL PRODUCT PRODUCTION**

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## **7. ECONOMIC ANALYSIS OF THE AGRICULTURAL OPERATION AND AGRICULTURAL PRODUCT PRODUCTION**

### **INTRODUCTION**

This unit elaborates on the economic aspect of agricultural production. The main concepts, the methods used, as well as the results of the economic analysis of the agricultural operation are presented.

### **KEY CONCEPTS**

Technical unit, Agricultural production sector, Agricultural operation, Agricultural region, Production factors, Expenditure, Profit/loss

### **TERMS**

Accounting year: An accounting year (commonly fiscal year) is the accounting period between two consecutive balance sheets, which usually covers a 12 month term.

### **UNIT GOALS**

After completing this unit, the trainees:

- ⇒ Will understand the Economics of agricultural product production
- ⇒ Will be familiarised with the economic fundamentals and relationships
- ⇒ Will understand how economic parameters affect agricultural production

## **7.1 MEANING, CONTENT, PURPOSE OF THE ECONOMICS OF AGRICULTURAL PRODUCT PRODUCTION**

### **7.1.1 Meaning**

More specifically, the economics of agricultural product production study the principles of the economics of production, that are connected with making decisions regarding the use of the available factors for the production of crops and livestock. The economics of agricultural product production is the oldest and most extended sector of agricultural economics, since the latter started and continue to develop basically as a study of the economics of the production of crops and livestock.

### **7.1.2 Content**

The economics of agricultural product production include the relationship between factors and products, the relationship between factors and the relationship between products. The economics of agricultural product production further include issues related to nature and the

The economics of agricultural product production is the implementation of the principles of production economics on the production of plant and animal products. The economics of agricultural product production further include issues related to nature and the combination of production factors, the methods and techniques of agricultural production led by agricultural programming, the production cost of crops and livestock, the performances of scale and the size of the operations, agricultural productivity and effectiveness, the absolute and comparative

advantage in combination with the determination of the position of the production of the various crops and livestock, the risk and uncertainty that affect decision making, etc. Agricultural accounting and agricultural appraisal are closely linked with the economics of agricultural product production and specifically the analysis and measurement of the effectiveness of their production.

### **7.1.3 Purpose**

The purpose of the economics of agricultural product production is the utilization of the restricted quantities of available factors through the production of crops and livestock, which ensure the maximization of the family's and the national agricultural income. Furthermore, the purpose of the economics of agricultural product production is the selection of those alternative combinations of available factors that lead to the minimization of the production cost of crops and livestock. In other words, the purpose of the economics of agricultural product production is connected with making decisions on the one hand on the selection of that alternative way of using the available factors to ensure maximization of the volume of produced products and on the other hand on the combination of the products that will ensure the maximum economic result.

The economics of agricultural product production are not limited only to the determination of the use of the production factors, but also proceed to determine the way in which these factors must be used. This is verified if we take into account that the basic pursuit of the economics of agricultural product production is to reach a given quantity for each agricultural product with the smallest possible quantity of production factors or a maximum quantity of each agricultural product with a given quantity of production factors.

We present a comprehensive example in order to understand the meaning, the content and the purpose of the economics of agricultural product production. We have an operation with agricultural land, cows, agricultural machinery as well as some employees working on it. We want to produce the greatest possible quantity of products at the lowest cost. Our final goal is to gain as much money as possible.

Which actions are to our best interest? To produce animal feed on our own or to buy it and grow other plants on our fields, but no animal feed? How many tractors and other machinery do we need to finish the farming works quickly and correctly at the lowest cost? Must we own all the machinery required for the crops and harvest of animal feed or how many more permanent and how many more seasonal workers must we employ to finish in time all the works? The best possible use of the above production factors is, in simpler words, the economics of production.

## **7.2 BASIC CONCEPTS AND RELATIONSHIPS OF THE ECONOMICS OF AGRICULTURAL PRODUCT PRODUCTION**

In order to better understand the economics of agricultural product production it is necessary to present certain basic concepts and relationships connected to it. These concepts and relationships are:

### **7.2.1 Basic concepts**

**a) Technical unit, production sectors, agricultural operation and agricultural region:**

**Technical unit** is a simple production unit.

It is the basis for calculating technical factors, i.e. those indicators that show the level of the technology applied in farming. Such units are e.g. one stremma, etc., whereas the technical factors are e.g. the required labour per stremma of crops, the quantity of fertilizer per stremma of crops, etc.

