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Literature review and collection of existing data on PPPs' distribution and accumulation in ecosystems, plants, animals, and humans

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1. General introduction

This deliverable is part of WP2 entitled "PPPs' distribution and health status". The aim of this deliverable is to provide an overview on the Plant Protection Product (PPP) concentrations measured in Ecosystem, Plant, Animal, and Human matrices (EPAH). This review will be the platform for the development of an inventory of PPP distribution and accumulation in EPAH (D2.3), for the development of an inventory of PPPs' exposure and validation of the model used in WP3 (D3.4), as well as for the development of health risk assessment toolbox (D5.1). In addition, the outcomes of this deliverable will feed into D6.2 - Health damages and external costs at the regional level.

The search of the publications was motivated by the collection of data allowing spatial mapping of pesticide concentrations.

The structure of this deliverable consists of providing EPAH PPP concentrations measured in each EU country represented in SPRINT by a CSS (Spain, Portugal, France, Switzerland, Italy, Croatia, Slovenia, Czech Republic, Netherlands, Denmark). The data collected in this review will complete the ones measured at the CSS (WP2), to refine and enhance the validation status of existing models for ecosystems and plants (D3.2).

The search criteria for the data included into this review meant for mapping were as follows:

1. We only included Plant Protection Products (PPP) concentrations for the CSS relevant 207 substances.
2. We compiled and considered the data collected from National Monitoring Programs (NMPs) of each EU- SPRINT CSS country (if possible), or European publications (e.g. EFSA, FAO). If these were not available, or if the retrieved data were limited, we considered national monitoring reports, overview studies carried out at the national scale including IPCHEM documents, the HBM4EU database, and other overview publications found using our search strategy.
3. The search of the above reports was limited to reports published from 2010 and onwards except for soil (a SPRINT review covering the last 51 years period has been published alongside this document, Sabzevari & Hofmann, 2022).
4. The PPP concentration in ecosystem, plants, animals and humans of the selected studies were preferably given as a mean value (arithmetic mean) of the point measurements (e.g. plot scale), but the median, geometric mean (GM), minimum and/or maximum concentrations were also provided if available.
5. If available, the coordinates of sampling location were provided for each measurement; if not, the name of the location (city, region, country) were provided to allow a more detailed (spatial) assessment. We included only disaggregated data (not averaged at large scale) except for animal and crop because of the very few articles found.



2. Search of national monitoring programs and overview studies

We started by asking our 11 CSS leaders (ten in Europe, and one in Argentina) to provide us information on any ongoing or past NMPs on PPP exposure and other relevant overview studies with data on PPP concentration in EPAH in their respective countries.

For human, relevant literature from National Human Biomonitoring (HBM) programs on PPP concentrations were identified and extracted. Literature included HBM reports or published articles presenting national HBM results. Regional biomonitoring programs within CSS countries were also included if available. After the initial HBM search and once the HBM information was provided by the CSS leaders, we used PubMed (<https://pubmed.ncbi.nlm.nih.gov>) and Web of Science (<https://www.webofscience.com/>) electronic data base for the search.

The literature search was performed for all SPRINT CSS countries using the following key terms (all fields): "**pesticide residue**" OR "**insecticide residue**" OR "**fungicide residue**" OR "**herbicide residue**" OR "**pesticide concentration**" OR "**insecticide concentration**" OR "**fungicide concentration**" OR "**herbicide concentration**" OR "**plant protection product**" combined with "**Human**" AND the country of interest (including countries with an HBM and IPCHEM).

For each country, all potential eligible articles were screened by the title and the year of publication. The first step was an initial limited search of a selection of relevant databases, followed by an analysis of keywords contained in the title and abstract, and of the index terms used to describe the article. A second search based on a Full-text articles was then undertaken across all included databases. A few original articles were additionally included in the PPP literature according to suggestions of the CSS leaders/SPRINT experts, or initially gathered publications. The number of the articles found, and the ones included in this report are given in **Table 1**.



