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SPRINT Research Agenda Outline: Working draft

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Please note: A full peer-reviewed paper is being prepared, which will provide greater insight into how the pesticide agenda was co-developed with pesticide experts.

Introduction

- Background (identified research gaps at the beginning of SPRINT), advancing the state of the art, priorities, and key objectives, policy landscape
- SPRINT Framework – Integrated (One) Health Approach
- SPRINT main findings (high level, 1-page)
- General overarching pillars of SPRINT Research Agenda:

Pillar	Comprehensive Assessment of Pesticide Effects on Health and the Environment:	Exposure and Robust Monitoring Methodologies	Scaling up to risk and larger spatial scales	Agro-ecological innovations, Economics and Stakeholder Adoption
Feeding WPs	WP2-Health status assessment; integration WP4-Ecotox and Human toxicology	WP2/WP3-Human /Environmental Monitoring WP3-Human Exposure	WP5-Toolbox & Health Impact Assessment WP6-Cost-Benefit Analysis	WP2-Innovative practices WP6-Cost-Benefit Analysis WP7-policies
Keywords/ main topic areas	Mixtures New indicators Differentiated data collection, analysis, and recommendations	Comprehensive assessments	Data availability & harmonization challenges	Stakeholder adoption Consideration for gender^{+} inclusion

Methodology

i. Consensus building in SPRINT consortium; literature review; field data; laboratory trials (SPRINT Results); expert interviews; SPRINT policy recommendations
ii. Validation with regulators (EFSA) – Interregional workshops, shared drafts
iii. Stakeholder Consultation

Output from i: Top 40 Research Priorities

Output from iii: most pressing issues per pillar -> Top 1 issue per pillar: Description and link to SPRINT + Specific questions/topics (0.5-1 page)

Overall Conclusion

Research Priorities

Pillar 1 – Comprehensive Assessment of Pesticide Effects on Health and Environment

More comprehensive hazard assessment methodology can be developed to assess impacts of pesticides on human and ecosystem health. Evolving approaches should better account for realistic ecosystem and human exposure (dietary and non-dietary), diversity in populations and ecosystems, and long-term effects.

Pesticide Effects on Human Health

1) **Advance research on pesticide hazard during window of susceptibility (e.g. pregnancy and early life) to? create safeguards where health risks for vulnerable populations are uncertain**, e.g. by.
   - Including prenatal and early life exposure in modelling and other experiments.
   - Examining (animal?) mother-child cohorts to confirm any findings in animal models
   - Applying gender differentiation in examining m/f differences in health effects and vulnerabilities around stages of changes in hormones as fetal stage, puberty, extreme weight loss, hormonal health treatments, fertility (IVF) procedures, pregnancy, delivery and stilling period, and menopause.

2) **Advance research on long-term, low-level effect of pesticides on human health outcomes**, e.g. by
   - Including additional exposure information to enable studying long-term inferences and starting cohort studies to overcome the lack of information on long-term effects. Both require m/f differentiation due to different functioning of hormones.
   - Exploring latency effects (cancer, neurological disease) in a pesticide context, differentiated by m/f due to different functioning of hormones and other vital body features.

3) **Extend, through hazard assessment, toxicologically relevant findings beyond the OECD guidelines**, e.g. by
   - Acknowledging that hazard assessment is a priority step,-based on *in vivo* and *in vitro* tests.
   - Advancing new indicators specifically for neurotoxicity and reproductive and developmental toxicity, for instance, in animal behavioral effects, endocrine disruption, and target organ toxicity appeared to be promising endpoints to assess the full impact of pesticides on non-target species.
   - Fostering research of pesticide-induced changes to the gut microbiome composition and adverse health effects to explore and link microbiome shifts with health outcomes, via deep functional profiling.

4) **Link population-based studies to laboratory toxicology work to identify the mechanism or pesticide of concern**, e.g. by
   - Integrate different streams of scientific evidence from *in silico*, *in vitro*, *in vivo* and population-based observational studies to examine inferences regarding the real-world impact of plant protection products on human, animal and ecosystem health.
   - Including for population-based observations: 1) other sectors beyond the studied agricultural sectors, e.g., also agricultural labourers, especially in the horticulture sector (flowers) and in land or park management; 2) who is regularly working or playing beyond who lives nearby fields where pesticides are used; 3) differentiation of exposure by organic and conventional plant health & protection methods, and 4) differentiation at minimum by gender and age/hormonal stages categories.