An **agricultural production sector** is a group of technical units, e.g. the cultivation of 10 stremmas of cotton.

An **agricultural operation** is a production unit or group of agricultural production sectors under the management of a single producer.

The farm is also a technical-economic unit, meaning that it consists of a number of production factors, the combined use of which in plant production sectors creates cost and produces revenue. An agricultural operation is the subject of agricultural microeconomics.

For example, the operation of the previous unit, with crops and livestock, is a an agricultural operation.

An **agricultural region** is a geographic region where certain plants are grown.

The agricultural region is a group of agricultural operations of the same or a different type of production, considered as whole both from the aspect of production factors and from the aspect of cost, revenue and income. The agricultural region as a unit of space is an object of agricultural macroeconomics.

## **b) Production factors:**

A **production factor** is any factor used during the process of agricultural product production.

Specifically, production factors are those factors which either themselves or their services are converted into products during a production procedure. Seed, fertilizers, fuel, pesticides, etc. fall under the first category, and soil, labour, buildings, machinery, etc. fall under the second category. There are basically two categories of production factors, on the one hand fixed and on the other variable production factors. Fixed production factors (such as buildings, machinery, etc) depend, within specific limits, on the size of the production sectors and are subdivided into factors that can serve multiple production sectors (e.g. tractor) and those than cannot serve multiple production sectors (sugar beet harvester, cotton picker). The variable production factors (such as seed, fertilizers, animal feed, etc.) change with the size of the production sectors and can be allocated between these sectors. The distinction of production factors into fixed and variable is of great importance for the calculation of technical factors, their presence being useful for programming agricultural product production and making the relevant decisions.

As we know, the main production factor for agriculture is land. To better understand agricultural

factors and for more details on the factor of Land and agricultural production you can read the corresponding document titled "Factors of Production".

### c) Product and production:

**Product** is the result of the use of the production factors or the conversion of their services.

A product for example is wheat, corn, cotton, tobacco, vegetables, milk, meat, eggs, etc. When we say production we mean the procedure for converting the services of two or more factors (e.g. land, labour, seed, fertilizers, animal feed, etc.) into one or more products.

## 7.2.2 Basic relationships

### a) Production function:

**Production function** is a technical and mathematical relationship, that describes the method and the extent to which a specific product depends on the quantities of the used factors or their services.

A production function is expressed in three ways, e.g. arithmetically, geometrically and algebraically. It is arithmetically expressed with a table; the one column includes the values of the production function and the other column the values of the produced product. It is geometrically presented in the form of a diagram, where the horizontal axis (X) represents the values of the factor and the vertical axis (Y) represents the values of the product. Finally, it is algebraically expressed in the form of an equation:

$$- Y = f(X)$$

- where Y is the produced product, as a dependent variable, and X the variable factor, as an independent variable.

We will mention here an example where labour will be the production factor and the production of watermelons will be the product.

As production factor unit we will have the MWU<sup>1</sup> (Man-Work Unit). The production factor will be the tons of watermelons produced. For labour equal to 1 MWU 12 tons of watermelons are produced, whereas for 2 MWUs, 30 tons are produced, for 3 MWUs 44 tons, etc. If we express it in the form of a table it takes the following form.

Production factor (MWU)(1)	Total product (tons of watermelons)(2)
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<sup>1</sup> Production factor (MWU)(1)

0	0
1	12
2	30
3	44
4	54
5	62

**b) Selection indicator:**

The **selection indicator** is the criterion that shows which of the two or more alternative combinations is the optimum one, meaning the one that will maximise the expected economic result.

Examples of selection indicators are the relationship between the prices of the products, the ratio of substitution of production factors, etc. In other words, deciding between alternative solutions is based only on the existence of one indicator which is a criterion or measure of selection of one of the alternative solutions. The selection indicators are always given in the form of a relationship.

