Protocol for the collection of data within the different case studies

WP2: DEMONSTRATING CONTEXT DEPENDENCY, SCALABILITY, AND SYNERGIES ACROSS POLLINATOR RESTORATION MEASURES AT THE LANDSCAPE SCALE AND BEYOND
TASK 2.4: ASSESS CO-BENEFITS OF POLLINATORS RESTORATION MEASURES

Milestone MS5

30 September 2024

[1]Kanonarchi F., [1]Basaran Z., [1]Prosperi P., [2]Thorsoe M., H., [3]Gallai N., [3]Del-Corso J.P., [4]Kyrgiakos L.S., [4]Kleisiari Ch., [4]Vasileiou M., [4]Angelopoulos V., [4]Vlontzos G., [5]Thompson A., [5]Kranke N., [5]Klein A., [6]Rundlöf M., [1]Kleftodimos G.

[1]*Mediterranean Agronomic Institute of Montpellier* (CIHEAM-IAMM)
[2]*Aarhus Universitet* (AU)
[3]*Ecole Nationale Superieure de Formation de l`Enseignement Agricole* (ENSFEA)
[4]*University of Thessaly* (UTH)
[5] *Chair of Nature Conservation and Landscape Ecology, University of Freiburg* (ALU-FR)
[6] *Department of Biology, Lund University, Lund, Sweden* (ULUND)

RestPoll

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

Prepared under contract from the European Commission

Grant agreement No. 101082102
EU Horizon Europe Framework Programme

Project acronym:	**RestPoll**
Project full title:	**Restoring Pollinator habitats across European agricultural landscapes based on multi-actor participatory approaches**
Start of the project:	Oct 2023
Duration:	48 months
Project coordinator:	Professor Alexandra-Maria Klein University of Freiburg, Freiburg, Germany www.restpoll.eu
Milestone title:	Protocol for the collection of data within the different case studies
Milestone n°:	MS5
WP responsible:	WP2
Lead beneficiary:	CIHEAM-IAMM
Citation:	Kanonarchi F., Basaran Z., Prosperi P., Thorsoe M., H., Gallai N., Del-Corso J.P., Kyrgiakos L.S., Kleisiari Ch., Vasileiou M., Angelopoulos V., Vlontzos G., Thompson A., Kranke N., Klein A., Kleftodimos G (2024). *Protocol for the collection of data within the different case studies*. Milestone MS5 EU Horizon RestPoll Project, Grant agreement No. 101082102.
Due date of milestone:	Month 12
Actual submission date:	30 September 2024

Milestone status:

Version	Status	Date	Author(s)
1.0	Draft	01 July 2024	Kanonarchi F., Basaran Z., Prosperi P, Kleftodimos G. [CIHEAM-IAMM]
2.0	Revisions	01 – 31 August 2024	Thorsoe M., H. [AU], Gallai N. [ENSFEA], Del-Corso J.P. [ENSFEA], Kyrgiakos L.S. [UTH], Kleisiari Ch. [UTH], Vasileiou M. [UTH], Angelopoulos V. [UTH], Vlontzos G. [UTH], Thompson A. [ALU], Kranke N. [ALU], Klein A. [ALU], Rundlöf M [ULUND]
3.0	Submitted Document	26 September 2024	Kanonarchi F., Basaran Z., Prosperi P., [CIHEAM-IAMM], Thorsoe M., H. [AU], Gallai N. [ENSFEA], Del-Corso J.P. [ENSFEA], Kyrgiakos L.S. [UTH],

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Kleisiari Ch. [UTH], Vasileiou M. [UTH], Angelopoulos V. [UTH], Vlontzos G. [UTH], Thompson A. [ALU], Kranke N. [ALU], Klein A. [ALU], Rundlöf M [ULUND], Kleftodimos G. [CIHEAM-IAMM]

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Table of contents

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Summary

This document aims to present the protocol for the collection of the bio-physical and socio-economic data within the different RestPoll case studies and their LL boundaries. The objective is to collect the necessary data for the modelling chain activities of Task 2.4 and Task 3.3. A farm typology and a farm questionnaire were created to help describe and characterize the representative farm types of every LL area. The following definitions were used in the protocol:

- Farming system: the local network of farms and other actors formally and informally interacting in a specific agro-ecological context. For example, cooperatives specialized in cereal production or arable production systems.

- Farm typology: the ensemble of farm types that capture the diversity of farms in the farming system of the LL area. For example, farm-type 1 specialized in perennial crops, Farm-type 2 specialised in cereals, Farm-type 3 specialised in oilseeds and animal production.

- Farm types: an average, 'stereotypical' farm whose characteristics resemble those of farms belonging to a specific group in an area, e.g. large and extensive farms or small and multi-functional farms.

- Representative farm types: real farms that are representative of a certain farm type.

This document is organized in three main sections. The first two sections illustrate successively the main steps considered collectively for defining LL boundaries and farm types. The third section describes the methodology used to create the questionnaire for farm survey, as well as its main goal and expectations. The full questionnaire of farm survey is presented in the Appendix 1.

1. Introduction

As part of the RestPoll project, Work Packages 2 (WP2) and 3 (WP3) focus on assessing the co-benefits of pollinator restoration measures and the direct and indirect impacts of these measures on the bio-economy. Task 2.4 specifically aims to assess the co-benefits of pollinator restoration measures, while Task 3.3 aims to assess the direct and indirect impacts of restoration measures on the bio-economy. To streamline efforts and ensure consistency, a single data collection protocol will be used to serve both tasks and support the creation of the bio-economic model. A bio-economic model of a farm is a tool used to analyze and predict how a farmer's decisions and activities impact both its biological (e.g., crop growth, livestock health, ecosystem services) and economic (e.g., income, expenses) outcomes. It helps farmers make informed choices to optimize their operations. Collecting data through a questionnaire helps feed the bio-economic model by providing essential information about the farm's practices, resources, and goals. By collecting this data, the bio-economic model can simulate different scenarios, assess risks, and provide recommendations for optimizing farm operations. For instance, it can

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

help farmers make decisions like when to plant, how much fertilizer to use, or whether to diversify their crops based on economic and environmental goals. Essentially, the data from the questionnaire becomes the foundation for making informed decisions and improving the overall efficiency and sustainability of the farm.

