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ENERGETIC AND WORK QUALITY TEST OF SUBSOIL CHISEL TOOLS

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ABSTRACT

Soil loosening has a very good environment capability both on dry and humid soils. In this chapter through practical examples some loosening tillage systems are presented. For the improvement of soil condition, a periodical deepening tillage system. Despite several years of drought, soil structure was improved, and risk of the reduced tillage was decreased.

In the course of the comparative investigation, energetic and working-quality tests made carried out with three frequently used soil-loosening implement types in field-land conditions – such as wide blade, duck-foot and chisel undercutting ('Paraplow') type loosening elements. In addition, the change of the tractive effort (drawbar pull) – as a function of the working depth and the travel speed of the tractor-implement combination – was measured and analysed. On this base, the working quality values of the tools made compared as well.

Keywords: soil loosening, subsoil chisel, energetic test, working-quality test.

INTRODUCTION

Soil loosening is the tilling method which disrupts (divorces) the settled, compacted soil layers damaged by plough pan (*sole*) deterioration by cracking them into all directions (Araya, K. – Gao, R. et al. 1995). Middle-deep subsoilers (loosening implements) are basic machines in the tillage system; they serve for deepening the tilled top soil layer and they can be effective in the struggle against the harmful compactness in the way of middle-deep sub-soiling process in depth range of 30 to 50 cm

(Birkás 2004, Gyuricza 2005). This primary tillage method is required to provide the suitable connection between the single soil layers as one of the fundamental conditions for the plants [5]. Amongst others, it is also important because the compacted layer decreases the water-absorption capacity of the soil, thereby disadvantageously influences the total life cycle of plant, and assists the cumulating of internal waters as well as decreases the water permeability of soils (E. Mckyes et al. 1985). The brief summary of the objectives conceived during the research are as follows:

1. Determination of profile equations of the three tested middle-deep subsoiler tools.
2. Comparison of three middle-deep subsoiler tools according to the agro-technical parameters.
3. Comparison of three middle-deep subsoiler tools according to the energetic parameters.

MATERIAL AND METHODS

A scale rule with an accuracy of 0.5 cm was used for measuring the working depth of the tilling tools, repeating five times.

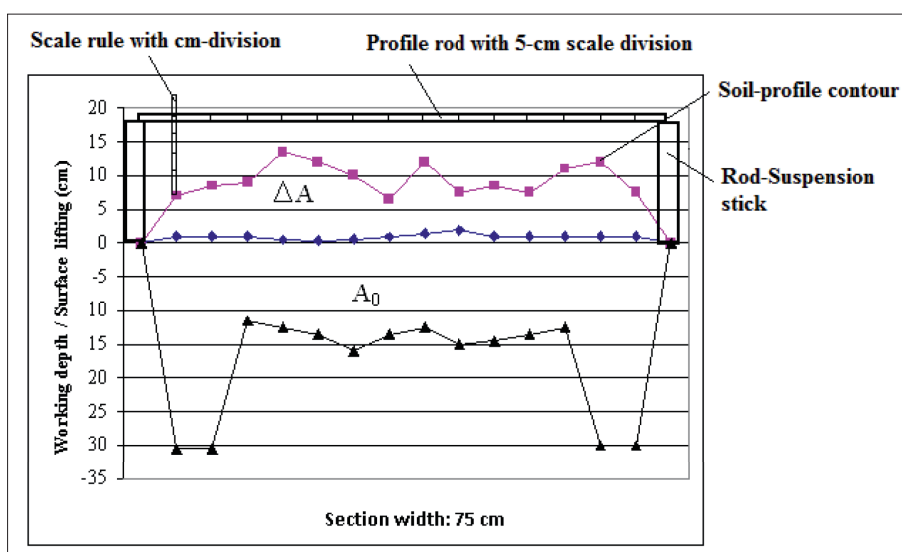


Figure 1: Method of profile measurement

For surveying (measuring) the looseness of soil in conventional way, a profile rod was put on the tops of two equally high sticks above the loosened soil strip. Then the rod was adjusted to the level by a bubble-level and the distances between the profile rod and the actual soil-section contour was measured by a scale rule with cm-scaling, step by step with 5-cm spacing. With every repetition, respectively, three data lines of profile mapping were recorded:

- data of the undisturbed soil profile before loosening – blue data line,
- data of the soil profile after loosening – pink data line,
- data of the non-loosened soil profile from the excavation (ditch) cross-section – black data line.

Through this data processing, ΔA is derivable from the before- and after-loosening soil profile; the value of A_0 is gained from the data of profile of the non-loosened soil recorded from the excavated cross-section trench (Figure 1). The computer-aided design drawing program Solid Edge V 18 was used for calculating these properties.

The determination of the required tractive effort of the subsoiler tools was carried out with the help of a tractor CASE IH 7210. Both lower hitch links as well as the third upper link (support spindle) are equipped with strain-gauge tapes.

Data received from all of the transmitters described in connection with the energetic properties were transferred to the amplifier data logger unit mounted on the ballast-weight pieces. The logger unit consists of a 160-MHZ computer *Pentium*, a measuring card *Advantech PCL 818* and an *APC* uninterruptable power supply unit; the measurement system is capable of receiving data through 16 analogue and 16 digital channels. The measuring system was controlled by a portable computer connected to serial port of the measuring computer, from the cab of the tractor.

During the tests, to measure the traveller speed of the tractor, the rear wheels were equipped with revolution transducers. These were inductive measuring transducers – they scanned passing-through elements (existing or separately fixed) on the rotating wheels.

The averages of the values measured along the experimental sections were simultaneously displayed on the screen of the PC thereby the operation of the measurement system was provided immediately on the spot.

