

Grant Proposal

RestPoll: Restoring Pollinator habitats across European agricultural landscapes based on multi-actor participatory approaches

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Abstract

RestPoll is a transdisciplinary project aiming to provide society with tools to reverse wild insect pollinator declines and to position Europe as a global leader in pollinator restoration and set the future agenda for pollinator restoration worldwide. The RestPoll consortium combines the expertise of natural and social scientists, as well as representatives of NGOs, businesses and ministries. RestPoll - together with stakeholders ranging from individual land managers to public authorities - co-designs, evaluates and refines measures and cross-sectoral approaches to restore pollinators and their services. Central to RestPoll is the establishment of a Europe-wide network of pollinator restoration case-study areas with Living Labs, which are unique hubs for experimentation, demonstration and mutual learning at various spatial scales (field, farm, landscape, European scales), in landscapes dominated by intensively managed crops or grasslands. The RestPoll consortium explores, tests, evaluates and refines cross-sectoral pollinator restoration approaches to conserve biodiversity and to benefit nature and society. Our holistic approach also aims to engage in participatory planning and the development of new business models along the food value chain by engaging through newly-developed participatory approaches at diverse social, ecological and political scales. Learning outcomes are communicated to a diverse range of regional and European partners and collaborators, which allows for making a lasting impact beyond the end of the project.

Keywords

pollinator, pollination, restoration, agricultural landscapes, co-design, multi-actor, Living Labs, Europe

Proposal Information

This grant proposal was submitted as part of the HORIZON EUROPE Food, Bioeconomy, Natural Resources, Agriculture and Environment programme call HORIZON-CL6-2022-BIODIV-02-two-stage on "Maintaining and restoring pollinators and pollination services in European agricultural landscape". The proposal was successfully funded as a HORIZON Innovation Action. The project runs from 1 October 2023 until 30 September 2027. Grant agreement: 101082102. DOI 10.3030/101082102.

List of participants

University of Freiburg (UFR, coordinator); Technical University of Munich (TUM); Helmholtz-Centre for Environmental Research (UFZ); International Center for Advanced Mediterranean Agronomic Studies (CIHEAM-IAMM); Ecole Nationale Supérieure de Formation de l'Enseignement Agricole (ENSFEA); Yuri Fedkovych Chernivtsi National University (CYFNU); Lund University (ULUND); Aarhus University (AU); Center for Ecological Research and Forestry Applications (CREAF-CERCA); University of Thessaly (UTH); Hungarian Research Network Centre for Ecological Research (HUN-REN CER); Trinity College Dublin (TCD); Toulouse Institute of Technology (INPT); French National Institute for Agriculture, Food and Environment (INRAE); Inland Norway University of Applied Sciences (INN); Baltic Studies Centre (BSC); Institute of Agrifood Research and Technology (IRTA-CERCA); Wageningen University & Research (WU); Confederazione Generale dell'Agricoltura Italiana (Confagricoltura); Bükk National Park (BNPI); Association de Développement d'Amenagement et de Services en Environnement et en Agriculture du Gers (ADASEA32); Swedish University of Agricultural Sciences (SLU); HVR; Pennsylvania State University; Federal Department of Economic Affairs, Education and Research (Agroscope); University of Cambridge (UCAM); University of Reading (UREAD); Bumblebee Conservation Trust (BBCT); Avalon Limited (now part of AM Fresh); Innocent Ltd.; Ministerium für Ländlichen Raum, Ernährung und Verbraucherschutz Baden-Württemberg (MLR-BW); Ministry of the Environment, Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg (UM-BW).

Excellence

Objectives and ambition

The ambition of our proposed pan-European project RestPoll is to contribute to a substantial and permanent restoration of more pollinator-friendly habitats and enhance connectivity of wild pollinator habitats in Europe. The focus is on strengthening society-wide awareness of, and capability to reverse, wild pollinator decline and stabilise pollination services and their societal benefits. Agricultural land use, covering by far the largest proportion of terrestrial land modified by human activities, is

crucial for feeding humanity and the decisions on how farmers manage their land are a major driver for biodiversity change.

Pollinators are a fundamental part of both farmed and semi-natural habitats of the agricultural landscape and can act as flagships for wider ecosystem restoration (Klein et al. 2007, Cariveau et al. 2020). Nearly 80% of wild plants in Europe benefit from a range of pollinator taxa (Ollerton et al. 2011, Rodger et al. 2021). RestPoll synthesises existing knowledge of restoration for pollinator habitats from environmental and socio-economic sciences and practice, develop and apply new participatory approaches and involve multiple actors at diverse social, ecological and political scales to enable sustainable transformation of European farmed cultural landscapes in harmony with nature. Building on context-relevant understanding of which restoration measures benefit pollinators at different scales - generated by using a coordinated network of case studies - we use validated approaches for pollinator and pollination service monitoring. We monitor pollinators in existing restored and non-restored sites and develop innovative restoration and policy measures from regional to European scale. Part of our output is a portfolio of guidance and tools, which assimilate these top-down (incentive-, payment-, policy-driven) and bottom-up approaches to the management and monitoring of wild pollinators and their habitats. Our restoration guidance comprises of a toolbox, able to assess the ecological and socio-economic values of specific pollinator restoration measures in different management and policy landscapes. By quantifying multiple co-benefits of pollinator restoration for biodiversity and ecosystems and for human society in terms of economies, health and well-being, RestPoll engages in and accompanies societal transformation for diverse and sustainable agricultural landscapes. RestPoll uses a multi-actor approach involving participation across communities of different socio-cultural backgrounds and agricultural landscapes representing the range of bio-climatic regions in Europe.

The RestPoll consortium consists of an experienced team of junior and senior experts from different scientific disciplines in natural (biology, ecology) and social sciences (economics, sociology, political science) or cross-disciplines (landscape ecology, socio-ecological systems research) and stakeholder groups ranging from NGOs, ministries, national parks to businesses and agricultural advisory services. RestPoll works within seven integrated work packages (WPs) towards the following six specific objectives:

1. Create a network of pollinator habitat restoration initiatives and Living Labs :

RestPoll identified 17 case study areas (CSAs) in agricultural landscapes in 14 European countries. These cover multiple restoration measures to conserve biodiversity in general and wild pollinators in particular, which consist of a mixture of existing agri-environmental schemes and novel, prospective schemes. such as payments for pollination/ecosystem services. Restoration activities in the CSAs were partly already set in place by stakeholders in cooperation with RestPoll researchers or vice versa before the start of the project. In a joint participatory approach, restored and control sites are further selected at the start of the project from the different areas, aiming for the most optimal design to achieve successful pollinator restoration outcomes across European agricultural landscapes and to test the value of co-designing restoration measures. Across these

CSAs, we also establish a European network of Living Labs for participatory demonstration and learning and for assessing both bottom-up (management-driven) and top-down (policy-driven) pollinator restoration measures to identify effective methods to facilitate engagement with public and private organisations, along with civil society, to accelerate the transformation towards pollinator-friendly agricultural landscapes in line with societal needs in Europe (WP1, WP4).

2. Validate context-dependence and synergistic effects of multiple pollinator restoration measures: Based on synthesising current knowledge and detailed monitoring in CSAs, RestPoll validates the effectiveness and synergistic effects of multiple restoration measures currently in place or recently established at field, farm, landscape, national and European scales for providing key complementary resources, such as nesting habitat, forage resources across life-stages and seasons for pollinators and to sustainably increase pollinator populations and pollination services (WP1, WP2).

3. Demonstrate how to strengthen benefits and co-benefits of pollinator restoration for nature and people: By exploring the links between pollinators, plants and other elements of biodiversity to human well-being in agricultural CSAs, RestPoll quantifies the direct and indirect co-benefits of pollinator and pollination restoration for provisioning ecosystem services, such as crop production, human nutrition, health and cultural or aesthetic values, such as the beauty of landscapes and human well-being in general (WP2, WP3).

4. Support the development of pollinator-friendly policies and market conditions : RestPoll provides conditions for implementing and adapting measures to restore pollinators and pollination services into European policies and beyond. This includes evaluations of policies including barriers and negative incentives, alternative uses of the land under restoration, as well as risks, costs and benefits of restoration options and alternative land uses. Governance of restoration incentives, including financing and simplified bureaucracies are evaluated across CSAs, regions and countries (WP3, WP4).

5. Test co-designed transferable tools for adaptive pollinator restoration : By developing a Pollinator Restoration Toolbox, which will be available to users at local, national and European levels, the RestPoll consortium reinforces the status of Europe as a global leader in adaptive pollinator management, including rapid assessment evaluations, for pollinator and habitat restoration and developing transferable approaches for countries both within and beyond Europe (WP5).

6. Provide open access to knowledge on pollinator restoration: RestPoll co-develops open-access resources of already existing and newly-generated data, traditional and expert knowledge and tools to enable researchers and stakeholders across relevant scales to compare the benefits of existing and forthcoming initiatives and to prioritise restoration measures that promote pollinator diversity across Europe (WP5, WP6, WP7).

RestPoll builds upon our current understanding of important restoration measures for the full range of wild and managed pollinators, including ecology-, economy- and

community-focused approaches, to produce a new evidence base, which enables a holistic demonstration of their applicability and effectiveness. Furthermore, RestPoll develops innovative assessment methods that enable stakeholders to prioritise different measures of the restoration of pollinator habitats at multiple temporal and spatial scales. Public, political and scientific actors in pollinator conservation have driven the implementation of restoration measures for pollinators across the EU and beyond (Wilson et al. 2017). Indeed, there is great potential for conservation actions to be implemented in a range of sites in agricultural landscapes (Tonietto and Larkin 2017). Although an abundance of online material promotes pollinator conservation, a better understanding of how some actions actually contribute to pollinator and pollination restoration is required (Majewska and Altizer 2019). Some general measures for insect conservation have been articulated (Harvey et al. 2020), but context-specific, tailored and actionable solutions are still in short supply. **RestPoll uses rigorous evidence assessment to validate the effectiveness of measures for reversing pollinator decline and to develop and empirically test methods for predicting and monitoring the utility of strategies designed to change human behaviour and promote activities aimed at restoring pollinator habitats** (Reddy et al. 2016, Green et al. 2019).

