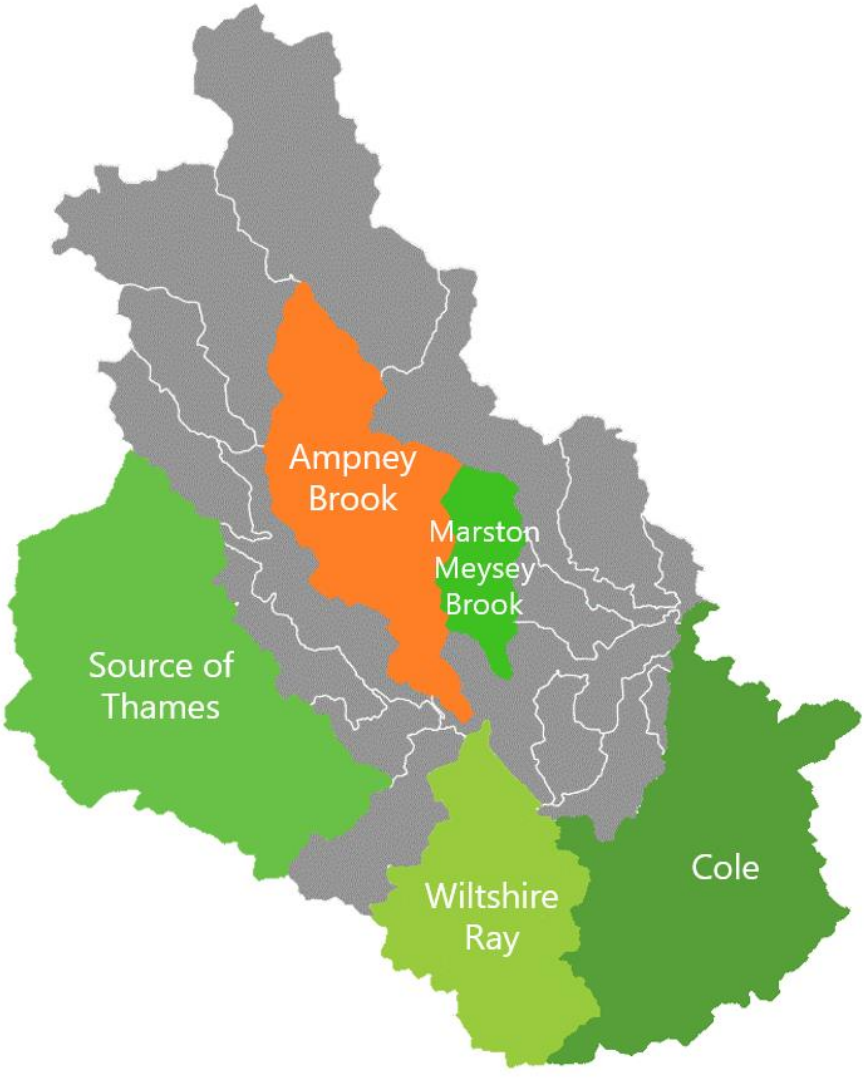
2019

Metaldehyde mitigation projects

Upper Thames

IMPLEMENTATION OF METALDEHYDE MITIGATION PROJECTS IN THE UPPER THAMES



Tristan LE MOIGNE – AgroSup Dijon
Chris SHORT – Countryside and Community Research Institute

Acknowledgements

I would like to thank Sarah Wells and Patrick Dreyer, from FWAG-SW, for sharing the results of their work with farmers, which are the basis of this report. They also provided advice about the writing of the report and clarified some misinterpreted points.

I would like also to thank Joanna Clint and Eloise Bolton, from Thames Water, for giving useful advice and for their comments on the report, which allowed to improve it significantly. They also provided some additional information which allowed to check the consistency of the interpretation.

Finally, I would like to express my sincere gratitude to Chris Short, from Countryside and Community Research Institute, for his support and his indispensable help, with numerous advice and the proofreading of the report.

List of acronyms

- **DEFRA**: Department for Environment, Food and Rural Affairs
- **FWAG-SW**: Farming & Wildlife Advisory Group South-West
- **PES**: Payment for Ecosystem Services
- **UK**: United Kingdom

Contents

List of Figures

List of Tables

List of Appendices

INTRODUCTION

For a number of years, the river Thames, like many large rivers, has had water pollution issues. Some of these issues are linked to diffuse pollution from agriculture. One particularly problematic substance is metaldehyde, the active ingredient of commonly used slug pellets, because it is very expensive to remove from drinking water to ensure levels do not exceed the Drinking Water Standard for pesticides. In 2013, in order to solve these issues, Thames Water, a private utility company which abstracts water from the river Thames, started to implement a programme of metaldehyde mitigation projects. This programme consists of working with farmers to reduce the amount of metaldehyde reaching rivers used as drinking water sources, through different projects (Thames Water, 2018).