5) **Continue to develop methodology to account for dose and exposure thresholds based on available data with inherent uncertainties**, e.g. by
   - Benchmarking dose methodology (BMD Approach - introduced by EFSA and ECHA) - better use existing data and incorporate variability and uncertainty
   - Fostering both testing at high and low doses. Testing at high doses on animals is necessary to detect hazards for animals/ humans in order to avoid false negatives. Testing at low doses helps find threshold doses at which toxic effects occur
   - Applying a component-based approach in risk assessment to combinations of pesticides that frequently co-occur in environmental compartments and biological matrices
   - Continuing to derive biological guidance values to support interpretation of human biomonitoring studies.

6) **Develop Methodology to translate animal toxicology results to human health**, e.g. by

- Refining physiologically based biokinetic (PBK) models to include modules to support placenta passage and the role of the gut microbiome in metabolism
- Filling in data gaps for data nowmissing on substance properties and physiological parameters to support high throughput generic PBK modelling
- Extending m/f animal testing in responsible numbers to further test and translate impact around stages of human m/f hormones changes as vulnerabilities around stages such as fetus, puberty, extreme weight loss, hormonal health treatments, pregnancy-delivery-stilling period, and menopause.

7) **Develop approaches to identify indirect effects of pesticides on human health**, e.g. by
   - detecting impacts on diets and consequently human health if pesticides kill bees,

Pesticide Effects on Ecosystem Health

Current field and laboratory assessments of ecosystem health may not capture the complete extent of ecosystem impacts from pesticides on ecosystem services and biodiversity. SPRINT field sampling campaigns found high numbers of pesticides, including banned active substances, in most samples from environmental matrices, including soil, air, water, sediments, and indoor dust. Risk assessment methodology, including tests endorsed by EFSA, can be extended to account for realism and environmental mixtures.

8) **Extend the portfolio of OECD tests with new methods to better account for ecological realism**, e.g. by
   - Increasing inclusion of native species
   - Exploring long-term effects
   - Adding endpoints for soil microorganisms
   - Including sub-individual endpoints (early warning indicators of damage)
   - Including microcosm tests for soil and aquatic systems
   - Developing multiple-year/long-term studies on low-level effects of pesticides on soil microorganisms, vulnerable species of concern (pollinators) and ecosystems
   - Developing standards for higher-tier testing to limit degree-of-freedom and variability

9) **Improve addressing of mixtures in ecotoxicity testing and ecological risk assessment of active substances and PPP**, e.g. by
   - Outlining realistic and predictable pesticide usage patterns by:

  - Strengthening testing of tank mixes which is still gray-zone in authorization, and making results of ecotoxicity of tank mixtures available to scientific community in a similar way as the ecotoxicity endpoints of individual a.s.
  - Testing impact of repeated and long-term exposure – i.e. spray series within season and multiple application across seasons (persistence considered), co-applications, (inc. field study over multiple seasons)
  - Testing mixtures based on realistic annual mixtures applied at fields (realistic complexity and levels; see SPRINT tool x)
- Detecting pesticides present in the environment, e.g. by:
  - Testing soil and water monitoring results as basis for mixtures (in parallel, promote mandatory pesticide pan-European monitoring based on WFD and SML)
  - Accounting for persisting pesticides no longer approved in testing as they add background effects to current pesticides
  - Exploring risk of PPPs (levels) approved in organic agriculture
  - Exploring holistic effects on soil health for co-exposures resulting from agricultural management (e.g., PPP and biosolid applications, PPP and agricultural plastics, PPP and industrial contamination, PPP and flooding areas, PPP and veterinary pharmaceuticals …)
- Improving knowledge on realistic environmental mixtures of pesticides – monitoring programs and modelling tools,e.g. those developed in WP5 to predict the spatio-temporal combinations of active substances in the environment after their applications
- Further developing and testing protocols and tools for selecting and prioritizing active substances for mixture testing, which determines a mixture's most hazardous composition from field monitoring results or PPP usage data, substance properties and existing ecotoxicity data

10) **Advance further research to fully understand the ecological implications of pesticide accumulation due to ecosystem transfer, as well as to evaluate the broader impacts on biodiversity and ecosystem health in both terrestrial and aquatic systems**

11) **Re-evaluate scientific justification of the current concept of PPP approval/ authorization where higher-tiers results have (more?) driving power in conclusions than lower tiers**, e.g. by
- Acknowledging that scientific results show that higher-tiers are not always more sensitive than low tier testing systems. This is to be explained by that higher-tier testing lacks sufficient standardization and therefore is prone to subjective interpretation of the results and risks inadequately supported conclusions and non-reflected bias.