While there is a growing understanding of how to assess the multiple values of nature to account for the plurality of worldviews, knowledge and value systems (e.g. see Pascual et al. (2017)), there is a gap in methodological approaches that directly focus on pollinator impacts on human well-being, especially from a socio-cultural viewpoint (IPBES 2016, IPBES 2022). **RestPoll reviews and assesses how stakeholders perceive wild pollinators and the direct and indirect social benefits provided by them, in terms of human health, cultural and other values.**

Methodology

a) Overall concept

Research on wild pollinator conservation in agricultural landscapes has shown that the reduction of semi-natural habitats, isolation of crop fields from those habitats and extensive use of agrochemicals are the primary drivers responsible for declines in wild pollinator diversity and pollination services to crops (Dicks et al. 2021). One response to these findings is maintaining, restoring and establishing flowering habitats near crop fields to increase wild pollinator populations. Restoration measures, other than flowering strips on arable land, are rarely studied with respect to wild bee and other insect pollinator populations, their diversity and pollination services and also, for flower strips, many questions remain open. Additionally, little is known about the co-benefits (such as wider biodiversity or cultural values) of different restoration measures and their direct and spill-over effects on entire landscapes and society at large. For example, restoration studies up to today mainly measure the attractiveness of the restored habitat, but not the effects on maintaining pollinator populations in the wider landscape. Reconnecting biodiversity protection and farming requires understanding the full range of benefits and co-benefits of restoring pollinator habitats as well as the motivations, barriers and

necessary incentives that drive (or prevent) stakeholders along the agri-food chain to invest in or promote the creation of pollinator-friendly agricultural landscapes and production. In our pan-European project, RestPoll addresses these major knowledge gaps in line with our conceptual framework to restore pollinator habitats across European agricultural landscapes, based on multi-actor participatory approaches (Fig. 1). Through transdisciplinary research and strong networking with other pan-European projects, RestPoll enables scale-specific prioritisation of restoration measures to quantify links between pollinator diversity and pollination services and to determine the wider effects of pollinators and co-benefits of restoring pollinator habitats. At the same time, we develop a comprehensive toolbox to support key stakeholders to take appropriate action themselves to reverse pollinator decline. All parts of the methodology comply with the “do no significant harm” principle as per article 17 of Regulation (EU) No. 2020/852.

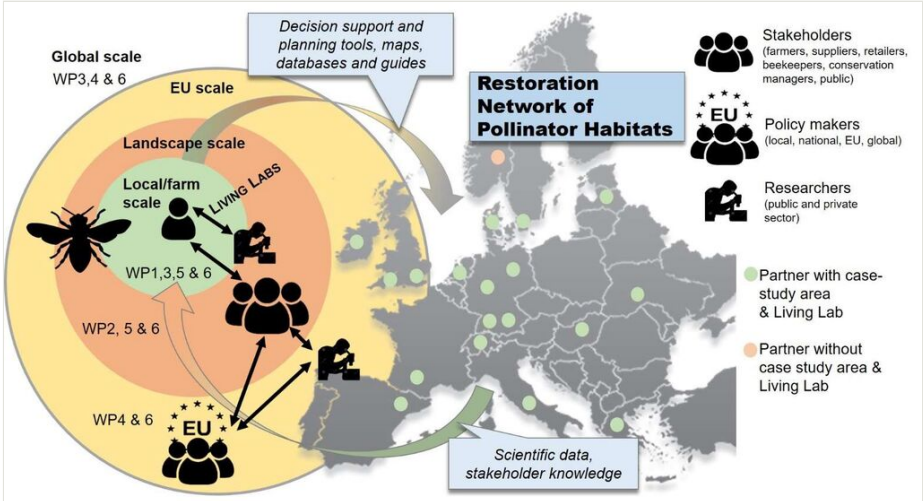


Figure 1. [doi](#)

Relationships amongst the work packages (see below), scales covered by RestPoll (field/farm-to landscape, European and global) and the distribution of partners. All partners, except one, establish a case-study area forming the restoration network. In a continuous multi-actor approach, Living Labs are established in all case-study areas of the restoration network, covering different climates, geographies, histories, land cover and land use, socio-economic characteristics, policies and levels of public engagement in restoring habitats for pollinators.

RestPoll identifies and develops novel methods and tools for restoration decisions, based on the best available scientific and stakeholder knowledge, as well as by creating new knowledge usable by both experts and non-experts. These are achieved by creating a network of pollinator restoration areas in at least 17 case-study areas in 14 countries across Europe (Fig. 1, Table 1). We choose three major restoration measures currently seen as being most important for pollinators: 1) improved nesting habitat, 2) improved flowering resources, and 3) reduction of agrochemicals in terms of pesticides and fertilisers.

Table 1.

Case-study areas of our European pollinator restoration network with information about the land-use type, the design approach (co-designed: ≥ 2 parties), extent of engagement (multi-actor ≥ 3 actors of a value chain from research to end users), the different restoration measures (improving nesting habitats, improving flower resources, reducing agrochemicals or a combination) and if restoration efforts are additionally at the landscape scale (all are conducted at the local/site scale). “Yes&No” = non-co-designed & co-designed sites available. All case-study areas have also non-restored sites as controls.

Region	Partners	Brief description	Co-design	Multi-actor engagement	Nesting	Flowers	Agro-chemicals	Landscape
Møn, DK	AU	Extensive grassland	No	No	x	x		
Occitanie, FR	ENSFEA, IAMM, INRAE, ADASEA32, INPT	Extensive grassland	Yes	Yes	x	x		x
Baden-Württemberg, DE	UFR, UM-BW, MLR-BW	Farmland	Yes&No	Yes	x	x	x	x
Brandenburg, Mecklenburg-Vorpommern, Lower Saxony, DE	TUM	Farmland	Yes&No	Yes	x	x	x	
Saxony-Anhalt, DE	UFZ	Arable farmland	No	No	x	x		
Eastern Macedonia-Thrace, GR	UTH, IAMM	Kiwi orchard	Yes&No	No	x		x	
South-Heves, HU	HUN-REN CER, BNPI	Farmland	Yes	No	x	x	x	x
Kildare, IE	TCD, NBDC	Farmland	No	No	x			
Puglia, IT	Confagricoltura	Farmland	No	Yes	x	x	x	
Latvia (Vidzeme region), LV	BSC	Extensive grassland	Yes	Yes	x	x		
Boshommel L. Geuldal, NL	WU	Arable farmland	Yes	Yes		x		x

Region	Partners	Brief description	Co-design	Multi-actor engagement	Nesting	Flowers	Agro-chemicals	Landscape
Catalonia, ES	CREAF, IRTA	Fruit orchard	Yes	No	x	x	x	
Skåne, SE	ULUND	Arable farmland	Yes	Yes		x		x
Valais, CH	WBF	Mixed farmland	Yes	Yes	x		x	x
Kent, GB	UREAD, Avalon, Innocent	Fruit orchard	No	No	x	x		
Somerset, GB	UCAM, BBCT	Mixed grassland	Yes	Yes	x	x		x
Chernivtsi, UA	CYFNU	Flowering habitats	Yes&No	Yes		x	x	x

We listed our CSAs according to the completeness of the restoration efforts (Table 1). All CSAs already had restoration measures established before the project started or established them within the project start. Before the project started, five case-study areas have completed restoration efforts of improving flower resources and nesting habitats and reduced agrochemicals, six have improved nesting habitats and flowering resources, but no reduction of agrochemicals, two have improved nesting habitats and agrochemical reductions, one has improved flowering resources and reduced agrochemicals, one has improved nesting habitats only and two have improved flowering resources only. Eight locations have specifically been targeted to restore the overall landscape, while all are established at the level of particular sites, for example, several orchards in a landscape. Restoration measures are to a large extent co-designed by different regional to national actors (e.g. beekeepers, farmers, food companies, ministries, NGOs, seed retailers or their organisations) in pre-existing collaborations with RestPoll researchers. All 17 areas have already established at least one restoration measure before the project started. Five areas have sites that are either co-designed by at least two parties (e.g. researcher and farmer) or non-co-designed. In eight areas, all sites are co-designed and, in four areas, all sites were co-designed and established with the start of the project. Eleven CSAs have already more than three actors of the value chain from research to end users involved (Table 1). Ten CSAs were already planning multi-actor workshops for knowledge exchange not funded by RestPoll. Other partners obtain funding to offer multi-actor workshops and invite actors to contribute to research activities in our Living Labs (see WP4). Four countries already incorporated citizen-science approaches to establish, maintain and document the restoration measures, although these were not all co-designed. These activities are responses to observed pollinator declines and were, therefore, established before the start of RestPoll.

The main restoration measures applied in the RestPoll CSAs include creating nesting habitat, establishing annual and perennial flowering resources and reducing pesticide and fertiliser use in fruit orchards, arable mono- and polycultures, grasslands and agroforestry systems in farmed land, as well as in private and public spaces. Additionally, established forest restoration sites with long-term bee monitoring data are available at the University of Freiburg to complement our farmland restoration measures. In summary, our proposed restoration network of pollinator habitats represents different initial levels of public and policy engagement in pollinator restoration, from high (e.g. DE: high-profile national strategy driven by popular petitions) to low (e.g. LV: low awareness, no focused national policy, sporadic initiatives), in the context of different natural and anthropogenic pressures. Finally, our US partner is involved in multiple pollinator restoration measures across agricultural landscapes in North America and builds up on tools and knowledge of the Integrated Crop Pollination (ICP) project.