The analysis of farm-type performance under different scenarios (i.e. different futures that the stakeholders in each LL are expecting or the impact of different managements or restoration measures) must adhere to several principles:

- The analysis of the impact scenarios of pollinator restoration measures will prioritize examining the resilience of farms. These farms must be representative of the agricultural diversity observed in each study area, as this representativeness is essential for extrapolating the results of the simulations.
- The definition of farm types must simultaneously consider structural, functional, and food needs criteria.
- All simulated farm types must be spatialized in order to extrapolate the resilience indicators generated by modelling.
- The choice of data to be collected for distinguishing between representative farm types must account for the objective of the typology and the modelling needs for simulating the scenarios.

By following these principles, the RestPoll project aims to provide a comprehensive assessment of the benefits and impacts of pollinator restoration measures on both the resilience of farms, other ecosystem services (e.g. water, soil, etc.), and the broader bio-economy.

2. Definition of LL boundaries

2.1. Introduction

The choice of the physical boundaries of a LL must be justified by one or more common issues relevant to the agricultural development of the territory concerned and must consider several criteria, such as the willingness of stakeholders to collectively address these issues and their perception concerning the existing status of the area. The boundaries of the farms for which the LL is representative also need to be specified. To illustrate the methodology to be used in the RestPoll case studies for defining the boundaries of the LL, we consider the following steps. Each step will be illustrated with an example from the Nestos LL in Greece.

2.2. Definition of the main LL challenges

This step aims to define the main challenges that a LL may face. We want to separately address the main drivers for every different case study area in the context of the RestPoll project. The goal is to help understand the stakeholders' point of view towards the acknowledgement or not of the challenges of pollination services and their collective

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

willingness to prioritise them in order to propose and implement restoration practices. Here we will present every challenge at the LL in the Nestos case study in Greece. This will help identify and examine every other potential challenge in the other LL areas.

The main challenges in the Nestos area are the agricultural practices of monoculture. The main crops of the area are kiwis, arable crops and asparagus. However, in the last decade, an enormous increase of kiwi farms has been observed, replacing other types of arboreal crops, like oranges, peaches and apricots. This phenomenon creates issues such as soil degradation, price fluctuations and, of course, loss of biodiversity, which in turn has led to a lack of pollination services. Another challenge that also contributes to low numbers of pollinators, is the limited awareness of farmers and in general of stakeholders, concerning the importance and utility of pollinators and the services they provide. In addition, farmers face regulatory and policy issues, such as difficult access to funding in combination with a complicated bureaucracy, thus leading to general deprivation of motive and education towards new and innovative practices. Another important challenge of the Nestos LL is the lack of labour availability. Due to the economic crisis, most young and able workers chose to leave or work elsewhere, where labour conditions are more satisfactory and inclusive. Lastly, climate change is one of the biggest challenges of the area. The unpredictable weather conditions, such as high variance in temperatures and precipitation, may cause distress to the crops and negatively affect their yield and quality, leading the farmers to overuse phytosanitary (i.e. plant protection) or fertilizer products to try and reverse any damage that may have occurred.

2.3. Spatial delimitation of LL boundaries

This step aims to define the location and justify the spatial delineation of the LL. Any agricultural area which constitutes the basis for a LL is often a continuum and a mixture of several cropping and farming systems. Consequently, a LL can be, depending on the objectives and the present financial and human resources, larger or smaller than an agricultural area, or even a combination of two or several interconnected agricultural areas. In order to properly determine and validate the farming systems in each LL, we will use this spatial delineation as a tool, which will also help us select stakeholders and define their role according to the project expectations and steps.

As an example, we chose the Municipality of Nestos as a living lab area (Figure 1). This municipality is a veritable continuum between an urban and a rural area and covers a surface of 67,900 ha. The choice of this area is motivated by the following points:

- The main trait of the Municipality of Nestos is its geographical position and morphology as it is located on a valley, through which the Nestos River passes before it pours to the northern Aegean Sea. As a result, a large Delta is formed, irrigating over 40,000 ha of land and supporting a wide range of wildlife.
- The Nestos River is included in the Natura 2000 network of protected areas. This special quality of the area enables a booming agricultural sector.
- There is a significant presence of beekeepers. There are more than forty-six thousand registered beehives in the wider region of the Kavala prefecture, as most professional beekeepers move their hives from Thasos, where they're located, to the greater region of Eastern Macedonia and Thrace for nectar supply, characterizing it as one of the most significant beekeeping areas in Greece.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

- The farmers in the area are all confronted with the same issues, such as inadequate funding, lack of pollination, climate change and lack of collaboration between stakeholders.
- Several stakeholders have expressed their collective interest in addressing the above issues. These stakeholders come from both public and private sector.