- Acknowledging that higher tiers results can work out opposite to precautionary principles resonating multiple lower tiers results.
- Developing additional or new protocols for PPP approval/authorization based on the scientific results on both higher and lower tiers levels.

Pillar 2 – Exposure and Robust Monitoring Methodologies

Human health and environmental quality depend on a realistic and robust understanding of exposure to pesticides, as well as the fate/distribution of pesticides in the environment. Evolving approaches should better account for realistic ecosystem and human exposure, diversity in populations and ecosystems, and long-term effects.

Biomonitoring

12) **Develop a better understanding of the human kinetics of pesticides to assess internal exposure and health risk**, e.g. by**.**
    - Fostering human kinetic data availability for pesticides up to the level of that type of data for medicinal products since it is very limited compared to those.
    - Filling in data gaps for most pesticides, specifically related to blood-tissue partitioning, fractions of pesticides bound to unbound in blood plasma, and fractions of pesticides available in whole blood (extracellular versus intracellular compartment).
    - Advancing research on the biotransformation of pesticides regarding the formation of primary and secondary metabolites and related Michaelis-Menten characteristics of these enzymatic conversions.
    - Following up on opportunities for sensitivity analysis and -when indicated- probabilistic modelling to further account for variability and uncertainty in some of the substance characteristics and population characteristics.

13) **Further develop external exposure pathways beyond consumer dietary and occupational exposure**, e.g. by
    - Including inhalation studies as a standard protocol requirement in animal studies since there is a lack of data regarding the toxicity of inhalation.
    - Extending research providing essential input data for exposure models since these are not available (e.g. gas/liquid/solid-phase pesticide skin penetration, hand-to-mouth contact and ingestion from environmental sources, etc.)

- Improving probabilistic models of non-dietary exposure routes. What is the tipping point at which non-dietary exposure becomes significant? - Monte Carlo Exposure Assessment, MCEA)
- Exploring methods for Data Harmonization among countries since- EFSA relies on data from each individual country which is highly variable and cannot easily be used for probabilistic models.
- Designing updates to Guidance on Operators, Workers, Bystanders, Residents.
    - Definition harmonization of consumers, residents/neighbors, workers, bystanders to enable defining the boundaries between these groups to assess exposure (distance?); especially in the operationalization of cross analysis of selected study participants, exposure data and questionnaires results
    - Refined assessment of farm women's exposure by differentiating their relation to farm work (time working with pesticides/ being in the field and various farm buildings (inc. house) /using farm equipment, doing farm overalls' laundry); parts can be also used to better differentiate among farm men, or farm labourers (m/f) and their partners
- Advancing - next to short-term and cross-sectional studies -longitudinal studies and studies that include more age groups/ representation of groups exposed to hormonal changes, while keeping up m/f cross comparison…
- Improve estimates for home dust uptake by inhalation and hand-to-mouth contact in children's age groups (based on particular dust contact) in comparison to other age groups
- Following up by testing level of decrease in home dust pesticide residue as result of prevention (exchange of working clothes before entering home, laundry measures) and cleaning regimes (ways of dry-wet cleaning, frequency, depth of cleaning)

14) **Develop a database providing information on the composition of feed for farm animal species for the purpose of risk assessment**, e.g. by
    - Advance research to develop a standard to support farm animal species-specific exposure and risk assessment, for instance, to use for recommended feed intake
    - Ensure that female farm animals are the main target group in setting such standard or recommendations since female farm animals are in the majority, thus ensure that it is thoroughly based on risk assessments for female animals, including various stages of vulnerability due to hormones changes (since feed is more and more differentiated as well), while singling out male animals for procreation for specific exposure and risk assessment

15) **Define feasible methodology for long-term human biomonitoring studies in order to be implemented in monitoring programs**, e.g. by

