A Web-based interface providing open access to quantitative results of the network

Deliverable D5.4

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An EU-wide farm network demonstrating and promoting cost-effective IPM strategies

Coordination and Support Action (CSA)

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Deliverable D5.4

A Web-based interface providing open access to quantitative results of the network

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☐	**CO**	Confidential, only for members of the consortium (including the Commission Services)

Abstract

This deliverable presents the **IPM***graph* tool developed within IPMWORKS task 5.5. This interactive web tool offers an easy and graphical access to quantitative results of IPMWORKS farms, collected during the project through survey#2, and complemented by data from the IPMWORKS-affiliated national networks DEPHY (FR) and PESTIRED (CH).

The document presents the background resources used in this task, the work done for developing the tool, the dataset feeding the tool, and its main functionalities.

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1. Objectives

The core of the IPMWORKS network is based on the 22 hubs of IPM demonstration farms set up at the beginning of the H2020 project. Each hub is based on 10 to 15 farmers, from the same region, living close enough to be able to meet regularly, growing the same crops and sharing the same pest problems. Those pionneer farmers were either:

- already implementing a holistic approach to Integrated Pest Management (IPM), and therefore using much less chemical pesticides as compared to most of the local farmers,
- or motivated to progress further in the adoption of IPM and to reduce the reliance on pesticides, thanks to-peer-to-peer learning and knowledge exchange within the hub.

All farmers were motivated to discuss, share knowledge both within the hub and with other farmers of the region, give and receive advice, test new IPM-based solutions, and develop confidence in innovative solutions thanks to technical discussions within the hub.

Each hub is coordinated by a Hub Coach, an advisor with a very important role, in charge of:

- providing individual advice to farmers, to help them find non-chemical solutions for pest management, adapted to each specific farm case, and to help them design their pest management strategy with a holistic approach;
- organising and facilitating knowledge exchange among farmers, to enhance peer-to-peer learning;
- organising demonstration events, based on success stories in IPM adoption within the hub, describing practical on-farm strategies and IPM solutions as implemented in IPMWORKS farms, always replacing the various aspects of pest management into a holistic vision of the farm strategy;
- ensuring a technical watch on new emerging IPM solutions, making use of external expertise and of the internal EU-wide IPMWORKS network of Hub Coaches.
- collecting both qualitative and quantitative data in IPMWORKS farms, through three surveys organised by the project:
    - **Survey#1,** at the beginning of the project, to collect qualitative information on IPM awareness of farmers, about the technical IPM options combined in the holistic IPM strategy, and about a self-assessment of farmers (level of IPM adoption, workload, yields, economic performances.
    - **Survey#2,** in the middle of the project, to collect details of IPM-based cropping systems, including details of pesticide treatments, to be able to compute quantitative indicators of pesticide use, pesticide impact, and economic perfomances. The web-based interface AGROSYST, already used by the DEPHY network in France for collecting data and computing sustainability indicators,

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has been adapted for the European context of IPMWORKS for this purpose (Task 5.2), and IPMWORKS Hub Coaches have been trained to use this interface (Task 5.3).

- **Survey#3,** at the end of the project, to collect a qualitative self-assesment of farmers about the progresses made in IPM adoption during the course of the project, and the consequences for pest control, yields, workloads and economic performance.

The objective of IPMWORKS Task 5.5 was to develop a web-based interface providing public access to IPMWORKS quantitative main results from Survey#2, with interactive functionalities allowing website visitors to select variables of interest and subsamples of IPMWORKS farms, to produce graphs and tables summarising simple statistics of interest.

This document presents the work done in Task 5.5, and the functionnalities of the '**IPM***graph*' interface.

