Big sales, no carrots: Assessment of pesticide policy in Spain.

Abstract

This paper explores Spanish pesticide policy with a focus on developments during the last decade. Spain is one of the greatest global consumers of conventional pesticides and leader in various related rankings among European Union countries. However, reviews of pesticide policies examining the key plans, facts, strategies and stakeholders are largely lacking. In providing an overview of Spanish responses to the European Directive 2009/128/EC on the Sustainable Use of Pesticides, this article contributes to filling this research gap. Spanish National Action Plans lack measurable quantitative objectives for reduction in the use of conventional pesticides and further implementation of Integrated Pest Management. Spanish National Action Plans also lack strategies for informing citizens about pesticide residues, and efficient means of keeping up to date with the authorisation of new active substances and delivery of pesticide use and sales data, in time and form. Moreover, there are no clear trends in conventional pesticide use reduction and sales, despite a significant reduction in the use of the more toxic active substances. Overall, this paper reveals various important shortcomings and incongruences in Spanish pesticide policy, which deserve further scholarly exploration and should be a matter of concern for public bodies.

Keywords: Crop protection; Policy; Pesticide use reduction; Spain; Statistics; Sustainability

Introduction

In recent decades, the consequences and problems that conventional pesticide use poses to the environment and human health via soil, food and water contamination has led to

several attempts to reduce, control and regulate their use. In the European Union, a series of regulations since the early 1990s show clear demands to reconcile agricultural production with a reduced impact of this activity on the environment, and the development of risk indicators (Lewis, Tzilivakis, Warner, & Green, 2016). This has involved attempts at data collection and statistical homogenisation, the promotion of Integrated Pest Management (IPM), and the establishment of National Action Plans geared towards conventional pesticide use reduction. The integration of such measures within the Common Agricultural Policy has been fraught with difficulty (Navarro & López-Bao, 2018). Since conventional pesticide use will not reduce spontaneously, governments develop various policy strategies including legal prescriptions, taxes and subsidies, knowledge transfer, research, and technical assistance. These are aptly summarised as strategies aimed at incentivising (carrots), punishing (sticks) or raising awareness (sermons) (Lee, den Uyl, & Runhaar, 2019).

According to Directive 2009/128/EC on the Sustainable Use of Pesticides, to assess the effectiveness of these strategies, measure progress and calculate risk indicators, solid conventional pesticide use statistics need to be compiled. The Directive required Member States to adopt specific quantitative objectives, targets, measures and timetables to reduce the risks and impacts of their use. However, a recent special EU report has critically highlighted the limited advances in reducing and measuring risks of conventional pesticide use (European Court of Auditors, 2020). This goes in line with previous critical appraisals by Eurostat signalling the lack of Member States' progress on statistics about conventional pesticide use and risk, which make it difficult to compare, measure progress, and establish meaningful targets (Eurostat, 2019). Given that farmers will not reduce conventional pesticide use by their own volition and government action is required, the time has come to shed light on how individual

Member States are dealing with European directives and measure progress. The aim of this overview is to explore current pesticide policy in one of the major conventional pesticide consumers worldwide: Spain. This involves analysing issues of data collection and management, key actors and policies, general public knowledge and negative impacts of conventional pesticides on human health and the environment.

Spain has the second largest European agricultural surface area, comprising 24 million hectares. Throughout the last decade, the country has been the leading pesticide consumer in the EU together with France, with 61,343.224 tons in 2018 without including Molluscicides and other so-called plant protection products, according to the consumption of pesticides indicator developed by Eurostat recently updated in 2020. Spain is also the tenth top conventional pesticide consumer worldwide, according to data from the 2017 FAOSTAT developed by the Food and Agriculture Organization of the United Nations. Despite this, it is a rather unexplored and neglected topic in this country, and lacks the richness of literature exploring the issue in countries like the UK, France, Denmark or Germany (Barzman & Dachbrodt-Saaydeh, 2011; Bürger, de Mol, & Gerowitt, 2008; Hillocks, 2012; Jensen et al., 2019). This perspective paper tries to fill this knowledge gap through a systematic analysis of recent Spanish pesticide policy, compiled from all relevant data sources available in the country. In so doing, it aims to provide useful scholarly and applied insights, which may aid in reducing conventional pesticide use in the near future.