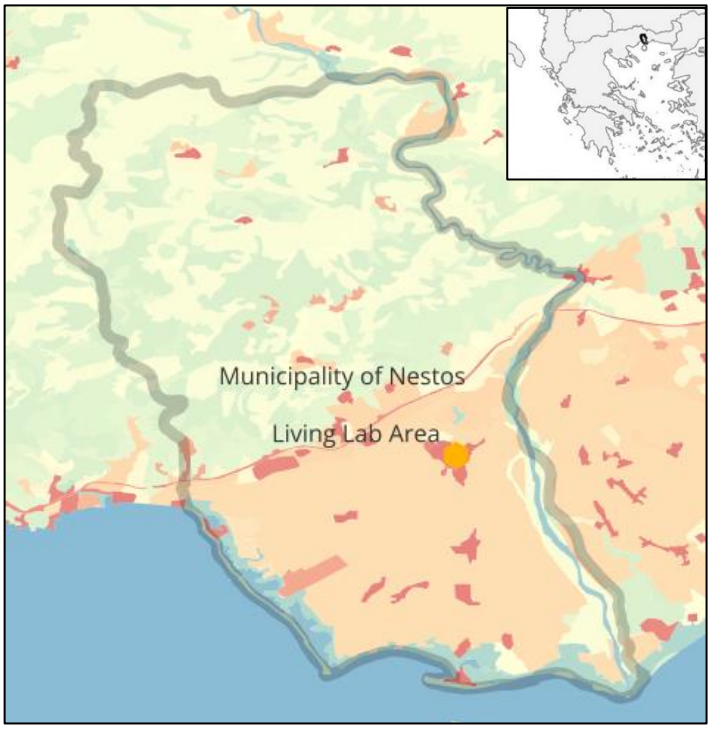

Figure 1: *Grey line: the limits of the LL; Green outline: mountainy zone; Light orange outline: the agricultural land in the valley; Dark orange outline: the selected agricultural systems.* **Data sources: Corine Land Cover (2018)**

3. Definition of farm types

3.1. INTRODUCTION

Several steps are often cited as necessary for selecting farm types in a LL. These steps include: i) specifying the objectives of the typology in concertation with local stakeholders, ii) defining the hypotheses associated with these objectives, iii) determining the typology criteria, iv) collecting data needed to define the different criteria, v) carrying out a statistical analysis (e.g. multivariate analysis or segmentation) to discriminate between the different types of farms, and finally iv) analysing the results of the typology in concertation with stakeholders in order to verify the initial hypotheses. This list is not exhaustive and some steps may be merged into one. These standard steps are followed to varying degrees depending on the availability and quality of the data, the time allocated to the study, as well as the human and financial resources available.
In the context of RestPoll, and after several meetings and discussions, we suggest five steps for defining the most representative farm types in the case study areas of the LLs.

3.2. Step 1: Define the objectives of the typology in concertation with local stakeholders

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

The main objective of RestPoll is to analyse the impact of different scenarios (yet to be defined) on the adoption of pollination restoration practices on different farm types at the level of each LL, by considering the diversity of production systems. A scenario is a combination of external environmental (e.g. climate change) and socio-economic (e.g. inflation, price variability, etc) drivers, policy measures, and technological innovations influencing pollination restoration practices. Our suggestions to LL leaders before defining the farm typology and its related steps, is to conduct focus groups with local stakeholders (around 20 stakeholders including farmers) to gain a better understanding of the current production process, organization, and constraints in each LL. These focus groups will play a significant role in gaining a better understanding of the functioning of the farm types in the LL (e.g. farmers' objectives, perception of pollination services and their role, the evolution of agricultural systems, the use of water and other resources, other existing sectors connected to agriculture and their influence, etc.).

For the Nestos Living Lab, we hosted a workshop with 22 stakeholders from the area, including farmers, cooperatives, extension services and local authorities. Via this workshop they identify the main threats they perceive about pollination services and they prioritize actions. For them, providing a sufficient level of pollination services are of paramount importance especially for the kiwi cultivations. Consequently, they are ready to undertake practices, such as the installation of melliferous plants, the reduction of herbicides or the renting honeybees from the local beekeepers. Even if the proposed practices and the scenarios have started to develop, there is a long process after the interaction of the stakeholders with the different WPs before we arrive at the final scenarios to be assessed by the model.

3.3. Step 2: Define farm type hypotheses

The goal of this step is to help define the main hypotheses for every LL area within the framework of the RestPoll project. These hypotheses will be constructed in close consultation with the main stakeholders, while considering all different aspects of the farm types, to address the objectives of the analysis. To be more precise, these hypotheses should be formulated according to the farm diversity assumed by local stakeholders. A hypothesis is a testable statement predicting the impact of specific factors on farming practices.

For example, one hypothesis for the Nestos LL could be that the high prices of kiwis could lead to a rapid transformation of the area to a monoculture of kiwis, thus being one of the main farm types. Without strong financial incentives and a better education for farmers to be informed concerning the consequences of the monoculture practices, the outcome will be grave and every sector will be negatively affected, such as their long-term financial prosperity and the quality of their production.

Another example of a hypothesis for the Nestos LL is the lack of pollination and the mislead perception of the farmers that this phenomenon does not fully affect their crop production and overall welfare. By refusing to acknowledge this fact, the possibility to implement different, pollinator-friendly agricultural practices or to protect and restore them will be low, as they will not have a strong motive to do so.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

In order to define our hypotheses in every LL four criteria should be considered as a basis (of course different contexts in different LLs may require more or less criteria). The examples of the previously formulated hypotheses lead us to consider four types of criteria for discriminating between representative farms:

i) Criteria that account for resource endowment: These criteria may be biophysical (available soil water capacity, organic matter, rainfall, temperature, altitude, etc.), that concern financial resource availability in monetary form (farm income, support from other family members, etc.) or in kind (animals, land), or institutional (ex. policy incentives to support the restoration of pollinators). These criteria also include structural aspects, such as the size of the farm, access to water resources or access to grazing (private or collective).

ii) Criteria that account for production intensification: These criteria should subsequently account for the level of crop practice inputs. They should be expressed at a farm level (e.g. amount of irrigation water used per hectare at farm level) but also at the level of the cropping system (e.g. amount of irrigation water per hectare of specific crop used). Some data will be difficult to collect accurately, pesticide-use for instance. In this case, the cost of these interventions (e.g. the cost of phytosanitary treatments) will probably have to suffice. That said, some key data (e.g. the quantity of irrigation water per hectare) may also be difficult to obtain because farmers cannot provide exact information (lack of meters). Therefore, it is essential to estimate this variable (e.g. according to the duration of an irrigation application, the number of applications and the average flow rate per application) and not only the cost of irrigation.