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2. Background

IPMWORKS methodology was partly inspired by the national French initiative of the DEPHY network in France (along with other sources of inspiration from previous European projects that developped peer-to-peer knowledge exchange for more sustainable agriculture (e.g. PLAID, and NEFERTITI). DEPHY was launched in France in 2010, as a main initiative of the National Action Plan for Sustainable Use of Pesticides (as an application of the SUD Directive 2009/128), and was associated with the IPMWORKS project, becoming the French branch of the EU-wide IPMWORKS network of IPM demo farms.

The DEPHY working plan includes yearly data collection in demo farms, to describe the details of cropping systems, the technical implementation of pest management, with all details enabling the computation of sustainaiblity indicators (pesticide use, pesticide impact, fuel consumption, workload, input and equipment costs, economic profitability). These data are collected in the AGROSYST system by DEPHY Hub Coaches and used for computation of sustainability indicators.

In DEPHY an interactive web interface was developed, called DEPHY*graph*, to provide a public and interactive access to DEPHY quantitative results. The users can select variables of interest and subsamples of farms (by sector, region, soil type, year, etc.) to produce graphs and tables presenting results and simple statistics for the selected variables and farms.

The plan for IPMWORKS (Task 5.5) was to adapt this interface for the European context of IPMWORKS, to provide a public access to quantitative IPMWORKS results, with the same functionalities.

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3. Development of the interface

The work done to develop **IPM***graph* was coordinated by INRAE (Nicolas Munier-Jolain, coordinating WP5, Alice Lorenc, recruited for IPMWORKS, and the AGROSYST team). INRAE collaborated for this task with the sub-contractant CODE LUTIN, which is also in charge of IT developments for the AGROSYST system, and was selected by INRAE according to the protocols and rules for public procurements in France.

The work to develop **IPM***graph* was done at the very end of the IPMWORKS project, to maximise the amount of data available, since many IPMWORKS Hub Coaches struggled to perform Survey #2 and were late in delivering data. Survey#2 was indeed initially planned for the end of 2023, but the deadline had to be postponed several times, and the last data was only available early 2025.

The work included :

- The creation of a new version of the DEPHYgraph system, hosted on an INRAE server (Figure 1).
  IPM*graph* is available at : https://dephygraph.fr/ipmworks/#/
  (note that the interface works better with some browsers, such as Chrome, especially for the translation, which, a the moment, is handled automatically by e.g. Google translate).
- The modification of the database structure, to include new variables, namely:
  - Country
  - Farm network (to be able to select data from IPMWORKS, DEPHY, PESTIRED)
- The processing of data from IPMWORKS and PESTIRED (CH) towards the format of the **IPM***graph* interface.
- The change of the graphical interface
  - Name of the system: **IPM***graph*
  - Logos of IPMWORKS and of the European Union
  - Acknowledgements of H2020 funding ("*This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 101000339*").

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- The change of the App producing a map visualising the origin of data, initially limited to France, now including all Europe.