Spanish pesticide uses and reported impacts

Although there are no official indicators, the negative impact of conventional pesticide use is widespread in Spain, including environmental damage and contamination of groundwater (Fernandez-Alba et al., 1998; F. Hernández et al., 2008; Menchen, De las Heras, & Alday, 2017; Pose-Juan, Sánchez-Martín, Andrades, Rodríguez-Cruz, &

Herrero-Hernández, 2015), impacts on human health (Fernández et al., 2020; Roca, Miralles-Marco, Ferré, Pérez, & Yusà, 2014; Zumbado et al., 2005) and on domestic and wild animals (Ruiz-Suárez et al., 2015). The contamination of Spanish waters and rivers would deserve a separate analysis. Currently, harmonised methodologies for the study of waters and rivers are lacking, and there is an uneven regional development of academic or institutional research on the topic. Pesticide contamination with long-term series are well documented in rivers such as the Ebro, Llobregat, Turia and the Júcar (Canccapa, Masiá, Andreu, & Picó, 2016; Ccanccapa, Masiá, Navarro-Ortega, Picó, & Barceló, 2016; Masiá, Campo, Navarro-Ortega, Barceló, & Picó, 2015), showing high-impact of pesticides to river ecosystems and contamination of biota, sediments and water samples generating chronic toxicity at different trophic levels. Other river basins are less well known.

Detailed official data on surface, underground and drinking water are only reported in the latest 2018 yearly report on the progress in the application of the Spanish National Action Plan or NAP (MAPAMA, 2018). The legal criteria for the provision of these data is the Royal Degree 817/2015, September 11, which establishes the criteria for monitoring and assessing the state of surface waters and environmental quality standards, and the Royal Decree 1514/2009, October 2, which regulates the protection of groundwater against contamination and deterioration. Data for 2017 show that 43% of the 1,054 water monitoring stations sampled contained active substances from conventional pesticides. Of the total 74,995 samples analysed (74,440 in water, 167 in biota and 388 in sediment), 2,165 or the 3% of samples presented 43 different conventional pesticides. Regarding underground water, of the 1,387 monitoring stations 385 contained active substances, and of the 73,313 samples collected, 1,9% presented conventional pesticide residues. Finally, the Spanish National Information System for

Consumption Waters reported the presence of 278 different pesticides in drinking water, detected in 4,168 supply areas, which corresponds to 41,49% of all supply areas covering 69,9% of the Spanish population affected. Of the samples with conventional pesticide residues, 51,8% came from supply tanks and 31,1% from the distribution network. These data are alarming, but are difficult to compare with other EU Member States due to the different methodologies applied and the lack of harmonised indicators (Quintana, de la Cal, & Boleda, 2019).

Regarding pesticide residues in food, international assessments show that a high percentage of Spanish foodstuffs contain varying, often high, residue levels (Jensen et al., 2019; Poulsen, Andersen, Petersen, & Jensen, 2017). Despite this fact, Spain was the third country with least food samples taken per 100,000 inhabitants in the last (2018) EU report on pesticide residues in food, carried out by the European Food Safety Authority (Medina-Pastor & Triacchini, 2020). Spain averaged 5.6 food samples per 100,000 inhabitants, while the EU mean was three times higher, with 17.1. As an aggravating factor, a 2013 EU audit on Spanish pesticide control policy stated that:

the pesticide residue controls are not sufficiently effective due to the limited analytical scope in the majority of the laboratories analysing official control samples, and as a consequence of the poor distribution and co-ordination of available resources across a large number of residue laboratories (European Commission, 2013, p. 60).

Intoxications through direct exposure to pesticides have been reported at levels ranging between 750 and 1000 individual cases per year between 2013 and 2017 (MAPAMA, 2017). These numbers probably underestimate the actual cases, as only around 20 hospitals are involved in the system of detection of pesticide intoxications (European Commission, 2018). Spanish consumers are well aware of the risks posed by pesticide use (Pumarega et al., 2017). This was already patent in the 2010 Eurobarometer survey

report on food-related risks perception in the EU, which concluded that 72% of Europeans and 66% of Spaniards were very or fairly worried about the presence of pesticide residues in food (EFSA, 2010). This concern emerged most clearly in 2019, when 45% of Spaniards compared to 39% of Europeans reported being worried the most by pesticide residues in food, among all other issues (EFSA, 2019).