- Defining a comprehensive methodology for long-term monitoring studies , preferably cost-effective, by .
    - Selecting targeted focus groups carefully, including which characteristics are meaningful for (cross-)analysis;
    - Advancing monitoring through selected early warning signals (mainly urine, but also blood)
    - Advancing wristbands as 'handy' research tool;
    - Including exposure through both direct contact testing and spread residue testing? (Dust, particle phase, gas phase).
- Starting longitudinal biomonitoring programs in prioritized crops like vineyards to show the effect of regulatory policy on exposure and risk
- Developing how human biomonitoring data can strengthen post-market evaluation, e.g. by performing back-calculations to assess exposure in an existing framework of reference values (ADI for humans and MRL in animal feed).
- Exploring the application of PBPK modelling to monitoring data and highlighting alarming paths and effects
- Over emphasis on short-term studies and cross-sectional studies

16) **Continue to develop biological guidance values (BGVs) as references value for monitoring of human exposure**, e.g. by
    - Capturing spatio-temporal pesticide exposure and risk to improve monitoring programs in environmental matrices. Several methodological improvements would improve monitoring programs. General Considerations include:

Environmental Exposure

17) **Develop more harmonized definitions and SOPs for monitoring across studies and programs**, e.g. by
    - Defining/harmonizating wording and conceptual coverage of key terminology at all steps of protocols – IPM vs. Conventional, crop selection, SOPs for different matrices (collection and analyses)

18) **Explore links between practices/local characteristics and monitoring findings**, e.g. by
    - Exploring dynamics in time, including collect data over the entire crop rotation.
    - Exploring tools to derive larger scale assessments (of practices in all region, not in a subset of fields), e.g. Visual soil assessment for soil and plant assessment
    - Assessing connectivity between landscape elements, farming practices, and environmental matrices, for instance.
        - Between farm practices - aquatic systems, farming practices farm home hygiene practices/regimes – pesticides residue in farm indoor dust

- Investigating the route of exposure and the interactions of sediments-rivers-groundwater
- Including influence of optional new or changed elements such as external soil addition, changes in rotation scheme (crops), in soil levelling, drainage, irrigation or watering, in impacts of flooding – draught, farm operational changes in management, pluri-activity, farming methods – equipment – supplies, membership studygroup, etc.

19) **Expand monitoring and tracer studies of pesticide outside of agricultural research fields to better assess diffuse-source pesticide pollution**, e.g. by
- Monitoring and tracer studies beyond agricultural fields of pesticides (used in agriculture) in from agricultural cultivation remote/non-targeted areas, for instance in labeled nature reservation areas or open public outdoor space as (recreation) parks or woods.

20) **Develop reference values for pesticide residues and mixtures in more environmental matrices, to inform on/about actions**, e.g. by
- Defining benchmarks in soil, growing season-specific?
- Exploring simple threshold proposals implications: e.g., setting PECsoil and PECwater as thresholds for soil/water monitoring. These values were used in approval process and if application approved, they are considered safe. Thus they should never be exceeded.
- Investigating what -and how- various health descriptors can be used as reference values or thresholds (e.g., how healthy is the soil, if no threshold exists, but pesticide levels, diversity, microbiome, etc. exists) regarding
  - Soil microbiome since little research exists on indicator species, for instance on what is healthy soil microbiome (for different ecological niches); what degree of deviation is acceptable, c.q. identifying tipping points and thresholds where ecosystems functions are not affected
  - Conventional soil, since insufficient research is available to support that it has lower diversity, therefore more unstable and more prone to dangers, thus less resilient to disturbance, including pesticides effects.

Pillar 3 – Upscaling Findings to Larger Spatial Scale

21) **Further develop spatial modelling methodology to predict environmental and human exposure across regions and countries**, e.g. by

- Modelling approaches are faster and cheaper than measurements or monitoring. They effectively utilize already existing data on PPP use and PPP registers.
- Modelling the levels in soils and water can be directly connected to risk assessment for ecosystems. However for human health risk assessment approaches based on such data should be developed.
- **Reducing the large uncertainty regarding pesticide exposure assessment**, which concerns both ecosystems and humans, by increasing the ability to assess possible impacts**.**
- **Implementing standardized registration of real PPP applications**, including detailed information of what, where, when, how, and how much, to greatly reduce uncertainty. This calls for standardization of PPP usage data.
- Developing through the modelling an alternative methodology for identification and prioritization of substances for withdrawal. (Policy connection)

22) **Upscale PPP data to the European level and make them publicly available to support spatio-temporal models of exposure and risk**, e.g. by
- Harmonizing data collection and format for national and European PPP data (national PPP registers, national PPP use statistics, EUROSTAT PPP data) in quality, quantity, accessibility, resolution, and harmonization to enable to use in models and tools needed for upscaling and then determining and monitoring PPP-related EU policies. Also
- Harmonizing of global data as next step requires to go beyond collecting data of sales only, to improve spatio-temporal resolution, and make these data publicly available (only commercial datasets exist now)

23) **Develop how to use health impact assessments to evaluate the effect of pesticide applications and policies on specific human health outcomes**, e.g. by
- Projecting/Making? estimations using scenarios of exposure (pesticide applications).
- Connecting estimated incidence of pesticide-to associated diseases or other health outcomes?