Positioning of the project with reference to Technology Readiness Levels (TRL)

RestPoll uses and adapts approaches to increase biodiversity and ecosystem services applied by preceding projects (see below: c) Collaboration with nation and international research and innovation activities). Monitoring methods align with the EU Pollinator Monitoring Scheme (EU-PoMS). Throughout the project, RestPoll drives the development of tools and processes from basic principles to operational systems. Examples include:

1. tools for rapid assessment of restoration success, incorporating participatory methods (TRL7);
2. indicators to enable farmers or citizen scientists to identify ecological benefits and co-benefits of pollinator restoration (TRL7-8);
3. methods for evaluating the non-market values of pollinators and pollination services (TRL7); and
4. transferable templates for pollinator restoration strategies/initiatives (TRL9).

b) Structure of the project

The backbone of RestPoll is our pollinator restoration network, including different types of intensively-farmed agricultural landscapes in urgent need of restoration, as well as landscapes hosting species of conservation concern. The underlying concept is that these areas provide bundles of benefits, including food, social and cultural values, as well as supporting biodiversity conservation and that restoration measures should optimise the provision of these values in ways that meet stakeholder requirements, including minimised conservation-crop productivity trade-offs. To maximise stakeholder engagement, RestPoll builds on and adds value to, well-established partnerships and projects to ensure successful long-term collaborations. The RestPoll consortium is organised into seven work packages (WPs), each with a leader and two co-leaders from different institutions and a balanced mix of natural and social researchers. This structure ensures coherent inter-disciplinary research across the project.

WP1: Establishing and testing co-adaptive management in a European pollinator restoration network (Lead: UFR / Co-lead: INP and WU)

This overarching WP, in collaboration with all WPs and stakeholders, implements and uses a co-design approach to continuously modify our multi-actor case-study network. This approach ensures that stakeholders are integrated into the design, implementation and evaluation of research, demonstration and learning activities throughout the pollinator restoration network (Task 1.1). WP1 provides standardised field protocols and simpler guides for different users to monitor wild pollinators and pollination services to crops and wild flowers aligned with those being developed by the EU Pollinator Monitoring Scheme (EU-PoMS; Task 1.2). These deploy in a broad spectrum of restoration measures ranging from: diversified farming including agroforestry systems, agrochemical reductions (under IPM and organic-certified management), enhanced habitat connectivity, provision of flowering and nesting habitats to the restoration of grassland and forests at site- and farm-scale or beyond when used to increase connectivity. WP1 validates the effectiveness of multiple restoration measures at the field scale (Task 1.3). Comparison of pollinator diversity (including inter- and intra-specific trait measures of species) and pollination success of wild and crop plants between restored and unrestored sites across our case-study network enable us to demonstrate the effectiveness of restoration measures for pollinator communities and pollination success for each case-study area and for different restoration measures. We produce a series of publications at the national level in their specific languages, targeting land users and a summary overarching multi-language policy report with specific recommendations. Rapid assessment measures and tools identify, co-develop and evaluate in WP5 and with our US partner within this WP (Task 1.4).

WP2: Demonstrating context dependency, scalability and synergies across pollinator restoration measures at the landscape scale and beyond (Lead: ULUND / Co-lead: UFZ and IAMM)

Initially, WP2 systematically reviews the literature on effects of a diversity of restoration measures on pollinator diversity, functional groups, population dynamics, and pollination services from farm- to landscape-scales (Task 2.1). Together with stakeholders and WP1, this WP uses the CSA network to evaluate context dependency, up-scaling potential and synergies of the implemented pollinator restoration measures (Task 2.2). Landscape stratified pollinator monitoring (designed in Task 1.2) is re combined with spatially explicit land-use/cover information in dynamic models to evaluate restoration measure context dependency and landscape-wide consequences for pollinator populations. Landscape-level restoration success criteria are identified in relation to factors limiting pollinator populations and region-specific challenges and opportunities. Synergistic effects of multiple restoration measures are evaluated, based on selected case study areas, specifically those with long-term data, capturing spatio-temporal variability in both restoration efforts and pollinator populations and communities. With this, we identify opportunities for improving the design of pollinator restoration measures (Task 2.3;

feeding into WP3-WP5). Finally, WP2 uses multiple models to assess water and soil quality co-benefits of pollination restoration measures from farm- to landscape-scale (Task 2.4), with outcomes feeding into bio-economic models (Task 3.3). Integration of comprehensive measures across scales are discussed with stakeholders in collaboration with WP3-WP5, to develop best practices on how to design pollinator restoration measures at landscape scales, which is fundamental for the improvement and adoption of future restoration measures meeting ecological, economic and social objectives.

WP3: Assessing socio-economic co-benefits, barriers and incentives for pollinator restoration (Lead: ENSFEA / Co-lead: AU and WBF)

WP3 creates, studies and analyses the feasibility of an innovative instrument: Payments for Restoration-mediated Pollination Services (PRPS). This PRPS is based on the principle of the Payment for Ecosystem Services scheme as it is proposed in the Common Agricultural Policy. This economic tool aligns with the Farm to Fork strategy that emphasises a transition to result-based payments, but includes more specific actions for wild pollinator restoration. The feasibility of this instrument is also critically evaluated. In the continuity of WP1 and 2, WP3 is situated at the farm- and landscape-scale in the different co-designed case study areas of RestPoll. This WP specifically:

1. assesses the perception of potential adopters of RestPoll measures;
2. develops a novel instrument, the PRPS;
3. estimates the feasibility and added value of this instruments; and
4. values the impact of wild pollinators and these instrument in the food value chain.

A detailed survey:

1. identifies and characterises the current status of wild pollinator restoration, identifies how farmers perceive economic benefits (marketed and non-marketed) and risks from the restoration measures; and
2. analyses the awareness of farmers towards wild pollinators and their willingness to protect them (Task 3.1).

This survey includes beekeepers and, more broadly, land users in the case-study areas where trade-offs with respect to pollinator management emerge. This is the basis for the development of a novel instrument based on Payments for Restoration-mediated Pollination Services (PRPS) and testing its transferability by assessing barriers and costs of payment schemes in panel meetings with different actors, including the wider public. WP3 also organises focus groups in each CSA to engage local stakeholders in co-designing policy scenarios, based on the re-orientation of the existing policy instruments and the innovative PRPS (Task 3.2). We then estimate the impact of implementing these scenarios at the scale of the different areas of each case study. For this purpose, existing bio-economic models (e.g. Farming System Simulator [FSSIM] & Dynamic Agricultural Household Bio-Economic Simulator [DAHBSIM]) are used to evaluate the socio-economic (e.g. incomes, input uses, labour availability etc.) and environmental (e.g. pollinator dynamics, carbon sequestration, water and soil quality etc.) impacts of different

restoration measures and alternative and novel management practices to promote pollinators in the case-study area network (Task 3.3). Finally, WP3 estimates the values added by wild pollinators to the food value chain (Task 3.4). More precisely, we estimate the impacts of pollinator shifts on price transmission and estimate the economic value of marginal shifts in pollination services on the income of these value chain actors. The results are synthesis-led for local public and private decision-makers and fed into WP5 to provide information for the development of new tools and policy options.

WP4: Enabling conditions for long-term pollinator restoration and Living Labs (Lead: AU / Co-lead: UCAM and INN)

An overarching objective of WP4 is to facilitate the establishment of “Living Labs” (LLs) in all case-study areas on top of the restoration network of pollinator habitats in RestPoll (Task 4.1). The LLs use the CSA sites as a unique experimentation, demonstration and learning network for habitat restoration across large areas of Europe (RestPoll Living Lab Network) to facilitate farmer-to-farmer, farmer-to-researcher and farmer-to-policy-maker knowledge (traditional to new-evidence-based knowledge) exchanges. Another overarching objective is to facilitate the upscaling of results from WP3 to the European and (where possible) global scale. While WP3 assesses existing regional (e.g. state level in Germany) and national policies, WP4 assesses European policies (e.g. CAP strategic plans, Biodiversity 2030 strategy, EU-PI actions) with direct and indirect effects on pollinator restoration measures and identifies incentives harmful to pollinators (Task 4.2). The research is based on a review of existing European and global policies including new initiatives under the CAP Strategic Plans and by considering the new EU Biodiversity Strategy, new EU Pollinators Initiative and the Farm to Fork Strategy. This includes an assessment to highlight policy coherence/incoherence at national and European scales by documenting the synergies and trade-offs with related policy arenas (such as climate change mitigation, promotion of nature-based solutions and nutrient management). Further, the assessment documents best practices of policy implementation, including opportunities for managing trade-offs and integrating pollinator restoration with other societal goals, like carbon sequestration, nutrient management and biodiversity conservation (Task 4.3). The establishment of LLs in case-study areas facilitates collaborative social learning amongst researchers, local stakeholders and actors across scales of governance within and beyond CSAs. Annual multi-actor LL workshops ensure a continuous stakeholder dialogue throughout the project. LLs are used to document, demonstrate and enhance pollinator restoration measures, as well as identify the enabling policy and market conditions of such initiatives. Further, LLs are used as a forum for experience exchange and peer-to-peer learning amongst practitioners across case-study areas in RestPoll. During workshops and other interactions in the individual LLs, horizon scanning towards strengths, weaknesses, opportunities and threats for regional pollinator restoration measures are conducted and compared across the CSAs in Europe (Task 4.4) and used in the RestPoll toolbox for WP5. Furthermore, the LLs provide an assessment of the opportunities and barriers for

developing a pollinator restoration toolbox for WP5 and feed into a roadmap for improving enabling conditions for pollinator restoration.

