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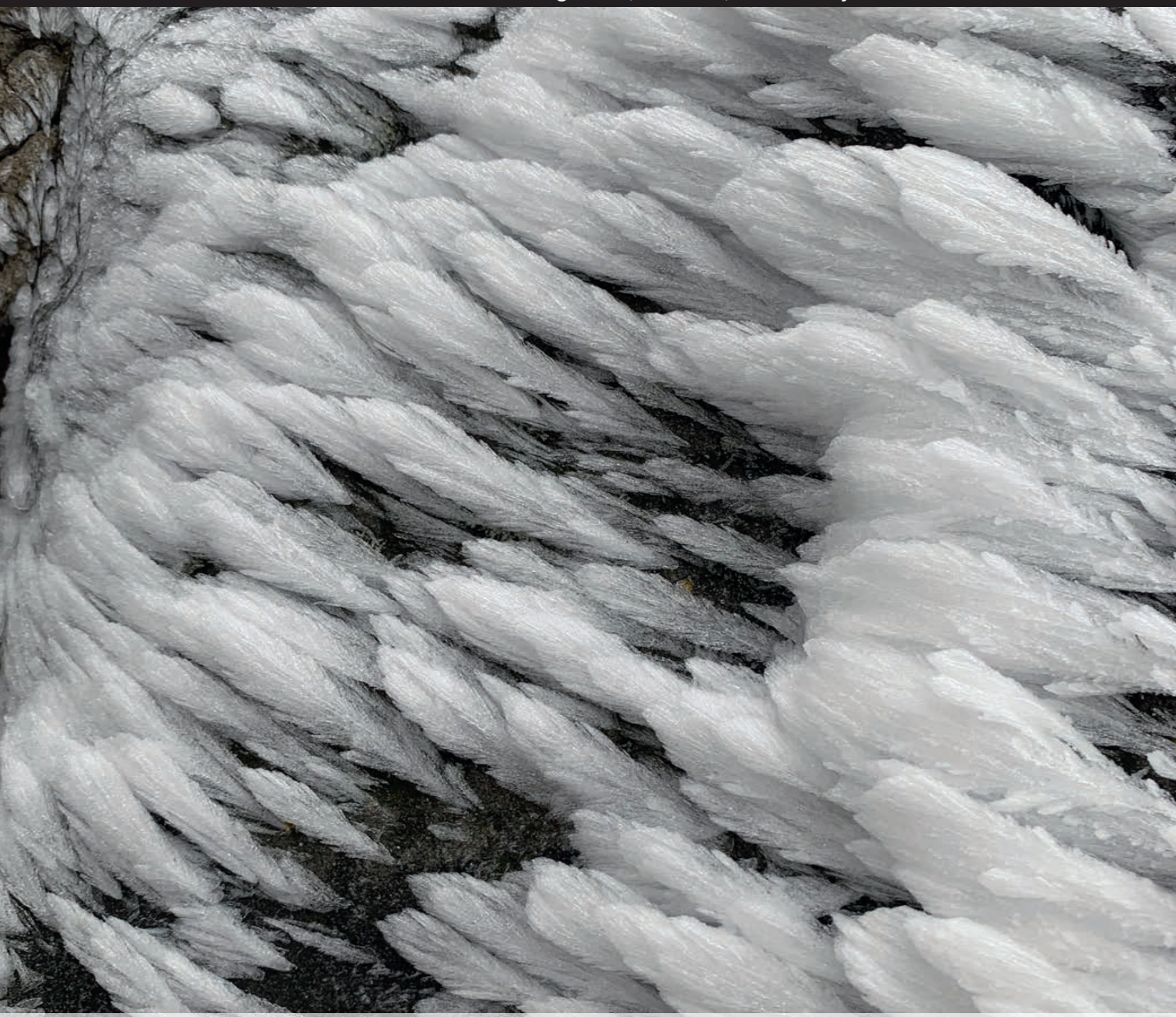
HUNGARIAN AGRICULTURAL RESEARCH

Fall-Winter 2021

Environmental management, land use, biodiversity



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EFFECT OF DIFFERENT SUPPLEMENTARY FEEDING METHODS ON SOME GROWTH PARAMETERS OF PIGEON NESTLINGS

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ABSTRACT

The aim of our study was to compare different feeding methods and efficiency of feed supplement liquid from commercial trade.
The growth and the meat production of nestling homing pigeons (n=78) was measured in three groups and in three brooding periods. 3 to 5-year-old couples and their nestlings were involved in the experiment. In the control group (d0), couples raised the nestlings in traditional way. The d1 experimental group was the drenching group, in the d2 experimental, the feed supplement liquid was added to drinking water of the couple on day 10, 15, 20 and 25. The birds were weighed at the age of 10, 15, 20, 25 and 30 days. The carcase weight was measured on day 30.
In the case of brooding periods, there was no significant different between groups in live weight parameter within the following dates: brooding 1: 10, 15, 20 days, brooding 2: 10, 15, 20, 25 days, brooding 3: 20, 25, 30 days. During the brooding 1 and 2 periods, the nestlings of the d2 groups had significantly higher live weight at the age of 30 days compare to the control group. During the early period (10 and 15 days) of brooding 3, d1 group had significantly favourable live weight parameter than d2 group. The beneficial effect of feed supplementation was observed, the d1 and the d2 groups had higher carcase weight compare to the control group. The d2 group had the highest carcase percentages compare to the control and the d1 groups during all three brooding, however these differences were significant only in the brooding 2. Based on our results, the direct feeding (drenching) is recommended, because less attention is given to the older nestlings by parents.

Keywords: pigeon, feed supplement liquid, rearing of nestling, drenching

INTRODUCTION

There was a tradition of pigeon keeping and of pigeon meat consumption in Hungary in the last century.
The homing pigeons have great reproduction parameters during the whole year, the weight of the four-week-old nestling is around 380-430 gram.
In the case of pigeon breeding, some special factors need to be considered. Pigeons can be bred only in pairs. The female pigeon lays only two eggs, therefore maximum two nestlings are expected. It is proved that because of the high energy content of the feed, the feed intake starts to reduce (Bu, 2015).
There are many roast pigeon farms, therefore the production of roast pigeon is the highest in the USA. Pigeon breeding is started after the 1950's in Europe. France, Italy and Hungary were the leader in the pigeon production. Before the change of regime in Hungary, there was a acquirer shall system for meat breed pigeons, then the birds were exported to west. before the (Biszkup et al. 1976, Horn et al. 2000, Mackrott 1992, Holdas et al. 1975). Since then, the production dramatically reduced, there are only one or two roast pigeon farms and the products are exported. National meat breed pigeon program has been started in 2018 in Hungary, it can be the future of this sector (AWE 2018).
The survive and growth of pigeon nestlings are the most important parameters in the pigeon breeding. Both members of the couple are involved in the care of the nestlings. The nestlings are fed with crop milk (water 84-87%, protein 13-18%, fat 10-12%, carbohydrate 4-5%) by their parents during the first four to five days after hatching. The growth depends on the female for 8-10 days, but because of the next nest, the male pigeon is also important to raise the nestlings. The growth of the nestlings is the most intensive during the period of crop milk feeding, therefore those couples, which can produce crop milk in long term, are very valuable. The couple sits on the nestlings until about the 10th day, and then the

feathering begins. The most relevant indicator of rearing ability of couple is the weight of the 28 or 30 days old nestlings. Selection can be done during these days within the population (Szűcs 1965, Aggrey és Cheng 1992, Meleg 2004)

Different factors can affect the meat production. Firstly, the growth of the nestlings, this parameter depends on the rearing ability of the parents. Couples that have a longer laying period and produce only 8-10 eggs per a year, their nestlings are heavier. The male nestlings have 5-7% more body weight. The number of nestlings can influence the body weight of them. It is obvious that single reared pigeons have higher slaughter weight. Important the slaughter time, the optimal for pigeon is between 28-32 days of age, because weight loss is observed after the nest leaving and because they learn to feed on their own (Horn 1981).

Our aim was to investigate the effect of different supplementary feeding methods (drenching nestlings or supplement liquid to drinking water of pigeon couple) on growth, the live weight and carcass weight of nestlings.

MATERIAL AND METHODS

The investigation was placed in Jászárokszállás in 2021. The dovecote was south-facing, 6 m long, 3 m wide, 2 m height, in the attic of outbuilding. The pigeons had 1.5 m^3/air space. The couples had one shelf with two nests.

The males and females were kept separately outside the breeding season. The body preparation was started 20 days before the couple pairing (Talabér 2003). Three days after pairing, the pigeons got ascorbic acid into water to reduce the effect of stress (Kertész 1974).

During the breeding season, breeding performance of 16 racing pigeon (3 to 5-year-old) couples was recorded. The pairing was between 22-23 February 2021 based on pairing plan (Rohringer 2011). Three brooding periods were recorded from every couple. Figure 1 shows four specimens from the investigation.

Pigeons were divided randomly into three groups: d0, d1 and d2. In the control group (d0), couples raised the nestlings in traditional way without supplementation. In the d1 experimental group, birds got feed supplement by drenching. In the d2 experimental, the feed supplement was added to drinking water of the couple in every five days. The concentration was the same in the d1 and the d2 groups.

Ingredients of the fed grain seed mixture was followed: French corn 10%, yellow corn 18, red sorghum 15%, white sorghum 8%, wheat 10%, green pea 14%, yellow pea 10%, sunflower 15%. Table 1 shows the calculated nutrient content of the fed seed mixture.

Table 1: Nutrient content of feed

AME	Nyersfehérje	Lizin	Metionin	M+C
MJ/kg	g/kg	g/kg	g/kg	g/kg
13,9555	133,43	7,436	2,775	5,504

Pigeons were given water *ad libitum* with daily water exchange and were restricted fed twice a day (Rohringer 2014).

In the case of d1 method, the feed supplement liquid was added to the crop of the pigeons by 6 cm infusion tube and 2 ml syringe. The tube and the syringe were sterilized in alcoholic antiseptic solution. This procedure can not harm or make suffer, as the Figure 2 represents.

