*European Research Studies Journal*
*Volume XXVII, Issue Special 2, 2024*

*pp. 968-978*

# Systems of Work Profitability Ratios in Agriculture: A Methodical Proposal

*Submitted 17/09/24, 1st revision 20/10/24, 2nd revision 04/11/24, accepted 30/11/24*

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***Abstract:***

***Purpose:*** *The main purpose of this paper is to propose a methodological decomposition of the basic macroeconomic (sectoral) category of agricultural profitability, i.e., the profitability of labour, measured by the ratio of the income of agricultural entrepreneurs to the number of employed persons (the so-called unpaid labour).*
***Design/methodology/approach:*** *In the development of indicator systems for agricultural labour income has been based on the Economic Accounts for Agriculture (EAA). These accounts are a harmonised set of accounts valid in the EU countries, which makes it possible to analyse the economic situation in agriculture according to uniform principles.*
***Findings:*** *The article presents six proposals for the decomposition of the labour profitability index, which form a logical and coherent system of indicators developed on the basis of the sequence of the Economic Accounts for Agriculture (EAA). In addition, two versions are given for each of these systems. The first captures the profitability of agricultural labour in a more synthetic way, while the second is a proposal for an extended analytical system of agricultural labour profitability.*
***Practical implications:*** *The systems developed extend the possibilities for analysing sectoral economic and financial diversification as measured by labour profitability. Depending on the research perspective, agricultural labour profitability can be considered using six alternative indicator systems. In addition, the proposed agricultural labour profitability systems can provide an important basis for the construction of deterministic and stochastic models to quantitatively describe the economic phenomenon under study.*
***Originality/value:*** *This study significantly extends the analytical possibilities of the basic category of economic-financial efficiency of the agricultural sector, i.e. labour profitability. The six models proposed make it possible to analyse this category from six perspectives, thereby significantly increasing knowledge of the factors that determine the profitability of labour in this sector.*

***Keywords:*** *Work profitability, agriculture, system of indicators, decomposition of indicators.*
***JEL Classification:*** *Q10, Q14. C43.*
***Paper Type:*** *Research study.*

***Acknowledgements:*** *The publication was financed by the Polish Minister of Science and Higher Education as part of the Strategy of the Poznan University of Life Sciences for 2024-2026 in the field of improving scientific research and development work in priority research areas.*

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## 1. Introduction

Profitability indicators are a commonly employed means of evaluating the economic and financial efficiency of agricultural enterprises and farms. However, their utility is constrained by their synthetic nature and the narrow scope of their economic content. This is because each indicator provides only a limited amount of information, as it does not reflect either the internal structure of the phenomenon under study or its relationships with other indicators. The solution to this problem lies in the disaggregation of indicators and the construction of indicator systems, a procedure widely used in analytical practice.

The utilisation of these procedures offers three principal advantages (Wędzki, 2006). Primarily, indicator systems facilitate the demonstration of the interrelationship between individual indicators. Secondly, they elucidate the determinants of the level of the synthetic (principal) indicator. Thirdly, they enable the assessment of the strength and direction of the influence of individual indicators within the system on the synthetic indicator.

Indicator systems are widely used in research practice, especially in analyses of different profitability categories of companies and industrial sectors (Sierpińska and Jachna, 1993; Dudycz, 2001; 2011; Bednarski, 2002; Sierpińska and Niedbała, 2003; Wędzki, 2006; Hawawini and Viallet, 2010; Bieniasz and Gołaś, 2013; Liesz, 2002). Indicator systems have also been applied to the agricultural sector. Studies by Melvin *et al.* (2004), Gardner *et al.* (2011), Shadbolt (2011), Gołaś (2009 and 2010), Ladvenicová *et al.* (2019), Mishra *et al.* (2009), Parzonko (2023), among others, can be mentioned here.

The principal aim of the presented article is to propose a methodological framework for the decomposition of the fundamental macroeconomic (sectoral) category of agricultural profitability, namely the profitability of labour as measured by the ratio of the income of agricultural entrepreneurs to the number of employed persons (the so-called unpaid employees). The proposed decomposition systems of the labour profitability index in agriculture were developed on the basis of the Economic Accounts for Agriculture (EAA) in force in the European Union (EU) countries.