WP5: Integrating assessment tools for decisions, education and evaluation
(Lead: UCAM / Co-lead: UTH and TCD)

WP5 takes stock of available decision support, planning or other software tools or guidance to support management for pollinators in agricultural landscapes. This involves wide stakeholder consultation, including electronic and social networks and literature review (Ratto et al. 2022). We include and expand on AI-based Apps (e.g. BienABest, iNaturalist, prototypes of Apps developed by partners, for example, Spiesman et al. 2021, van Klink et al. 2022) for pollinator identification from different regions and relevant decision support tools for pollinators identified or developed by the implemented pan-European projects, Safeguard and SHOWCASE. To evaluate and communicate the effectiveness of pollinator restoration measures and enable evidence-based decision-making, we collate and assess scientific evidence and technical knowledge (Task 5.1), following the well-established method “Subject-wide Evidence Synthesis” (Sutherland et al. 2019). Outcomes would be published on the fully open access online resource ConservationEvidence.com, which is also to be integrated into the RestPoll website. We work with stakeholders in each RestPoll case-study area, using focus groups and workshops to evaluate available tools, prioritise those for inclusion in a RestPoll toolbox and identify gaps for new tool development (Task 5.2). The most promising tools are taken forward as the basis of the capacity-building effort in WP6 and are tested and evaluated in WP1. We also undertake a consumer survey (with WP3), assessing willingness to purchase agricultural products and foodstuffs produced in a pollinator-friendly way and Willingness To Pay (WTP) a premium for these products (Task 5.3). The consumer survey design applies the Theory of Planned Behaviour (TPB) model. It aims to identify specific market segments that are positively-orientated towards pollinator conservation, increasing the effectiveness of tailored marketing strategies to establish innovative, ‘pollinator-positive’ value chains. In collaboration with retailers, suppliers, growers and third-party certification schemes, we co-design metrics suitable for reporting and labelling pollinator-friendly products and products grown in pollinator-friendly systems and develop a potential business model around these, informed by previous outcomes of WP5 (Task 5.4). The RestPoll toolbox contains a range of tools tailored to the restoration-environmental, operational-economic needs of the key stakeholders (e.g. growers, suppliers, extension services, beekeepers, conservation managers) including a help-desk. Initially, the toolbox is hosted on the RestPoll website and, in the final year of the project, contents will be migrated to the European Commission's HIVE and potentially also to the FAO's International Pollinators Initiative website (Global Pollinator Platform).

WP6: Communicating and exchanging knowledge and engagement (Lead: HVR / Co-lead: TUM and UFR)

The objective of WP6 is to foster social learning and contribute to behavioural and institutional change to upscale and broaden pollinator conservation through effectively communicating the project results and engaging diverse actors in the future use and uptake of results. WP6 facilitates the RestPoll overall communication, engagement and impact strategy together with other project partners of WP1, 3, 4 and 5 and delivers a unique project brand (Task 6.1). An engaging and dynamic website with integrating e-learning and open access archiving functions serve as the main communication and knowledge exchange interface for RestPoll to engage with policy-makers, practitioners, business actors and researchers (Task 6.2). Specific tools and actions are deployed to enable social engagement throughout the project (Task 6.3). Social media activities (on Twitter (X) or Bluesky, LinkedIn, Instagram) give strong visibility to the project at cross-country and international levels and maximise outreach towards farmers and citizens (including children and young people). Short educational videos, as well as public events organised yearly on for example, World Bee Day and as part of EU Pollinator Week, are offered to enhance the general knowledge of society about wild pollinators and the habitats and landscape management strategies that safeguard them. Finally, WP6 supports trans- and multi-disciplinary training, networking events and teaching material for various stakeholder groups, with special emphasis on farmers, agricultural schools and extension specialists, beekeepers, business actors, farm advisors and public administration bodies (Task 6.4). These events include both physical events and webinars and are build on collaborations with existing, well-known and respected dissemination platforms and knowledge exchange structures linking people and nature.

WP7: Coordinating, networking and data management (Lead: UFR / Co-lead: UREAD, BSC)

WP7 is responsible for central coordination and administration of the entire project and oversees the administrative and scientific project management and reporting (Task 7.1). WP7 also provides continuous networking amongst all relevant stakeholders within and outside the consortium. This includes expanding the existing networks between relevant H2020/Horizon Europe projects (such as the cluster of nature-based solutions of H2020 projects) and other projects and initiatives with a focus on pollinator conservation. These important networking activities engage joint activities and communications to ensure H2020/Horizon Europe complementary research and knowledge exchange. Finally, WP7 ensures that all data gathering conforms to GDPR through its Data Protection Officer (Task 7.2) and that the project both internally and externally is run in line with the principles of responsible research and innovation (incl. gender and ethics; Task 7.3). The RestPoll case-study area network information are linked (via an API) to the Oppla Platform. WP7 also provides online training for data management in multi-actor projects including a detailed RestPoll data management plan, meta-data training following standards of ABCD (Access to Biological Collection Data) and AgMES (Agricultural

Metadata Element Set). Protocols, recommendations and data are published open access and data management and publications are coordinated in strong collaboration with Safeguard, SHOWCASE and SPRING by adapting their open access and publication rules including compliance with the FAIR principles of data publications and involving rapid data archiving in permanent online repositories. Finally, WP7 oversees the creation and involvement of a high-level Advisory Board drawn primarily from our collaborations with global pollinator policy experts (e.g. DG AGRI, EU PI, FAO, EEA, ENV, IEEP), industry (e.g. Bayer, BASF, ELO, Syngenta, COPA-COGECA) and NGOs (Conservation International, Endangered Landscape Programme UK, IUCN, WWF).

c) Collaboration with national and international research and innovation activities

RestPoll benefits from links with a significant array of international and national research and innovation, engagement, policy and conservation activities. Our partners currently lead, have led or will lead or play/have played key roles in many global, European and national projects. RestPoll benefits uniquely from the experiences, stakeholder networks and outputs of these projects (see Table 2 for a selection of international actions to highlight the most relevant links to RestPoll). Specifically, several partners (UFR, ENSFEA, TCD, TUM, ULUND, UREAD, UFZ, WBF, WU) have/had leading roles in coordinated European research and monitoring projects and implementations related to pollinators and pollination ([EU-PoMS](#), [EcoFruit](#), [NutriB2](#), [PoshBee](#), [Safeguard](#), [SPRING](#), [STEP](#), [SHOWCASE](#), [SuperB](#), [MAMBO](#)), generating scientific information on drivers of trends in wild pollinator populations and tools for assessment and monitoring of pollinator diversity and health across Europe. Partners have played and/or play leading roles in science-policy innovations (UFR, TCD, ENSFEA, UCAM, ULUND, UREAD), including the IPBES Assessment of Pollinators, Pollination and Food Production and Assessing and implementing the diverse values of nature in real-life decisions, for example, EASAC policy report on risks of neonicotinoid pesticides in agriculture, EFSA work on risk assessment of pesticides for bees and the Eklipse project to produce guidance on knowledge-synthesis methods for science-policy mechanisms. All partners are leading experts in diverse projects focusing on people and nature, agriculture and sustainable development at the EU level, including [MAMBO](#) (EU Horizon Europe); [AgriLink](#), [ALL-Ready](#), [MIXED](#), [PLAID](#), [SALSA](#), [NoAW](#), [EMPHASIS](#), [TOMRES](#) (EU H2020); [QuESSA](#), [LIBERATION](#), [STEP](#) (EU FP7); [ECODEAL](#), [OBServ](#), [FarmLand](#) (EU BiodivERsA); and at national levels, for example, [GreenHort](#) (ERDF Latvia), [INCASE](#) (Irish EPA), [SustainScapes](#) (Novo Nordisk Foundation). Of significance, RestPoll partners play key roles in global (e.g. FAO, CBD, IPBES, IPCC) (UFR, UREAD, UFZ) and national (TCD, UFR, UCAM, ULUND, UREAD, INP) pollinator conservation strategies or policy consulting. Overall, this diversity of strong links enables RestPoll to be uniquely positioned in terms of integration with past, current and future activities at national, European and global levels.

Table 2.

Summary of the most relevant recent and ongoing international research and innovation activities whose results will feed into RestPoll and the action taken to establish the collaborative links. The table has been updated since the proposal to include newly-funded projects that are relevant or related to the RestPoll project. Leads are indicated in bold.

Projects	Relevant outputs and links	RestPoll Partners	Website
SPRING (2021-2023)	We use and adapt the protocol from the EU Pollinator Monitoring Scheme (EU-PoMS) that will be created during this project for the monitoring protocol	UFZ , HUN-REN CER, ULUND, UREAD, AU	https://www.ufz.de/spring-pollination/index.php?en=49053
STEP (2010-2015)	We use data on trends and the EU Red Lists to establish indicators of different restoration levels and scales	UFR, ULUND, UREAD , WU, UFZ	http://www.step-project.net/
SuperB (2014-2018)	We extend policy analysis and analyse perceptions and barriers in business and economic models to enable valuation of payments to restore pollinator diversity and pollination	UFR, TCD, UREAD, WU, HUN-REN CER, UFZ, UCAM	http://superb-project.eu/
EcoFruit (2015-2018)	We use data from implemented agro-Environmental Schemes not co-designed to access the value and impact of co-design	UFR , CREA-F-CERCA	https://www.biodiversa.eu/2022/10/31/ecofruit/
Eclipse (2016-)	We employ the developed knowledge synthesis methods to evaluate pollinator restoration success evidence concerning the policy cycle	UCAM, UFZ	https://eklipse.eu/
IPBES (2012-)	We identify knowledge gaps related to pollination services (variety-related analysis, payment schemes for pollination services)	UFR, UCAM, UFZ, UREAD , CER, CREA-F-CERCA	https://www.ipbes.net/
PoshBee (2018-2023)	We use gained knowledge on pesticide exposure to develop landscape-scale restoration success criteria and to model risks to develop pollinator risk indicators	UFR, TCD, UFZ, ULUND, UREAD, BBCT	https://poshbee.eu/
NutriB2 (2020-2023)	We use the data on pollen quality and bee pollen needs to develop restoration success criteria	UFR, TUM	https://nutrib2.project.uj.edu.pl/
SHOWCASE (2020-2025)	We share knowledge and data on co-design to evaluate the most effective incentives, marked and non-marked values to restore wild pollinators	UREAD, WU	https://showcase-project.eu/