Figure 2: Drenched feeding (Source: Ármin Lengyel)

The feed supplement liquid was prepared prior to each dosing freshly (16 ml/l) and was added to the birds on day 10, 15, 20 and 25. The nestlings were weighed at the

Figure 1: Homing pigeons of the stock (Source: Ármin Lengyel)

Table 2: Guaranteed content of the supplement (source: recommendation of the supplement on packaging 100 ml)

active ingredient	ad 1000 ml	active ingredient	ad 1000 ml	active ingredient	ad 1000 ml	active ingredient	ad 1000 ml
vit. A	2500000 I.U.	lysine	5000 mg	serine	900 mg	sodium propionate	3000 mg
vit. D3	500000 I.U.	glutamic acid	3500 mg	sodium chloride	5000 mg	tirozine	650 mg
vit. E	5000 mg	glycine	3000 mg	magnesium sulphate	1500 mg	tryptophane	600 mg
vit. B1	1000 mg	threonine	3000 mg	potassium	1000 mg	histidine	525 mg
vit. B2	2000 mg	methionine	1500 mg	manganese sulphonate	600 mg	isoleucine	500 mg
vit. B6	2000 mg	arginine	1000 mg	zink sulphonate	600 mg	cysztine	200 mg
vit. B7	2 mg	phenylalanine	900 mg	iron sulphonate	20 mg	valin	800 mg
vit. B12	10 mg	proline	900 mg	vit. K3	1000 mg	alanin	750 mg
vit. C	3000 mg						

The data were analysed using one-way ANOVA test with Tukey post-hoc tests.

age of 10, 15, 20, 25 and 30 days before dosing. The slaughter was on day 30. In the d1 group, the nestlings were given 2 ml drenching liquid before their parents fed them. In the d2 group, the couple got the supplement liquid into the water *ad libitum,* the concentration was the same in the two treated groups. The couples did not have other water resources and had only fresh water from the next morning.

The hemavit FORTE MAX multivitamin feed supplementation was applied, Table 2 shows the guaranteed nutrient content.

RESULTS AND DISCUSSION

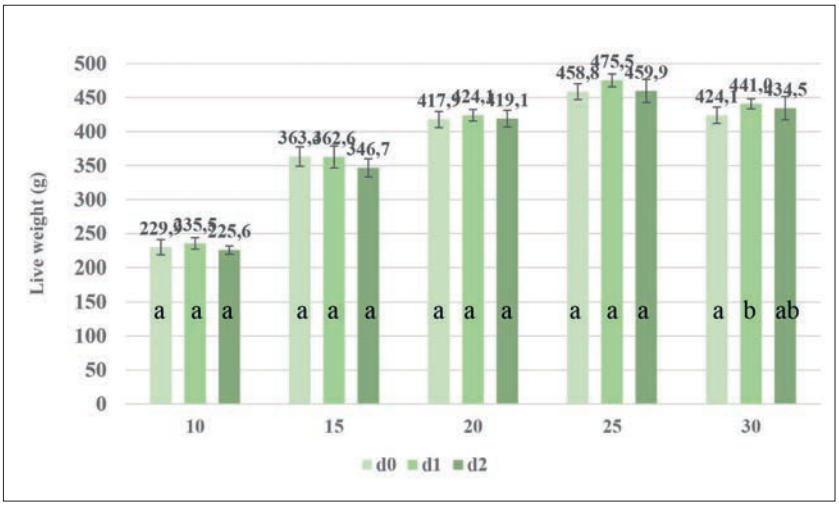

Figure 4: The live weight of the nestling during the second brooding period
(d0: control, d1: drenching, d2: feed supplement was added to drinking water, numbers on the abscissa: live weight of that days)

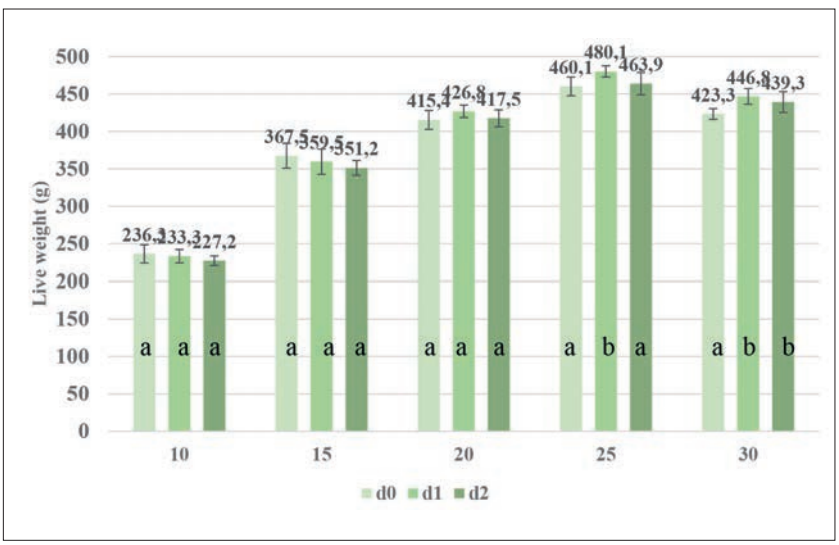

Figure 3: The live weight of the nestling during the first brooding period
(d0: control, d1: drenching, d2: feed supplement was added to drinking water, numbers on the abscissa: live weight of that days)

In the first 20 days, there was no significant differences in the parameter of live weight of the nestlings. The beneficial effect of the feed supplementation was observed on day 20, 25 and 30, the d1 and the d2 groups had higher body weight compare to the control group. The d1 group had significantly higher live weight value compare to the d0 ($p=0,009$) and d2 ($p=0,027$) groups on the day 25, during the first brooding period (Figure 3). On day 30, the d1 and the d2 groups had significantly better live weight results than the control group (d1-d0: $p=0,001$; d2-d0: $p=0,015$).

During the second brooding period (Figure 4), both experimental group were better in the parameter of live

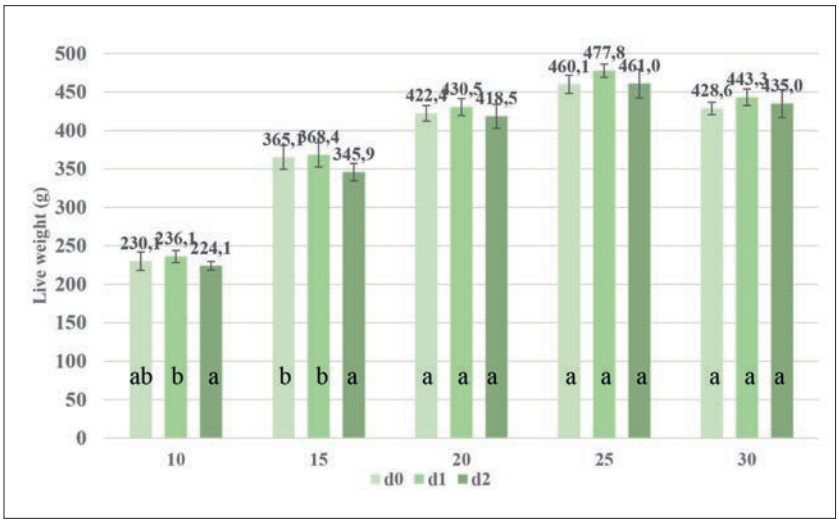

Figure 5: The live weight of the nestling during the third brooding period
(d0: control, d1: drenching, d2: feed supplement was added to drinking water, numbers on the abscissa: live weight of that days)

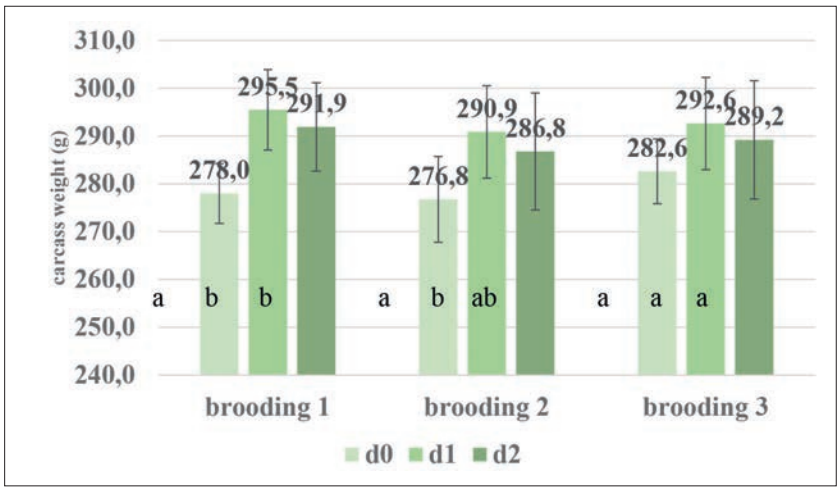

Figure 6: Averages of carcass weight of nestlings slaughtered during the season
(d0: control, d1: drenching, d2: feed supplement was added to drinking water)

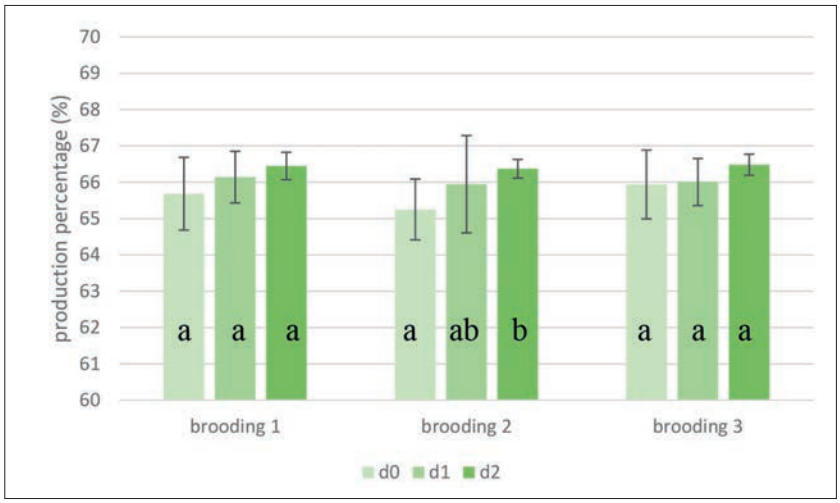

Figure 7: Averages of production percentage of slaughtered nestlings during the three brooding
(d0:control, d1:drenching, d2: feed supplement was added to drinking water)

weight than control groups on day 20, 25 and 30. However, this difference was significant only between d1 and d0 groups on day 30 (p=0,0477).