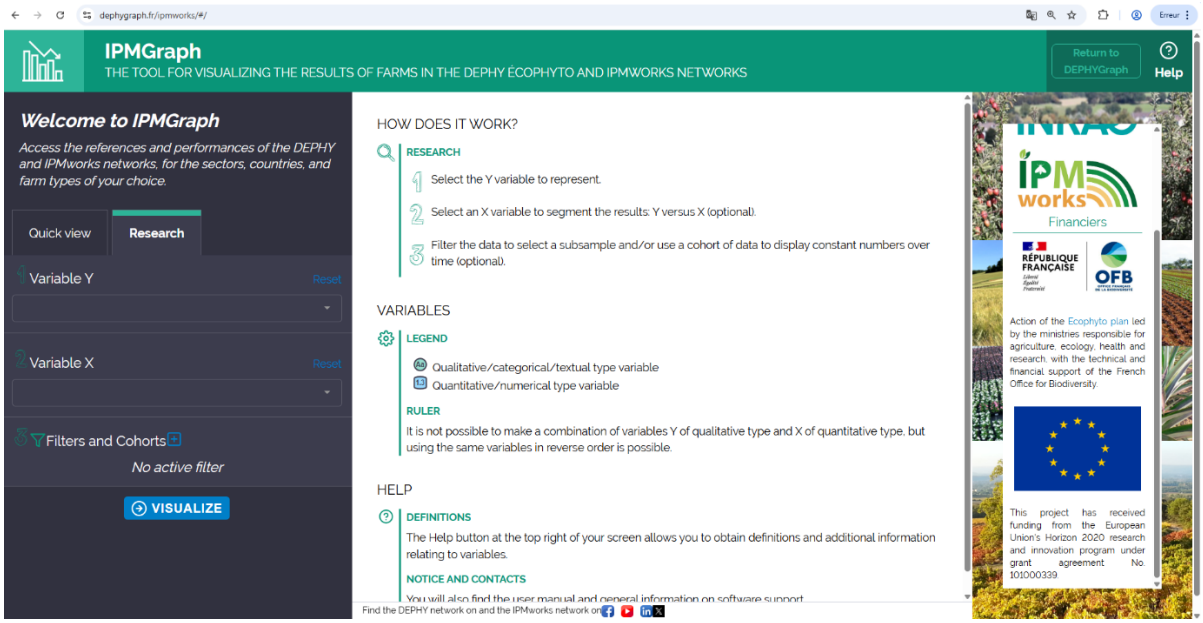

Figure 1. Home page of the **IPM***graph* interface

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4. Outcome: the IPM*graph* interface

4.1. Data

IPM*graph* includes all quantitative data collected from IPMWORKS farms available at the end of the project from Survey #2, either from the 22 hubs of demo farms launched and monitored during the project, or from affiliated national initiatives that provided data, namely DEPHY (FR) and PESTIRED (CH) (Table 1). DEPHY provides the greatest amount of data (cropping system * year), both because of the larger number of farms (about 2 000) and because of the longer period of monitoring (14 years, from 2011 to 2024). PESTIRED provides a relatively large amount of data, reflecting the number of farms (90) monitored over 4 years, for two cropping systems, namely the 'business as usual' and the 'innovative'. The amount of data from the 22 IPMWORKS hubs is limited, because Survey#2 collected data from one year only, and many Hub Coaches struggled to complete such a detailed survey (for different reasons: lack of time, or reluctance of farmers to provide detailed data).

Moreover, not all sustainability indicators could be computed for all farms due to missing data on certain parameters. Indicators related to pesticide use (Treatment Frequency Index) and pesticide impact (HRI-1) could be computed for all farms, but indicators of economic performances have been computed only from farms of the sector of arable field crops, for those farms where all the details were provided, including yields, amounts of fertilizers, equipment, etc.

Table 1. Number of cropping systems included in the **IPM***graph* database at the end of the H2020 IPMWORKS project.

Sector	IPMWORKS	DEPHY (FR)	PESTIRED (CH)
Arable Crops	56	9 231	720
Orchards	5	1 713	
Vineyards	13	3 678	
Vegetables (greenhouse and outdoor)	29	2 069	
Total	**103**	**16 691**	**720**

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4.2. Functionalities

The home page of **IPM***graph* explains the functionalities of the interactive interface. The user can select two variables of interest, namely an X-variable and a Y-variable, in a list of:

- Qualitative variables
  Country/Sector/Year-campaign/Number of years since joining the network/Organic-Conventional/Tillage strategy…
- Quantitative variables
  - Pesticide use: TFI (total, herbicide, fungicide, insecticide, others)
  - Pesticide impact: Harmonised Risk Indicator
  - Technical: amount of N, P, K mineral and organic fertilisers, frequency of mechanical weeding
  - Economics: Input costs, equipment costs, labour costs, workload, gross products, gross margin, net margin

The user can make a selection of a farm sub-sample, based on all qualitative variables.