CONDITIONS OF INVESTIGATION

Table 1: Experimental conditions

Test field	Plain cereal stubble
Moisture content of soil [W/W%]	23.8
Penetration resistance of soil $_{0-40}$ [MPa]	2.8
Arany's soil-cohesiveness K_A	33
Physical type of soil	sandy loam

Table 2: Technical properties of the middle-deep subsoilers put to tests

Denomination	Tool types		
	Kühne	Jympa	Paraplow
Web-plates	- width 30 mm - height 1200 mm	30 mm 800 mm	20 mm 750 mm
Type of loosening tool	wing	wedge	chisel
Width of loosening tool	220 mm	50 mm	30 mm
Length of loosening tool	150 mm	170 mm	370 mm
Angle of penetration into soil	25°	25°	25°
Mass of tool	80 kg	50 kg	45 kg

RESULTS

1. Determination of the cutting-edge profile formulae of the three compared middle-deep loosening tools

The profile of the cutting edge significantly affects, amongst others, the traction resistance of the actual tool (Jóri 1993). In my judgement, this is why the thorough knowledge of the equations of the profile curves is essential.

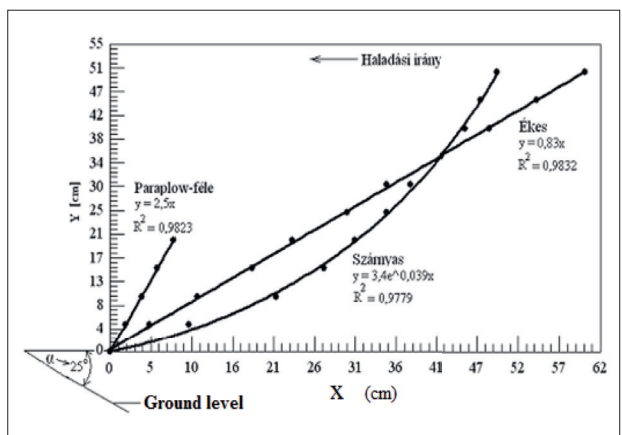


Figure 2: Determination of profile equations of the three tested middle-deep subsoiler tools in their side view

It can be shown in Figure 2 that the cutting edge of the tool type *Paraplow* is the steepest while that of the *wing-type* tool – less steep due to its curved design.

The cutting-edge profiles can be described the best by linear (straight-line) and exponential functions as the values R^2 have shown the maximum with this function types. The derivative function of the profile equation defines the loosening angle α of an actual point of the tool.

The derivative of the straight line is a constant ($y = c$) and that of the exponential function ($y = ae^{bx}$) is the relationship $\ln y' = \ln(ab) + bx$ accordingly $y' = tg\alpha$.

Changing in values gained by the differentiation can be seen in Figure 4. According to the diagram, amongst the tested tools, the steepest or maximum angle (all along

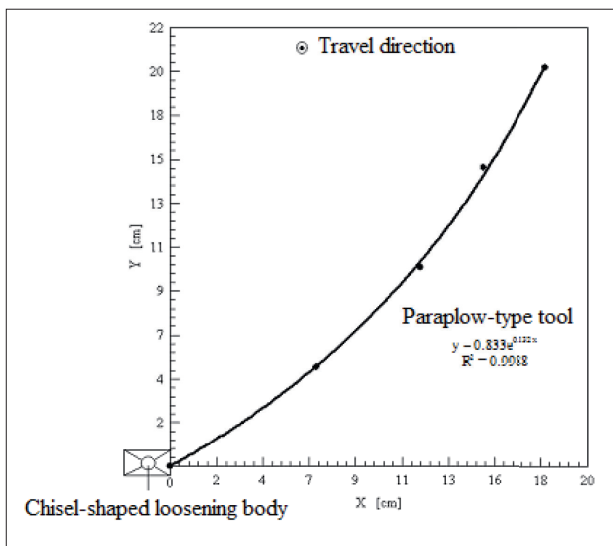


Figure 3: Determination of profile equation of the subsoiler tool type *Paraplow* in its front view

the tool wedge) arises with the design type *Paraplow* while the smallest – with the curve-shaped tool.

2. Working-quality tests of the loosening tools

The working-quality investigations were carried out with the 40-cm working depth and the operating travel speed of 7.6 km/h; the comparison was performed in the same kind of soil. The measuring tests were repeated three times in the case of each tool.

The tool type *Paraplow*, slipping under the soil section, loosens the soil by lifting the section then dropping it back on the same spot meanwhile the front beak of the chisel-form loosening body prebreaks the bottom layer of the soil section to be cut out. This is carried out by the wing part mounted on the bottom part of the web plate. The soil slice cut out, advancing over the surface of the loosening body and the wing part, elevates up to the actual height. Finally, the soil slice gets back to the same point from the loosening body.

By my opinion, a relatively quick re-compaction of the loosened soil attends this loosening mode due to the comparatively little air admission. With an actual soil type, the standard deviation of the set working depth is slightly greater than that of the tool with loosening wedge. The

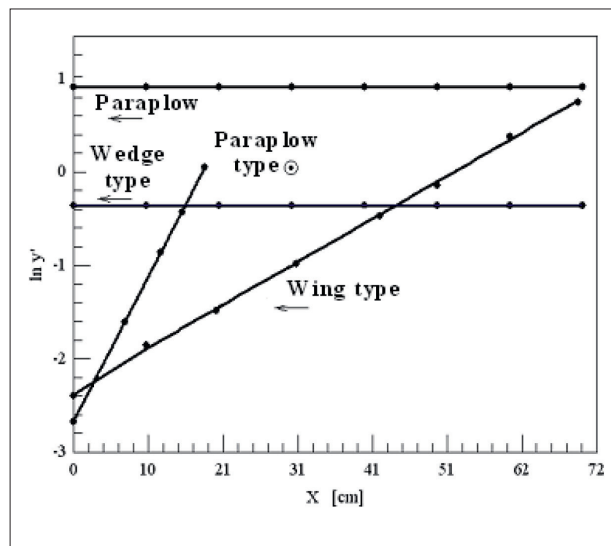


Figure 4: Changing in the loosening angle of the blade profiles in the side view of tools