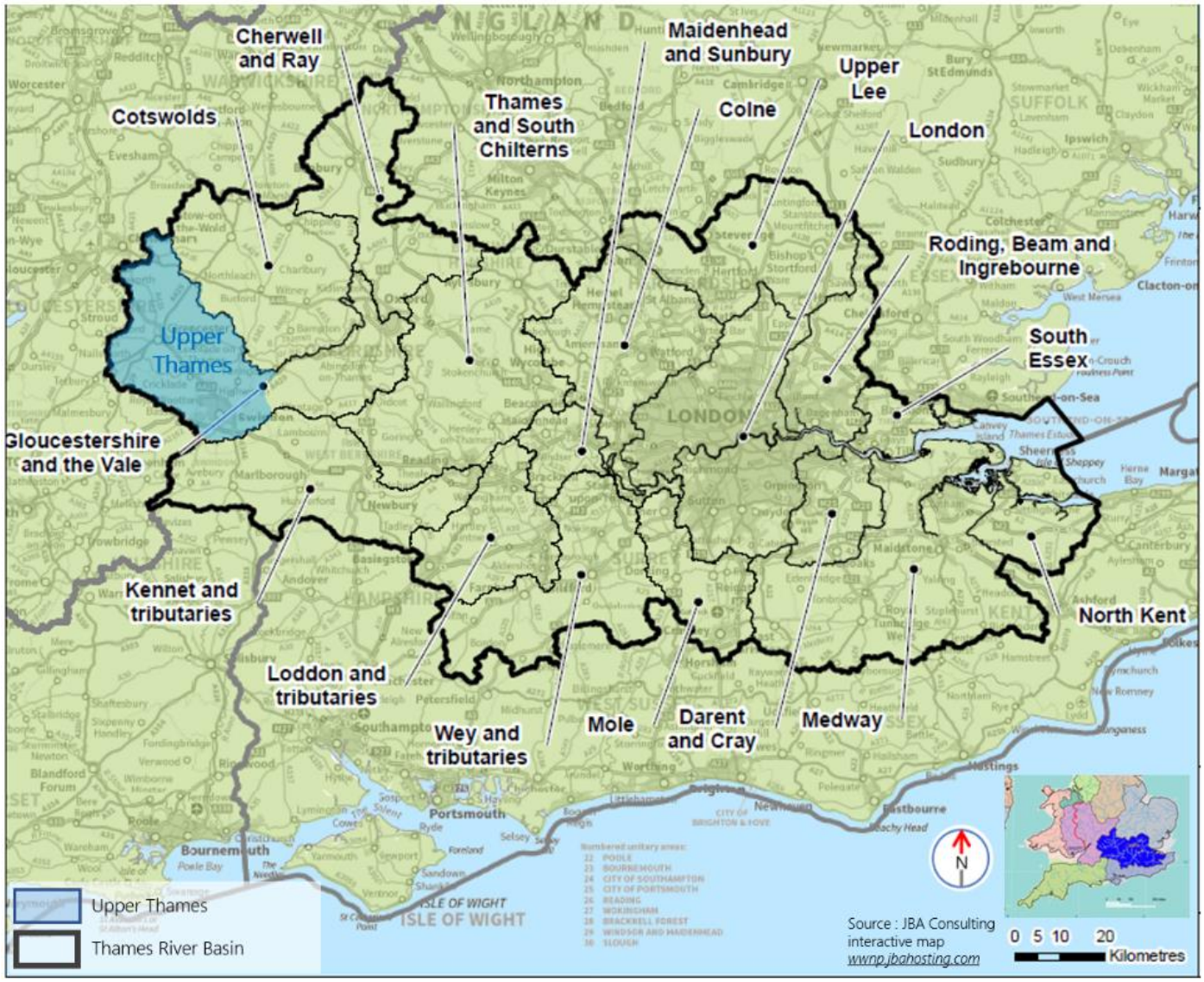


Figure 1 – The Upper Thames catchment in the Thames river basin

In the Upper Thames catchment, the two main projects are Payment for Ecosystem Services (PES) and the Product Substitution trial. For this catchment, Thames Water has made the charity FWAG South-West responsible for farmers' recruitment and data collection about these projects. FWAG-SW has led walkover surveys on different water bodies in the Upper Thames since 2015, starting with the Ampney Brook water body. Then, walkover surveys have been extended to the Cole (2015), the Marston Meysey Brook (2016), the Wiltshire Ray (2016), and the Source of Thames (2018) water bodies.

