Short communication

IDENTIFYING CURRENT POLICY AMBITIONS AND FUTURE SOIL ASPIRATIONAL GOALS IN SLOVAKIA

Michal Sviček, Kristína Buchová, Tatiana Čičová

National Agricultural and Food Centre – Soil Science and Conservation Research Institute

Coresponding author: *Ing. Michal Sviček, CSc. Soil Science and Conservation Research Institute NPPC, Trenčianska 55, 821 09 Bratislava, Slovakia, michal.svicek@nppc.sk*

Citacion: Sviček, M., Buchová, K., Čičová, T. (2022). Identifying current policy ambitions and future soil aspirational goals in Slovakia. *Pedosphere Research,* vol. 2, 2022, no. 1, pp. 48 –XX. NPPC – VÚPOP 2022. ISSN 2729-8728.

Abstract

To develop and deploy a roadmap of the project H2020 EJP SOIL program titled "Towards climate-smart sustainable management of agricultural soils" was the main goal of this study. In Slovakia, the survey of the Task 2.1 addresses expertise of nine stakeholders and reviewing 17 documents which consisted of two phases. The first phase was elaborated a desk study in which policy documents and market-based initiatives were analysed in terms to detect current policy ambitions and realisations. In the second phase, the opinion of key stakeholders was asked on how they perceive policy realisations and what aspirational goals for agricultural soil and management towards 2050. To avoid soil erosion, to enhance soil biodiversity, optimal soil structure, and avoiding N_2O, CH_4 emissions were the most covered soil challenges to be addressed by management practices. On the other hand, soil sealing was not involved into the survey at all, because of management practices cannot be applying. According to the stakeholders, enhance water storage capacity; avoid soil erosion and maintain/increase soil organic carbon (SOC) are the three most important soil challenges in the country in the upcoming decades. Measures to be implemented for avoiding N_2O, CH_4 emissions, enhance of soil biodiversity and enhance of soil nutrient retention/use efficiency also received a relatively high rating from stakeholders. The survey results: the most promising management practices for the country suggested by stakeholders, as controlled traffic farming and precision agriculture, are barely covered by policy documents. The situation is similar for fertilisation plans, too. The results at the European level were almost identical to the national ones in Slovakia in terms of soil management practices and soil challenges.

Keywords: stakeholders, questionnaires, inventory, soil related targets, soil management practices, soil challenges, policy analysis

INTRODUCTION

The main objective of the European Joint Programme EJP SOIL H2020 (https://ejpsoil.eu/) is to enhance the contribution of agricultural soils to key societal challenges such as climate change adaptation and mitigation, sustainable agricultural production, ecosystem services provision, prevention and restoration of agricultural land and soil degradation and biodiversity maintenance (Cocklin *et al*. 2007, Dalkir 2005, Paustian *et al.* 2016, Piorr 2003). This approach is in line with Voluntary Guidelines for Sustainable Soil Management (FAO 2015). Slovakia is one of the 24 countries participating in the EJP SOIL national research effort. Research was being conducted at the Soil Science and Conservation Research Institute of the National Agricultural and Food Centre (NPPC) in Bratislava, which is the major pedological institution in Slovakia. The institute is active in many areas of pedological, agricultural and environmental research. NPPC provides expert services for governmental authorities, partners, and education institutions and other bodies conducting activities in agriculture, environment, urban planning and regional development (Kobza *et al.* 2014, Sviček *et al*. 2019, *etc.*). A roadmap has been developed, and for this elaboration an input on the current status "state of the art" knowledge, the system and development of knowledge was needed. Several information data like new research, synthesis of research as well as needs for knowledge sharing and transfer, harmonization databases, and knowledge

application, were gathered in each country and have been the subject of a survey and evaluation. A part of this input was the analysis of current policy ambitions in Slovakia and stakeholder opinions of future aspirational goals.

Our national input consists of three tasks:

Task 2.1: Identifying current policy ambitions and future soil aspirational goals;

Task 2.2: Knowledge availability and use;

Task 2.3: Identification of barriers and opportunities by scenario development.

In our paper we focused on the Task 2.1 and its outputs on the member state level. This task report provided an input for the roadmap development that reflect the current situation and needs in each region in Europe and outline the key research and capacity building priorities, supporting soil data harmonisation, policy-making and knowledge implementation. Therefore, contributing to this task is our opportunity to highlight the situation and needs from our country which were taken up in the roadmap and subsequent internal and external research calls in the coming years in EJP SOIL. The outputs of the Road map EJP SOIL programme are available on website (Keesstra *et al.* 2021).

The main goal of the paper is to get acquainted with the situation regarding research and capacity building priorities, supporting soil data harmonization, policy-making and knowledge implementation in Slovakia and to find out its place within the European countries.

MATERIAL AND METHODS

The used methodology was the same in each country and according the guidelines provided by Jacob *et al.* (2021) and Ruysschaert *et al.* (2020) consisted of two phases. The overall EU report on identified regional, national and European aspirations on soil services and soil functions that compiles the results of all countries can be found on website (Jacob *et al.* 2021). The first phase is a desk study in which policy documents are analysed in order to detect current policy ambitions and realisations. In the second phase, the opinion of key stakeholders is asked on how they perceive policy realisations and what aspirational goals for agricultural soils and its management they would express towards 2050.