Projects	Relevant outputs and links	RestPoll Partners	Website
Safeguard (2021-2026)	We are sharing knowledge on assessment, especially related to monitoring and rapid assessment to complement each other's project goals	UREAD, UFZ, WBF, WU, HVR, CER, BBCT, ULUND	https://www.safeguard.biozentrum.uni-wuerzburg.de/
MAMBO (2022-2026)	We share knowledge and data on monitoring and tools developed to evaluate habitat conditions	UREAD, UFZ, AU	https://www.mambo-project.eu/
New EU projects			
PollinERA (2024-2027)	We share knowledge on tools used for monitoring pollinators that are co-designed	AU, ULUND, SLU	https://pollinera-horizon.eu/
WildPosh (2024-2027)	We use knowledge on pesticide exposure to develop landscape-scale restoration success criteria and to model risks to develop pollinator risk indicators	UFR, UFZ, UREAD,	https://wildposh.eu/
AGRI4POL (2025-2028)	We sample at overlapping Living Labs and share similar stakeholders. Tasks and goals will build upon each other.	UFZ, UREAD, WU, ULUND, UFR, WBF	https://agri4pol.eu/
VALOR (2025-2028)	We sample at overlapping Living Labs and share similar stakeholders. Tasks and goals will build upon each other.	UREAD , SLU, UFR, WU, ULUND	https://valor-project.eu/
BUTTERFLY (2025-2029)	We sample at overlapping Living Labs and share similar stakeholders. Tasks and goals will build upon each other.	IAMM, ENSFEA, UTH, TUM, AU, UFZ	https://butterfly.project.uj.edu.pl/start
ProPollSoil (2025-2029)	We sample at overlapping Living Labs and share similar stakeholders. Tasks and goals will build upon each other.	TUM , UTH, UFZ, AU	https://www.propollsoil.eu/
EU Pollinator Hub (2024-2026)	We share knowledge and data for creating general guidelines of management.		https://pollinatorhub.eu/

d) The multidisciplinary and diverse character of the project

The multi-disciplinary and multi-actor RestPoll consortium are used to encourage an integrated, trans-disciplinary approach to restoring habitats for pollinators, their benefits for the value chain, as well as to integrating biodiversity into farming systems. The expertise of partners is complementary, which is integrated into leadership of the work packages (Fig. 1). The core of RestPoll is the establishment of case study areas with Living Labs where co-design and communication between local stakeholders and scientists are facilitated. World-leading conservation and pollination ecology scientists with expertise in undertaking monitoring, empirical studies, as well as meta-analyses,

unite with socio-economic scholars, based on long-term previous collaborations. Commercial organisations facilitate the development, as well as the establishment of pollinator-friendly labels facilitating investment in biodiversity independent of governmental subsidies. NGOs, conservation projects and national parks feed in with hands-on experience in restoring habitats and protecting pollinator species with expertise in dissemination to various stakeholders. Local ministries, as well as a farmer organisation, complement and complete the consortium's expertise. The joined forces of RestPoll with its complementary skill-set enable long-lasting impact and contribute to a new era of biodiversity research.

RestPoll partners have been chosen to warrant comprehensive sectoral representation. The consortium consists of universities (14; 45%), public research institutions (eight; 26%), industry partners/commercial organisations (three; 10%), non-profit organisations (four; 13%) and ministries (two; 6%). The value chain is covered by including growers (a farmers' association) and two global retailers, Avalon (now part of AM Fresh) and Innocent, directly as partners in the consortium. The integrative approach of the project with the case study areas and Living Labs as their core ensures in addition the involvement of stakeholders along the value chain.

The RestPoll consortium covers all geographical sub-regions as defined by EuroVoc with five (16%) Northern, 18 (58%) Western, four (13%) Southern and three (10%) Eastern European partners as well as one partner from the US (3%). This ensures relevant regional perspectives of restoration measures, as well as a broad set of policy regulations and instruments. Specifically, 22 (71%) partners are situated within the EU, while nine (29%) are located outside of the European Union, including the US. In addition, the UK as a country, which recently left the EU, gives us the unique opportunity to investigate its consequences for pollinator restoration efforts. YFCNU, as a partner from Ukraine, might be challenged by obstacles due to the war with Russia. Pollinator restoration efforts might also be affected negatively by the war in Ukraine as well as in other countries due to the fluctuations in crop prices. Political changes and their consequences are integrated into the RestPoll research.

e) Gender dimension

Lack or inadequate consideration of gender and diversity in research, land management and development of agricultural policy is known to constrain successful long-term implementation of sustainable land use (Villamor et al. 2014). Hence, we aim to carefully embed overall gender and diversity dimensions throughout our research and innovation activities. We have developed and are regularly updating a project-specific gender, diversity and equality plan (Adamsone-Fiskovica et al. 2023). The plan has been elaborated with an aim of promoting gender equality, diversity and social inclusion across all project activities; fostering respectful, inclusive and supportive work environment; ensuring fair and equal opportunities and access to resources for all participants, irrespective of gender, race, ethnicity, disability or any other characteristic; and encouraging diverse perspectives to enhance the project's creativity, innovation,

effectiveness and acceptance of measures. The document provides the baseline information on the current state of play of gender balance and diversity within the project. It lays out the plan's implementation strategy with regard to staff recruitment, management of the multi-actor consortium, work environment, composition of the advisory board, stakeholder engagement, research process and content, training and capacity building and whistle-blowing and support system. The document also describes the monitoring and evaluation of the plan's implementation, summarising the specific measures and activities, identifying their content, expected results, time-frame and organisations in charge, as well as their implementation status at the time of the regular update of the plan. All RestPoll partners guarantee equality in opportunities and work against discrimination and under-representation of any kind. To further sensitise partners in leading roles of RestPoll to these issues, we encourage their participation in respective workshops offered by their institutions or national contact points. These provide them with guidelines on how to detect problems and on respective countermeasures.

Gender balance in the consortium has been integrated throughout the work packages. Above all, the coordinator of the consortium, UFR, is led by a female researcher. Each work package has one lead and two co-leads of which ten are female and eleven are male. The strong leading role of females (14 of the 31 partners are represented by females) guarantee a strong integration of female interpretation of our research outputs. Most work related to dissemination is led by females. As presentations of females are visited by a higher proportion of females in the audience, our consortium is likely to attract many female stakeholders. This should have an impact on future land management. RestPoll aims for an equal number of female to male postdocs and PhD students to be employed. Gender equality measures have a high priority in the project.

f) Data management and open science practices

A data management plan is created which outlines the rules and responsibility for data creation and management within the RestPoll project from collection to publication (Wintermantel et al. 2024). All data gathered are managed under the FAIR principle and conforms to the GDPR. The data management workflow also adheres to the Open Science principles. A joint drive is used to store and exchange data within the project. On this drive, data are accessible to data file managers, who are responsible for the maintenance of the data. Sensitive personal data are not stored on the RestPoll drive, but on secure institutional drives. Central to the plan is the RestPoll data dictionary, where all data files with their respective file managers are listed and all variables across all RestPoll data files, as well as key concepts, are defined, which is pivotal to allow data re-use. We plan to share our data with existing infrastructures like GloBI, GBIF and the EU Pollinator Hub, along with the "RestPoll Horizon" community within Zenodo. All protocols and our Living Lab network data are linked to the Oppla platform.

Our publication strategy includes several rules for integrative RestPoll dissemination within and beyond the project:

1. compulsory open access publishing, including RestPoll data, protocols and results;
2. multi-targeted dissemination and communication including regional participatory communications within our Living Labs;
3. multiple use of data and results through our open access policies; and
4. engagement of science-society platforms in several languages and use of social media platforms in cooperation with other projects and stakeholders focusing on pollinator restoration. Moreover, key results (e.g. best practices report, policy briefs and factsheets) are communicated in all languages of our case study area network and be shared with other projects.

Impact

The EU HORIZON Europe Food, Bioeconomy, Natural Resources, Agriculture and Environment work programme's call on "Biodiversity and ecosystem services" lists five outcomes for this topic (A: Agricultural land is restored through co-designed measures; B: Wild pollinator habitat is managed according to scientific and policy recommendations; C: Stakeholders are enabled through effective learning environments; D: Better coordinated governance and data accessibility; E: Continuous monitoring and assessment of outcomes inform the adaptive management of measures) and eight expected impacts, of which one or more should be addressed in the project. To demonstrate and quantitatively evaluate how the planned outputs and outcomes of RestPoll generate and exceed the expected impacts of the call and benefit the call's target groups (agricultural schools, farm advisors, farmers, beekeepers, gardeners other land managers, business actors, researchers, NGOs and policy-makers), we have defined a set of explicit target indicators (highlighted in our Communication and Dissemination plan, (Taylor et al. 2024)). Below in the section "Expected impacts," we elaborate on how RestPoll reaches the impact points, while in the section "Requirements and potential barriers that may determine whether outcome and impacts will be achieved," we elaborate on the requirements and potential barriers to achieving these impacts. In the section "Measures to maximise impact - Dissemination, exploitation and communication," how we plan to maximise and exceed them with our dissemination, exploitation and communication strategy.

Expected impacts

Expected Impact 1: Biodiversity decline, its main direct drivers and their interrelations are better understood and addressed.

Data on the effects of land-use management on biodiversity and ecosystem services exist from finalised and ongoing EU-funded and other projects. Many of those datasets focus, on or include, pollinators. Some datasets are available open access, but many others are not fully available and data are not harmonised across ecosystems and target species. To

better understand the main drivers of pollinator decline and their interrelations, RestPoll synthesises knowledge through:

1. compiling existing data;
2. collecting new data on pollinator communities and pollination services in a unique, large and diverse network of active restoration projects targeting pollinators;
3. collaborating and exchanging intensively with other EU projects (e.g. having access to data from field experiments and surveys on pesticide and nutrient stressors of PoshBee, WildPosh and NutriB2) and beyond (e.g. exchanging protocols with EU-PoMs, EMBAL, LUCAS, Safeguard, SHOWCASE, VALOR, Butterfly and Agri4Pol and jointly providing information for policies with National Academies of Sciences, ESAC, FAO, DG-Agri and DG-Env); and
4. conducting novel syntheses and analyses to add value to existing data and extend knowledge on the drivers of pollinator biodiversity declines.

Although RestPoll focuses on mitigating pollinator decline by restoration measures, we aim to maximise insight into the role of drivers of decline by relating pollinator data with simultaneously collected data on direct (e.g. use of agrochemicals) and indirect drivers (e.g. political actions on biodiversity decline). To ensure research with maximised impact and actionable knowledge on drivers of decline, we collect data across the full range of EU production systems. These include annual (vegetables, sunflower and oilseed rape) and perennial (apple, kiwi and olives) crop production systems and grassland managed for a range of livestock animals, from northern to southern and eastern to western countries. RestPoll's innovative restoration measures are, to a large extent, already implemented by using co-development approaches in a multi-actor and multi-disciplinary setting to engage all relevant stakeholders and tailor measures to user requirements across sectors with long-term impact. While developing the proposal, we have preselected case study areas with existing restoration activity from local/site- to landscape scales. When implementing the RestPoll project, we select sites within those landscapes for detailed data collection. We continuously add national sites of other projects to increase the area and actors involved in our restoration network. By doing so, we increase regional to international visibility for the network, and build a common understanding of the benefits of multi-actor co-development for pollinator restoration, across a range of contexts and objectives.