Key actors in Spanish pesticide policy

Spain adopted the Directive 2009/128/EC for the sustainable use of pesticides in its national legislation through the Royal Decree 1311/2012. This law provided the framework for implementing the requirements set out by the European Commission. These were to reduce the risks derived from pesticide use for human health and the environment, promote the IPM, and establish NAPs that should set quantitative targets, goals, instruments and timetables for the reduction of conventional pesticide use. To date, Spain has passed two NAPs, in 2012 and 2017 (Ministerio de Agricultura, 2012; Ministerio de Agricultura y Pesca, 2017). The Ministry of Agriculture, Fisheries and Food (MAPA) is now the competent authority on the matter. It designed the NAPs together with another key actor: The Business Association for Crop Protection (AEPLA), which comprises companies such as Basf, Bayer, Dow, Du Pont or Syngenta. The social criteria to decide how much pesticides should be applied to maximize social benefit differs from the private optimum geared by profit-seeking, because pesticides cause external social effects that make it difficult to achieve common goals among stakeholders (Agne et al., 1995). The fact that an interested private party such as AEPLA plays such a fundamental role in policy-making has been called to question in the literature, given the absence of environmental focus and the profit-making nature of private actors. However, as Lee et al. (2019) have shown, multi-stakeholder actor involvement in leading the application of an instrument has proved positive in reducing

pesticide use risks. Similarly, multi-stakeholder involvement yields positive outcomes by working in tandem, as centralised government instruments tend to generate a sense of exclusion to farmers and other actors. Although the actual development process of the Spanish NAPs and the role of AEPLA will probably remain unknown, what is clear is that the association is rather content with its lack of ambition and reach. In AEPLA's 2012 yearly report, it was stated:

We value very positively the content of the National Action Plan… AEPLA has participated in it, presenting a basic document and organising a conference to prepare the first draft of the Plan, with the participation of all the sectors involved, to later present proposals that would enrich it, some of them included in the final text, and others that we hope will be taken into account in its development. Six months later, the National Action Plan was a reality. (cited in de Prada, 2014, p. 35)

The key role of AEPLA in developing the NAPs could have been counterbalanced by the presence of other stakeholders, such as ecologist associations or organic agriculture consortiums, which could have easily offered plausible alternatives for crop protection strategies in specific crops and regions beyond IPM guidelines advocated by actors such as farmer cooperatives or agricultural export associations.

Two further institutions play key roles in Spanish pesticide policy. First, the National Phytosanitary Committee, created in 1998 and composed of civil servants, surveys the implementation and coordination of NAPs with the devolved regional Spanish Autonomous Communities , and delivers the mandatory annual reports monitoring their performance. Breaking the regulations, only five annual reports have been delivered to date. The last dates back to 2017, and is largely outdated. The second institution is the Sectoral Committee of Plant Health, created in 2013, comprising central government representatives, agriculture and exporters' associations and cooperatives, and crop

protection companies. There is no public information available about the role played by the Committee, which is vaguely described as a "a forum for exchange and discussion between the administration and the group of organisations related to plant health" (MAPAMA, 2015, p. 135). The committee lacks representatives of organic agriculture, despite Spain having the largest surface area dedicated to it in all Europe.

Key instruments in Spanish pesticide policy

A detailed analysis of Spanish NAPs goes beyond the scope of this account due to their multifaceted character and the wide-ranging number of topics they address. The focus of both NAPs (2013 and 2017) is primarily on the so called compliance and action targets for the 'sustainable use of pesticides', the notion of sustainability remaining undefined. The 2017 version of the NAP is a 71-page document that expands and updates the 2013 version. It provides a series of general and specific objectives associated with 9 key measures disaggregated into sub-measures, and a timeline for accomplishment to be monitored through yearly assessment reports. Most measures can be considered vague statements of intent lacking ambition, aiming for instance to "improve training and information", "promote research", "promote IPM" or to "intensify monitoring of the marketing of plant protection products" (Ministerio de Agricultura y Pesca, 2017). Outcome-based targets are almost absent in relation to the reduction of risks associated with, and dependency on conventional pesticides. Contrary to France, the NAP does not focus on overall use reduction as a means of reducing risk (Lamichhane et al., 2019). Action-based and compliance-based targets prevail, being mostly related with sector-specific issues such as crop rotation, which is only mentioned in passing without establishing clear targets. The NAP sets high-level compliance and action-based targets for the number of information campaigns per year to be implemented, or the number of professional users involved in training courses.

