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SHIFT-HOUR PERFORMANCE OF POWER MACHINES IN DIFFERENT BRANCH OF PLANT PRODUCTION SUBJECT TO FARM SIZE

ODREĐIVANJE KOLIČINE OSTVARENIH RADNIH ČASOVA POGONSKIH MAŠINA ZA RAZLIČITE VRSTE BILJNE PROIZVODNJE

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REZIME

Određivanje najefikasnijeg sastava mehanizacije za svako imanje vrlo je značajno u današnje vreme. Neophodno je izraditi matematičke modele za planiranje sastava mehanizacije za mala, sradnja i velika imanja koja se bave ratarskom, povratarskom i vinogradrskom proizvodnjom.

Određivanje iskorišćenosti mašina koje se može primeniti na imanjima različite veličine, neophodno je sa aspekta dobijanja informacija vezanih za ekonomičnu mehanizovanu proizvodnju.

Uzimajući u obzir sadašnju usitnjenu strukturu imanja, postavljen je cilj da se odredi najefikasnija kombinacija mašina, koja bi se koristila za različite vrste biljne proizvodnje u zavisnosti od veličine imanja. Takođe je izračunata minimalna veličina imanja u rataskoj, povratarskoj i vinogradrskoj proizvodnji ispod koje izgradnja spostvenog mašinskog sistema ekonomski nije opravdano.

Ključne reči: iskorišćenost mašina, mehanizacija sa niskim troškovima, mehanizacija imanja različite veličine, planiranje sastava mašinskih sistema.

SUMMARY

The present study is a comprehensive survey covering the analysis of the development of the machine stock and the use of the machines of field crop producing, field vegetable growing and plantation cultivating farms by the application of the means of computer-guided modelling. The characteristics of the machines demanded by the production of different plants are taken into account and special attention is paid to the application of machines with reasonable capacity and technical level in respect of cost by different farm sizes.

Our aim is to stipulate the range of farm size under which the development and operation of an own machine stock is not even with additional machine cost offering worth in the branches surveyed. By this the farm size limit under which the use of the logistically more defenceless lease work is reasonable in order to keep the cost of machine work at an acceptable rate will be defined. This limit varies from branch to branch. This way the fact that the mechanization of the individual branches is highly dependent from the farm size and the diversity of parameters effecting mechanization can be pointed out.

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Key words: mechanisation of small and medium sized farms, machine fleet planning, machine utilisation, low cost machine fleet, machine investment and usage cost.

INTRODUCTION

Work done by an efficiently developed machine system is a significant condition of the fruitfulness of farming. The machine prices and the cost of their utilization are extremely high and all these result in extraordinarily high production costs (Husti, 2004). Rational machine utilization is a definitive factor of the efficiency of venture-farming (Malinović et al, 2007) Nikolić et al, 2007). According to our experiences the machine stock of a venture and the way and rate of utilization of same are reserves which can substantially contribute to the increase of corporate income (Magó et al, 2005; Malinović and Mehandžić, 2006).

Contrary to former practice the concept of "optimal machine system" is not to be interpreted within the framework of corporate enterprise only but we are to find a solution for solving the mechanization problems and planning the machine utilization of small and medium size farms as well (Fenyvesi et al, 2003). The wide range of enterprise sizes characteristic nowadays and the great number of power and working machine types available are also to be considered (Hajdú and Gockler, 2005).

Considering the shift-hour performance of the machines under given production circumstances an overall system for building up a machine system adapted to small, medium and large farm size can be developed. The areal size limits and cost of the utilization of self-owned power machines of different performance level and harvesting machines of diverse functions can be determined as well as the number of shift-hours to be performed which also effects the efficiency and cost of machine utilization (Savin, 2004). In case of power machine families representing different quality, resp. cost level the cost level of the given power machines carrying out the individual work operations at different farm sizes can be determined (Magó, 2008d).