We decided to focus on multiple restoration measures with moderate to strong evidence for their effectiveness in promoting different levels of pollinator restoration and pollination services. We provide a strong focus on diversified agro-ecological practices, including agroforestry and on integrating pesticide reduction measures and extensified grasslands with a high proportion of native flowers. A key strength of our network is that we are not only focusing on insect pollinators as an overall group or on common pollinators, but also pay attention to specific specialist and threatened pollinator species in some areas, for example, *Bombus sylvarum* in one of its few remaining UK populations. Hence, RestPoll delivers harmonised datasets on drivers of pollinator decline with different restoration goals (targeted to single species or whole communities). Our survey data are collected

using methods aligned with EU-PoMS and contribute to long-term monitoring datasets, which provide additional novel insights into the interrelationships between pollinator diversity and its drivers. RestPoll's monitoring approach is highly acknowledged by researchers and NGOs and ensures continuous knowledge development beyond our project by contributing substantially to open access, harmonised, long-term biodiversity data and measures to restore biodiversity.

Main project pathways to impact:

- RestPoll ensures timely site selection after the project start, to develop a multi-actor pollinator restoration network covering local (site) to landscape restoration measures in an area of around 15,000 km² of productive landscapes in 17 case-study areas across 14 EU countries (Task 1.1);
- We establish distinct branding (logo, webpage, social media) and join forces with ongoing EU projects focusing on pollinator conservation (e.g. Table 2) in which RestPoll partners are involved (Task 6.2). We empirically identify the importance of the main drivers of pollinator decline (lack of nesting and flower resources, agrochemical use; Task 2.2) and synergies amongst restoration measures to counter declines (Task 2.3);
- We conduct knowledge exchange activities specifying direct and indirect drivers of decline and restoration success across the RestPoll network to share experience on effective measures in landscape-scale restoration projects to mitigate pollinator loss and functions. We showcase a range of approaches including multiple drivers, such as designating farms as 'Champion sites' for promoting pollinator species (as in the *Bombus sylvarum* conservation action plan), celebrating organisations as 'Evidence champions' (as in the Conservation Evidence project) and providing incentives through local labelling or branding initiatives (as in southern Germany by using a state-wide branding for biodiversity demonstration farms; Task 4.3);
- We conduct a horizon scan of direct and indirect drivers of pollinator decline (threats) and opportunities for restoring pollinator habitats (Task 4.4);
- We include RestPoll's standardised surveys in long-term national to European-wide monitoring data, such as EU-PoMS (Task 1.2).

Expected Impact 2: Biodiversity and natural capital are integrated into public and business decision-making at all levels for the protection and restoration of ecosystems and their services.

RestPoll uses multidisciplinary perspectives by studying ecological, agronomic, policy and market options to optimise conservation of pollinator habitats, while maintaining provisioning and cultural ecosystem services. We capture perceptions of local, national and global stakeholders to understand levers and barriers to adopting pollinator-friendly management practices. We co-develop metrics and approaches as an option to integrate conservation of pollinators into agri-food certification schemes, for example, with labels and payments for biodiversity and pollination services. RestPoll delivers a portfolio of decision-support tools and good practice guides (RestPoll toolbox), which include tools

and metrics targeted at extension services, growers, suppliers, retailers and the wider agri-food sector and provides templates for sector-to-sector sharing. These templates are also to be used by our US partner and to be shared with colleagues in other countries not involved in RestPoll within and outside the EU for wider impact.

Pollinator populations and communities can only be conserved when the European agri-food sector actively restores pollinator habitats and, thus, natural capital in farmed landscapes throughout Europe, using the combined scientific and multi-actor knowledge developed with European funding and made accessible through the RestPoll toolbox. In the context of a current European Pollinators Initiative and many years of previous research and innovation projects (e.g. EcoFruit, STEP) and also the COST Action Super-B, we can monitor the uptake and use of the tools and knowledge we generate and the diversity and scale of landscapes and sectors in which they are used. Additionally, we use our LLs to showcase our restoration tools to raise awareness and boost our multi-actor-generated knowledge to the public, policy-makers and decision-makers at all relevant levels. By providing options to reduce harm to pollinators, land managers can use these new tools to expand protected areas allowing land-use management to a politically defined extent, for example, under certain regulations on the use of agrochemicals. Hence, we fully integrate pollinator diversity and pollination services, drivers and restoration options into public and business decision-making. This triggers food producers and sellers in the business sector, as well as society at large, to implement restoration measures at multiple spatial and temporal scales to ultimately promote natural capital recovery and contribute to SDG 15 (Life on Land).

Main project pathways to impact:

- RestPoll establishes a series of case study areas with Living Labs (LL) as unique learning sites for pollinator restoration (Task 4.1);
- In the regional (LL) and Europe-wide workshops, we enable farmer-to-farmer, farmer-to-researcher, farmer-to-policy-maker and farmer-to-journalist knowledge exchange across scales (Task 4.2, 4.3);
- We conduct workshops and surveys in the first two years of the project (Tasks 1.4, 3.1, 3.2) and integrate local and traditional knowledge from our network of restoration landscapes into the tools, methods and guidance selected for the RestPoll toolbox (Task 5.2);
- We develop a novel instrument, based on Payments for Restoration-mediated Pollination Services (PRPS) (Task 3.2);
- We deliver with the RestPoll toolbox a portfolio of decision-support tools and good practice guidelines, including tools and metrics targeted at extension services, growers, suppliers, retailers and the wider agrifood sector (Task 5.2) and co-design metrics for reporting and labelling pollinator-friendly products and products grown in pollinator-friendly systems and develop a potential business model (Task 5.4). For this, RestPoll has two industry partners as funded beneficiaries and also engages with additional industry partners to be long-standing collaborators of RestPoll partners (e.g. Bayer CropScience, Syngenta and many national food and seed companies), to ensure all business tools (e.g.

planting schemes for different spatio-temporal scales, certification schemes for end-products) are co-designed to fully meet user requirements;

- We develop teaching materials to be used by farmers, other land users, agricultural schools, extension specialists, beekeepers, business actors, farm advisors and public administration bodies, also to be shared with colleagues in other countries for wider impact (Task 6.4).

Expected Impact 3: Europe builds competitive sustainability and tackles climate change and natural disasters through the deployment of nature-based solutions.

RestPoll aims to substantially increase the visibility of pollinator habitat restoration measures regarding habitat quality and quantity. Through our Research and Innovation activity in active restoration, from site to landscape scales, Europe is accelerating the rebuilding of green infrastructure across ecosystems, contributing further to mitigation of climate change impacts. For example, we increase pollinator populations and pollinator diversity to promote pollination services (Tasks 1.1, 1.2). This leads to more stable pollination services in times of more variable and even extreme weather. We also model carbon sequestration of soils in our European restoration network (Task 2.4, contributing to SDG 13: Climate Action). Our restoration measures (hedgerows, agroforestry) act as windbreaks and buffer water shortages (e.g. through complementary uptake of water by plants). All of our restoration measures can support other beneficial insects and birds acting as natural pest control. Additionally, many of our restoration measures decrease soil erosion which poses a growing challenge in light of the forecasted increased frequency of flooding events on agricultural land. RestPoll specifically addresses nature-based solutions to buffer climate change and natural disasters in our e-learning materials. This ensures easy accessibility of knowledge on pollination habitats as a key strategy to increase awareness of nature-based solutions to, for example, extreme drought events. Our LLs are central to boosting knowledge of nature-based solutions related to beekeeping. To make full use of the power of our pollinator-restoration LLs, we collaborate with LLs of other EU projects in which we are involved (e.g. the Experimental Biodiversity Areas of SHOWCASE or other Horizon projects such as [proGleg](#)). Recognising the central role of LLs in advancing the restoration of green infrastructure — enhancing rural development, social well-being and environmental resilience, while mitigating natural disasters — we integrate RestPoll's LLs into the European Network of Living Labs to foster long-term impact aligned with SDG 15 (Life on Land).

Main project pathways to impact:

- RestPoll surveys pollinator populations, pollinator diversity and pollination services in restored and non-restored areas (Task 1.2) and evaluates the effectiveness of nature-based measures, including contributions to the mitigation of climate change and natural disasters, of pollinator habitat restoration measures (Task 1.3, 2.1) across landscapes (Task 2.2) and synergies amongst measures (Task 2.3);

- We use biophysical-models on water and soil properties to analyse co-benefits essential for mitigating drought effects and upscale nature-based co-benefits from restoration sites to wider landscapes (Task 2.4);
- We implement bio-economic models including pollination and other nature-based co-benefits for providing decision tools for farmers (Task 3.3) to be integrated into the RestPoll toolbox, which can then be used as decision tools to mitigate climate-change effects (Task 5.2).

Expected Impact 4: The interrelations between biodiversity, health, food, soil, water and climate are better known.

Pollinator restoration is strongly interrelated with multiple ecosystem services (as outlined above) to produce healthy high-quality food, as pollination does not only relate to fruit and seed production quantity, but also nutritional quality. In addition, pest control and fertilisation with agrochemicals are standard management practices on agricultural land and in many other ecosystems (private gardens, public spaces, forests), which not only affect pollinators, but also soil and water quality. Hence, we create a better evidence-based understanding of these interrelations by addressing farmers' needs and alternatives to the use of agrochemicals (fertilisers, pesticides). In the LLs, we discuss our approaches and outcomes with land managers, business sectors and policy-makers. We also aim to engage human health specialists in public events to highlight interrelations between nature-based pollinator restoration measures, food nutritional quality, diets, climate and human health. Our goal is that not only land managers, but also health professionals, with a special focus on illnesses related to environmental destruction, pollution and climate change, increase their awareness and knowledge about the importance of habitat restoration for human health and well-being.