iii) Criteria that account for production goals: These criteria must largely justify the farmer's choices in terms of production, and can be expressed according to the choices being made in terms of:

- The type of workforce mobilisation (family-oriented vs. hired staff)
- The type of farming practised (e.g. cereal vs. vegetable crops, perennial vs. annual crops, livestock vs. arable crops)
- The farmer's decision and choice to be in an agroecological or conventional production dynamic. This refers, for example, to be a member of a cooperative (or any other type of association) advocating best agricultural practices (with or without certification)

iv) Criteria that can explain the future adoption of pollination restoration measures in the scenarios to be tested: These criteria may be of the following types: i) the current situation of the farm: for example, the age and level of education of the farm leader (we can hypothesise that the younger the farmer, the more likely they are to adopt the practices), ii) pluriactivity (i.e. having an additional income) acting as a possible brake on the adoption of an innovation, or iii) the status of the land, assuming, for example, that the adoption of pollination restoration measures will be easier for privately owned land than for rented, undivided or collectively owned land.

In practical terms, we suggest that each LL manager should start by drawing up (perhaps by carrying out consultations and relying on their knowledge and local bibliography) an initial document explaining the issues at stake, the objectives of the typology, the main hypotheses and the most important criteria for carrying out a typology in their LL, from their point of view. This document can be developed together with the activities of task 4.1. This initial step could be followed by the organisation of a workshop with local

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

stakeholders (farmers, irrigation associations, cooperatives, regional agricultural officials, etc.) to validate and complete the first document.

3.4. Step 3: Define farm types

Two approaches are proposed for the definition of farm types:

i) Farms types are to be chosen based on expertise: In this case, the approach consists of defining farms that are representative of the diversity observed in a territory, according to the criteria retained above and based on a certain number of local stakeholders. In concrete terms, this involves two main steps; 1) an initial classification of representative farms based on the last existing agricultural censuses (or equivalent), where it involves the definition of the main farm types based on data often available in the agricultural censuses, specifically structure criteria (surface, irrigable surface) and production choice criteria (e.g. technical-economic orientation), and 2) Once these broad types have been drawn up (by segmentation or multivariate analysis), the work of the experts will mainly be to refine this typology by adding other criteria as described above. This work could be achieved through the organisation of a workshop with a few farmers (chosen by crossing a few structural and production choice criteria), agricultural advisors, representatives of irrigators' associations, representatives of cooperatives (or equivalent), and researchers working in the study area.

- **Advantage**: this type of typology has the advantage of i) being quick to carry out, and ii) selecting farm types based on the production choices of farmers (it is this criterion that experts often use to characterise farm types).
- **Disadvantage**: this type of typology can be biased due to the wrong choice of experts (e.g., a dominant type compared to others, the partial vision of the experts in relation to the issues at stake in the typology and to the diversity of the criteria).

Once this typology has been refined and completed according to the selected criteria, field surveys are to be conducted to characterise these representative farms. We propose to survey between 3 and 5 representative real farms per farm type.

ii) Farm types are to be defined by using statistical cluster analysis: In this case, the first step will be to collect data from a fairly large sample of farms. Two issues must be highlighted: that of defining the sample size, and of deciding on the type of farms to be surveyed.

In order to specify these two criteria (sample size and farmer types), it is necessary to start by characterising the diversity of the farming systems in the LLs. The main idea is that our sample should be as representative as possible of the diversity observed. In practice, the choice of farmer types and their number could be made in two different ways:

- By considering a random sample of farms without taking into account any discriminating criteria. In this case, the idea is to consider a fairly large sample in order to increase the chances of having a fairly representative sample of farming system diversity. In practice, the number of farms to be surveyed will also depend on the means and time available to both collect and process the data.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

- By carrying out a pre-diagnosis with local stakeholders in order to pre-identify archetypes of farms in the study area. These archetypes will be defined by considering the criteria mentioned above. The pre-diagnosis may also be preceded by an analysis of regional statistical data (if available) to determine the total number of farms in the area and their diversity based on a few discriminating criteria. The number of farms to be surveyed will be determined in a second step by trying to be as representative as possible with respect to the diversity of farms (by considering the archetypes) and the time and means allocated to these surveys.

After several discussions and meetings, we Greek LL leaders agreed to adopt the first approach for Greek LL based on a combined mobilization of regional statistical data and local stakeholder knowledge to define the representative farm types of each LL. This approach was selected due to its swift and efficient nature and due to the patterns observed among the farmers and their crops, as they all share very similar approaches and perceptions per farm type concerning pollination services, use of pesticides, and overall agricultural practices. Every LL is free to choose the most suitable approach, however, we propose the second one as it is more time efficient.

3.5. Step 5: Validate farm typology

We collectively agreed that it would be preferable (if not essential), and in the interest of transparency regarding LL stakeholders, to validate the typology before using it. This validation, which should take place as part of a workshop, can be articulated (also in connection with the starting hypotheses) around three important points: validating the criteria and the farm types, validating the functioning and production choice of each farm type, and finally validating (in relation to the main theme of RestPoll) the strengths/opportunities and weaknesses of each farm in relation to its aptitude/desire to adopt pollination restoration measures (this last point can be seen as a pre-step towards defining the scenarios to be tested afterwards, via modelling). In application, two steps are necessary:

- Confirming or if necessary, adapting the criteria on which the characterization was based. It is up to the facilitator of each LL to (re)define these criteria and to justify their choices, based on the information and lessons learned in step 2 and 3. A meeting with local stakeholders is essential to validate these criteria. Criteria could be related to farmers' objective, resource endowment and/or production intensification.
- Validating/completing the farm type characterization by considering all criteria identified in point 1 and the information and lessons learned in step 2 and 3. A workshop with relevant local stakeholders is recommended to be organized for validation. Here too, a validation guide for the generic typology could be collectively developed and adapted to the context of each LL and used by LL facilitators.