The results of the third brooding showed different trend (Figure 5). Initially, there were significant differences (day 10: d1-d2: p=0.019; day 15: d0-d2: p=0.022 and d1-d2: p=0.007), but later these differences had been eliminated. However, d1 and d2 groups had more favourable results than control group.

In the case of all three brooding, the results of live weight on day 30 were lower than the results on day 25. At this time the pigeon couples had been participated in the care of the new nestlings, so the elder nestlings got lower amount of feed. After the nestlings had left the nest, the daily rate of movement raised also.

On the day of slaughter, the nestlings of d1 group weighted 15-23 grams more, d2 group weighted 7-16 grams than d0 group. The volume of standard deviation was major in the d2 group. These results could be relevant, if intensive roast pigeons are produced and the couples raise nestlings through 12 months. The nestlings of d1 group had more uniform live weight.

The carcase weight results are connected with live weight trends (Figure 6). The average carcase weight was 278-283 gram is the d0 group. This parameter was 287-292 gram is the d2 group with major standard deviation volume. In the case of the first brooding, significant difference was found between d0 and d1 groups ($p<0.001$) and between d0 and d2 groups ($p<0.0159$). There was significant difference between d0 and d1 groups ($p<0.0477$) during the second brooding. There was no significant difference during the last brooding.

In the case of slaughtered production percentage, the d2 group had the highest value during all of the three brooding period (Figure 7). Significant difference was detected between d0 and d2 groups in the period of the second brooding ($p<0.0357$).

CONCLUSIONS

Our results were demonstrated that the feed supplementation had positive impact on the body weight gain of the nestlings. The nestlings of d1 and d2 groups had higher live weight at the time of separation from the nest.
In the case of racing and breeding pigeons, homogenous live weight can be attained by d1 and d2 technologies. Therefore, more stable body and better performance can be expected.
The applied technologies have advantages and disadvantages.
These can be conclude based on our results of d1 technology:

Advantages:
- Higher slaughter weight
- The growth of the nestlings is dynamic
- The body will be more stable and can tolerate stress

Disadvantages:
- Extra work is needed
- It requires precise administration
- Strict animal health guidelines must be followed

These can be conclude based on our results of d2 technology:

Advantages:
- Higher slaughter weight compares to d0 technology
- Easy to apply and track

Disadvantage:
- Large live weight difference can be shown between nestlings in the same nest

Further goal is to detect the perfect dose which can maximise the body weight gain.
Economic calculation is required to get information about drenching technology, because of need of extra work.

ACKNOWLEDGEMENTS

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REFERENCES

1. Aggrey, C. (1992): Estimation of genetic parameters for body weight traits in squab pigeons, Genet Sel Evol, 24, 553-559
2. Biszkup F., Guoth J., Horn P. (1976): Haszongalambtenyésztés, Mezőgazdasági Kiadó, Budapest, 5-9 p.
3. Holdas S., Perényi M., Biszkup F., Horn P., (1975): Hústermelés kisállatokkal a háztájiban, Mezőgazdasági Kiadó, Budapest, 203-223 p.
4. Horn P. (1981): A Baromfitenyésztők Kézikönyve, Mezőgazdasági Kiadó, Budapest, 638-641 p.
5. Horn P, Bogenfürst F., Meleg I., Mihók S. (2000): Állattenyésztés 2. - Baromfi, haszongalamb, Mezőgazda Kiadó, 348 p.
6. Kertész A. (1974): A stressz jelentősége a versenygalamb tenyésztésben, Postagalambsport, XXI. évfolyam, 6.szám, 9-10p.
7. Mackrott, H. (1992): Galambtenyésztés. Szegedi Kossuth Nyomda Kft., 160-164 p.,
8. Meleg I. (2004): A galamb és tenyésztése 1., Gazda kiadó, Budapest,154-157 p.
9. Rohringer I. (2011): A galambjaink tenyészidénye. Galamb és kisállat magazin, 53(3): 8-10 p.
10. Szűcs L., Szécsényi I. (1965): Galambtenyésztés. Mezőgazdasági Kiadó, Budapest, 7-15p.
11. Talabér Zs. (2003): Galambok gazdaságos gyógykezelése, Vitál-Kontrol, Kecskemét, 199-205p.
12. Bu. Z., Xie.P., Fu, S.Y., Tong, H.B., Dai, X. (2015): Effect of energy and protein levels on performance, egg quality, and nutrient digestibility of laying pigeons, Journal of Applied Poultry Research, 1 September 2015, Pages 371-379

AGRICULTURE AND THE CLIMATE CHANGE

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ABSTRACT

This paper investigates the question of climate change. Does it exist in the nearby areas of my hometown? Is there actual proof concerning the phenomenon or is it just an excuse of human negligence? I seek to provide proof about its actual, valid existence in the area with the help of local farmers (5+1) through interviews (20-40 minutes long, due to dialect differences no transcription was made) and records going back 20 years. After showcasing the gathered evidence from these sources, that proves my thesis correct, the effects of climate change are real and noticeable, I would highlight what types of actions the farmers performed or tried to do to minimalise or mitigate the damage caused by this change. Following that I would propose some suggestions for concerned farmers, how they could also fight back against the problems caused by these changes before I finish this paper.

keywords: Agriculture, climate change, weather, season drought, flood, temperature, modernisation, irrigation

INTRODUCTION

Nowadays, the debate about the reality of global climate change is a regularly renewed topic with increasingly convincing arguments that it is a process that humanity must take seriously. A series of scientific researches are proving that the planet's climate is becoming more extreme, that the Earth is warming, and that the water and atmosphere are changing. This is evidenced by the fact that, from an economic point of view, the famous Stern Review (Stern 2006) already considers this factor to be the biggest risk in the world economy, and estimates that the damage caused by climate change could reach 20% of global gross domestic product. I'd also like to mention the recent report issued by the International Panel on Climate Change called „Sixth Assessment Report, Climate Change 2021: The Physical Science Basis", that issued a red alert. Meaning if we do not perform actions against this phenomenon, then we will reach the point of no return.

Climate change is also having an increasing impact on the crop and livestock sectors. Climate change has different effects on different sectors. For some sectors, the impact is minimal (closed systems, mushroom farms), but it is certain that crops grown on arable land and livestock sectors in more informal farming (preferably in their natural habitat) are the most vulnerable parts of agriculture. The more the grower relies on external climatic factors, the more the farmer is affected by the negative effects of global warming. In view of the above-mentioned information, my article set the following goals:

- whether the farmers surveyed are actually aware of the effects of climate change
- if so, which aspects of climate change directly and indirectly affect the farms on the land of the deer and the surrounding area,
- whether these factors have led to a real change in the weather locally in recent years,
- which are the most exposed agricultural sectors, what technological changes and modernization activities farmers use to alleviate and eliminate the existing problems.

MATERIAL AND METHODS

I collected the data for my research in Békés county. The county is located in the Southern Great Plain region of Hungary, its seat is Békéscsaba. It has an area of 5631.05 km^2, 9 districts (Békéscsaba, Békés, Szeghalom, Gyomaendrőd, Szarvas, Orosháza, Mezőkovácsháza, Gyula, Sarkad) in which there are 75 settlements (1 county town and 21 other cities) according to Central Statistic Office surveys in 2018 about 338025 people live in Békés county with an average population density of 66.8 people / km^2 (KSH 2013, KSH 2018) Békés county is located in the Great Plain, its area is flat. The plain between the Körös-Maros and the Körös-Berettyó region is almost perfect. The altitude of the county fluctuates around 81-106 meters above sea level. The area of the county is covered with a thick layer of sandy-loess sediment. The most significant mineral treasure of the county is natural

gas. The continuity of the plain is divided by the relatively dense river network. The county has 8 rivers by number: the Körös (Fehér, Fekete -, Kettős -, Sebes - and Hármas-Körös), Berettyó, Száraz-ér, Hortobágy-Berettyó. (KSH 2013, KSH 2018)

During my data collection, I first had to collect data, to this end I contacted local farmers who met the criteria agreed upon in advance (both small and large scale farmers, young and old) and began to inquire about their willingness to provide data on the following information back 20 years to determine if the data was available. This may be a sign that there has been some change in its agrotechnics and that this may be due to climate change. The data examined are the species of crop spread on their land, the type of crop, the size of the cultivated area, the method of soil preparation and the method of stock management during sowing, nutrient replenishment, harvest in tonnes / hectare, stubble cultivation and description of cases of vis major.

The farm where the research was conducted is a modern small-scale primary producer farm located next to Nagyszénás (formerly a sole proprietorship, but it ceased to exist in 2020), the land is 100 hectares large and is maintained by a family with the help of occasional auxiliary work (they do not deal with animal husbandry, the farm also possesses a number of machines: two tractors, one combine, sprayer, precision seeder, two chemicalizers (small and large), combine adapters, trailers, cultivator, plow, disc). The arable land is located on the border where the clayey loam meadow soils typical of the northern part of the county and the southern chernozem soils meet so the golden crown value of the land fluctuates between about 28-40. It should be noted that farmers in the area have also been struggling with inland water problems recently.

In the second phase of my research, I conducted semi-structured interviews in March 2021 (5+1 with the owner of the researched farm concerning the previously provided data). The interviews were also audio-recorded using a dictaphone for later processing. They range in length from 20 to 60 minutes. A literal transcript of the interviews was not made. I based the interview on the methodology described in the book made by Heltai and Tarjáni (Heltai és Tarjáni 1999). The completed interviews were subjected to quantitative evaluation and content analysis based on the methodological suggestions of Babbie (2003) and Newing (2011). The data of the interviews with the farmers concerned are illustrated in the table below:

Surename	Age	Profession
Mihály	77	Primary producer
Pál	67	Primary producer/ Primary Family Farm
Pál	76	Family maintaned Limited company.
Tibor	47	Primary producer/Site manager
Zsombor	41	Family maintaned Limited company.