Then the button 'Visualize' generates a graphical visualization of the selected data, with three screen zones:

- A map highlighting the countries contributing to the displayed data. The countries are coloured as a function of the number of data contributing to the selected graph.
- A graph presenting the results. The type of graph depends on the combination of qualitative/quantitative nature of selected variables X and Y (scatter plot, box plot, bar plots). Box plots indicate the average value, the median, the quartiles and the min and max values. The Y-scale can be modified to zoom in on part of it.
- A table displaying the simple statistics corresponding to the selected variables (number of farms, average, median, quartiles…)

A 'quick view' tab offers a selection of interesting pre-designed graphs, namely:

- Comparison of pesticide use (Treatment Frequency Index) by countries, for the sector 'Arable Field Crops'
- Comparison of pesticide use (Treatment Frequency Index) by countries, for the sector 'Viticulture'
- Harmonised Risk Indicator (HRI-1) as a function of pesticide use (Treatment Frequency Index), for the IPMWORKS farms, sector 'Arable Field Crops'
- Pesticide use (Treatment Frequency Index) for both 'Business as usual' and 'Innovative' cropping systems of the Swiss PESTIRED network.
- Gross margin as a function of pesticide use (Treatment Frequency Index) for the IPMWORKS farms, sector 'Arable Field Crops'

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A ‘Question Mark’ button opens a window with some information about the selected variables.

A url address is generated for each generated graph. This url can be saved, either to re-do the selected graph, or to disseminate it to other users.

Below, we show a selection of generated graphs, illustrating the power of the tool to explore the dataset (Figure 2 – 5):

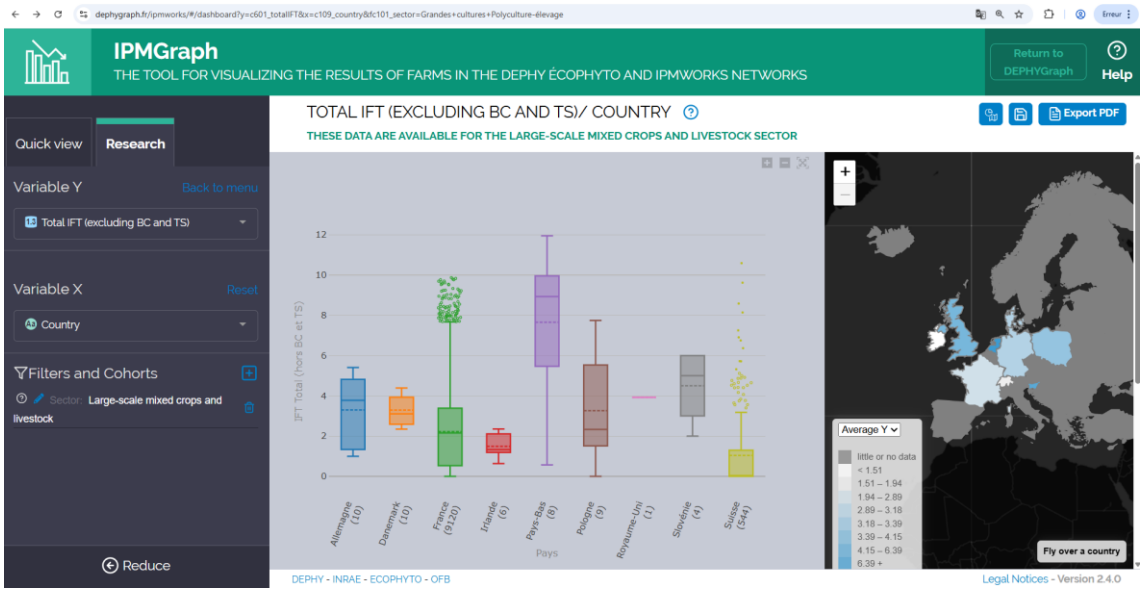

Figure 2. Comparison of pesticide use (Treatment Frequency Index) by countries, for the sector ‘Arable Field Crops’
https://dephygraph.fr/ipmworks/#/dashboard?y=c601_totalIFT&x=c109_country&fc101_sector=Grandes+cultures+Polyculture-%C3%A9levage