In the economics of agricultural product production almost all the problems involve selection indicators or relationships, because their presentation shows the relevant value or gravity connected to one solution compared to another. Selection indicators are also used in the cases where there are two or more alternative combinations and either the one that achieves maximum product with the same cost or the one that ensures minimum cost for the production of the same product is preferred. Selection indicators refer in general either to profit maximisation problems or cost minimization problems.

In the previous example we will add an extra column which will be filled-in with numbers that are the quotient of columns

Total product/production factor i.e. Column 2/ Column 1

Production factor (MWU)(1)	Total product (tons of watermelons)(2)	Selection indicator(3) (2):(1)=(3)
0	0	0
1	12	12
2	30	15
3	44	14,7
4	54	13,5
5	62	12,4

The third column essentially shows us how many tons of watermelons may be produced depending on the number of workers we use.

In observing column (3) we conclude that with the use of 2 workers, the average production goes up to 15, whereas the employment of 3 workers reduces the average performance at 14.7 and it continues to decrease as the workers increase.

Therefore, profit maximisation is achieved with the use of 2 workers.

### c) Equal product quantity curve:

An **equal product quantity curve** is the curve on which all possible combinations of the two production factors produce the same quantity of product.

In other words, the equal product quantity curve shows all possible combinations of the two production factors for the production of a given quantity of product. It is noteworthy that along an equal product quantity curve the level of production remains fixed but the ratio of the combination of the two factors constantly changes.

All the combinations of the two factors along the equal quantity product curve are technically possible, but only one of them is the most economically efficient one, the one that achieves the same quantity of product at minimum cost. The equal product quantity curve is graphically represented on a system of rectangular axes as a curve with its ends becoming asymptotes on the two axes.

E.g.

We want to spray two stremmas of trees. Our purpose is to find the best combination of the factors of production which consist of mechanical and human labour. This means that the more we use mechanical labour (tractors) the more human labour is decreased, and the vice versa, always referring to the spraying of 2 stremmas. A combination of the two factors performs the most economic result in the specific agricultural work. For example, the participation of human to machine labour could be 1:2 to result in the best economic result in the operation.

### d) Equal cost line:

**Equal cost line** is that line that shows the quantities of all the possible combinations of the two variable factors that can be bought with a given quantity of money.

In other words, each one of all the possible combinations of the two production factors has the same total cost. The equal cost line is graphically represented on a system of rectangular axes as a line with its ends ending on the two axes.

### e) Production curve:

**Production curve** is a curve that shows the limits of all possible combinations of the products of two production sectors, which can be produced from a given quantity of the variable factor or the quantity of each product which can be produced from a given cost.

### f) Equal income line or price line:

**The equal income line or price line** is the line or curve that shows the relationship of the prices of two competitive production sector products.

In other words, an equal income line or price line is a line which determines all possible combinations of the two production sectors that achieve equal income.

### 7.3. MEANING, CONTENT AND SIGNIFICANCE OF MOST IMPORTANT ECONOMIC RESULTS

The most important economic results, that are linked with the production of agricultural products, is the gross revenue or gross income, production expenses, profit or loss, the agricultural income, the agricultural family income, the revenue from the land, revenue or income from work, net revenue with return of capital, gross profit and income outside the agricultural operation.

#### a) Gross revenue or gross income:

**Gross revenue or gross income** is the total produced quantity of products, in their broader meaning, expressed in money, which is achieved as a result of the economic activity developed in an economic unit in a specific period of time.

The content of the gross revenue or gross income differs depending on the economic unit, meaning that the content when referring to an entire agricultural operation is different than when we refer to an independent agricultural production sector. The gross revenue or gross income of an agricultural operation (specifically its production plan) consists of the value of the sold products (as they are or as processed within the operation, such as grapes or wine), granted to foreign workers or foreign machinery in the form of a fee, available for covering family needs, products found in storage at the end of the accounting year, the seed of own production available or intended for sowing appraised products, as well as in the form of wood or saplings of appraised products and not sold until the end of the accounting year.