Phase 1 consisted of three steps: identification of relevant policy documents, analysis of the policy documents and validation of policy documents analysis by key contact persons. In the specific case of Slovakia, the key persons were recruited from the Ministry of Agriculture and Rural Development of the Slovak Republic and from the Ministry of the Environment of the Slovak Republic. In the 1st step three types of documents were considered that formulate targets for agricultural soils or mention management practices that impact agricultural soils: policies that are national or regional transpositions of European legal acts, policies that are not linked with European policies but specific for Slovakia and important market-based initiatives with a clear link with soil, fertiliser or manure management.

For Slovakia documents of Common Agricultural Policy (only the "old" CAP 2014 – 2020), namely Greening measures, Cross-compliance including Good agricultural and environmental conditions (GAEC) and Rural development including Agri-environmental schemes has been considered and analysed. Documents from the following areas were also surveyed:

- National Energy and Climate Plan (NECP),
- National Long-term Strategies (NLS),
- National Adaptation Strategies (NAS),
- National and Regional Action Programmes (Nitrates Directive – ND),
- Water Framework (WFD),
- Groundwater Directive (GD),
- Flood´s Directive (FD),
- Areas with Natural Constraints (ANC),
- Habitat Directive (HD),
- Birds Directive (BD),
- Sewage Sludge (SSD),

- Sustainable Use of Pesticides (SUP),
- Environmental Impact Assessment (EIA),
- Strategic Environmental Assessment (SEA).

All policy packages – EU legal acts listed above were transposed into Slovakian national legislation (McNeil *et al.* 2018). At the EU level, an attempt to ratify the Soil Framework Directive failed. This Directive should have provided a legislative basis for soil protection and unify soil protection measures under one directive to respond to the soil threats identified in the Soil Thematic Strategy (European Commission 2006).

For each of the documents found, a key person, mostly at policy departments, was identified that was closely involved with the development of the policy packages or market-based initiatives or has good knowledge on its content and how it was developed.

In the 2nd step, the gathered documents were analysed and the following information was extracted: policy targets on soils, indicators used to monitor the targets, current status of the indicators, tools or methods used for monitoring and phase of development, farm management practices mentioned in the documents in terms to reach the targets, other policy instruments mentioned in the documents in terms to reach the targets and other policy instruments mentioned in the documents used or to be developed to reach the targets and phase of development. In this analysis, following abbreviations were used for the soil challenges:

Table 1

Abbreviations of the soil challenges (Jacob *et al*. 2021)

Soil Challenge	**Abbreviation**
Maintain/increase SOC	SOC
Avoiding N_2O, CH_4 emissions	Emission
Avoid peat degradation	Peat
Avoid soil erosion	Erosion
Avoid soil sealing	Sealing
Avoid salinization	Salinization
Avoid acidification	Acidification
Avoid contamination	Contamination
Optimal soil structure	Structure
Enhance soil biodiversity	Biodiversity
Enhance soil nutrient retention/use efficiency	Nutrient
Enhance water storage capacity	Water
Other relevant targets which could not be related to the defined soil challenges	Extra

After analysing the policy documents, key persons from the ministries were identified and asked to validate submitted analysis and to assess if the analysis was correct and complete. The questions were sent in the form of a questionnaire based on the template of Annex II in Jacob *et al.* (2021). Questionnaire template based on the policy analysis in phase 1 was adjusted for Slovakia.

In the phase 2, key stakeholders completed a questionnaire, consisting of 4 main steps: 1. policy analysis validation, 2. policy realisation and defining aspirational goals, 3. how to achieve aspirational goals and 4. policy prioritization.

According to the guidelines provided by Jacob *et al*. (2021) the stakeholders were asked to validate the draft policy analysis compiled in the phase 1. In Slovakia, the stakeholders were approached by e-mail. After the expert validation by all the stakeholders, the status of the policy analysis was confirmed and changed from draft to final version. In this step the inventory of policy documents and market-based

initiatives was created in the table view, which consisted of overview of policy packages and market based initiatives of importance for agricultural soils. The table, respecting the guidelines provided by Jacob *et al.* (2021), contains items on: Policy ID, Policy Name, Corresponding EU policy, Government level, Responsible policy department, Contact persons. Information about Market based initiatives contains data on Initiative ID, Initiative name, Application level, Responsible organisation and Contact person.

In the 2nd step, stakeholders were asked to provide their expert opinion on the current realisation of the policy ambitions and targets set in the policy analysis. To do this, they were asked to indicate how wide is the gap between the current policy targets and realisation. To answer this question a Likert scale with five categories (very large, large, halfway, small and no gap) was provided (Uebersax 2006) The stakeholders were also asked to write a short argumentation explaining their vote.

After evaluating the current policy realisation, again, a Likert scale was used to answer the question whether the current policy targets are futureproof with a horizon to 2050. In addition, in the table was required to fill an answer's argumentation. In this case, the Likert scale had four options (futureproof, almost futureproof, far from futureproof, very far from futureproof).

