



DRAFT Synthesis report on soil science in European Higher Education

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Draft Synthesis report on soil science Higher Education

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Abstract

The European Joint Partnership “Towards climate smart sustainable management of agricultural soils” (EJP SOIL, <https://projects.au.dk/ejpsoil/>) is a European 5-year effort to strengthen research capacity and new knowledge on climate adaptation and mitigation for agricultural soils. This survey is supporting by providing a baseline on the current state of soil science in European Higher Education institutions (HEI). This was done through a survey to 274 HEIs in Europe. A total of 86 complete answers were received where every EJP SOIL country was represented with at least one response. Preliminary results showed that only 10% of the HEIs had a dedicated soil science department. The majority of soil science is embedded in a department where environmental sciences, agricultural sciences and earth sciences are the main academic topics. Respondents reported an increased enrolment at BSc, and no change for MSc and PhD. Mixed trends could be seen for specific countries and universities, with both increases and decreases in student enrolment. Traditional lecture based teaching dominated soil science teaching and learning activities, both at BSc and MSc levels. However, results suggested that study programs are evolving to include more generic competences as well as active learning methods (e.g. problem-based learning, case studies). Still, at BSc level the proportion of courses that did not have any computer/modelling component was about 1/3. Top 3 priorities for internationalisation were to i) attract students from abroad, ii) provide more opportunities to send students abroad and iii) develop strategic research partnerships. Finally, respondents’ perception was that job opportunities for soil science students have mainly increased in the past ten years.

Keywords: Baseline survey, Europe, tertiary education, capacity building, climate smart, agriculture

Preface

This work is part of the EJP SOIL project (Towards climate-smart sustainable management of agricultural soils) work package 5 “Education, training and capacity building”. The study was funded by EJP SOIL and the Swedish University of Agricultural Sciences (SLU), which are gratefully acknowledged. We thank the contributors to the survey.

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Abbreviations

BSc	Bachelor of Science
EJP SOIL	European Joint Programme on agricultural soil management
EC	European Comission
EU	European Union
HE	Higher Education
HEI	Higher Education Institution
ISCE	International Standard Classification of Education
MSc	Master of Science
MOOC	Massive Open Online Course
SDG	Sustainable Development Goal
WP	Work Package

1. Introduction

The European Joint Partnership “towards climate smart sustainable management of agricultural soils” (EJP SOIL) is a European 5-year effort to strengthen research capacity and new knowledge on climate adaptation and mitigation for agricultural soils. The initiative has a strong ambition to contribute to advance research capacity and research network across Europe to address climate smart sustainable agricultural soils. The WP5: Education, training and capacity building contributes towards building human and institutional capacity among young and established scientists in Europe, and strengthen institutional and individual networks for improved delivery of soil science and knowledge in line with the EJP SOIL Roadmap. In WP5 Task 5.1 the objective is to provide a synthesis on the current state of soil science in European HE. This activity will contribute to the expected impact of strengthening scientific capacities and cooperation across Europe including training of young scientists.

The specific questions that WP5 Task 5.1 explores are:

- 1) How is soil science embedded as an academic topic in HE at Bachelor (BSc), Master (MSc) and Doctoral (PhD) level currently offered in Europe
- 2) Understand the capacity in teaching and learning for delivery of soil science in HE
- 3) Elaborate the linkages of soil science HE programs to nation and international collaborative actions, as well as explore teaching content.

Soil science is, and will continue to be, highly important for a number of challenges in Europe and worldwide. It is therefore important to understand how soil science subjects are taught, what new trends that can be seen and how the academic society consider a number of issues related to courses and programs in soil science. This information will also feed into other parts of EJP SOIL.

In this report, we present the draft findings of the survey of soil science in HE in European institutions, within and beyond EJP SOIL partnership. This draft report is based on preliminary results¹. These draft results are a standalone unique baseline of soil science HE, and in addition intended to inform other EJP SOIL activities, including Task 5.2: Foresight study for soil science professional needs, Task 5.3: PhD school program, WP2: Developing a Roadmap for EU Agricultural

¹ As of 20 January 2021, not all survey responses had been submitted and a full analysis was not possible

Soil Management Research, and potentially Task 7.6 Design capacity building and contractors and Task 8.3 Support and translate.

2. Materials and Methods

The The survey instrument used to define a baseline in soils science HE in Europe has been developed to be comparable to other HE surveys related to soil science e.g. (Diochon et al., 2017, Hartemink et al., 2008). The protocol of the survey was developed through a mixed methods approach , by i) conducting a literature review, identifying HE surveys published in scientific (Hartemink et al., 2008, Diochon et al., 2017, Havlin et al., 2010) and ‘grey’ literature (EUA, 2013, EC, 2009a), in comparable natural science academic topics, and ii) in consultation with selected EJP partners and expertise in HE and Learning (pedagogics) at SLU (Sweden). The timeline of the project is presented in Figure 1.

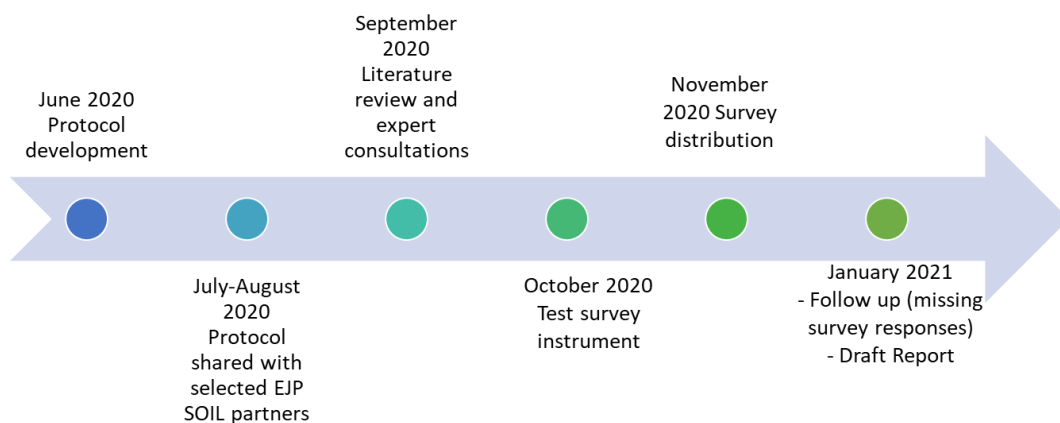


Figure 1 Timeline in brief for WP5 Task 5.1 from June 2020 until January 2021 (M12).

2.1. Survey Content

The survey consists of 7 sections: respondent and information about participating institutions/departments, teaching and research capacity, academic topics and degrees offered, student enrolment, courses and learning approaches, internationalisation and diversity, and job market for graduates. All the questions formulated in the survey are included in Appendix 1.

Soil science is relevant for many areas in society and in many academic disciplines. Traditionally it has been more common with departments, or the like, where soil science was the only topic. We were interested in finding out how common this situation is today. Whether soil science is formally embedded or not, in a broader scientific context and in a mix of subjects, may influence how education in soil science develops and what is included and not included in courses and programs, which in turn may influence future students' abilities to contribute in society and within what areas they might find jobs. We were also interested in the profile of the staff and whether the teachers have specific pedagogic training or not, within departments that offer courses and programs in soil science. We assume the latter question indicates quality and we were interested in potential correlations between the profile of staff and topics such as what is taught and how courses are organised.

Soil science in HEI is basically taught at three academic levels in Europe, bachelor level (BSc), master level (MSc, M Eng) and PhD. What does the distribution look like in this respect? Which is most common, institutions that offer all three levels, or specialised institutions that focus on e.g. BSc, or BSc and MSc? Will the highest level of offered exams influence what how soil science education is organised, or the attraction from a student perspective? Other interesting questions relate to domestic and international collaboration, in relation to the level of courses and programs offered, or potential correlations between the use of "new tools" such as MOOCs and the level of the education offered.

Today it is obvious that soil science is highly relevant for the global SDGs and for a number of important initiatives within the EU (e.g. Green Deal, Farm to Fork, CAP). Are such aspects included in today's programs and courses? Are students trained to understand broader aspects of how soil science is relevant in a societal context? And are they trained in English or in their native language? All these were questions that we aim to explore and were the basis when building the survey.

The survey was built to be comparable to other datasets, surveys and guidelines regarding HE in general and, in particular, soil science HE. The main references used for each section are presented in the following:

- Teaching and research capacity: The main reference used was the "Tertiary education statistics" from (EUROSTAT, 2020b) that present figures such as number of students and share of students to academic staff. Seeber and Lepori (2014) was also used for institutional indicators (e.g. size, research intensity, teaching intensity). Throughout the survey, the terminology that refers to the levels of education was the one presented in the "International Standard Classification of Education - ISCED 2011" (UNESCO-UIS, 2012) which was also used in statistics presented by EUROSTAT. Thus, the terms "Bachelor's or equivalent level", "Master's or equivalent level" and "Doctoral or equivalent level" were used in the survey together with "BSc", "MSc" and "PhD", respectively.