Main project pathways to impact:

- RestPoll analyses fruit and seed quality measures in relation to pollinator restoration measures to secure the quality of human food (Task 1.3);
- We collect and analyse data on the use of agrochemicals and its effect on pollinators, soil and water quality (Tasks 2.2, 2.4);
- We implement bio-economic models including data on the use of pesticides and fertilisers for providing decision tools for land managers and professionals in human health (Task 3.3);
- We integrate these health-related decision tools into the RestPoll toolbox to mitigate the combined effects of pollution, climate change, natural disasters and habitat destruction (Task 5.2).

Expected impact 5: Practices in agriculture and forestry support biodiversity and the provision of other ecosystems services.

Land-management practices towards pollinator biodiversity conservation and restoration do not only support pollinators and pollination services, but also natural pest enemies (biological control), carbon sequestration, soil properties or humidity retention, which is

essential for mitigating climate change effects, such as extensive heat and drought and benefit overall biodiversity. RestPoll is determining co-benefits of various pollinator restoration measures for these additional ecosystem services and is providing information about these co-benefits in collaboration, outreach and dissemination events. For example, RestPoll is assessing the value of agroforestry systems for pollinator restoration regarding other ecosystem services. Agroforestry is considered a promising tool for not only increasing biodiversity, but also integrating and benefitting multiple ecosystem services simultaneously, with the potential to increase longer term productivity. RestPoll is evaluating pollinator restoration measures across a wide range of European regions thereby connecting pollinator restoration not only to managing biodiversity-mediated ecosystem services, but also to wider socio-economic benefits mediated by nature-based solutions. The Living Labs facilitate knowledge exchanges between land users, researchers, policy-makers and the general public. Furthermore, based on interactions with local stakeholders, RestPoll is assessing the performance of existing restoration policies and provides a roadmap for improving conditions for pollinator restoration actions. Labelling can be a powerful tool to boost pollinator-friendly production and other ecosystem services, but only when carefully co-designed to reflect the environmental footprint of the production. A multi-actor approach in the development of the labelling process is also increasing the chance to be widely accepted by consumers. RestPoll uses different educational tools, such as videos with artistic animations, flipbooks and policy briefs, besides co-designing schemes for labelling, to reach the industry and retailers of pollinator-dependent crop and seed production. Informed policy and labelling engaged by RestPoll supports pollinator-friendly management practices.

Main project pathways to impact:

- RestPoll assesses co-benefits of pollinator restoration measures for multiple ecosystem services (Task 2.4);
- We build up an inventory of the existing policy measures and related enabling conditions and conduct a comprehensive assessment highlighting best practices of policy implementation, including opportunities for managing trade-offs and integrating pollinator restoration with other societal goals, like carbon sequestration, nutrient management and biodiversity conservation (Tasks 4.3, 4.4);
- We assess conservation evidence and technical knowledge on the effectiveness of management practices promoting pollinators (Task 5.1), evaluate consumers' willingness to pay for pollinator-friendly products (Task 5.3) and develop a certification scheme framework for pollinator-friendly labels (Task 5.4);
- We develop policy briefs and tools for their adaptations towards SDG 15 (Life on Land) and 2 (Zero Hunger) by thoroughly evaluating established and novel restoration measures to support adaptive management exceeding project duration (Task 6.3).

Expected impact 6: Approaches for enabling transformative changes in society.

Transformative societal changes are needed to reverse pollinator declines at large spatial and temporal scales. To help drive transformative change, RestPoll brings together internationally leading expertise across the range of disciplines together with a diverse community of influential stakeholders, to co-design ambitious new ways to tackle pollinator declines. This includes a portfolio of new concepts, novel tools and innovative ways of exchanging knowledge and raising awareness to empower multiple sectors of society to work together in halting and even reversing, the declines in pollinators and reinforcing the benefits they bring. Our first four work packages are developing tools to identify direct (WP1, WP2) and indirect drivers of pollinator habitats (WP2, WP3, WP4) leading to all necessary instruments needed to achieve these goals. The elaboration of the toolbox is following a sequential process by qualitative data collections in the other WPs directed by WP5. RestPoll aims to test as many tools as possible during the four years of the project before engaging their implementation in policy, business, law and society. This approach ensures that our tools become mainstreamed amongst the relevant stakeholders. Successful tools are included in the toolbox and communicated - by targeting journalists and politicians, in particular - in WP6. Our last work package (WP7) supports good-practice actions within the project by consulting the RestPoll Advisory Board, supporting publications with clear publication rules, such as circulating manuscripts to the whole consortium and by paying attention to gender diversity and equality throughout the life of the project. RestPoll's long-term goal is that society, at large, enjoys the flowering cultural and productive landscapes visited by different pollinator species including species that are currently Red-listed. RestPoll also trains researchers and the wider society in the Living Labs to identify pollinators. As humans preserve best what they value, RestPoll contributes to sustainable transformation pathways towards reaching SDG 12, 13, 15: Responsible Consumption & Production, Climate Action and Life on Land.

Main pathways to impact:

- RestPoll brings together internationally leading expertise across a range of disciplines with a diverse community of influential stakeholders (Tasks 1.1, 4.1);
- We evaluate the individual and societal perception of insect pollinators of stakeholders in the CSAs (Task 3.1);
- We co-develop a novel framework of payments for restoration-mediated pollination services (PRPS) including a full range of marketed and non-marketed benefits (Task 3.2);
- We mobilise bio-economic models to evaluate and assess farmers' adoption decisions for PRPS and impact of potential policy changes on farmers' incomes, labour, allocations and other socio-economic indicators. This improves the quantification and assessment of the socio-economic and environmental performance of restoration measures contributing to sustainable agriculture practices, supporting farmers and access to local and international markets (Task 3.3);

- We evaluate the socio-economic conditions of private and public incentives and existing policy measures for pollinator restoration (Task 3.3);
- We consider the impact of pollinators on the full range of actors in the food value chain (Task 3.4);
- We evaluate and integrate all developed tools (from WP1-WP4) in the RestPoll toolbox (Task 5.2).

Expected impact 7: Biodiversity research is interconnected.

Bees and butterflies are popular and can be effective indicators of wider ecosystem function and are, therefore, well suited as flagship taxa for terrestrial habitat restoration; however, pollinators cover only a small fraction of biodiversity. To enhance the ambition of national to European policies, RestPoll collaborates with other national, pan-European and international partners and projects (EuropaBON, EU-PoMS). RestPoll actively fosters joint activities with other pan-European projects/initiatives to combine and harmonise data and generate new approaches (e.g. EuropaBON), syntheses and incentives during and after the project. This includes long-term biodiversity monitoring across multiple habitats (e.g. EU-PoMS, EEA) and joint training of species identifications (e.g. SPRING and EPIC BEE). RestPoll also exchanges data templates and protocols with our partners' projects (e.g. VALOR and Agir4Pol) and with projects of our partners being involved in other EU projects focusing on biodiversity in a broader sense. The interconnected nature of RestPoll with other EU projects in this call leads to high-impact publications of the full set of drivers of decline and mitigation tools of biodiversity from field to landscape, regional, European and global scales in collaboration with the partner project in this call. Our joint activities also include sharing our networks with major players in business and policy-making to increase political ambitions and conventions towards biodiversity restoration beyond the end of the project contributing to SDG 17.

Main pathways to impact:

- RestPoll is joining forces with additional actors from other EU-funded projects (led/contributed to by RestPoll partners, see Table 2) and stakeholders for: (1) assessing existing agricultural and environmental actions; (2) exchanging contacts with complementary stakeholder groups, such as other NGO organisations, ministries and policy forums; (3) exchanging results on the effectiveness of restoration measures for specific landscape, regional- and country-specific regions with responsible stakeholders to facilitate long-term pollinator restoration (Task 7.1);
- We integrate previous projects' rules and regulations in our data management and publication strategy (Task 7.2);
- We classify pollinator restoration measures as either harmful or beneficial to biodiversity and as implemented on regional, national or European scale (e.g. by comparing new organic and IPM plus schemes);
- We create a gender, diversity and equality plan to be used by future EU projects of our partners (Task 7.3).

Finally, as a minor, but important contribution to expected impact, monitoring is being conducted on a wide range of crops and varieties and seed plants and breeds in our case-study area network. Crop varieties are also considered in our pollination experiments (Task 1.2) and meta-analysis (Task 2.1). We also have access to global data sets on crop pollinators and pollination at the institutions of some partners (e.g. UFR and UREAD) that are, to a large extent, linked to crop varieties and can be used by RestPoll. Furthermore, we collaborate with local projects to select crop varieties that are resilient to drought and heat stress and are resource-efficient despite climate change (e.g. [BayKlimaFit2](#)). By focusing on polycultures and a wide range of crop varieties/seed breeds, RestPoll contributes to providing information about genetic resources targeting pollinator/pollination restoration under climate change to tackle all expected impacts of the call.

Requirements and potential barriers that may determine whether outcome and impacts will be achieved

Fluctuations in crop prices and/or costs of agricultural inputs almost certainly influence impact achievement. The increasingly unpredictable weather conditions caused by climate change, (temporary) war-induced declines in exports of agricultural products from Ukraine and possible future bans on imports of agricultural products from Russia, two major agricultural exporters and (temporary) lockdowns caused by the Covid-19 pandemic have most likely led to higher variability in crop prices and input costs. Such fluctuations could represent both a barrier and a catalyst for RestPoll impacts. Achievement of impacts could be compromised if increased crop prices trigger farmers to focus on the maximisation of agricultural production regardless of costs to pollinators and the environment (e.g. by cultivating uncropped habitats). Achievement of impacts could be boosted if reduced crop prices and/or enhanced costs of agricultural inputs would trigger farmers to diversify their activities, adopt biodiversity-based approaches to reduce costs and seek biodiversity-based economic incentives. RestPoll develops a framework of payments for restoration-mediated pollination services (PRPS), including a full range of marketable and non-marketable benefits and, therefore, be able to anticipate the consequences of fluctuating global agricultural commodity markets. RestPoll partners recently demonstrated a 32% reduction in variation in the yields of crops visited by bees and other pollinators than those grown in absence of pollinators (Bishop et al. 2022).