RESULTS

Examining the data of the researched farm, it can be seen that the farmer also carried out deep plowing and plowing (initially admitted in an interview that he was only medium deep) and dialing the land for several years. During the interview, I asked about this and said that the first goal was to repair the damage (trampling) caused by the newly procured tanker for applying the basic slurry, but later the changing climate also made it necessary to carry out this work. In addition, the shift in the sowing dates of the crops grown in the last few years is further evidence of the changing weather in the areas. The perception of the phenomenon of climate change by the farmer can be established. I would like to highlight the following words from the interview to further illustrate this (please note, that the original language of the interviews was Hungarian and the interviewed farmers mostly spoke with dialects).

"… In terms of precipitation and weather change, the length of rainless and rainy periods has increased, as I said a loosened area is much better able to withstand suddenly large amounts of rainfall,… ..but this also brings with it the fact that it did not coincide last year, rainless period and deep loosening time, last year was also a problem that summer, late summer, second half of summer, early autumn period which would be suitable, but during this period a huge amount of rainfall fell ……

"… .. last year there was a about extremely low rainfall period, where according to our own measurements 150 mm fell in the first 5 months, then 600 mm in the other months, it was a serious problem plus there was so much moisture in the soil for those sown in the spring, ……." / Lénárt, age 40/

Even if this is not fully perceptible in the text format, the farmers were noticeably proud of their farms during the interviews (body language, emphasis). They felt that they have years of experience, they actually know the lands they cultivate, their economy is important to them. It was noticable in the interviews, that the most outstanding problems are considered by farmers to be the distribution of precipitation and the capriciousness of the dry, rainy period. Other minor problems (milder winters, increased frequency of inland water) are also causing damage to farms.

"… .Or the rain falls at the same time, or there is a long drought… the plants suffer so much in this black prickly ground…. like in the old days when there was snow, it is not covered for winter rest, the autumn sowings are not covered very often or only sparingly… it can't even be used as feed " / Mihály, age 77 /

"… there was a case or three years ago that we watered 15mm on the corn, got 25 then the next day, then 50 and stopped the water… we also pumped the water but it could not withstand the amount… they are extreme

enough (the temperature), now, for example, there was no winter (cold) in winter, the external water pipes did not freeze, we did not drain the water for the first time… then when the heat wave and atmospheric drought occur…a continuous warming is felt , even if we dig the upper soil to the already dry "/ Pál, age 67 /

In addition, it should be noted that three of the five subjects took conscious action to counteract the processes of climate change and two tried but did not have a real opportunity to do so, inhibited by some external human or natural factor (land position in the county, lack of material background, surrounding farmers negative attitude towards irrigation) in its implementation, but at least in such cases he at least tried to implement them. Furthermore, it is important that for the most part, irrigation, the modernization of farms and the cooperation of farmers working in the surrounding areas were seen as a solution to the problems caused by climate change.

"… It can only be prevented by having such a small hectare of land that there must be contact with those around me or those near me, because if one does not hold back, the damage usually passes to the other board… irrigation is not possible because there are no canals nearby, there are actually only drainage ditches, drainage canals that bring inland water, such that it is not possible to irrigate it. " / Mihály, age 77/

"… Although there is irrigation equipment, it doesn't matter, if they (the canals) don't give water, we always sow on March 5th, we would irrigate already in early April, but the canals only open canals in early May… we can only water ourselves with groundwater"/ Pál, age 67/

DISCUSSION

It can be no longer said that climate change does not exist. Its effects are noticeable in the area and they are the cause of major detriments for the local farmers. Those who work in the agriculture sector must learn how to fight back against this phenomenon, and work together with others to mitigate or reverse the already existing problems if they wish to see their lands flourish and thrive in these changing times.

CONCLUSIONS

The main goal of my hypothesis was that climate change is real, it can be really perceived by farmers in the area surrounding Szarvas, a real phenomenon, not only a reason without basis for hiding human errors in farms, but also a real problem what is perceived by the interviewees, it causes actual damage to agriculture.

My hypothesis was confirmed, the interviews with farmers and the data of the researched farm confirmed that they perceive the phenomenon of climate change in their own production and everyday life. They are also aware of its potential for future catastrophes and to reverse these harmful processes of climate change and prevent further deterioration, the farmers actively work (or at least attempt to do so) against the damages with various methods (irrigation, modernisation).

For the future the precision economy (site-specific, Global Positioning System-based, Information Technology -assisted crop production system, in which knowledge of spatially changing soil properties and site conditions, adapting to the needs of the cultivated plant, processing and taking into account Geographic Information System data, In addition to site-specific agrotechnical interventions required by crops to ensure sustainability, protect the environment and arable land, and be profitable.) might be a great help, but farmers have other options to address the challenges posed by a changing climate. Many of the practices typically associated with sustainable agriculture can help increase the resilience of agricultural systems to the effects of climate change, such as diversifying crop rotations, integrating livestock with crop production systems, improving soil quality, minimizing off-farm flows of nutrients and pesticides; cultivation of plants and hybrids that are more resistant to climate, tolerant of extreme climate change.

Returning to the other big problem, which, in addition to human factors, is the main cause of farmers problems, is the lack of capital to invest. The most appropriate help in this problem is provided by the tenders issued by the state.

ACKNOWLEDGEMENTS

I would like to thank my mentor, Rákóczi Attila for supporting me throughout the creation of this article, for helping me consolidating my goals for the future. I would also like to give my gratitude to the farmers, who made my research possible by providing me with insights into their lands.

REFERENCES

1. Stern 2006: Nicholas Stern, The Economics of Climate Change The Stern Review Cambridge University Press
2. HELTAI E.–TARJÁNYI J. (1999): A szociológiai interjú készítése. Budapest: TÁRKI.
3. BABBIE, E. (2003): A társadalomtudományi kutatás gyakorlata. Budapest: Balassi Kiadó.
4. KSH 2013: Központi Statisztikai Hivatal, Békés megye számokban
5. KSH 2018: Központi Statisztikai Hivatal, Magyarország közigazgatási helynévkönyve, 2018.január 1

ENVIRONMENTAL AND ECONOMIC CONSCIOUSNESS OF THE FARMERS OF JÁSZ-NAGYKUN-SZOLNOK COUNTY IN SOIL MANAGEMENT BASED ON TALA METHOD

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ABSTRACT

With the recent face of climate change and the increase in the world's population feeding the entire world has become a challenge. The natural resources used in food production are depleting due to the selected agrotechnology by farmers. Therefore, there is a need to select appropriate technologies, and the environmental consciousness of farmers is of importance. Data collection was by use of questionnairres developed on the base a novel idea called TALA method involving 106 randomly selected farmers. The data were analyzed through the simple statistical method to calculate frequencies and percentages. The result of the description analysis led to the conclusion that the majority of farmers are more economic than environmentally conscious. The study indicated that availability of cheaper alternatives, costs involved, profits, and lack of interests are some of the main factors that influence farmers choice of agrotechnological elements.

keywords: environmental consciousness, economic consciousness, agrotechnology

INTRODUCTION

The study of Weersink - Fulton (2020) showed that farmers adopt new sustainable technology to increase production and stay in business, and if the benefits derived from a certain technology are perceived by the farmers to be in the far future they are less likely to adopt it (Nowak 1992). Accessibility to credit is another element that determines farmers' adoption of technology. (Havens - Flinn 1975) concluded that a farmer is likely to adopt a technology when he/she has access to credit but less likely if the technology is not available or are denied access to it. However, if a farmer has higher debt they tend to be involved in activities that are less costly as compared to costly conservation practices (Osgood 1986). The incentive also facilitates the adoption of technologies (Gallagher - Muehlegger 2011), farmers who receive incentives for input and output like tax waivers will tend to adopt technology easily. Through incentives, they can be able to finance and expand their operations to maximize the profit potentials.

However, some studies have questioned the assumptions that farmers are more economic-oriented than environmentally conscious.Some profitable technologies are not adopted by farmers (Neill - Lee 2001), and a growing number of farmers now are becoming environmentally conscious (Lokhorst - Dijk 2011). However, environmental-conscious farmers were the most risk-averse and they will ensure a reduction in risk before they could adopt agrotechnology, some are knowledgeable about the harmful effects of their selected agrotechnological elements, but the thought of them making profits from these practices makes them ignore the negative impacts on the environment (Arisoy - Ataseven 2017).

Jász-Nagykun-Szolnok (JNS) is a county in Hungary with many agricultural fields of both large farm owners and small-scale hobby gardeners who face some challenges in adapting to climate change to optimize their field production capacity and maintenance of sustainable crop

production. The region faces various environmental challenges ranging from secondary salinization, methods of soil cultivation to fertilizers being used of which all have an impact on the environment. The objective of the study was to evaluate the environmental and economic consciousness (EEC) of farmers of JNS county in the selection of agrotechnology.

MATERIAL AND METHODS

We elaborated a new technique of data collection called TALA method. TALA is based on our idea that we should share useful information on the most up-to-date scientific results that can be used by the agricultural practice. TALA includes a data collection technique with the principle of 'Teaching by Asking question and Learning by Answering (TALA). Therefore, the application of this method is not only collecting information from farmers but also involves the transfer of knowledge to farmers. The data collected was aimed to encourage environmental awareness among farmers and emphasized the appropriate agrotechnology selection among farmers.

The MATE Research Institute of Karcag (RIK) has the main goal to develop region-specific agriculture accommodating to its environment since 1947. The researchers of the institute are working on the harmonization of the agricultural practice and research based on the information given by the local farmers. One of the elements of this harmonization is the TALA questionnaire providing up-to-date and relevant information for the benefit of both sides. The TALA questionnaire consisted of three soil management-related topics including statements of the environmental and economic consciousness of them and also the relevant questions on the plan of the farmers if they want to apply them in the near future.

EEC in soil cultivation

According to Forgács et al. (2005) and Zsembeli et al. (2015), land-use change from conventional to reduced tillage can save soil organic carbon and soil moisture in a typical soil of the Great Hungarian Plain. Due to the lower number of tillage operations, there is a 30-50% decrease in fuel consumption and an environmental load of greenhouse gases can be expected. On the other hand, shifting to reduced tillage from conventional probably needs the purchase of new machinery. The relevant question in the questionnaire: Do you consider changing the management system of your cropland from conventional to reduced tillage in the near future? If yes, why? If not, why not?