- Academic topics and degrees offered: The fields of education in question 3.2. were selected from “Fields of Education and Training 2013” (UNESCO-UIS, 2015). This typology was selected to be comparable to EU statistics regarding tertiary education (EUROSTAT, 2020b). Different options were given to the respondents to select the fields that best described the academic program of the department: environmental science, natural environments and wildlife, earth science, environmental protection technology, crop and livestock production, forestry. For each of the fields, examples of programmes and qualifications also from the UNESCO-UIS classification were given for clarification.

In addition, question 3.10 which dealt with the evolution of soil science education in terms of generic competences included (e.g. communication skills and learning to learn) and programmes for part-time students was formulated from the “Flash Eurobarometer 260 (Students and Higher Education Reform)” (EC, 2009b). This survey dealt with the students’ perception about the situation in the HE-system to be comparable to the HEIs’ perception in relation to the same issues.

- Student enrolment: Several surveys regarding student enrolment in soil science courses and programs were used as a reference and for comparative purposes (Diochon et al., 2017, Hartemink et al., 2008, Havlin et al., 2010). Particularly, question 4.4 which deals with how the number of students has changed over the last ten years (giving options such as “increased by more than 25%”, “increased by less than 25%”...) was formulated from Diochon et al. (2017) to describe the trends in student enrolment and completion in the different education levels.

- Courses and Learning approaches: The discourse on healthy soils, and the role of healthy agricultural (and other) soil resources has evolved greatly in the last five years, as expressed e.g. in the focus on soil in EU with policies and strategies such as the Green Deal and Farm to fork (EU, 2020), and the emphasis of the relevance of healthy land and soil resources. Given this, the capacity and expertise to understand and work with such issues must also be developed. In this section, the document “Education for Sustainable Development Goals – Learning objectives” (UNESCO, 2017) was used to select different learning objectives in relation to soil science (question 5.17). Misch (2011) was used for examples of different experiential learning methods (question 5.12) and Amador (2019) was used as a reference of an example in the use of problem-based learning in soil science education.

- Internationalisation and diversity: The main reference used regarding the different internationalisation related questions (6.5, 6.6 and 6.7) was the report “Internationalisation in European Higher Education: European policies, institutional strategies and EUA support” (EUA, 2013). Questions related to the share of students from abroad (questions 4.6 and 4.7) and those related to participation of men and women in tertiary education (questions 4.8, 4.9 and 4.10) could be compared to the statistics presented in EUROSTAT (2020a) and

EUROSTAT (2020b), respectively. The share of foreign academic staff (questions 6.1, 6.3 and 6.4) could be used to describe the internationalisation and diversity of the different HEIs and countries as described also in Seeber and Lepori (2014).

The Flash Eurobarometer 260 (Students and Higher Education Reform)” (EC, 2009b) could be used to compare students’ perception towards mobility (e.g. plans to study abroad and obstacles to studying abroad) and the strategies and priorities selected by HEIs for internationalisation.

- Job market for graduates: In this section several questions from the Flash Eurobarometer 260 (Students and Higher Education Reform)” (EC, 2009b) were used to be compared, in particular, questions 7.3 and 7.6. These questions deal with the HEIs’ perception on issues such as innovation and entrepreneurial mindset, job market opportunities or involvement of enterprises in curricula design and funding.

2.2. Process of survey development and distribution

The survey instrument was developed out of the feedback on the protocol and as mentioned above covers the following issues: teaching and research capacity; courses and degrees offered; student enrolment; learning and teaching approaches applied; internationalisation and diversity; and job market.

The draft survey instrument was sent out to three EJP SOIL partners (in France, Denmark and Finland), to two Directors of Studies at the Department of Soil and Environment at SLU (Sweden) and to two experts in statistics and survey instruments at SLU (Sweden). This was done to get feedback for improvement and potential additional questions. The feedback was positive and constructive and was incorporated for the final distribution. SLU has also involved all EJP SOIL partners in identifying relevant respondents for the survey, all over Europe as detailed below.

The survey was distributed in the online platform of Netigate². The survey was distributed to 248 departments at HEIs in EJP SOIL countries and to 17 departments at HEIs in European countries that are not part of the EJP SOIL program starting 20th November 2020. The key contacts at respective HEIs were selected as:

- Listed contact for EJP SOIL WP5: Education, training and capacity building
- National coordinator of EJP SOIL, invited to share key HE contacts in country.
- Open invitation on EJP SOIL website, Twitter and LinkedIn.
- Targeted invitation and follow up, in case option 1 and 2 did not generate any response for a specific country

² <https://netigate.net>

3. Results and Discussion

3.1. Survey response and geographical distribution

- A total of 86 complete answers were received. Every EJP SOIL country was represented with at least one answer. For non-EJP SOIL countries the participation was low with only 1 answer (Figure 2). In addition 26 respondents answered part of the survey.
- Usually there was one answer per HEI but in a few cases there were several answers from different departments within the same HEI.
- In average the respondents had 17 years of experience at their department.

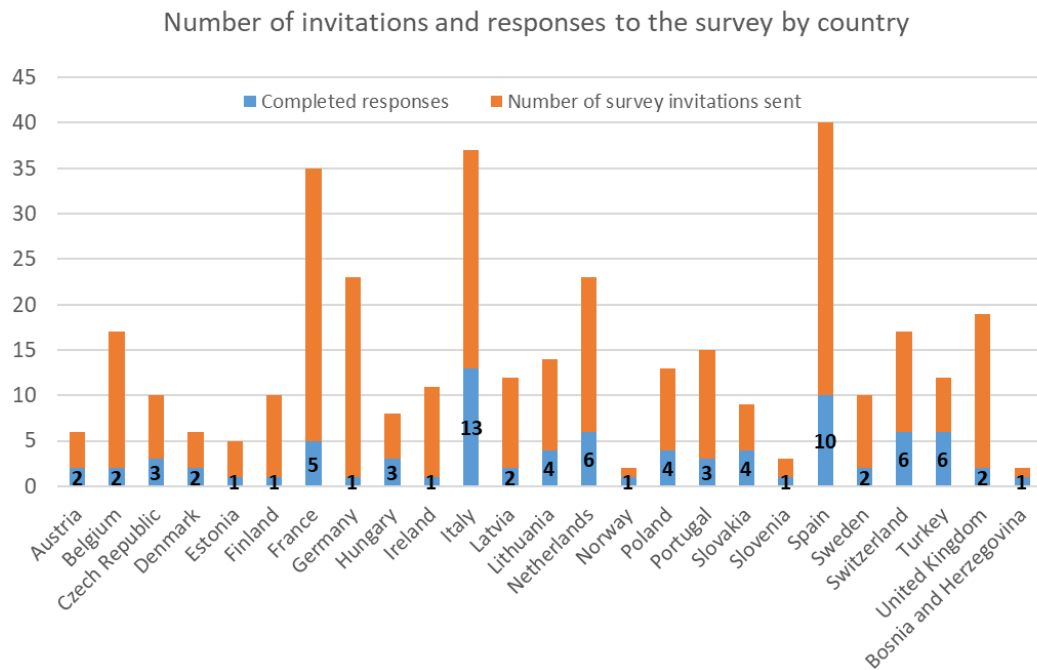


Figure 2 Number of invitations and responses received by country. Total number of invitations sent was 273.

3.2. Teaching and Research Capacity

Soil science in HEI is basically taught at three academic levels in Europe, Bachelor level (BSc), Master level (MSc) and Doctoral level (PhD). A majority the respondents were part of a HE or academic institution (92%) while a minority was part of a research institution (10%). The median size in terms of number of academic staff of the departments was 30 (mean was 60).

The proportion of the different staff categories at the departments showed that in more than approximately 40% of the cases, staff from different categories (i.e. senior, intermediate and junior) were all present in the range of 1-25%. In individual cases senior and junior staff counted for more than 75%, respectively (Figure 3). A majority of the teaching staff have taken a basic course in higher teaching and learning (in more than 60% of the cases) (Figure 4).