Table 1. Articles found considering our search strategy and the ones considered in this report.

Country	Platform	Articles found	Overview/ Review	Considered in this report																							
				Soil	Air	Water	Plant/ Crop	Animal	Human																		
Spain	PubMed	3406(879)	379(168)	9 (+11)	1	2	2*	1*	7																		
	WOS	2535(861)	87(16)																								
Portugal	PubMed	1306(285)	118(62)	3	0	1			2*	1*	1																
	WOS	695(860)	42(16)																								
France	PubMed	3882(690)	320(102)	6	1	12					2*	1*	5														
	WOS	1992(861)	118(16)																								
Switzerland	PubMed	1390(274)	135(45)	3	1	8							2*	1*	1												
	WOS	679(860)	481(16)																								
Italy	PubMed	4739(1173)	493(247)	2	0	3									2*	1*	2										
	WOS	1850(860)	141(16)																								
Croatia	PubMed	285(76)	21(8)	2	0	2											2*	1*	3								
	WOS	182(860)	14(16)																								
Slovenia	PubMed	276(47)	14(10)	1	0	1													2*	1*	4						
	WOS	156(860)	13(16)																								
Czech R.	PubMed	1003(183)	95(34)	7	0	1															2*	1*	2				
	WOS	712(860)	35(16)																								
Netherlands	PubMed	1702(225)	168(29)	2	0	1																	2*	1*	3		
	WOS	746(860)	56(16)																								
Denmark	PubMed	1145(329)	77(46)	1	0	1																			2*	1*	3
	WOS	559(860)	41(16)																								

WOS: Web of Science; *including the EFSA report (Carrasco Cabrera and Medina Pastor, 2021) ; values in brackets are those of Human part; in the case of Spain, additional soil studies (11) are published, but raw data are not yet received.

3. Overview of the matrices considered

This deliverable provide:

- Overview of the human biomonitoring programs available
- Overview of the Ecosystem monitoring programs available
 - > Overview of available data of PPPs in soil
 - > Overview of available data of PPPs in water
 - > Overview of available data of PPPs in air/dust
 - > Overview of available data of PPPs in crops/plants
- Overview of available data of PPPs in animal products



4. Summary

The studies found in the literature on the concentrations/residues of detected pesticides in EPAH, and the locations of their point measurements are hardly comparable, because of the following:

- The investigations were conducted in distinct regions with specific portfolio of pesticides following the regional crop production and plant protection products approved by regional regulatory agencies.
- The use of different LOQs and other survey parameters.
- The studies did not always report on the conditions of the selected sites in terms of cropping system and agricultural management practices.
- The majority of the studies found in the literature focused primarily on the development of analytical procedures and their calibration and validation, and less focus on soil and crop characteristics.
- Finally, time and year of sampling that is different from study to study.

The above considerations strongly biased the comparison between the studies and the conditions of the experimentation used, and consequently the comparison between the concentrations of pesticides found.

5. Gaps and steps forward

In the case of some CSSs, we encountered three main difficulties, (i) limited data / NMPs, (ii) existing of aggregated data (or only maps without data) not appropriate for our purpose (mapping), and (iii) the data are not accessible for public use (e.g. NMPs). In addition, in some cases, the reports are in the local languages and no English versions are available.

It would be of great interest for the SPRINT project to ask the national institutions to deliver missing raw data to be used within the project. The corresponding CSS leaders could start negotiation for this purpose with the support of WP2 and the coordination team.

It may be wise to update the actual database that will include both data gained from the literature and the one measured at the CSSs to serve as the basis for a scientific publication.



References

HBM4EU - European Human Biomonitoring Initiative. <https://cordis.europa.eu/project/id/733032>

IPCHEM – Information Platform for Chemical Monitoring. <https://ipchem.jrc.ec.europa.eu/>

Sabzevari S. and Hofman J. (2022) A worldwide review of currently used pesticides' monitoring in agricultural soils. Science of The Total Environment 812, 152344.