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Issue of organization of material logistics of work of agricultural machinery in complex mountain-level land conditions

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A B S T R A C T

At any stage of the development of society, scientific-technical progress represents the main conditioning factor for this development. As far as scientific-technical progress represents the process of guaranteed development of any field of engineering. Therefore, some unconscious, unprofessional and interfering dependence with this process is accompanied by sufficiently multilateral negative results. The complex natural and industrial conditions of Georgia, especially in mountainous and complex-relief conditions, necessitate the introduction and development of special scientific directions, in particular the need to develop issues of mechanization of mountain agriculture at the level of modern scientific-technical progress in this field.

Keywords: Energy means, Assembly units, Exchange fund, Consumption of spare parts, Fuel consumption, Agrotechnical.

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Introduction

The natural and climatic as well as production conditions of agriculture in Georgia are quite diverse and this diversity is particularly sensitive on the performance of agricultural processes in mountainous and having complex relief areas, when such factors as the size and contouring of the processed area, the inclination and general state of the relief, climatic and soil conditions etc., significantly affect on the individual operational indicators of the performed processes (agrotechnical, energy, technical-economical etc.). This circumstance necessitates the development of a special directions of agriculture in Georgia, in particular, the development of issues of mountain agriculture and the corresponding means.

The development of mountain agriculture in Georgia requires the upgrading of relevant research, design, technological, engineering, and experimental works at the modern level, since they are a significant reserve for the perfect development of the country's agriculture [1, 2].

It is determined that in Georgia more than 60% of the land area, profitable for the production of agricultural products, is located on the slopes. It is also determined that the tasteless properties and nutritional value of the products produced on the slopes of the high-mountainous zones are quite high and they are exceeding the analogous indices of production produced on plain conditions. At the same time, it has been calculated and determined that development of the slopes, with steepness up to 8 ... 10°, would additionally produce more than 10 ... 15% of production (fruit, grapes, tea, etc.), and the development of slopes with value more than 20°, makes additional income in production – it is doubled [2,3].

Just like the general development of agriculture, the perfect development of slopes and mountain lands primarily depends on the level of mechanization of production processes. The issue of the rational selection of energy means and technological machines, as well as the implementation of complex

mechanization for plain conditions, is relatively easy to solve. Mechanization of agriculture in having complex relief and mountain lands, as well as in other similar conditions, is a problematic issue.

First of all, the mechanization of production processes of agriculture depends on the providing and proper selection of the corresponding mobile energy means and technological machines. Significant is, also determined due the according calculation of parameters the correct compilation and completion of the corresponding machine and tractor units, based on the theoretic calculations, determination of their technological parameters and operating modes, the improvement of methods of application of technology, the structural optimization of all links in engineering service. For modern agriculture, the uninterrupted, consistent and effective implementation of researches and development in this direction represents a significant problem [4, 5].

To ensure a high level of mechanization of field husbandry works in the agricultural enterprise and the implementation of complex mechanization of crop production, as well as for the full value realization of the operational properties and capabilities of machinery, the available power of work should be in range of 22...25 kW/man, and the energy supply of agriculture should be 4...6 kW/ha. As significant parameter is also the complex parameter-the density of mechanized works (conditional standard ha/ha) [6, 7].

In order to achieve and maintain of mentioned parameters in a specific region or in an agricultural enterprise, it is necessary to select and operate agricultural machinery on the basis of proper engineering calculation with taking into account the corresponding natural-production conditions.

At the present stage, in the conditions of management polymorphism, the selection and distribution of agricultural machinery by region is not obey the full value engineering calculations or control checks and the nomenclature-quantitative selection is mainly made by an individual approach. For this reason, incomplete application of their capabilities or cases of their work with overload is frequent.

In addition, the general organization of material logistics for the operation of agricultural machinery that is the main task of the logistics and oil products supply, provides a reliable modern supply of agricultural enterprises by the necessary machinery, equipment and spares for them, as well as materials for the operation of these machines and equipment, as well as for all branches of the economy.

The required number of exchange stock of unit assemblies for the whole economy would be determined from the simplified formula:

$$n_{O.\Phi} = m\rho T_B K_H / T_{CP} \cdot \qquad (1)$$

where m - is the number of machines on that these assembly units are installed;

ρ – is the number of assembly units for one machine;

T_B – is the time of complete restoration of the assembly unit, including the time on transportation;

K_H – is the coefficient taking into account deviations from the established terms of restoration and other normative (K_H= 1,2 ... 1,8);

T_{CP} - is the average life of the assembly unit before replacement.