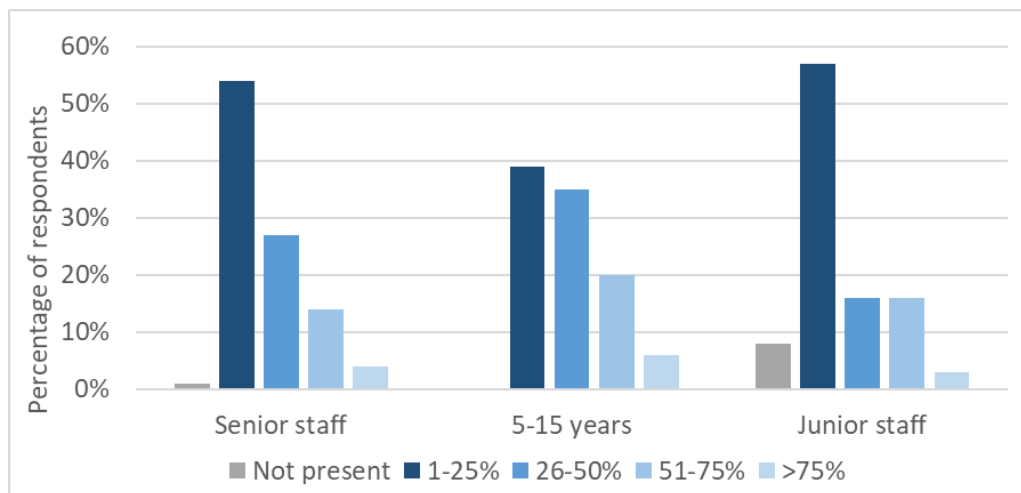


Figure 3 Proportion of different staff members per category at the departments.

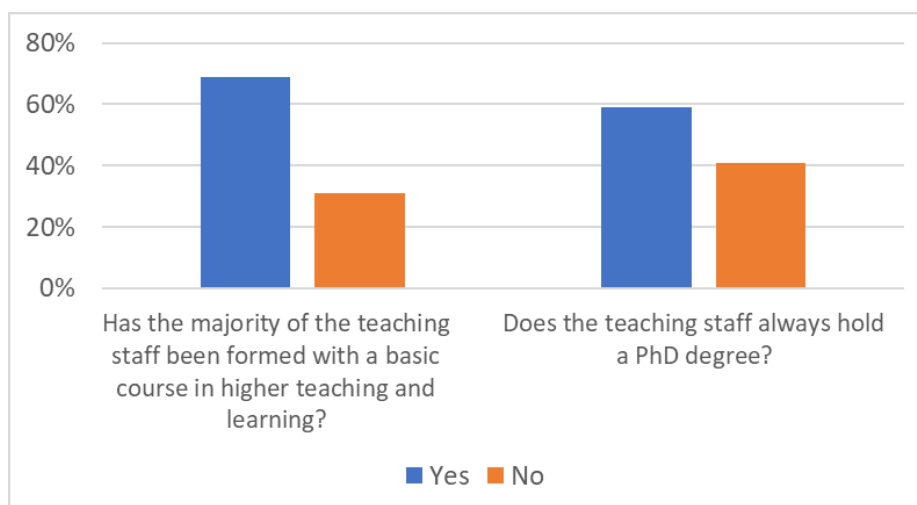


Figure 4 Formation of teaching staff at HEIs

3.3. Academic Topics and Degrees Offered in Soil Science

Preliminary findings indicated that only 10% of the respondents work at a dedicated soil science department (or a similar organisation). In 90% of the responses, soil science was instead a sub-unit of larger academic departments (Figure 5, left). About 25-30% of the respondents had soil science degrees/programs at BSc, MSc and PhD level (Figure 6), meaning that most soil science is taught under other types of exams, degrees and majors such as Agricultural Science, Environmental Science and Earth Sciences degree programs. These were the main fields that best described the academic programs at the investigated departments (Figure 5, right). In 72% of the cases the respondents selected more than one option of academic topics, suggesting that soil science was an integrated part in multiple academic disciplines and degree curricula.

Among the respondents, there were 13 departments that offered full soil science programs at all levels (i. e. BSc, MSc and PhD level). Of the 22 departments that offered full soil science programs at PhD level, only 6 did not offered full programs at BSc and/or MSc. Therefore, if there existed a soil science program at PhD level one could expect that programs at Master and Bachelor levels were also offered.

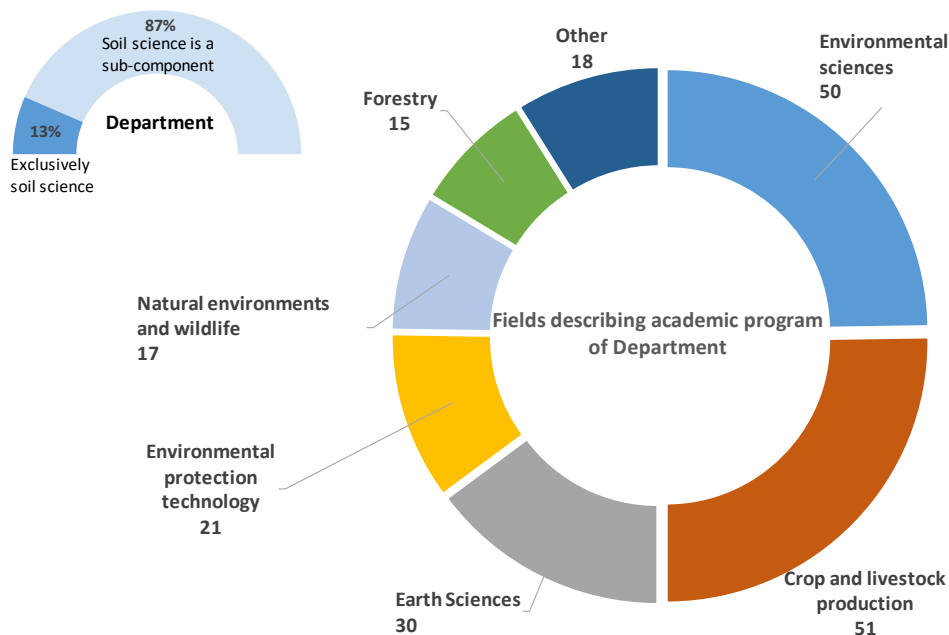


Figure 5 Main areas and academic topics that best describe the departments with soil science courses.

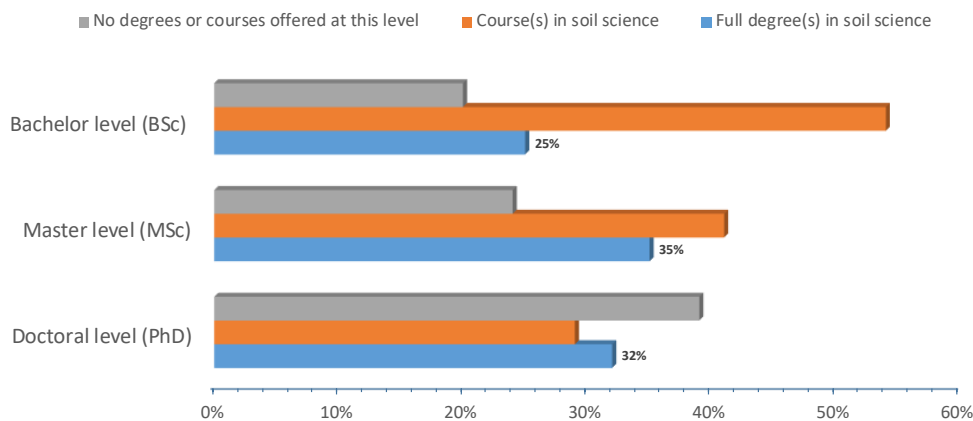


Figure 6 Proportion of soil science full programs and courses offered at the departments (N=75).

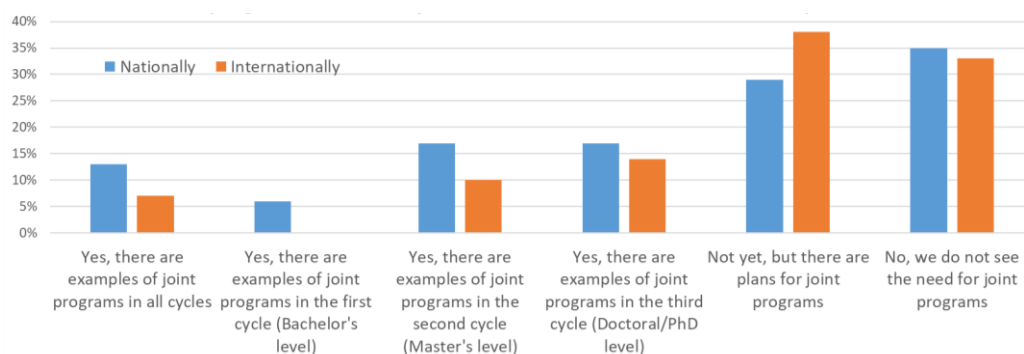


Figure 7 Joint programs with soil topic offered in collaboration with other institution in the same and in other country.