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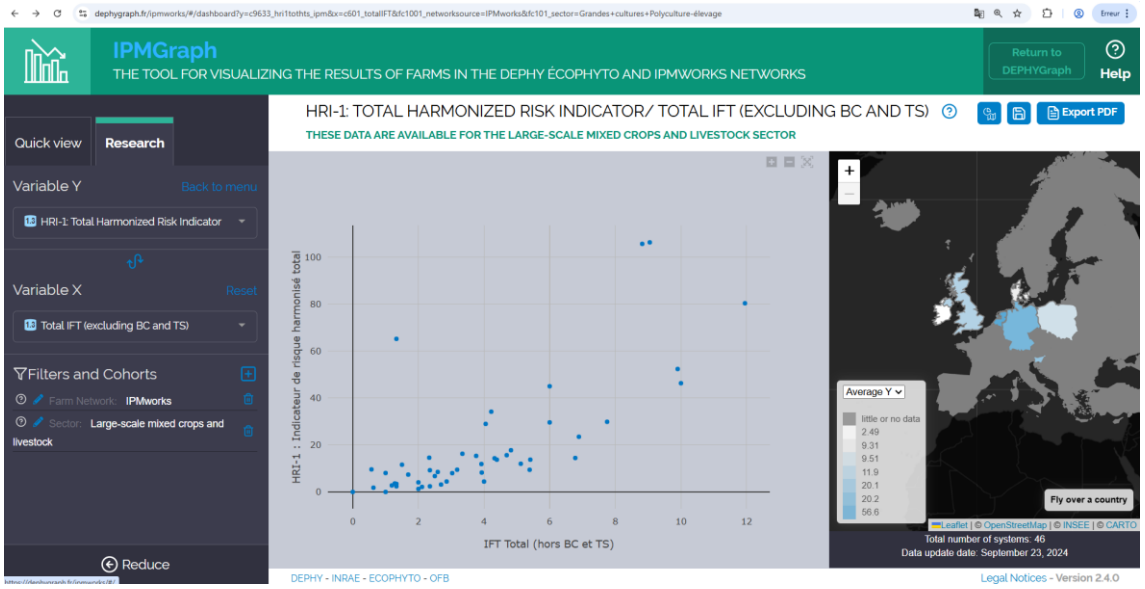

Figure 3. Harmonised Risk Indicator (HRI-1) as a function of pesticide use (Treatment Frequency Index), for the IPMWORKS farms, sector 'Arable Field Crops'
https://dephygraph.fr/ipmworks/#/dashboard?y=c9633_hri1totths_ipm&x=c601_totalIFT&fc1001_networksource=IPMworks&fc101_sector=Grandes+cultures+Polyculture-%C3%A9levage