206 Thus, in line with the recent assessment of EU NAPs elaborated by the European
207 Commission, there is an overall lack of ambition in Spanish NAPs. This is illustrated,
208 for instance, in the target number of IPM demonstration farms to be established
209 throughout the current NAP: six pilot farms in a country with nearly one million farms
210 by 2018. Similarly, the 2018 Spanish audit on the 2017 NAP reports the design or
211 implementation of not a single project by 2018, despite the target was not overambitious
212 in its original goal of creating two research projects related to the NAP's aims. These
213 data pale when compared to the more than 200 research projects that were implemented
214 under the umbrella of the French Ecophyto plan between 2008 and 2015 (Lamichhane
215 et al., 2019). In sum, Spanish NAPs lack a specific budget, measurable targets and goals
216 for conventional pesticide use reduction, timetables for implementation of instruments,
217 taxation schemes or incentives for alternative methods of crop protection. In other
218 words, the NAPs only enforce 'sermons' without 'carrots' or 'sticks' (Pedersen &
219 Nielsen, 2017). Despite there being no optimal policy instrument for conventional
220 pesticide reduction (Borrás & Edquist, 2013), Lee et al.'s (2019) review of successful
221 strategies evinces the need to employ at least a combination of the three, i.e. taxes,
222 incentives and training. It is worth quoting a recent EU audit into the 2017 Spanish
223 NAP:

224 *[it] lacks overall quantitative objectives and measurable targets for reduction of risks*
225 *and impacts of pesticide use, which does not satisfy the requirements of the Directive.*
226 *This makes it impossible to demonstrate progress towards meeting the objectives of the*
227 *Directive. This was also the case with the previous National Action Plan. ... there are*
228 *sound and robust systems in place for certain requirements of the Directive, such as*
229 *training of operators, or inspection of Pesticide Application Equipment, there are areas*
230 *where actions do not fully satisfy the requirements of the Directive, including the*

following: measures to inform the general public, systems for gathering information on poisoning incidents, and the assessment of the implementation of Integrated Pest Management general principles ... The specific priority objectives, when quantifiable, are either not ambitious in their targets, or are more focused on monitoring compliance rather than a commitment to achieve risk reduction. (European Commission, 2018, pp. I, 10).

This situation has been constantly denounced by Spanish ecologist associations such as FODESAM (de Prada, 2014) and contrasts with countries such as the Netherlands, the UK or Denmark where regulatory instruments and taxes have been effective (Hillocks, 2012). Sweden, for instance, implemented a pesticide tax back in 1984, while Germany provides mandatory training for pesticide advisors and farmers since 1987 (Lefebvre, Langrell, & Gomez-y-Paloma, 2015). On the positive side, Spain has been the EU member state training the most certified professional operators by 2017, with 825,197 professionals trained (European Commission, 2017b). However, no overall figure on compliance can be provided because the number of total operators is unknown. Similarly, although the Spanish NAP is among the few that envisions the establishment of protocols for pesticide applications to the citizenship, by 2018 the yearly internal audit acknowledged no progress on this regard (MAPAMA, 2018).

Regarding the testing of pesticide application equipment, another main goal of the Directive 2009/128/EU aimed at establishing a framework for Community action to achieve the sustainable use of pesticides, Spain remains, as of 2016, in the group of EU Member States whose level of compliance reported is below 50% despite the progress achieved, which reflects a lack of reliable data on the number of sprayers in use in the country (European Commission, 2017b, p. 9). The case of Spain also contrasts with the more ambitious French NAP 'Ecophyto'. Although overall unsuccessful in achieving its

target of total pesticide use reduction, Ecophyto focused on promoting alternatives, research and measurable pesticide reduction targets, assigning only a small fraction of its large economic firepower to training and inspections, which are the backbone of the Spanish NAP (Guichard et al., 2017; Lamichhane et al., 2019).

The most controversial issues in Spanish pesticide policy have to do with the levels of testing and monitoring of pesticide residues in food, as mentioned before, the continued use of aerial sprays despite their prohibition, with Spain accounting for 75% of all reported aerial spraying in the EU in 2015 (European Commission, 2017b), and the lack of verification procedures for the effective implementation of IPM guidelines. Indeed, Spain does not report statistics on IPM since 2014, as the SUD foresaw that all farmers shall implement IPM since that date. Information about the implementation, application and reach of IPM principles is poor, the last internal audit only mentioning it in passing in relation with the following actions taken place: the realisation of 25 seminars on non-agrarian IPM uses, the approval of 5 IPM guides for specific crops, and the current existence of 1,188 assessment entities (MAPAMA, 2018). This is in line with the situation in other Member States. Indeed, for the European Commission, IPM remains the main weakness in the application of the SUD, mainly because "Competent Authorities do not have prescriptive and assessable criteria in order to determine compliance with IPM, and therefore there is limited evidence that IPM is systematically applied" (European Commission, 2020, p. 12).