Almost 15% of the respondents indicated that they had national collaborations for example with a joint program in all education levels with another national institution. A considerable proportion had plans for joint programs both with institutions at the same country (29%)³ and almost 40% of the respondents had plans to develop international collaborations for teaching and learning (Figure 7). In other words, it was much more common with existing and/or planned collaboration, as compared to those that only organise courses and programs on their own. On the contrary, only 28% of the cases (17) the Department was involved

³ The HEIs that have plans for joint programs at the same country are from: Belgium, France, Hungary, Italy, Latvia, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain and Turkey

in a soil related Research School for Doctoral (PhD) students and consequently 72% were not involved in a Research School.

In relation to MOOCs, only a minority of the respondents (16%) offered these type of courses. An example of such a course was “Partnering for Change: Link Research to Societal Challenges”⁴ as answered by the University of Bern (Switzerland) and the course “An introduction to soils ecosystems and livelihoods in the tropics”⁵ offered by KU Leuven (Belgium) in cooperation with ISRIC – World Soil Information. One more MOOC is planned to start 2021/2022 on climate change offered by the University of Vienna. This seems to be a low figure, in times when online education increase in many different forms.

In terms of course development within soil science and development of study options, a majority of respondents (65%) stated that courses in soil science have not changed over the last 5 years. At the same time, 64% agree/strongly agree that the development of teaching and learning for lifelong learning/professionals/post degree courses have evolved and increased (Figure 8). These results therefore need more in depth analyses. The low level of renewal opens for discussions of future content in soil science courses and curricula for existing programs. Efforts within lifelong learning/professionals/post degree courses might be new initiatives.

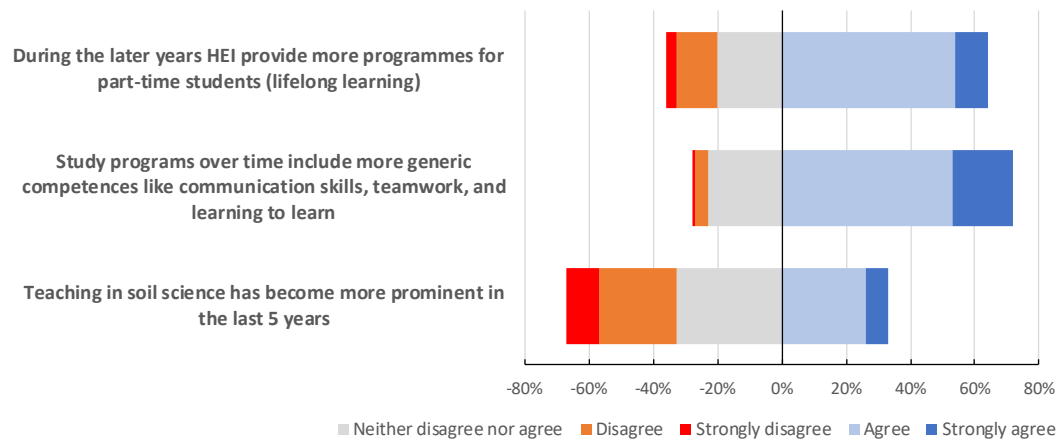


Figure 8 Evolution of different aspects in soil science education

⁴ <https://www.unige.ch/gsi/fr/formations/partnering-for-change-link-research-to-societal-challenges-mooc/>

⁵ <https://www.edx.org/course/as-above-so-below-an-introduction-to-soils-ecosity-2>

3.4. Student Enrolment

In regard to student enrolment, the respondents reported an increased enrolment at BSc with soil science topics, and no change for MSc and PhD. There seemed to be mixed trends for specific countries and universities, with both increases and decreases in student enrolment.

Of all the HEIs offering programs at BSc level a 43% reported increases in enrolment over the last ten years. In the case of students entering an MSc study program, the percentage of increased enrolment was 36%, which was almost the same as the HEIs that indicated a decrease (34%). In the case of PhD programs, a majority of HEIs (44%) indicated that the student enrolment stayed about the same (Figure 9). In comparison a study by Diochon et al. (2017), showed enrolment trends in Canada with a greater percentage (67%) of reported stable enrolment in undergraduate programs over the last 10 years (2005-2015) while 33% of institutions reported increases of less than 25%. In our case, trends were more split between either increases or decreases reported by the HEIs. Especially in the case of MSc programs where the reported increases and decreases of students entering the programs were almost the same (Figure 9). Trends of first year earth science students at 5 Dutch universities showed that a decline from the early 1990s, but stabilized since the late 1990s (and until 2005) (Hartemink et al., 2008), even if these figures are rather old now. The number of Master level students with a soil science major peaked in the mid-1990s, decreased, but then had another peak in 2004. In the same study, the number of students were also surveyed in other parts of the world. The US reported an overall decrease but with mixed trends for specific countries and universities, which is similar to the results shown here.

In our survey, decreases in student enrolment trends were reported in 10 countries for BSc programs and in 13 countries for MSc programs. As an example, in Poland and Slovakia all of the HEIs (4 in each country) reported decreases in enrolment trends. In other countries such as in Spain and France there were cases of both increases and decreases reported.

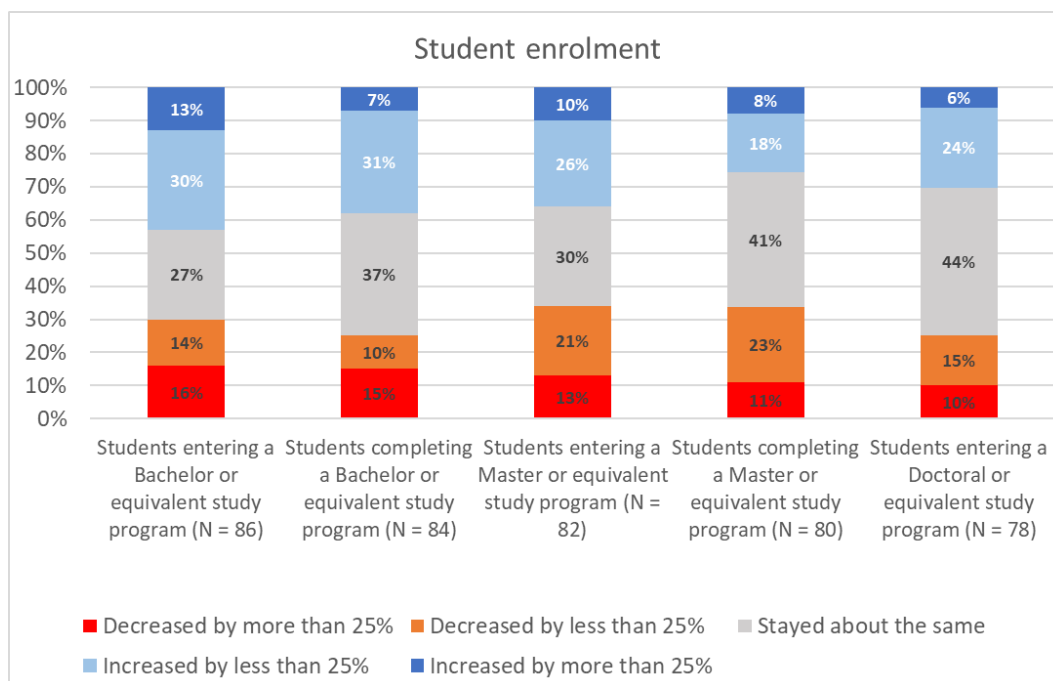


Figure 9 Student enrolment at BSc, MSc and PhD levels

3.5. Courses and Teaching and Learning Approaches

Current teaching practice is still dominated by lectures, especially at Bachelor level. However, results suggested that study programs are evolving to include more generic competences (e.g. communication skills, teamwork, and learning to learn) as well as active learning methods such as problem-based learning, field work and case studies. Still at Bachelor level the proportion of all BSc courses that did not have any computer/modelling component was considerable (about 1/3).

The survey suggested that ‘traditional lecture based’ teaching still dominates soil science teaching and learning activities across the responding institutions both at BSc and MSc levels (Figure 10). Yet it was recognized by the respondents that today’s students also need generic skills in communication, team work and learning to learn (Figure 7) to be prepared for careers related to e.g. soil management and other areas of work. However, results also showed that different ways of learning from traditional education such as problem-based learning or case studies were also being included in the courses (Figure 11). Only 14% of respondents answered that none experiential learning methods were included in soil courses. Other methods were incorporated in 2% of the cases (e.g. inverted classroom). These experiential learning methods were examples of more active ways of learning which enhance

critical thinking or problem-solving skills, which are needed to e.g. address sustainability problems (UNESCO, 2017).

In terms of other teaching elements, about 1/3 of all BSc courses did not, as noticed, have any computer/modelling component. However, the percentage increased at MSc. As reported below, the field work component was relatively high at MSc level where peer-learning, as expected, also took a larger share compared to what is the case at Bachelor level.

