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Analysis Of Scientific Innovation Obtained Through The Study Of The Effectiveness Of Agroaviation Works

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Abstract: This scientific article analyzes the practical significance of scientific innovations identified as a result of research conducted on the topic "Justification of the efficiency and flight-technical parameters of aircraft in agricultural work." In this case, the mathematical model of the effectiveness of agroaviation work, the assessment of the influence of flight parameters on efficiency through a multifactorial correlation model, and the forecast of the results achieved in 2025-2030 are highlighted. The influence of flight parameters on aircraft performance has been scientifically substantiated through a multifactorial correlation model, such as flight speed, operating altitude, payload weight, and operating time.

Also, the article fully explains the correlation and regression models corresponding to the research direction and graphically depicts the growth dynamics of the agroaviation efficiency index (ASI) in 2025-2030 through practical calculations.

Keywords: Agroaviation; efficiency of agroaviation work; flight-technical parameters; multifactorial correlation model; regression analysis; efficiency forecasting; aviation efficiency index (API); intelligent modeling; optimization; statistical relationships; functional relationships; digital management system.

Introduction: As a result of the research conducted on the topic "Justification of the efficiency and flight-technical parameters of aircraft in agricultural work," scientific innovations were created in the following four areas:

a system-integrated approach to assessing the effectiveness of aircraft in the field of agro-aviation efficiency has been developed;

the process of performing agro-aviation work in the direction of formalization methodology was formalized using a mathematical model;

a functional relationship was established between the factors affecting the flight characteristics (agrotopography, wind, cargo weight, fuel consumption, altitude, etc.) in the direction of the interaction of factors;

In the direction of the marketing system, an innovative marketing module was developed for the implementation of agro-aviation services for farms and dehkan farms.

Table 1.

Direction	New scientific result	Practical significance
Effectiveness of agroaviation	A system-integrated approach has been developed for assessing the effectiveness of aircraft.	For each region, it is possible to create an optimal aviation chemical treatment scenario.
Formalization	The process of performing aviation chemical works was formalized using a mathematical model.	Possibility of integration into digital control systems for aviation processing

methodology		
Factor interaction	A functional relationship was established between the factors influencing flight characteristics (agrotopography, wind, cargo weight, fuel consumption, altitude, etc.).	The ability to calculate performance and safety indicators in advance
Marketing system	An innovative marketing module has been developed for the implementation of aviation-chemical services for farms and dehkan farms.	Creates a basis for the development of market mechanisms in the field of agro-aviation.

SCIENTIFIC MODEL (MATHEMATICAL MODELING)

In the study, the agroaviation efficiency index (ASI) was adopted as the main calculation indicator. This index is a comprehensive indicator that assesses the technical, technological, and economic effectiveness of operations carried out in agricultural aviation. This index is intended for the following tasks:

- selection of effective flight mode and spraying parameters;
- assessment of the degree of accuracy and uniformity of processing;
- monitoring compliance with the established chemical standard;
- Determine the relationship between air operator costs and productivity;
- Comparative analysis between different aircraft (aircraft, drone, motodeltaplan).

ASI indicator can be calculated as follows:

$$\text{АСИ} = \frac{P_t \times K_o \times E_f}{C_t}$$

where:

P$_t$ - integral indicator of flight parameters (for example, speed, altitude, stability, etc.);

K$_o$ - optimal processing coefficient (ha/hour);

E$_f$ - processing efficiency (in %);

C$_t$ - time and fuel cost index.

Formula for the relationship between factors:

The influence of flight parameters is assessed using a multifactorial correlation model:

$E_f = a_1 \cdot V + a_2 \cdot H + a_3 \cdot M + a_4 \cdot T + \varepsilon$

where:

V - flight speed, km/h

H - working height, meters

M - weight of the cargo, kg

T - working time (minutes),

a_i - coefficients of influence of factors,

ε -random error.