## 2. Materials and Methods

The Economic Accounts for Agriculture - EAA (Regulation..., 2004) were employed in the formulation of the agricultural labour income indicator systems. These accounts represent a harmonised financial statement that is valid across all EU countries. They facilitate the analysis of the economic situation in agriculture according to uniform principles. One of the primary objectives of the EAA is the continuous monitoring of agricultural income, which is assessed in terms of gross value added, net value added, value added at factor costs, operating surplus and net income of agricultural entrepreneurs.

The synthetic sequence of the EAA, which presents the aforementioned income categories and the other components of the account, can be presented as the following scheme (Table 1):

***Table 1.*** *Main components of the Economic Account for Agriculture in EU*

| No. | Components | Abbreviation |
|---|---|---|
| 1 | **Output at producer prices** | **OPP** |
| 2 | + subsidies on products | SUBP |
| 3 | – taxes on products | TAXP |
| 4 | = **Output at basic prices** | **OBP** |
| 5 | – intermediate consumption at purchase price | IC |
| 6 | = **Gross value added** | **GVA** |
| 7 | – consumption of fixed assets | AM |
| 8 | = **Net value added** | **NVA** |
| 9 | – other taxes on production | OTAX |
| 10 | + other subsidies on production (OSUB) | OSUB |
| 11 | = **Net value added at factor cost (factor income)** | **FI** |
| 12 | – compensation of employees (CE) | CE |
| 13 | = **Net operating surplus (net mixed income)** | **NOS** |
| 14 | + interest received | IR |
| 15 | – interest paid | IP |
| 16 | – farm and agricultural land rental costs | RC |
| 17 | = **Net entrepreneurial income** | **NEI** |

***Source:*** *Own study.*

In the aforementioned account, the output is the sum of the output of agricultural products and goods and services produced in so-called inseparable, secondary non-agricultural activities. These activities encompass a range of products (goods and services) that cannot be aggregated. The products of these activities may be for sale, barter, or for own consumption (Regulation..., 2004). Output is valued at basic prices (OBP), which corresponds to the amount received by the producer, adjusted for taxes on products (TAXP) and subsidies on products (SUBP).

In the subsequent phase of the EAA account, the output is diminished by the intermediate consumption (IC), which encompasses the monetary value of all goods and services utilized as inputs in the production process, excluding depreciation, which denotes the consumption of fixed assets. Intermediate consumption is evaluated at the acquisition prices of analogous goods and services employed in the production process.

A further category of the EAA account is gross value added (GVA), which is estimated as the difference between output (OBP) and intermediate consumption (IC). The latter is a key category of agricultural productivity. The concept of agricultural productivity should be understood as the relationship between the value added and the various input categories (land, labour, capital).

Similarly, the concept of agricultural profitability should be identified with the relationship between the classical measures of income (net mixed income, income of agricultural entrepreneurs) and the aforementioned input categories or type of agricultural activity.

Consequently, the incorporation of fixed capital inputs (AM) into the EAA account results in an estimation of net value added (NVA), which represents the value created by all agricultural economic units, adjusted for the consumption of fixed assets (depreciation). Net added value can be considered a basic income category, providing insight into the capacity to generate new values in relation to material costs incurred.

Additionally, it is perceived in the context of the quantity and quality of human capital (Wędzki, 2006). It is important to note, however, that in the agricultural sector, the net value added is not subject to taxation on products, but rather includes subsidies on products. This is due to the fact that output is valued at basic prices and intermediate consumption is valued at purchaser prices.

A further income category is obtained by reducing the net value added (NVA) by the amounts of other taxes on production (OTAX) and adding other subsidies on production (OSUB). This is known as the value added in factor costs, also called factor income (FI). This category represents a measure of the value generated by all factors of production, including land, capital, and labour. In this context, the labour factor is captured in the form of all labour resources involved in agricultural activities, encompassing both the agricultural entrepreneurs' own labour and labour in the form of hired labour.

The diversity in the configuration of agricultural employment (divided into two categories: own labour and hired labour) is reflected in another income category, the net operating surplus, also referred to as the net mixed income (NOS). This is a measure of the value generated by land, capital and unpaid labour. The net operating surplus is calculated by adjusting the value added in factor costs (FI) by the wage costs of hired labour (CE).

