



FUTURE  
ONE HEALTH

The background of the cover is a composite image. It features a glowing blue globe with lightning bolts striking across it, set against a dark green background of trees and foliage. In the foreground, a hand holds a magnifying glass over a small green seedling growing in a pot of soil. The entire scene is framed by a circular, futuristic-looking interface with a grid and radial lines. A bright green diagonal stripe runs across the bottom of the image.

# One Health and the Environment at SLU: Current Status and Opportunities

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Amrei Binzer-Panchal, Anna Székely, Erik Bongcam-Rudloff, Maja Malmberg and Stefan Bertilsson  
SLU Future One Health reports | Report number 4 | 2025

**SLU Future One Health – a strategic initiative for tomorrow's complex challenges**

**SLU Future One Health is a strategic platform that stimulates interdisciplinary research, education, and collaboration, promoting the health and welfare of animals and humans within sustainable ecosystems. This initiative supports SLU's vision of playing a key role in developing sustainable living through science and education, advancing the university's efforts towards a sustainable society.**

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**One Health and the Environment at SLU: Current Status and Opportunities**

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## **Background**

This report\* was initiated and funded through a call launched in 2024 by SLU Future One Health for researchers to write reports on One Health and the environment. As the environmental aspect of One Health is more recent, and less specified, than human/animal health, there was a need to concretise SLU's focus and work within this field. Two reports (\*\*\*) were written on previous and current SLU research in environmental issues linked to One Health, and future perspectives of this research (both within SLU and on a global scale). The aim of these reports are to identify gaps, challenges, and opportunities for enhancing SLU's contribution to the environmental parts of One Health.

\* SLU Future One Health reports, report number 4

\*\* SLU Future One Health reports, report number 3

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# Summary

## Executive Summary

This report explores the development and integration of the **environmental pillar of One Health** at SLU. Despite SLU's strong expertise in environmental and ecological sciences, its One Health activities have traditionally focused on veterinary sciences, with limited emphasis on environmental health. Globally, the importance of environmental health within One Health frameworks is increasing, driven by challenges such as antimicrobial resistance (AMR), biodiversity loss, and the impacts of climate change and pollution.

## Key Findings

- **Education:** While SLU's programs address environmental topics like sustainable agriculture and forestry, explicit links to One Health remain limited. Only one program explicitly identifies as One Health-related.
- **Research:** Many researchers work on environmental health topics but often do not explicitly connect their work to One Health, highlighting an opportunity for better alignment.
- **Collaboration:** Few centers explicitly identify with One Health, though many have the potential to integrate its principles through existing research and partnerships.

## Recommendations

1. **Enhance Awareness:** Raise awareness of the One Health framework across SLU faculties through targeted outreach and educational initiatives towards lesser represented areas.
2. **Integrate into Education:** Develop interdisciplinary courses and programs that explicitly promote the incorporation of environmental sciences into the One Health framework.
3. **Foster Collaboration:** Strengthen connections between veterinary, plant, and environmental sciences, using existing platforms to facilitate transdisciplinary research.
4. **Aid Funding Opportunities:** Advocate for large-scale funding to support ambitious, integrated projects addressing One Health challenges.

By addressing these gaps and leveraging its strengths, SLU can position itself as a global leader in advancing the environmental dimension of One Health, contributing innovative solutions to critical global health and sustainability challenges.

# Introduction

The One Health concept, originally rooted in the **"One Medicine" framework** (Schwabe, 1984), began as an interdisciplinary approach focusing primarily on the interconnected health of humans and animals. Its early development, marked by the landmark 2004 symposium organized by the Wildlife Conservation Society, established the **Manhattan Principles**, which highlighted the critical role of ecosystems and biodiversity in disease prevention. While the environmental perspective was implicitly included, **the initial focus remained on zoonotic disease transmission and the interaction between humans and animals**. Subsequent reviews, such as that by Destoumieux-Garzón et al. (2018), noted that **the role of ecosystems in One Health often remains underexplored**, typically reduced to the backdrop for transmission rather than an integral component of health frameworks.

This historical trajectory mirrors the development of One Health activities at the Swedish University of Agricultural Sciences (SLU). **Despite SLU's strong foundation in environmental and ecological sciences, its One Health initiatives have primarily focused on the original concept, emphasizing the interconnectedness between human and veterinary health, without fully embracing the broader scope including the environmental perspective.** This report explores the development and current status of the environmental pillar in the global One Health scene, whether the environmental perspective has indeed been less emphasized at SLU, examines the current directions where SLU could play a leading role in advancing the environmental dimension of One Health, and assesses the strategic value of engaging with emerging global trends in this area. By doing so, we aim to illuminate opportunities for SLU to leverage its strengths and position itself as a key actor in integrating ecological, evolutionary, and environmental sciences into the One Health framework.

## The Environmental Pillar of One Health:

### Evolution of the Concept

The environmental pillar of One Health has evolved significantly from its early, implicit inclusion to becoming a more explicit focus in recent years. Initially, the One Health concept as derived from the "One Medicine" framework (Schwabe, 1984) primarily emphasized the interconnections between human and animal health (Figure 1, King 2021). This foundation prioritized combating zoonotic diseases through the collaboration of medical and veterinary sciences. The 2004 Manhattan Principles of One Health, acknowledged the critical role of ecosystems and biodiversity in disease prevention and control.

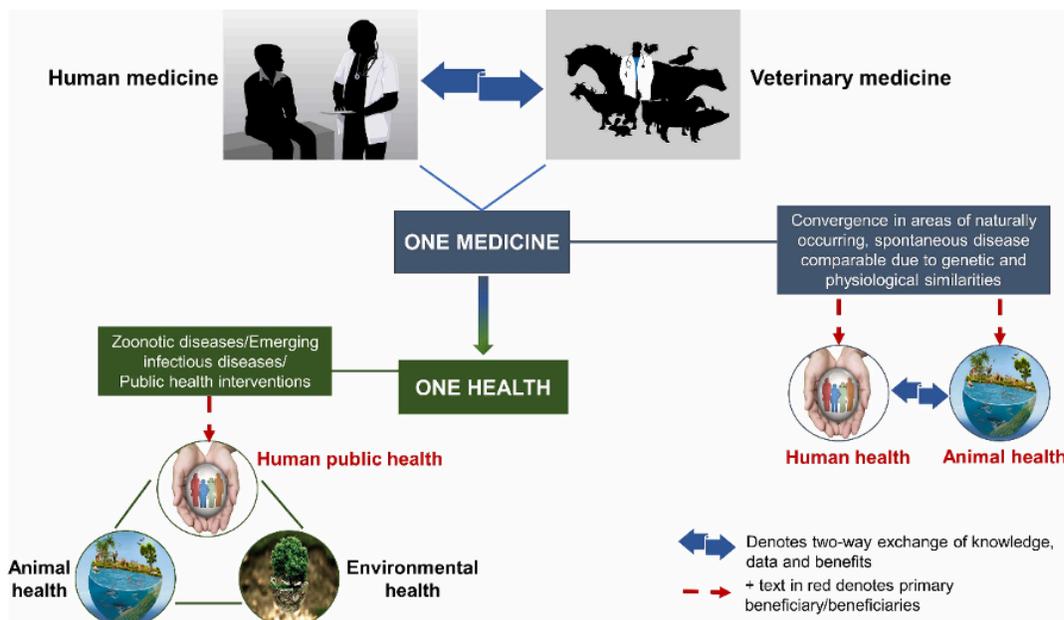


Figure 1: The evolution of One Health according to King 2021.

However, these environmental considerations were largely framed in terms of their role in zoonotic disease emergence ([One World, One Health, 2004](#)). Early activities within One Health often relegated broader environmental issues to a secondary role, treating them as a passive backdrop for health interactions rather than recognizing them as an integral and active component of the One Health framework. In such studies, the environment is only assessed to explore the environmental conditions that facilitate the zoonotic spillover (Figure 2, Bonilla-Aldana et al., 2020.)

A decade later, Destoumieux-Garzón et al. (2018) critically reviewed the status of One Health and highlighted its limited incorporation of ecosystems beyond their function as transmission sites. They observed that while environmental factors were often acknowledged, they were often mentioned only superficially, typically as the stage for disease transmission, without considering their dynamic roles in the ecology of health. Key challenges like changes in ecosystems, biodiversity, and habitat structure remained underrepresented, limiting One Health’s capacity to address complex global health issues effectively.

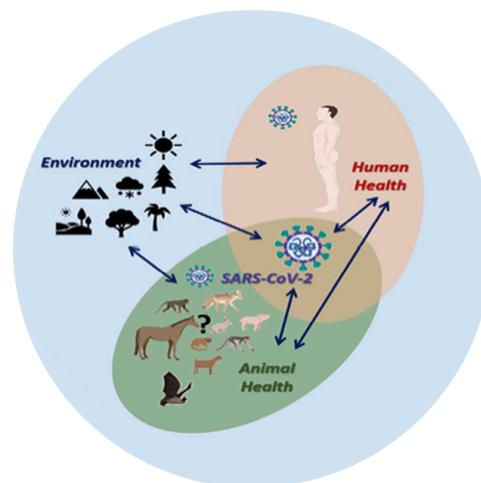


Figure 2: The environment as a backdrop in the One Health concept of probable zoonotic spillover of SARS-CoV-2 according to Bonilla-Aldana et al., 2020.

## Key Environmental Dimensions in One Health

Destoumieux-Garzón et al. (2018) highlighted key environmental dimensions within One Health that hold significant potential to enhance the environmental focus and help to fully realize the capabilities of the One Health framework:

### 1. Ecological Resilience and Biodiversity

Ecological resilience, defined as the ability of an ecosystem to absorb disturbances while maintaining its functions, structure, and adaptability, plays a vital role in health outcomes. Resilient ecosystems are better equipped to regulate disease dynamics and prevent the emergence of health crises. For example, maintaining biodiversity may enhance the ability of ecosystems to buffer against the spread of infectious diseases by promoting predation, competition, and host-symbiont interactions. Diverse ecosystems can also reduce disease transmission through mechanisms such as dilution effects, where a greater variety of hosts reduces the likelihood of pathogens finding susceptible hosts. These crucial aspects of the ecosystem have been typically underrepresented in One Health initiatives, which tend to focus narrowly on the host-pathogen interface without considering the broader ecosystem dynamics.

### 2. Nature-Based Solutions

Nature-based solutions—eco-inspired strategies that harness ecosystem services to tackle a range of challenges—hold significant promise for integration into the One Health framework. These approaches include innovative methods to combat vector-borne diseases through microbial symbiosis, phage therapy, or the development of antimicrobial peptides derived from natural processes. As the threat of antibiotic resistance continues to escalate, research into these alternatives has become an international priority, with the WHO strongly advocating for a One Health-based global action plan to address this critical issue.

### 3. Environmental Pollution and Ecotoxicology

Environmental pollution is a global concern with far-reaching impacts on health at multiple levels. It contributes to the rise of multifactorial non-communicable diseases, weakens immune systems—increasing susceptibility to infectious diseases—and reduces overall physiological resilience. The "One Toxicology" concept underscores the interconnected effects of contaminants on human, animal, and environmental health, advocating for integrated approaches to mitigate pollution's consequences within the One Health framework.

### 4. Urbanization and Health

Urbanization represents a major environmental change that leads to increased air and water pollution, habitat fragmentation, and shifts in lifestyle. On the one hand, as most commonly attributed to One Health research, urbanization creates new ecological niches for zoonotic vectors, facilitating the emergence and spread of infectious diseases. On the other hand, urban lifestyles expose individuals to multiple stress factors (exposome) and contribute to non-communicable multifactorial diseases and chronic health issues, such as respiratory diseases, cardiovascular and neurological problems, metabolic diseases, and cancer.

Humboldt-Dachroeden and Mantovani (2021) specifically focused on examining the role of environmental factors in One Health and underscored the frequent neglect of this critical component. They pointed out the importance of healthy soils, clean water, and intact ecosystems in human and animal disease prevention and health promotion, and identified two primary scenarios where environmental health intersects with One Health: (1) **Environmental changes modulating risk factors for health**, such as climate change altering vector distribution or pollution affecting immune systems, and (2) **Anthropogenic activities introducing risk factors**, including agricultural runoff, industrial emissions, and antimicrobial resistance stemming from environmental reservoirs like soil and water. Their study reinforced the necessity of integrating environmental and ecological sciences into One Health to address both infectious and non-communicable diseases.

A broader review of the **One Health programs of the European Joint Programmes (EJP)**, illustrates the challenges in operationalizing the environmental dimension. Taylor et al. (2024) noted that while the EJP successfully advanced collaborations in human and animal health, integrating environmental science proved more difficult. Only a few joint research projects focused specifically on environmental aspects, reflecting ongoing uncertainties about how best to include this pillar within existing frameworks.

Robbiati et al. (2023) explored the integration of **One Health within prevention, preparedness, and response (PPR) strategies** to health threats. Their findings revealed that while human and animal health dominate One Health activities (95.7%), the environmental sciences are less frequently incorporated (58%). They identified a need for stronger multisectoral approaches and more concrete frameworks for addressing neglected threats like environmental hazards and their role in pandemics.

## Current Perspectives

In recent years, the importance of strengthening the environmental pillar of One Health has gained significant attention as the intricate connections between environmental factors and health outcomes have become increasingly evident. However, much work remains to fully realize its potential.

Key drivers of this enhanced focus include the **fight against antimicrobial resistance (AMR)**. AMR extends beyond human and animal health, with pollution from antibiotics, biocides, heavy metals, and other anthropogenic substances disrupting microbial homeostasis across ecosystems. These disruptions not only accelerate AMR but also threaten biodiversity and ecosystem stability, highlighting the urgent need to integrate environmental perspectives into One Health strategies (Hernando-Amado et al., 2019).

Another emerging area is **Exposome research** (Wild et al., 2005), which examines the cumulative impact of environmental exposures on human and animal health. This field offers a comprehensive approach to understanding the interplay between environmental changes and health outcomes. We provide a more detailed exploration of this critical area in a later section, focusing on current international projects and initiatives in this domain.

Additionally, collaboration or integration with the **Planetary Health movement**, introduced in 2015 (Whitmee et al., 2015), can also promote the emphasis of the environmental perspectives of the One Health framework. The concept of Planetary Health is based on the understanding that human health and civilization depend on flourishing natural systems and the wise stewardship of these systems; however, human activities, such as environmental degradation, climate change, and resource exploitation, are increasingly disrupting these systems, posing significant risks to both planetary and human well-being. A comparative analysis by Castañeda et al. (2021) highlights both the distinctions and synergies between One Health and Planetary Health. While One Health traditionally focuses on zoonoses and animal health, Planetary Health adopts a broader perspective on environmental and societal factors. Fostering collaboration between these frameworks presents an opportunity to expand the scope of One Health and build transdisciplinary research communities capable of tackling urgent global health and environmental challenges effectively.

The **new definition of One Health**, as outlined by the WHO's One Health High-Level Expert Panel (OHHLEP et al., 2022, Figure 3), explicitly highlights the importance of integrating Eco-Health and Planetary Health into the One Health framework. This redefinition shifts focus from an anthropocentric approach to an ecocentric perspective, emphasizing the critical role of environmental and ecosystem health. The ongoing Quadripartite Joint Plan of Action for One Health (2022–2026), developed by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Organisation for Animal Health (WOAH), and the World Health Organization (WHO), further underscores the need for cross-sectoral collaboration. This includes engaging disciplines that extend beyond traditional One Health approaches, such as food and water security, energy, and environmental health, to address complex global health challenges.

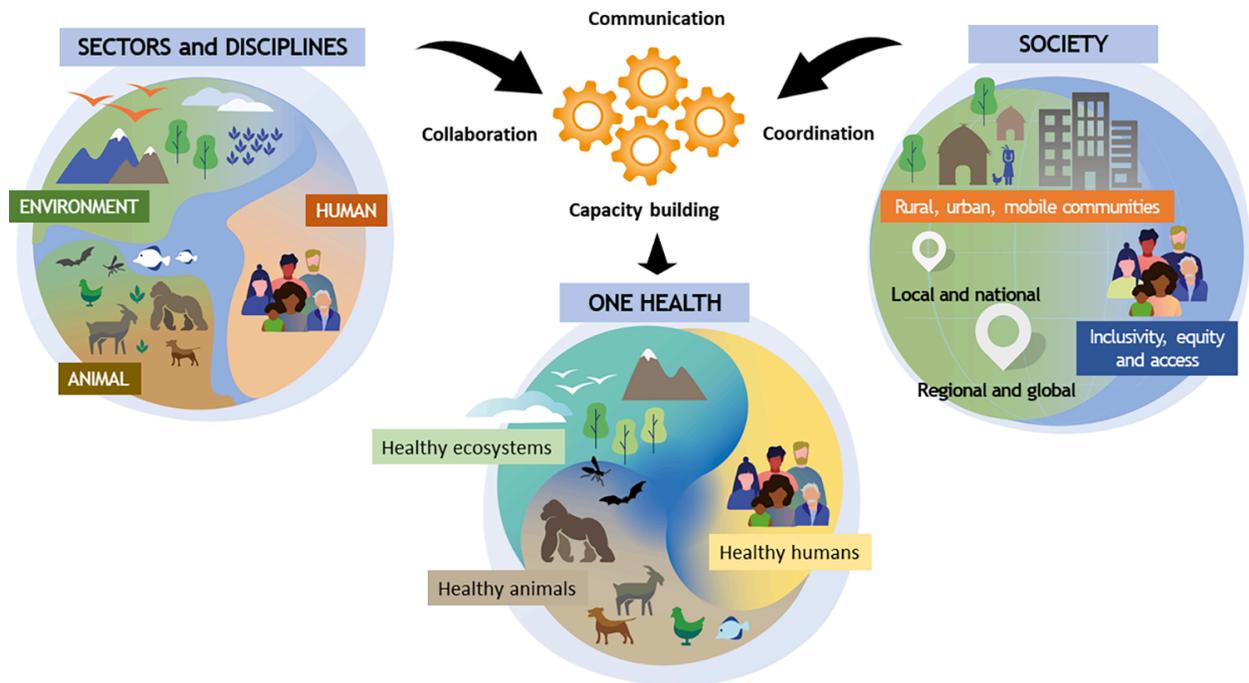


Figure 3: The new definition of One Health according to OHHLEP (2022) focuses on the inclusion of all sectors relevant to aims of One Health.