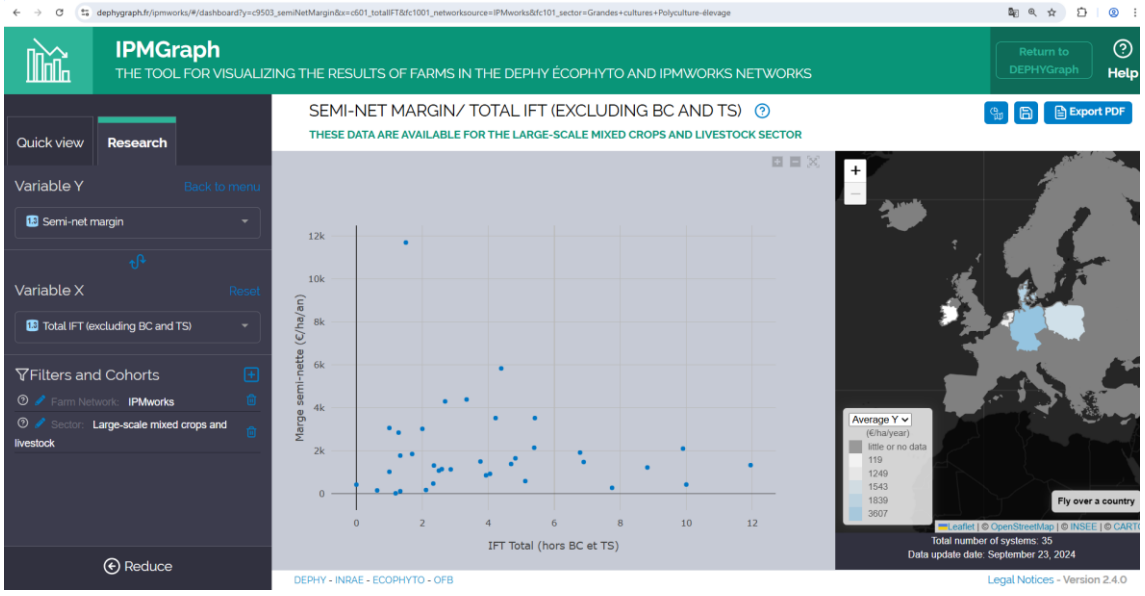

Figure 4. Net margin as a function of pesticide use (Treatment Frequency Index) for the IPMWORKS farms, sector 'Arable Field Crops'. This graph can be used to support the demonstration that reducing pesticide use through holistic IPM does not impair economic profitability. The demonstration is even more convincing if a sub-sample of farms from one specific country is selected, to compare farms from a more homogeneous farming context.
https://dephygraph.fr/ipmworks/#/dashboard?y=c9502_grossProfit&x=c601_totalIFT&fc1001_networksource=IPMworks&fc101_sector=Grandes+cultures+Polyculture-%C3%A9levage

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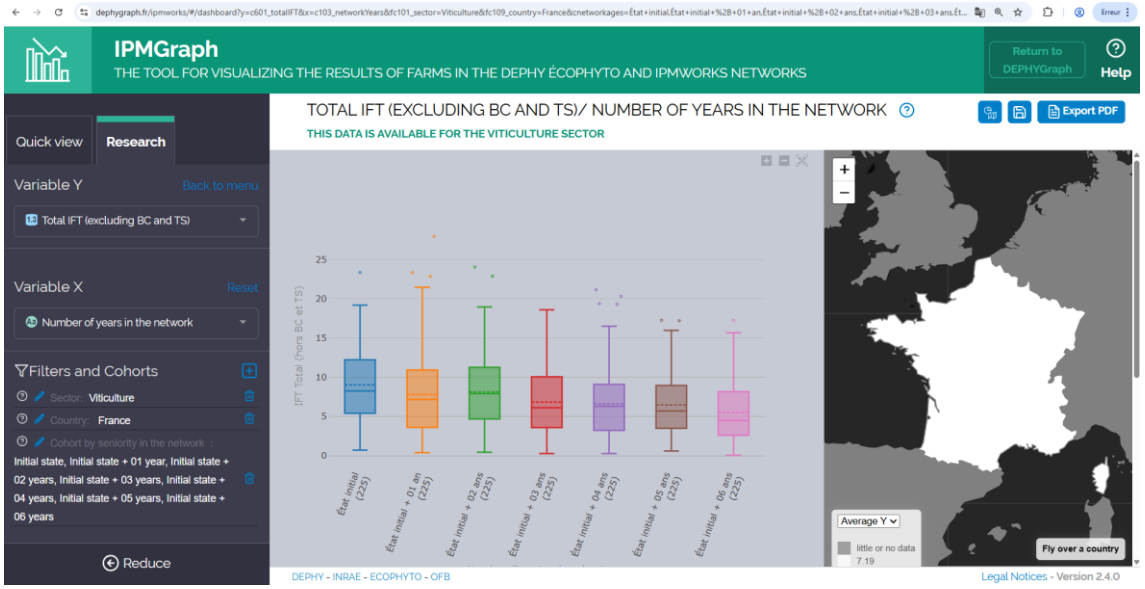