PERCENTAGE RANGES OF DIFFERENT TEACHING-LEARNING ELEMENTS

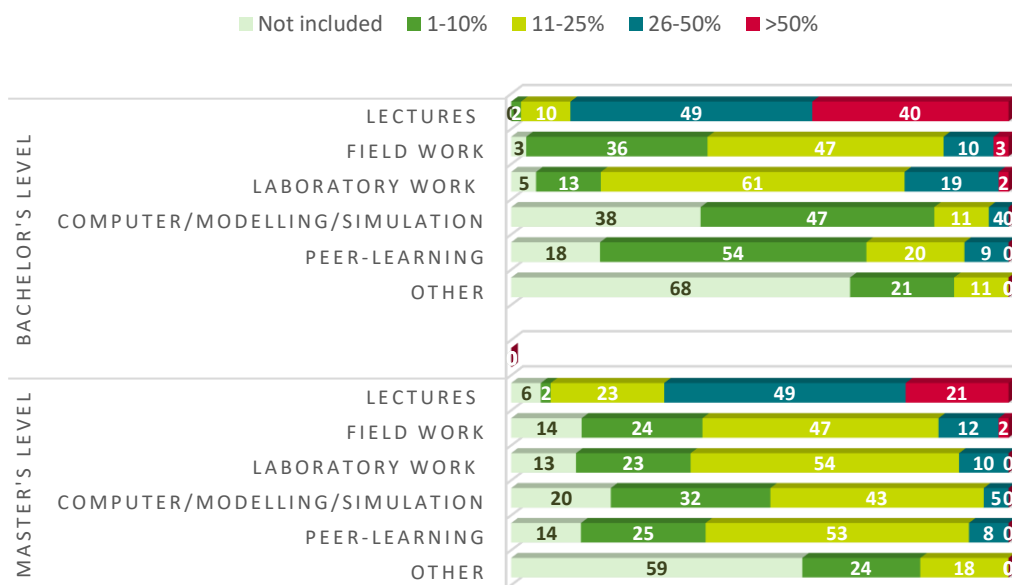


Figure 10 Proportion of different teaching-learning elements in soil courses

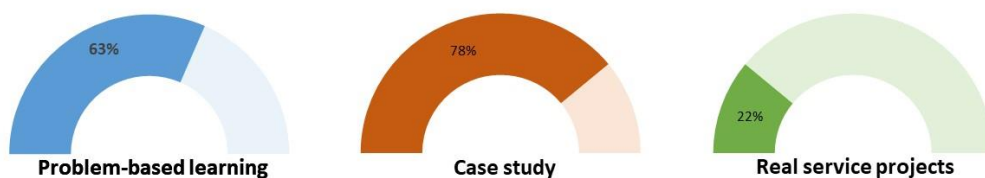


Figure 11 Experiential learning methods included in the soil courses. More than one option could be selected by the respondents.

The most common language used in courses at Bachelor's level was the local language (87%) in contrast to English (8%). The use of English as the most common

language used in teaching increased at Master’s level up to 32% versus the local language (67%) (Figure not shown in this draft report).

Preliminary results from the survey showed that different learning objectives from the SDGs related to soil (which include soil health and sustainable food production) (UNESCO, 2017) were included in a majority of the courses (70-96% depending on the learning objective) (Figure 12).

When focusing on policy topics, results showed that the CAP was included in half of studied soil courses. The EU Green Deal and EU Farm to Fork were also already being covered in some of soil courses (37% and 33%, respectively) but in a lesser extent (Figure 12) than the Water Framework Directive (WFD) which was also covered in approximately half of the soil related courses (Figure 13).

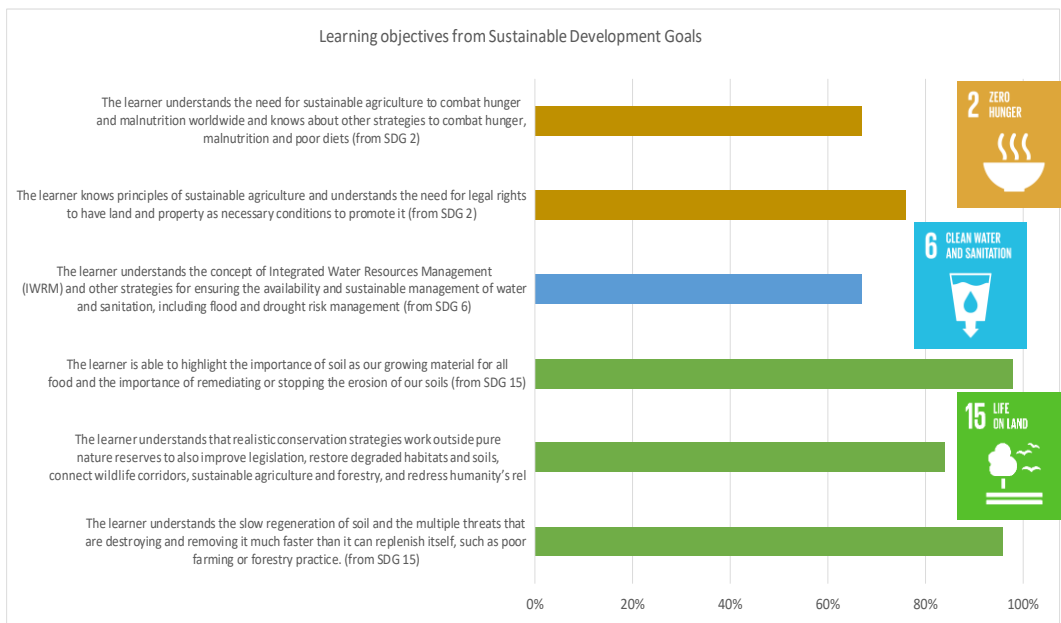


Figure 12 Percentage of different learning objectives from the Sustainable Development Goals (SDGs) included in soil courses.

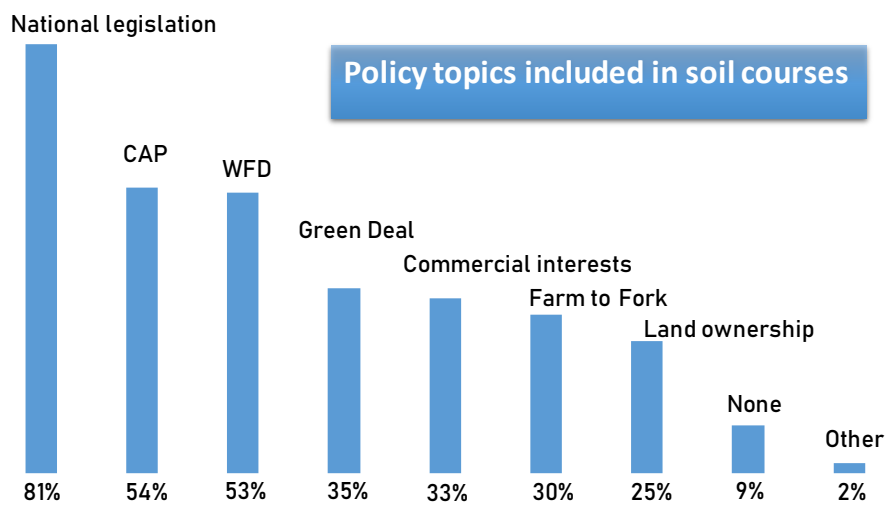


Figure 13 Proportion of policy topics included in soil courses. More than one option could be selected by the respondents.

3.6. Internationalisation and Diversity

More than 60% of respondents stated having strategies for internationalisation. The preferred mechanism was to have student exchange/offer students to study abroad. Secondly, to develop strategic research partnerships with other institutions.

A high percentage of institutions had either an existing internationalisation strategy (62%) or internationalisation was considered in other strategies (24%) (Figure 14). These numbers were very similar to the ones presented in the consultation conducted by the European University Association to HEIs in Europe (EUA, 2013).

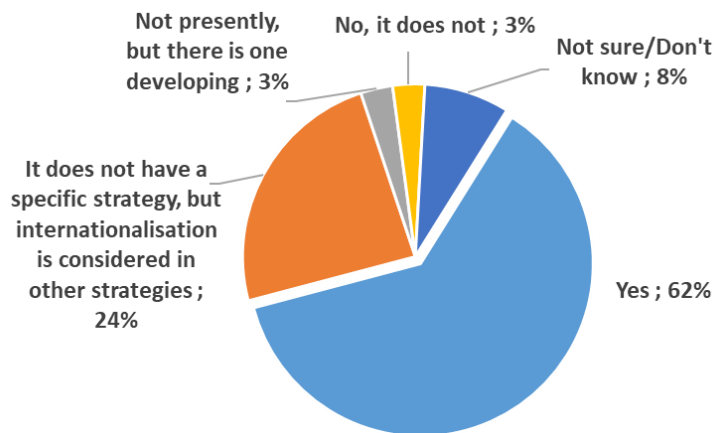


Figure 14 Existence of internationalisation strategy at institutions (N=74).