MATERIAL AND METHODS

The parameters of model calculations

The surveys can be conducted by modelling the machine working processes of agricultural production. In the case of field crop production a crop plan including cereal plants for human consumption, maize for animal breeding and for energy production purposes and oil seeds – as sunflower and the nowadays very popular crucifer - appropriate for human consumption and energy production as well and reflecting the special features of production in Hungary has been applied. Our calculations have been based on a crop plan including cereal plants, sweet corn, onion and root vegetables in case of field vegetable growing while in case of plantation cultivation the data of a vine growing farm have been taken into account. Depending on farm size the proportion of the crop area of the individual plants has been stipulated in view of the agronomical and production technological conditions.

The basic figures of machine utilization have been determined with the help of the data base of the Hungarian Institute of Agricultural Engineering (Grockler, 2007).

The model-calculations have affected the determinative farm size points of machine stock development in a farm size range of 2-1000 ha depending on branch. On this basis we can come to statements affecting a wider segment of the agricultural property structure, resp. to conclusions concerning mechanization and machine utilization.

RESULTS AND DISCUSSION

Results of the model calculations concerning the composition of the power machine system and the shift hour performance of the power machines.

The composition of the power machine systems assigned to the individual areas has been determined by power machine categories. Under given machine working conditions as sowing structure and production technology characteristic of the special features in Hungary regular coherences can be stated considering the composition by categories of a cost efficient power machine system developing according to farm size (Magó, 2008d, 2008e).

The number of shift-hours achievable by different farm sizes effects the composition by category of the power machine system.

In case of field crop growing considering the smallest farm size (max. 50 ha) the utilization level of the tractors is low: maximum 400-500 shift-hours annually.

In case of medium size farms (50-300 ha) this quantity is bigger: 800-1400 shift-hours per year.

In case of large size farms (over 300 ha) the performance (1000-1800 shift-hours a year) of the tractor categories is already significant.

A grain harvesting machine with rationally chosen capacity achieves good utilization by farm sizes over 300 ha with a shift-hour performance of about 300/year and an acceptable operational cost hereby (Magó, 2008c).

The number of calculated shift-hours achievable in case of field vegetable growing subject to farm size is as follows (Magó, 2008b):

By the smallest farm size surveyed (max. 20 ha) a low level of utilization of tractors can be achieved: maximum 500 shift-hours a year.

In case of medium farm sizes (20-100 ha) the number of shift-hours is already remarkable: 500-1000 shift-hours per year.

In case of large farm sizes (over 100 ha) the tractor categories may already have a significant performance (1000-1800 shift-hours per year).

The level of shift-hour performance by plantation cultivation:

By the smallest plantation sizes surveyed (max. 20 ha) only a low level of utilization, maximum 600 shift-hours a year can be achieved even if a low capacity power machine is applied.

In case of medium and large size plantations (over 20 ha) this quantity grows and the tractors may have a remarkable (600-1250 shift-hours annually) performance.

The number of shift-hours per unit of area decreases with the increase of farm size. In case of field crop production on small size farms 10-15 shift-hour/ha/year is performed. In the size range of 30-300 ha a shift-hour performance of 8-10/ha can be calculated, from this size on an annual figure of about 6 shift-hours per hectare becoming constant with the realization of an efficient labour plan can be observed. (Figure 1).

In case of field vegetable growing by the small farm sizes 20-25 shift-hours per hectare per year are realized. In the size range of 30-200 ha 18-20 sh/ha can be calculated but with the increase of labour effectivity even the favourable 15 shift-hours per hectare performance can be achieved.

By plantation cultivation in case of small farm sizes 35-40 shift/hours can be achieved. In the size range of 10-50 ha shift-hours per hectare are performed, from this size range on the still significant annual figure of 24 shift-hours per hectare becomes constant.