The 3rd step contains the question how to achieve the aspirational goals identified in the step 2, and was answered by the stakeholders. The stakeholders had to indicate three priority management practices for

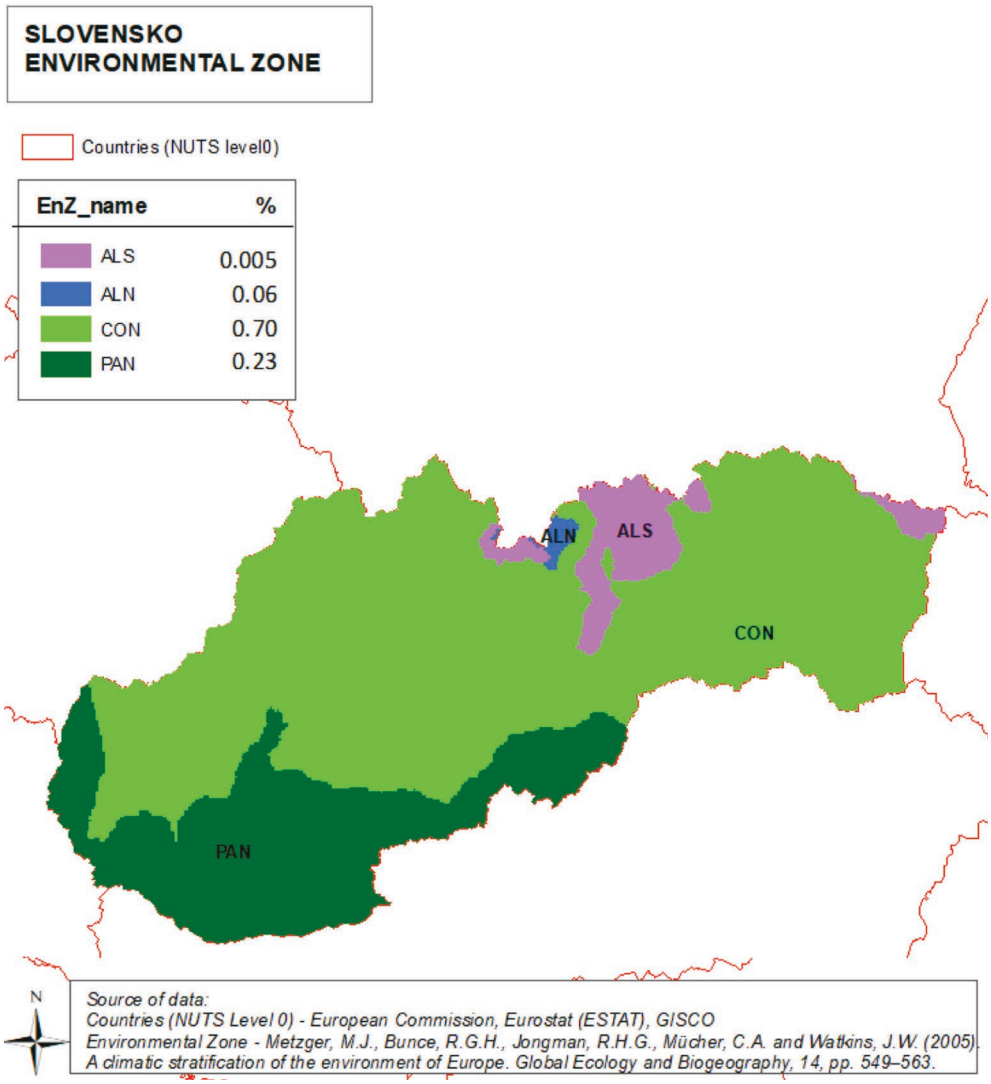


Figure 1 Environmental zones in Slovakia: Alpine South (ALS), Alpine North (ALN), Continental (CON), Pannonia Pontic (PON) (Metzger *et al.* 2005)

each soil challenge and having been requested to indicate the other instruments if applicable. As in the step 2, the proportional vote for every management practice was calculated per soil challenge.

In the 4th step, the stakeholders were asked to prioritise the soil challenges in the dominant environmental zones defined by Metzger *et al*. (2005), developed at the country level in I-Sompe (2021). The stakeholders divided total 100 points among the individual soil challenges. In general, three zones can be distinguished in Slovakia, the Continental (prevailing zone), Pannonian and South Alpine with very small area belonging to North Alpine zone (Fig. 1). However, the policy packages are listed only as the Continental zone, which covers most of Slovakia. The legislation applies to the entire Slovak Republic; it is not divided separately for individual climate zones, so the legislation does not make a distinction between the zones although the Pannonian zone has a very particular climate and high agricultural production. (Sviček, Buchová, Hutár 2020).