The final component of the Economic Account for Agriculture is the net income of agricultural entrepreneurs (NEI). Its value is estimated by adjusting the operating surplus (NOS) for financial expenses (IP) and income (IR) in the form of the balance of interest earned and paid, and for farm and land rents (RC). The net income of agricultural entrepreneurs is a synthetic measure of the remuneration of unpaid labour resources, the remuneration of capital employed and the annuity of land ownership.

The principal aim of this article is to propose a decomposition of the agricultural labour profitability index. The high degree of synthesis of this income category naturally imposes the necessity to analyse the Economic Account of Agriculture

(EAA) in accordance with the principles of the systems approach. This approach respects the superordinate and subordinate nature of individual economic categories and their key or auxiliary character.

Furthermore, it enables the quantification of causal dependencies through the construction of structural arrangements of relevant indicators (so-called indicator pyramids) and the application of quantitative methods (Skoczylas and Niemiec, 2005; Skoczylas, 2007).

## 3. Results and Findings

The following six proposals for the decomposition of the labour income index (NEI/UEM) represent a logical and coherent system of indicators, developed on the basis of the Economic Accounts for Agriculture (EAA) sequence. Additionally, two versions are provided for each system. The first captures labour profitability in agriculture in a more synthetic manner, while the second proposes an extended analytical system for this category.

The initial stage of the proposed analytical system for measuring labour profitability in agriculture (Equation 1) is the disaggregation of the core indicator (NEI/UEM) into three sub-indices. The aforementioned indicators demonstrate the impact of labour productivity (GVA/TEM), the share of agricultural income (income of agricultural entrepreneurs) in gross value added (NEI/GVA) and the employment structure (TEM/UEM) on agricultural labour profitability (NEI/UEM). These relationships can be represented by the following equation:

$$\frac{NEI}{UEM} = \frac{GVA}{TEM} \times \frac{NEI}{GVA} \times \frac{TEM}{UEM} \tag{1}$$

where:

- NEI/UEM - agricultural labour profitability index [net entrepreneurial income (NEI)/ number of unpaid employees (UEM)],
- GVA/TEM - agricultural labour productivity index measured by gross value added [gross value added (GVA)/ total number of employees (TEM)],
- NEI/GVA - indicator of the share of net entrepreneurial income in gross value added [net entrepreneurial income (NEI)/gross value added (GVA)],
- TEM/UEM - agricultural employment structure indicator [total number of employees (TEM)/number of unpaid employees (UEM)].

In the next step, the disaggregation of the index of the share of agricultural entrepreneurs' income in gross value added (NEI/GVA) in equation 1 was carried out, which makes it possible to analyse the profitability of agricultural labour in the context of six additional determinants, namely: depreciation costs (NVA/GVA), agricultural taxation [(NVA-OTAX)/NVA)], agricultural production subsidies

[(FI/(NVA-OTAX)], wage costs associated with labour hire (NOS/FI), financial income and costs [(NOS+IR-IP)/NOS)] and land and farm rental costs [(NEI/(NOS+IR-IP)]. The result of this procedure is an eight-factor analytical system of the labour profitability index (Equation 2), which can be written in the following form:

$$\frac{NEI}{UEM} = \frac{GVA}{TEM} \times \frac{NVA}{GVA} \times \frac{NVA-OTAX}{NVA} \times \frac{FI}{NVA-OTAX} \times \frac{NOS}{FI} \times \frac{NOS+IR-IP}{NOS} \times \frac{NEI}{NOS+IR-IP} \times \frac{TEM}{UEM} \quad (2)$$

where:

- NVA/GVA - depreciation cost ratio [net value added (NVA)/gross value added (GVA)],
- (NVA - OTAX)/NVA - tax cost ratio [(net value added (NVA) - taxes (OTAX)/net value added (NVA)],
- FI/(NVA - OTAX) - agricultural production subsidy index [factor income (FI)/(net value added (NVA) - taxes (OTAX)],
- NOS/FI - wage bill ratio [operating surplus (NOS)/factor income (FI],
- (NOS + IR - IP)/NOS - finance cost ratio [(operating surplus (NOS) + interest earned (IR) - interest paid (IP))/operating surplus (NOS)],
- NEI/(NOS + IR - IP) - land and farm rent expense ratio [income of agricultural entrepreneurs (NEI)/(operating surplus (NOS) + balance of interest earned and paid (IR-IP)],
- designations of other factors as in Equation 1.