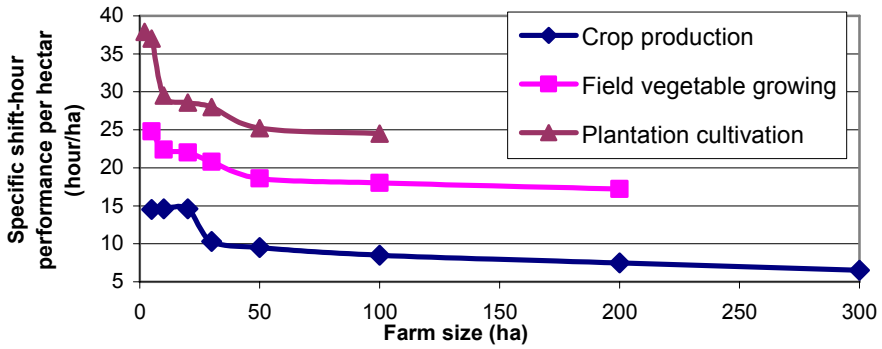

Fig. 1. The total shift-hour performance of power machines subject to farm size in the different branches

The above figures are characteristic of the utilization of the low investment cost power machines and they alter a bit if high investment cost power machine families are used. The more up-to-date power machine-working machine connections need shorter time for executing their labour tasks and this is also reflected in the above mentioned specific index. In field crop production, for instance the utilization of the more expensive and higher technical level results in a benefit of 0,3-0,5 shift-hour per hectare annually. But presuming internal home work only this benefit is a disadvantage considering utilization as the annual shift-hour performance of the individual machines decreases and hereby their specific utilization cost increases.

It can be stated that the most machine working hour demanding branch for the cultivation of one hectare is the plantation cultivation, field vegetable growing comes next, and the last one in the row is the field crop production. Obviously farms producing grain and oilseeds have the lowest machine working hour input demand. With the growth of the farm size the specific number of machine working hours necessary for the cultivation of one hectare area decreases in each branch and the figures are nearly halved in case work is done under more favourable and more efficient large scale farming conditions with high performance machinery.

The great number of hours experienced by small farm sizes increases the living labour expenditure as well (Ponjičan et al, 2008). Though for farm of this size category the application of mainly low performance machines is characteristic due to the limited level of machine utilization the general expenses and, therefore also the operational costs are high (Bajkin et al, 2008; Ponjičan and Bajkin, 2008).

Surveying the decreasing tendency of machine utilization costs parallel with the increase of farm size it is clear that in case of real small-scale farming the machine costs are several times, three or may be even six-seven times higher than the acceptable and economically reasonable level of the medium, but especially the large-scale farms. Consequently it can be stated that in spite of the reasonably chosen power machine capacity there is no technical solution which could acceptably solve the cost problem of farms smaller than about 16-20 ha in case of field crop production, 9-12 ha in case of field vegetable growing and 5-7 ha in case of plantation cultivation (Magó, 2007).

Furthermore, the capacity of the machines assigned to the crop growing technologies applied in the latter branch is lower, their purchase price is mainly lower and this effects the machine cost level of small-scale farming in a more favourable way than the phenomena experienced in field crop production (Đurovka et al, 2006; Ponjičan et al, 2008).

It must be pointed out that under the indicated farm size limits the development of an own machine stock is not economical if there is no lease-work possibility besides home labour whereby the machine utilization can be increased, the period of returning of machine investments can be shortened and a more fruitful farming can be achieved. (Baranyai et al, 2007).

All the above can be even more specifically supported by demonstrating the specific costs of machine investment. By small farm sizes the specific costs of machine investment are obviously higher and their period of return is statutorily longer.

There is a possibility for the use of own machines also beneath the above mentioned farm sizes limits which do not ensure effective machine utilization. In this case the solution for the small-scale farms may be the operation of second-hand machines already over the amortization period which need close attention and are in many cases repaired by the owner personally (Magó 2008a, 2008c).

CONCLUSION

The aim of our research work and the exposition of its results are the professional support of the machine investment decisions and the machine utilization practice of the different size farms promoting hereby the creation of the conditions of fruitful farming and rational machine investment decisions.

In the present study we have tried to offer a general guideline considering a general crop plan and production technology characteristic of several branches with an overview of the composition of machine stock from the use of the lowest cost level to the highest technical level machinery, the machine demand and the utilization level of those together with investment and utilization costs which may serve as a basis and may open further research perspectives for the reduction of machine utilization costs both for the producers and for the professional organizations.

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