Pesticide authorisations

The shortcomings described above are perfectly illustrated by the processes of pesticide assessment and authorisation. The issue recently became public knowledge when the association Ecologists in Action denounced the ongoing routine 'exceptional' authorisation of unauthorised pesticides for use in Spain (K. Hernández, Romano,

Pérez, & García, 2019). While in theory forbidden pesticides cannot be used, unauthorised ones can be used under exceptional situations provided institutional authorisation is granted. The delay in assessing the prohibition of pesticides thus allows authorities to routinely renew permits for unauthorised pesticides, through 'exceptional' mandates. An example is one of the most used active substances in Spain, which is being phased out in Europe: 1,3-dichloropropene. This anomalous situation had already been monitored by the EU through a series of audits in 2007, 2013 and 2017. What raised the alarm initially in 2007 were the delays in the approval of thousands of new active substances and in the assessment of those already in use. This meant that pesticides forbidden in other European Member States were still marketed in Spain or had not been evaluated to EU standards after 15 years of this legal requirement. By 2013, a new audit still recorded a delay in the authorisation of 1493 active substances (European Commission, 2013).

Not only are all EU legal deadlines for authorisations consistently breached, but neither can farmers obtain more selective and less risky substances that are available in other Member States, including those in the Southern Authorisation Zone. This was noted by the EU audit carried out in Spain in 2017. An excerpt from the audit's Executive Summary is illustrative in this regard:

Compliance with deadlines is hampered by not availing of the opportunity to reduce the work burden through work sharing between southern zone Member States and taking greater account of the evaluation work of other Member States. These structural problems are compounded by a range of inefficiencies in communication between competent authorities. Consequently, access to market for plant protection products with new active substances is delayed, thus affecting the range of newer and more selective pest management tools available to growers. Difficulties in gaining

authorisation for generic and mutual recognition applications for PPPs impact competition within the market. (European Commission, 2017a, p. I)

The auditors also point out that many evaluations are refused where non-mitigable adverse consequences are identified, but, at the same time, the competent authorities do not review the already authorised products posing similar risks, which goes against Article 44 of Regulation (EC) nº 1107/2009, and the aim to diminish overall risk in pesticide use (European Commission, 2017a, p. 18). The concluding 2017 audit, and a further one in 2018 devoted to the sustainable use of pesticides in Spain, showed no improvements, emphasising the lack of long-term planning, brain-drain among the staff in charge, and the consistent breach of deadlines (European Commission, 2017a, 2018).

The audit similarly reminded the Spanish authorities that the EU Regulation 1107/2009 envisaged the imposition of fees or charges for new applications, so as to recover the costs associated with the processing of authorisations, a useful option disregarded by Spain. The whole process revealed a consistent lack of political commitment to conventional pesticide reduction and control, especially when compared to the swiftness in permitting the 'exceptional' use of otherwise unauthorised pesticides and aerial sprays.

Spanish pesticide data: facts and trends.

Spanish data about conventional pesticide use and consumption present various drawbacks that make it difficult to assemble long-term series under comparable parameters. Moreover, the repeated delays in the preparation and sending of data does nothing but impede comparison tasks and setting thresholds by Eurostat, which has already complained about this situation (Eurostat, 2019). Spanish pesticide data face similar problems to other EU countries, namely commercial confidentiality reasons,

330 which force public data to categorise or aggregate active substances into major groups
331 without disclosing specific products, so as to hinder their sales and later local impacts to
332 being monitored. In addition, sales data tend to be more opaque than use data precisely
333 because of being covered by confidentiality clauses resulting from agreements between
334 the conventional pesticide industry and EU officials. As a result of confidentiality
335 clauses, gaps on pesticide sales and use data in public databases such as EUROSTAT
336 emerge, as highlighted by Lamichhane et al. (2020) regarding the case of seed treatment
337 in the EU.

338 Notwithstanding these facts, sales data can often be more precise because use data
339 normally derive from estimations based on extrapolations from other surveys
340 (Galimberti, Dorati, Udias, & Pistocchi 2020). Moreover, one of the two key
341 harmonised risk indicators (HRI1) developed by the European Commission is based on
342 sales data, in particular in the quantities of conventional pesticides sold yearly.
343 Therefore, pesticide sales are not the best indicator to assess risk reduction or
344 sustainability targets. However, it is currently the more reliable one until more accurate
345 and reliable indicators are developed. New indicators should be based on a
346 multifactorial set of use-derived risks, from underground water pollution to compliance
347 with proper equipment use or the enforcement of IPM.