Mathematical model of optimal efficiency:

$$\text{АСИ}_{opt} = max\left(\frac{E_f}{C_t}\right)$$

This model determines **the maximum efficiency** for each region, **depending on the flight conditions, type of** work, and technical capabilities.

PROGNOSIS AND RESULTS (2025-2030)

Through the multifactorial correlation model and the mathematical model of optimal efficiency, work efficiency and the growth forecast of the optimal ASI indicator are determined.

Table 2.

Year	**Flight parameter index,** P_t	**Processing efficiency,** E_f (%)	**Expense Index,** C_t	**ASI (Indicator),** ASI_{opt}	**Prognotic Growth** (%)
2025	1.00	82.4.	1.00	0.824	-
2026	1.07	85.0	0.98	0.928	+10.4
2027	1.12.	87.6	0.95	1.034	+10.6

2028	1.18.	90.2.	0.93	1.144.	+11.0
2029	1.25	92.8	0.91	1.275	+13.1
2030	1.30	94.5	0.90	1.365	+9.0

Result of the forecast: If the developed methodology is implemented in practice, the efficiency of agro-aviation processing (Ef) can increase **from approximately 82.4% to 94%** as a result of **the ASI** index<4-increasing on average by +10.8% per year during 2025-2030.

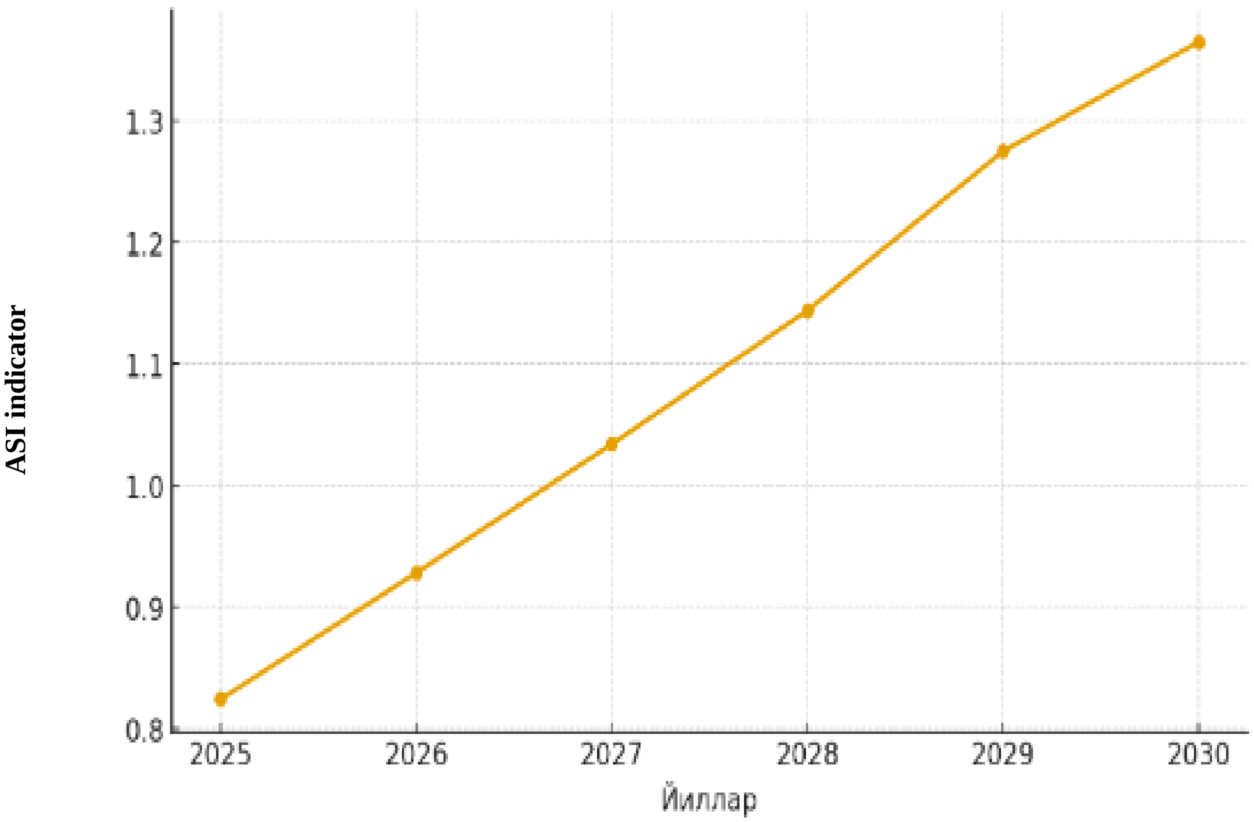


Figure 1. Growth dynamics of the Agroaviation Performance Index (API) for 2025-2030 (in graphical form).