When asked about the importance of different internationalisation strategies, almost half of the respondents (45%) considered it was very important sending students abroad (Figure 15). The same percentage answered as a top priority, attracting students from abroad at all levels (Figure 16). Sending students abroad however, needs to be coupled to the language in which the courses are given in the different countries (as data showed that only 8% and 32% of the courses are given in English at BSc and MSc), since courses in English can be followed by a much larger group of students than courses in any other language. A very high percentage (80%) considered the awareness of opportunities that internationalisation offers among staff to be important or very important. In contrast, a clear minority (20%) chose “providing our staff with opportunities to go abroad” in the top 3 priorities for internationalisation. Almost 80% considered the development of institutional partnerships with new regions and countries important or very important. In terms of development of partnerships, 41% of the respondents answered that the development of research partnerships was in the top three priority as compared to 27% that for the development of partnerships regarding teaching and learning (Figure 16). Similarly to the EUA survey (EUA, 2013), a very small percentage selected the option to help build the capacity of partners in developing countries.

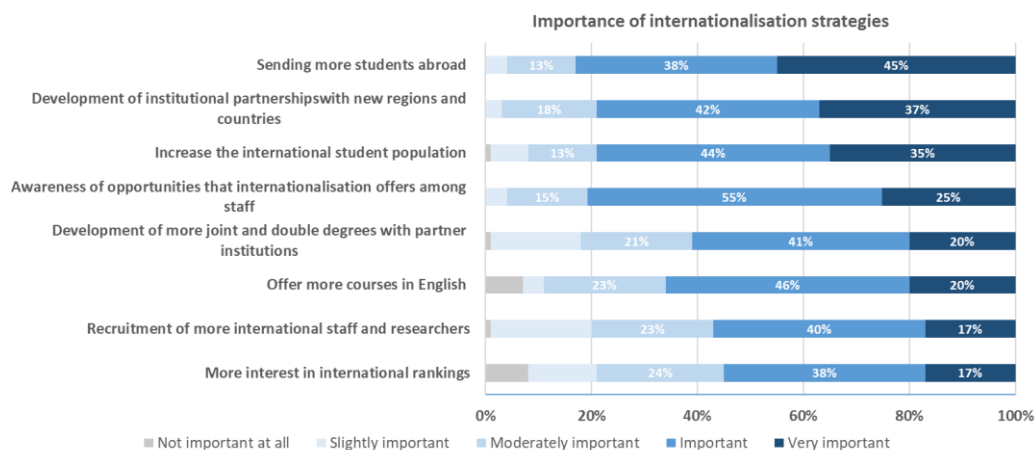


Figure 15 Importance of different internationalisation strategies viewed by respondents (N=71).



Figure 16 Top priorities for internationalisation. Respondents answered to the three top priorities

3.7. Job Market for Graduates

The overall impression was that students in soil science had a positive future, in relation to jobs. A majority of the answers indicated an increase of job opportunities in the past ten years for students. Less than 5% of students were expected to find job internationally, which indicated a low moment also within Europe.

Regarding the future for bachelor students after graduation, a majority of the answers pointed towards the continuation into Master level studies (Figure 17). Only 19% answered that most of the students will enter the labour market while a minority will continue to study at MSc level (Figure 17). A great majority of respondents reported that the students will most likely enter the national labour market (62%) versus the international (5%) and local (21%) labour markets (Figure 18).

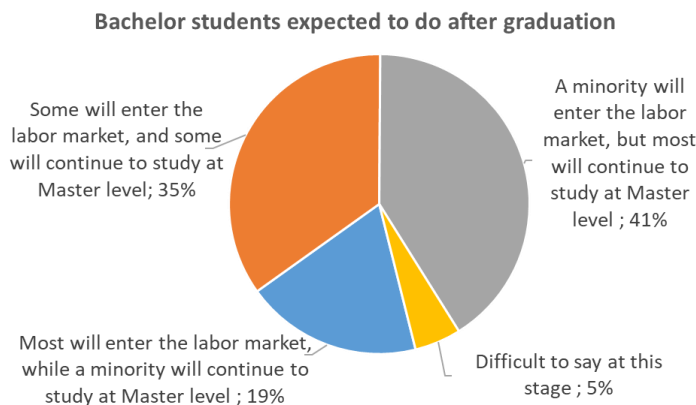


Figure 17 Bachelor students after graduation (N=78)

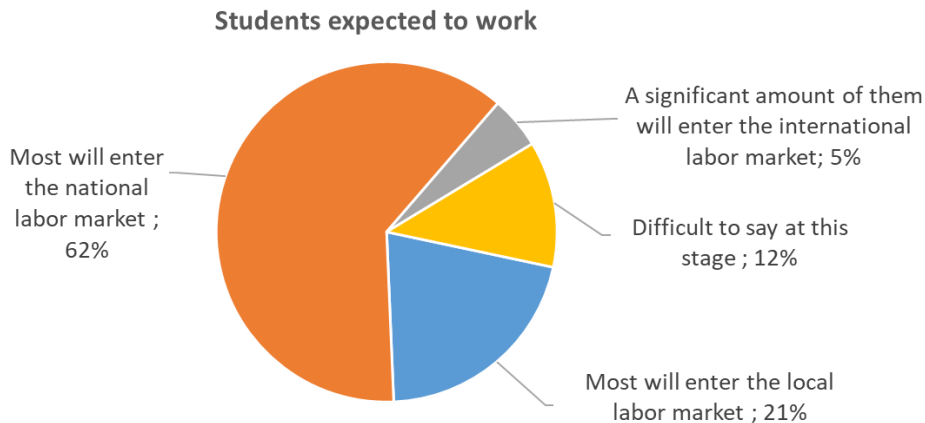


Figure 18 Geographic ambit where students are expected to work when graduating (N=76)

Given the increased importance of soil science, not the least for the development of more sustainable societies within Europe and globally, our results indicated that we already see positive trends in the labour market, but that HEIs in Europe foresee a very low in- and outflow of soil scientists in their respective labour markets. This indicates that each region or each country will rely on domestic students for the future need of soil scientists and it contrasts the rather strong position that was reported for internationalisation and its importance for education in soil science, reported above.

Regarding respondents' perceptions of job opportunities for students graduating, most of the answers indicated an increase of job opportunities in the past ten years for students (Figure 19), although almost the same percentage pointed that opportunities stayed about the same. Only an 8% indicated that job opportunities decreased in the past 10 years. The 8 respondents that indicated decreases in opportunities came from 6 different countries. In contrast, increases (either option "increased somewhat" and "increased greatly") were reported by respondents in 22 countries (out of a total of 25 countries that are represented in the survey). An increase in job availability is important to attract new students. For instance, it was indicated as a main reason to choose soil as a major by students in a survey conducted by Collins (2008).

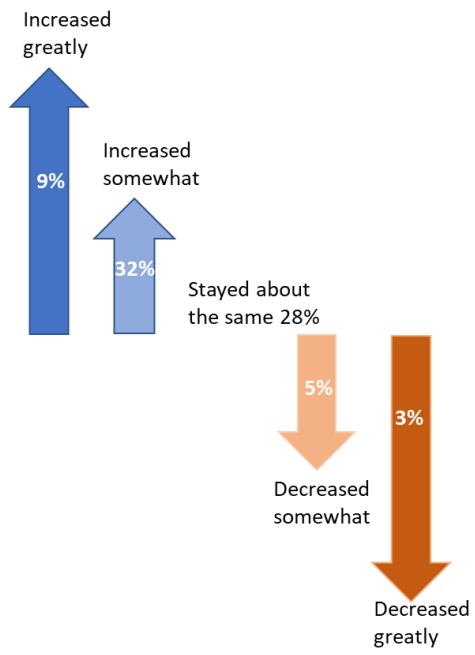


Figure 19 Job opportunities for students graduating at the department (N=75).

4. Conclusions

This preliminary report presents some of the results from a survey sent to almost 250 HEI in soil science in Europe. We still have not had time to analyse the results more than very briefly and individual responses might still come in. In the final report, later this year, we will therefore be able to give more details and a broader picture of the state of art in soil science in higher education institutions in Europe today. As discussed above we can still identify a number of interesting questions and conclusions already.