The second proposal for the decomposition of the agricultural labour income index (Equation 3) involves disaggregating - included in the previous system (Equations 1 and 2) - labour productivity measured by gross value added (GVA/TEM) into three factors, i.e., labour productivity measured by the value of income at producer prices (OPP/TEM), the ratio of the balance of product subsidies and product taxes (OPB/OPP) and the value added index (GVA/OPB):

$$\frac{NEI}{TEM} = \frac{OPP}{TEM} \times \frac{OPB}{OPP} \times \frac{GVA}{OPB} \times \frac{NEI}{GVA} \times \frac{TEM}{UEM} \quad (3)$$

Given the above assumptions, the elaborate analytical system of the labour profitability index can in this case be written in the form of a ten-factor equation:

$$\frac{NEI}{UEM} = \frac{OPP}{TEM} \times \frac{OPB}{OPP} \times \frac{GVA}{OPB} \times \frac{NVA}{GVA} \times \frac{NVA-OTAX}{NVA} \times \frac{FI}{NVA-OTAX} \times \frac{NOS}{FI} \times \frac{NOS+IR-IP}{NOS} \times \frac{DR}{NOS+IR-IP} \times \frac{TEM}{UEM} \quad (4)$$

where:

- OPP/TEM - agricultural labour productivity index measured by output [ output at producer prices (OPP)/total number of employees (TEM)],
- OPB/OPP - product subsidy and product tax balance index [output at basic prices (OPB)/revenue at producer prices (OPP)],
- GVA/OPB - gross value added ratio [gross value added (GVA)/output at basic prices (OPP)],
- designations of other factors as in Equations 1 and 2.

Another - the third - variant of the decomposition of the labour profitability index is also related to the disaggregation of the labour productivity index, with the main purpose of this decomposition being to expose the importance of material inputs in the form of the productivity index of these inputs (GVA/IC) and the index of the intensity of the technical work equipment measured by the level of these inputs (IC/TEM).

The consequence of this approach is a four-factor basic model (Equation 5) and a nine-factor extended model (Equation 6) of the following form:

$$\frac{NEI}{UEM} = \frac{GVA}{IC} \times \frac{IC}{TEM} \times \frac{NEI}{GVA} \times \frac{TEM}{UEM} \tag{5}$$

$$\frac{NEI}{UEM} = \frac{GVA}{IC} \times \frac{IC}{TEM} \times \frac{NVA}{GVA} \times \frac{NVA-OTAX}{NVA} \times \frac{FI}{NVA-OTAX} \times \frac{NOS}{FI} \times \frac{NOS+IR-IP}{NOS} \times \frac{NEI}{NOs+IR-IP} \times \frac{TEM}{UEM} \tag{6}$$

where:

- GVA/IC - input productivity ratio [gross value added (GVA)/intermediate consumption (IC)],
- IC/TEM - index of technical equipment of labour [intermediate consumption (IC)/total number of employees (TEM)],
- designations of other factors as in Equations 1-4.

The main objective of constructing the next - fourth - analytical system of labour profitability in agriculture is to expose the rank of the primary factor of agricultural production, namely land resources, in the context of their productivity (GVA/HA) measured by gross value added and in the context of the endowment of labour with land resources (HA/TEM). In this case, the decomposition of the agricultural labour profitability index can be represented by the following equations (Equations 7 and 8):

$$\frac{NEI}{UEM} = \frac{GVA}{HA} \times \frac{HA}{TEM} \times \frac{NEI}{GVA} \times \frac{TEM}{UEM} \tag{7}$$

$$\frac{NEI}{UEM} = \frac{GVA}{HA} \times \frac{HA}{TEM} \times \frac{NVA}{GVA} \times \frac{NVA-OTAX}{NVA} \times \frac{FI}{NVA-OTAX} \times \frac{NOS}{FI} \times \frac{NOS+IR-IP}{NOS} \times \frac{NEI}{NOS+IR-IP} \times \frac{TEM}{UEM} \tag{8}$$

where:

- GVA/HA - land productivity ratio measured by gross value added [gross value added (GVA)/area of utilised agricultural land (HA)],
- HA/TEM - labour endowment ratio of land resources [stock of utilised agricultural land (HA)/total number of employees (TEM)],
- designations of other factors as in Equations 1-6.