RESULTS AND DISCUSSION

Survey´s results of the Phase 1

Policy targets

- All policy packages – EU legal acts listed in EJP SOIL guidelines stated in Jacob *et al.* (2021) for analysis at the member state level were transposed into Slovakia national legislation.
- At EU level, an attempt to ratify the Soil Framework Directive (COM (2006)232 final) (European Commission 2006) failed in 2014. This Directive should have provided a legislative basis for soil protection and unify soil protection measures under one directive in terms to respond to the soil threats identified in the Soil Thematic Strategy (COM (2006)231 final). In Slovakia, however, does exist a legal document – the Act No. 220/2004 Coll. on the protection and use of agricultural land and amending Act no. 245/2003 Coll. on Integrated Pollution Prevention and Control and on the amendment of certain laws. It protects agricultural land against water erosion, soil compaction, decrease of soil organic matter, and against risk substances. Specific laws are devoted to agricultural land take and levies for taking the land

In addition to the above transposed policy packages, other policies on protection and use of agricultural land, specific for Slovakia, were identified and analysed. They are: Act No. 330/1991 Coll. on land consolidation, land ownership arrangements, land offices, land resource and land associations and the Act on Fertilizers No. 136/2000 Coll. and amendment to Act No. 394/2015 Coll.

Soil targets do exist for all listed soil challenges. For some soil challenges there are more targets and also reverse, some soil targets include several soil challenges. Some soil challenges are addressed by several soil packages; they are not covered evenly. Survey results are shown in the Tab. 2.

Table 2

Soil targets for soil challenges in Slovakia

Soil challenges	**Soil targets for soil challenges**
Maintain/increase SOC	Control soil erosion and land degradation
	Improved soil structure management
	Improved nutrient management
	SOM management for C sequestration
Avoiding N_2O, CH_4 emissions	Improved water storage and water use efficiency
	Control soil erosion and land degradation
	Improved soil biodiversity
	Improved soil structure management
	Improved nutrient management
	SOM management for C sequestration

Avoid peat degradation	Improved water storage and water use efficiency
	Improved soil biodiversity
	SOM management for C sequestration
Avoid soil erosion	Improved water storage and water use efficiency
	Control soil erosion and land degradation
	Improved soil biodiversity
	Improved soil structure management
Avoid soil sealing	Control soil erosion and land degradation
Avoid salinisation	Control soil erosion and land degradation
Avoid acidification	Control soil erosion and land degradation
	Improved soil biodiversity
Avoid contamination	Improved water storage and water use efficiency
	Control soil erosion and land degradation
	Improved soil biodiversity
	Improved soil structure management
	Improved nutrient management
Optimal soil structure	Control soil erosion and land degradation
	Improved soil biodiversity
	Improved soil structure management
Enhance soil biodiversity	Improved soil biodiversity
	Improved soil structure management
Enhance soil nutrient retention/use efficiency	Improved water storage and water use efficiency
	Control soil erosion and land degradation
	Improved soil biodiversity
	Improved nutrient management
Enhance water storage capacity	Improved water storage and water use efficiency
	Control soil erosion and land degradation
	Improved soil biodiversity
Other (please specify) Avoid water pollution	Improved water storage and water use efficiency
	Improved soil biodiversity
	Improved nutrient management
Other (please specify) Floods protection	Improved water storage and water use efficiency
Maintain/ creation of landscape features	Control soil erosion and land degradation

In most policies there are not quantified targets, or they are vague. Two policies are exceptions, namely The 2030 Climate and Energy Framework – National Energy and Climate Plan (NECP) and 2050 Long-term Climate Strategy – National long-term strategies (NLS). The targets there involved are more clear and obvious (Tab. 3). For example, in Slovak WFD_GD is mentioned target – 45 Regulates protection, efficient and economical use of water, rights and obligations liability for breach of obligations, Avoid water pollution, Enhance water storage capacity, but without measurable indicators and specific monitoring. The same also applies to SK_Land_Cons policy.

Targets of the policy packages are different and quite evenly represented as regards the specification in relation to the soil. From the seventeen identified policy packages, a maximum of eight targets are non-soil specific (NS), i.e. the target includes soils perceived in general (not only agricultural soils) but also

water, air, climate (Tab. 3). Five targets are specific for agricultural soils (SAS) and four belongs to soil specific (SS), i.e. for agricultural and forest soils.

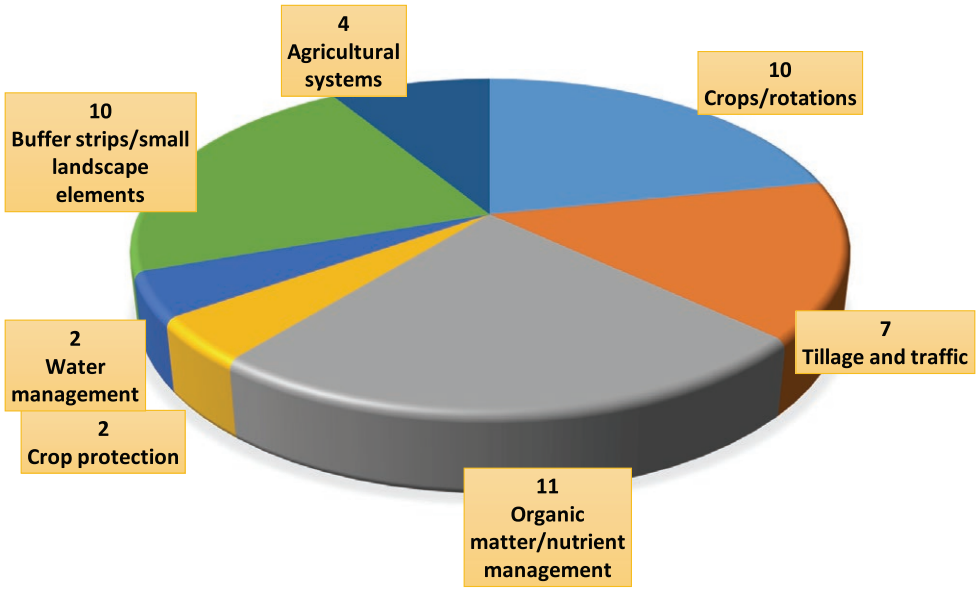
Table 3
Targets of the policy packages in Slovakia