Overall, significant challenges remain. Interdisciplinary collaboration across environmental, ecological, and social sciences is still underdeveloped in many One Health initiatives. **Limited data on ecosystem health and agreement of how to assess it, coupled with the marginalization of environmental science in program designs, restrict the framework's ability to fully integrate this pillar.** Addressing these gaps will require dismantling disciplinary silos, fostering collaboration, and investing in research and policy that prioritize ecosystem health alongside human and animal health.

As the environmental dimension of One Health evolves, institutions like SLU are uniquely positioned to play a leading role. With expertise in environmental, ecological, and social sciences, SLU can drive innovation in integrating ecological resilience frameworks, biodiversity conservation, and environmental health into One Health programs. By addressing both infectious and multifactorial non-communicable diseases influenced by environmental factors, SLU can play a key role in shaping a more inclusive and effective One Health framework for global health challenges.

# Assessing the Status of One Health Activities and the Environmental Perspective

To evaluate the integration of the environmental perspective within One Health activities at SLU, we gathered data on both research and educational initiatives. This was achieved through a systematic review of SLU's educational programs, collaborative centers, and ongoing projects, as presented on the university's official websites. Additionally, we conducted an online survey targeting SLU employees to gain further insights into their engagement and perceptions of the environmental dimension in One Health.

## Data Collection Approaches

### A) Online survey

An online survey titled "**One Health and the Environment**" was created using Google Forms to gather insights into past, present, and potential future activities related to One Health and environmental science at SLU. The survey targeted SLU employees and aimed to assess their involvement with the One Health framework and its environmental pillar.

The survey included the following sections and questions:

#### 1. **Demographic Information:**

- Faculty and department.
- Optional questions about name and email for follow-up.

#### 2. **Engagement with One Health:**

Participants were asked about their research interest and areas of work through a set of questions illustrated primarily with SLU's One Health imagery.

- *Do you identify your work within the One Health concept?*

Possible answers:

- *Yes, I work partly or entirely within the One Health framework.*
- *My work is not related to the One Health concept.*
- *I am not really familiar with the One Health concept.*

- *Do you work with any of the following areas?*

Multiple choice. Possible answers: animal health, human health, environmental health, plant health

- *Can you place yourself under SLU's One Health umbrella?*

Multiple choice. Possible answers: Food production, Infections, Antimicrobial resistance, Ecosystems & environmental indicators, Climate change, Translational & comparative medicine, Human-animal interaction & health, Nature & health

**3. Involvement in Environmental Sciences:**

Participants rated their level of engagement with the main topics of environmental sciences such as aquatic sciences, atmospheric sciences, biodiversity, ecotoxicology, sustainable development, urban ecology, and more on a scale ranging from "I don't work with it" to "It is my main focus."

**4. Research Funding:**

- *Have you received any funding in the past eight years for One Health or environment-related activities?*
- *If yes, specify funding sources.*

**5. Future Participation:**

- *Can you imagine working within the context of One Health and the Environment in the future? – Possible answers: "Yes", "No", "Maybe".*

**6. Feedback:**

- *Do you have any comments regarding SLU's strategy on One Health and the Environment? – open-ended question*

The survey was distributed through SLU's internal communication channels, including email lists, targeted emails to the leadership of SLU's environmental monitoring and assessment (EMA) programmes for enhanced engagement of environmental sciences actors, and to the department heads asking for further distribution. The survey was also advertised on the annual One Health day, and through flyers distributed on campus. We made sure to reach not only Ultuna campus, but also Alnarp and Umeå. Respondents had 3 weeks to complete the survey and we sent one reminder during that time.

B) Systematic Meta-analyses:

Analysis of SLU collaborative projects and educational activities as presented on the SLU website.

Collaborative centres and projects

We collected information from SLU's collaborative projects and centres as listed on their homepage ([Collaborative centres and projects](#), as of July 2024). For each entry, we evaluated whether it explicitly self-identified as being aligned with One Health. Additionally, we assessed whether the projects described on their pages

could be categorized within one or more of the following One Health areas: environmental health, animal health, or human health.

The categories used for this assessment were:

- **Yes:** The presented projects align with the One Health area.
- **No:** They do not align with the particular One Health area.
- **Potentially:** They could align with the One Health area if the focus were adjusted slightly.

As part of this analysis, we also recorded the listed agencies, funding sources, and collaborations with state and private actors associated with each project.

### Educational programs

We systematically reviewed the BSc and MSc courses offered by SLU, as listed on their homepage (<https://www.slu.se/en/education/programmes-courses/>). For each program, we screened the Programme information, Content, Career, and Syllabus sections, as well as Programme courses (if not available in Syllabus). We also collected information on the education level (undergraduate or postgraduate), language of teaching (English or Swedish), whether the program self-identifies as One Health-related, and its relevance to specific One Health areas: environmental health, animal health, human health, or plant health.

The categories for assessment were the same as those used for the collaborative projects:

- **Yes:** The program aligns with the One Health area.
- **No:** The program does not align with the particular One Health area.
- **Potentially:** The program could align with the One Health area if its focus were adjusted slightly.

### C) Summary of Past Projects

We have contacted previous coordinators for U-share and read the evaluations and reports from the initiative.

### D) Swedish Trends

We summarize examples of relevant initiatives related to the environmental aspects of One Health in Sweden. The selection was made by combining knowledge within the team and searching the web using google.com and Gemini, with search terms/prompts like for example "One health and the environment" and "what kind of research activities within the field of "one health and the environment" are there in Sweden, now and recently?"

## E) European Initiatives and Trends

This study summarised relevant European Union-funded projects and infrastructures, including ESFRI EIRENE, EHEN and others, to provide a comprehensive overview of efforts related to the exposome at the European level. Information was gathered and synthesised from multiple sources to ensure a broad and accurate representation.

Data collection involved:

1. Web-based Research: Information was extracted from official web pages, online documentation, and publicly available reports of the identified initiatives and infrastructures.
2. Personal Communications: Insights were obtained through direct interactions and discussions with stakeholders, project participants, and experts during workshops and conferences relevant to exposome research and European initiatives. This allowed for firsthand acquisition of data, including updates on ongoing projects, strategic priorities, and future directions.

The methodology aimed to integrate diverse perspectives and data sources to capture the scope and impact of these initiatives comprehensively. This provided a detailed understanding of the current landscape of exposome research and its supporting infrastructures in Europe.

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# One Health at SLU

## Survey of One Health Research at SLU

A total of 123 researchers participated in the survey. The majority of respondents identified NJ (Natural Resources and Agricultural Sciences) or VH (Veterinary Medicine and Animal Science) as their faculty, while approximately 25% are located at LTV (Landscape Architecture, Horticulture and Crop Production Sciences) or S (Forest Sciences) (Figure 4).

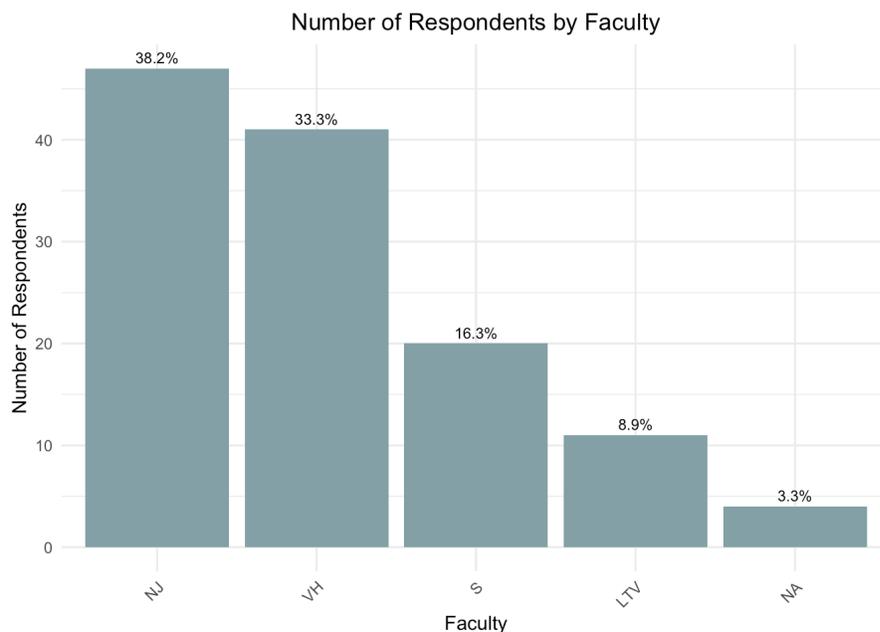


Figure 4: Survey respondents by faculty identification

## Engagement with the One Health Concept

Overall, 71.9% of respondents claimed to work partly or entirely with the One Health concept. Another 10.7% are familiar with the concept but reported that their work does not relate to it. Meanwhile, 17.4% stated they are “not really familiar” with the One Health concept (Figure 5).

These results suggest that many researchers at SLU engage with One Health-related topics. However, the higher response rate from researchers interested in One Health may have skewed the results, potentially underrepresenting researchers less familiar with the concept. To mitigate this potential bias for certain questions, in the following we compare the results of those working with One Health, and those familiar with the concept but not actively working with it.

The 17.4% of respondents who are "not really familiar" with One Health highlight the need for targeted outreach and educational efforts to raise awareness about the concept and its relevance. These individuals could represent untapped potential for interdisciplinary collaboration.

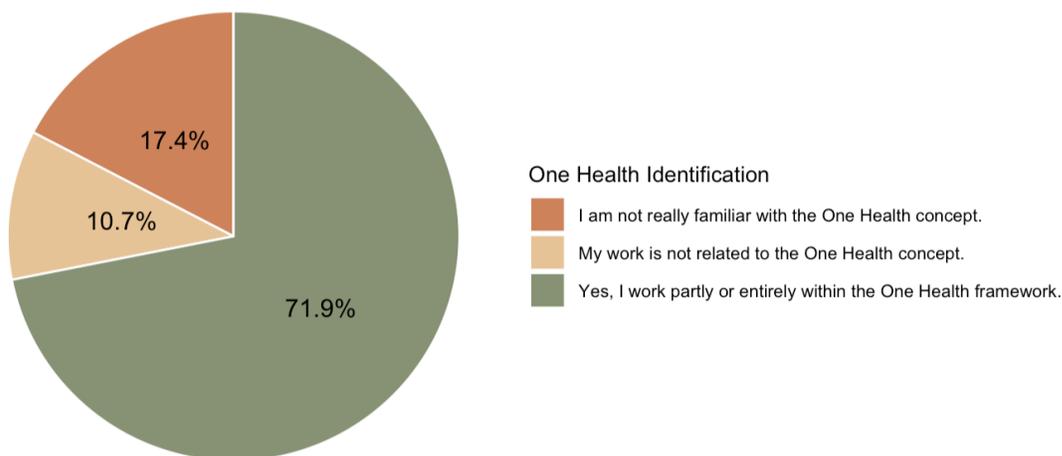


Figure 5: **Do you identify your work within the One Health concept?, Answer alternatives:** a) Yes, I work partly or entirely within the One Health framework. b) My work is not related to the One Health concept. c) I am not really familiar with the One Health concept.

### Faculty-Wise Analysis

Analysis by faculty reveals a similar trend: most respondents identify their work with One Health, though a notable minority, even at the VH faculty, remain unfamiliar with the concept (see Table 1). The largest potential for raising awareness for One Health seems to be given in the NJ faculty.

Faculty	Yes	Unfamiliar	No
NJ	27 (57.5%)	12 (25.5%)	8 (17%)
VH	36 (87.8%)	3 (7.3%)	2 (4.8%)
S	14 (70%)	4 (20%)	2 (10%)
LTV	9 (81.8%)	2 (18.2%)	-

Table 1: Identification and familiarity with the One Health concept, by respondents' faculty.

## One Health Research Areas and Engagement with the Environmental Pillar

The survey explored which areas of One Health - animal health, human health, plant health, or environmental health - respondents work in.

Environmental health emerged as a key focus, with 69 respondents working in this area (Figure 6). The majority of respondents from S (48.4%) and NJ (43.5%) reported engagement with environmental health, while this topic was underrepresented among respondents from LTV (16.7%) and VH (19.2%). These disparities highlight potential areas for targeted promotion to strengthen the environmental pillar of One Health within underrepresented faculties (Figure 7).

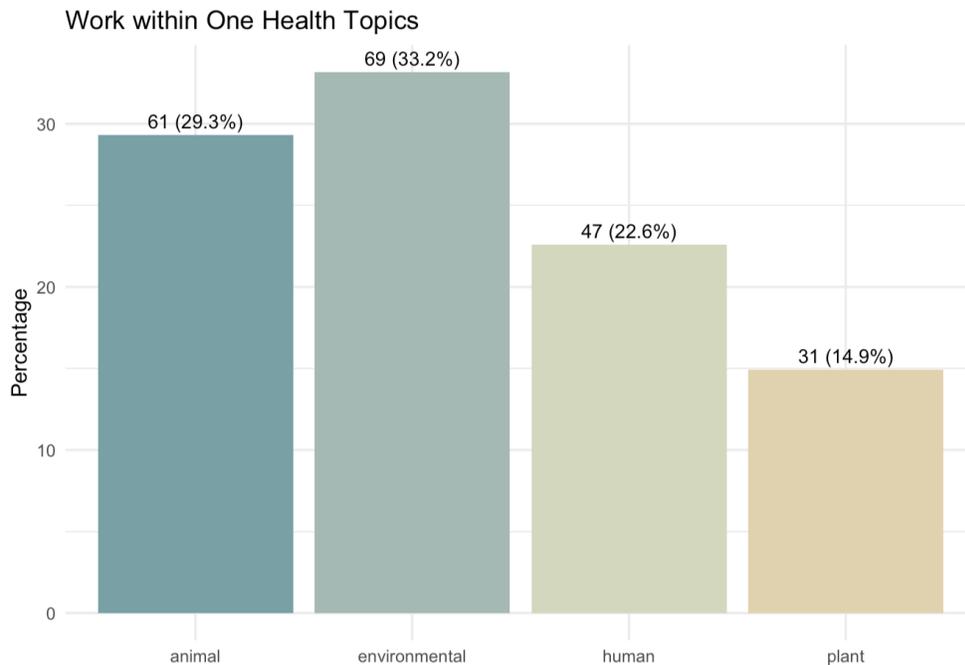


Figure 6: Areas within One Health that survey responders work within. Respondents could select multiple areas.

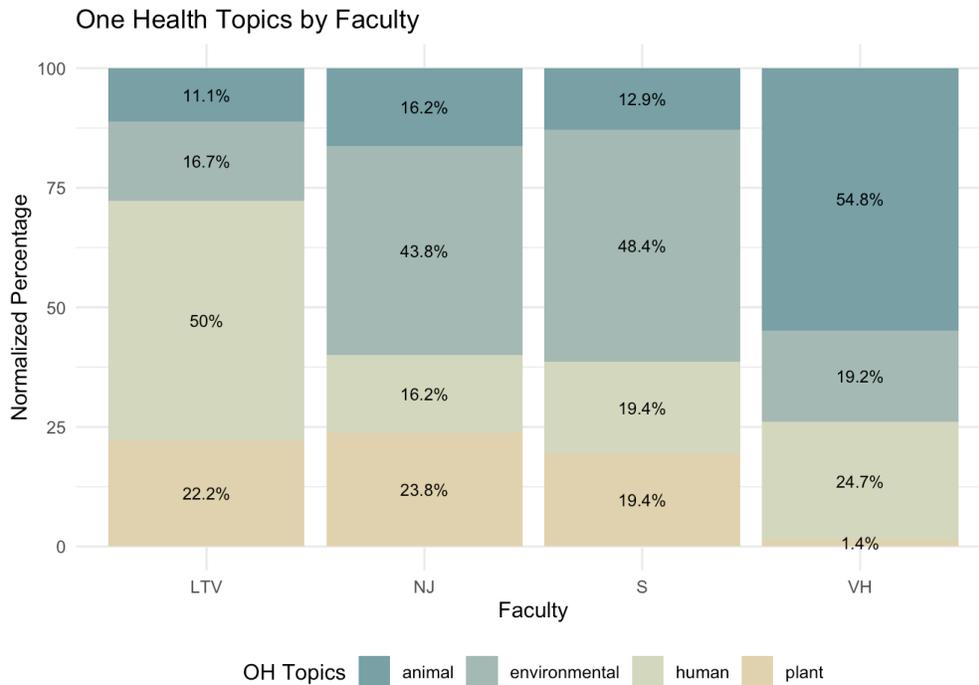


Figure 7: One Health topics by faculty.

Finally, among the 69 respondents engaged with environmental health, the majority (47) were also involved with other pillars of One Health: animal health (30), human health (28), and plant health (20). Notably, among those engaged with plant health and other pillars (21 respondents), the majority indicated either engagement with all four pillars (9 respondents) or exclusively with the environmental pillar (9 respondents). Suggesting a strong integration of the environmental pillar among those engaged in plant health (Figure 8 and Figure 9). There was no overlap between plant health and human or animal health, highlighting a potential area for targeted interdisciplinary collaborations promoting activities.