3.6. Step 5: Data collection per farm type

This step consists of carrying out 3 to 5 detailed surveys with representative farms belonging to a farm type. This is done for each farm type identified in the LL. The choice of those actual farms should be made in concertation with engaged stakeholders and by focusing on covering the variation within the group. The challenge here is to use the

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

questionnaire (and therefore the surveys to be conducted) both for the typology of farms and for the bioeconomic modelling (bio-physical and socio-economic data) as described in WP2 and WP3. For this reason, we collectively (WP2, WP3, WP4) decided to cross the questionnaire elaborated by WP2 for the modelling part (which is exhaustive in terms of the mapping of cropping systems, data for the calculation of the costs of livestock and its feeding). The idea was to conduct a single survey that will serve both WP2 and WP3. Moreover, the proposed questionnaire (see section 4) should be comprehensive enough to capture production choices at plot level, structure and access to resources at farm level, but also the perceived level of pollination services in each farm. For this reason, the questionnaire was designed based on a systemic approach, from the plot to the farm type. Overall, we expect to spend two hours per survey, i.e. 3 surveys per interviewer per day. We recommend performing personal interviews due to the length of the questionnaire. However, LL leaders are flexible to adapt it to their needs.

4. Farm survey

4.1. Introduction

The primary objective of the questionnaire is to collect the necessary data in order to identify and characterize the main i) socio-economic and bio-physical characteristics of the most representative farm types, ii) the composition of farms, their agricultural practices such as pesticides use, their structure and needs, and iii) their perception and behaviour towards pollinators and pollination services.

It is necessary to explain to the different LL leaders the structure and our expectations from the questionnaire, while giving them the possibility to adapt it according to their local context. To do this, two trainings of 2 hours each are going to be provided for all LL leaders. The first training will take place in September 2024 with the objective of explaining the methodology to be followed in defining LL delineation (as explained in section 2) and how to co-define with stakeholders' typical farms. The second training will take place in October and it aims to propose recommendations for successfully interviewing farmers, as well, to explain questionnaire structure and expectations. Each LL leader will have the obligation, if the data are collected on paper, to transcribe (and translate) the information. The information will ultimately be inputted into Excel.

4.2. Questionnaire structure and components

The questionnaire is structured in 7 sections, 6 are compulsory and 1 is optional. The optional section of the survey may be relevant for each case study, so the LL leader can decide to skip it. However, we highly recommend to the LL leaders to try and collect the maximum amount of data, even for the optional section, as they contain important information for the farm typology.

- Farm characteristics (Section A)

The first section of the questionnaire entitled "A: Farm characteristics" aims to collect vital socio-economic and demographic characteristics of the farm, such as its

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

composition, land availability and labour availability. Concerning labour availability, generally, we advise the LL leaders to pay specific attention on the correct use of units proposed in the questionnaire. In order to avoid errors and bias on data collection, universal unit systems are proposed in the questionnaire.

- Land use and cropping pattern (Section B)

The second section of the questionnaire entitled “B: Land use and cropping pattern” is of paramount importance for the farm typology. In this section the main agricultural activities of the farm concerning crop production must be collected in order to create the necessary input-output crop matrix for the modelling chain. This crop matrix interlinks each production activity with specific crops, sets of biophysical factors (soil type, weather conditions, etc.), input use (e.g., fertilizers, pesticides, labour), different types of technology, and socio-economic factors (e.g. market prices, self-consumption, etc.). Here, we ask the participants to declare the activities of at least three main crops[1], while information about addition crops is optional. However, it is highly recommended to collect the maximum amount of information.

- Input quantification and costs (Section C)

The third section, “C: Input quantification and costs,” is complementary to section B and collects the input and cost data for the declared main crops in order to complete the aforementioned crop matrix. In this section, the collected data refer to the quantities of input used per crop and per plot as well as their associated costs. In this part, we advise the LL leaders to ask the farmer provide quantities for their main crops (separately) and not for the totality of their agricultural land.

- Water resources (Section D)

This section, "D: Water Resources", aims to collect information on the different irrigation systems of the farms. This is a very important section as not all countries have the same type of water resources and water availability.

- Finances (Section E)

The section entitled “E: Finances” focuses on collecting the economic data of the farm, such as the relative share of the gross margin, along with additional economic activities.

- Agricultural knowledge (Section F)

[1] A "main crop" refers to the primary or dominant crop that is intentionally cultivated and harvested for commercial or subsistence purposes. This crop typically represents the primary source of income and sustenance for the farm or agricultural operation. The choice of a main crop can vary depending on factors such as climate, soil type, market demand, and the specific goals of the farmer.

Funded by the European Union

This project receives funding from the European Union’s Horizon Europe Framework Programme under project No. 101082102.

This section, "F: Agricultural knowledge", is optional and also qualitative. It investigates the importance that farms attribute to extension services and at what extend it affects their decision-making process.

- Pollination related questions (Section G)

The last section of the questionnaire, "G: Pollination related questions", is of paramount importance. Our goal here is to examine the farmers' perception on the importance of pollination services from wild and managed pollinators, the practices they follow for their provision, if any, and their general willingness to implement new practices or not.

5. Appendixes

5.1. Appendix 1

Questionnaire Detailed farm survey – *draft*

For the **RestPoll** project, three objectives for the detailed farm survey were identified.

Objectives:

(i) Identify and characterize the current level of innovation adoption and socio-economic and bio-physical performance of the most representative farm types
(ii) Characterize the corresponding farm-types (composition, demographics, etc.)
(iii) Collect data for the integrated modelling chain[2]

We want to interview five farmers per farm type. All responses will be kept confidential, and data will be anonymized before being shared or analyzed. We will adhere to GDPR and ethical guidelines by ensuring that all participants give informed consent, understand the purpose of the research, and participate voluntarily. The data collected, including minimal personal information such as name, gender, and location, will be stored securely and used only for project activities. Participants also have the right to withdraw their data prior to analysis, and no personal data will be shared or published without explicit consent.