Policy target	Policy/Initiative ID
SS – soil specific	**SK_A-RD** (Rural Development Program 2014 – 2020 version 1.3, after 6th modification approved by the European Commission on March 24, 2020)
	SK_SSD (Act no. 188/2003 Coll. Act on the Application of Sewage Sludge and Bottom Sediments to the Soil and on Amendment to Act no. 223/2001 Coll. on Waste and on amendments to certain acts, as amended)
	SK_ANC (Government Regulation no. 75/2015 Coll. of the Slovak Republic laying down rules for the subsidies in respect of the Rural Development Program measures, §3 – §6 Payment for areas with natural or other specific constraints)
	SK_Land_Cons (Act No. 330/1991 Coll. on land consolidation, land ownership arrangements, land offices, land fund and land communities)
SAS – specific for agricultural soils only	**SK_A-CC** (Government Regulation No. 36/2015 Laying down the rules for granting support in agriculture in connection with schemes of coupled direct payments, Government Regulation No. 342/2014 Laying down rules for granting support in agriculture in connection with decoupled direct payments schemes)
	SK_A-GM (Government Regulation No. 342/2014 Laying down rules for granting support in agriculture in connection with decoupled direct payments schemes)
	SK_SOIL (Act no. 220/2004 Coll. Act on protection and use of agricultural land and on amendment of Act no. 245/2003 Z.Z. on integrated pollution prevention and control)
NS – non-soil specific – the target includes soils but is broader than agricultural soils only	**SK_A-RD** (Rural Development Program 2014 – 2020 version 1.3, after 6th modification approved by the European Commission on March 24, 2020)
	SK_NECP (Integrated National Energy and Climate Plan for 2021 – 2030)
	SK_NLS (Low-Carbon Development Strategy of the Slovak Republic until 2030 with a View to2050)
	SK_NAS (Climate Change Adaptation Strategy of the Slovak Republic)
	SK_HD_BD (Act no. 543/2002 Coll. on Nature and Landscape Protection, as amended by its implementing Decree of the Ministry of the Environment of the Slovak Republic No. 24/2003 implementing the Act.)
	SK_SUP (Act no. 405/ 2011 On Phyto-sanitary Care and on the amendment of the Act of the National Council of the Slovak Republic No. 145/1995 Coll. on Administrative Fees as amended)
	SK_FD (Act no. 7/2010 Coll. on flood protection)
	SK_WFD_GD (Act no. 364/2004 Coll. Water Act)
	SK_ND (Government Regulation no. 174/2017 Z.z. establishing sensitive areas and vulnerable areas; 215/2016 Coll. laying down details on the management of agricultural land in vulnerable areas; 136/2000 Coll. on fertilizers)

The Slovak policy packages are established and are in force. Monitoring for several policy packages was not established. Generally, monitoring of agricultural soils (Kobza *et al.* 2014) is performed in a sparse network, but covers all significant soil indicators. The aim of this monitoring network is evaluation of

the current state and development of basic soil parameters (soil contamination, acidification, salinization and sodification of soils, loss of soil organic matter and available nutrients, soil compaction and erosion, also soils used for energy purposes). Monitoring network consists of 318 monitoring sites (localities). In this respect, the current situation should be improved by the targeted increase in the number of probes.

Some management practices are mentioned in several policy packages and are therefore well covered as you can see on the Graph 1. In particular, they include: organic matter/nutrient management, crops/rotations and buffer strips/small landscape elements. Relatively less mentioned are tillage and traffic, water management.



Graph 1 Comparison of the management practices representation in Slovak policy packages

Survey´s results of the Phase 2

Sixteen stakeholders were invited (nine answered) to complete the comprehensive questionnaire by e-mail, including a press release (https://ejpsoil.eu/fileadmin/projects/ejpsoil/National_Webpages/Slovakia/ejp_soil_tlacova_sprava_01_2020.pdf) and EJP SOIL stakeholder's information document (https://ejpsoil.eu/fileadmin/projects/ejpsoil/National_Webpages/Slovakia/Informacia_pre_zainteresovane_strany_-_SK.PDF). The questionnaire was provided to them, and the required tables were adjusted. The questionnaire was translated into Slovak language.