Most of the time, the initial walkover survey is undertaken in summer. Then farmers, if they wish to be involved in the project, have to sign up just before autumn, before the beginning of the "high-risk" season. Payments are usually delivered the following spring, based on the agreed criteria.

During the walkover survey, FWAG-SW staff, following Thames Water's instructions, ask farmers some questions, mainly about farm context, land use and use of pesticides. A post-season survey is also undertaken, dealing more specifically with slug pressure and pesticides use over the "high-risk" season.

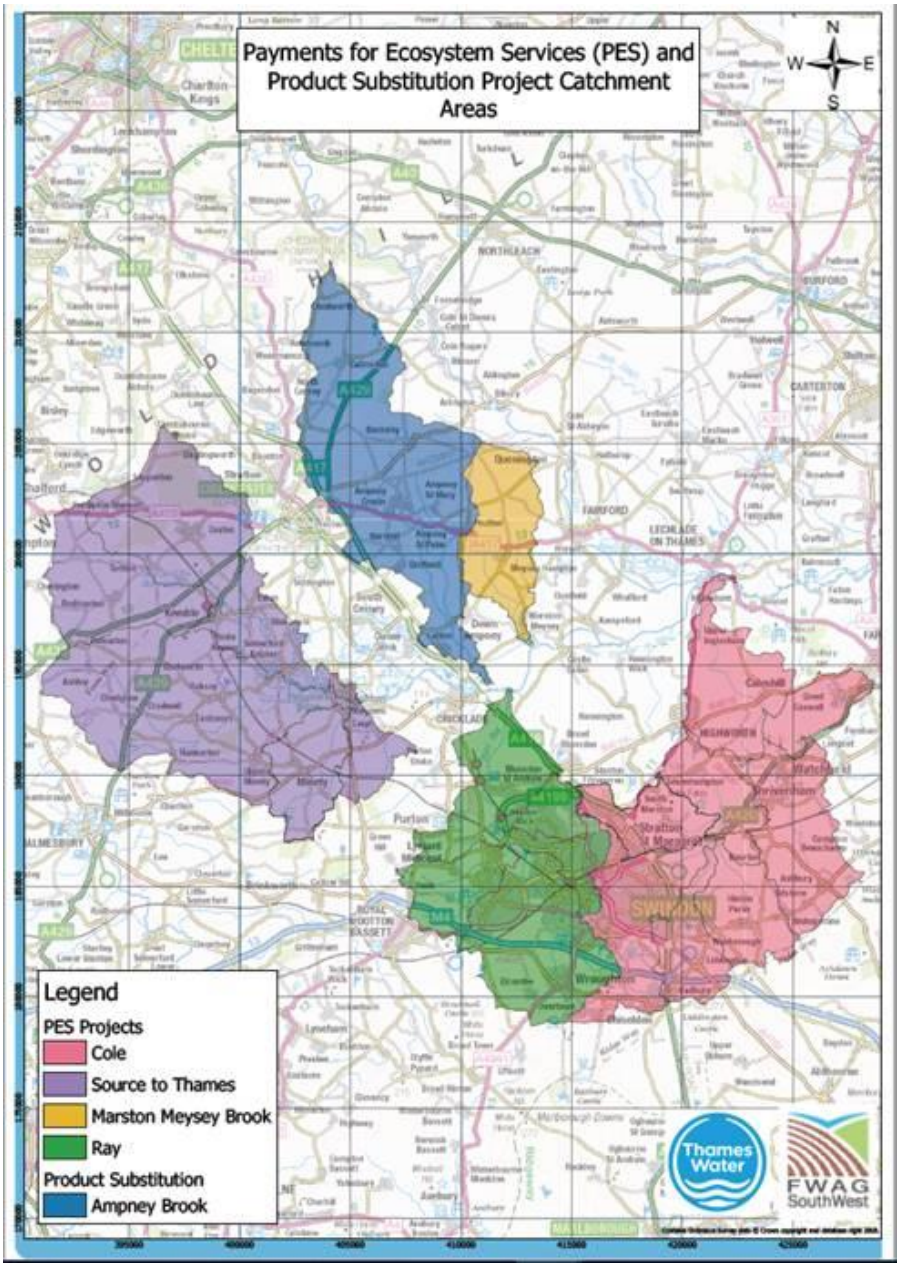


Figure 2 – Water bodies in the Upper Thames catchment where PES and Product Substitution trial are implemented
Source: FWAG South-West and Thames Water, 2019