- Broad, deep and up-to-date knowledge in soil science will probably increase in importance in the future. At the same time, we have seen that two thirds of all responding departments says they have not made any changes in courses or curricula in soil science during later years. With low levels of renewal and with a clear dominance of traditional lecturing it is not obvious that HEIs in Europe will provide the skills in soil science that will be needed in the future.
- Very few respondents reported that they work with MOOCs. Even if MOOCs are one of many potential new forms of teaching, the low interest might implicate a low engagement in digitalisation and the new options within HE in Europe.
- Many respondents reported a significant interest in internationalisation issues. Most departments have or work with strategies for internationalisation and a fairly high ratio stated that they already have, or plan for, international cooperation in programs or courses in soil science. An implication of this is an increased European integration in HE in soil science. On the other hand, courses and programs are still taught in native language in many countries, both at BSc and MSc, and even at PhD level. If programs and courses are only given in the native language it significantly reduces the options for students from other countries.
- In 90% of the responses soil science was part of a sub-unit of larger academic departments being environmental science, agricultural science and earth science the main academic topics of the departments. About 25-30% of the respondents had soil science degrees/programs at BSc, MSc and PhD level.

- It is more common that courses and programs in soil science are organised in collaboration with partner, domestically or internationally, than that is organised without external partners.
- About 40% of the responding HEIs reported increases in enrolment of students at Bachelor level over the past 10 years. Enrolment at Master level showed the same percentage of reported increases than decreases. For Doctoral programs, a majority of HEIs reported that the enrolment of students stayed about the same.
- ‘Traditional lecture based’ teaching still dominates soil science teaching and learning activities across the responding institutions both at BSc and MSc levels. However, results suggested that study programs have evolved to include more generic competences (e.g. communication skills, teamwork, and learning to learn) as well as active learning methods such as problem-based learning, field work and case studies.
- Top priorities for internationalisation included both attracting students from abroad as well as providing more opportunities to send students abroad. Another top priority was related to developing strategic research partnerships.
- According to respondents’ perception, job opportunities for students have mainly increased in the past ten years. As noted, at the same time education in soil science did not show a renewal that could match the continually evolving job market, in terms of new soil courses offered or number of students and skills developed (based on a preliminary analysis).
- Future work will include a more detailed analysis of the questions presented in this draft report as well as analysis of other data (e.g. diversity and gender data) not presented here.
- Qualitative data collected in the survey will also be analysed and incorporated in to the final version of the report due on July 2021.

References

- AMADOR, J. A. 2019. Active Learning Approaches to Teaching Soil Science at the College Level. *Frontiers in Environmental Science*, 7.
- COLLINS, M. E. 2008. Where Have All the Soils Students Gone? *Journal of Natural Resources and Life Sciences Education*, 37, 117-124.
- DIOCHON, A., BASILIKO, N., KRZIC, M., YATES, T. T., OLSON, E., MASSE, J., AMIRO, B., KUMARAGAMAGE, D. & YANG, X. M. 2017. Profiling undergraduate soil science education in Canada: Status and projected trends. *Canadian Journal of Soil Science*, 97, 122-132.
- EC 2009a. European Commission Students and Higher Education Reform: Survey among students in higher education institutions, in the EU Member States, Croatia, Iceland, Norway and Turkey. Special Target Survey, Analytical Report. Brussels.
- EC 2009b. Flash Eurobarometer 260(Students and Higher Education Reform). In: THE GALLUP ORGANISATION, B. G. D. A., COLOGNE (ed.) Data file Version 1.0.0 ed. Brussels.
- EU 2020. Farm to Fork Strategy - For a fair, healthy and environmentally-friendly food system. Brussels.
- EUA 2013. Internationalisation in European higher education: European policies, institutional strategies and EUA support. Brussels, Belgium.
- EUROSTAT. 2020a. *Learning mobility statistics* [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php/Learning_mobility_statistics#Number_and_share_of_students_from_abroad [Accessed 23 October 2020 2020].
- EUROSTAT. 2020b. *Tertiary education statistics* [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics [Accessed 22 October 2020 2020].
- HARTEMINK, A. E., MCBRATNEY, A. & MINASNY, B. 2008. Trends in soil science education: Looking beyond the number of students. *Journal of Soil and Water Conservation*, 63, 76A.
- HAVLIN, J., BALSTER, N., CHAPMAN, S., FERRIS, D., THOMPSON, T. & SMITH, T. 2010. Trends in Soil Science Education and Employment. *Soil Science Society of America Journal*, 74, 1429-1432.
- MISCH, D. M. 2011. McKeachie's Teaching Tips: Strategies, Research, and Theory for College and University Teachers. *Journal of the American Academy of Child and Adolescent Psychiatry*, 50, 197-199.
- SEEBER, M. & LEPORI, B. 2014. The Internationalization of European Higher Education Institutions In: BONACCORSI, A. (ed.) *Knowledge, Diversity and Performance in European Higher Education*. United Kingdom of Great Britain and Northern Ireland: Edward Elgar Publishing Inc.

- UNESCO-UIS 2012. *International Standard Classification of Education ISCED 2011*, Montreal, Canada, UNESCO Institute for Statistics.
- UNESCO-UIS 2015. *International Standard Classification of Education: Fields of Education and Training 2013 (ISCED-F 2013) – Detailed Field Descriptions*. Montreal, Canada.
- UNESCO 2017. *Education for Sustainable Development Goals: learning objectives*, France, United Nations.

Appendix 1

Survey content:

1. Respondent And Institutional Information

Please fill in the following background reference information from your home Higher Education Institution

1.1. Please select from the list the country of your Higher Education Institution

Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Russia, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom.

1.2. Please give the name of your Higher Education Institution

1.3. Please give the name of department/section/sub unit within organization with relevance to soil science

1.4. Is your organization primarily (select one option)

Higher education or academic/learning institution (e.g. university)

Research institution (public or private)

Other (please state): _____

1.5. Please indicate what is your role at the department

1.6. Please indicate the years of employment (in any capacity) at the department

2. Teaching & Research Capacity

This section includes questions regarding the composition and characteristics of your department

2.1. Please indicate approximately the total number of academic staff at the department

2.2. Please provide an approximate percentage of the following staff members per category indicated below

Not present 1-25% 26-50% 51-75% >75%

Senior staff. Examples of senior staff categories: Professor, Principal/senior researchers/investigator, Research leader/manager

Number of staff with approximately 5-15 years of expertise. Examples in this category: Associate professor, Lecturer

Number of staff with approximately <5 years of expertise. Examples from this category: Junior researcher, Junior lecturer, Postdoc

2.3. Does the teaching staff always hold a PhD degree?

Yes

No, please indicate the approximate percentage (%) that does not hold a PhD

2.4. Has the majority of the teaching staff been formed with a basic course in higher teaching and learning?

Yes No

3. Academic Topics and Degrees Offered

You will now find questions regarding the academic fields and the degrees offered by your department

3.1. Is your department exclusively soil science, or is soil science a sub-component of a larger department?

Exclusively soil science

Soil science is a sub-component (please indicate which is/are the other sub-component(s) of the department):

3.2. Which of the following fields best describes the academic program of your department (more than one option may be selected)

Note: The fields are selected from the International Standard Classification of Education

Environmental Sciences (including programmes such as Ecology, Environmental Science)

Natural environments and wildlife (including programmes such as National parks and wildlife management, Nature conservation, Wildlife)

Earth Sciences (including programmes such as Earth science, Geography (physical), Geology)

Environmental protection technology (including programmes such as Ecological technology, Environmental engineering, Industrial discharge control, Water pollution control)

Crop and livestock production (including programmes such as Agricultural sciences, Agronomy and crop science, Crop growing, Soil science)

Forestry (including programmes such as Forest keeping, Forest product techniques, Logging tree felling)

Other, please specify the field: _____

3.3. Please select if your department offers full degrees in soil science or courses

Full degree(s) Course(s) Non applicable (e.g. no degrees or courses offered at this level)

At Bachelor level (BSc) or equivalent

At Master level (MSc) or equivalent

At Doctoral (PhD) level or equivalent

3.4. Does your department offer joint programs with soil topic with other institutions in your country?

Yes, there are examples of joint programs in all cycles

Yes, there are examples of joint programs in the first cycle (Bachelor's level)

Yes, there are examples of joint programs in the second cycle (Master's level)

Yes, there are examples of joint programs in the third cycle (Doctoral, PhD level)

Not yet, but there are plans for joint programs

No, we do not see the need for joint programs

3.5. Could you please provide the name(s) of the joint program(s) in your country

3.6. Does your department offer joint programs with soil topic with other institutions in another country?

Yes, there are examples of joint programs in all cycles

Yes, there are examples of joint programs in the first cycle (Bachelor's level)

Yes, there are examples of joint programs in the second cycle (Master's level)

Yes, there are examples of joint programs in the third cycle (Doctoral, PhD level)

Not yet, but there are plans for joint programs

No, we do not see the need for joint programs

3.7. Could you please provide the name(s) of the joint program(s) with other institutions in another country

3.8. If you wish, you can comment any general changes in curricula for programs/change in content over the last 10 years

3.9. Does your department offer any MOOCs (Massive Open Online Courses)?

No

Yes, please provide name of the course(s)