Figure 5: Work of the tool type *Paraplow*

Table 3: Results of the working-quality tests

Measured working-quality properties	Paraplow-type tool	Loosening-wedge tool	Wing-type loosening tool
Section area of surface elevation ΔA (cm ²)	557.5	340.5	975
Area of loosened section A_0 (cm ²)	1227.6	930.3	1597.6
Degree of looseness (%)	45.41	36.60	61.02
Deviation of evenness of the surface contour s_{a1} (cm)	5.33	8.29	17.66
Deviation of working depth s_{d1}	5.12	3.54	6.82
Working depth (cm)	40	40	40



Figure 6: Work of the tool with loosening wedge



Figure 7: Work of the with wing-type tool

loosened soil surface is even which is important for the secondary tillage or seed-bed preparation (Figure 5).

The shape of the soil section cut away by the loosening wedge is V-form which is then loosened by elevating and crushing; the section moves upwards along the web plate, meanwhile ruptures, and the soil parts and layers is continuously changing over. So during loosening, the soil moves forwards, upwards and laterally; in the case of cohesive soils, in the course of the process, clods may formed on the surface. The soil loosened this way is less liable to re-compaction than that tilled by the tool type Paraplow. The depth control of the tool, in my judgement, is acceptable. The evenness of the surface can be considered as good with this tool as well (Figure 6).

The loosening of the wing-type subsoiler tool is also similar to that of the wedge-type blade with the essential difference that, due to the wings mounted on the loosening wedge, the loosened strip is much wider. In addition, the soil-section lifting and breaking impact – consequently the performed looseness – with this construction are the most effective amongst the tested implements. In terms of the working quality, similarly, the operation of this tool is the most effective in

my judgement for the re-compaction takes place at the latest due to the significant loosening effect. However, the worst working-depth control and a rough, cloddy soil surface attend this positive effect (Figure 7).

3. Examination of the tractive effort and the travel speed During the investigation the characteristic tractive effort required of the tool was measured with six travel speeds ($v = 4.68, 5.65, 6.51, 7.66, 8.64, \text{ and } 9.93 \text{ km/h}$) and a constant working depth ($a = 35 \text{ cm}$), and in three replications, respectively.

4. Examination of the tractive effort and the working depth

In this case, the characteristic tractive effort required of the tools was measured in three different working depths

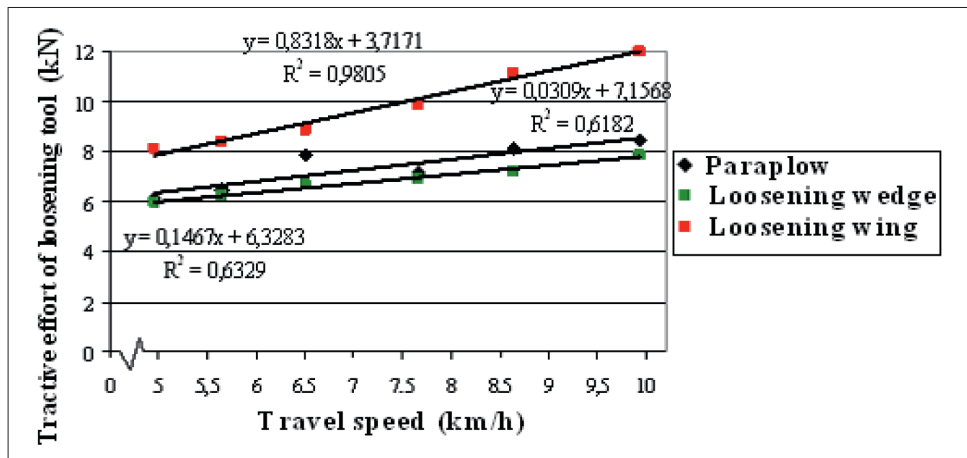


Figure 8: Measured tractive-effort data as a function of travel speeds

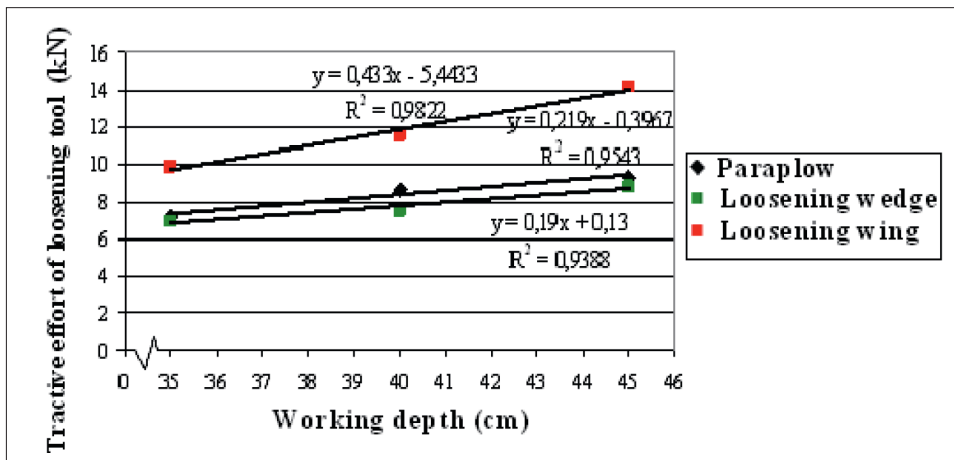


Figure 9: Measured tractive-effort average data as a function of working depth

($a = 35, 40, 45$ cm) and at a constant travel speed ($v = 7.66$ km/h), and in three replications, respectively.