EEC in soil conditioning

According to Zsembeli et al. (2019), after 6 years of soil conditioning, the soil depth with favourable physical, chemical and biological status increased by 10 cm in a meadow chernozem soil. From economic point of view, it was found that one third of the autumn basic fertilizer can be saved without yield depression. The cost of soil conditioning per hectare is about 25-30 thousand HUF per year. The relevant question in the questionnaire: Do you plan to use a soil conditioner in your area in the near future? If yes, why? If not, why not?

EEC in compost application

According to Tuba et al. (2019), the basic autumn fertilizers can be replaced with compost without yield depression. In addition, the organic matter and lime content of compost significantly improves soil cultivability, reduces soil acidity, and provides nutrients for the crops for several years. The cost of using compost per hectare is about 50,000 HUF per year, or 100,000 HUF every three years. The relevant question in the questionnaire: Do you plan to use compost in your area in the near future? If yes, why? If not, why not?

RESULTS

We received 106 responses in the issues of soil cultivation and soil conditioning, while 104 responses in the issue of compost application, respectively. The responses to the question if the farmers would consider changing the management system of their cropland from conventional to reduce tillage are shown in *Fig. 1*.

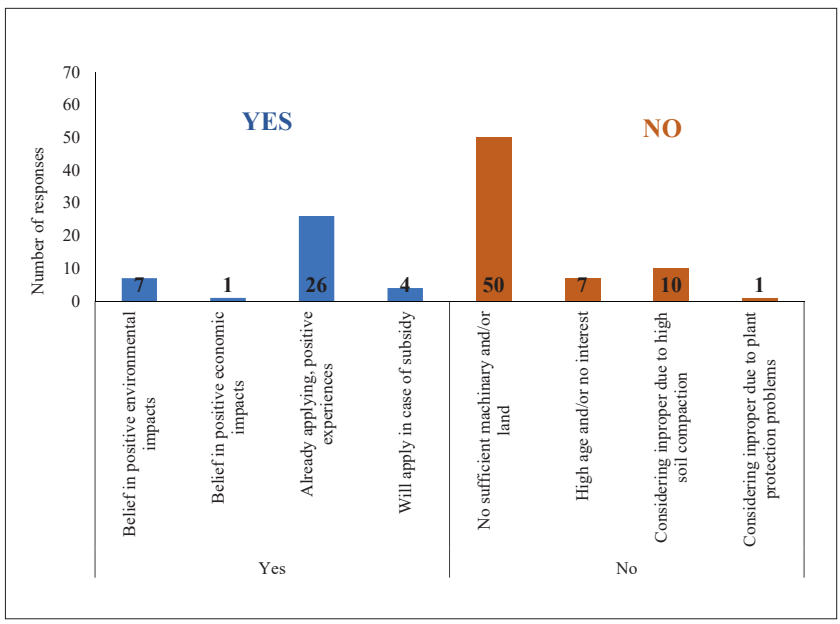

Figure 1: Responses of farmers to the question in the soil cultivation issue

The descriptive analysis revealed that among the interviewed farmers 36% would consider changing the management system of their crops from conventional to reduced tillage, while 64% would not. The study shows out of the 36% that would consider change, 68% was due to the positive experiences they had when applying, 18% of the respondent would consider changing due to the belief that it has a positive environmental impact, 11% of the respondents said they may consider under subsidy and 3% stated their belief on positive economic impact as being the reason for wanting to change to reduced tillage. Out of the 64% that would not consider changing their management practices, 74% said no due to the requirement of changing the machinery and insufficient land, 15% due to high soil compaction, 10% said no due to their age and lack of interest, and 1% would not consider due to plant protection problems.

The responses to the question if the farmers would consider applying soil conditioning are shown in *Fig. 2*.
The result of the analysis indicated that 52% of respondent farmers would consider applying the soil conditioner on their farm in the future, while 48% would not. Out of the 52% who would consider applying soil conditioner, 55% were already applying and they have a positive experience, 22% would consider but on small-scale, 16% believe in its positive environmental impact, 5% would consider applying because it increases yield and its cost-efficient and 2% gave no explanation. Out of the 48% of the respondents who would not consider applying soil conditioner, 37% had no interest, 29% considered soil conditioner too expensive, 18% preferred applying organic manure instead, 14% had no information regarding soil conditioner and 2% did not explain.

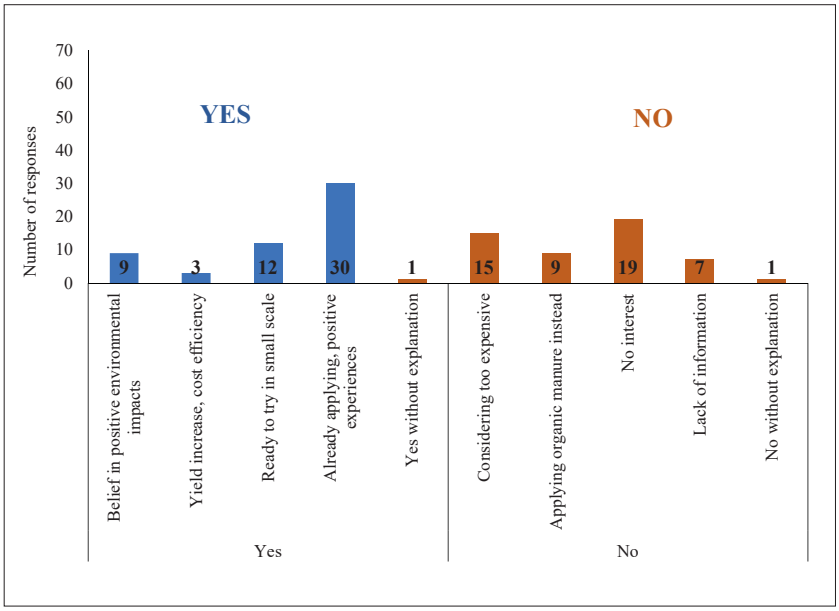

Figure 2: Responses of farmers to the question in the soil conditioning issue

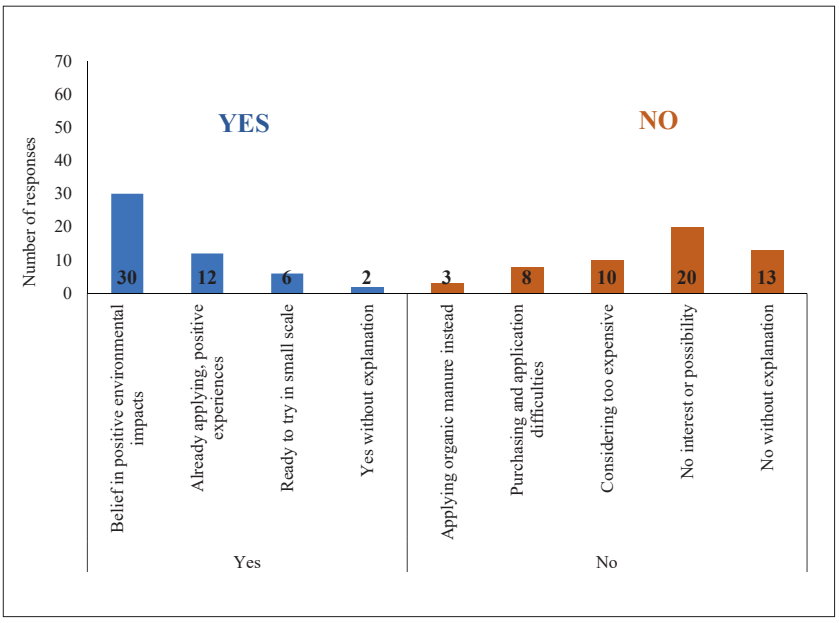

Figure 3: Responses of farmers to the question in the compost application issue

The responses to the question if the farmers would consider applying compost are shown in *Fig. 3*.

48% of the respondent farmers would consider applying compost on their farms, while 52% would not consider it. Out of 48% that would consider compost application, 24% is due to the positive experience as they are already applying it, 12% are ready to apply on small-scale and 4% did not give any explanation. Out of the 52% of the respondents who would not consider applying compost to their farm, 37% had no interest, 24% did not give any explanation, 18% consider compost application too expensive, 15% said no due to difficulties in purchasing and applying, while 6% prefer to apply organic manure instead.

DISCUSSION

Greater number of the respondents indicated that they would not consider changing their crop management systems from conventional to reduced tillage due to the requirement in changing of machinery and insufficient land due

to fragmentations, problems of soil compaction, and others were due to old age in addition to lack of interest lack of interest. However, some of the respondents indicated that they would consider changing due to the positive experiences while some stated that they would only consider reduced tillage under subsidies. A significant number of the respondents indicated that they would consider applying soil conditioner on their farms. However, they displayed a level of doubt as some say they would only try applying soil conditioner on small-scale, but the majority pointed out increased yield, cost efficiency, and positive experiences from using soil conditioner as a reason to adopt. While a significant number of respondents indicated that cost, availability of alternatives, lack of interest, and lack of information being their main factors for not considering applying the soil conditioner. The majority of the farmers stated that they would not consider applying compost to their farms due to the availability of cheaper alternatives like organic manure, high cost involved, purchasing and application difficulties, and lack of interest. Others stated that they would only consider it only on small scale and a few numbers stated positive experiences as being the reason for considering the application of compost on their farms.

CONCLUSIONS

Based on the results of the analysis, our expectation was proven to be right, that a larger number of the farmers are more economic than environmental conscious, as the result of the study showed that the majority are aware of the environmental impacts of these elements of soil management. The availability of cheaper alternatives, costs, profits, and lack of interest as being factors that influence farmers' decisions in the selection of agrotechnological elements. Even those who consider changing to environment-friendly technologies stated that they would only try the agro-technologies under subsidies and on small scale due to the high cost involved.