If a producer has cows, then, as gross revenue, we would recognize the sum of the money that would arise from:

- The money collected from the sale of milk-meat
- The amount in euros that all the products spent for feeding the family cost which came from raising the cows.
- Anything in the refrigerator or storage (meat-milk).

#### b) Production expenses:

**Production expenses** of an agricultural operation or an agricultural production sector are all types and forms of realized expenses and generally sacrifices during the production procedure for producing the products which are the gross revenue of the operation or the production sector.

It is the sum of the total expenses for the operation, as in the case of the watermelon producer:

The purchase of seed, the salaries for the workers, the rents paid for the rented fields as well the money he would receive if the property was rented. The expenses for irrigation, power consumption, etc, must be added.

### c) Profit (loss):

**Profit** is the additional fee of the used factors in the production activity of a farm or a production sector, in addition to the fee or expense calculated or paid for their use.

Profit shows what the farmer achieves additionally to what he would receive if he leased his and his family's labour, if he leased out his capital and rented his fields to other producers. Profit is achieved as a result of the successful combination of production factors on the part of the operation's manager or the farmer's production sectors, since the formulation of the price for the products lies beyond the farmers' sphere of influence. In the case of an unsuccessful combination of production factors on the part of the farmer we have loss instead of profit. Profit is the first net economic result of the production activity of an agricultural operation or an independent production sector, in which both professional farmers as well as micro-producers are interested, meaning that the first aim mainly, if not exclusively, at profit, and the latter consider profit a basic element of their income. Furthermore, profit is the basis for the calculation of any other form of net economic result, of which, by definition, it constitutes an important part.

Example:

Let us assume that the rent paid for renting agricultural land in an agricultural region, is 15 euro per hectare. In this case, to say that a producer has gained from the exploitation of privately owned land, he must collect more than 15 euro per privately owned hectare. If he collects an amount equal to 15 euro we can say that the exploitation of the privately owned land brought no income, and if he collects less than 15 euro his business presented loss. The same must apply for the capital he must allocate to the business.

### d) Agricultural income:

**Agricultural income** is the amount that represents the fee of the production factors (land, labour, capital) and which arises from their combined use in the production procedure of an agricultural operation or an independent agricultural production sector, regardless of their source of origin (farmer or third parties).

Agricultural income essentially represents that part of the gross revenue or gross income that remains after deducting the values consumed and ensuring the smooth operation of the agricultural operation or the agricultural production sector as a production machine.

Agricultural income is one of the most important economic results: a) because it shows the total fee of the three production factors that have been invested in agricultural production during the accounting year; b) because it is the basis for the comparison of the various types of agricultural operations and agricultural production sectors as it is considered the most objective criterion for this comparison; and c) because it determines the minimum size of the agricultural operation for ensuring an elementary standard of living for the farming family.

Example

A producer of watermelons produced in total 100 tons of product and collected in total 40000 euros.

His expenses were 20000 euros and included fees for workers, seed, fertilizers, pesticides, etc.

The producer's income amounts to 20000 and arises from deducting expenses from total revenues.

#### **d) Agricultural family income:**

**The agricultural family income** is the fee of the three production factors (land, labour, capital) that essentially belong to the farmer and his family, and which arises from their combined use in the production activity of an agricultural operation or an independent agricultural production sector.

The agricultural family income essentially represents that part of the gross revenue or gross income that remains after deducting the consumed materials and ensuring of the smooth operation of the agricultural operation or the agricultural production sector, beyond the fee of the production factors that belong to third parties and are used for the farmer's operation or production sector.

Actually, the agricultural family income is that part of the agricultural income that belongs to the farmer and his family. In other words, the agricultural family income is an economic result of special importance, closely linked with each specific producer of a given operation or a given production sector.

#### **Example**

In order to understand what the agricultural family income is we must distinguish which of the production factors are privately owned and which are leased. Let us take the factor of land in the previous example with the watermelons.

The farmer cultivates 15 hectares with watermelons of which

10 are privately owned, and he collected 25000 euros for the production while his farming expenses for the specific hectares were 15000 euros.

