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Algorithm for Calculating the Fuel Demand of Tractor-Transport Works on Farms

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Abstract

The article discusses the issues of determining the demand for petroleum products by regulatory methods in agriculture of the Surkhandarya region. The calculation of fuel demand is based on the use of individual standards, taking into account climatic, production factors. A mathematical model for calculating the individual norms of fuel consumption for tractor-transport processes on regional farms is proposed and the results of the calculations are presented

***Keywords:** agricultural machinery, individual and group norms, fuel demand, fuel consumption*

Introduction

Finding the demand for petroleum products on the farm is one of the most important issues to be addressed every year. How accurately the demand for petroleum products is calculated determines not only the uninterrupted supply of consumers with petroleum products, but also the precise calculation of production volumes, the balance of economic indicators.

Typically, the demand for petroleum products on many farms is determined by the level of consumption in previous years. Such an approach to the issue is not objective, and in some cases leads to over-consumption or untimely delivery of petroleum products to consumers. At present, the deep economic reforms being carried out in the country's agriculture are creating a new type of agrarian relations aimed at the efficient use of land, water, labor, energy and other resources. As a result, farms are oriented towards the efficient use of productive resources in growing agricultural products [1,2].

Literature Review

Scientists in the field of economics are studying the demand for petroleum products in farms and the scientific and practical issues of its supply. At the same time, the factors and methods for determining the efficiency of fuel and energy resources are poorly studied theoretically and methodologically.

According to Nan Li, Heilin Mu, Juanan Li and Shusen Gui, the determination of fuel and energy resource efficiency should be based on special models of systematic analysis of factors (total power, diesel consumption, etc.).

In their research, E.B.Tolparov, R.Z.Zlobin, N.I.Bychkov, A.G.Levshin showed ways to develop an appropriate methodological framework for the preparation of a feasibility study to increase the efficiency of fuel and energy resources. [4].

Research methodology

An important tool for planning the demand for petroleum products today is the application of economic-mathematical models and methods. There are several ways to find demand for petroleum products, the application of which depends mainly on the type of petroleum products, where they are

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used, the volume and description of use, the planning stages, the level of use of computer technology and so on.

One such method is the normative method, which is part of many economic-mathematical methods. However, the calculation of demand can be described in the form of an algorithm based on the consumption of petroleum products and can be performed on a computer. In this case, the normative method is closer to the mathematical-statistical method.

Analysis and results

It is known that the enterprises of the agro-industrial complex use two norms in determining the demand for petroleum products: individual and group. Often the second norm is used in the planning of petroleum products.

The group norm is established by processing the data of previous years by mathematical and statistical methods. Of course, the failure to take into account climatic and production factors (yield, field structure, load class, road grouping, fertilizer rate, etc.) when using this method leads to errors in planning.

The proposed mathematical model is based on the use of individual standards in calculating the fuel demand of tractor-transport works on farms. This, in turn, takes into account climatic, production factors, and secondly, gives the most accurate results as possible at the lower level of planning (farmers, farms) [5,6]. Using this model, it is possible to find a group norm for a specific type of work and type of agricultural crop on all hierarchical links of agro-industrial complex management.

According to the data in [4,7], the structure of diesel fuel and gasoline consumption in agricultural enterprises is as follows: when using a car-tractor fleet - 73.9% diesel fuel and 2.5% gasoline; 79.1% gasoline and 3.6% diesel fuel for truck operation and 13% gasoline for special and light vehicles. It can be seen that fuel savings are mainly the responsibility of the car-tractor and car park. Reducing and saving on petroleum products requires standardizing the volume of mechanized work and accurately calculating the need for them.

The developed mathematical model is designed to calculate the demand for diesel fuel and gasoline in normative and agriculture.

The farmer's planned workload on diesel fuel is the sum of the fuel needs of the tractor-field, tractor-transport, road-transport, harvesting and stationary engines. The annual demand for gasoline is the need for truck work, engine start-up, maintenance and repair of cars, tractors, combines.

Below we get acquainted with the mathematical model of calculation of individual norms of fuel consumption for tractor-transport processes. To do this, we enter the following definitions:

J - a set of transport work serial numbers.

C_i - load capacity (т), $i \in J$.

β_i - load class accounting coefficient, $i \in J$.

UQ_i – the carrying capacity of the transport (т), $i \in J$.

γ_1 – norma hours for loading and unloading operations.

$L_i^1, L_i^{II}, L_i^{III}$ - the distance of carriage of cargo from the first, second and third group of roads, respectively, км, $i \in J$.

V_i^1 - speed limit of transport without cargo along the first group of the road, km / h, $i \in J$.

V_i^2 - norm of load speed of transport, km / h, $i \in J$.

η_i^0 - conversion coefficient into norma - hours, $i \in J$.

g_i - hourly fuel consumption when the vehicle is moving without a load on the first group of roads, kg / h, $i \in J$.

η_i - coefficient adjusting the fuel consumption rate depending on the relief, $i \in J$.