CONCLUSIONS AND DISCUSSION

The adjunct phenomenon to the subsoiling is the clod forming on the soil surface. This is in relation to the construction of the used subsoiler tool as well. The differences between the soil surfaces produced by the three tools can be seen well in the presented pictures as well. By my opinion, the uneven and cloddy soil after subsoiling is less liable to the re-compaction. The soil surface, like this, can be perfectly tilled after and packed by the roller harrows with different profiles applied on the middle-deep subsoilers.

It has revealed from the investigation that, under the effect of increasing the travel speed, the tractive effort required by the wing-type design increases in the highest degree. The increase in required tractive effort of the other two tools is not significant (Figure 8).

At the same time, the travel speed greatly influences the working quality because higher speeds cause more intensive disruptive effect. Accordingly, it is reasonable to carry out the middle-deep subsoiling in the speed range of 6 to 8 km/h in all kinds of soils.

Comparing the three tools, the required tractive effort of the loosening-wedge type blade increases in the lowest degree – from 6.9 kN to 8.8 kN. That of the design Paraplow increases from 7.1 kN to 9.3 kN when the working depth increases by 10 cm. The tractive effort increases in the highest degree in the case of the wing-type loosening blade – from 9.12 to 14.21 kN (Figure 9).

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ECONOMIC EFFECTS OF THE ELECTRONIC SMALL-SCALE PRODUCER LICENSE AND THE ELECTRONIC PUBLIC ROAD TRADE CONTROL SYSTEM FROM THE POINT OF VIEW OF TAXATION

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ABSTRACT

The research focuses on the small-scale producer license and the Electronic Public Road Trade Control System (EKÁER), because both have significant influence on the whitening of the economy. In the work It has been studied the literature relating to the EKÁER, and presented the taxation through the operation of a sample farm. The results showed that the EKÁER and the electronic small-scale producer license have significant whitening effects in the economy. Furthermore, it concluded that with regard to taxation the rate of the health care contribution (EHO) does not encourage the farmers to produce more to reach a higher income. It also concluded that the trading activity provides a higher income than the small-scale producer activity. The objective of the work is to highlight the possible weaknesses of the old small-scale producer administration system through the activities and taxation of a sample farm, and to draw attention to the significance of the introduction of the Electronic Public Road Trade Control System (EKÁER), and also to show the economic importance of the parallel operation of the above-mentioned two systems.

Keywords: Electronic Public Road Trade Control System, EKÁER, Electronic small-scale producer license

INTRODUCTION

Due to the exponential growth of the population of Earth, the population reached 7 billion by the beginning of the 21st century (Robert E. Lucas 2000). With regard to our planet, it means enhanced load as the area of arable land decreases and at the same time the area occupied by cities and roads increases. The risks arising from the

environment pollution also affect the living spaces and the agricultural productivity. It entails that the food for the ever growing population must be supplied from ever decreasing agricultural areas. Since the establishment of Hungary, agriculture has always played a significant role in our country. During the different historical eras agriculture has always had a key role in the economy, in some eras even more so than in others. After Hungary joined the European Union, and especially in recent years, agriculture has shown growth in the GDP. The share of agriculture in the GDP is 3.6%, which is double the EU average. Owing to the conditions of Hungary and the continuously growing demand for food, agriculture plays a significant role in the economy (KSH 2018). There must be great opportunities in our country for the agriculture, despite the fact that the GDP digits are low. Agriculture is a strategically important sector. It is true for the agriculture, as well as for the other economic sectors, that the old administration systems for the production, sales, taxation and administration have become obsolete due to the digitalized administration. Therefore the government continuously develops new systems, and these are the main topics of my scientific work. In Hungary, the small-scale producers have special taxation rules, which is unique even in Europe. Private persons may acquire a joint small-scale producer license, which means that people living in the same household wish to pursue the small-scale producer activities together with their family members. The precondition for the joint license is to have the same permanent or temporary address. A family member may be the small-scale producer's spouse, direct ascendant or descendant, adopted or step children, or the step parent or guardian of the adopted person. Another condition is to choose the same taxation method for all the members in the joint license. On 1st July

2016 the definition of agricultural small-scale producer was modified. The main point of the change was that the small-scale producer license may only be obtained if the private person has own farm on the territory of Hungary, or if the assets of the small-scale producer includes rented land (NAV 2016). Act LII of 2018 on the new social contribution came into force on 1st January 2019. According to the said regulation, the tax rate of the agricultural small-scale producers shall be 17.5% annually, instead of 27% as of 1 July 2019 (NAV 2019). 436/2015 (XII.28) Governmental decree on the new agricultural small-scale producer license came into force 1st January 2016 (Hungarian Journal 2016). The administration of the small-scale producer license, the issue, modification, change or withdrawal of the license may be requested at the county administration organisation competent for the permanent address of the client. The direct contact persons are the village consultants. The aim of the new regulation is to enable the customers to recognize the small-scale producers who have valid license, to identify the small-scale producers' products produced in Hungary. For this end, the small-scale producers, at the place of sale or on the product, have to give their license number and the words "Product from own small-scale producer activity" to inform the customers suitably. A part of the goods trade is goods imported to Hungary, and a significant part of those goods is agricultural products, raw materials, foods. After many decades a system was long due which ensures food safety and proper state tax income. The modern information technology, satellite technology and the internet access made the system possible. The system of e-road toll was introduced in 2013. The amount of the toll depends on the number of axles, environmental classification, weight of the vehicle and the type of the road and other environmental conditions. The taxation law of 2014 contained modifications for the whitening of the economy. The introduction of EKÁER played an important role in the regulation. (Csete 2006). The aim of the system is to avoid the circulation of goods which were not previously reported to the tax authority (EKÁER 2016). The main topic of my research is the trade of water melon. Water melon is one of the most popular seasonal vegetables, and its nutrition content reaches the values of fruits. However, it is important to note that the trade of water melon (by small-scale producers, traders) is often in the center of attention, therefore is a good example for my research. In Hungary, almost every village and town produces something on smaller or bigger areas. The main agricultural areas are Heves, Békés and Baranya county. (Balázs 2004).