1 – FARMERS PARTICIPATION IN THAMES WATER'S PROGRAMME IN THE UPPER THAMES

1.1 – Analysis of Thames Water's programme implementation in the Upper Thames

Thames Water started discussions in 2013 by exploring the concept of PES in the Ampney Brook water body. First registrations occurred in 2015 in this same water body, with the Production Substitution trial. PES have been implemented in the Cole, the Marston Meysey Brook and the Wiltshire Ray in 2016 and in the Source of Thames in 2018. Some changes have occurred throughout the implementation of the programme: calculation of payment methodology for ecosystem services and level of subsidies. Table 1 presents the chronology of the implementation of PES and Product Substitution projects in the Upper Thames catchment.

Table 1 – Details of the implementation of metaldehyde mitigation projects in the Upper Thames

Year	Programme	Calculation of subsidies	Water body	Outcome*
2013	PES (Pilot project)	/	Ampney Brook	*Exploration of the concept of PES*
2015	Product Substitution	£1/kg of ferric phosphate	Ampney Brook	Contacted: 22 farms Registered**: 5 farms
2016	PES	Amount of clean water produced by the water body	Cole	Contacted: 36 farms Registered: 31 farms (14 farmers)
			Marston Meysey Brook	Contacted: 13 farms Registered: 10 farms (6 farmers)
			Wiltshire Ray	Contacted: 15 farms Registered: 6 farms (10 farmers)*
	Product Substitution	£1/kg of ferric phosphate	Ampney Brook	Contacted: 25 farms Registered: 13 farms
2017	PES	£2/ha of arable land, based on the proportion of clean samples	Cole	Contacted: 39 farms Registered: 28 farms (22 farmers)
			Marston Meysey Brook	Contacted: 11 farms Registered: 10 farms (9 farmers)
			Wiltshire Ray	Contacted: 5 farms Registered: 5 farms (6 farmers)*
	Product Substitution	£1/kg of ferric phosphate	Ampney Brook	Contacted: 15 farms Registered: 13 farms
2018	PES	£1.50/ha of arable land, based on the proportion of clean samples	Cole	Contacted: 44 farms Registered: 32 farms (24 farmers)
			Marston Meysey Brook	Contacted: 11 farms Registered: 9 farms (8 farmers)
			Wiltshire Ray	Contacted: 18 farms Registered: 8 farms (7 farmers)
		£1/ha of arable land, based on the proportion of clean samples	Source of Thames	Contacted: 66 farms Registered: 31 farms (24 farmers)
	Product Substitution	£1/kg of ferric phosphate	Ampney Brook	Contacted: 24 farms Registered: 13 farms

** Outcome: according to registration spreadsheets. A same farmer could manage several farms. The numbers of farms have been taken from registration spreadsheets, completed for some of them before the "high-risk" season, and some late registrations and withdrawals could have not been considered. The numbers of farms have been taken from payment data, which correspond to effective registrations.*

*** Registered: corresponds to registration or to the wish to register, depending on information available. Consequently, these figures could not directly correspond to effective registrations.*

Concerning the registered area, it is worth noting that the methodology for calculating subsidies has changed since 2017. Until 2016, the whole holding within water bodies was registered and subsidies were based on the amount of clean water produced by the water body. However, Thames Water decided this methodology was complicated to implement. Since 2017, only land included in arable rotation within water bodies is registered and payments are based on the area registered at the start of the year.

Since the beginning of the implementation of the programme in the Upper Thames, the area registered has regularly increased; for instance, registered arable land has increased by 51% between 2017 (7,600 ha) and 2018 (11,506 ha) (Table 2). However, in some water bodies, areas registered have decreased from the beginning of the implementation of the programme, such as in the Marston Meysey Brook, where the registered area reduced by half. This can be explained partially by changes in the water body area by the Environment Agency in 2017. Also, two major farms, registered in 2017, have not registered in 2018, possibly due to the boundary changes. (Table 2).