24) **Continue to refine lifecycle analysis (LCA) methodology for pesticide damage costs across the entire value chain**, e.g. by
- Elaborate on SPRINT models of these LCA approaches since more data is needed.
- Following up on the developed approach of calculating damage costs regarding:
    - High uncertainty of outcomes, but it still gives an idea of impacts of various practices; Even range of uncertainty give a conservative upper limit for policymakers.

- Ensuring better data availability to carry out a trade-off between pesticide risk and profitability at the EU level

25) **Investigate the lifecycle impacts of "biopesticides", especially those used in IPM and organic agriculture**, e.g. by
    - Investigating the Bioagents – we are missing defined impacts. Focus on some selected bioagents and defining impact pathways (especially those used in IPM and Organic). Linked to LCA and other state of the art.
    - Connecting to the new EU Agriculture vision which focuses on faster/wider rollout of biopesticides.

26) **Identify high-impact practices and pesticides with the highest exposure potential and health risk and propose alternatives**, e.g. by
    - Defining safe distances from high-risk applications
    - Measuring of external exposure of workers during spraying
    - Linking farmers' information on their (spraying?) equipment (and routine?) and their exposure levels in biological media

27) **Explore Innovation and agronomic alternatives**, e.g. by
    - Addressing unresolved questions about how, where, and under what conditions alternatives (e.g. biocontrol, crop rotations, machinery) are effective through research that includes technical feasibility, adaptability, and trade-offs.
    - Advancing research that increase the options and knowledge of farmers in their selection of biological control agents that effectively protect crops in the field.
    - Fostering research based on field trials that validate the efficiency of selected SLMs under varying biophysical and agronomic conditions. Such trials facilitate more targeted and locally adapted implementation strategies.

Pillar 4 – Agro-ecological innovation, Economics, and Stakeholder Adoption of Low-Pesticide Practices

28) **Continue research to better capture the true farm-level economic costs and performance of well-defined lower pesticide use systems (e.g. IPM, regenerative farming, or pesticide-free agriculture)**, e.g. by
    - Refining revealing economic performance and revealing underlying mechanisms.
    - Including multiple sources of income generation by farm household members

- Including farm household dynamics around farm decision-making
- Including further exploring division of farm labour and the effects of organic farming in comparison to conventional farming on various labour inputs for specific activities.
- Integrating productivity, income, or environmental risk indicators, such as the Pesticide Load Index (Kudsk et al., 2018), would enable an important analysis of economic and environmental trade-offs or synergies at the farm level.

29) **Extend economic analysis to the crop level to enable providing farmers with more practical information on the associated costs, yield effects and revenue changes in specific production systems.**

30) **Investigate factors influencing conventional farmers' perceived production risk when switching to organic agriculture**, e.g. by
    - Extending research among study participants beyond their perceived production risks when switching by interrogating and analysing the reasoning behind it.
    - Redressing reasons and factors behind perceived production risks to revert the perception that farming without synthetic pesticides is very risky and consequently reducing the reliance on synthetic pesticides.

31) **Investigate barriers and opportunities to increase consumer and market demand for disease-resistant varieties**, e.g. by
    - Investigating the consumer and market barriers and opportunities for disease resistant varieties that are perceived as a cost-effective way for conventional/ IPM farms to reduce their reliance on synthetic pesticides
    - Redressing in barriers and profiting from opportunities for sufficient market demand and relaxation of AOC (controlled designation of origin) specifications.
    - Developing measures to sustain responsible increase of consumer and market demand

32) **Explore economic models and risk-sharing mechanisms**, e.g. by
    - Extend research on potential effective measures to support transition of stakeholders while economic risk is considered a core barrier, especially through transition financing, including how economic risk from yield loss or upfront investment can be shared across the food system (e.g. via policy instruments, consumer incentives, supply chain actors).
    - Implement research to support value chain redesign and change in consumer behaviour by investigating how retailer standards, visual quality norms, and consumer education can be leveraged to support alternative production models and reduce pesticide dependency.