MATERIAL AND METHODS

Through the operation of the sample farm I draw the attention to the weaknesses of the previous administration

systems (agricultural administration, taxation and EKÁER for small-scale producers). I put special emphasis on taxation, mainly on tax payment and tax avoidance, thus proving the economy whitening effects of the newly introduced systems (electronic small-scale producer license, EKÁER). From the point of view of the small-scale producers, I examine the possibilities of "loopholes" of the administration and taxation regulations in force before the introduction of the new regulations through the activities of the sample farm, with five approaches. I highlight the possible weaknesses of the old regulation with the results of the tax return made on the basis of the five scenarios. Features of the tax returns made on the basis of the five scenarios:

"A": the sample joint small-scale producer produced 30 tons of water melons per hectare, altogether 120 tons of water melons, and sold the whole quantity directly to the customers at the market. The average price per kilo was 79 HUF.

"B": the small-scale producer sold the produced 120 tons of water melons, and bought another 80 tons illegally, from other producers who do not have licenses or certificates, or bought illegally imported early water melons. Thus the producer sold 200 tons of water melons and reported this quantity as own production. In reality, the own production was 120 tons and 80 tons were illegally obtained. The average price of the 80 tons was 30 HUF, and sold at 79 HUF. The 79 HUF price was given in the tax return.

"C": in this case the small-scale producer sold the 120 tons of own production at 79 HUF average price as own production and indicated it in the tax return. The average price of the illegally obtained 80 tons was 30 HUF/kg, and sold at 79 HUF. However, the illegally obtained 80 tons were not indicated in the tax return.

"D": in this scenario we take the data from scenario "B", but in this case the small-scale producer followed the regulations and the 80 tons of water melons were not given as own production, but as sold in trade. Thus 120 tons were sold as small-scale producer activity, and 80 tons were sold as individual entrepreneur activity, and the tax was paid accordingly. The average price of the water melons sold in both activities was 79 HUF/kg, the 80 tons were bought at 30 HUF/kg.

"E": in this scenario we wish to demonstrate what happens when the small-scale producer produces more water melons with higher investment. The expenditure per hectare is higher, but he/she produces altogether 200 tons of water melons (50t/ha), as in the above scenarios, and gives this quantity in the tax return as own pro-

duction. The tax is paid as it is specified for small-scale producers. The average price is 79 HUF/kg. The costs of the production technology and the related costs are higher, and also the transport costs are higher due to the higher quantity.

RESULTS AND DISCUSSION

For easier comparison the results are shown in a summarizing table.

According to the taxation rules of 2019, the rate of the personal income tax decreased from 16% to 15%. Furthermore, the health contribution (EHO) of 27% for the small scale producers was replaced by the social contribution (SZOCHO), the rate of which is 17.5%. This modification significantly changed the amount of tax, therefore the net income increased.

Evaluation of scenario "A": The rate of the personal income tax decreased to 15% compared to 2015, and the rate of the social contribution (previously EHO) decreased to 17.5%, however, it still does not have an upper limit. As it can be seen in Table 8, the earnings before tax remain the same, but the tax payable decreased to 842 322 HUF, the net income increased due to the tax reduction with more than 300 000 HUF, so altogether in 2019 it was 2 369 130 HUF.

Evaluation of scenario "B": The earnings before tax remain the same, and the not accountable cost of 2 400 000 HUF is still there. The tax payable decreased with 800 000 HUF due to the modified personal income tax and the social contribution, so the payment obligation is 2 076 122 HUF, thus the net income is higher, 2 527 330 HUF.

Evaluation of scenario "C": The earnings before tax remain the same for 2019, the tax payable decreased with more than 300 000 HUF due to the tax reduction, to 842 322 HUF. The net income is 6 289 130 HUF, but the income of 3 920 000 HUF from the illegal trade is not given in the tax return.

This behaviour entails high risks due to the inspections.

Evaluation of scenario "D": As the data in Table 2 show, the earnings before tax remain the same, the amount of tax payable decreased to 2 354 462 HUF. Therefore the net income increased with more than 250 000 HUF to 4 776 990 HUF. The social contribution of the individual entrepreneurs increased from 14% to 17.5%, which is the same as in case of the small-scale producers, but for the small-scale producers there is still not an upper limit. The upper limit for the individual entrepreneurs is 450 000 HUF. In case of the personal income tax, the rate is 15% for both cases.

Evaluation of scenario "E": the extra production for the higher income provided increased income with 500 000 HUF due to the changes of the taxation rules in 2019 compared to the previous years. Thus the income was 3 572 400 HUF. It can be stated – on the basis of the data of scenario "E" – that it is more profitable to sell the extra 80 tons as an individual entrepreneur, because in this case the income is higher than in the case when the small-scale producer produces extra quantity with extra expenditures.

CONCLUSIONS

My scientific work reached its set goals. It showed that the introduction of the electronic small-scale producer license and the operation of the EKÁER system have significant whitening effects in the economy.