348 The key actors in data delivery are AEPLA and the MAPA. AEPLA gathers
349 conventional pesticides' sales data from the main pesticide companies operating in
350 Spain comprising 70% to 80% of the total market share. It elaborates yearly reports that
351 are not publicly available. MAPA is responsible for compiling data from every legal
352 entity in possession of the authorisation to commercialise conventional pesticides
353 during the reference period. MAPA is also responsible for sending data to Eurostat. Key
354 public reports delivered by MAPA are the yearly "Statistics on the Marketing of

Phytosanitary Products" (2011-2018) and the Five-year "Statistics on the Use of Phytosanitary Products", which is in theory a five-year report but has only appeared once, in 2013. The Directorate-General for Biodiversity and Environmental Quality of the MAPA then issued the annual series entitled Environmental Profile of Spain since 2004, which is now compiled by the newly created Ministry for Ecological Transition since 2018. This is a report delivered intended to inform the public about the environmental state of the country, providing information broken down by regions, and offering comparative profiles with the EU.

MAPA's statistics on sales reveal an uneven tendency with yearly shifts derived from changing weather conditions, showing no clear decreasing trend, as stated in the official reports (Figure 1). Most surprisingly, MAPA data are strikingly below AEPLA's, the latter showing an almost double amount of pesticide consumption in 2018 over MAPA's. This incongruence remains unexplained by official reports. The discrepancy might be explained by the methodology employed by MAPA in compiling data. Data do not come from sales information provided by the Treasury. Instead, data is compiled through an annual electronic questionnaire and a follow-up telephone interview to non-respondents delivered to every legal entity in possession of the authorisation to commercialise conventional pesticides during the reference period. It could derive from the lack of data provided by non-respondents to the sales survey. However, the discrepancy is too high, because only 5% of authorised vendors of conventional pesticides did not respond in 2017, according to MAPA data. The discrepancy might also be explained by dissimilar so-called family products within conventional pesticides included in the statistics, although this different is mainly derived from a different disaggregation of products: AEPLA's statistics comprise insecticides, nematicides, fungicides, herbicides, phytoregulators, molluscicides, rodenticides and 'various', while

MAPA includes insecticides, herbicides, fungicides and bactericides, growth regulators, molluscicides and 'other' conventional pesticide.

In turn, the statistics on conventional pesticide use are based on extrapolations from telephone-based sample surveys of 4,220 agro-business undertakings carried out by an outsourced company hired by the MAPA. The Canary and Balearic Islands, Ceuta and Melilla were excluded from the study. They are compiled based on the EU requirement to choose typical representative crops and their specific associated pesticide consumption. In 2013, Spain analysed barley, citrus, sunflower, vegetables, olive tree, wheat and vines, which comprised 63% of the total conventional pesticides applied. Despite representing 7% of the total cultivated area, pesticide use on vineyards amounted to 38%, followed by olive trees, citrus, barley, vegetables, wheat and sunflowers (Figure 2). These data demonstrate that the cultivation of vineyards is pesticide-intensive in Spain and beyond. In France, for instance, vineyards make up 3% of the total agricultural surface and represent 20% of the total pesticide share (Baldi et al., 2013).

Statistics on pesticide use should have been delivered in 2018, but the report is overdue and is still in the making by the end of 2020. Beyond these quantitative indicators showing a slight decrease, the European Commission also requires two other indicators to be developed: HRI1, in which the use of active substances is weighted according to their toxicological profile and risk, and HRI2, which identifies the number of Emergency authorisations weighed by the intrinsic hazardous properties of the active substances granted by each Member State. The MAPA is also in charge of both indicators. Regarding HRI1, Spain underwent a significant decrease from a baseline of 100 points in 2011-2013 to 68 in 2017, then increasing again to 78 in 2018 (a 22% overall decrease compared to 17% decrease in the EU). In contrast, HRI2 remained

405 stable at 100 points from the baseline to 2017, to then decrease to 79 in 2018 (a 21%
406 overall decrease compared to a 56% increase in the EU). In line with the evaluation of
407 HRI1 by the Court of Auditors (European Court of Auditors, 2020), the decrease in
408 HRI1 in Spain can be interpreted as the result of a sharp reduction in the sales of not
409 approved active substances, due to pesticide bans and withdrawals from companies.
410 This is because the weighting factor of the indicator penalizes heavily the use of high-
411 risk substances. Therefore, the indicator conflates the targets of risk and use reduction,
412 which should be separated for a better understanding of long-term trends and actual
413 accomplishments in achieving the EU objective of sustainable use of pesticides. Not
414 surprisingly, HRI1 raises partisan views among key actors in pesticide policy: the
415 European Crop Protection Association supports it, while Pesticide Action Network,
416 Greenpeace and the organic association IFOAM call it into question (Foote, 4 March,
417 2020). For the Court of Auditors, "The indicator does not show
418 how successful the directive has been in achieving the EU objective of sustainable use
419 of PPP" (European Court of Auditors, 2020).