Indicators:

- Social indicators (e.g. family, labour ratio)
- Economic indicators (e.g. profitability, land and labour productivity and farm income ratio)

[2] A bio-economic model of a farm is a tool used to analyze and predict how a farm's decisions and activities impact both its biological (e.g., crop growth, livestock health) and economic (e.g., income, expenses) outcomes. It helps farmers make informed choices to optimize their operations. Collecting data through a questionnaire helps feed the bio-economic model by providing essential information about the farm's practices, resources, and goals. By collecting this data, the bio-economic model can simulate different scenarios, assess risks, and provide recommendations for optimizing farm operations. For instance, it can help farmers make decisions like when to plant, how much fertilizer to use, or whether to diversify their crops based on economic and environmental goals. Essentially, the data from the questionnaire becomes the foundation for making informed decisions and improving the overall efficiency and sustainability of the farm.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

- Bio-physical indicators (e.g. water use efficiency, nitrogen use efficiency, pesticide use efficiency, biodiversity)
- Geographical indicators

All sections besides one are compulsory. The **Living Lab leader** can decide to skip the optional sections of the survey if deemed irrelevant. At the top of each section, it is indicated whether it is compulsory or optional.

A. Farm characteristics – Compulsory

A1. Farm identification (General Module)

Country	
Living Lab region	
Name of village	
District/community	
Contact no of farmer (mob.)	
Date of visit	

A2. Farm general information (Socio-economic module)

Gender of farm head	Male=1; Female=2; Other=3; Prefer not to say=4	
Age of farmer [yrs]		
Highest level of education farmer		
Years of farming [yrs]		
Primary occupation of hh head based on time of interview	Farming – other (specify)	
Respondent if not hh head:		
Position in the farm		
Highest level of education respondent[2]		
Gender	Male=1; Female=2; Other=3; Prefer not to say=4	
Age [yrs]		
Family type[3]		
[1]**Position in farm:** 1= Farm head 2= Joint farm head 3= Spouse of head 4= Family member 5= Other	[2] **Highest Level of Education** 1 = no formal education 2 = elementary 3 = middle 4 = secondary 5 = university 6 = other (Coranic)	[3] **Family type** 1= Live together 2= Single, divorced or widowed 3= Spouse works away 4= Other adult in charge 5= Child headed 6=Multi-genartional family 7=Extended family living together 8=Other:.....

A3. Number of available (active) persons per month for farm labour provisioning.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

		Month											
Labour type	Gender	1	2	3	4	5	6	7	8	9	10	11	12
Family labour	Male												
	Female												
	Other												
	Prefer not to say												
Hired permanent labour	Male												
	female												
	Other												
	Prefer not to say												
Hired occasional labour	Male												
	female												
	Other												
	Prefer not to say												

A4. Farm family members

♦ ***include only members who live in your farm at least 3 months per year.***

Number of people in your farm _ _ _ _ _ _ _ _

A5. Farm size and ownership

Local area unit (l.u.)	
Total land area [l.u.]	
Total cultivated land [l.u.]	
Rented land [l.u]	
Own land [l.u.]	
Communal land [l.u.]	
Concession (state owned) [l.u.]	
Conversion of local unit to ha	
Other…	

B. Land use and cropping pattern - Compulsory

Compulsory for 3 main crops; OPTIONAL for more/all crops

B1. Crops: Which 3 (or more if applicable to the system) main crops[3], including vegetables, trees, fodder crops and grassland did you grow in the last season and why?

Crop ID	Crop	Name of the variety/varieties	Improved or local (e.g. GMO, local, etc,)	Crop in association/intercropping if any	Name of the association/ intercrop variety/varieties	Improved or local	Top 3 Reasons for crop choice[1]
1							

[3] A "main crop" refers to the primary or dominant crop that is intentionally cultivated and harvested for commercial or subsistence purposes. This crop typically represents the primary source of income and sustenance for the farm or agricultural operation. The choice of a main crop can vary depending on factors such as climate, soil type, market demand, and the specific goals of the farmer.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

2							
3							
4							
5							
6							
7							

[1] Reason for crop choice (multiple answers possible): 1 = tradition; 2= advice (other farmers/extension); 3= Revenue value;4= Yield security;5= Cheap seeds; 6= Adapted to local soil characteristics; 7= Self-consumption; 8=Diversification and crop rotation; 9= Adapted to droughts or other climate conditions; 10= Nutritional or medicinal properties; 11= Pest or disease resistance; 12= Other (specify)

B2. Main crop rotations

Crop rotation description[1]	Main reason for having this specific crop rotation

[1]Describe the full rotation in place where each cropping season is separated by a '-' and intercrops by a '/', e.g. wheat – beans - wheat. In case of perennials, the plantation cycle should be described, e.g. plantation/intercrop (5 years) – plantation (10-15 years). Also include green manures if applicable.

B3. What are the soil characteristics per field/plot? Include all fields.

	Plot ID	1	2	3	4	5
Soil & water characteristics	Soil type[1]					
	Soil fertility[2]					
	Slope [3]					
	Visible erosion[4]					

1. Soil type (as perceived by the farmer): 1 = Clay Soil, 2 = Loamy Soil, 3 = Sandy Soil
2. Soil fertility (as perceived by the farmer): 1= low; 2=Medium; 3=High
3. Slope (as perceived by the farmer): 1=flat; 2= gentle; 3= steep
4. Visible erosion (as perceived by the farmer): 1=none; 2=moderate; 3=severe

B4. What were your farm management practices and perceived biodiversity levels on your farm during the **last season**?