Table 1: Income statement based on the tax rules of 2015 earnings before tax (1); amount of tax (2); net income (3)

model	„A“	„B“	„C“	„D“	„E“
Earnings before tax	3.211.452	7.003.452 (2.400.000 cost not accountable)	3.211.452	7.131.452	4.996.147
Amount of tax	1.180.924	2.811.484	1.180.924	2.631.324	1.948.344
Net income	2.030.528	1.791.968	5.950.528 (3.920.000 /from illegal trade/ 2.030.528)	4.500.128	3.047.303

Table 2: Income statement based on the tax rules of 2019 earnings before tax (1); amount of tax (2); net income (3)

model	„A“	„B“	„C“	„D“	„E“
Earnings before tax	3.211.452	7.003.452 (2.400.000 cost not accountable)	3.211.452	7.131.452	4.996.147
Amount of tax	842.322	2.076.122	842.322	2.354.462	1.423.748
Net income	2.369.130	2.527.330	6.289.130 (/3.920.000 from illegal trade / 2.369.130)	4.776.990	3.572.400

The higher income shown in scenarios “B” and “C” may be attractive, but these activities are against the law and entail high risks according to the above explanation (EKÁER). Therefore to pursue those activities is not realistic. The modification of the taxation rules of 2019 does not cover the small-scale producers, thus the traders are still in a better position when it comes to taxation. The taxation system in force from 2019 provides more favourable financial conditions for the small-scale producers compared to the previous years, thus it encourages the producers to produce more for higher income. I recommend the maximum amount limit of the social contribution for the small-scale producers as well, for more favourable profitability and the resulting esteem.

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THE IT DEVICE USE HABITS OF AGRICULTURAL ENTERPRISES

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ABSTRACT

My field of examination is concerned with agriculture, an important sector of economy. My aim was to map, as precisely as was possible, the relationship of agrarian enterprises and their owners to information technology, innovative information technology methods and ERP systems. The relevant Hungarian and international literature dealing with the interrelatedness of agriculture, agrarian economy and info-communication technologies (hereinafter ICT) besides my own research convinced me about the importance of the use of information systems in this field as well. The enhancement of digitization and helping its widespread use could make the management of Hungarian agrarian enterprises more competitive and effective. In my research, I present the ICT characteristics of agricultural enterprises using Hungarian double-entry bookkeeping, based on the results of a questionnaire survey. My interest was focused on what factors influence businesses to use an IT tool, and what the reasons are behind it. The present paper contains my unpublished results and my SPSS analyses in connection ICT use by agricultural companies.

INTRODUCTION

The foundation of the research was a questionnaire survey. As Babie (2008) puts it in relevant literature, a survey evaluates the characteristics of a certain population by a sample of that population and by an assessment method based on statistical methodology. Based on Hunyadi-Vita (2008), I used simple random sampling, which is generally used "in the case of homogeneous finite multitude when the sample is selected without placement, providing the same probability for any sample with an element 'n,'" which is the precondition for representativeness (Hunyadi-Vita, 2008).

In my investigation, I consulted the agrarian enterprises applying double-entry bookkeeping with the help of a questionnaire, using simple random sampling. During the sampling, I only focused on the enterprises applying double-entry bookkeeping as the size of the population

did not make it possible to carry out a complete survey of agrarian enterprises, due to time and financial constraints. Compiling the database necessary for sampling, I applied the comprehensive list of agrarian enterprises applying double-entry bookkeeping provided by the Éva Székelyné Raál (2010) (AKI [Research Institute of Agricultural Economics]) that contained the enterprises broken down by counties.

During the compilation of the questionnaire, preliminary, semi-structured interviews were conducted with ten agricultural enterprises of different sizes, surveying what major questions to focus on within the topic. The investigated areas were built up and are going to be presented on the basis of the themes of the main groups of questions, which are as follows: the enterprise and its leadership; information management; the IT system of the enterprise and the plans, relationship network and leadership of the enterprise. (Szabóné Berta – Juhász, 2020)

On the basis of the questionnaire survey I carried out the statistical analysis of the sample of 270 respondents. I focused on the question whether there was any connection between the general characteristics of the enterprise and its relation to management and the use of ICT tools. I therefore formulated my hypotheses for the justification of which I used an SPSS statistical software. The data gained were analyzed by statistical methods to find out whether the hypotheses could be justified on the basis of the representative sample or not.

THE ANALYTICAL BACKGROUND OF THE INVESTIGATION

My primary aim was to assess the attitude of the enterprises of the sector and their owners in relation to the most important technical invention of the future: namely, what kind of attitude can be detected in connection with information technology and innovations. In compiling the survey, another dominant factor was to learn what influences the use of IT devices, computers and the internet. My main focus was to find out whether the diversification, the size of the enterprise or certain demographic data describing the owner has any effect on the modes

how the owner uses these systems, the internet or perhaps precision agricultural devices.

The Impact of the Sex, Age and Qualification of Enterprise Leaders on the Use of IT Tools

My starting point during the research was that the demographic traits of the leaders and decision-makers of the enterprise – whether they are owners or managers of the company – can determine the image and the attitude of the company to technological development. Thus, I also examined this factor in the case of Hungary's agrarian enterprises on the basis of the representative sample at my disposal.

I formulated my hypotheses, broken down into three factors: sex, age and qualification were the components of the null hypothesis, which was examined with the help of cross-tab analysis. I used the latter method, because, according to Sajtos and Mitev (2007), this is the recommended analytical method in the case of the correlation between two or more nominal variables, also showing the combined frequency distribution of these variables. Basically, the analysis seeks to answer the question whether the ordinal or nominal variables have any correlation, and if they do, what kind of correlation that is.

One of my assumptions was that the use of IT tools and the demographic traits of the enterprise leaders (qualification, sex and age) showed no correlation. In my analysis, I examined the qualifications, age and sex of the

leaders or decision-makers of the enterprise, assuming that this kind of analysis would reveal if there is any such connection. The research carried out by Rhoades (2004) found a very strong, stochastic relationship between the use of IT devices and the internet and the qualifications of the subjects.

The first part of the analysis referred to the sex of the owner, being the first part of the hypothesis. The null hypothesis contains the assumption that the two variables, that is, the use of IT devices and the sex of the decision-makers or leaders of the company had no correlation at all. I carried out the investigation at a 5% significance level in all cases.