- Widen the research and policy scope of possible incentives beyond organic, for instance encouraging agroecological and IPM practices that do not fall under formal organic certification but contribute to system-wide sustainability.

33) Explore research approaches including gender⁺ considerations, e.g. by

- Including in research that in agriculture the farm household is the basic unit for decision-making, labour division, income generation and that historically grown gendered and generational differences and inequalities at least require being examined which key ones perpetuated or changed
- Considering the various types of farm household operations, for instance when one of the spouses or living-in family bring in income from other sources than the farm, farm production cost-benefit analysis is not complete for farm household decision-making if other optional income/labour sources are not included
- Completing big data sets as being used and including EU-stats with realistic m/f data, e.g. on farm co-management, non-farm income, farm labour, to enable reliable scientific analysis and modelling, and effective policy recommendations and measures

34) Foster research that includes and assesses alternative participatory formats, e.g. by

- Identifying and using formats that move beyond the limitations of conventional, non-interactive public consultations since the current consultation formats tend to entrench polarised views rather than foster mutual understanding or collective reasoning
- Including more dialogic and structured forms of engagement since these are considered essential for navigating complex, value-laden transitions like pesticide reduction, for instance by facilitating citizen debates and juries, consensus conferences, or deliberative panels
- Using and assessing more refined participatory methods with stakeholders or study participants as double diamond (first diving into possible underlying problems, then formulate solution areas on various levels), lotus blossom exercise (first exploring all aspects or influences), ladders (discussing levels of positioning within spectrum of options)

35) Investigate how alternatives to chemical pesticides are framed as viable, feasible, or desirable and how these framings shape influential policy pathways, regulatory priorities, and innovation funding, e.g. by

- Investigating interdisciplinary which underlying interests and worldviews of different actors are behind the narratives for contestation of what counts as a "realistic" or "scientific" alternative.

- Investigating interdisciplinary how such narratives are constructed, validated, and challenged within transition governance.

36) **Uncover and redress power asymmetries in participatory policy processes**, e.g. by
    - Examining and monitoring possible power asymmetries by performing an ex-ante assessment, adjusting and monitoring both group selection criteria and participation facilitation strategies with regular input from the participant groups
    - Examining and monitoring transcripts and outcomes from participatory input on possible influential power asymmetries
    - Implementing alternative or additional ways (e.g. specify low threshold invitations and methods, or organise specific meetings for underrepresented or less heard target groups) to secure input from all participating groups
    - Including methods that raise awareness of power dynamics, for instance by asking about the influence of various stakeholders and positioning themselves among them

37) **Examine and redress how formal and informal power dynamics shape who participates in public consultations, how influence is expressed, and which voices are amplified or marginalized**, e.g. by
    - Examining why and finding how to redress that research as SPRINT (?)reveal a highly uneven participation landscape, with coordinated industry submissions often overshadowing fragmented input from less-resourced groups
    - Selecting, implementing and assessing criteria that enable safeguarding fair representativeness and legitimacy of stakeholder engagement processes in EU policy-making.

38) **Assess implementation and coherence of EU policy**, e.g. by
    - Investigating **why existing pesticide regulations (e.g. Sustainable Use Directive)** have not reached full implementation or achieved all stated goals
    - Examining how better cross-sectoral governance can align agricultural, health, and environmental objectives.

39) **Elaborate on Systemic transition design: Towards integrated and context-sensitive pathways**, e.g. by
    - Developing **systemic transition frameworks** capable of addressing the **interdependencies of agronomic, economic, regulatory, and cognitive lock-ins** since current approaches often tackle barriers in isolation, missing how they are interconnected and reinforce one another.

- Including that **transition strategies are sensitive to context**, accounting for regional differences in farming systems, crop types, climate conditions, and market and governance structures.
- Identifying **scalable yet adaptable models** for transitioning away from pesticide reliance that reflect the complexity and diversity of European agriculture.

40) Explore cultural and cognitive drivers of transition decisions, e.g. by

- Implementing research to to understand how farmers' values, identities, and perceptions of success (e.g. yield, risk, "good farming") shape resistance or openness to change as highlighted as crucial in SPRINT reports (from work package 7).
- Including how cultural norms and emotional attachments influence decision-making at farm level, and how this varies across regions, farming systems, and gendered and generational perspectives.
- Unlocking such dynamics is to be considered critical for designing effective support mechanisms and narratives around system redesign.