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IMPROVEMENT OF METHODOLOGY FOR ECONOMIC EFFICIENCY DETERMINATION OF SCIENTIFIC DEVELOPMENTS

The article presents an improved method for determining cost efficiency of agricultural technologies, their elements and technical facilities.
***Keywords**: methodology; economic efficiency; innovation; annual economic effect technology; crop rotation; prime cost; profit*

Introduction. Economic estimation of scientific research efficiency on agricultural issues is increasing due to concentration of huge resources in intensive agriculture and the need to use them. The economic estimation methods help to reveal available reserves and to determine the prospects of agriculture based on economical and scientific conclusions [2].

Calculation of economic efficiency of completed scientific research bases on actual data, as well as regulations and reference materials. The source of information may be indicators of product quality, purchasing prices, reporting and statistical data, as well as business reports.

Determining the annual economic effect is going through comparison base and new variants for:

- production capacity (new operations, processes, technologies, machines, various plant anti-pest protection means, diseases and weeds, fertilizers etc.);
- quality indicators;
- determining methods of physical and cost indicators;
- prices, which are used to determine the expenses and efficiency;
- material and social factors of production and product usage, taking into consideration the impact on the environment.

Determination of the annual economic effect is based on comparison of expenses on basic and new variants, as well as yield and other indicators.

For a basis of comparison in determining the annual economic effect and efficiency calculation were taken annual average indicators or the average for three years prior to the introduction of new variants in the same climatic conditions [3, 4].

Research goal. Improvement of methodology for determining the economic efficiency of technological elements in agricultural production.

Materials. Indicators of newly registered hybrid annual economic effect are determined within five calendar years after the use of the hybrid in the relevant area annually.

Actual annual economic effect calculation of the hybrid usage in farms is based on the data of the hybrid area volume, the main and by-product gross yield, quality indicators, costs for storage, the actual material and money expenditures, capital investment, sales terms, effect indicators for new hybrid productivity in area rotation, purchase prices for the main and by-products.

Economic efficiency of new registered hybrid is determined by comparing it with the best existing hybrid, which was grown at the farm.

Annual calculation for 5 years was conducted by:

- additional amount of sugar beet and plant tops on 1 ha;
- increased sugar content in roots, %;
- economic results of sugar beet technology in relation with variety renewal;
- the hybrid influence on average productivity of 1 hectare of arable land rotation.

In case the base hybrid crops absence in the farm, then the additional sugar beet quantity is calculated on the basis of stated yield surplus (%) according to state annual test hybrid zoning in the region and average sugar beet yield in the farm in current year.

Sugar beet increased cost per 1 hectare was calculated by estimating additional yield purchase prices of roots derived from zoned hybrid [1]. By-product (plant tops) cost as green fertilizer is determined by standard calculated expenses.

Hybrid economic efficiency from increase of main products (roots) and by-products (plant tops) on 1 hectare (B_{n1}) was calculated as follows:

$$B_{n1} = [(Y_{rn} - Y_{rs}) \times P_r + (Y_{tn} - Y_{ts})] \times P_t \quad (1)$$

where: Y_{rn}, Y_{rs} – sugar beet root yield of new hybrid and previously zoned hybrid on 1 ha of crops (t);

Y_{tn}, Y_{ts} – plant tops yield of new hybrid and previously zoned hybrid on 1 ha of crops, t;

P_r,P_t – estimated price of 1 ton of sugar beet roots and plant tops (UAH).

Sugar beet hybrid economic efficiency from higher sugar content, if it is not included in the purchase price (PP_{n2}), was calculated as follows:

$$PP_{n2} = [(S_n: S_s - 1) \times Y_n)] \times MPP, \quad (2)$$

where: S_n, S_s – sugar content in new and standard hybrids (%);

Y_n – sugar beet new hybrid yield, t/ha;

MPP – minimum (purchase) price of 1 ton sugar beet roots (excluding sugar content rate), UAH.