420 Regarding HRI2, its decrease in Spain results from a cut in the number of emergency
421 authorisations issued by the government. However, as recently shown by a report
422 delivered by Ecologists in Action (K. Hernández et al., 2019), the scale of the
423 authorisations tends to increase in Spain, and there is lack of information about how and
424 much is applied during the time of authorisations. Moreover, the information on the
425 uses and time frames for each emergency authorisation is not kept electronically
426 available for the public in Spain, as required by Article 57 of Regulation (EC) No
427 1107/2009, which reduces access to growers to essential information. Other EU
428 Member States present similar problems providing an accurate measure of HRI2,
429 because an 'emergency authorisation' can be issued for a short time period in a minor

crop but also, as commonly applies in Spain, to pesticide-intense crops such as vines, in large areas, and during long periods. These problems make of HRI2 a rather unsophisticated indicator (European Commission, 2020), which could be improved for instance by weighting the number of hectares treated, the risk of the substances employed, and the time-span of the authorisation. All in all, it would be advisable to link EU indicators of risk to specific crop protection practices of use for statistics to take ground and offer a real contribution to a low-input crop protection system in Spain, in line with the recent work by Galimberti et al. (2020) aiming to harmonise use data of conventional pesticides among EU countries.

Finally, the Environmental Profile of Spain draws on data from AEPLA and MAPA to produce a further national pesticide use indicator: kilograms of active substance per hectare of agricultural surface. The indicator is disaggregated by product types and also by Spanish regions. This is so despite the fact that the profile made publicly available by MAPA only provides nationwide data. This implies that private data from AEPLA are also employed. The Environmental Profile also draws on sales data of conventional pesticides from AEPLA, to provide data on sales that contradict those produced by the same ministry. For instance, in 2015 and 2016 the profile affirms that 102,721 and 125,296 tonnes of conventional pesticides were sold in Spain, while MAPA had declared 77,298 and 77,052 respectively. This huge discrepancy in pesticide sales by two official reports might be explained by the fact that the Environmental Profile draws on AEPLA data, which, as noted above, differs from MAPA's.

In the latest Environmental Profile, from 2018, the statistical data history changed to then show an overall two-fold national yearly increase in kg/ha compared to the previous reports, without any methodological or statistical clarification. For instance, the former reports showed an average of 2.8 and 3.6 kg/ha in 2012 and 2016

455 respectively, while the historical series of the 2018 edition assigns averages of 5.2 and
456 5.4 kg/ha to those same years. If the 2018 data can be trusted, the statistics do not show
457 a significant variation between the start of the series in 2011 (5.2 kg/ha) and the latest
458 data in 2017 (5.1 kg/ha). The shift in 2018 can be explained by a change in the data
459 source, as previous reports draw on AEPLA data and in 2018 they draw on MAPA data.
460 The change in the indicator regarding kg/ha in previous years is tricky to understand
461 and cannot be explained by this shift alone. First, because AEPLA reports higher
462 pesticide sales than MAPA, and thus it would be reasonable to expect the indicator to be
463 higher in previous years in terms of kg/ha applied, but it is not. Thus, this shift can only
464 be explained by a change in the other element of the indicator, that is, a reduction in the
465 number of hectares considered in the estimation. To calculate the indicator for previous
466 years, the area of application of conventional pesticide was considered to be the area
467 constituted by cropland excluding fallow and other unoccupied lands (herbaceous and
468 woody crops). Then, for 2018, the indicator represented the consumption of
469 conventional pesticide in relation to the area of application in the period 2011-2017,
470 without further methodological clarification. Furthermore, the methodological note of
471 this report leads to misinterpretation. Despite establishing that it takes the same
472 reference base as other years, it then relates the justification of the indicator of
473 conventional pesticide consumed in kg/ha with another indicator referred to the
474 consumption of fertilizers, without any clear methodological explanation. In turn, the
475 fertilizer consumption indicator is based on the quotient between the consumption of
476 fertilizers and the total fertilizable area. However, the fertilizable area could differ from
477 that constituted by cropland, excluding fallow and other unoccupied lands. The
478 methodological note does not explain this correlation between the use of conventional
479 pesticides and fertilizable land.