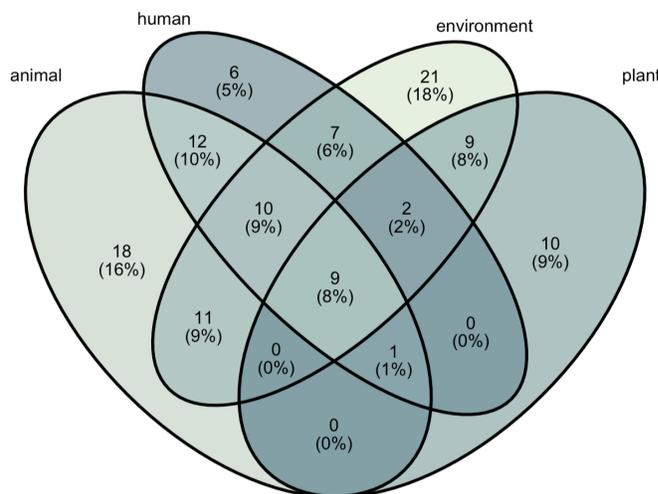


Figure 8: Venn diagram of the research topics listed by the survey respondents. Numbers are counts, with percentages in parentheses, multiple answers are indicated by the intersections.

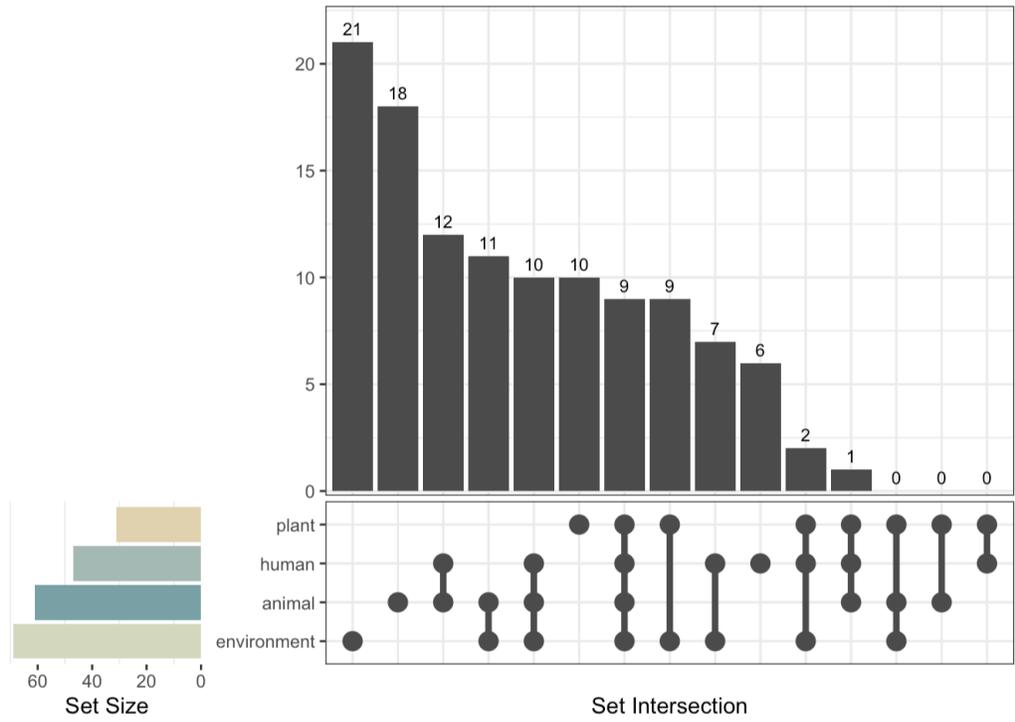


Figure 9: UpSet plot of the same data as before: research topics of the survey respondents. Numbers are counts, multiple answers are indicated by the set intersections.

### Misalignment of OH Awareness and Research Areas

Interestingly, researchers who stated they are “not really familiar with the One Health concept” or whose work is “not related to One Health” still identified areas where their research aligns with One Health principles, primarily environmental health (Figure 10). This suggests that while environmental health is widely recognized as important, and worked with, researchers may not explicitly associate it with the One Health framework.

Looking at it from another angle: environmental health is the One Health area with the highest proportion of respondents who are unfamiliar with the concept or believe their work is unrelated (Figure 11). By contrast, researchers focused on human health at SLU appear to be the most familiar with the One Health framework.

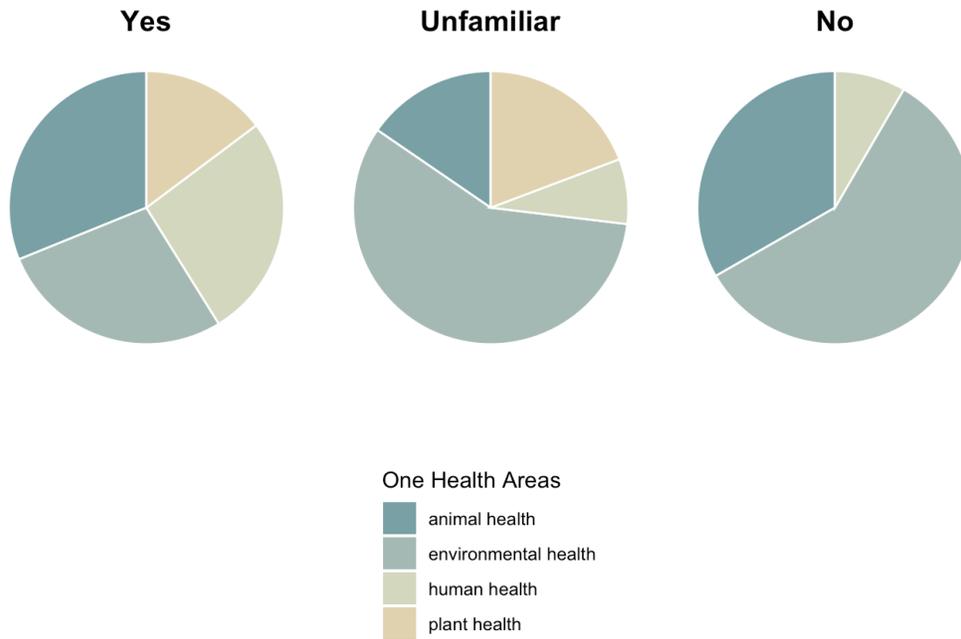


Figure 10: Identification and familiarity with the One Health concept by the One Health areas. A: Yes, I work partly or entirely within the One Health framework. B: I am not really familiar with the One Health concept. C: My work is not related to the One Health concept.

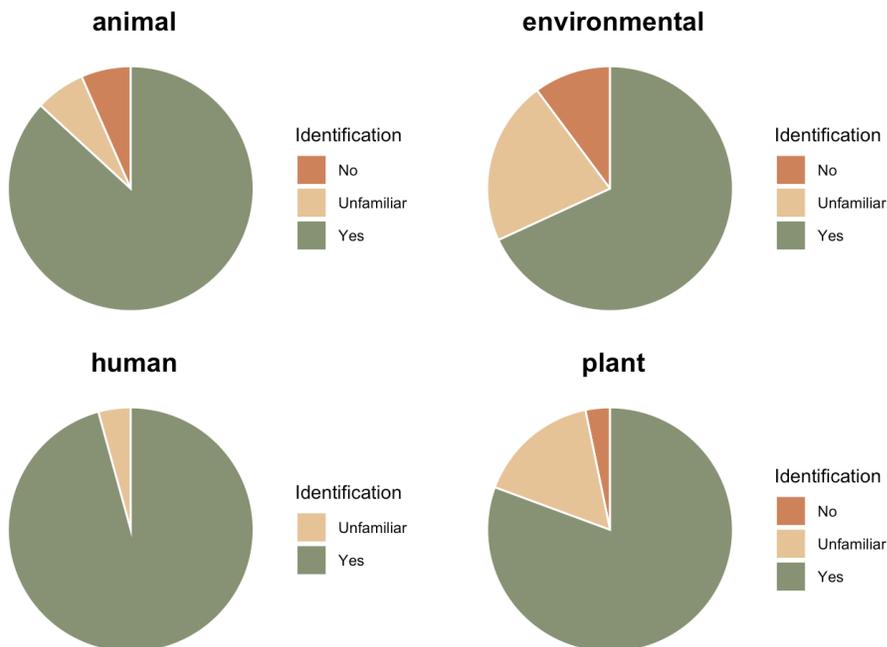
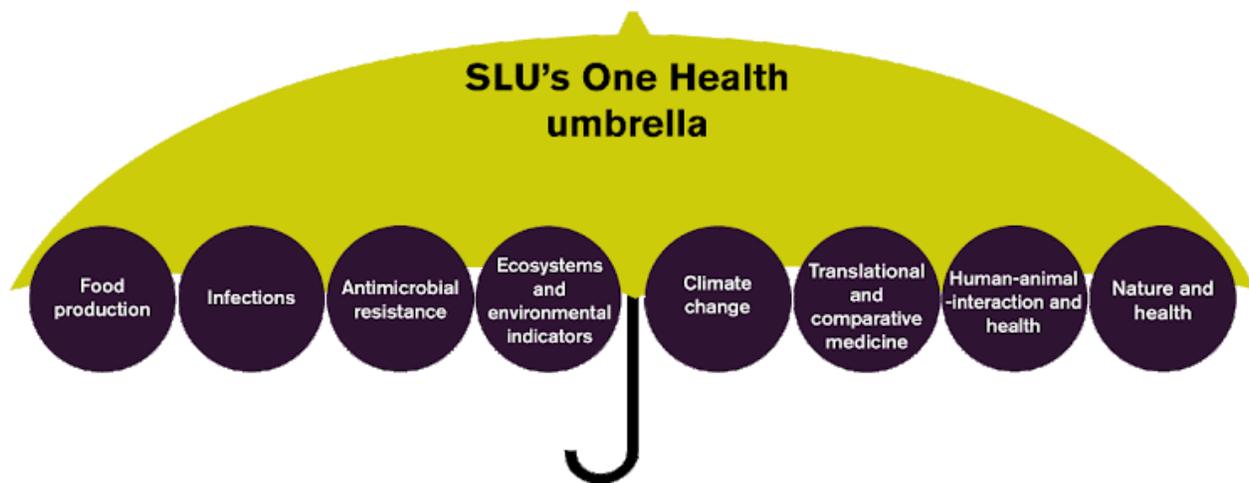


Figure 11: One Health areas by identification and familiarity to the One Health concept.

## Engagement with research topics under SLU's One Health umbrella



When asked to identify specific topics within their work that are One Health related (multiple selections allowed), 18% of respondents chose food production, followed by ecosystems and environmental indicators, climate change and human-animal interaction & health (see Table 2). Additional topics specified are:

- Animal health and farm economy and environment
- Animal health and welfare
- Biosafety and hazard of microbial inputs in agriculture,
- Effekter av kemikalier från miljön på hälsa hos människor och djur
- Environmental monitoring
- One Welfare (2x)
- Plant Biology (Fundamental Science)
- Toxicology
- biobased materials (sustainable fibers and biomedical materials)
- plant disease epidemiology
- soil health
- well being animal in farm

Among the 51 respondents who identified ecosystems and environmental indicators as their research topic, climate change (25) and food production (22) were the most commonly co-indicated areas. In contrast, infections (4), antimicrobial resistance (2), and translational and comparative medicine (1) were notably underrepresented, suggesting limited interdisciplinarity between traditional medicine-focused One Health topics and environmental aspects (see Table 2).



and **waste management** had the least engagement. This distribution partially reflects the research priorities at SLU and partly the uneven representation of research fields among survey participants (see Table 3 and corresponding plots in Appendix 3).

Topic	Main focus	Part of work	Marginally work with	Don't work with
sustainable development	21.1	29.3	23.6	16.3
ecology and biodiversity	19.5	26.8	18.7	22
environmental assessment monitoring	15.5	22.8	16.3	32.5
climate change	4.1	32.5	32.5	22.8
natural resources	8.1	24.4	22	30.9
conservation biology	8.1	22	19.5	35
aquatic sciences	10.6	7.3	12.2	59.4
pollution and environmental contamination	6.5	12.2	15.5	49.6
soil science	4.9	12.2	22	47.2
forestry	2.4	13	17.9	48.8
environmental policy	1.6	13	17.9	48.8
ecotoxicology	2.4	9.8	13.8	56.9
urban ecology and environmental planning	3.3	8.9	12.2	56.1
environmental chemistry	4.1	6.5	13	57.7
environmental technology	0.8	8.9	13.8	57.7
waste management	3.3	3.3	13	61.8
environmental ethics and justice	0	6.5	16.3	56.9
geosciences	0.8	6.5	5.7	69.9
atmospheric sciences	0	3.3	9.8	72.4

Table 3: Identification with different aspects of environmental science.

## Challenges in Funding

Despite significant engagement in One Health research, particularly in environmental health, 65 respondents (56%) reported not receiving dedicated funding for One Health or environmental health activities (see Table 4). Of these, 27 respondents indicated limited alignment of their work with the One Health concept (17 being unfamiliar with the framework and 10 not actively working within it). Notably, 38 respondents who lacked dedicated funding still identified their work as partly or entirely within the One Health framework. This suggests that much of their

research may be driven by individual initiative and curiosity rather than institutional or financial support.

Funding for One Health (last 8 years)	Total		Work within One Health framework	
	Count	%	Count	%
No	65	56.0	38	43.7
Yes, as main PI	22	19.0	18	20.7
Yes, as main PI, Yes, as collaborator	15	12.9	13	14.9
Yes, as collaborator	14	12.1	13	14.9

Table 4: **Have you received any funding in the past 8 years for One Health and the environment related activities?** Include research funding, monitoring assignment, etc.

## Future Potential for One Health

Encouragingly, all but five respondents expressed interest in future work related to One Health and the environment (see Table 5). Notably, 55% of researchers unfamiliar with One Health and 46% of those currently not engaged in it are open to exploring it in the future. This highlights significant potential for expanding One Health initiatives at SLU.

Identification with the One Health concept	Future: yes (%)	Future: no (%)	Future: maybe (%)
I am not really familiar with the One Health concept.	55	5	40
My work is not related to the One Health concept.	46	0	54
Yes, I work partly or entirely within the One Health framework.	91	0	9

Table 5: Distribution of Future environmental One Health plans by current identification with One Health.

## Summary of open-ended comments

Of the 123 respondents, 33 provided further comments about SLU's strategy regarding the environmental pillar of One Health. Below is a summary of these comments arranged by the themes of the comments:

### 1. Awareness and Understanding of SLU's Strategy

Lack of awareness or clarity of the strategy of SLU was expressed even by respondents otherwise identifying as "working partly or entirely within the One Health framework" (2):

- "Cannot find a strategy document on the Medarbetarwebb."
- "I am not aware of SLU's strategy."
- "I don't really know what SLU's strategy concerning 'One Health and the Environment' looks like."

## 2. Criticisms and Suggestions for Improvement

Broadening the scope beyond the traditional focus on veterinary and human medicine to adopt a more inclusive perspective:

- "At SLU, One Health is **not inclusive** at all and only focuses on human and veterinary medicines, which is a pity for an agronomy university."
- "Several initiatives are heavily **biased towards veterinary medicine** for the moment. It needs to be broadened considerably."
- "It should be **broader defined**, now only a few specific topics are mentioned and we do not fit these"

Simplification:

- "We tend to **over-complicate** the One Health issue and try to integrate (sometimes force) as many aspects as possible at the expense of impact and feasibility."
- "Very important gaps that are preventing us from making progress will never be addressed if we impose **another layer of 'mandatory' cross disciplinarity** which gives little space/little value to expert knowledge."

Need to emphasis unifying themes and specific topics:

- Unifying themes
  - "Would be good to further consider the shared, **non-infectious diseases** between humans and animals."
  - "The strategy should also cover **One Welfare**."
  - "**Human-Animal Interaction** and Health is almost forgotten"
  - "How is human health contributing to animal health?"
- Plant health:
  - "There is too little focus on **plants and plant diseases**."
  - "It would be good if it more clearly could include **plant health**."
  - "I miss **agroecology and plant biology**"
- Animal health:
  - "Include **horses and horse industry** in SLU's One Health programs and activities"

- *"Fish welfare during farming and fishing is closely linked to the One Health approach"*
- Environmental health
  - *"Soil health should be a part of this strategy."*
  - *"Nature and Health is almost forgotten"*
- Human health
  - *"I'd like to see more acknowledgement and incorporation of **Indigenous knowledge** into the program, especially since we have Indigenous populations in the Nordic and Scandinavian countries."*

Strengthening trans-institutional and interdisciplinary collaboration:

- *"Strengthen **collaboration with UU** to form a Uppsala hub in One Health Research."*
- *"I truly wished there were more possibilities for **interactions of researchers across disciplines.**"*
- *"involve more people at SLU, a lot of **PhD students** are more interested than professors"*

### 3. Positive Feedback

Recognition of existing strengths:

- *"SLU's One Health strategy is **one of a kind** and must continue and expand."*
- *"I think it is good."*
- *"One Health is a clever re-packaging of activities in line with what VH has been working with for a long time."*
- *"I have taken several One Health courses as a student, and they were great. I am a new PhD student and I will participate at some of the One Health events."*

### 4. Challenges of environmental One Health at SLU

Lack of clarity of concept:

- *"Quite difficult to see how the concept relates to activities around **animal production/nutrition.**"*
- *"Hard to identify with 'One Health.' Hard to grasp '**ecosystem health**' and even harder to grasp 'One Health.'"*
- *"To me, it is a bit **vague.**"*

Lack of funding and resources:

- *"Improve the financial situation for researchers so they do not have to apply for so **many small and diverging grants** will improve the quality of research."*
- *"Assisting more with **proposal writing**."*

## 5. Opportunities for Strategic Focus

### Improve awareness:

- *"Even if our research fields perfectly match the OneHealth concept, I do not know any of my colleagues who know what OneHealth at SLU is and who have at least the impression to be close to any of the SLU OneHealth projects."*

### Emerging and innovative areas:

- *"Push harder on **digital agriculture**, including **bioinformatics**, **machine learning**, and **GIS**."*
- *"We should invest more at SLU in **high-end data science** and **deep-tech applications**."*
- *"SLU needs more capacity for **systems thinking** and **transdisciplinarity in education and research**"*

### Strategy suggestions:

- *"There are significant gaps in **basic scientific knowledge** about One Health issues, where **SLU can play a key role** internationally. Science-based society and science-based governance needs '**scientific facts**' for **dialogue between natural and environmental sciences, social sciences, policy makers** ... put emphasis on the expert scientific and technical knowledge."*

## Educational programs at SLU and One Health

We reviewed 41 undergraduate (BSc) and postgraduate (MSc) programs at SLU to evaluate their alignment with the One Health concept. This assessment included analyzing publicly available information from SLU's homepage to determine whether programs self-identify as One Health-related and whether their content subjectively aligns with One Health principles.