As can be seen, as a result of the implementation of the developed model and methodology, the effectiveness has a stable growth trend, which is expected to increase from 0.824 in 2025 to 1.365 by 2030 approximately **more than 54.1%** growth.

STRUCTURE OF THE STUDY MODULE

We divide the research module developed as a result of scientific research into the following 4 parts:

1. **Analytical module:** current state of agro-aviation work and statistical analysis.
2. **Mathematical Modeling Module:** Assessment using ASI and correlation models.
3. **Optimization and Forecasting Module:** Calculation of the state of maximum performance and 5-year forecast.
4. **Marketing and Innovation Module:** a method for introducing aviation chemical services to regional markets.

In this study, the use **of correlation analysis** and **regression models** is not only possible, but **necessary.** These models help to **determine the functional relationship** between flight parameters and the effectiveness of agro-aviation work.

Below, we will fully explain the **correlation and regression models** corresponding to the research direction, and then construct this model in graphical form with practical calculations.

CORRELATION ANALYSIS MODEL

The main factors in the study were: flight speed of the aircraft, processing height, mass of the tank filled with liquid, processing time, and operational efficiency.

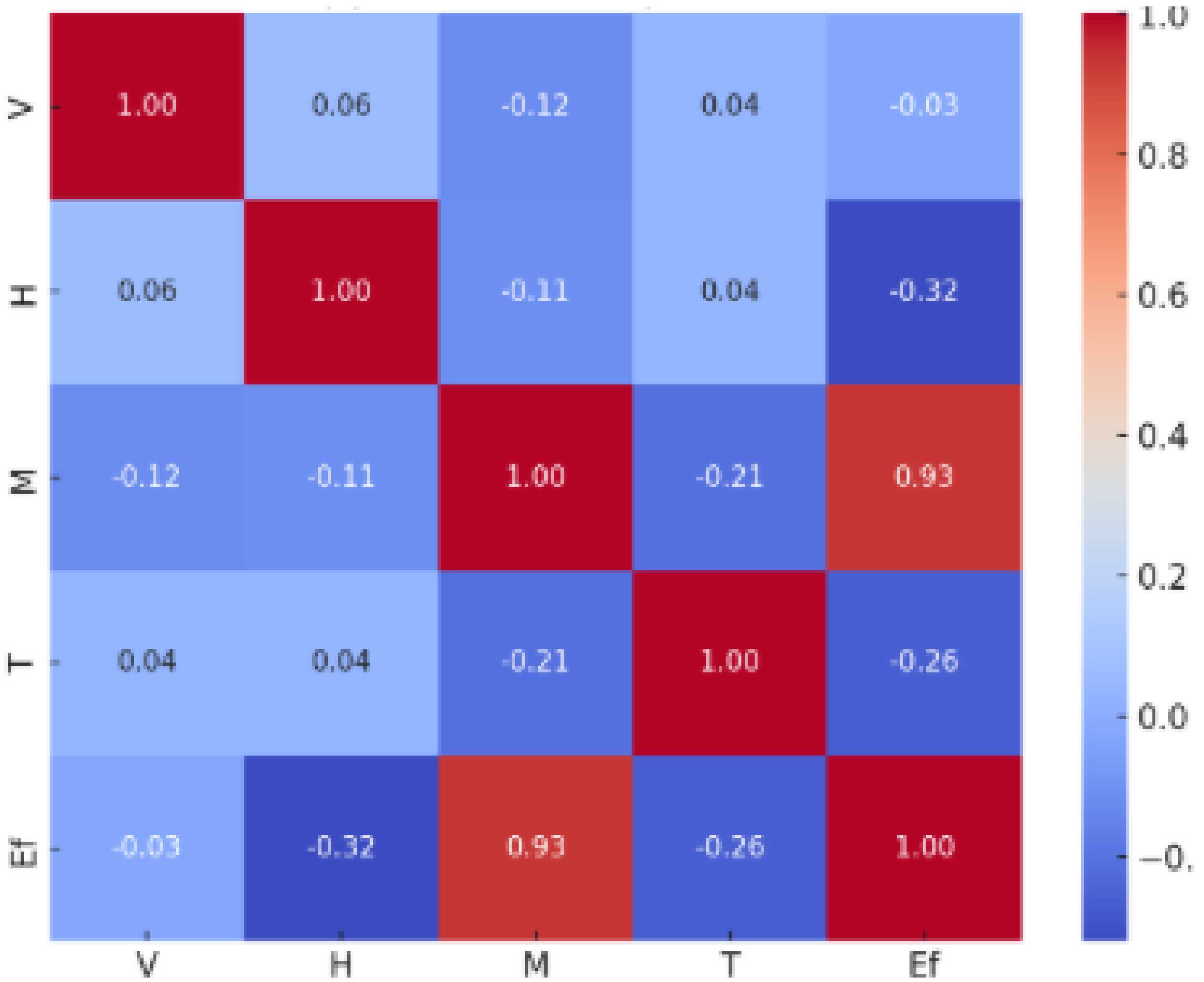
Table 3.