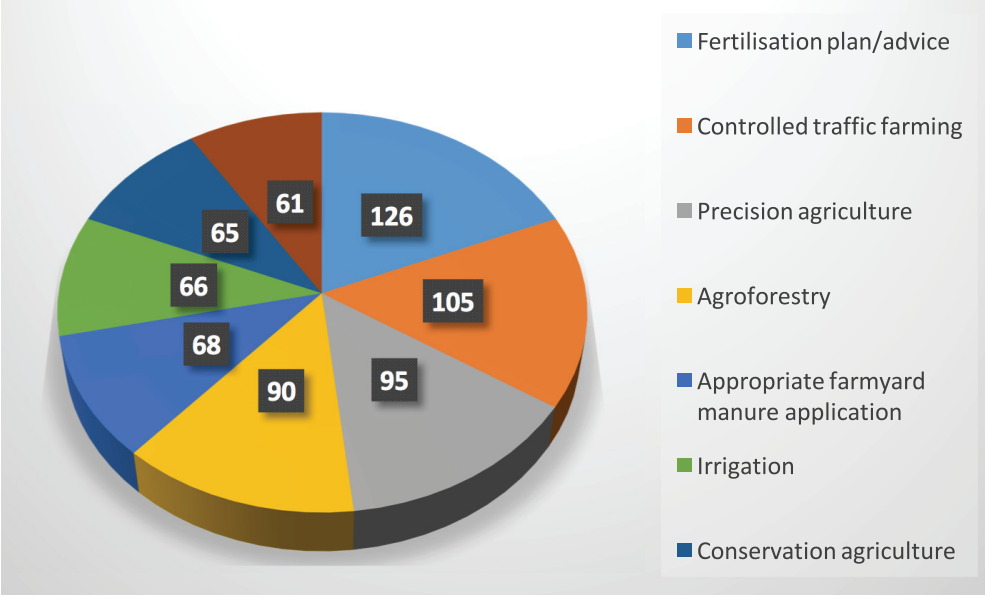
Stakeholder's representation

A total of nine completed questionnaires were received. They represented following stakeholder groups: national European soil partnership representatives (independent researcher from National Forest Centre); national policy stakeholders (Ministry of Agriculture and Rural Development of the Slovak Republic); research communities (National Forest Centre, Slovak Hydrometeorological Institute); middle & higher educational institutions or universities (two representatives per each group – Slovak University of Agriculture); farmer´s organisations (Association of Young farmers in Slovakia) and laboratories, National Science testing, verification centres *etc.* (Tab. 4). The questionnaires were send to several farmers. Although farmers are directly involved into the sustainable systems of agricultural management, no questionnaires were returned. from farmers, although the questionnaires were send to several of them. This is unfortunately any disadvantage, because farmers are directly involved into the sustainable systems of agricultural management.

Table 4
Number of participants in each stakeholder group

Stakeholder groups	Number of participants
National European soil partnership representatives	1
National policy stakeholders (local governance and policy implementing representatives)	2
Research communities	2
Research funders	0
Middle & Higher educational institutions	2
Farmer Schools	0
Farmers and demonstration farms	0
Advisors	0
Farmers‘ organisations	1
Agro-industry	
Laboratories, National science testing, Verification centres *etc.*	1
Industry, Supply & Retail	0
NGOs and community-based organizations	0
Total sum of participants	9

As it can be seen from the Graph 2, the three most promising management practices in Slovakia suggested by stakeholders are identified: fertilisation plan/advice; controlled traffic farming and precision agriculture, but also agroforestry has a high rating. Crop protection and agricultural systems are also mentioned but to a lesser extent. Summary on agricultural management systems was made by EJPSOIL report D2.6 (Munkholm, Zechmeister-Boltenstern (2021)).



Graph 2 Ranking of the most promising management practices in Slovakia

The results are in line with the survey results in most European countries, especially relating to improved fertilizer plans, precision farming, reduced tillage (Jacob *et al.* 2021). Except better water management – irrigation which achieved a higher ranking in Slovak conditions.

Between given soil challenges significant differences exist. To avoid soil erosion, to enhance soil biodiversity, optimal soil structure, avoiding N_2O, CH_4 emissions are the most covered soil challenges by management practices. To avoid soil sealing or land take is not involved into the set of management practices at all, because effective and strict legislation is needed for its elimination.

Management practices identified by stakeholders (the stakeholders had to indicate three priority management practices for each soil challenge) are quite often different in comparison to the management practices listed in the current policy. The management practices, namely controlled traffic farming, precision agriculture, as well as fertilization´s plans are barely covered by policy documents. These results confirm the fact that there is a fairly large gap between innovative technologies and their reflection in policy making which is confirmed by the stakeholders. In Slovakia the gap between policy realisation and target halfway, large or very large is dominant generally for most soil challenges, specifically for Enhance water storage capacity; Enhance soil biodiversity; Avoid soil sealing; Maintain/increase SOC; Avoiding N_2O, CH_4 emissions from soils and Avoid soil erosion. The relative assessment of the gap is more balanced for Avoid contamination and Avoid salinization soil challenges.

The dominant proportion of the current policy target futureproof or almost futureproof does not occur for soil challenges. The situation is similar to case described in answer to first question. Stakeholders consider the situation to be even less sufficient in the future.

The results do not show significant differences between different stakeholder groups. Some stakeholders assessed and responded only to some soil challenges. This is especially valid of stakeholders from National policy stakeholders (local governance and policy implementing representatives – Ministry of Agriculture) and research communities. The policy targets are usually far or very far from being futureproof.

In the EJPSOIL report (Jacob *et al.* 2021) in which the results of the questionnaires completed by stakeholders from most EJP soil partner countries were described it is confirmed that the realization´s gap for the current policy targets is halfway to large and the policy is almost too far from futureproof.