While researchers at SLU demonstrate familiarity with One Health and its diverse areas, this is less evident in the educational programs (Figure 12). Of the 41 programs examined, only one - the veterinary program - explicitly self-identifies as One Health-related.

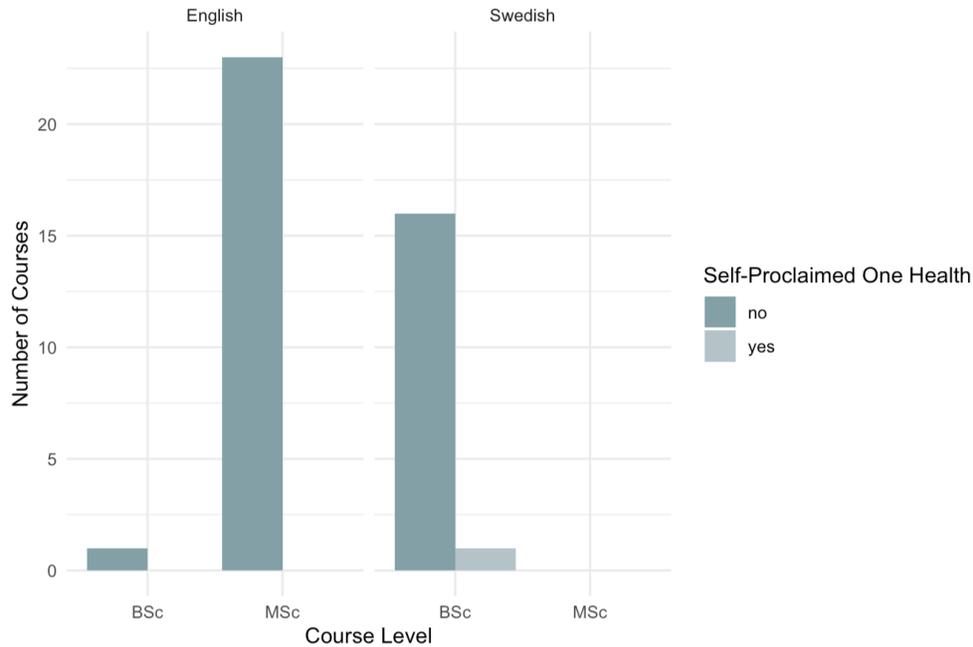


Figure 12: Education at SLU, presented by language, education level (BSc and MSc) and self-identification to One Health.

However, based on the authors' assessment of course content (Figure 13), many programs already address aspects related to One Health, or have the potential to do so. Despite this, few programs currently integrate content explicitly associated with One Health areas.

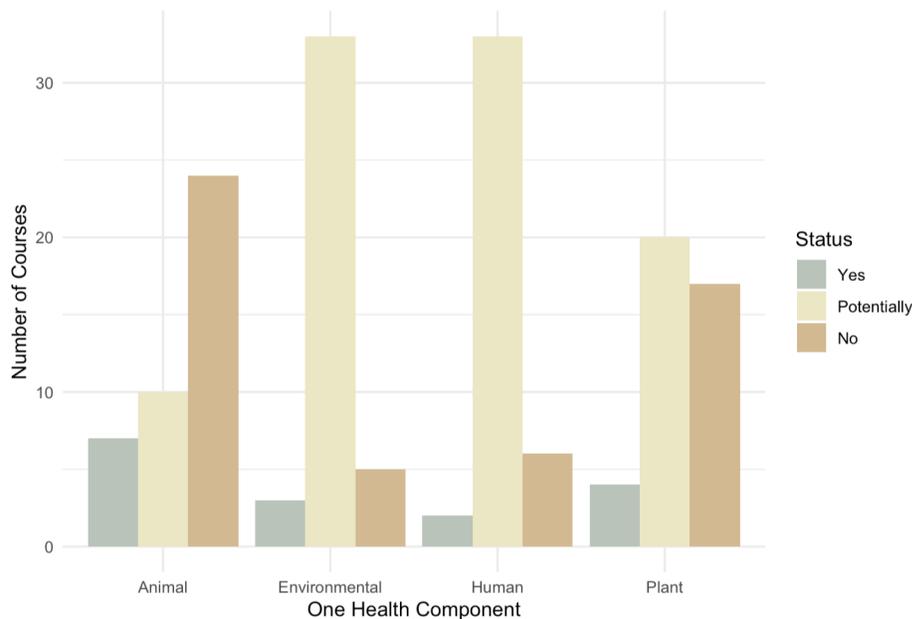


Figure 13: Does the course content align with one of the four major areas of One Health, as by the author's assessment.

Venn Diagram of 'Yes' and 'Potentially' in One Health Components

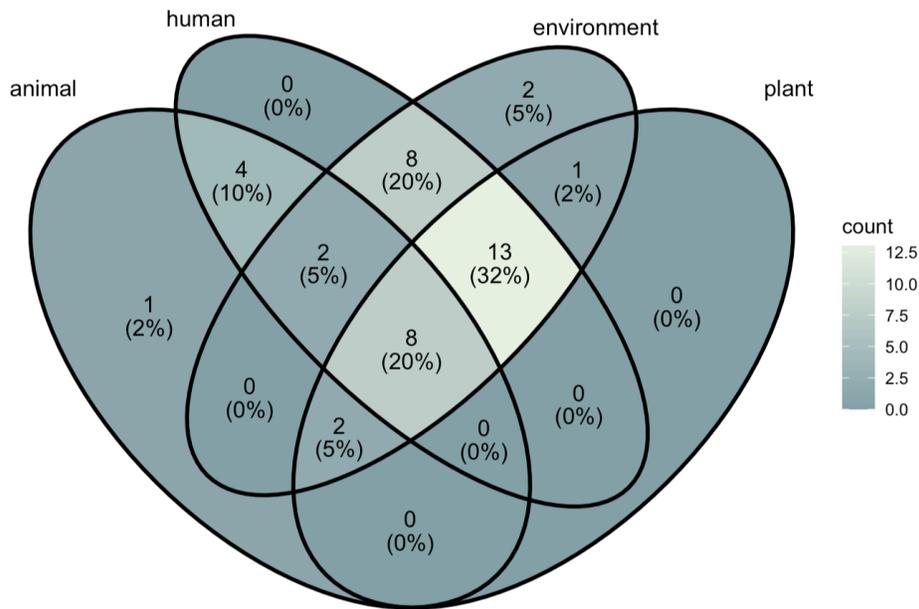


Figure 14: Venn diagram of the different educational programs at SLU and their teaching, and potential teaching of One Health related subjects (according to the authors' assessment of the courses homepage).

## Environmental One Health in SLU's Educational Programmes

The analysis of SLU's educational programmes by the authors reveals that SLU's educational programmes exhibit a **limited direct focus on environmental health**, with very few explicitly emphasizing environmental health-related topics as part of their curriculum. However, there is significant **potential for integration**. Many programmes already address environmental topics, either directly or indirectly, such as sustainable agriculture, forestry, and resource management. These connections present opportunities to strengthen the environmental pillar of One Health by explicitly linking these topics to its principles.

There is also **uneven representation of the pillars across programmes**. The most common inclusion of a pillar of One Health is for the inclusion of animal health, which was explicitly mentioned in the description of 7 programmes: Animal Science, Veterinary nursing, Djurskötare, Etologi och djurskydd, Hippolog, Veterinär, Lantmästare. However, these programs showed the least straightforward potential for the inclusion of other pillars as other than the Lantmästare training, they had no explicit mention of topics related to the other pillars. Interestingly, the potential to incorporate One Health concepts through multiple pillars is more

evident in programmes not explicitly focused on animal health, offering a unique opportunity to broaden One Health's scope within SLU's educational offerings.

In summary, while SLU's educational programmes offer a solid foundation in animal health and sustainability, the environmental pillar of One Health remains underrepresented. To address this, targeted efforts to explicitly integrate environmental aspects into animal health-related programmes, along with broader incorporation of the One Health concept into non-animal health programmes, are needed. These will not only enhance awareness of One Health among future professionals but also contribute to achieving the overarching goals of the framework.

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## Centres and projects at SLU and One Health

We examined SLU's collaborative centres and projects listed on the university's homepage as of July 2024. Of the 74 entities identified, only seven explicitly self-identify as One Health-related. The majority (56) do not associate themselves with One Health, while 10 additional centres and collaborations were assessed as having potential connections to One Health (Figure 15).

### **Centres and Collaborations Self-Identifying with One Health:**

- Etik vid SLU
- Hyggesfritt skogsbruk
- Nationellt centrum för djurvälstånd
- Swedish Centre for Animal Welfare (SCAW)
- SLU Swedish Biodiversity Centre (CBM)
- Swedish Centre for Nature Interpretation
- SLU Future One Health
- SLU hästcentrum

### **Centres and Collaborations Potentially Linked to One Health (Authors' Assessment):**

- Baltic Sea Science Center
- Optimized utilization of Salix (OPTUS)
- SITES (Swedish Infrastructure for Ecosystem Science) at SLU
- SLU Centre for Pesticides in the Environment (CKB)
- SLU Ekoforsk
- SLU Future Food
- SLU Future Forests
- SLU Urban Futures
- SLU Water Forum
- Trees and Crops for the Future

This analysis reveals opportunities to integrate One Health into collaborative initiatives. Many centres and projects, even those not explicitly aligned with One Health, could enhance their impact by incorporating relevant interdisciplinary themes.

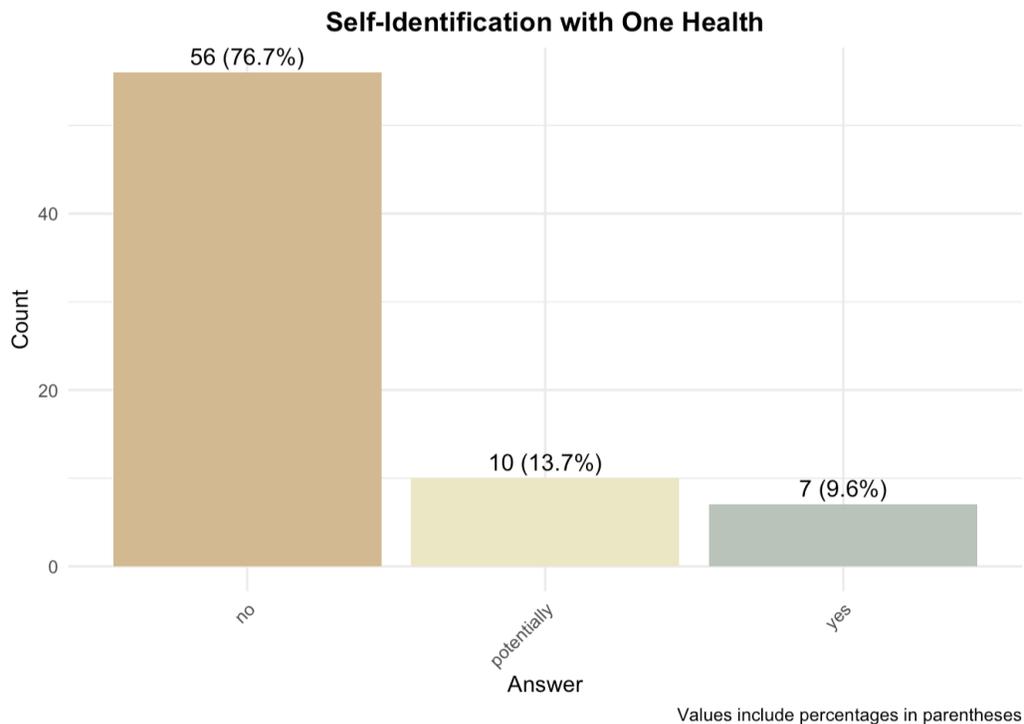


Figure 15: Self-identification of SLU's centres and collaborations with One Health.

Based on the information on the homepages of SLU's centres and collaborations, we categorized their projects into three areas of One Health, animal health, environmental health and human health.

### Environmental One Health in SLU's centres and projects

Unsurprisingly, centres and collaborations that self-identify with One Health are estimated to be involved with all three areas of One Health (Figure 16). Of the three areas human health scores the lowest. All centers that identify with the One Health concept are, at a minimum, potentially engaged in aspects of animal health.

The centres and collaborations that, according to their homepage, potentially identify with One Health, are primarily involved in environmental and human health (Figure 17).

And even the ones that do not self-identify with One Health work on projects that can be related to environmental health (Figure 18).

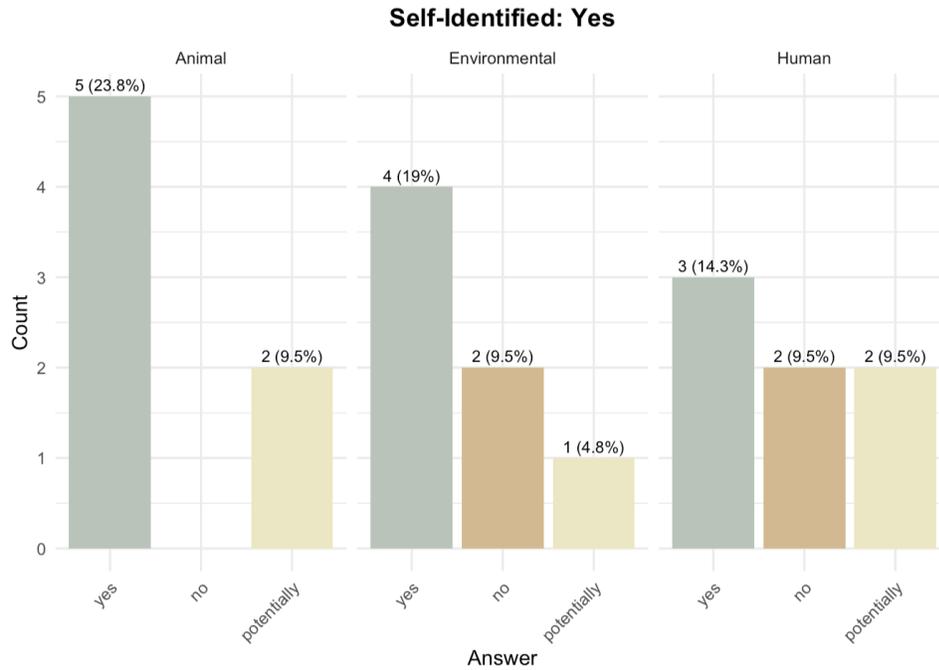


Figure 16: Author’s assessment of the One Health areas the centres and collaborations that self-identify as One Health related are involved in.

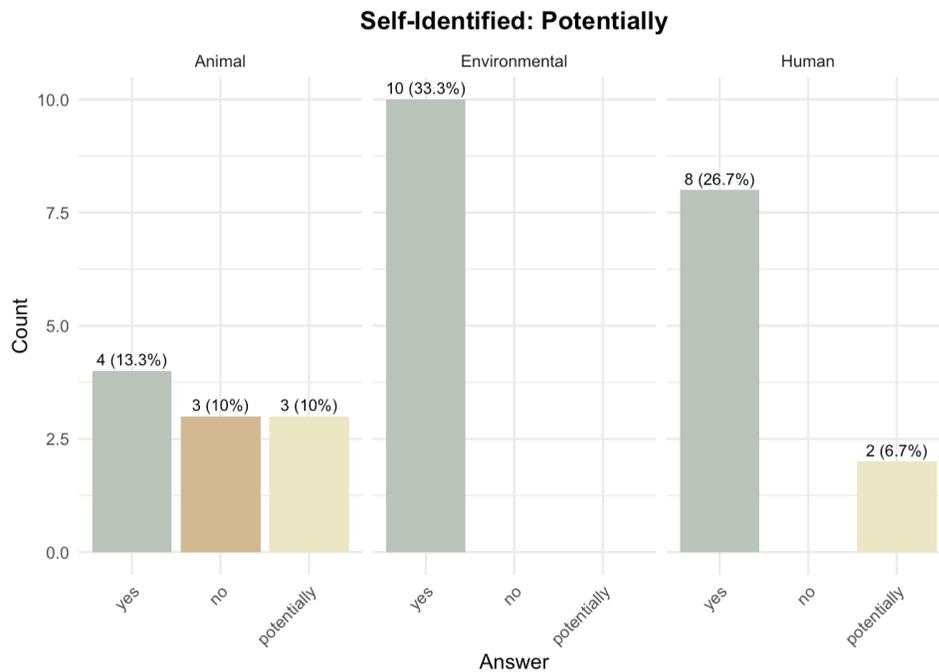


Figure 17: Author’s assessment of the One Health areas of the centres and collaborations that could self-identify as One Health related, according to the authors.