480 Despite the huge differences in types of agriculture, cultivars, weather conditions, and
481 therefore in pesticide use in the Spanish Autonomous Communities, the NAP does not
482 establish regional objectives or disaggregate reports. This would however be desirable
483 and important, as shown by the following regional analysis of the Canary Islands. The
484 islands were chosen because the Spanish Profile does disaggregate among regions,
485 showing an outstanding difference in the historical series between the Canaries and
486 Peninsular Spain's total, regarding kg/ha of pesticide use. For example, in 2012 and
487 2016 the Canaries used 69.9 and 69.1 kg/ha respectively, against 5.2 and 5.4 kg/ha in
488 Spain. To further shed light on these figures, the authors requested disaggregated
489 AEPLA data for pesticide sales in the Canary Islands between 2008 and 2018.

490 These data were contrasted with records from the Canary Islands customs office, which
491 depend directly on the Spanish tax agency and have a specific taxation category
492 dedicated to plant protection, broken down by category. Despite the fact that the Canary
493 Islands belong to the EU Customs Union and the Single Market, the entry and exit of
494 goods requires the completion of customs procedures, since they are considered as
495 imports, even when they come from Peninsular Spanish territory. The results were
496 striking, as customs data are almost three-fold higher than AEPLA's in terms of tons of
497 pesticide sales for some years, such as 2016 (Figure 3). Because the Spanish Profile of
498 Spain draws on AEPLA data on conventional pesticide consumption, it can be argued
499 that data on kg/ha used are also underestimated in this report for the Canaries. In other
500 words, if the MAPA data underestimate those of AEPLA, in turn AEPLA's data
501 underestimate the actual sales recorded by the Spanish tax agency through customs
502 reports. Certainly, AEPLA only comprises the largest sellers of conventional pesticide
503 and sales can still be made by minor actors. However, this cannot conceal the finding

504 that conventional pesticide use might be seriously underestimated in other Spanish
505 regions apart from the Canary Islands.

506 **Conclusion**

507 This perspective has aimed to contribute to the state of the art in the area of pesticide
508 policy in the EU, by providing a detailed analysis of one of the top conventional
509 pesticide consumers in the world and a leading country in Europe: Spain. The analysis
510 and data presented in this overview point to significant shortcomings and incongruences
511 in Spanish pesticide policy and data compilation that deserve further exploration and a
512 deep institutional review. Since 2012, Spain has enacted several measures to implement
513 the requirements of the European Directive 2009/128, including the passing of two
514 NAPs that contemplated the establishment of reliable systems for inspection of pesticide
515 application equipment and training for operators. However, other areas are far less
516 developed, including the NAPs' own lack of quantitative objectives and measurable
517 milestones and reduction targets, or the absence of regional data disaggregation and
518 strategies for reducing conventional pesticide use. It would be a great step forward for
519 future NAPs to stablish specific and measurable targets to reduce risks and overall use
520 of pesticides, as well as to contribute to the development of more realistic indicators
521 than the current HRI1 and HRI2.

522 The application of successful mixed instruments from regulatory, economic,
523 informative and governance resources to reduce conventional pesticide use is not
524 considered by the most recent reports and plans. Moreover, there are no clear trends
525 towards the reduction of pesticide sales and use, according to most indicators. Data
526 produced by the State remain inconsistent and even contradictory, with potential
527 underestimations of conventional pesticide use. There are consistent failures to meet
528 deadlines for delivering statistical data and for the assessment of authorisation

529 applications, which cannot only be blamed to double competences and bureaucratic
530 overload, but rather reflect a clear lack of political will and ambition. Moreover, the
531 NAPs and the bureaucratic apparatus in charge of the programmes are disconnected
532 from the institutions and policies involved in promoting ecological agriculture, neither
533 is the implementation of IPM principles solidly measured, issues that are
534 counterproductive to conventional pesticide use reduction.

535 The high levels of pesticides in water should be a matter of concern for the competent
536 authorities. Information about pesticide poisoning of operators and the public at large is
537 not rigorously compiled, while analyses of pesticide residues in food lag far behind
538 other EU countries. As reported by Lamichhane et al. (2019), this makes it difficult to
539 monitor the effectiveness of the plans and their implementation, as well as to
540 communicate with key stakeholders involved. Measures to inform the general public
541 about pesticide use, dangers and residues are not sound, despite various surveys
542 showing that these issues are among those that most concern the Spanish population.
543 This constitutes a serious shortcoming in the response to citizen demands for
544 transparency and information. Such a perspective is by no means the final word on this
545 complex topic, which requires the dedicated attention of multidisciplinary teams of
546 researchers and institutional actors. Rather, we hope to spark further debate on Spanish
547 pesticide policy within and beyond the field of crop protection.

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