Figure 5. Evolution of pesticide use (Treatment Frequency Index) since the year of joining the network, in the French DEPHY network, sector 'Viticulture'
https://dephygraph.fr/ipmworks/#/dashboard?y=c601_totalIFT&x=c103_networkYears&fc101_sector=Viticulture&fc109_country=France&cnetworkages=%C3%89tat+initial,%C3%89tat+initial+%2B+01+an,%C3%89tat+initial+%2B+02+ans,%C3%89tat+initial+%2B+03+ans,%C3%89tat+initial+%2B+04+ans,%C3%89tat+initial+%2B+05+ans,%C3%89tat+initial+%2B+06+ans

4.3. The language issue

IPM*graph* is adapted from **DEPHY**graph, which has been developed in French only. Considering the limited time and budget available, and considering that web browser of effective and rapidly improving translation functionalities, it was decided not to develop a specific functionality of translation in the many languages of the 16 countries of IPMWORKS partners.

Therefore, the default language of **IPM***graph* is French, with users relying on translation functionalities of the browser to get an interactive website in the language of his/her choice. To date, the translation functionality works better with some browsers (e.g. Chrome) than others (e.g. Firefox), so users should pay attention to this feature.

The automatic translation of browsers work quite well, but:

- Acronyms (e.g. TFI, for 'Indice de Fréquence des Traitements') are not translated
- Some translations of short word sequence produce odd results. Example, Google Chrome translates 'Grandes Cultures et Polyculture-élevage' to 'Large-scale mixed crops and livestock' instead of 'Arable Field crops, including mixed farming with livestock'.
- Legends and titles in displayed graphs are not translated, remaining in French (contrary to data displayed in tables, that are translated.

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5. Perspectives & conclusions

The interactive web interface **IPM***graph* offers a powerful tool to explore available quantitative data collected in IPMWORKS farms (including farms of the DEPHY network in France and from the PESTIRED network in Switzerland). It can be used by individual farmers to benchmark their own cropping systems, by advisers whishing to use it as support for knowledge sharing, or by policy makers to visualise potential consequences of reducing pesticide use.

If the IPMWORKS network is able to find funding solutions for the continuation of an IPMWORKS coordination at EU scale, after the end of the H2020 project, and therefore to continue and expand the network of IPM demonstration farms, efforts will have to be made to strengthen data collection in farms (eventually by using automatic live data collection using specific devices), so as to feed the **IPM***graph* database. Yearly data collection will make it possible to quantify (and visualize) reductions of pesticide use and pesticide impact over time, thanks to a further adoption of holistic IPM. Efforts will be requried to fix the few translation issues of the current version. Furthermore, some further IT development could be carried out, for example:

- Data are currently presented at the farm/cropping system scale only. This could be extended by adding a tab to the system to present results at the crop scale. This would allow the contribution of a given crop to both pesticide use and economic performance to be quantified, and the comparison of pesticide use for a given crop across a range of farms on a gradient of IPM adoption.
- The benchmarking power of the tool could be enhanced by providing a technical description of the IPM strategy of a given farm, identified as reconciling low pesticide use and good farm profitability in a given context (crop rotation, cultivars, sowing dates, soil tillage, fertilisers, biocontrol solutions, etc.). This benchmarking functionality would provide a unique technical guidance for farmers wishing to progress further towards holistic IPM, hence becoming a strategic Decision Support System.

The **IPM***graph* tool developped within IPMWORKS task 5.5 is paving the way for such important resources for both the farming community, the advisory services, and policy makers.

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