Column 2 of Table 1 shows the absolute frequency of sexes within the enterprises of the sample. There were 11 respondents where sex was either irrelevant or difficult to determine. In these cases, the companies were either managed by the state or a local council, or was a plc where the sex of the leader or owner was irrelevant according to the respondent. Column 3 shows the percentage distribution of subjects, while Column 4 takes valid answers into consideration.

As shown by Table 1, the dominance of men among agricultural enterprise leaders is obvious. In several other cases, the enterprise is managed by a family, where, although decision making is shared, men tend to outnumber the other sex. In cases where ownership is shared (plc or co-op) it is also men who tend to function as lead-

Table 1: The Statistical Chart of the Sex of the Owner(s)

(Source: the author's own research, n=259; 2018)

		Frequency	Distribution	Relative Frequency	Cumulated Frequency
Valid	Male	98	36,3	37,8	37,8
	Female	4	1,5	1,5	39,4
	Both	157	58,1	60,6	100,0
	Total	259	95,9	100,0	
Missing	System	11	4,1		
Total		270	100,0		

Table 2: The Cross-Tab Analysis of the Owners' Sex and Their IT Device Use

(Source: The author's own research, n=259; 2018)

		Do you use computers in your work?		Total	
		Yes	No		
The Owner(s) Sex:	Male	Count	95	3	98
		% within:	96,9%	3,1%	100,0%
	Female	Count	2	2	4
		% within	50,0%	50,0%	100,0%
	Both	Count	146	11	157
		% within	93,0%	7,0%	100,0%
Total	Count	243	16	259	
% within:		93,8%	6,2%	100,0%	

ers, but the number of female leaders is also significant, though it may be represented otherwise because of ownership specificities.

The first section of the cross-tab analysis reveals (Table 2) that 96.9% of men tend to use computers while managing the company, while 50% of women gave the same response. In the case of shared management or shared ownership, 93.0% used computers in their work.

During the analysis, where I examined Pearson's Chi-square value, and, in close correlation with that, Cramer's V value, it became clear that the observed value of the indicator was 15.081 besides a significance level 0.001, which did not exceed the 0.05 value. That is to say, the indicator value was below the 5% significance level. Thus, the null hypothesis is invalid; in other words, there is a strong correlation between the sex of the owner or manager and computer use in the case of agricultural enterprises. The probability rate here is 8.021, and the indicator also found a significant relationship here, whose value was 0.018, below the 5% significance level. Both the Phi value and Cramer's V value are 0.241, indicating that the examined data yielded a valid result. The value of these indicators is 0.001, also meaning a significant relationship between the two variables.

Summarizing the above: the value of all indicators are below the 5% significance level, thereby cancelling the null hypothesis. In other words, the sex of the leader does affect computer use in the case of the owners or managers of agricultural enterprises.

During the second analysis, the focus of the examination was the age of the owner (part B of my hypothesis). The null hypothesis proposed that the computer use habits of the manager or decision-maker of the enterprise and their age had no re-

lationship at all. The same cross-tab analysis was used here as well, since the variable is an ordinal variable in this case.

Table 3 reveals the absolute frequency of age within the enterprises. It is to be seen that 5 respondents are below the age of 30 but the majority are between the ages of 40 and 60. Eight respondents refused to give their age. The reasons can be that the company is either owned by the local council, or that female respondents were reluctant to comply. This is altogether 3% of the subjects, which is negligible from the point of view of the overall result. The data clearly show that the composition of owners represent an aging tendency in the case of agrarian enterprises. Owners or managers under 40 amount to only 38 persons, which is 14% of the owners of the sample.

Figure 1 shows the result of the first sectional chart of the cross-tab analysis, stating that 93.9% of the respondents use computers in their work and 6.1% do not. What is surprising is that in the age group below 30, four respondents indicated computer use while one person indicated the lack of that, which is a 20% ratio in this case. In the age group 31-40, everyone indicated computer use, but the ratio of usage in the rest of the age groups (41+)

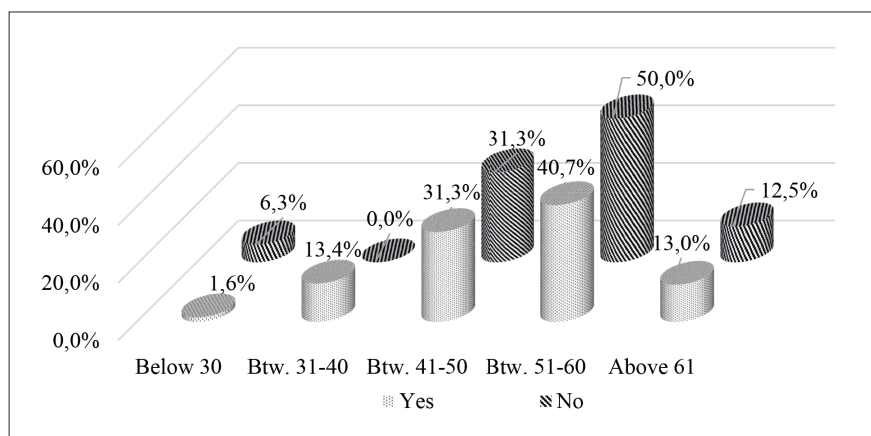


Figure 1: The Owners' Age and Their Computer Use on the Basis of Cross-Tab Analysis, in a Percentage Distribution

(Source: the author's own research, n=262; 2018)

Table 3: The Statistical Chart of the Age Distribution of the Respondents

(Source: the author's own research, n=262; 2018)

		Frequency (persons)	Distribution (%)	Relative Distribution (%)	Cumulated Distribution (%)
Valid	Below 30	5	1,9	1,9	1,9
	Btw. 31-40	33	12,2	12,6	14,5
	Btw. 41-50	82	30,4	31,3	45,8
	Btw. 51-60	108	40,0	41,2	87,0
	Above 61	34	12,6	13,0	100,0
	Total	262	97,0	100,0	
Missing	System	8	3,0		
	Total	270	100,0		

was also 90%, forecasting a promising tendency in the future.