REFERENCES

1. Weersink, A., - Fulton, M. 2020. Limits to Profit Maximization as a Guide to Behavior Change. Applied Economic Perspectives and Policy, 42(1), 67–79.
2. Nowak, P. 1992. Why farmers adopt production technology Overcoming impediments to adoption of crop residue management techniques will be crucial to implementation of conservation compliance plans. *J. Soil. Water Conserv.,* 47(1), 14–16.
3. Havens, A. E. - Flinn, W. 1975. Green Revolution Technology and Community Development: The Limits of Action Programs. Economic Development and Cultural Change, 23(3), 469–481. https://doi.org/10.1086/450809
4. Osgood, B. T. 1986. Sociological aspects of the adoption of conservation practices.
5. Gallagher, K. S. - Muehlegger, E. 2011. Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology. *J. Environ. Econ. Manage.*, 61(1), 1–15. https://doi.org/10.1016/j.jeem.2010.05.004
6. Neill, S.P. - Lee, D.R.. 2001. Explain the adoption and the disadaption of sustainable agriculture: the case of cover crops in Northern Honduras. Economic Development and Cultural Change, 49 (4), 793–820.
7. Lokhorst, A. M. - Dijk, J. Van. 2011. What ' s in it for Me ? Motivational Differences between Farmers' Subsidised and Non-Subsidised Conservation Practices. 60(3), 337–353. https://doi.org/10.1111/j.1464-0597.2011.00438.x
8. Arisoy, H. - Ataseven, Y. 2017. Evaluation of Environmental Consciousness Level of Farmers in Agricultural Practices in Turkey: the Case of Province of Konya, Turkey. *J. Environ. Prot. Ecol*., 18(4), 1593–1604.
9. Forgács, L. – Zsembeli, J. – Tuba, G. 2005. Examination of a soil protective cultivation method in the Research Institute of Karcag. In: Realizáciou poznatkov vedy a vyskumu k trvalo udrzatel'nému pol'nohospodárstvu. 64-68.
10. Zsembeli, J. - Szűcs, L. - Tuba, G. - Czimbalmos, R. 2015. Nedvességtakarékos talajművelési rendszer fejlesztése Karcagon. In: Madarász, B. (ed) Környezetkímélő talajművelési rendszerek Magyarországon: elmélet *és* gyakorlat. Budapest, Magyarország: MTA CSFK Földrajztudományi Intézet. 122-133.
11. Zsembeli, J. – Sinka, L. - Rivera-García; A. - Czellér; K. – Tuba, G. – Krištof, K. – Findura, P. 2019. Effect of soil conditioning on the moisture content and the salt profile of the soil under irrigation with saline water. Polnohospodarstvo-Agriculture 2019(65), 77-87.
12. Tuba, G. - Kovács, Gy. - Czellér, K. - Zsembeli, J. 2019. A szennyvíziszap-komposzt hatása a kukorica termésére *és* a talaj néhány tulajdonságára. Növénytermelés 68(3) 73-89.

NATIONAL PEDOLOGICAL DATABASE, NEW MILESTONE THROUGH SOIL CONSERVATION

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ABSTRACT

The National Food Chain Safety Office (NÉBIH) in consortium with the Hungarian University of Agriculture and Life Sciences (MATE) submitted a winning competition to the National Institute of Agricultural Technology for the development of Agrotechnology National Laboratory in 2020. In the Laboratory establishment the SoilWeb project will be implemented by having main objective of creating a central pedological database. Nowadays there is a great demand for up-to-date soil information nationally and internationally. These can not be met by the exclusive use of traditional laboratory analytical (wet chemical) methods. The laboratory test practice of the Hungarian soil labs lack spectroscopic (dry chemical) methodology that enables the cost- and time-efficient and environmentally friendly determination of soil properties.
Due to the 150-year-old Hungarian soil conservation tradition more than 200.000 soil tests are carried out annualy. But this huge asset is not utilised. And the heterogeneity of current soil testing methods can not measure correctly the changes in soil parameters. The development of harmonised soil tests is important not only for environmental sustainability but also for the competitiveness of agricultural production and for objective measurement methods that can measure the environmental impact of the use of EU subsidies.
Development of a central IT system will be suitable for automatic collection, quality control and database integration of data generated by the soil laboratories.
The SoilWeb is an integral part of the European Green Deal, the European Union's Biodiversity Strategy, the From farmer to - Consumer Strategy and the sustainability goals for sustainable agriculture and food production under the Common Agricultural Policy. The frame of research is proposed by FAO Global Soil Partnership and based on experience of soil information systems LUCAS and AFSIS.
Materials are archived soil samples from the Soil Information and Monitoring (TIM) System and will be examined by mid-infrared spectroscopy. Calibration of spectral data will be performed in the TIM with reference data of wet chemical methods. Physical, chemical paramaters and plant nutrients will be utilized. Statistical relationship between soil properties and soil spectral properties will be developed. Predictive models are based on MIR and VIS-NIR spectrometric methods. By completing the project, a quality control based on algorithms and machine learning complex database will be developed.
The data will be shared for FAO Soil Laboratory Network (GLOSOLAN).
The information stored in the web application can be used by public bodies, authorities, research centers, universities, and consultants.

INTRODUCTION

In 2020 the National Office for Research and Innovation announced a competition entitled "Establishment of a National Laboratory 2020", in the framework of which the National Food Chain Safety Office (hereinafter: NÉBIH) in consortium with the Hungarian University of Agriculture and Life Sciences (hereinafter: MATE) submitted a winning competition to the National Institute of Agricultural Technology for the development of Agrotechnology National Laboratory. The NÉBIH as the background institution of the Ministry of Agriculture, oversees compliance with food chain security rules, fights against food counterfeiting and promotes reliable food production. The Office considers it of paramount importance that it

meets the expectations of the Hungarian population at all times, in addition to its professional interests. It does this with its constantly evolving laboratory network and knowledge base of professionals with diverse expertise. The mission of the Office is to implement the objectives set out in the Food Chain Security Strategy developed in 2014, in which - for the first time at the international level - the first member of the food chain is defined as arable land. The main goal of NÉBIH's Directorate of Plant Protection Soil Conservation and Agri-Environment is to bring the cultivation and nutrient management habits of farmers and the innovations and technological developments achieved in the agricultural science sector closer together. In addition to the work of the soil conservation authority, the performance of prevention tasks is becoming more and more important every year. An unparalleled possibility is that the SoilWeb project will be implemented within the framework of the establishment of the Agrotechnology National Laboratory, the main objective of which is to create a central pedological database. The Ministry of Agriculture and the Ministry of Innovation and Technology play a coordinating role in the development of the pedological database, in cooperation with the National Food Chain Safety Office, the Agricultural Economics Research Institute, the National Chamber of Agriculture the Hungarian University of Agriculture and Life Sciences (MATE) and the Hungarian State Treasury with the Earth Observation Operatianal Center.

RESEARCH PROBLEM

Nowadays, there is a great demand for adequate quality and quantity of up-to-date soil information nationally and internationally. This increased need for soil information cannot be effectively met by the exclusive use of traditional laboratory analytical (wet chemical) methods. The laboratory test practice of the Hungarian soil labs lack a spectroscopic (dry chemical) methodology that enables the cost- and time-efficient and environmentally friendly determination of the properties of the soils influencing the fertility and environmental functions of the soil. The methodology used as a spectroscopic, mobile soil laboratory for the in situ estimation of soil parameters is lacking in the field soil sampling practice.

Soil is critical for the survival of life and the preservation of a livable environment. Its functions are often impaired for natural or anthropogenic reasons, and soils are degraded due to various degradation processes. Much of the development of soil degradation processes can be prevented, and much of it can be reduced and improved. In order to understand the processes and tendencies, studies are needed to get to know the condition of the soils, which provide a good basis for reasonable intervention. Due to the 150-year-old Hungarian soil protection tradition and the extensive legal system, more than 200.000 soil tests are carried out in Hungary every year. However, this huge asset is not collected or not utilised.

The problem is that due to the heterogeneity of current soil testing methods, changes in soil parameters cannot be measured correctly. At national level, the effects of environmental change (eg climate change) and agrotechnological interventions cannot be objectively examined. This hampers the development and deployment of modern nutrient management services and forecasting systems.

The development of soil tests is important not only for environmental sustainability but also for the competitiveness of agricultural production.

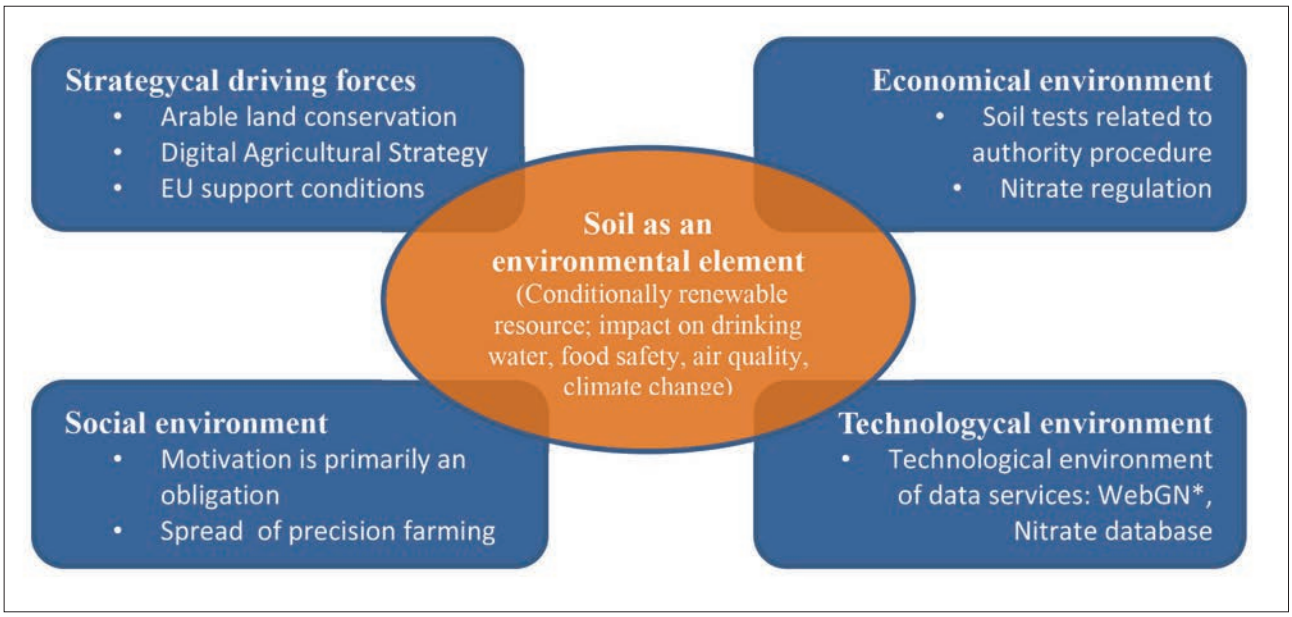

Figure 1: Problems and drivers

The development of Hungarian agriculture is largely supported by the cultivated land and livestock and investment subsidies of the European Union. The European Union's ambition is to link aid to environmental performance. Therefore, there is a need for objective measurement methods that can measure the environmental impact of the use of subsidies.