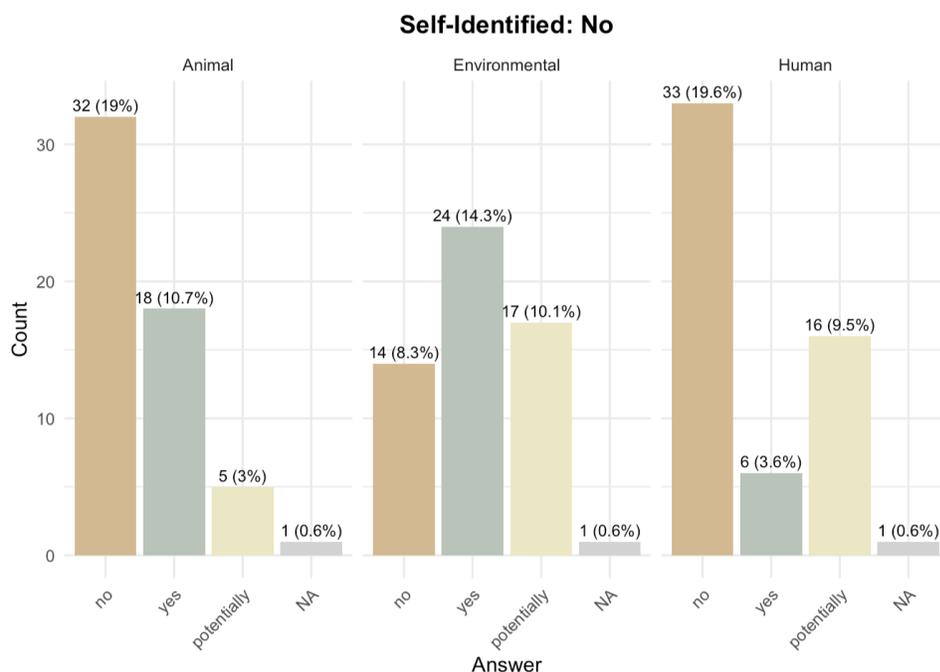


Figure 18: Author’s assessment of the One Health areas of the centres and collaborations that do not self-identify as One Health related, and could not potentially, according to the authors.

## Collaboration Partners of SLU’s Centres and Projects

SLU’s centres and collaborative projects that are involved in, or could potentially be involved in environmental One Health are collaborating with a great deal of partners. These can, for example, be other universities, university groups, research institutes, national or international organizations (see table 6).

The pool for potential collaboration partners is wide and varied: most collaboration partners are only listed once. Swedish Universities are popular collaboration partners, named by more than one centre or project - and they even list specific initiatives within SLU (such as SLU Global, or SLU One Health) as collaborators.

Topic	Collaboration Partner
Universities	Umeå Universitet (4) Lunds Universitet (3) Lunds Universitet - Innovationskontor Syd (IKS) (1) Stockholm Universitet (3) Göteborg Universitet (2) Karolinska Institutet (2) SLU - institutionen för landskapsarkitektur (1) SLU Global (1) SLU One Health (1)

	<p>SLU landskap - Planering och förvaltning (LAPF) (1)  Linköpings Universitet (1)  KTH (1)  Linneuniversitet (1)  Uppsala Universitet (1)</p>
Research Institutes	<p>Skogforsk (3)  RISE Research Institutes of Sweden (1)  Swedish Polar Research Secretariat (1)</p>
Funding agencies	<p>Vetenskapsrådet (1)</p>
Government & Policy	<p>Jordbruksverket (2)  Havs- och vattenmyndigheten (1)  Swedish Meteorological and Hydrological Institute, SMHI (1)</p>
Environmental and Agricultural Organizations & Companies	<p>Lantmännen (1)  Stockholm Environment Institute (1)  Swedish National Forest Inventory (NFI) (1)  Södra Skog (1)  Swedish Farmers Foundation for Agricultural Research (1)  Växa Sverige (1)  Biogas Väst (1)  Biogas ÖST (1)  Hushållningssällskapet (1)  Häckeberga Säteri (1)</p>
International Organizations & Partner	<p>Food and Agriculture Organization of the United Nations, FAO (1)  Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES (1)  International Union for Conservation of Nature and Natural Resources, IUCN (1)  Convention on Biological Diversity, CBD (1)  Nordic Committee for Agricultural and Food Research (NKJ) (1)  NordGen (1)  NordPlant (1)  Nordiska ministerrådet (1)  fifteen European countries (1)  European Plant Science Organisation (1)  CORE Organic (1)</p>
Research & Development Networks	<p>Association of Household Societies (1)  BRC (1)  Biogas Research Center (1)  Ekhaga Foundation (1)  Plant Biologicals Network (1)  ReiGN (1)  Scandinavian Plant Physiology Society (1)  SkogForsk (1)</p>
Miscellaneous	<p>Skansen (1)  Västra Götaland (1)</p>

	Stockholm Vatten och Avfall (1)
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Table 6: Collaboration partner named on the homepages of Centres and Collaborations at SLU that are, or could potentially, be related to environmental One Health. Numbers in parenthesis specify how many Centres or Projects named the collaboration partner on their homepage.

## Agencies involved in SLU's Centres and Projects

Jordbruksverket is the single most important agency for SLU's Centres and Projects working with environmental One Health at SLU (see table 7). Apart from that there is again a variety of parties interested and involved in environmental One Health at SLU.

Topic	Agency Name (count)
Agriculture/Food	Jordbruksverket (6) LRF Trädgård (1) Livsmedelsverket (1) FritidsOdlingens Riksorganisation FOR (1)
Environmental Protection	Naturvårdsverket (2) Skogsstyrelsen (2) Havs- och vattenmyndigheten (1) Landsbygds- och infrastrukturdepartementet (1) SLU landskap - Planering och förvaltning (LAPF) (1)
Research/Academia	Vetenskapsrådet (1) RISE (1) SLU (1) SLU water (1) Swedish Research Vessel Infrastructure for Marine Research (SWERVE) (1)
Regional/International Organizations	BalticWaters (1) NordGen (1) Nordiska ministerrådet (1)
Government/Other	NILS (1) skogstyrelse (1)

Table 7: Relevant agencies named on the homepages of Centres and Collaborations at SLU that are, or could potentially, be related to environmental One Health. Numbers in parenthesis specify how many Centres or Projects named the agency on their homepage.

# Funding sources for environmental One Health at SLU

## Funding research at SLU - survey responses

The single most important funding agency for researchers at SLU that receive funding for their One Health and the environment related research is Formas (see Table 8). The total number of funding bodies named by SLU researchers is 48 (see Appendix 1). However, only six of them are funding three or more researchers. The other 42 are funding only one or two projects, making the landscape of funding bodies for environmental One Health research very diverse. Three of the six top funders are different EU programs, funding a total of 10 researchers at SLU. We did not combine them into one line in the list because it is unclear how they are related.

The funding sources reflect a wide variety of internal, national and international contributors, with several recurring agencies and institutions:

### **1. Internal SLU funding**

- SLU Internal Funding was mentioned 10 times through platforms such as SLU Future, SLU Grogrund, or SLU One Health.

### **2. National Funding Bodies:**

- Formas was the most frequently mentioned funding source (24) with respondents from all four faculties having One Health related Formas grants (VH-9, NJ-7, S-5, LTV-3). Jordbruksverket (The Swedish Board of Agriculture) was indicated 5 times (NJ-3, VH-2), while VR only twice (VH).

### **3. International and EU Funding:**

- EU funding sources (12), primarily Horizon Europe (4) and Biodiversa (3), were the most common international funding. Other international sources include the Bill and Melinda Gates Foundation (1), UK Medical Research Council (1), The Center for Responsible Seafood (1), or Japan Society for Promotion of Science (1), as well as various Nordic sources (6) such as NordForsk (2) or the NovoNordisk Foundation (2).

### **4. General Private Foundations and Organizations:**

- Knut and Alice Wallenberg Foundation (KAW) (1) and Novo Nordisk Foundation (2): Supporting high-impact projects.
- Carl Tryggers Stiftelse (2), and Olle Engkvists Stiftelse (1): Research grants and stipends within natural sciences, and sciences in general, respectively.

### **5. Specialized Private Foundations and Organizations:**

- Agria & Svenska Kennelklubben Forskningsfond : Regularly supporting animal health-related research.
- Petra Lundberg Foundation (2), and Thure F och Karin Forsbergs Stiftelse (1): Specialized funding for veterinarian/animal welfare related research.

- Ingeborg Ögren (1), Skriftställare Birgitta Carlssons (1): Private donations-based SLU funds.

## 6. Specialized and Sector-Specific Agencies:

- Swedish Energy Agency (Energimyndigheten) and Swedish Environmental Protection Agency (Naturvårdsverket): Funding environment-focused activities.
- Forestry-related organizations: Contributions from Skogssällskapet, Skogsskadecentrum, and Södra Skogsägarna.

Funding source research	Count	Percentage
Formas	24	24.74
Swedish board of agriculture - Jordbruksverket	6	6.19
Agria & Svenska Kennelklubben Forskningsfond	4	4.12
EU Horizon Europe	4	4.12
EU	3	3.09
EU Biodiversa	3	3.09

Table 8: Funding sources named by survey respondents 3 or more times. Excerpt from Appendix 1.

The total number of researchers funded from within SLU is 9 (see Table 9). That would make SLU the third largest funding body for environmental One Health research at SLU, right after Formas and the EU. Notable though is the variety of SLU internal sources that give funding. So not only are the SLU external funding sources rather diverse, the same is true for SLU internal funding sources.

Funding source research	Count	Percentage
SLU unspecified	1	1.03
SLU Future platform One Health	1	1.03
SLU Ingeborg Ögren foundation	1	1.03
SLU One Health	1	1.03
SLU Skogsskadecentrum	1	1.03
SLU Skriftställare Birgitta Carlssons Fond	1	1.03
SLU aquaculture platform	1	1.03
SLU faculty funding	1	1.03
SLU minor project	1	1.03

Table 9: Funding sources within SLU named by survey respondents. Excerpt from Appendix 1.

## Funding Centres and Collaborations at SLU

The Swedish Government and SLU itself are the two major funders of Centres and Collaborations at SLU whose work is, or could be, related to environmental One Health (see Table 10).

Funding sources environmental Centres and Collaborations	Count
Svenska regering	7
SLU	6
Formas	3
Göteborg Universitet	2
NordForsk	2
SLU Ekofors	2
Vetenskapsrådet (VR)	2

Table 10: Funding sources of Centres and Collaborations at SLU that are, or are potentially, related to environmental One Health. Only sources that are named by at least two different Centres are listed here. The full table can be found in Appendix 2.

The diversity of funding sources highlights the multidisciplinary nature of One Health, encompassing strong internal support, national funding primarily through FORMAS, EU collaborations, and private sector contributions. The funding landscape for One Health at SLU also demonstrates significant variation in both the level of financial support and the scope of supported projects, as well as substantial internal contribution, all of which can help drive inclusive research and development of this area, but can also indicate a fragmented landscape without reliable long-term funding sources.

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## Summary of past projects

Compilation of related completed projects led by SLU.

From 2017 to 2022 there was an initiative called U-share that aimed to strengthen the collaboration between Uppsala University and SLU, with focus on the area of medicine, pharmacy, veterinary medicine and animal sciences. One way in which this was done was through calls for funding for post-doc positions. In total 5 projects were supported and one of them had a One Health and the environment component (Title: De novo establishment of in vitro fish bioassays via CRISPR/Cas9-mediated reporter gene knock-ins for pro- and retrospective environmental toxicity testing. PI: Björn Hellman. Post-doc: Sebastian Lungu-Mite).

# Swedish trends within environmental One Health

Many actors in Sweden are involved in environmental One Health in some way. Two important initiatives are **One Health Sweden** and **WaSH**.

**One Health Sweden** is a national platform that brings together researchers, policymakers, and stakeholders from different sectors to address One Health challenges. The main partners are SLU, Uppsala University, National Veterinary Institute (SVA) and Linnæus University. SLU is the current coordinator.

**WaSH** is a transdisciplinary network of Swedish and international collaborators in Burkina Faso, Kenya and Mozambique that aims to exchange knowledge and experiences and to develop concepts in applying a One Health approach to water, sanitation and hygiene to reduce zoonotic diseases and AMR while also enhancing environmental health. The work is led by SEI.

## Emerging trends related to environmental One Health in Sweden

The **Swedish government's AMR surveillance strategy** includes monitoring AMR in livestock, companion animals, and the environment, as well as in human clinical settings. There are also studies on the **impact of climate change on infectious diseases**, which investigates how climate change may alter the distribution and transmission of infectious diseases in Sweden (Amuakwa-Mensah *et al.*, 2017). Research is also **exploring how environmental factors can increase the risk of disease emergence**, for example by changes in land use and deforestation. Another research field is **environmental pollution and human health**, where research is being conducted on the impact of air and water pollution on human health, including studies on the effects of microplastics and other pollutants on respiratory and cardiovascular health. Researchers are also investigating the links between environmental pollution and the development of chronic diseases, such as cancer and diabetes. Lastly, the **role of biodiversity in human health**, is exploring the role of biodiversity in maintaining ecosystem health and its implications for human well-being. Studies are also investigating the impact of biodiversity loss on the emergence and spread of infectious diseases.

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# European Initiatives: the Exposome

## European Initiatives: the Exposome

Europe has taken a leading role in exposome research through collaborative initiatives that establish strong networks for environmental health studies. These initiatives foster innovative approaches, benefiting countries like Sweden and promoting cross-border knowledge sharing to tackle environmental health challenges.

The exposome refers to the totality of environmental exposures an individual experiences throughout their lifetime, from conception onwards. This includes a wide range of factors, such as air pollution, diet, stress, lifestyle, and even social environments, which can influence health and disease. By studying the exposome, scientists aim to understand how these complex interactions between genetics and environment impact human health and contribute to the development of various conditions.

While the exposome concept currently focuses on how the environment affects human health, it has potential for advancing environmental health studies. Investments in exposome research have driven the development of innovative mechanisms and methods for environmental monitoring. These advancements can be applied to assess and enhance environmental health.

Moreover, exposome research raises awareness of environmental health issues and increases recognition of their importance. European exposome initiatives, in particular, provide opportunities to establish a network for environmental health research, which could benefit research in Sweden.

## ESFRI (EIRENE) - under construction

The Research Infrastructure for Environmental Exposure Assessment in Europe ([EIRENE RI](#)) is the first European initiative dedicated to studying the environmental determinants of human health, focusing on the Human Exposome. EIRENE RI aims to support large-scale, interdisciplinary research on factors such as indoor and outdoor environments, lifestyle, socioeconomics, and individuals' ability to cope with stressors like infections or diseases. It will offer harmonized workflows, tools, and services for data and sample collection, accessible through an open-access system and knowledge hub for academic researchers, companies, authorities, and the public.

EIRENE RI builds on the expertise of the Czech national RECETOX RI, with over 10 years of experience. Now included in the ESFRI Roadmap 2021, it connects 50

research institutions from 17 countries. The project is rooted in European environmental monitoring networks and databases, global monitoring initiatives, and several EU projects related to biomonitoring and the exposome, expanding research on the impact of long-term exposure to stressors on population health and chronic disease development.

It builds on the legacy of the European environmental monitoring networks and their databases (EMEP, GMP, GMOS), GEO Initiatives (GOS4POP and GOS4M) and related H2020 projects (ERA PLANET, e-SHAPE), EU biomonitoring initiatives (DEMOCOPHES, HBM4EU), UNEP/WHO global biomonitoring efforts, EU exposome (HELIX, EXPOSOMICS, HEALS and EHEN cluster) and other related projects (HERA, EURION cluster).

At this time, Sweden is not an official member of this initiative, even though it would be a good opportunity for Sweden to become part of this particular European network.

## European Exposome Network (EHEN)

The [European Human Exposome Network](#) is the world's largest initiative studying the impact of environmental exposure on human health. Comprising 9 research projects and supported by over €100 million from the Horizon 2020 programme, the Network focuses on issues such as air quality, noise, chemicals, urbanisation, and their health effects.

The findings will support the European Green Deal's goal of protecting citizens' health from pollution by providing evidence for improved preventive policies. The Network builds on decades of collaboration between environmental and health research, aligned with global frameworks like the UN Sustainable Development Goals and the European Commission's partnership with WHO Europe.

## EU Project (HEAP)

One of the 9 EU-funded Exposome projects within EHEN is coordinated by KI. The [HEAP project](#) focuses on understanding the impact of the exposome—the totality of environmental exposures—on human health and society. It will develop an open-access research platform that allows scientists to assess these impacts using high-quality data from five different cohort studies. The platform is designed to be scalable and adaptable to any research setting, helping advance knowledge on how environmental factors influence health outcomes.

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# Conclusions

At SLU, there is widespread engagement, but uneven awareness, of environmental One Health. The survey conducted at SLU highlights that the One Health concept is widely recognized among a large part of the responding researchers. However, a notable minority of respondents are unfamiliar with the concept, indicating a need for targeted outreach and education.

Environmental health is a strong focus at SLU, and is often combined with animal and human health research. In contrast, plant health remains less integrated, presenting opportunities for interdisciplinary collaborations.

SLU's educational programs lack explicit identification with One Health, despite addressing relevant topics. Many programs have the potential to incorporate One Health principles. Targeted efforts to align curricula with the concept could increase interdisciplinary understanding among future professionals.

Few of SLU's centers and projects explicitly identify with One Health, though many have potential connections to its principles. SLU collaborates with a diverse range of partners, including Swedish universities, international organizations, and national agencies.

Funding for One Health research at SLU comes from a variety of sources, reflecting the multidisciplinary nature of One Health. Unfortunately, funding is often fragmented and inconsistent. Many researchers lack dedicated financial support for their work, suggesting that much of the research relies on personal initiative.

Despite these challenges, SLU researchers and institutions express a strong interest in expanding their engagement with One Health, particularly in environmental health. With greater integration of the concept into education, targeted outreach, and improved funding coordination, SLU has a great potential to advance interdisciplinary One Health research and collaboration.