The smaller values of K_H are assumed for large farms and vice versa.

The value of the coefficient K_H at operation of agricultural machinery in complex mountain-plain conditions undergoes a change in the direction of increase that also leads to an increase in the number of required assembly units.

The number of replaceable working bodies of machines and recoverable spares would also be calculated using the following simplified formula

$$n_{з.ч} = m_м \rho_м \left[\frac{\Omega_C}{T_P \left(1 + n_{рем}\right)} + A_{CTP} \right], \qquad (2)$$

where m_M - is the number of the same type machines;

ρ_M – is the number of parts or work tools per machine;

Ω_C, T_p - are respectively, the seasonal load per machine and the average periodicity of parts replacement, ha,h;

n_{pem} – is the number of parts repairs for the period of its service;

A_{CTP} – is the number of insurance fund sets per machine.

At existing reasonable norms for the consumption of spares, their required quantity would be determined by the formula

$$n_{з.ч} = m_м M_н / 100, \qquad (3)$$

where M_Y – is the rate of consumption of this part for 100 vehicles per year.

The required amount of materials for the repair, maintenance and storage of machines would be determined in accordance with the available regulations according to the following formula

$$Q_{м} = \Pi_{р} M_{н.м}, \qquad (4)$$

where Q_M – is the required quantity of materials, kg, pcs., etc.;

Π_p – is an annual program of this type work;

$M_{H.M}$ – is the rate of consumption of this type of material per machine.

The annual requirement of the economy in the each type fuel is determined from the statistical data of past years or by a simplified calculation by formula [3, 6]

$$Q_{т.г} = \frac{Э_{т.д}}{1000}\left(\Sigma F_i Q_{Ti}\right), \qquad (5)$$

where $Q_{TГ}$ – is the annual fuel consumption, t;

$Э_{T.D}$ – is a correction factor that takes into account the additional fuel consumption, connected with the inclination and roughness of the surface of the plots, passages, preparation

F_i – is the volume of *i* work, ha, t, etc.;

Q_{Ti} – is the fuel consumption per unit of performed work, kg/ha, kg/t, etc.

In the absence of more reliable data, the value $Э_{T.D}$ would be approximately accept as $Э_{T.D}$= 1,05 ... 1,08. The values of F_i and Q_{Ti} are accepted accordingly of the flow charts and the norms of production and consumption of fuel for mechanized work.

According to the Q_{Ti} is determined required capacity of fuel storage tanks, m³

$$V_{х} = Q_{т.г} Э / \rho, \qquad (6)$$

where Э – is the coefficient, taking into account the necessary production stock of oil products;

ρ – is the density of fuel.

For diesel fuel and petrol, respectively, we can accept the average values ρ=825 kg/m³ and ρ=700 kg/m³.

The numerical value of Э depends on the conditions for the delivery of oil products to the farm and would vary from 0.1 up to 0.5. Averaging for common farms would be accepted as Э= 0.15 ... 0.20.

The need for fuel for the month, season, etc. would be calculated by the formula (5).

The general principles of the organization of the engineering and technical service described are also valid for the newly created machine and technological stations (MTS), the number of which is continuously growing throughout all Georgia, and whose main tasks are: rendering services in the production of mechanized works; processing of agricultural products; provision of equipment for rent and hire; rendering of services in the field of maintenance, including maintenance and repair of equipment; manufacture of spares; material logistics of agricultural enterprises in the service area; execution of construction works, etc. With consideration of these areas of activity, the structure of the engineering and technical service of modern MTS is formed on the basis of general principles of specialization and division of labor [8,9].

In the field of engineering and technical services of large farms and MTS, with consent of farmers would also be included the farm enterprises. On the orders of farmers, they can be provided with the following types of services, either on a permanent or temporary basis or on a one-time basis: implementation of mechanized activities for the production and realization of agricultural products; rent of equipment; on effective application and maintenance of equipment; sale and pre-sale service of machinery, etc. All these services are possible only on a voluntary mutually beneficial basis that represents the fundamental principle of a market economy.

Conclusion

The calculated accordingly of enterprise's production directions rational supply of its functioning by material and technical means, in particular the appropriate machinery, replacement working bodies of machines and spares, materials for repair, maintenance and storage of machines, annual fuel requirements, as well as a qualified engineering and technical management of all production processes, represents the determinative factor of the whole activity and functioning of the economy, not depending on its production scale.

Rational organization and professional management of the process of material logistics of agricultural technological processes represent a necessary condition for achieving of optimal final results.

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