μ_i - integral coefficient, $i \in J$.

The following indicators are used to calculate fuel demand for transportation operations

1. Number of trips

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$$N_i = C_i / (\beta_1 \cdot UQ_i) \qquad i \in J \qquad (1)$$

$$n_i = \{N_i\}$$

where {} is the fractional part, of the decimal fraction; [] is the integer part of the decimal.

$$N_i^0 = \begin{cases} N_i & if \quad n_i = 0 \\ [N_i]+1 & if \quad n_i > 0 \end{cases} \qquad (2)$$

2. Total distance along the first path group

$$L_i = L_i^1 + 1.27L_i^{II} + 1.56L_i^{III} \qquad (3)$$

3. Distance traveled with cargo.

$$L_i = N_i^0 \cdot L_i \qquad (4)$$

4. General traveled distance.

$$L_i^2 = 2L_i^1 \qquad (5)$$

5. The average volume of cargo carried per trip.

$$MR_i = C_i / N_i^0 \qquad (6)$$

6. Norma hours for loading, unloading and moving accordingly.

if $n_i = 0$

$$W_i^I = 0.07N_i^0$$

$$W_i^{II} = \gamma_1 \cdot N_i^0$$

$$W_i^{III} = N_i^0 \cdot L_i \cdot (1/V_i^1 + 1/V_i^2)$$

if $n_i > 0$

$$W_i^{II} = \gamma_1 \cdot N_i$$

$$W_i^{III} = N_i \cdot L_i \cdot (1/V_i^1 + 1/V_i^2)$$

7. The volume of transport work performed in norma hours.

$$W_i = W_i^I + W_i^{II} + W_i^{III} \qquad i \in J \qquad (7)$$

8. Volume of transport operations in ton-kilometers.

$$P_i^0 = L_i \cdot C_i \qquad i \in J \quad (8)$$

9. Road utilization rate of transport.

$$K_i^I = L_i / L_i^2 \qquad i \in J \qquad (9)$$

10. The share of traffic time in total working time

$$K_i^{II} = W_i^{III} / W_i \qquad i \in J \quad (10)$$

11. Labor capacity of one ton of cargo.

$$T_i = W_i / C_i \qquad i \in J \qquad (11)$$

12. Conditional workload given in conditional norma hours.

$$P_i = UQ_i \cdot \eta_i^0 \cdot W_i \qquad i \in J \quad (12)$$

13. Fuel consumption for total transported cargo

$$GT_i = W_i \cdot g_i \cdot \beta_i \cdot \eta_i \cdot \mu_i \cdot MR_i \cdot K_i^I \cdot K_i^{II} \mu_i \qquad i \in J \qquad (13)$$

14. Fuel consumption for all tractor-transport works on the farm

$$GT = \sum_{i \in J} GT_i \qquad (14)$$

The following table shows the results of finding the amount of fuel consumed in the transportation of mineral fertilizers (cargo class 2) for different farms in Termez district using the above mathematical model.

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Name of farms	Aggregate structure		Carrying capacity, t	Average distance of cargo transportation, km	Number of trips	Distance traveled with cargo, km	Load capacity of one ton of cargo, norm-hour / t	Fuel consumption norm, kg / t	Total fuel consumption, kg
	Tractor type	Trailer type							
Loading using a crane capable of lifting 1 ton, unloading is mechanized									
Halkobod Nuryogdusi	T-40M	2-PTS-4	136,3	5,1	35	178,5	0,34	1,08	147,3
	MTZ-80	2-PTS-4	132,4	5,1	34	173,4	0,30	0,95	126,2
Loading is manual, unloading is mechanized									
Amudaryo Surhon Baraka	T-40M	2-PTS-4	202,0	35,0	51	1785	1,22	7,54	1524,3
	MTZ-80	2-PTS-4	199,0	35,0	50	1750	0,90	6,68	1330,1
	MTZ-50	2-PTS-4	225,0	32,0	57	1824	0,96	5,80	1305,9
Loading and unloading is manual									
Sebzor Termiz	T-40M	2-PTS-4	104	3,3	26	85,8	0,29	0,71	74,7
	MTZ-80	2-PTS - 4	112	2,6	28	72,8	0,28	0,14	53,5
	MTZ-50	2-PTS - 4	108	2,0	27	54,0	0,25	0,38	41,5
	T-40M	2-PTS-4	100	2,0	25	50,0	0,27	0,43	43,5

Based on the working conditions of farms in Termez district of Surkhandarya region, individual standards of fuel consumption for tractor-transport works and calculations of the need for total work as experimental calculations show the correctness of the chosen approach, as well as sources of fuel savings in agricultural production. identification, perform multi-option calculations for informed decision-making, and rationally attach techniques to transport operations.

Conclusions and suggestions

In conclusion, it can be noted that the above mathematical model and algorithm can be used to calculate fuel consumption for tractor-transport operations on other farms. This, in turn, will be the basis for the establishment of monitoring of fuel consumption during the cultivation of agricultural products.

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