Table 2 – PES programme's implementation in the Upper Thames

		PES implementation the Upper Thames		
		2016 Registered area: Whole holding in water body	2017 Registered area: Arable land	2018 Registered area: Arable land
Cole	*Registered area (ha)**	3,580ha	4,716ha	4,219ha
	Level of subsidies (£/ha)	Amount of clean water produced	£2/ha	£1.5/ha
	*Amount of subsidies (£)***	£2,863	£9,278	£12,629
Marston Meysey Brook	*Registered area (ha)**	1,233ha	2,636ha	1,122ha
	Level of subsidies (£/ha)	Amount of clean water produced	£2/ha	£1.5/ha
	*Amount of subsidies (£)***	£1,571	£4,674	£3,683
Wiltshire Ray	*Registered area (ha)**	762ha	249ha	352ha
	Level of subsidies (£/ha)	Amount of clean water produced	£2/ha	£1.5/ha
	*Amount of subsidies (£)***	£2,232	£2,003	£2,277
Source of Thames	*Registered area (ha)**	*Not yet implemented*	*Not yet implemented*	5,603ha
	Level of subsidies (£/ha)			£1/ha
	*Amount of subsidies (£)***			£14,003
PES in Upper Thames	*Registered area (ha)**	5,575ha	7,600ha	11,296ha
	Level of subsidies (£/ha)	Amount of clean water produced	£2/ha	£1/ha or £1.5/ha
	*Amount of subsidies (£)***	£6,666	£15,955	£32,592

** Registered area: corresponds to the sum of registered arable land (for 2017 and 2018) or to the sum of all land of registered holdings (for 2016) located in water bodies.*

*** Amount of subsidies: corresponds to the overall amount of subsidies invested by Thames Water in the water body (potential bonuses and penalties included).*

In considering only water quality payments, the overall amount of PES in the Upper Thames has increased by 21% from 2017 to 2018 (Appendix 1) while the registered area has increased by 49% (Table 2). The decrease of the level of subsidies from 2017 to 2018 for the Cole, the Marston Meysey Brook and the Wiltshire Ray, and the lower level of subsidies chosen for the Source of Thames when the water body has been included in the area of application of the programme explain the low increase of water quality payments. Thereby, this strategy would allow Thames Water to involve more farms in the programme without increasing the finances for it. Nevertheless, payments for ecosystem services are not only based on registered area: the programme also includes additional bonuses for each involved farms of a water body. If every sample shows good results during the "high-risk" season (concentration of metaldehyde remaining below 0.1µg/L), each farm of the water body would receive a £250 bonus (which represents £15,750 for the 63 registered farms belonging to water bodies having good results for every sample in 2018). Additionally, each farm would receive additional £100 on its first year of registration (which represents £2,700 for the 27 farms having registered for the first time in 2018). A £50 "early adopter" payment was also given to farmers in 2016. With these additional bonuses, the overall amount of support has doubled in 2018 by comparison with the water quality payment without bonuses. In 2017, registered farms from the Cole did not get the £250 bonus because some samples exceeded the agreed limit on metaldehyde concentration. These results led to penalties: a twelfth of final payment is deducted for each sample showing a concentration of metaldehyde above 0.1µg/L (Appendix 1).

Figure 3 shows the number of farmers registered to PES and the overall amount of subsidies allocated to PES by Thames Water. The level of investment in PES has increased more significantly than registrations since the beginning of the programme, especially because all farmers in each water bodies has received the additional water quality bonus in 2018. Thereby, the average level of payment per farmer has increased, from £222 per farmer in 2016 to £517 per farmer in 2018.