RESEARCH HYPOTHESIS

The increased demand for soil information can be incorporated into the Hungarian soil laboratory practice as an effective complement to wet chemistry procedures. Nutrient management planning based on a research database is a more environmentally friendly solution for the soil load and a more cost-effective solution for farmers than a traditional nutrient management plan. Presumably, the impact of climate change will be more objectively measurable by projecing overlays of soil quality parameters and time-series GIS data on agricultural damage mitigation. Proof of environmental performance supported by soil survey data demonstrates the use of EU funds.

PURPOSE OF RESEARCH

Development of a central IT system suitable for the automatic collection, quality control and database integration of data generated in Hungarian soil laboratories. With this, a time series database covering the agricultural and forestry areas of Hungary can be developed. A research infrastructure containing the quality parameters of Hungarian soils will be created in a time-series and georeferenced way (National Soil Database = National Soil Laboratory).
By the implementation of the project, a national soil conservation knowledge center will be established, which will be in active contact with all soil laboratories, universities and research centers using the database. The knowledge center can participate in research topics both nationally and internationally.
The aim is to provide state actors with quality data that will enable the development of the service legs discussed in the DAS.
Other goals are to create a reference collection of soil research methodologies for standardized studies, to correlate the georeferenced quality parameters of soils and agricultural damage mitigation (inland water, drought) data in order to map the effects of climate change. During the development, several result products are created to produce data filtering and validation processes that allow data quality control. In addition, the quality assurance of accredited laboratories will be possible, also on the basis of time series and location-based information.
The various information stored in the web application can also be used by public bodies, authorities, research centers, university, private and corporate consultants.

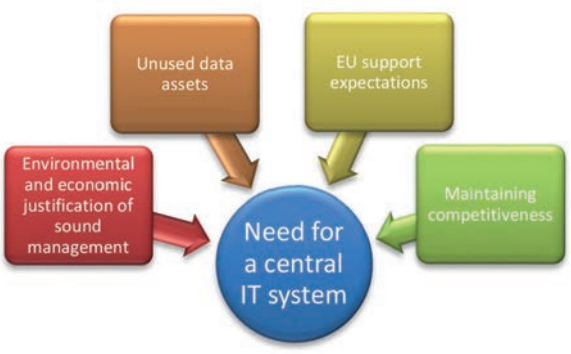

Figure 2: SoilWeb

LITERATURE REVIEW

In recent years, it has become necessary not only in domestic politics but also in the international arena to preserve the quality of soils, maintain biodiversity, reduce greenhouse gas emissions, and produce healthy food. As a result, directives, strategies and action plans in the fields of environment, nature conservation and agriculture set out effective measures for soil conservation. The SoilWeb project joins the objectives in several places.
The Hungarian Digital Agricultural Strategy (DAS) addresses, among other things, the needs for soil data and the significant data assets available. The DAS formulates the establishment of the soil conservation advisory system and the digital soil science database as separate measures.

The main results expected from the implementation of the measure are the following:
- establishment of a soil conservation advisory system,
- an automated advisory system and web application related to administrative data provision,
- decreasing nitrate load,
- decreasing under-fertilization,
- decreasing GHG emissions,
- increasing fertilization efficiency,
- increasing cost efficiency

The measure in the DAS emphasizes that the system should not impose additional administrative burdens on either the producer or the laboratories, as it is based on an automated data collection process from the soil samples provided by the producers and the exact location and verification information in the laboratories. the resulting georeferenced soil survey data is automatically transmitted to a central state soil science repository, which can be the basis for additional services.
The SoilWeb is an integral part of the European Green

Deal, including the European Union's Biodiversity Strategy, the From Farmer to - Consumer Strategy and the sustainability goals for sustainable agriculture and food production under the Common Agricultural Policy (CAP). The CAP in the period 2021-2027 focuses on the issue of the sustainability of natural resources.Until now, there have been several support programs (agro-ecological management) that have also addressed the issue of soil management. The extent and territorial scope of these are expected to increase, the data provision, monitoring and evaluation requirements specific to European Agricultural Fund for Rural Development (EAFRD) resources will also apply to area based support, and environmental expectations will be strengthened. For this reason, the Hungarian public administration must develop solutions that enable the collection and analysis of the significant amount of data required to meet the data provision and monitoring requirements related to the environmental performance of subsidies.

The mission of the Food Chain Security Strategy, adopted by the government in 2013, is to improve food chain security by identifying health and economic hazards in the food chain and reducing their risks. There are two main ways to reduce risk, which are also the two pillars of the strategy.

By managing risks directly, that is, by effective regulatory risk mitigation, we can have an impact on food chain security in the short term, while the way to achieve longer but deeper changes is to facilitate the flow of data, information and knowledge, increase the level of knowledge of actors, organization.

The development of the database could contribute to the strategic direction 'Restoring European Ecosystems and Biodiversity and Managing Sustainable Natural Resources' set out in the Horizon Europe Strategic Plan 2021-2024.

Furthermore, the data collected in the SoilWeb can be integrated into the National Directorate General for Disaster Management GIS risk assessment system, with which the results of soil contaminant testing can be evaluated together with the professional layers of other fields. Once data integration is complete, data will be shared internationally, for which the FAO Soil Laboratory Network (GLOSOLAN) is an appropriate platform. The domestic coordinator of GLOSOLAN is the Soil Conservation Laboratory of NÉBIH located in Velence.

MATERIAL AND METHODS

• *parameters, location identification, methodology*

The research is framed by the structure proposed by GLOSOLAN, one of the main technical networks of the FAO Global Soil Partnership (GSP). GLOSOLAN's goal is to establish the harmonization of soil analytical tests and data nationally and internationally at the global level. GLOSOLAN plays a major role in the reliability and comparability of data generated by soil laboratories in different countries, projects, or even within countries. This is a prerequisite for decision-making procedures that also affect soils, based on facts and figures, thus supporting sustainable land use.

Another pillar of GLOSOLAN is the integration of spectroscopic methods in soil sampling and analysis as an effective complement or even alternative to traditional laboratory analysis methods. During the project, the recommendations of the GLOSOLAN soil spectroscopy working group will be used primarily. These recommendations are based on the experience gained during the construction of soil information systems (LUCAS, AFSIS), in which laboratory and field soil parameter estimation procedures based on spectroscopic methods and spectral libraries have been given a prominent role. MATE (Hungarian University of Agriculture and Life Scineces) participates in this project as a team leader and maintains working relationships with professionals who develop state-of-the-art methods for building a spectral database. Within the framework of this work phase, the soil testing protocols of the accredited laboratories operating in Hungary will also be reviewed. The construction of spectral libraries and efficient spectral-based soil parameter estimation services can only be achieved by establishing a statistical relationship between the spectral properties and the physical and chemical properties of soil samples collected from representative sites in the study area and by creating predictive models.

In the next phase of the work, the activity will start building on the existing instrument base. As an initial step, soil samples from the soil archive of the Soil Information and Monitoring (TIM) System will be collected and examined by mid-infrared spectroscopy.

Calibration of the spectral data will be performed in the TIM with reference soil data determined by wet chemical methods. Physical parameters of physical soil type; sand, dust and clay content. Chemical parameters of organic carbon; carbonated lime content; total water soluble salt content; pH, cation exchange capacity, base saturation, exchangeable cations, plant nutrients. This phase of the work will provide an idea of the spectral-based determinability of the listed soil parameters of Hungarian soils. Building on the new instrumentation, a statistical relationship between soil properties and soil spectral properties will be developed. Predictive models are based on MIR and VIS-NIR spectrometric methods. The extraordinary richness of information of the MIR technology, the spectra recorded in the middle infrared range of the electromagnetic spectrum, allows a reliable laboratory determination of a wide range of soil parameters. The spectra provided by VIS-NIR technology in the visible and near-infrared range of the electromagnetic spectrum are also rich in soil information,

and the portability of the instrumentation creates a field implementation of soil spectral analysis, which is a prerequisite for efficient and reliable operation of a mobile soil laboratory. The framework and the mainstay of the spectral database (spectral library) based on the two spectral technologies presented will consist of soil samples collected from more than 1.200 points in the country at 3 depth intervals as part of the TIM survey. Essential reference soil parameters for the development of predictive models will be provided by the Soil Conservation Laboratory of NÉBIH located in Velence. Based on the VIS-NIR and MIR spectral measurements, the foundations of the spectral library are developed based on the predictive models created. This database will be an integral part of the information system to be developed. It will also contain the spectral properties of all soil samples tested as well as the reference soil parameters. This provides an opportunity for researchers and laboratories to test predictive models. An integral part of the spectral library will be the soil parameter estimation service, which offers the possibility to determine the physical and chemical properties of soil samples on a spectral basis. This test method is a time-, cost-effective, and environmentally friendly alternative to traditional laboratory analytical procedures. Considering that the estimation of soil parameters on a spectral basis is a multivariate mathematical-statistical procedure, the reliability of the estimation of soil parameters will be given by statistical metrics.
The final phase of the research is to test the laboratory and field prediction efficiency of the spectral library and soil parameters. At this stage, soil samples from the country's soil laboratories will be tested, comparing the results of estimating soil parameters with laboratory, wet chemical results.
With the implementation of the project, a quality control based on algorithms and machine learning will be developed on a national, complex (soil, farming and economic data) sample database. The database contains the data that will be available in the SoilWeb database and is currently available in the Test Plant Information Network, as well as in the WebGN (web based farming diary) database. This database makes it possible to create algorithms that can be used to replace missing data with the help of machine-learning-based algorithms during subsequent data collection, and to enable the development of aggregation and classification processes.