Designation	Name	Unit of measurement
V	Flight rate	m/s
H	Working height	m
M	Weight of the payload	kg
T	Working hours @@22 min	<1>E
Processing efficiency	%	The correlation coefficient is calculated as follows:

<1>This formula determines the relationship between each factor and efficiency (

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Fig. 2. Correlation Matrix.



The figure above shows the correlation between each factor (V, H, M, T) and effectiveness Ef.

Including:

<1>V

***H* (height)** and E_f - negative correlation (coefficient ≈ -0.30)

***M* (load)** and E_f - positive correlation (coefficient ≈ +0.33)

***T* (operating time)** and *Ef* - negative correlation (coefficient ≈ -0.16)

***T* (иш вақти)** ва E_f – салбий боғланиш (коэффициент ≈ -0.16)

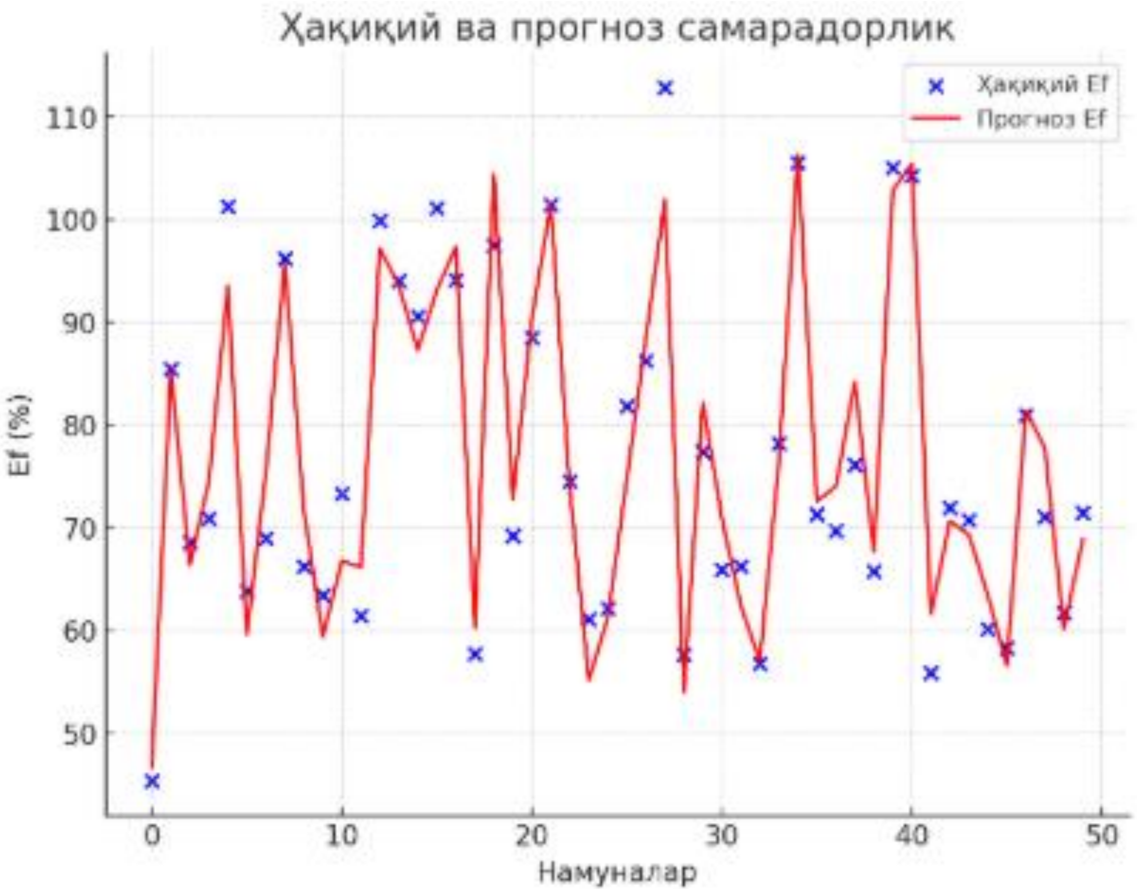


Figure 3. Graph comparing forecast performance calculated by the model with actual (measured) performance values.

MULTI-FACTOR REGRESSION MODEL

Based on the data obtained as a result of the conducted practical experiments, the following multifactorial regression model is constructed:

$E_f = \beta_0 + \beta_1 \cdot V + \beta_2 \cdot H + \beta_3 \cdot M + \beta_4 \cdot T + \varepsilon$

where:

β_0 - constant (basic efficiency),

β_i - coefficient of influence of each factor,

ε - random error.

For example, the results might look like this:

Table 4.

Factor	**Coefficient (β_i)**	**Direction of influence**
V - speed	+ 0.42	increasing speed increases efficiency
H - height	-0.25	performance decreases at too high altitude