In analyzing the connection, Pearson's Chi-square coefficient Phi and, closely related to the former, Cramer's V coefficient were used. In this case, the observed value of Pearson's Chi-square was 4.151 by a significance level 0.386, which is above the 0.05 limit. The probability ratio is conjunct with Chi-square (5.552), which is likely in the case of large samples (Sajtos – Mitev, 2007). There is no significant connection here, because its value is 0.235, also exceeding the 0.05 significance level. The values of Phi and Cramer's V are both 0.126, indicating that the analysis yielded valid results. At the same time, no significant connection has been detected, since on the basis of the calculation, the significance level of the indicator is 0.386 in both cases, exceeding the 5% limit. Thus, the null hypothesis proved to be valid: computer use is independent of the age of the leaders within the sample of agrarian enterprises.

In the third section of the analysis, I examined the qualifications of the owners in relation to computer use. The null hypothesis was that there is no significant connection between the two variables. This examination was also conducted with a cross-tab analysis, since regarding the nature of data, it seemed to be a relevant option.

Table 4 displays that 14 persons graduated from secondary school without GSCE and 16 persons with GSCE. Forty-two respondents completed technical school [secondary school providing both vocational qualification and GSCE], 69 graduated from college and 127 from a university. There were two respondents indicating either 'other' qualifications or primary school (with 8 grades completed) but both of them had completed a secondary-level course for farmers. In order to avoid these two pieces of data distorting the full multitude, their qualification was also regarded as 'secondary school.' Only two subjects did not regard it important to indicate qualification because the enterprise was in state ownership so the



(Source: pexels.com/Pixabay)

leader's competence in decision-making is relatively low. In these cases, the basis for analysis was the leader's or owner's qualification. The cross-tab analysis was based on these data; that is to say, qualifications were divided into 'secondary' and 'higher education.'

Table 4 also reveals the ratio of leaders and owners using computers in their work, yielding 94.1% of the full sample. The cumulated results show that 82.7% of subjects with secondary school degrees and 98.5% of subjects with higher education degrees use computers to assist their work. In other words, 17.3% of secondary school graduates and 1.5% of higher education graduates replied that they did not use computers to assist their work. This is almost 20% of all the respondents, which is comparatively high in view of the fact that agriculture now is heavily dependent on the use of IT devices whose applicability has fairly penetrated the sector.

The detailed cross-tab analysis, in which the value of χ^2 is 24.240 and the probability ratio is 21.289, reveals that there is a strong and significant relationship between computer use and the respondents' scholarly qualification. The data chart of the analysis also yields a significant correlation, since the significance level is 0.000, well

Chart 4: The Cross-Tab Analysis of the Owners' Qualifications and Their Computer Use

(Source: the author's own research, n=270; 2018)

	Do you use computers in your work?		Do you use computers in your work?	
	Yes	Distribution	No	Distribution
The Qualification of the Owner/Decision-Maker:				
Primary school completed	1	100,0%	0	0,0%
Secondary school (without GCSE, and with vocational qualification)	10	71,4%	4	28,6%
Secondary school (with GCSE)	14	87,5%	2	12,5%
Technical school (GSCE with vocational qualification)	35	83,3%	7	16,7%
College	68	98,6%	1	1,4%
University	125	98,4%	2	1,6%
Other	1	100,0%	0	0,0%
Total	254	94,1%	16	5,9%



(Source: [unsplash.com/Scott Graham](https://unsplash.com/photos/Scott-Graham))

below the 5% significance limit, which was the basis of the analysis.

Cramer's V value is 0.300, while the value of Phi is also 0.3000, which, though being in the negative range, does not modify the value of the relationship (Csallner, 2015). These indicators also point to a strongly significant relationship, indicating a 0.000 value. It can be stated on the basis of the above that the null hypothesis proved to be invalid, that is, there is a very strong correlation between computer use and educational qualifications.

On the basis of the above analysis, it was possible to formulate the thesis that those Hungarian agrarian enterprises use computers in their work where the manager's or the owner's qualification is higher. The higher this qualification is, the more likely it is that the leader/owner tends to use IT devices. At the same time, while such a relationship could not be detected in the case of the age, there is a strong, stochastic correlation between the sex of the owner or leader: men are more likely to use computers in their work than women.

SUMMARY

Deutscher Bauernverband, the organization uniting farmers in Germany, publishes an annual report on the most important agricultural questions and issues of each year. In a recent report, it points out the fact that while in the 1900s, a farmer provided food for 4 people, today one farmer has to solve the same task for 135 people (Internet 1). These shocking numbers also highlight that more efficient and, at the same time, more economical production for the agrarian sector is indeed a great challenge. The study also underlines the fact the agrarian sector and agribusiness/agrarian economy are far from being synonymous terms, because while agribusiness can partake of even 10-15% of domestic production and trade, the agrarian sector, in the strict sense of the word, provides only a few percent of the total GDP. This is why the strengthening and developing of the bond between this sector and the modern, digital worlds is essential.

In my general research, I attempted to find an answer to the question as to what kind of factors influence the use of IT devices in the life of the enterprise: whether it is the size, the diversity of activity of the company or the demographic features of the manager that determine the attitude of digitalization. My PhD thesis could not provide enough space to expand upon several research findings that may be useful from the aspect of decision-makers or agrarian experts, so with the publication of further results I do hope to contribute to a deeper insight into the sector, to its digital mapping and its development.

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