Swedish One Health initiatives integrate academia, government, and international partners, with SLU playing a central coordinating role in many. Key research areas include antimicrobial resistance (AMR), climate change, pollution, and biodiversity's impact on disease emergence. While SLU excels in these fields, stronger collaboration with other Swedish partners could enhance impact and outreach.

The exposome offers a holistic approach to understanding the environment-health nexus, with European initiatives like EIRENE RI, EHEN, and HEAP showcasing Europe's commitment to advancing environmental health science, supported by significant investments and strong interdisciplinary networks. The exposome concept aligns closely with SLU's focus on Environmental One Health. By incorporating exposome methodologies, SLU can further contribute to innovative solutions addressing human and environmental health challenges.

# Recommendations

Within SLU, there exists considerable potential to further advance the One Health framework, particularly its environmental dimension. Numerous researchers are already engaged in projects aligned with this area, while many others envision opportunities to incorporate One Health principles into their future work.

Many educational programs at SLU could easily incorporate different, or even multiple, aspects of One Health into their curriculum, raising awareness at early levels of academia and entry level workforce members.

To maintain SLU's cutting-edge profile and contribute to global solutions for the benefit of humanity, it is essential to prioritise and enhance its One Health initiatives. To achieve this, we suggest the following strategic actions:

## 1. Clarify and Promote the Concept of Environmental Health

- Grasping the concept of "environmental health" can be challenging not only for SLU. Focus instead on actionable opportunities.
- Use targeted initiatives to emphasize concepts that help the integration of the environmental pillar such as **exposome research, ecotoxicology, ecosystem thinking, and One Health-conscious urban development.**

## 2. Balance the Focus Between Veterinary and Non-Veterinary One Health Activities

- Acknowledge that One Health at SLU, similarly to the concept itself has been historically veterinary-centric. Meanwhile, the environmental aspects have been most underrepresented in SLU's veterinary-focused activities.
- Leverage the environmental focus already present in non-veterinary fields, ensuring they are more aware of their relevance to the One Health concept.

## 3. Expand Targeted One Health Activities in Specific Fields

- *Plant Health and Agricultural Sciences:*
  - Increase their inclusion in One Health initiatives through specific programs or projects tailored to their work in plant, environmental, and human health.
  - Highlight their importance in tackling issues like food security, pesticide impacts, and soil health.
- *Environmental Sciences and Monitoring:*
  - Improve awareness of One Health within this sphere, especially through targeted activities and inclusion into educational programmes.

- Promote the integration of One Health thinking into monitoring practices and ecosystem assessments.
- *Harness Ecological Expertise for One Health:*
  - Promote the development of interdisciplinary projects that leverage ecological expertise in biodiversity, ecosystem resilience, and species interactions to address health-related challenges within the One Health framework.
- *Forestry Sector:*
  - Initiate activities targeted towards the Forestry faculty as they have great potential to incorporate all One Health pillars—environmental, plant, and animal health (with human health addressed indirectly).
  - Promote the adoption of One Health principles in forestry research and education in a similar fashion as it has been done for the sustainability principles of SLU.
  - Develop targeted programs or educational modules focusing on sustainable forestry practices aligned with One Health.

#### 4. Promote Transdisciplinary Collaboration

- Support cross-disciplinary research and projects by connecting fields like veterinary medicine, plant health, and environmental sciences.
- Use SLU's existing platforms (e.g., **IDA**) to facilitate One Health inspired collaboration and provide resources for large-scale transdisciplinary efforts.
- Highlight successful cross-disciplinary projects that include the environmental perspective to inspire and encourage further One Health collaborations.
- Develop topic-specific actions by leveraging existing research areas, that are already being studied from diverse disciplines, such as AMR research, to establish and strengthen transdisciplinary initiatives and collaborative networks.

#### 5. Enhance Funding Strategies

- Help researchers to move beyond reliance on small grants by promoting **large-scale funding acquisition** that supports ambitious, integrated research projects.
- Develop internal resources to assist researchers in applying for large grants, with a focus on transdisciplinary collaborations that align with One Health priorities.
- Establish incentives for departments or groups securing significant funding for One Health-related initiatives. For example, support such projects through the SLU One Health platform

## 6. Integrate One Health into Education

- Embed One Health thinking more prominently in educational programs, especially in environmental sciences, forestry, and agriculture.
- Support the development of One Health themed interdisciplinary courses and modules that target students in programmes at all faculties.
- Encourage projects and theses that address One Health challenges, offering funding or recognition for outstanding contributions.

## 7. Promote Cutting-Edge One Health Initiatives

- Advance **Exposome Research**: Establish SLU as a leader in exploring the cumulative impact of environmental exposures on health by integrating exposome methodologies into interdisciplinary projects and collaborating with global initiatives like EHEN, HEAP, and EIRENE RI.
- Align with **OHHLEP Principles**: SLU's expertise in ecosystem services, biodiversity conservation, and sustainable agriculture aligns perfectly with OHHLEP's expanded framework. Promote OHHLEP's expanded One Health definition, emphasizing **Eco-Health**, and **Planetary Health**, into SLU's research, education, and policies.

By clarifying the concept of environmental health, fostering interdisciplinary collaboration, and embedding One Health thinking into education and funding strategies, SLU can significantly enhance the integration of the environmental pillar into its One Health activities. These actions will not only address current gaps but also position SLU as a global leader in advancing One Health with a strong environmental focus.

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# Appendix

Funding sources One Health and the environment	Count	Percentages
Formas	24	24.74
Swedish board of agriculture - Jordbruksverket	6	6.19
Agria & Svenska Kennelklubben Forskningsfond	4	4.12
EU Horizon Europe	4	4.12
EU	3	3.09
EU Biodiversa	3	3.09
Carl Tryggers Stiftelse	2	2.06
Energimyndigheten	2	2.06
FOMA	2	2.06
KSLA	2	2.06
NordForsk	2	2.06
Novo Nordisk Foundation	2	2.06
Petra Lundberg Foundation	2	2.06
SLU Grogrund	2	2.06
Skogssällskapet	2	2.06
VR	2	2.06
other	2	2.06
BalticWaters	1	1.03
Bill and Melinda Gates Foundation	1	1.03
EU ERC	1	1.03
EU Erasmus+	1	1.03
EU Marie Curie ITN	1	1.03
FHF – Norwegian Seafood Research Fund	1	1.03
Japan Society for Promotion of Science; University of Alaska Fairbanks	1	1.03
KAW	1	1.03
LKAB	1	1.03
Lantmännens forskningsstiftelse	1	1.03

Funding sources One Health and the environment	Count	Percentages
Medical Research Council (UK)	1	1.03
No funding related to "One health" but for "environment related activities": Transport administration	1	1.03
Olle Engkvists Stiftelse	1	1.03
Open Philanthropy	1	1.03
SLU	1	1.03
SLU Future platform One Health	1	1.03
SLU Ingeborg Ögren foundation	1	1.03
SLU One Health	1	1.03
SLU Skogsskadecentrum	1	1.03
SLU Skriftställare Birgitta Carlssons Fond	1	1.03
SLU aquaculture platform	1	1.03
SLU faculty funding	1	1.03
SLU minor project	1	1.03
Skogsstyrelsen	1	1.03
Stiftelsen Djursjukvård i Stor-Stockholm	1	1.03
Swedish Environmental Protection Agency	1	1.03
Södra Skogsägarna	1	1.03
The Center for Responsible Seafood	1	1.03
Thure F and Karin Forsberg Foundation	1	1.03
Uppsala Diabetes Center	1	1.03
Vinnova	1	1.03

Appendix 1: Full list of funding sources for researchers at SLU that received funding for One Health and the environment related research, with counts and percentage named.

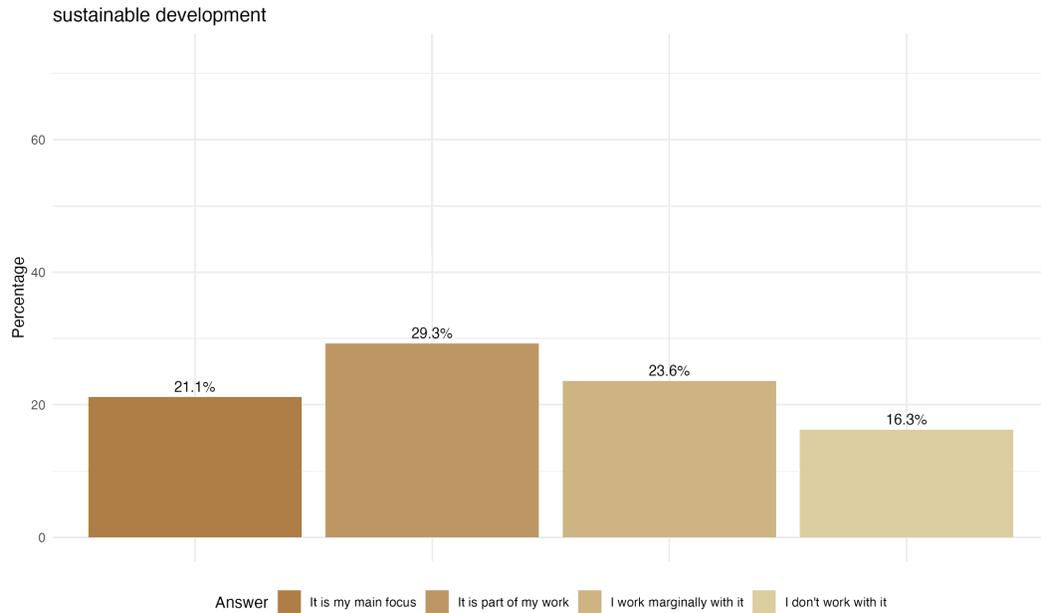
Funding sources environmental Centres and Collaborations	Count
Svenska regering	7
SLU	6
Formas	3

Funding sources environmental Centres and Collaborations	Count
Göteborg Universitet	2
NordForsk	2
SLU Ekofors	2
Vetenskapsrådet	2
AGROVÄST	1
BRC	1
BalticWaters	1
Biogas Research Center	1
Biogas Väst	1
Biogas Öst	1
DuPont	1
EU Life+	1
Jordbruksverket	1
Livsmedelsverket	1
Lunds Universitet	1
Naturbruksgymnasiet Uddetorp	1
SLU water	1
Sida	1
Skansen	1
Skara Kommun	1
SmurfitKappa	1
Stockholm Vatten och Avfall	1
Swedish environmental protection agency	1
Uppsala Universitet	1
Vinnova	1
Västra Götalandsregionen	1
WHO	1
statliga kalkningsanslag	1
users	1

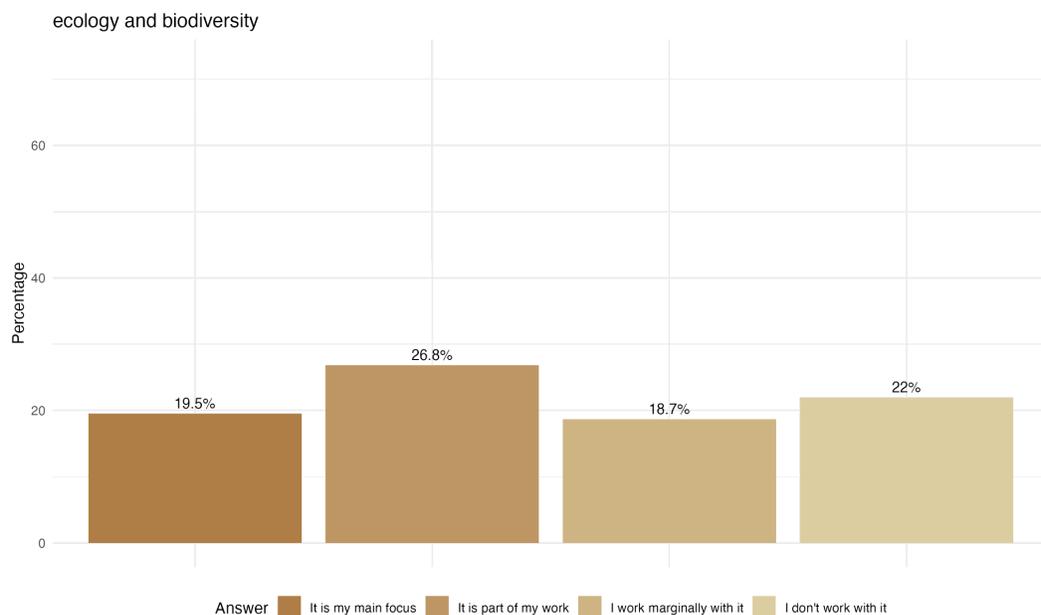
Appendix 2: Funding bodies of Centres and Collaborations at SLU that identify with environmental One Health, or could potentially be related to it.

Appendix 3 Barplots: Specific topics of environmental health that survey respondents were asked to categorize with respect to the involvement of their work. Possible answers: i) It is my main focus, ii) It is part of my work, iii) I work marginally with it, iv) I don't work with it.

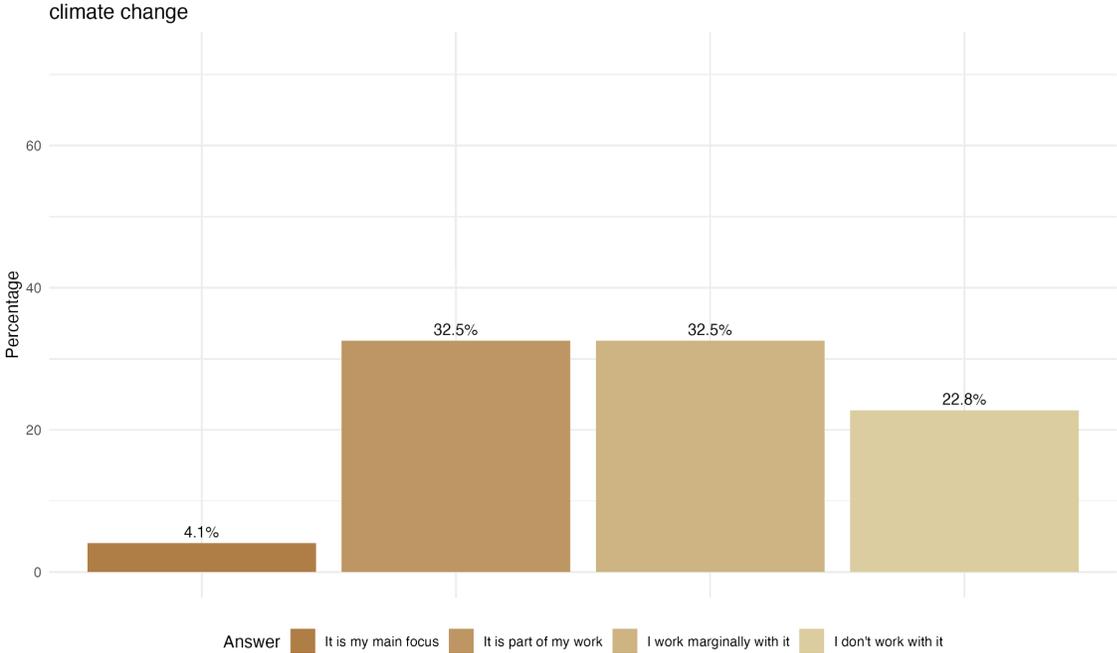
### Sustainable development:



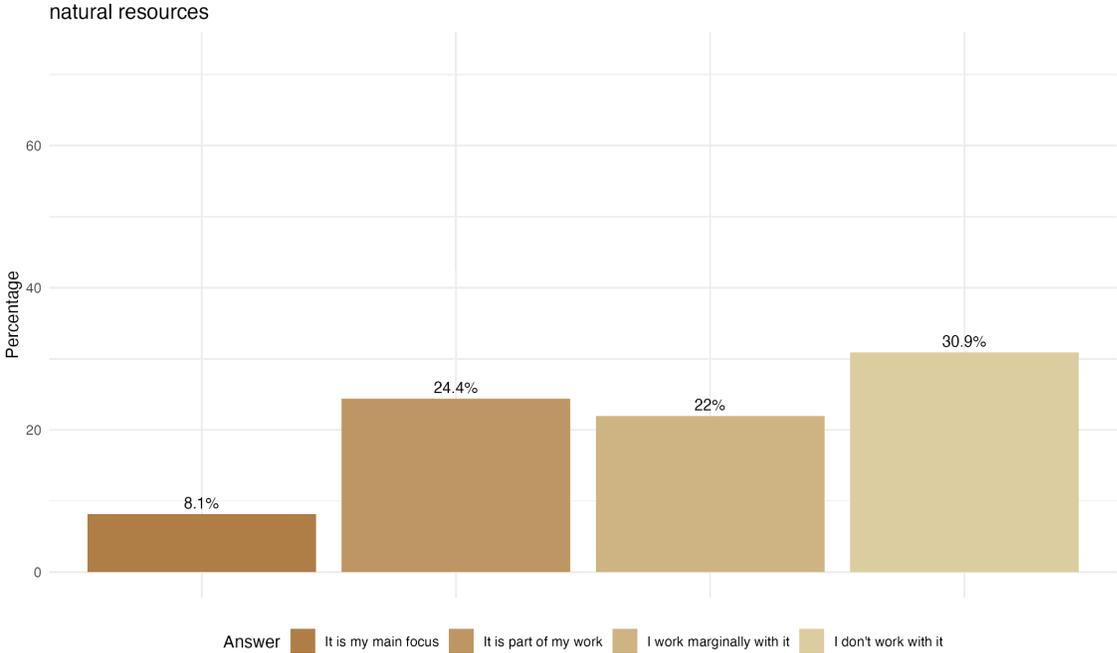
### Ecology and biodiversity:



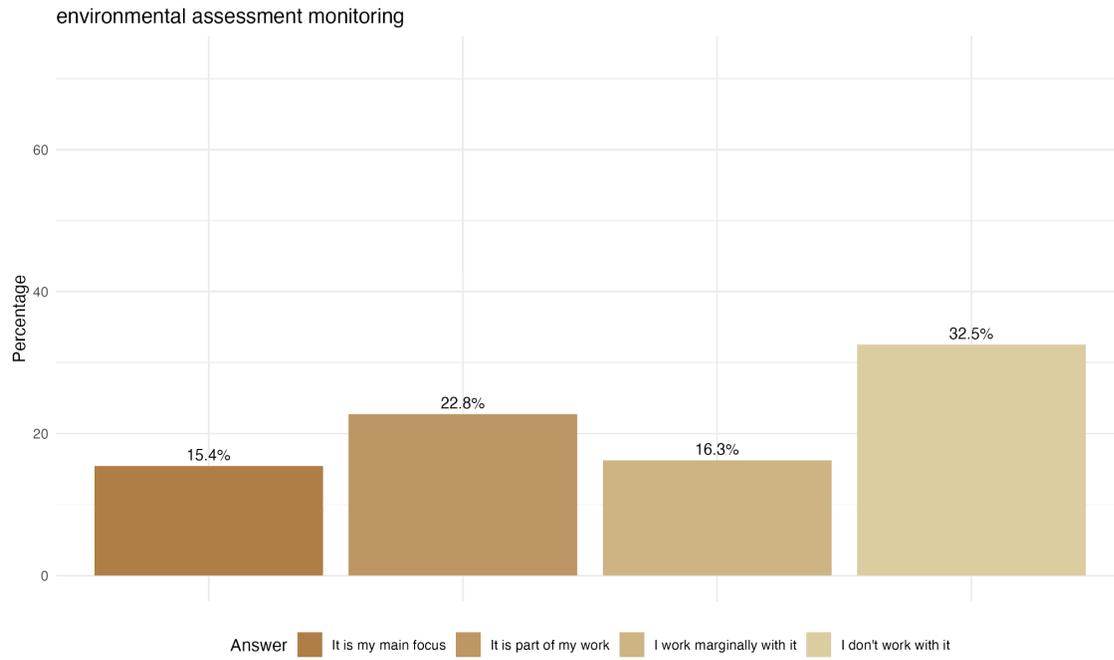
# Climate change



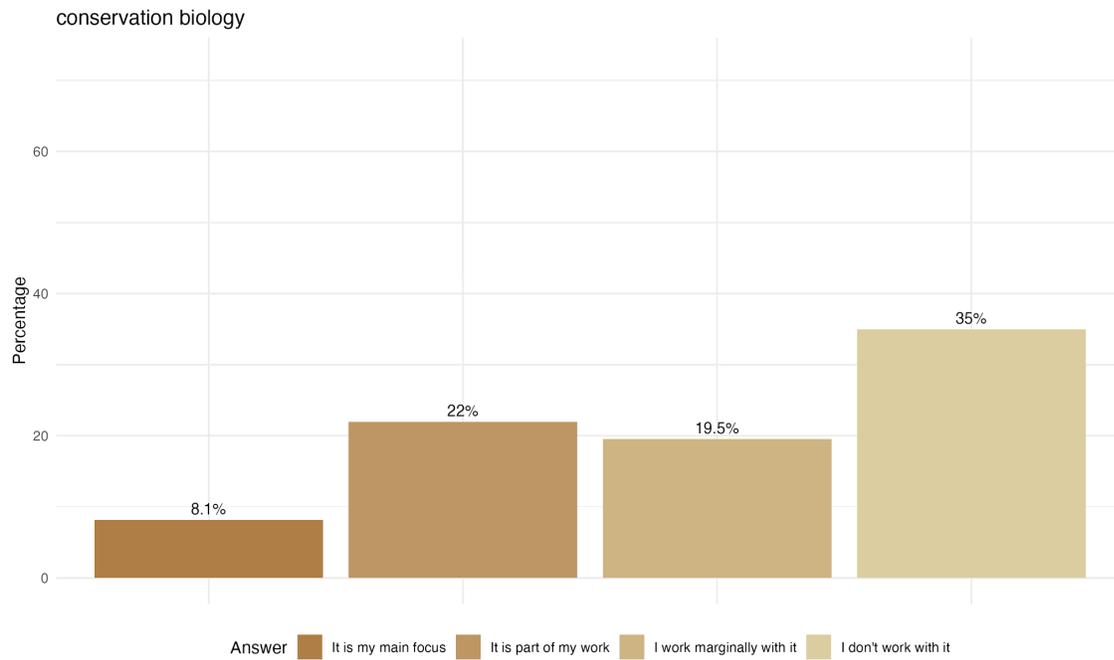
# Natural resources:



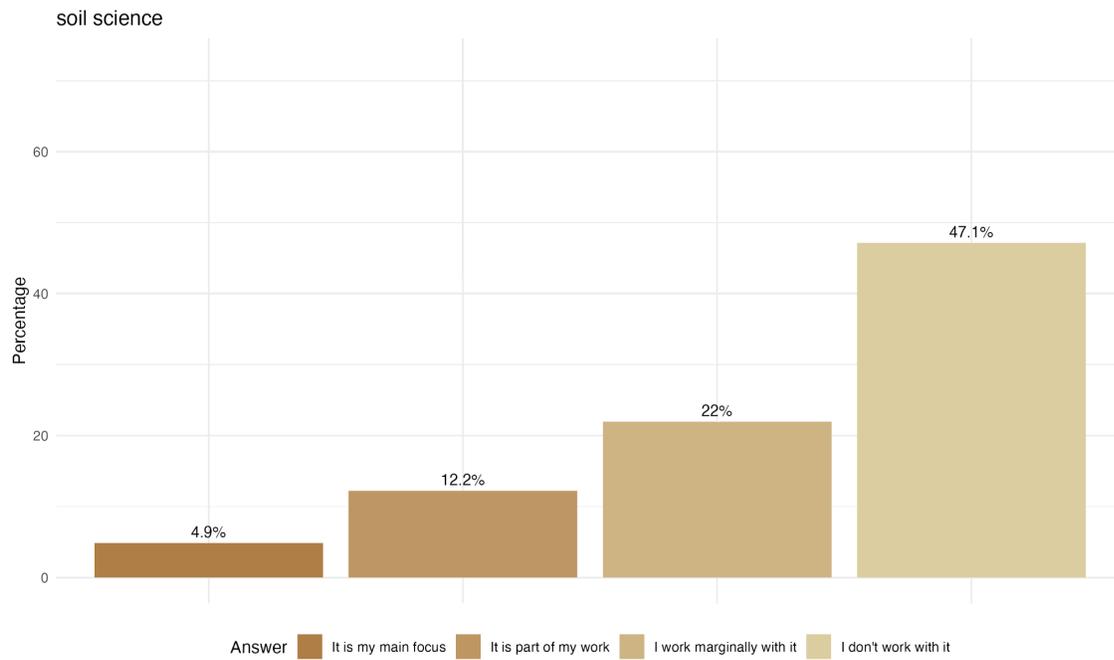
## Environmental assessment monitoring:



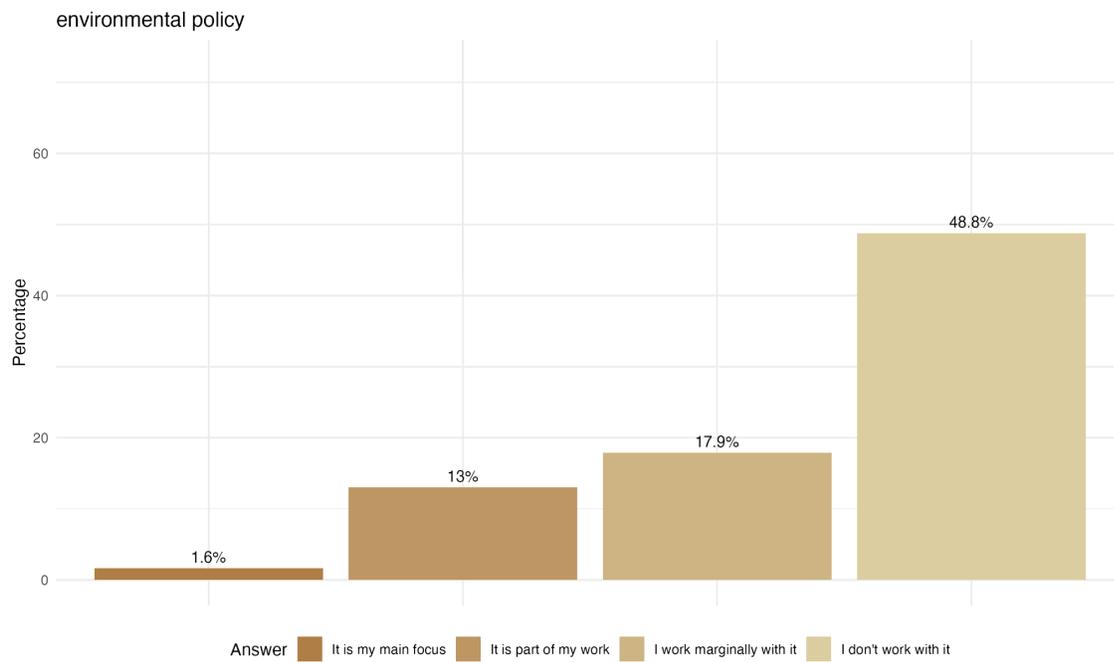
## Conservation biology:



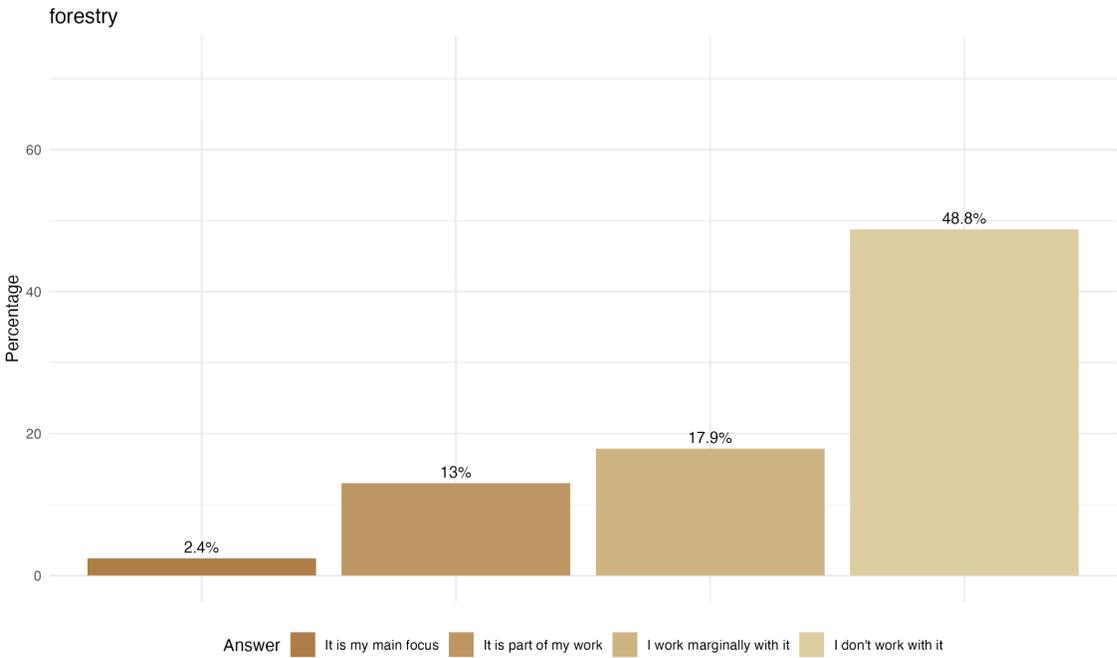
## Soil science:



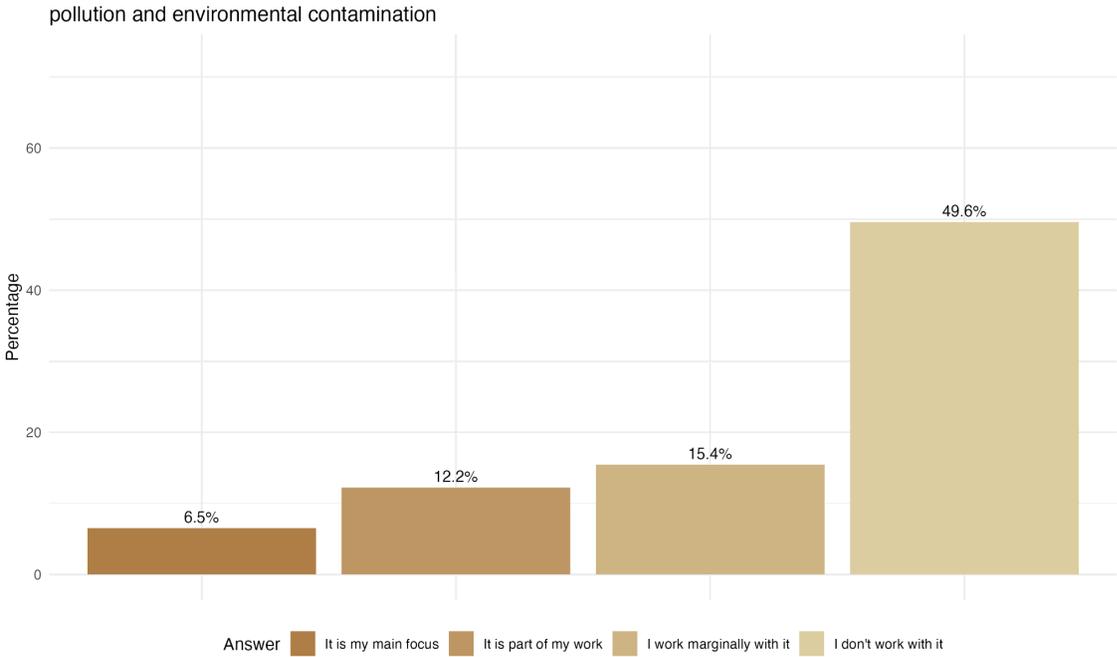
## Environmental policy:



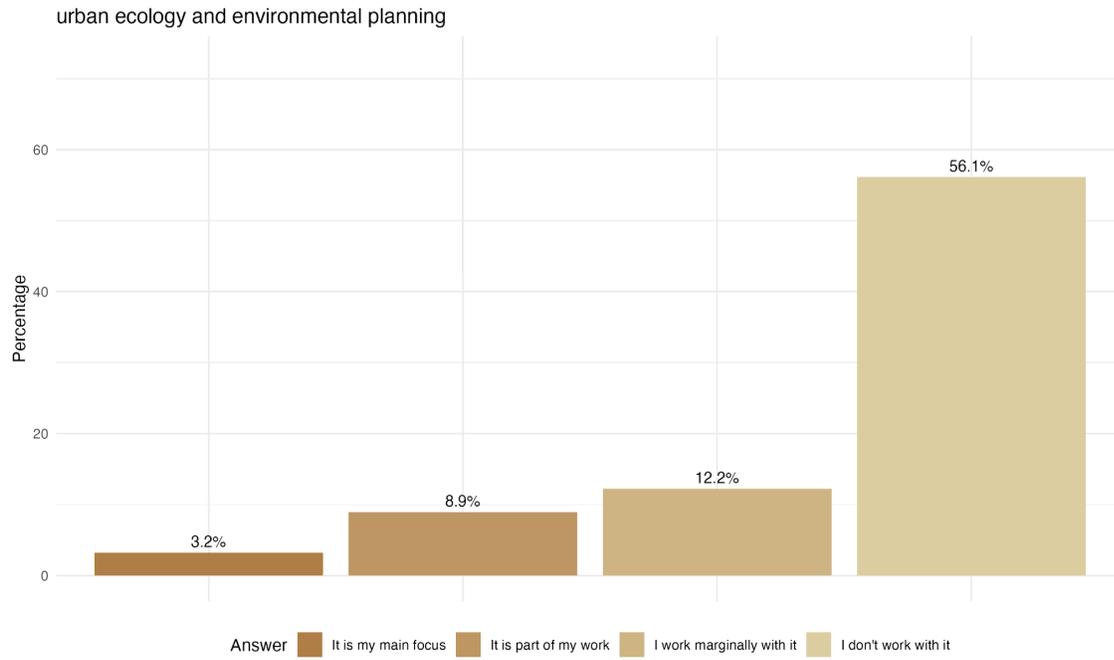
Forestry:



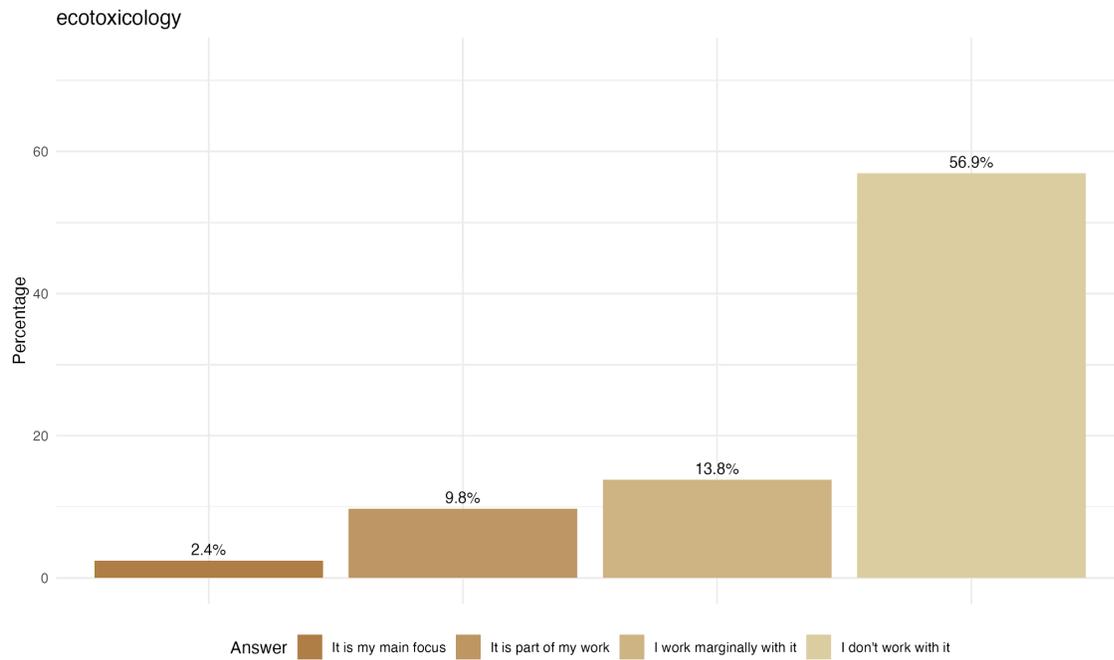
Pollution and environmental contamination:



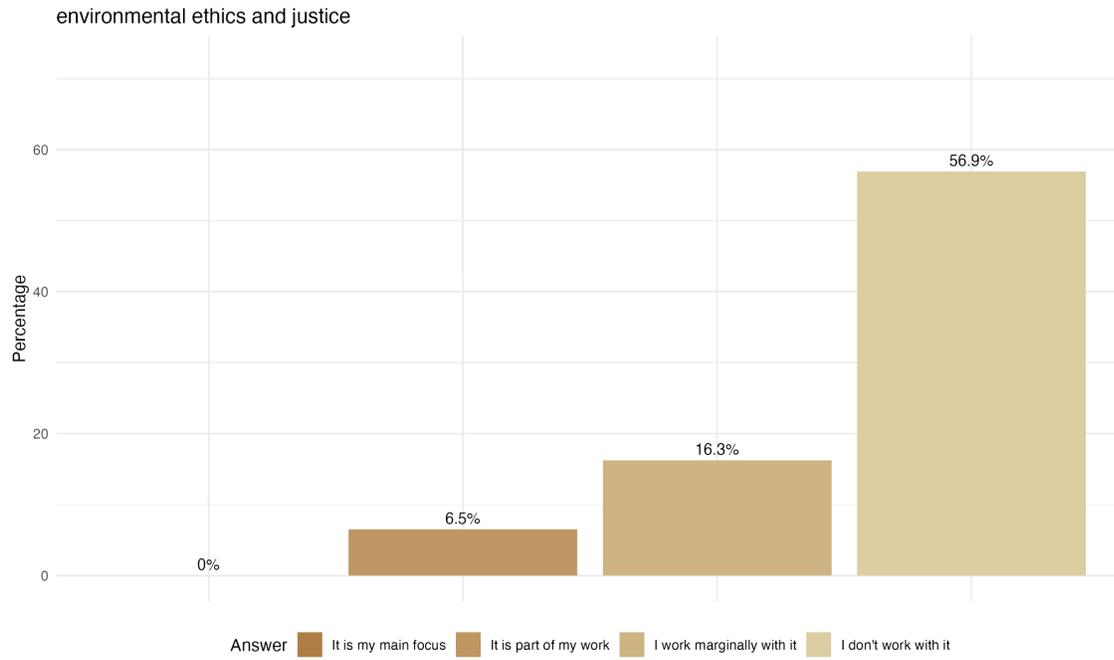
## Urban ecology and environmental planning:



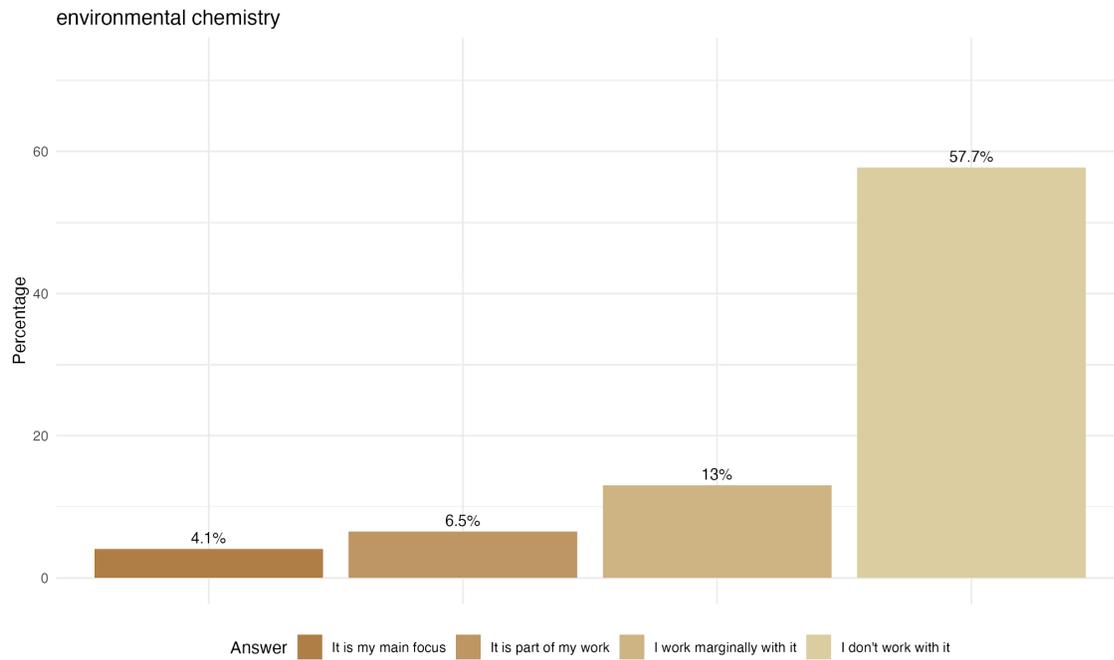
## Ecotoxicology:



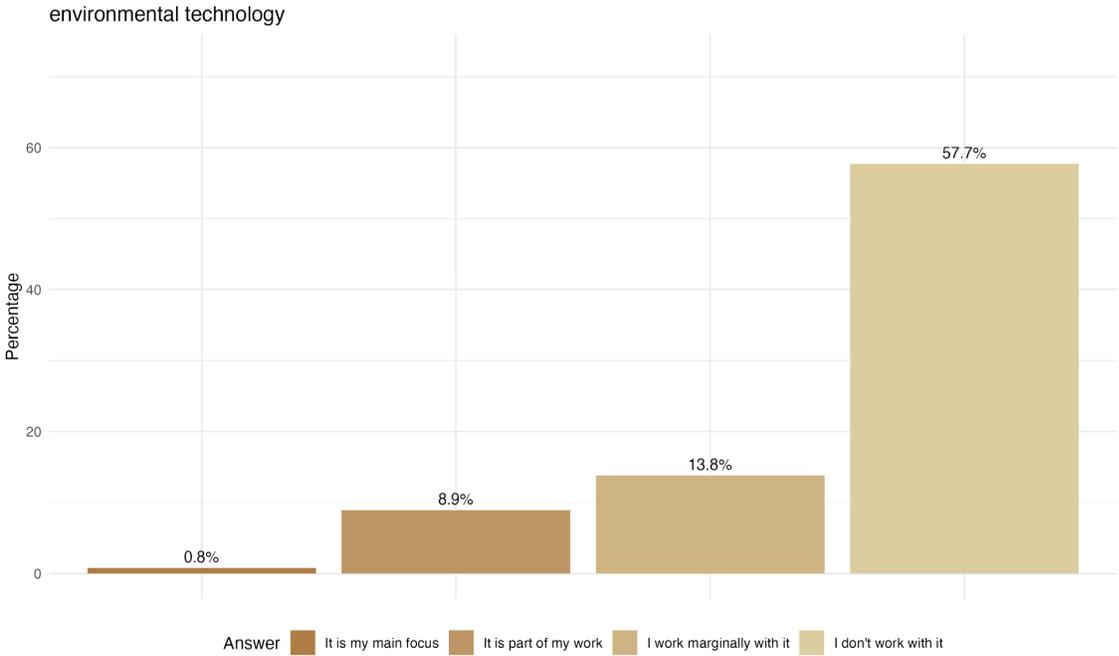
## Environmental ethics and justice:



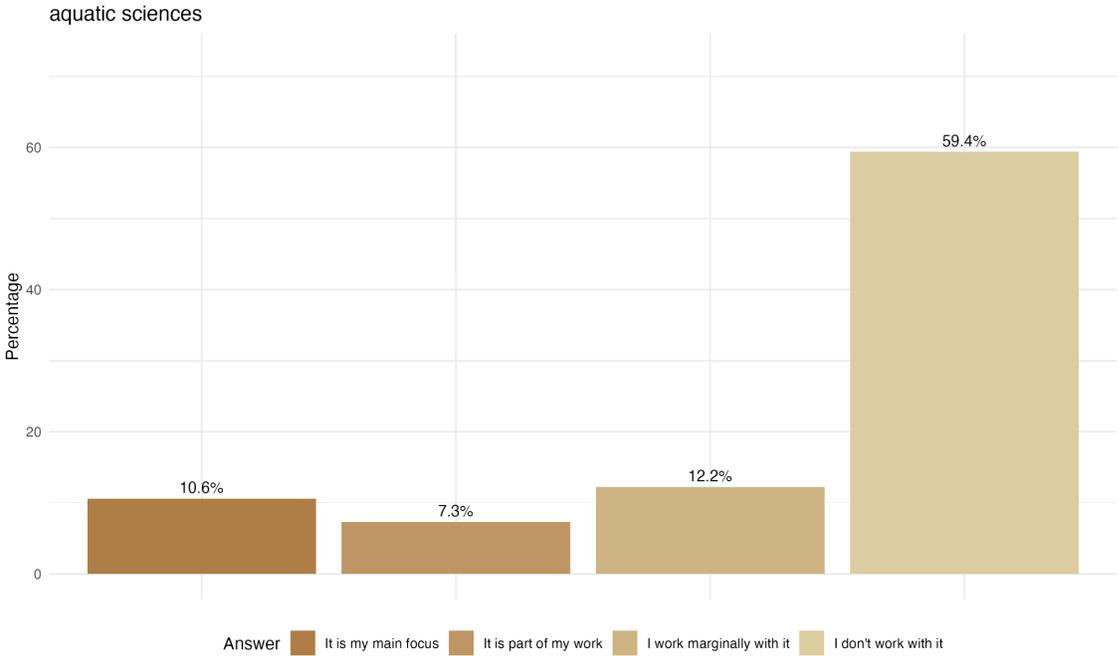
## Environmental chemistry:



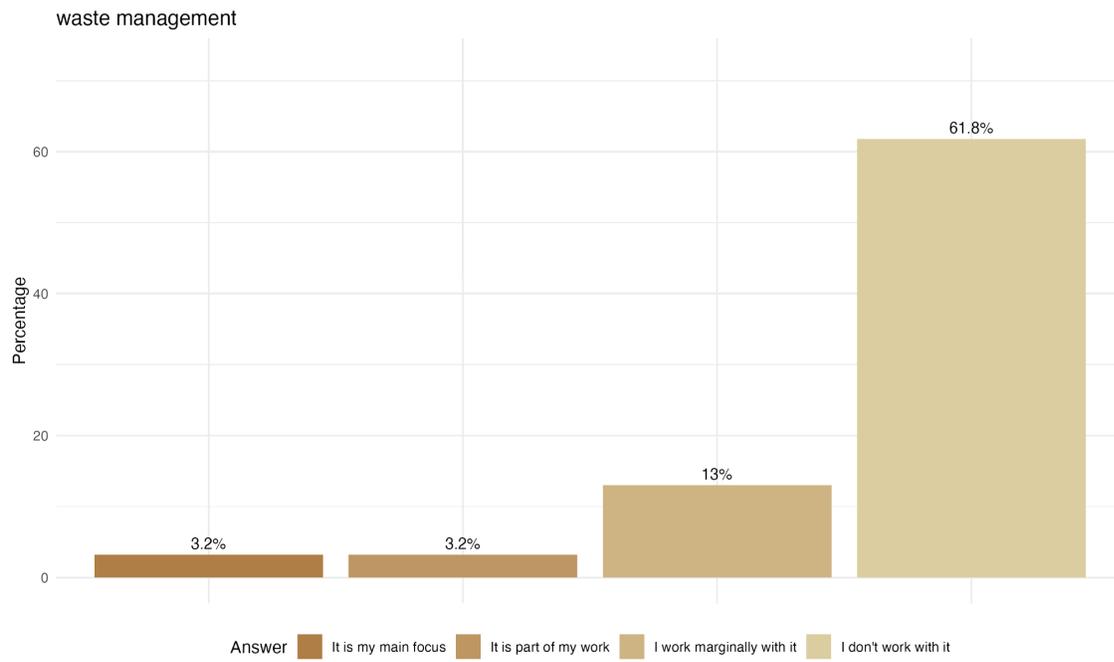
### Environmental technology:



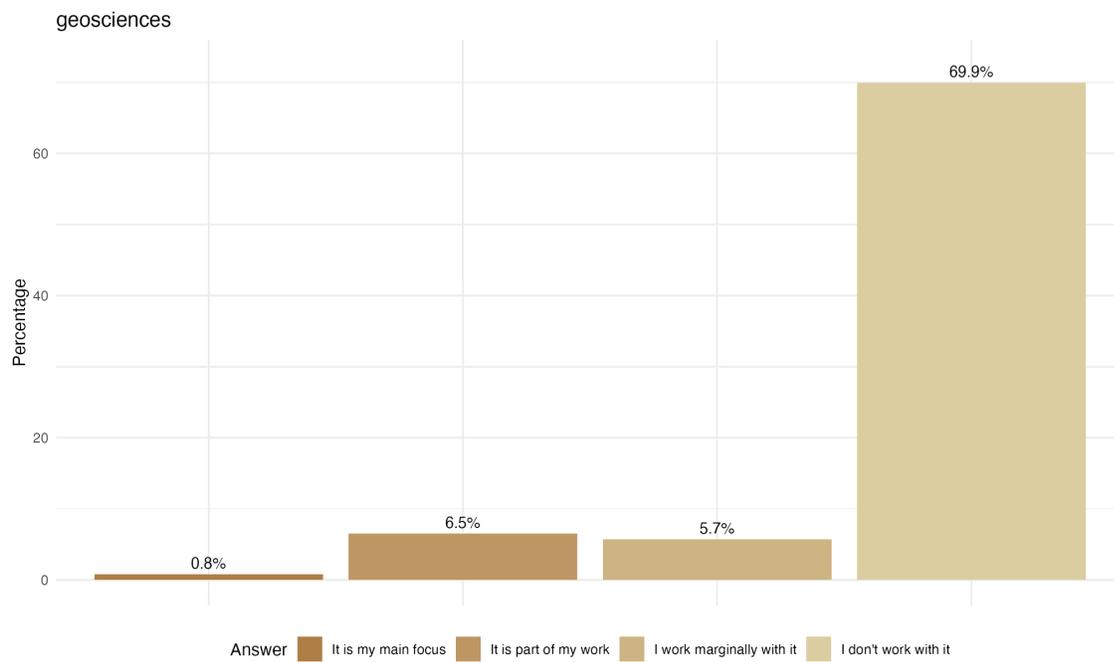
### Aquatic sciences:



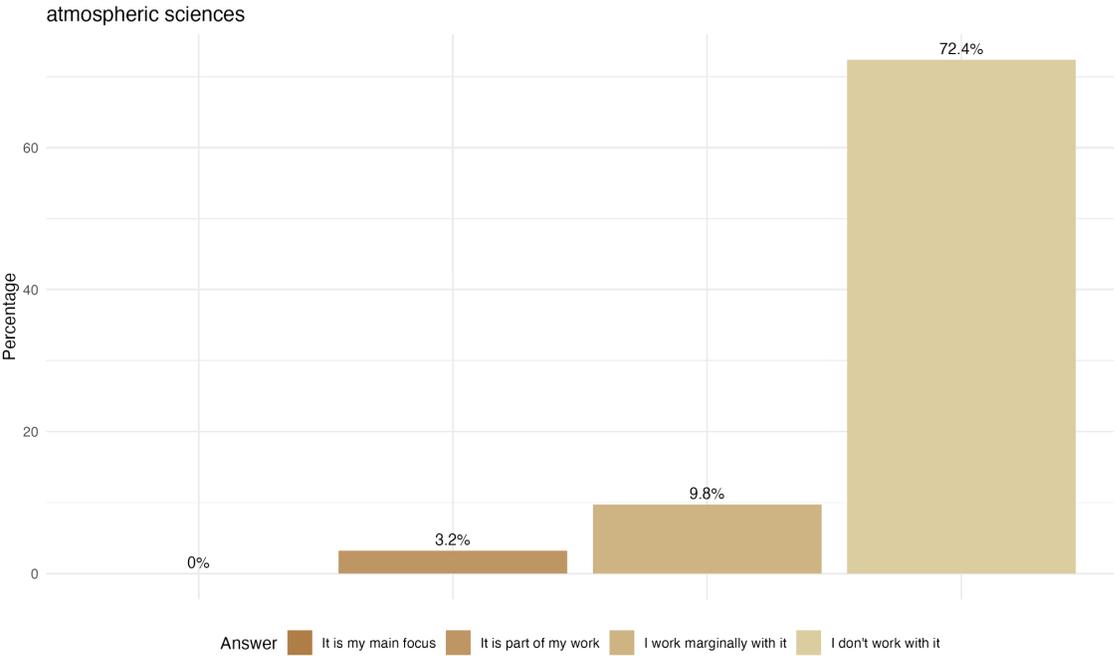
## Waste management:



## Geosciences:



Atmospheric sciences:







FUTURE  
ONE HEALTH



SCIENCE AND  
EDUCATION **FOR**  
**SUSTAINABLE**  
**LIFE**