The expenditure savings from the changes in technology in connection with the use of a new zoned hybrid $З_p$ was calculated as follows:

$$ES_n = E_s - E_n, \quad (3)$$

where: ES_n – expenditure savings from the use of new hybrid, UAH;

E_s, E_n – standard and new hybrids crop expenditure, UAH.

The annual economic effect from certain technology processes (applying of pesticides, fertilizers etc.) was calculated as follows:

$$E = [(PP_n - C_n \times У_н) - (PP_s - C_s \times У_б)] \times O_n, \quad (4)$$

where: PP_n, PP_s – product unit purchasing price in new and base variants, UAH/t;

C_n, C_s – product unit prime cost in new and standard variants, UAH/t;

Y_n, Y_s – yield in new and base variants, t/ha;

O_n – output, ha.

The annual economic effect from usage of new fertilizers, means, pesticides, when their cost affected only the certain prime cost stages, as well as yield and quality of roots increased or remain unchanged, was determined as follows:

$$E = (C_s \times R_s - C_n \times R_n) \times A_n, \quad (5)$$

where: C_n, C_s – prime cost of 1 kg (liter) of the means in base and new variants, UAH;

R_s, R_n – application rate of base and new means per 1 ha, kg (litre);

A_n – applying area of means, ha.

In case within the high cost of means and fertilizers the effect was absent, but these elements influenced positively on productivity as a whole, the annual economic effect was determined as follows:

$$E = [(P_n - C_n) \times Y_n) - (P_s - C_s) \times Y_s] \times A_n, \quad (6)$$

or was determined as increase revenue and net profit

$$E = (P_n - C_n) \times Y_n - (P_s - C_s) \times Y_s. \quad (7)$$

In calculation of the economic efficiency of mechanization, we considered the new technology, which included research results that firstly implemented in sugar beet production, inventions and other scientific and technological achievements, as well as new or more or less sophisticated production technological processes, means and objects of labor, that provide grow of technical and economic indicators of production or improvement of social and other issues of agriculture in accordance with the development of science and technology plans.

The annual economic effect (E) from the results of SEW was calculated as follows:

$$E = [(C_s + E_n \times K_s) - (C_n - E_n \times K_n)] \times A_n, \quad (8)$$

where: C_s, C_n – product unit prime cost of base and new variants, UAH/t;

K_s, K_n – investment share (per product unit) in base and new variants, UAH;

E_n – standard investment efficiency rate, equal to 0.15;

A_n – application parameters of SEW results, ha.

If using the SEW results and new equipment the product quality and the prices are changed, the annual economic effect is determined with consideration of product gross output growth and profit (net profit) as follows:

$$E = [(C_s + E_n \times K_s) - (C_n - E_n \times K_n) + (P_n - P_s)] \times A_n, \quad (9)$$

where: P_n, P_s - minimum (purchase) price per product unit in new and base variants, UAH.

In determining the annual economic effect through profit the following formula was used:

$$E = (_{\Delta}PR - E_n \times K_n) \times PR_n, \quad (10)$$

where: $_{\Delta}PR$ – profit (net profit) increase as a result of high quality products sale (PR_n - PR_s), UAH, where:

PR_n, PR_s – profit from high quality products sale in new and base variants, UAH.

Today, Ukrainian agricultural sector requires improved economic relations, a new approach to the production and environment protection. Agricultural products must be ecologically safe [5, 7].

To increase agricultural production to the proper level, the complex of measures should be implemented (including environmental protection) covering a wide range of socio-economic, technological and legal issues.

From this perspective, we proposed to determine ecological and economic effect (E_c) from reducing agrochemical load on agricultural ecosystems:

$$E_C = \left(1 - \frac{Y}{Y + Y_{Д}}\right) \times (З_a + П_y) \times \mathrm{V} \times \mathrm{S} \quad (11)$$

where: Y – crops yield, t/ha;

Y_{ad} – additional yield resulting from farming practices, t/ha;

E_a – mineral fertilizers and plant protection cost, UAH;

C_l – cost of economic losses prevention from food pollution due to agricultural production chemicals per unit of chemical fertilizers and plant protection, UAH;

V – volume of mineral fertilizers and plant protection, kg/ha;

S – protected area of arable land, ha.