According to the Slovak stakeholders, the three most important soil challenges in the upcoming decades are (Tab. 5): to enhance water storage capacity; to avoid soil erosion and to maintain/increase SOC. Avoiding N_2O, CH_4 emissions; enhancing soil biodiversity and soil nutrient retention/use efficiency also received a relatively high rating. Soil challenges as avoiding salinization and contamination received rather a low rate (Tab. 5).

Table 5

Relative score and ranking of the soil challenges in Slovakia

Environmental zone: Continental	
	Average (sum of scores / number of stakeholders)
Enhance water storage capacity	22,78
Avoid soil erosion	16,67
Maintain/increase SOC	15,56
Enhance soil nutrient retention/use efficiency	10,56
Avoiding N_2O, CH_4 emissions	8,33
Enhance soil biodiversity	7,78
Optimal soil structure	7,22
Avoid acidification	5,56
Avoid peat degradation	2,78
Avoid soil sealing	1,67
Avoid contamination	1,67
Avoid salinisation	0,56

Similar results were observed on European Level Maintaining/increasing SOC (16,6), enhancing soil nutrient retention/use efficiency (11,3) and enhancing water storage capacity (10,1) are three most relevant soil challenge in the upcoming decades in Europe. Avoiding acidification and salinization are low ranked priorities also in other European countries (Jacob *et al.* 2021).

CONCLUSIONS

The process of identifying current policy ambitions and future soil aspirational goals is part of the national input for the Roadmap towards climate-smart sustainable agricultural soil management and research developed within the European Joint Programme EJP SOIL (Keesstra *et al.* 2021).

The number of stakeholders surveyed was significantly higher than those who completed the questionnaire. Overall, nine completed questionnaires from several Slovak stakeholder groups were provided.

In Slovakia, three environmental zones were distinguished: The Continental (prevailing zone), Pannonian and South Alpine, however need to mention that the Pannonian zone is very significant climate zone concerning to high agricultural production.

Responsible policy departments for soil protection an overall environmental protection are the Ministry of Agriculture and Rural Development, and the Ministry of Environment of the Slovak Republic. All EU policy packages relating to soil were transposed into the Slovak national legislation. In addition, in Slovakia, there is a separate legal document on protection and use of agricultural land. In most policy documents, the targets are not well quantified. Soil monitoring does exist only for several policy packages or is performed in a sparse network.

In Europe, maintaining/increasing SOC, enhancing soil nutrient retention/use efficiency and enhancing water storage capacity are the three most relevant soil challenge in the upcoming decades. Avoiding acidification and salinization are low ranked priorities. Generally, management practices identified by stakeholders in Slovakia are quite often different in comparison to the management practices listed in current policy. The gap between policy realisation and target is predominantly halfway, large or very large for most soil challenges.

The recommendations clearly arising from these findings are as follows: to increase the implementation of the objectives for most soil challenges and also to align the management practices listed in the current policy with the identified practices by stakeholders.

The three most promising management practices for the country, as suggested by the stakeholders are: fertilisation plan/advice; Controlled traffic farming and Precision agriculture, but also Agroforestry has a high rating. It is comparable with the survey results in most European countries (Jacob *et al.*, 2021), especially for improved fertilization plans, precision farming, reduced tillage and better water management. Soil challenge enhancing water storage capacity was preferred by National European soil partnership representative and by stakeholder from Farmers organisation group. The Research communities group also rated it highly, while the Middle & Higher educational institutions group allocated it less percent. Otherwise, there are differences between individual stakeholder groups per other soil challenges, but they do not seem systematic. Some soil challenges stakeholders prioritize and identify the biggest gaps in current policy documents in Slovakia.

ACKNOWLEDGEMENT

This project has received funding from the European Union's Horizon 2020 Programme EJP SOIL H2020-SFS-2018 – 2020/H2020-SFS-2019 – 1, GA 862695.

REFERENCES

Act No. 220/2004 Coll. Act (March 10, 2004) on the protection and use of agricultural land and amending Act No. 245/2003 Coll. on Integrated Pollution Prevention and Control and on the amendment of certain laws.

Act No. 330/1991 Coll. Act (July 12, 1991) on land readjustment, land ownership arrangements, land offices, land fund and land associations

Act on Fertilizers No. 136/2000 Coll. Act (March 17, 2000) on fertilizers.

Act No. 394/2015 Coll. Act (November 12, 2015) amending Act No. 136/2000 Coll. on fertilizers.

Cocklin, C., Mautner, N. & Dibden, J. (2007). Public policy, private landholders: Perspectives on policy mechanisms for sustainable land management, *Journal of Environmental Management* 85(4): 986 – 998.

Dalkir, K. (2005). The knowledge management cycle. *Knowledge management in theory and practice. Oxford: Elsevier*, pp. 25 – 46.