National Strategic Plans (NSP) for the 2023-2027 CAP budget period was being finalised during the proposal writing and both changes compared to current CAP programmes (the reference point for RestPoll) and last-minute changes to draft NSPs informed and fine-tuned the framework RestPoll uses to achieve impacts. RestPoll continuously evaluates the outcome of the CAP decision-making process and actors to further improve its policy impacts. However, RestPoll targets (mixes of) both public and private incentives and impacts are, therefore, not solely dependent on the availability of governmental subsidies. RestPoll ensures an active ongoing dialogue with policy and regulatory experts (with strong integration of our Advisory Board and by linking our outcomes to EU

(e.g. EU PI) and global policy events (e.g. Promote Pollinators) to tailor our outputs to a changing policy environment, as well as help drive high-level policy agendas. The succession of global crises has increased costs for research, shifted public and political priorities and led to financial insecurities, which may reduce RestPoll impacts. The RestPoll team addresses these challenges through a unique communication and dissemination plan (Taylor et al. 2024). We have, from the very beginning, integrated stakeholders and society at large, specifically accounting for their diverse perceptions (which may change during the project), concerns, ideas and specific interests. Via our Living Labs and additional communication and collaboration network available to the RestPoll consortium, we are maintaining constant exchange throughout the project, thus adapting and optimising impact achievement.

New restrictions of widely-used insecticides could produce synergies with pollinator restoration and, therefore RestPoll's impact achievement, but unanticipated side-effects of newly-released insecticides may undermine impact achievement. RestPoll collects and analyses data on the use of agrochemicals and is, therefore, in a good position to analyse regulation-induced changes for crop protection products and how this may affect restoration efforts and impact achievement. Further, by having strong representation from the industrial sector on our Advisory Board, we have direct and timely access to leading industry expertise. The EU Restoration law, with binding targets on pollinators, helps drive the beginning of a new era in the conservation of biodiversity. RestPoll's evidence-based restoration measures and policy approaches co-designed with stakeholders can make a significant contribution to reaching the target of restoring 15% of degraded ecosystems.

Measures to maximise impact - Dissemination, exploitation and communication

To foster social learning and contribute to behavioural and institutional change to upscale and broaden biodiversity and, in particular, pollinator conservation and restoration, RestPoll effectively communicates the project results by engaging diverse actors to uptake project outcomes for long-term and large-scale future land management. By working actively with two-way learning and knowledge exchange in case-study areas and integrated LLs, RestPoll ensures the relevance of research activities for targeted user groups, as their considerations are integrated in the research objectives and design since the time we started to develop this proposal.

a) Communication and engagement strategy

The communication and engagement strategy for RestPoll outlines and discusses the objectives, tactics, tools and metrics regarding communication of the project in all stages ranging from dissemination to evaluation, along with our engagement strategy with stakeholders involved in the project (Taylor et al. 2024). We aim to engage agricultural stakeholders, the scientific community and education institutions, politicians, environmental and conservation NGOs and the general public through different types of

media (e.g. social media, workshops and events, surveys, articles, Living Lab network etc). The goal of the RestPoll communication and engagement strategy is to reach a wide range of stakeholders and audiences interested in and relevant to the project's goals and objectives. It aims to engage and inform these audiences, fostering support and participation in the RestPoll project. The goals encompass:

1. Raising awareness about the RestPoll project and the significance of the decline in wild pollinators and their habitats;
2. Engaging stakeholders at various levels (including farmers, researchers, policy-makers and the general public) and scales in the restoration efforts;
3. Communicating project findings, tools and recommendations to a broad audience;
4. Promoting collaboration and knowledge exchange amongst project partners.

Throughout the duration of the project, content is communicated and disseminated. These activities are being monitored and measured by evaluating the actual results (output), determining what dissemination may contribute to our objectives (outcomes) and developing our communication strategy and activities to maximise this input (Thompson et al. 2025). We monitor the efficiency of each established communication channel and engagement with stakeholders to determine if our goals and expected impacts are reached. Throughout the project, we continue to refine our outreach strategies, enhance dissemination efforts and expand our Living Lab network to maximise the impact of our work. By establishing multi-actor collaboration and fostering co-design, we aim to ensure long-term sustainability and meaningful contributions to pollinator restoration across Europe.

Contribution of the project results towards the wider impacts in the longer term

The RestPoll project catalyst a wide array of scientific, economic and societal impacts with its key outcomes. Through the project, it ushers in a new era of applied biodiversity research via the establishment of long-term harmonised pollinator and pollination data and monitoring, providing an essential foundation for future ecological studies. Businesses and society at large implement restoration measures at multiple spatial and temporal scales, while stakeholder engagement in enhancing pollinator habitat connectivity, for example, through hedgerows as storm breakers or polycultures like agroforestry, deliver climate resilience and disaster mitigation co-benefits. The human health sector actively support habitat restoration to reduce disease risk and improve well-being. RestPoll's innovative pollinator certification scheme is gaining traction amongst the fruit and seed industries, retailers and consumers, making pollinator-friendly products visible in mainstream markets and raising awareness of broader ecosystem services. Across Europe, flower-rich cultural and productive landscapes flourish, attracting a diversity of insect pollinator species, including species that are currently threatened. Lastly, RestPoll's strong collaboration with other initiatives fosters a lasting framework for

communication and political ambition towards biodiversity restoration beyond the project's lifetime.

Quality and efficiency of the implementation

Work plan and resources

The RestPoll project consists of seven distinctive, but highly interconnected work packages. Each WP has a lead with the necessary know-how and a co-lead with complementary competence, combining socio-economic and agro-ecological expertise. The University of Freiburg (UFR), as the project coordinator, is in charge of establishing the restoration network and the overall pollinator surveys and monitoring (WP1), integrating data management according to the FAIR principle and ensuring proper attention to diversity and equality issues in the project (WP7). WP2 is based on data collected in WP1, upscaling it to the landscape level. The core of RestPoll is the establishment of Living Labs (WP4, see Fig. 1) facilitating the research carried out in WP1, WP3 and WP5, as well as the dissemination efforts in WP6. Tasks are linked within and across WPs. Six tasks engage with the LLs directly, all others indirectly and 17 tasks produce input for the RestPoll toolbox. Task 1.1 (establishing the case-study area network), Task 4.1 (establishing the LLs), Task 5.2 (elaborating the RestPoll toolbox) and all tasks in WP1 and WP7 are providing coordination and services for all other tasks. Tasks have been bundled around the annual LL workshops (Fig. 2) to enable effective work-flow. The RestPoll Living Lab Network aims to achieve long-lasting impact beyond the duration of the project.

The budget has been carefully allocated to partners considering their contributions and needs. This ensures the achievement of their project goals by providing adequate resources to fulfil given roles. Around half of the staff effort (47%) has been allocated to tasks in WP1 and WP4, ensuring the establishment of the restoration network area and the Living Labs, including pollinator monitoring and stakeholder engagement and participation. More than 12% of the staff effort has been allocated to WP6 ensuring that dissemination leads to target impacts.

Ethics self-assessment

Ethical dimension of the objectives, methodology and likely impact

(1) Pollinator monitoring: In order to identify pollinators to species level, it is required to collect individuals, which may potentially include a small number of Red-listed species. The preferred method to catch insects is hand-netting to minimise the number of insects collected and, therefore, to minimise the impact on populations. Our methods align with those recommended by the EU Pollinator Monitoring Scheme (Potts 2021).

(2) Social science: With respect to social data, RestPoll uses data provided by stakeholders in workshops, interviews and surveys that may classify as personal

Compliance with ethical principles and relevant legislation

(1) Pollinator monitoring: Research is confined to basic monitoring including observing and extracting identified pollinators. Monitoring is performed in agricultural areas as well as protected areas. Other than pollinating insects, no additional material or bio-active compounds are exported from the RestPoll countries. When possible, pollinating insects are identified by local experts or the consortium partners within the same country. Otherwise, the Nagoya protocol is observed when sharing insect specimens between the partners. Thus, only basic research permits are required, which are applied for upon positive evaluation of this proposal. We confirm that research, sampling, export and import permits can and are obtained in agreement with the law of the countries where observations and sampling take place. All research in RestPoll is being conducted according to the Nagoya protocol and the Convention on Biological Diversity (CBD).

(2) Social science: We emphasise that the tasks that involve personal information of research participants are carried out in accordance with the GDPR, as well as national and organisation-specific guidelines, always ensuring that participants consent to the collection, storage and processing of their personal data. Further, participants are informed about their rights when providing us with such data according to article 13 of the EU GDPR (Information to be provided where personal data are collected from the data subject). Data collected in the context of the project are stored according to GDPR and deleted following the finalisation of the research activities for which it is used. Data collection instruments include informed consent forms, trained interviewers and guidelines ensuring a standardised process across the consortia.

Personal data are only collected for specific, explicit and legitimate purposes and is processed fairly and lawfully and is adequate, relevant and not excessive. Data are only collected, held and processed to the extent necessary from a quality control, sampling and analytical perspective. In terms of data storage and processing, a secure SharePoint folder is set up for internal data management and exchange amongst project participants hosted by the project coordinator on a server placed within the EU. Data access is only provided to team members that process data according to the specified work packages, adhering to the GDPR. Personal information is not shared with third parties. With respect to qualitative data, anonymisation involves the removal of all names, specific occupational information, physical or electronic addresses or other personal identifiers. With respect to quantitative data, anonymisation involves processing, analysing and reporting results in aggregated form to ensure that specific participants cannot be identified.

Data management in RestPoll is based on the FAIR principles of data management (findable, accessible, interoperable and reusable). Findings are presented in open-access publications of international peer-reviewed journals, thus providing public access to the scientific output of the project. Data are only published in aggregated anonymised form. All publications and dissemination materials from RestPoll respect the research participants' right to privacy and there is no link to actual persons included in such materials without their informed consent.

Raw data from workshops and surveys are not made publicly available due to GDPR restrictions. Import/export of data that emerge from the project will only take place in anonymised form, thus not in a form where such information classify as personal data.

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The authors have declared that no competing interests exist.

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