Each crop needs specific soil and climatic conditions, therefore crops should meet their requirements concerning biological development. The recommended structure of sown areas of nature-economic zone should be determined differentially in each case according to existing environmentally suitable land for growing selected crops.

The optimal proportion of crops in rotation (V), depending on the ecologically available land for their cultivation, is recommended to calculate on the following:

$$П_B = \frac{V \cdot P_n}{P_3}, \quad (12)$$

where: V – crop share of other crops in the farm, %;

P_r – arable land in rotation, ecologically suitable for the certain crop cultivation, %;

P_t – the total area under crops in ecologically suitable land in the farm for the certain crop cultivation, %.

The overall economic effect of increasing agricultural land productivity or prevention and reduction of expenses is calculated according to the difference of their assessment before and after environmental protection.

The economic effect of land contamination reducing (E_c) is defined by:

$$E_c = (П_1 - П_2) \times A, \quad (13)$$

where: GO_1 – amount of gross output unit after land pollution reduction, t/ha;

GO_2 – amount of gross output unit on the contaminated land, t/ha;

A – the size of cultivated area after pollution reduction.

Agriculture is closely associated with organic matter and the most effective component of soil - humus. The more humus in the soil, the better productivity is. Reserves of humus in the plow soil layer (H) are defined as follows:

$$H = H_c \times M \times D \times 100, \quad (14)$$

where: H_c – humus content in arable soil layer, %;
M – soil weight, g/cm3;
D – depth of arable soil layer, m.

The effectiveness of environmental measures (E_m) for certain types of agricultural products is determined by:

$$E_m = У_1 \times (Ц - C_1) - У_2 \times (Ц - C_2), \quad (15)$$

where: Y_1, Y_2 – yield obtained in pure and contaminated lands t/ha;
MP – minimum (purchase) price per product unit, UAH/t;
C_1, C_2 – prime cost of product obtained from pure and contaminated areas, UAH/t.

The partly ecological pure products are produced in many regions. Their efficiency (E_{pp}) is defined by:

$$E_{pp} = (V_2 \times MP_2 - C_2) - (V_1 \times MP_1 - C_1) \times A, \quad (16)$$

where: V_2 – amount of ecological pure products, t/ha;
MP_2 – minimum (purchase) price per unit of ecological pure products, UAH/t;
C_2 – prime cost per unit of ecological pure products, UAH/t;
V_1, MP_1, C_1 – corresponding amount of ordinary agricultural products;
A – the area of ecological pure products, ha.

In market conditions with new equipment (especially foreign) high prices the efficiency of equipment use is evaluated long before the time of its purchase and operation. It should be noted that in practice there were cases when significant funds were spent for new equipment in vain, which brought company losses. Therefore, the term “innovation” was introduced, which means new forms of work organization and management implementation, covering not just one company, but also the entire agriculture. New equipment is considered one that meets the highest world standards and is operated not more than three years.

Estimation of new solutions is determined by such indicators as the effect and efficiency. Effect is the result of new technology adaptation is aimed at improving product quality, reducing production time and circulation, release resources etc.

Efficiency is a relative amount, which characterizes the productivity of any costs, namely: the economic effect of production costs, the payback period of additional costs for the new technology adaptation etc.

Annual economic effect of new equipment in the case of increasing its productivity is determined by:

$$Ee = \left(Cs \cdot \frac{Vs}{Vn} - Cn \right) \cdot Vn,$$

where Cs, Cn – the cost of production per unit in base and new variants;
Vs, Vn – productivity of base and new equipment.