Therefore, the agricultural family income that is related to the land factor is

$25000 - 15000 = 10000$  euros.

If we calculate in a similar way the performance of the other production factors and add the sum of all those we will get the agricultural family income of the specific operation.

#### **f) Revenue from the land:**

**Revenue from the land** is the revenue that corresponds or refers to the production factor "land", utilized in the agricultural productions and represents that part of the gross revenue or gross income that comes from the participation of the land in the production activity of an agricultural operation or an agricultural production sector.

Revenue from the land is of particular importance on the one hand because it is as a rule an objective basis for the determination of the rent of a field, on the other hand because with it we calculate the production value of the land, meaning the value that arises from the utilization of the land in the agricultural production.

#### **g) Revenue or income from labour:**

**Revenue or income from labour** is that income that corresponds or refers to the production factor “labour”, utilized in agricultural production. It represents that part of the gross revenue or gross income that comes from the participation of labour in the production activity of an agricultural operation or an agricultural production sector.

The revenue or the income from labour is mostly linked with family-type agricultural operations, because it shows the total fee of the human labour integrated in the agricultural production and the amount of the daily fee of the workers in the agricultural production. The latter is of particular importance, because the expression of the revenue or the income from labour per day of offered labour is the basis for comparison on the one hand between the agricultural production sectors or types of operations, on the other hand between farming and other sectors of economic activity.

#### **h) Revenue from the capital or net revenue and capital performance:**

**Revenue from capital or net revenue** is that revenue that corresponds or refers to the production factor “capital”, utilized in agricultural production, and represents that part of the gross revenue or gross profit that comes from the capital from its participation in the production activity of an agricultural operation or an agricultural production sector.

The revenue from capital or the net revenue has a limited importance when expressed in euros because it simply shows to the specific farmer the total revenue from the capital invested in the agricultural operation or the agricultural production sector, without containing the element of comparison. On the contrary, the revenue from capital or the net revenue is of particular importance as return from capital, meaning as a percentage of the total invested capital. Revenue from capital, as return from capital is in fact comparable and leads to beneficial conclusions. Among them, of particular importance are:

1. the comparison of the performance of the capital invested in various agricultural production sectors, because in this way the professional farmer selects the sectors with the greatest performance;
2. the comparison of the performance of the capital invested in the agricultural operation with that corresponding to any other form of operation, because in this way the capital-owner businessman is supported on an objective foundation when selecting the most efficient investment for his available capital;
3. the comparison of the performance of the capital invested in the agricultural capital with the interest paid by an Agricultural Bank or other source of loaning or finally with the interest paid by the various credit institutions to their depositors.

#### **Example**

The watermelon producer had 42000 euros (40000 euros from sales and 2000 still in storage)

The land production sector participates with 30%, meaning that the revenue from the land amounts to  $42000 \times 30\% = 12600$  euros.

The labour production sector participates with 50%, meaning that the revenue from labour amounts to  $42000 \times 50\% = 21000$  euros.

And the capital production sector participates with 20% with revenue from capital  $42000 \times 20\% = 8400$  euros.

Having these facts, we can judge that investments in land bear more gains than in labour and capital.

#### i) Gross profit:

**Gross profit of an operation** is that part of the gross revenue or gross income, which must cover the total fixed cost or the cost of the pre-existing production factors, whereas **gross profit of a production sector** is the contribution of this sector in dealing with the total fixed cost of an agricultural operation or the addition of a net amount in the available amount for covering the fixed cost of the operation. Also, the gross profit of a production sector is the indicator and the measure of calculation of what this production sector adds to the total profit of the operation.

The knowledge of the gross profit is of great importance if we take into account that it is one of the most commonly used forms of economic result in modern agricultural economic analysis. More specifically, its importance is greater for comparisons between various sectors of agricultural production during the preparation of an optimum production plan for an agricultural operation with the implementation of both the simplified as well as the mathematical programming, that aims at the most productive utilization of the available production factors.

#### j) Income outside the agricultural operation:

**Income outside the agricultural operation** is the income obtained by the farming family from the activity of its members and the use of other production factors outside the agricultural operation.