Farm management practices	Irrigation[1]	
	Soil & water conservation methods[2]	
	Pest and disease management[3]	
	Tillage system[4]	
	Land use diversity[5]	
	Field margins, boundaries and corners[6]	
	Share of not cultivated area (% of total)	
Wild (non-domestic) biodiversity	Presence of wild (non-domestic) animal species[7]	
	Diversity of wild (non-domestic) animal species[7]	

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

	Presence of wild (non-domestic) plant species[7]	
	Diversity of wild (non-domestic) plant species[7]	

1. Irrigation: 1= no; 2=surface; 3= drip; 4= sprinkler
2. Soil & water conservation methods (multiple answers possible): 0=None; 1=Terraces; 2=Mulching; 3=Soil bunds; 4=Stone bunds; 5= Broad bed and furrow (BBF); 6=no grazing after harvest; 7=Cover crops and permanent vegetal cover; 8= Other (specify)____
3. Pest and disease management (multiple answers possible): 0=Integrated management, 1=biological methods, 2=non-synthetic pesticides, 3=synthetic pesticides, 4=mechanical and physical control, 5=selective pesticides, 6=non-selective pesticides, 7=other (specify)
4. Tillage system (multiple answers possible): 0=conventional, 1=no tillage, 2=minimum tillage
5. Land use diversity (multiple answers possible): 0= Agroforestry, 1=small patches of native bush and trees, 2=solitary or well-spaced trees, 3=grass strips and grass areas, 4=Rocks, logs, and branches
6. Field margins, boundaries and corners (multiple answers possible): 0=woodland edges, hedges, 1=low walls, 2=stone bunds, 3=trees, 4=naturally occurring plants, 5=shelterbelts
7. Emphasize on the perception of the farmer regarding what is beneficial for sustaining production on the farm. Presence and diversity of wild (non-domestic) biodiversity levels: 0=Very Low, 1=Low, 2=Medium, 3=High, 4=Very High. Presence refers to the existence or occurrence of non-domestic wild animal or plants. Diversity is referred to the variety of species of non-domestic wild animal or plant species. Also here, emphasize on the perception of the farmer regarding what is beneficial for sustaining production on the farm. To elicit a response you could ask how many different species are present. Wild plants and animals are species that grow and live naturally without direct human intervention through breeding, harvesting or management for agricultural purposes. Wild animals can include species of insects, birds and mammals among others.

B5. Did the area of certain crops increase or decrease on your farm, compared to the last two cropping seasons (between 5 to 10 years)? (leave empty if the farmer indicates that the farm is neither expanding nor decreasing) (these questions are needed for model calibration)

Expanding crops (Crop ID)	% of increase in area	Reason [1]

[1] Reason: 1= Government supports (improved seed, subsidized fertilizer); 2= increase crop product selling price; 3= labour available; 4= extension advice; 5= self-consumption needs increased; 6= increased irrigation possibilities; 7= land extension; 8 =other, specify

Decreasing crops (Crop ID)	% of decrease in area	Reason [1]

[1]Reason 1= selling price decreased; 2= other crops yield more; 3= experience drought last cropping season; 4= experience flooding event last cropping season; 5= pest attack during last season; 6= selling/renting out land; 7= too much labour required; 8=other – specify

B6. Crop yields and use of crop products of last season

Local unit for production	
Conversion to ton	

Crop ID (Table B1)	Production of the last year in local unit (farm level)
1	
2	

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

3	
4	
5	
6	
7	

C. Input quantification and costs - Compulsory

C1. Input use: quantity and costs for each crop → for the total crop area

Plot ID (this ID is only to help filling out the tables)	1	1	2	2	3	4	5
Intercropping (1) /succession (2)							
Crop Id							
If perennial: age of the plantation							
Seed/plants							
If seeds: quantity applied							
Specify quantity unit[1]							
If plants: planting density							
Specify density unit[2]							
Unit price (local currency/unit)							
Mineral fertilizer							
Type 1							
Name							
Total quantity applied							
Specify unit[1]							
Unit price							
Type 2							
Name							
Total quantity applied							
Specify unit[1]							
Unit price							
Type 3							
Name							
Total quantity applied							
Specify unit[1]							
Unit price							
Organic fertilizer (compost and manure)							
Type							
Total quantify applied							
Specify unit[1]							
Unit price							
Herbicide							
Local name							
Chemical name							
Total quantity applied							
Specify unit[1]							
Frequency of application							

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Unit price							
Insecticide [3]							
Local name							
Chemical name							
Total quantity applied							
Specify unit[1]							
Frequency of application							
Unit price							
Fungicide[3]							
Local name							
Chemical name							
Total quantity applied							
Specify unit[1]							
Frequency of application							
Unit price							
Other (specify)							

[1] Unit: 1=kg; 2=bag of 25 kg; 3=bag of 50 kg; 4=1L bottle; 5= ½ L bottle; 6=1/4 L bottle; 7=wheel barrow; 8=truck load; 9=other (specify)

[2]Ask for an empty bottle, sachet or the sample of pesticide (i.e. herbicide, insecticide, fungicide)

C2. Current **agricultural practices** and labour use for crops

	Plot Id	1	1	2	2	3	4	5
	Crop ID							
1	**Land preparation**							
	Number of tillage practices							
	Types of tillage							
	Month/week in the year							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	Equipment: 1 =hand hoe; 2=animal ; 3=moldboard; 4=disc; 5=cultivator; 6=other (specify)							
	Costs excl labour tillage							
2	**Sowing/planting**							
	Sowing method							
	Method: 1=manual broadcasting, 2=mechanical broadcasting, 3= drill, 4= zero tillage seeder, 5= other-----							
	Month/week of the year							
	Labour requirement (Number of persons X days/lu)							
	Sowing cost, excl. seed and labour							
3	**Weed control**							
	weeding 1							
	Month/week in the year							
	Method							
	Method:1= handweeding; 2 = mechanical weeding; 3 = herbicide use							

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	weeding 2							
	Month/week in the year							
	Method							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	weeding 3							
	Month/week in the year							
	Method							
	labour requirement (Number of persons X days/lu)							
	Equipment used							
4	**Pest and disease control**							
	Frequency							
	Month/week in the year							
	Method							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
5	**Fertilizer application**							
	Month/week in the year							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	Application costs (excluding fertilizer and labour costs)							
6	**Manure application**							
	Month/week in the year							
	Method							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	Manure material costs							
7	**Mulching**							
	Material							
	Amount							
	Month/week in the year							
	Method							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
8	**Irrigation**							
	Frequency							