Annual savings from innovation (new equipment) is determined as follows:

$$E_p = (Cn - Cs) \cdot A_n,$$

where Cs, Cn – prime cost for standard and new production organization;
An – annual production volume under the new organization of labor and management.

Conclusions:

1. Technical re-equipment of agriculture takes place within different levels of technology development. The complexity of the situation, particularly in the technological policy, is that it is difficult to be aware in this variety of technology levels and equipment models. It should be noted that each equipment, each equipment complex created for specific conditions, which in agriculture

are soil and climatic conditions, technology, certain crop production technology level and, not least, a farming type.

Therefore, it is necessary to use the methods of equipment economic efficiency determination thoroughly when purchasing it.

2. It is advisable to use in agricultural enterprises a rational combination of domestic and foreign equipment, including tractors, agricultural machinery, harvesters etc. Within market economy penetration of various foreign equipment in our agriculture is inevitable. Therefore, this process based on economic grounds should be guided into the best direction.

3. Improving technology discipline, both in relation to ordinary equipment and agricultural equipment is important direction of economic effective technology policy in agriculture.

4. To increase the efficiency of agricultural production it is recommended to create machine-technological stations and to use equipment in agricultural enterprises and farms.

5. The combination of equipment usage with strong organization of their operation will stimulate high productive and profitable agricultural production.

References

1. Визначення економічної ефективності технологій, нової техніки, винаходів та завершених наукових розробок в рослинництві: методичні рекомендації / [М.В. Роїк, В.Л. Курило, В.М. Сінченко та ін.]. – Вінниця: Нілан-ЛТД, 2013. – 90 с.

2. Проблеми формування ринкової економіки: міжвід. науковий збірник. – К.: КНЕУ, 2000. – Спеціальний випуск. – 420 с.

3. Організаційно-економічні нормативи витрат та інформаційно-статистичні матеріали з виробництва рослинницької продукції за біоадаптивними технологіями: методичні рекомендації. – К.: ТОВ «Нілан-ЛТД». – 2014. – 194 с.

4. Статистичний аналіз агрономічних дослідних даних в пакеті Statistica 6: методичні вказівки / Е.Р. Ермантраут, О.І. Присяжнюк, І.Л. Шевченко. – К., 2007. – 55 с.

5. Сахарная свекла. Выращивание, уборка и хранение / [под ред. Д. Шпаара]. – Минск: ЧУП Орех, 2004. – 325 с.

6. Сінченко В.М. Управління процесами біоадаптивної технології виробництва цукрових буряків / В.М. Сінченко, В.І. Пиркін // Цукрові буряки. – 2013. – № 3. – С. 5-14.

7. Сінченко В.М. Управління формуванням продуктивності цукрових буряків: [монографія] / В.М. Сінченко. – К.: ТОВ «Нілан-ЛТД», 2012. – 582 с.

8. Медведовський О.К. Енергетичний аналіз інтенсивних технологій в сільськогосподарському виробництві / О.К. Медведовський, П.І. Іваненко. – К.: Урожай, 1988. – 336 с.

Анотація

Сінченко В.М., Пиркін В.І., Москаленко В.П., Шамсутдінова А.В., Аскаров В.Р.

Удосконалення Методики З Визначення Економічної Ефективності Наукових Розробок

Пропонується удосконалена методика визначення економічної ефективності елементів технології, технічних засобів, технологій виробництва сільськогосподарської продукції.

Ключові слова: *методика, економічна ефективність, нововведення, річний економічний ефект, технологія, сівозміна, собівартість, прибуток*

Аннотация

Синченко В.Н., Пыркин В.И., Москаленко В.П., Шамсутдинова А.В., Аскаров В.Р.

Усовершенствование методики определения экономической эффективности научных разработок

В статье предлагается усовершенствованная методика определения экономической эффективности элементов технологии, технических средств, технологий производства сельскохозяйственной продукции.

Ключевые слова: *методика, экономическая эффективность, нововведение, годовой экономический эффект, технология, севооборот, себестоимость, прибыль*