European Commission. (2006). *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Thematic Strategy for Soil Protection* [SEC(2006)620] [SEC(2006)1165]. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52006DC0231

FAO. (2015). *Voluntary Guidelines for Sustainable Soil Management.* Available on: http://www.fao.org/3/bl813e/bl813e.pdf.

i.-SOMPE (2021). *Maps of environmental zones in each country.* EJP SOIL, (H2020 -SFS-2018 – 2020/H2020-SFS-2019 – 1, GA 862695). Available at: https://isompe.gitlab .io/blog/help/2021/02/01/surveyhelp-enz.html

Jacob, M., Maenhout, P., Verzandvoort, S., Ruysschaert, G. (2021). *Report on identified regional, national and European aspirations on soil services and soil functions. Deliverable D2.5. Report WP2/EJP SOIL* (H2020-SFS-2018 – 2020/H2020-SFS-2019 – 1, GA 862695), 182 p. Available at: https://ejpsoil.eu/fileadmin/projects/ejpsoil/WP2/Deliverable_2.5_Report_on_identified_regional__national_and_European_aspirations_on_soil_services_and_soil_functions.pdf.

Keesstra, S.D, Munkholm. L., Cornu, S., Visser, S.M., Faber., J., Kuikman, P., Thorsoe, M., de Haan, J., Vervuurt, W., Verhagen, J., Neumann, M., Fantappie, M., van Egmond, F., Bispo. A., Wall, D., Berggreen, L., Barron, J., Gascuel, C., Granjou, C., Gerasina, R., Chenu, C. (2021). *Roadmap for the European Joint Programme SOIL. Deliverable D2.4. Report WP2/EJP SOIL* (H2020-SFS-2018 – 2020/H2020-SFS-2019 – 1, GA 862695), 103 p. Available at: https://ejpsoil.eu/fileadmin/projects/ejpsoil/WP2/Deliverable_2.4_Roadmap _for_the_European_Joint_Programme_SOIL.pdf

Kobza, J., Barančíková, G., Dodok, R., Hrivňáková, K., Kobza, J., Makovníková, J., Pálka, B., Pavlenda, P., Schlosserová, J., Styk, J., Širáň, M. (2014). *Soil monitoring of the Slovak Republic. Current state and development of monitored soil properties as a basis for their protection and further use*. (4th monitoring cycle 2007 – 2012). NPPC – SSCRI Bratislava, 2014, 252 p. ISBN 978-80-8163 -004-0.

Munkholm, L.J., Zechmeister-Boltenstern, S. (eds) (2021). *Set of reports on State of knowledge in agricultural soil management Deliverable D2.6. Report WP2/EJP SOIL* (H2020-SFS-2018 – 2020/H2020-SFS-2019 – 1, GA 862695), 110 p. Available at: https://ejpsoil.eu/fileadmin/projects/ejpsoil/WP2/Deliverable_D2.6_Set_of_reports_on_State_of_knowledge_in_agricultural_soil_management.pdf

McNeill, A., Bradley, H., Muro, M., Merriman, N., Pederson, R., Tugran, T., Lukacova, Z. (2018). Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques. *Scientific Report* No. 9, available at: www.soilcare-project.eu

Metzger, M.J. Bunce, R.G.H., Jongman, R.H.G., Mücher, C.A. and Watkins, J.W. (2005). A climatic stratification of the environment of Europe. *Global Ecology and Biogeography*, 14, pp. 549 – 563

Paustian, K., Lehmann, J., Ogle, S., Reay, D., Robertson, G. P. & Smith, P. (2016). Climate-smart soils. *Nature*, *532*(7597), 49 – 57.

Piorr, H.P. (2003). Environmental policy, agri-environmental indicators and landscape indicators. *Agriculture, Ecosystems & Environment*, *98*(1 – 3), 17 – 33.

Ruysschaert, G., Jacob, M., Munkholm, L.J, Thorsøe, M., Farina, R., Marandola. D., Di Bene, C., Piccini, Ch, Vanino, S., O'Sullivan, L., Wall, D., Keesstra. S. (2020). *Toward a roadmap for EU Agricultural Soil Management. Guidelines for the national input of work package 2 – task 2.1 – 2.2 – 2.3.*

Sviček, M., Pálka, B., Bezák, P., Hutár, V. (2019). Verifikácia satelitných snímok s vysokým rozlíšením

"HRL" trvalých trávnych porastov za referenčný rok 2015. (Verification of high resolution layer („HRL") of permanent grasslands for the reference year 2015)). *Geografická Revue.* [online]. Banská Bystrica, 2019, 15 (1), 43 – 52 [cit. 2019 – 07-18]. Available at: https://doi.org/10.24040/GR.2019.15.1.43 – 52

Sviček, M., Buchová K, Hutár, V. (2020). EJP SOIL Task 2.1: *Identifying current policy ambitions and future soil aspirational goals.* Report Slovakia. Version 4. September 2020.

Thorsøe, M.H. *et al.* (2021). *Report on the current availability and use of soil knowledge. Report WP2/EJP SOIL* (H2020-SFS-2018 – 2020/H2020-SFS-2019 – 1, GA 862695), 122p. Available at: https://ejpsoil.eu/fileadmin/projects/ejpsoil/WP2/Deliverable_2.7_Report_on_the_current_availability_and_use_of_soil_knowledge.pdf

Uebersax, J.S. (2006). Likert scales Dispelling the confusion. *Statistical Methods for Rater Agreement* website. 2006. Available at: http://john-uebersax.com/stat/likert.htm.