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

	Method							
	Method: 1-flooding 2-Sprinkler 3-Drip							
	Labour requirement (Number of persons X days/lu)							
	Irrigation costs excl. labour							
9	**Pruning & grafting (trees only)**							
	Month/week in the year							
	labour requirement (Number of persons X days/lu)							
	Equipment used							
	Grafting costs for trees excl. labour							
10	**Harvesting**							
	Month/week in the year							
	Method							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	Cost harvesting excl. labour							
11	**Threshing and cleaning**							
	Month/week in the year							
	Method							
	Labour requirement (Number of persons X days/lu)							
	Equipment used							
	Cost threshing/cleaning excl. labour							
13	**Transportation from field to home**							
	Labour requirement (Number of persons X days/lu)							
	transport used							
	Cost transport excl. labour							
14	**Storage**							
	Storage facility on farm (1=Yes/0=No)							
	Type of storage facility							
	Costs storage facility							

D: Water resources – Compulsory

Compulsory only if irrigation is part of the system

D1. Which water sources do you use and how much?

Item	Sources of water			
	River	Canals	Well	Other----

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Privately owned				
Communally owned				
Discharge (liters/second)				
Duration of irrigation (hours per irrigation event)				
Overall quality of water (1=high; 2=average; 3=low)				
Construction or management cost (local currency)				
Actual area under irrigation (local area unit)				
Annual irrigation costs (local currency/local area unit)				
Investments irrigation. (local currency/local area unit)				

E: Finances – Compulsory

E1. Farm income from various source for the last 12 months

Sources	Relative share in gross income (% of money)[1]
Crops	
Livestock	
Hiring out labour to other farms	
Permanent job outside agriculture	
Casual labour outside agriculture	
Hiring out machinery	
Subsidies	
Pensions	
Gifts	
Remittances from abroad	
Others (specify)	

[1] Relative share (in steps of 5%): 0 -5%; 5-10%; 10-15% etc. In case a farmer is having difficulties to answer, 20 stones/pebbles could be used where each stone/pebble represents 5%. As this concerns a sensitive topic, do not persist in getting an answer in case the farmer is reluctant to disclose information.

F. Agricultural knowledge - Optional

F1. Where do you get information on extension and agricultural development?

Institute	Importance of this source [1]
Government extension service	
Farmer Cooperatives or groups	
Neighbour farmers	
Traders/Agro-dealers	
NGOs	

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Media	
Other (specify)----------	
[1] importance : 1 = important ; 2 = normal ; 3 = not important	

F2. Type and frequency of extension

How often did you visit the agricultural extension office during the past 12 months? [number]	
How often did the extension staff visited the farm during the past 12 months? [number]	
Main topics of extension visits[1]	
Have you hosted on-farm demonstration on your own farm?	Yes=1/no=0
Have you participated in any field days for crops?	Yes=1/no=0
Have you participated in any field days for livestock?	Yes=1/no=0
Have you attending in any training during the last 12 month?	Yes=1/no=0
Main topics of extension visits[1]	
Main topics[1] you would like to get extension on	
[1]Topic: 1=crop ; 2=livestock; 3=nutrient management; 4=social organization; 5=weed/pest/disease control; 6 = Other	

G. Pollination related questions - Compulsory

G1. Do you have a shortage of pollination services in your production systems?

- ☐ Yes
- ☐ No

G2. If so, do you think your yields are currently lower than they could be due to a lack of insect pollination on any of your crops? (If no, skip to question G4).

- ☐ Yes
- ☐ No

G3. Do you have a specific strategy to deal with this shortage?

Pollination Services (Yes or No)	
Managed honeybees (*Apis mellifera*)	
Managed bumblebees	
Managed solitary bees	
Manual pollination	
Mechanical pollination	
Other	
None	

G4. If you rent/buy managed pollinators for your pollination services, how many of them do you typically use per ha?

Managed pollinators per ha	
Managed honeybees (*Apis mellifera*)	

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

Managed bumblebees	
Managed solitary bees	

G5. If you rent/buy managed pollinators for your pollination services, how much do you typically spend per hive?

Cost of Managed pollinators (€/hive)	
Managed honeybees (*Apis mellifera*)	
Managed bumblebees	
Managed solitary bees	

G6. Do you use the following management measures to encourage pollinators in your growing systems?

- □ Field borders rich in flowers
- □ Reduced use of insecticides during flowering periods
- □ Maintain hedges
- □ Other :.....
  .....

G7. Do you use other habitat management measures to encourage pollinators on your land? If so, please use this space to tell us what they are and why you use them.....
.....

G8. On a scale of 0 to 5, with 5 being very useful and 0 being not at all useful, how useful do you think these domestic pollinators or habitat management measures are in increasing your yields?

Managed honeybees (*Apis mellifera*)	
Managed bumblebees	
Managed solitary bees	
Field management to increase wild pollinators	

G9. Are there any practices you are considering adopting to improve/safeguard your crop pollination services that you are not currently implementing?

- □ Practice 1.....
- □ Practice 2.....
- □ Practice 3.....

G10. What obstacles prevent you from implementing these practices?

I don't have the necessary expertise	
It is too expensive for me	
I don't know how to handle it properly	
It would require me to purchase additional equipment	
It would be too time consuming	
Other	

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.

6. Acknowledgements

This report is compiled for the RestPoll project (Horizon Europe Grant Agreement no. 101082102). Colleagues at partner organisations have contributed information on specific details relating to the types of data expected to be collected and processed. The production of this document is based on the works of Milestone 3 of the Horizon Europe NATAE project which falls under the project coordinating institute, the CIHEAM-IAMM.

Funded by the European Union

This project receives funding from the European Union's Horizon Europe Framework Programme under project No. 101082102.