The main sources of this form of income is the fee of the members of the agricultural family from an agricultural or non-agricultural employment outside the agricultural operation, the rent of the fields and the fee of other assets of the operation from their use by third parties, the interest of capital lent to third parties, the revenue from machinery and any work animals from their use outside the operation, etc.

A typical example of income outside the agricultural operation is the use of the agricultural tractor in paid works outside the farmer's operation. Such works are the ploughing of foreign fields or spraying, etc.

## SELF-EVALUATION TEST

**Answer True (T) or False (F) to the following questions:**

1. The economics of agricultural product production study the principles of the economics of production, connected with making decisions regarding the use of the available factors for the production of crops and livestock.

a) True

b) False

2. The purpose of the economics of agricultural product production is connected with making decisions on the one hand on the selection of that alternative way for using the available factors to ensure the maximisation of the volume of produced products and on the other hand on the combination of the products that will ensure the maximum economic result.

a) True

b) False

3. The agricultural region does not consist of a group of agricultural operations and therefore cannot be considered as a whole.

a) True

b) False

**Select the correct answer to the following questions:**

1. Fixed production factors:

A) are dependent of other factors

B) include fertilizers and pesticides

C) are divided into those that can serve multiple production sectors and those that cannot serve multiple production sectors

D) are the only ones taken into account in the programming of the agricultural product production and the relevant decision making

2. It is geometrically presented in the form of a diagram:

A) where the horizontal axis (X) represents the values of the factor and the vertical axis (Y) represents the values of the product.

B) where the horizontal axis (X) represents the values of the product and the vertical axis (Y) represents the values of the factor.

C) where the horizontal axis (X) represents the values of the factor and the vertical axis (Y) represents the values of the income.

D) where the horizontal axis (X) represents the values of the income and the vertical axis (Y) represents the values of the product.

**3.** Across an equal product quantity curve:

A) the production level remains fixed, and the ratio of the combination of the two factors constantly changes

B) the production level changes, and the ratio of the combination of the two factors constantly remains fixed

C) both the production level and the ratio of the combination of the two factors constantly change

D) both the production level and the ratio of the combination of the two factors remain fixed

**4.** When we say gross revenue or gross income we mean:

A) the total produced quantity of products expressed in quantity, which is achieved as a result of the economic activity developed in an economic unit in a specific period of time.

B) the total produced quantity of products, in their broader meaning, expressed in money, which is achieved as a result of the economic activity developed in an economic unit in a specific period of time.

C) the total produced quantity of products, in their broader meaning, expressed in money, which is achieved as a result of the economic activity developed in an economic unit in an indefinite period of time.

D) the total produced quantity of products, in their broader meaning, expressed in money, which is achieved as a result of the economic activity developed in the economic units of a country in a specific period of time.

**5.** When we say income outside the agricultural operation we mean:

A) the income ensured by the farming family from the activity of its members and the use of the other production factors outside the agricultural operation

B) the income ensured by the farming family from the activity of its members and the use of the other production factors in the agricultural operation

C) the income ensured by the agricultural family exclusively from the activity of its members

D) the income ensured by the state from the activity of the farmers and the use of the other production factors outside the agricultural operation

## **ACTIVITIES**

1. Taking into account the distinction of the production factors presented in unit 5.2 select which of the following information must be used in the production of the agricultural product “peach” and mention which category of production factor they belong to

a) Field c) seed e) water g) warehouse i) accountant services k) sun heat	b) plot d) tractor f) workers h) fertilizer
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Ans. Labour: workers, Land: field, seed, water

Capital: tractor, warehouse, fertilizer

2. Taking into account the distinction of the production factors presented in unit 5.2 match the data of the first column with the data of the second column

1. Labour	a) Buildings
a. Land	b) Pesticide implementation
3. Capital	c) Establishment of a new processing unit for agricultural products
4. Entrepreneurship	d) Geographical surface

Ans. 1-d, 2-a, 3-b, 4-c

3. One of the most popular investments for farmers is the purchase of a tractor. Make an effort to evaluate the specific production factor (capital) in their business compared to the other ones (land, labour) in order to determine whether there is a comparative advantage in this investment.