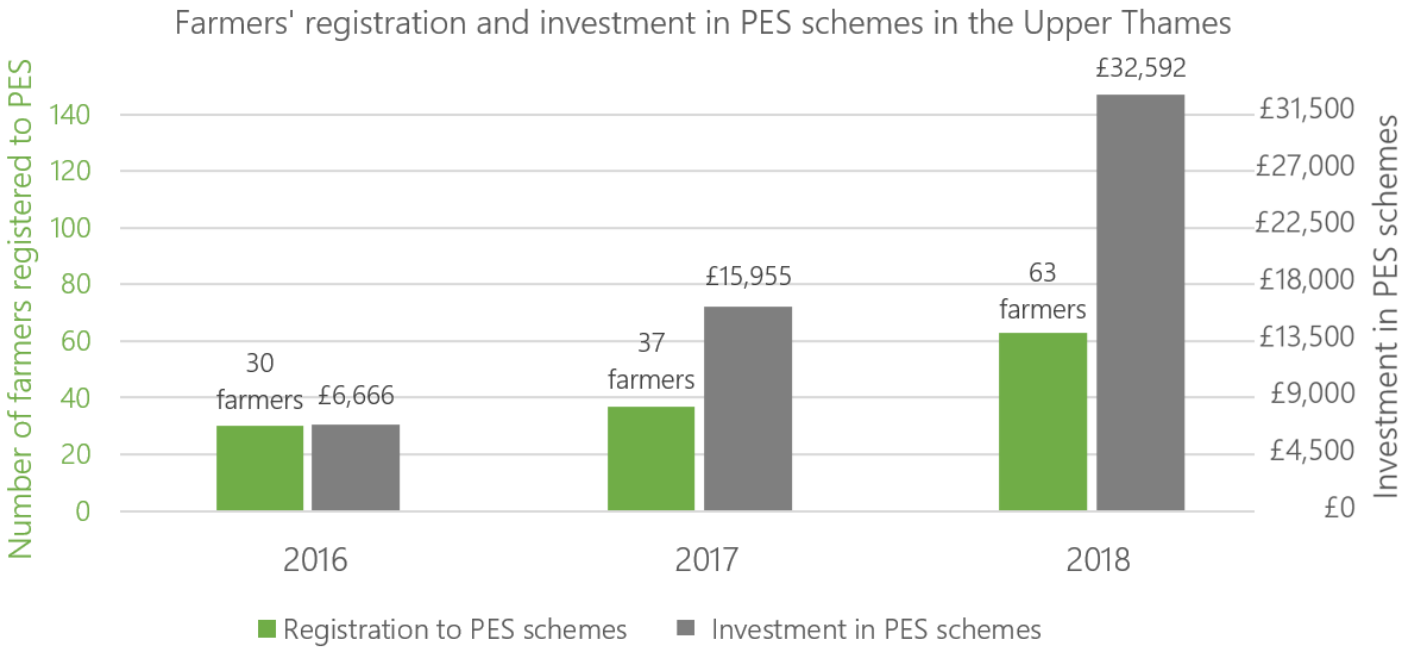


Figure 3 – Farms' registration and investment in PES schemes in the Upper Thames

If the number of farmers having registered has effectively increased, some of them have chosen to not renew their registration to schemes. However, the proportion of farmers who did not renew their commitment in 2018 after having signed-up the previous year is very low, even with the decrease of the level of subsidies in some water bodies (Cole, Marston Meysey Brook and Wiltshire Ray). The number of farmers not renewing their commitment is slightly more important in the Ampney Brook, while the level of subsidies has stayed the same during the three years of implementation of the programme (Figure 4). However, under product substitution trial, farmers do not necessarily have to register in advance, and take part only if slug pressure is high enough to require pellets application. This depends on crops grown and the weather. Moreover, these proportions of farms having not registered in 2018 after having registered the year before might be overstated, since some farms could have been reorganised (e.g. change of ownership). Programmes appear to remain worthwhile for farmers, even with a lower level of subsidies. In addition, for water bodies where projects have been implemented before 2018, the proportion of farmers having register before 2018 represent a significant part (more than half) of all registered farmers. Thereby, the success of these projects is also linked to farmers who have been interested in the programme at the start.