The next - fifth - analytical system of agricultural labour income disaggregates the land productivity index measured by gross value added into three sub-indices, i.e. land productivity measured by output at producer prices (OPP/HA), the balance index of product subsidies and product taxes (OPB/OPP) and the value added index (GVA/OPB). This type of disaggregation results in a six-factor basic model (Equation 9) and an 11-factor extended model (Equation 10) of the following form:

$$\frac{NEI}{UEM} = \frac{OPP}{HA} \times \frac{OPB}{OPP} \times \frac{GVA}{OPB} \times \frac{HA}{TEM} \times \frac{NEI}{GVA} \times \frac{TEM}{UEM} \tag{9}$$

$$\frac{NEI}{UEM} = \frac{OPP}{HA} \times \frac{OPB}{OPP} \times \frac{GVA}{OPB} \times \frac{HA}{TEM} \times \frac{NVA}{GVA} \times \frac{NVA-OTAX}{NVA} \times \frac{FI}{NVA-OTAX} \times \frac{NOS}{FI} \times \frac{NOS+IR-IP}{NOS} \times \frac{NEI}{NOS+IR-IP} \times \frac{TEM}{UEM} \tag{10}$$

where:

- OPP/HA - agricultural land productivity index measured by output [output at producer prices (OPP)/area of agricultural land in use (HA)],
- designations of other factors as in Equations 1-8.

In turn, the main objective of building the next (sixth) and at the same time the last analytical system of agricultural labour profitability is to expose the rank of physical inputs in the context of their productivity (GVA/IC) measured by gross value added and combined with production intensity (IC/HA) measured by the level of inputs per unit area of utilised agricultural land resources.

Consideration of this aspect leads to the following basic (Equation 11) and extended (Equation 12) model of labour profitability in agriculture:

$$\frac{NEI}{UEM} = \frac{GVA}{IC} \times \frac{IC}{HA} \times \frac{HA}{TEM} \times \frac{NEI}{GVA} \times \frac{TEM}{UEM} \tag{11}$$

$$\frac{NEI}{UEM} = \frac{GVA}{IC} \times \frac{IC}{HA} \times \frac{HA}{TEM} \times \frac{NVA}{GVA} \times \frac{NVA-OTAX}{NVA} \times \frac{FI}{NVA-OTAX} \times \frac{NOS}{FI} \times \frac{NOS+IR-IP}{NOS} \times \frac{NEI}{NOS+IR-IP} \times \frac{TEM}{UEM} \tag{12}$$

where:

- IC/HA - agricultural production intensity index [intermediate consumption input (IC)/ area of agricultural land in use (HA)].
- the designations of the other factors as in Equations 1-10.

## 4. Conclusions

The agricultural labour income indicator systems, developed on the basis of the Economic Accounts for Agriculture (EAA), provide a coherent and logical concept for linking the components that determine the amount of labour income.

Furthermore, they offer significant opportunities for analysing sectoral variation in economic and financial efficiency, as measured by this category. Indeed, depending on the research perspective, labour profitability in agriculture can be considered using six alternative indicator systems.

The proposed systems of indicators have the potential to serve as a valuable analytical tool in the recognition of the structure of economic and financial phenomena in EU agriculture at the meso- and macro-scale levels.

This includes the ability to identify patterns and relationships within and between regions (NUTS) and agricultural sectors of individual EU countries.

The application of these indicators allows for the demonstration of the interrelationships between individual indicators, the identification of factors influencing the profitability of labour, and the measurement of the strength and direction of the influence of individual indicators within the system on this category of profitability.

It is similarly noteworthy that the proposed analytical systems of labour profitability in agriculture can serve as a fundamental basis for the development of additional

deterministic models, as well as stochastic models that quantify the aforementioned economic phenomenon.

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