M - cargo weight	+ 0.31	optimal load mass increases efficiency.
T - working hours	-0.18	extending working hours reduces performance

Regression model result:

$E_f = 45.3 + 0.42 \cdot V - 0.25 \cdot H + 0.31 \cdot M - 0.18 \cdot T$

Using this model, it is possible to **forecast** efficiency, **optimize** flight conditions, or **minimize** energy consumption for each region.

Based on the simulated data, the regression formula looks like this:

$E_f = 42.46 + 0.577 \cdot V - 0.300 \cdot H + 0.334 \cdot M - 0.159 \cdot T$

These coefficients are close to the theoretical ***β*** coefficients in the study and show the influence of various parameters on efficiency.

CONCLUSION

In conclusion the scientific significance of the research result is as follows:

Using the models developed during the dissertation work, statistical and functional relationships between the flight-technical parameters of the aircraft and the effectiveness of agro-aviation work were scientifically substantiated.

The regression results are used to create a digital management system for agro-aviation services.

A scientific novelty has been introduced into the research: "Optimization of the efficiency of agro-aviation work based on elements of intelligent modeling."

The graph in Figure 3 shows the actual efficiency (in blue) and the efficiency predicted by regression (in red). By analyzing this graph, it can be seen that the created model correctly predicts real data.

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