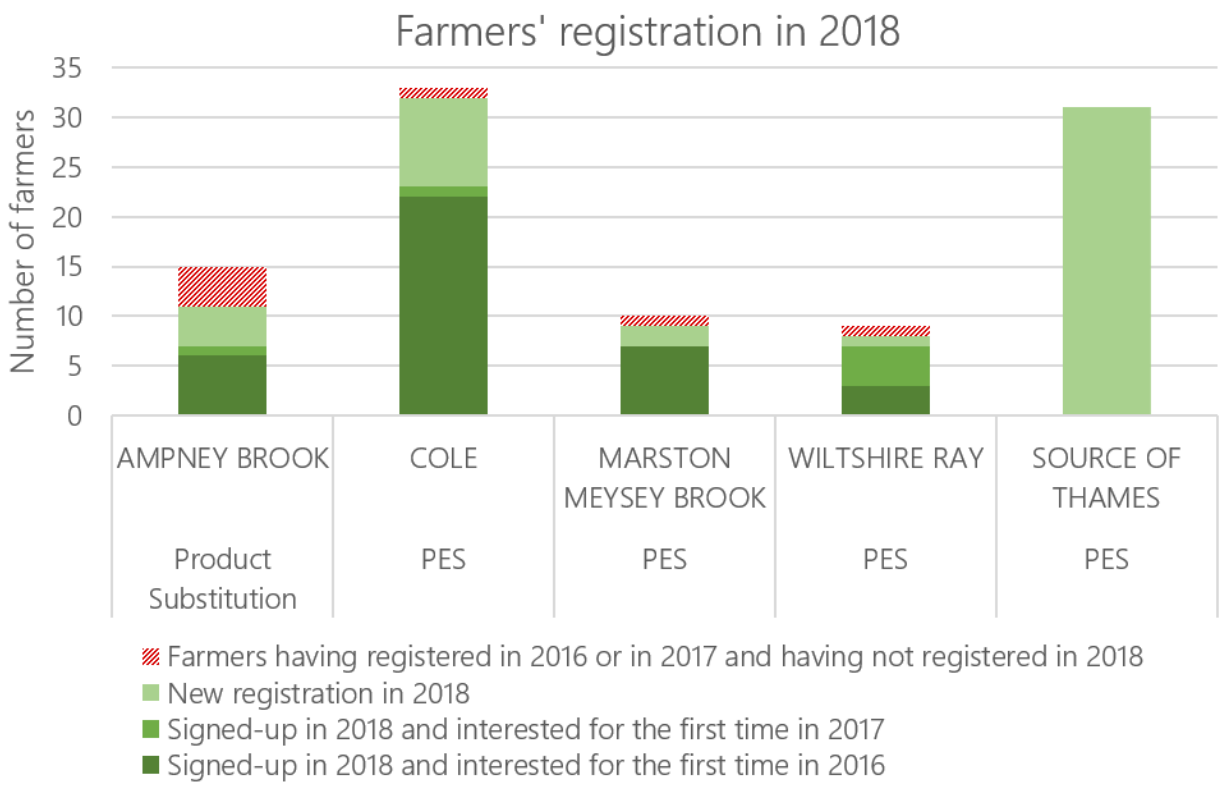


Figure 4 – Details of farmers' registration to Thames Water's programme in 2018 in the Upper Thames

After having analysed the process of registration, the report will now focus on data collected during initial walkover surveys. For these data, the distribution of farms and their land are detailed for each tributary of a same water body. Consequently, some farms can be listed several times if the land is located on more than one tributary. Figures considering this approach are given in Table 3. If this approach has an influence on numbers of farms, this influence should be much more limited in terms of proportions.

1.2 – Eligibility to PES and Product Substitution programmes

Table 3 shows a summary of the outcome of the work done by FWAG-SW in 2018 as part of PES and Product Substitution programmes. Throughout water bodies within the programme area, 213 farms have been contacted, and 59% of them have registered to schemes or have confirmed that they are willing to do so in 2018. These figures do not correspond exactly to effective registrations as some farms, while interested, did not register. These figures will be retained in the analysis to follow.

Table 3 – Farms' involvement in Upper Thames water bodies in 2018

	Registered to schemes or willing to do so	Eligible but not registered to schemes*	Non-eligible	Total number of farms listed upon initial walkover surveys
Ampney Brook	15	11	65	91
Cole	50	26	101	177
Marston Meysey Brook	12	2	16	30
Wiltshire Ray	9	12	116	137
Source of Thames	40	36	198	274
Other water bodies			759	759
Upper Thames	126	87	1255	1468

* "Eligible but not registered to schemes": corresponds to contacted farms which have not registered to scheme in spite of their eligibility.

1.2.1 – Criteria of eligibility to PES schemes

Thames Water defines eligible farms for PES schemes as non-organic farms with land in arable rotation inside the project area (Thames Water, 2019). In the Upper Thames, the project area corresponds to the following water bodies: Cole, Marston Meysey Brook, Wiltshire Ray and Source of Thames. As the outcome of walkover surveys, FWAG-SW has drawn up a list of farms which are, for some of them, in compliance with criteria of eligibility to PES. Figure 5 shows the proportion of contacted farms by FWAG-SW among the eligible ones, and among the ones that are not eligible. If 82% of eligible farms have been contacted, FWAG-SW has also chosen to contact 10% of non-eligible farms. This could be explained by the fact that these farms are part of other eligible farms, and by changes in farms' situation since initial walkover surveys (Figure 5).