3.10. How much would you agree or disagree with the following statements?

Strongly disagree, Disagree, Neither disagree nor agree, Agree, Strongly agree

Teaching in soil science has become more prominent in the last 5 years

Study programmes over time include more generic competences like communication skills, teamwork, and learning to learn (acquire learning skills for later life)

During the later years Higher Education Institutions provide more programmes for part-time students (lifelong learning)

4. Student Enrollment

In this section you will find questions regarding the number of students at Bachelor's, Master's and Doctoral (PhD) level

4.1. Please indicate the approximate number of students at Bachelor's level or equivalent in your department in the academic year 2019/2020

4.2. Please indicate the approximate number of students at Master's level or equivalent in your department in the academic year 2019/2020

4.3. Please indicate the approximate number of students at Doctoral (PhD) level or equivalent in your department in the academic year 2019/2020

4.4. Please indicate how has the number of students changed over the last ten years (2010-2020) for the different options below

Increased by more than 25%, Increased by less than 25%, Stayed about the same, Decreased by less than 25%, Decreased by more than 25%

Students entering a Bachelor or equivalent study program

Students completing a Bachelor's or equivalent study program
Students entering a Master's or equivalent study program
Students completing a Master's or equivalent study program
Students entering a Doctoral or equivalent program

4.5. What do you see as the main reason(s) for projected changes in student enrollment?

4.6. Please indicate the approximate total joint number of foreign Bachelor and Master students at your department

4.8. Please indicate what is the approximate percentage (%) of women at Bachelor's level or equivalent

4.9. Please indicate what is the approximate percentage (%) of women at Master's level or equivalent

4.10. Please indicate what is the approximate percentage (%) of women at Doctoral level or equivalent

5. Courses and Learning Approaches

This section deals with courses offered by your department (number of courses, teaching/learning elements and other content,...)

5.1. How many courses with soil topic is your department responsible for at Bachelor's level or equivalent?

5.2. How many credits (ECTS) with soil topic is your department responsible for at Bachelor's level or equivalent?

5.3. How many courses with soil topic is your department responsible for at Master's level or equivalent?

5.4. How many credits (ECTS) with soil topic is your department responsible for at Master's level or equivalent?

5.5. How many courses with soil topic is your department responsible for at Doctoral (PhD) level or equivalent?

5.6. How many credits (ECTS) with soil topic is your department responsible for at Doctoral (PhD) level or equivalent?

5.7. Please give the name of the main soil courses (maximum 3) that your department offers including the level (Bachelor, Master, Doctoral/PhD). If possible please give the webpage link to the course/course plan

5.8. Please indicate the percentage (%) of the different teaching-learning elements that are used in the main

courses you have selected at Bachelor's level.

not included 1-10% 11-25% 26-50% >50%

Lectures

Field work

Laboratory work

Computer/modelling/simulation
(including GIS-RS and other big data)

Peer-learning (e.g.
group/project work)

Other

5.9. Please indicate the percentage (%) of the different teaching-learning elements used in the main courses you have selected at Master's level.

not included 1-10% 11-25% 26-50% >50%

Lectures

Field work

Laboratory work

Computer/modelling/simulation
(including GIS-RS and other big data)

Peer-learning (e.g.
group/project work)

Other

5.10. Have new soil science courses been added to your department's core curriculum within the past five years?

No

Yes, please specify the name(s) of the new courses

5.11. Please indicate the most common language used in courses at each of the following levels

Local English

Other non-local
language

Non applicable (e.g.
no courses offered at
such level)

Bachelor's level or
equivalent

Master's level or
equivalent

Doctoral level or
equivalent

5.12. Does any of the soil courses incorporates experiential learning methods such as (more than one option may

be selected):

Problem-based learning

Case study

Real service projects

Other, please specify: _____

5.13. Is your department involved in a soil related Research School for Doctoral (PhD) students?

No

Yes, please specify name: _____

5.14. Would you like to add if there is something that you would like to implement in the soil courses but are not able to do it?

5.15. In the case that you would like to implement something in the soil courses what do you consider to be the main reason for not being able to do it?

Lack of time to plan

Constraint by the study plans

Lack of resources

Lack of support

Other, please specify if possible _____

5.16. Would you like to add anything in relation to teaching and learning methodologies you are currently developing in soil science?

5.17. Please indicate if the following learning objectives from the Sustainable Development Goals (SDG) are included in your soil courses

Yes No

The learner understands the slow regeneration of soil and the multiple threats that are destroying and removing it much faster than it can replenish itself, such as poor farming or forestry practice. (from SDG 15)

The learner understands that realistic conservation strategies work outside pure nature reserves to also improve legislation, restore degraded habitats and soils, connect wildlife corridors, sustainable agriculture and forestry, and redress humanity's relationship to wildlife (from SDG 15)

The learner is able to highlight the importance of soil as our growing material for all food and the importance of remediating or stopping the erosion of our soils (from SDG 15)

The learner knows principles of sustainable agriculture and understands the need for legal rights to have land and property as necessary conditions to promote it (from SDG 2)

The learner understands the need for sustainable agriculture to combat hunger and malnutrition worldwide and knows about other strategies to combat hunger, malnutrition and poor diets (from SDG 2)

The learner understands the concept of Integrated Water Resources Management (IWRM) and other strategies for ensuring the availability and sustainable management of water and sanitation, including flood and drought risk management (from SDG 6)

5.18. Is any of the following topics related to policy covered in the soil courses (more than one option may be selected):

Common Agricultural Policy (CAP)

EU Green Deal

EU Farm to Fork

EU Water Framework Directive

National legislation and regulations of importance for soil

Commercial interests of importance for soil science matters

Land ownership and related regulations

Other, please specify _____

6. Internationalisation and Diversity

In this section you will find questions regarding the international dimension contributing to the education at your department

6.1. Please indicate the total number of foreign academic staff at your department

6.2. Please indicate the number of international recruitment (academic staff) the department has done in the last 5 years

6.3. Please indicate the approximate percentage (%) of women in your department (of the academic staff)

6.4. Please indicate the approximate % of women with a Professor position in your department

6.5. Does your Higher Education Institution have an internationalisation strategy?

Yes

It does not have a specific strategy, but internationalisation is considered in other strategies

Not presently, but there is one developing

No, it does not

Not sure/Don't know

6.6. According to you, how important is it to develop each of the following strategies in higher education?

Not important at all Slightly important Moderately important Important Very important

Development of institutional partnerships with new regions and countries

Sending more students abroad

Increase the international student population

Awareness of opportunities that internationalization offers among staff

Offer more courses in English

Development of more joint and double degrees with partner institutions

More interest in international rankings

Recruitment of more international staff and researchers

6.7. Please select the top three priorities for the internationalisation of your department

Attracting students from abroad at all levels

Internationalisation of learning and teaching

Providing our students with more opportunities to have a learning experience abroad

Developing strategic research partnerships with other institutions

Attracting graduate students from abroad

Creating an international environment for our students / "internationalisation at home"

Developing strategic partnerships with other institutions regarding teaching and learning

Improving our position in national and international rankings

Attracting researchers and staff from abroad

Helping to build the capacity of partners in developing regions

Providing our staff with opportunities to go abroad

7. Job Market for Graduates

This last section deals with questions regarding job opportunities for students

7.1. What do you expect your students to do after the Bachelor's level education?

Most will enter the labor market, while a minority will continue to study at Master level

Some will enter the labor market, and some will continue to study at Master level

A minority will enter the labor market, but most will continue to study at Master level

Difficult to say at this stage

7.2. Where do you expect your students will work after exam(s)?

Most will enter the local labor market

Most will enter the national labor market

A significant amount of them will enter the international labor market

Difficult to say at this stage

7.3. In your opinion, in which sector do you think your students will work after exam(s). Please rank the following

in order of importance (where 1 is the highest important and 6 the least important)?

1 2 3 4 5 6

Industry
Public
service/government
Education and
training
Agriculture/agro
industry
Consultancy
Research

7.4. In your opinion, how have job opportunities in soil science for students graduating from your department changed over the past ten years?

Increased greatly
Increased somewhat
Stayed about the same
Decreased somewhat
Decreased greatly

7.5. What would you consider to be the main reason for the change in job opportunities?

7.6. How much would you agree or disagree with the following statements?

Not important at all important, slightly important, moderately important, very Important

Higher Education Institutions (HEIs) should foster innovation and an entrepreneurial mindset among students and staff

There should be a possibility to undertake work placements in private enterprises as part of the study programme

HEIs should provide tailor-made study programmes for enterprises to help upgrade their work force

Enterprises should be more involved in higher education management, curricula design and funding

7.7. Please indicate if your department or your higher education institute offer continuing vocational education and training in a topic related to soil science

No
Yes