Agricultural research, development and innovation that produce modern and competitive results that can be put into practice cannot be imagined without the right quality databases and the right amount of big data. The application of Artificial Intelligence (deep learning) is of paramount importance in the availability of the right quality and quantity of data.
In the first step, the internal quality control algorithms of SoilWeb are developed, which include interval, correlation, outliers, and evaluate the validity of the data based on geolocation and the nearest neighboring sampling sites.
The heterogeneity of soil parameters and measurement methods from soil testing do not allow for comparison of soil properties. Therefore, the project considers it necessary to make them comparable with a harmonization process. During harmonization, the units of measurement for the given parameters are also standardized. The harmonization methods contribute to the comparability and easier evaluation of the Hungarian national soil database. The harmonization follows a specific timetable, in which the methods to be harmonized in the following year are defined in October-November each year in the context of the annual GLOSOLAN meeting. It is also part of the enforcement of the methods that the methods are used as widely as possible during the comparisons and round examinations. NÉBIH participates in the performance of the round tests and devotes a lot of energy to recommending harmonized methods within the Hungarian soil laboratory network.
Using the data of the complex database created by SoilWeb and the Soil Information and Monitoring System (TIM), machine learning-based classification systems are developed that allow the aggregation of raw soil data. This allows them to add a new dimension to WebGN and Test Plant Information Network databases. For this, both the existing soil classification systems (genetic and the new diagnostic approach) and the numerically descriptive land evaluation systems will be used. A significant part of the data content of SoilWeb will contain the results of soil samples from surface soil sampling, mainly for nutrient management purposes, the data content of which is insufficient for the classification processes. In the course of the research, artificial intelligence-based algorithms are taught in the complex database and in the TIM in order to be able to derive soil type and soil quality from the results of surface sampling.

• *laboratory data analysis*
In Hungary, about 200 thousand soil tests are performed every year, the results of which remain in the soil laboratories and thus cannot be utilized. In addition to linking

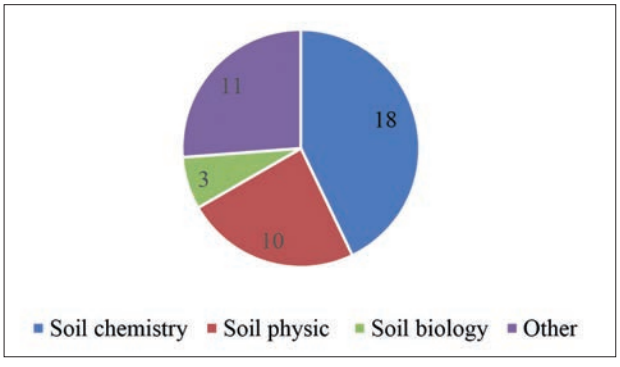

Figure 3: Main profile of laboratories (%)

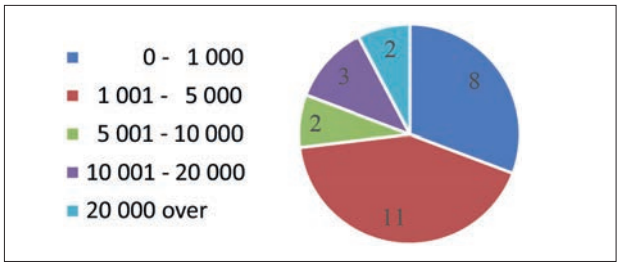

Figure 4: Average number of soil samples received by laboratories per year (quantity)

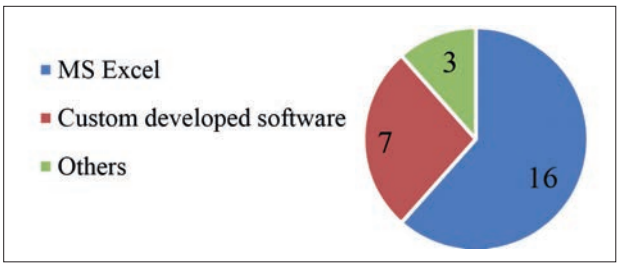

Figure 5: Current data management of laboratories (%)

existing information, the geocoded collection of the results of soil tests performed in accredited soil laboratories and the creation of a database containing uniform data in such a way that development does not place an unacceptable burden on laboratories is important.

In the framework of the market laboratory survey, most soil testing laboratories were visited in order to minimize the additional administrative burden and to avoid high resistance among prospective data providers. A total of 26 laboratories participated in the market laboratory survey interviews. In addition to the knowledge of the laboratory profiles and the matrices examined, the questions covered the sample quantities tested by the laboratories, the test methods and the IT systems and documentation systems used by the laboratories.

The laboratories participating in the market laboratory survey covered approximately 90 0000 to 150 000 samples out of a nationally estimated annual sample of 250 000 to 300 000, with more than two million soil tests per year. When examining the laboratory profiles, the aim was to assess the main profiles of the laboratories, but it varies from laboratory to laboratory in that it is exhausted in one category or possibly in several categories.

The volume of soil tests fluctuates every year, which is affected by periodic EU subsidies, leading to major extremes.

• *data upload, data management*

Mapping the current data management of laboratories, it is possible to determine what software is used to manage the test data. The preliminary assumptions were that the test data would typically be released by the laboratories only to the customer, and that their results would most likely be processed in the form of Microsoft Excel, Word files with their own structure, in the absence of their own laboratory management software.

The need for development has emerged in most of the laboratories interviewed, but implementation often faces economic constraints. More than half of the labs are planning to invest in lab IT. These laboratories in equal distribution either envisaged the further development of their existing systems or the introduction of new ones. For laboratories that do not use a dedicated laboratory program, it has been suggested that they consider the use of a free cloud-based system operated by NÉBIH in the future.

During the project, the goal is to create the database in a way that takes into account the needs of future data providers and users. Based on the experience of the survey, it can be stated that the automatic upload of data to the SoilWeb system via an interface is the most supported, which is in line with the solution preferred by NÉBIH. In addition, it will be necessary to provide Excel-based data upload, which could be supported by an additional cloud-based protocol service operated by NÉBIH. The latter service would be used by several smaller laboratories, thus providing an additional service that helps in the acceptance and support of the SoilWeb program.

Using the data of the created complex database and the Soil Information and Monitoring System (TIM), machine learning-based classification systems are being developed that allow the aggregation of raw soil data. Fullfelling this purpose both existing soil classification systems (genetic and new diagnostic) and numerically descriptive land valuation systems are used.

• *draft data usage*

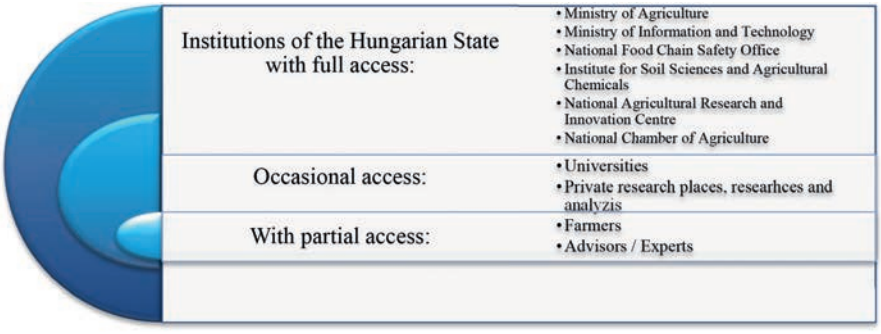

Figure 6: draft data use

RESULTS

With the implementation of the project, a soil protection knowledge center will be established, which will be in active contact with all soil laboratories, universities and research centers, and which will be able to participate in research topics at the national and international level.
A unified laboratory testing methodology will be developed with the necessary infrastructural and tool improvements.
The developed web application will publish derived soil parameters in map form, in an aggregated way, on an open access interface, based on the database integrating the data of the Hungarian soil laboratories.
A customized interface system for public institutions will be developed to allow access to various databases or data downloads.
Using a complex database of soil, management and economic data, test methods can be developed that allow the test farm information network to be examined along a new dimension. Thus, providing a more realistic picture in terms of the performance, profitability and future opportunities and growth of Hungarian agricultural enterprises. It becomes possible to have an objective evaluation system for the effect of the condition of the soils and the applied agrotechnics on the efficiency of farming. Different farming practices can be evaluated separately according to their soil effect and environmental parameters according to their impact on the soil. As a result, in addition to the more unfavorable environmental parameters, the evaluation of farmers also becomes more objective.
Using the objective assessment system, by processing the data received in the first year of the SoilWeb database, a national soil condition map will be published.

THE CONTACT SYSTEM OF THE PROJECT

Participants implementing the project are the Ministry of Agriculture, the Hungarian University of Agriculture and Life Sciences, domestic soil laboratories, the Institute of Agricultural Economics Nonprofit Ltd., the National Chamber of Agriculture, the Hungarian State Treasury and the FAO Global Soil Partnership. The article was prepared within the framework of the National Laboratory of Agricultural Technology, with the support of the Ministry of Innovation and Technology.

HUNGAIRY

IMPROVING AIR QUALITY AT EIGHT HUNGARIAN REGIONS TROUGH THE IMPLEMENTATION OF AIR QUALITY PLAN MEASURES

Project area:
10 Hungarian municipalities
Duration:
01.01.2019.–31.12.2026.

Project budget:
15 967 741 €
EU contribution:
10 870 540 €

BÉKÉSCSABA
BUDAPEST
DEBRECEN
EGER
KAPOSVÁR

KARCAG
MISKOLC
PÉCS
SZOLNOK
TATABÁNYA

Main actions:

Installations of new air quality monitoring stations • Deployment of a decision support air quality modelling tool • Residential emission reduction • Promoting enviromentally friendly modes of transport • Promoting enviromentally friendly agricultural technologies • Awareness raising and knowledge transfer

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