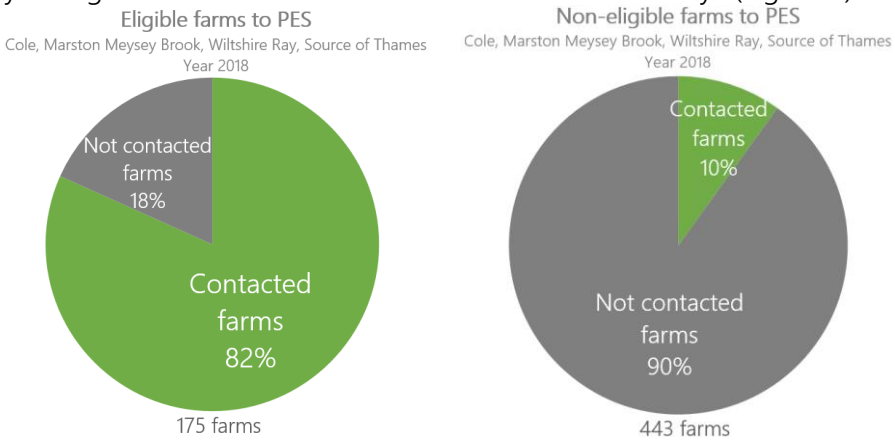


Figure 5 – Eligibility to PES and contacted farms

Since the programme aims to mitigate metaldehyde and other pesticides reaching water bodies, the next section outlines the potential use of plant protection products made by eligible farms.

1.2.1.1 - Suitability for PES and pesticides use

Thames Water is especially interested in five plant protection products: two molluscicides (metaldehyde and ferric phosphate) and three herbicides (carbetamide, mecoprop-P and propyzamide). These different plant protection products have specific features in terms of controlled pests and applications, which are summarized in Table 4. One shared feature of these five pesticides is that they are applied on large areas, which explains why their concentration in drinking water sources could be problematic.

Table 4 – Main features of studied Plant Protection Products

	Metaldehyde	Ferric phosphate	Carbetamide	Mecoprop-P	Propyzamide
Description	A contact and systemic molluscicide bait	Used to control a variety of slugs and snails	A pre- and post-emergence herbicide	An herbicide for post-emergence	A residual, systemic post-emergent herbicide
Examples of pest controlled	Slugs and snails	Slugs and snails	Annual grasses (including blackgrass) and some broad-leaved weeds	Broad-leaved weeds on grassland and cereals	Annual and perennial weeds (certain grasses and broad-leaved)
Examples of applications	*Cereals, oilseed rape, fruits, vegetables and ornamentals*	*Cereals, oilseed rape, fruits, vegetables and ornamentals*	*Oilseed rape and vegetables*	*Lawns and cereals*	*Fruits, vegetables, oilseed rape, alfalfa, ornamentals and non-cropped area*
Example of commercial names	*Caracol 3, Enzo* and *Gusto*	*Ironmax Pro,, Ferramol, Ferrox, Sluxx…*	*Carbetamex, Crawler, Kartouch, Riot* and *Scrum*	*Headland, Jewel, Prompt*, and 39 other commercial names	*Conform, Edge, Kerb, Stroller* and 54 other commercial names

Sources: University of Hertfordshire, European Commission and AgroBase UK

The eligibility for PES was compared with the use of four conventional pesticides: metaldehyde, mecoprop-P, propyzamide and carbetamide. It appears that the great majority of farms that have never used these pesticides are not eligible for PES. At the opposite, 82% of farms having already used metaldehyde are eligible for PES. Nevertheless, 15 of the farms eligible for PES have never used any of the four pesticides, which means that selected criteria for the definition of the eligibility for PES would also select some less relevant farms for registration to schemes (Figure 6). However, for the three studied herbicides, the name of active ingredients is not necessarily known by farmers, who are more familiar with commercial names. Thereby, results should be analysed with caution for herbicides.

In addition, there are twenty-five non-eligible farms which have historically used metaldehyde. However, five of them are part of eligible farms located on other tributaries of the water body, and seven other farms have temporary grassland which is included in arable rotations. Finally, four other not eligible farms are registered to PES schemes with a significant area of arable land in 2018, which means that data from initial walkover surveys are not necessarily up to date, and this could explain the ten remaining farms using metaldehyde without being eligible. Thus, almost all farms using metaldehyde are effectively eligible for PES.

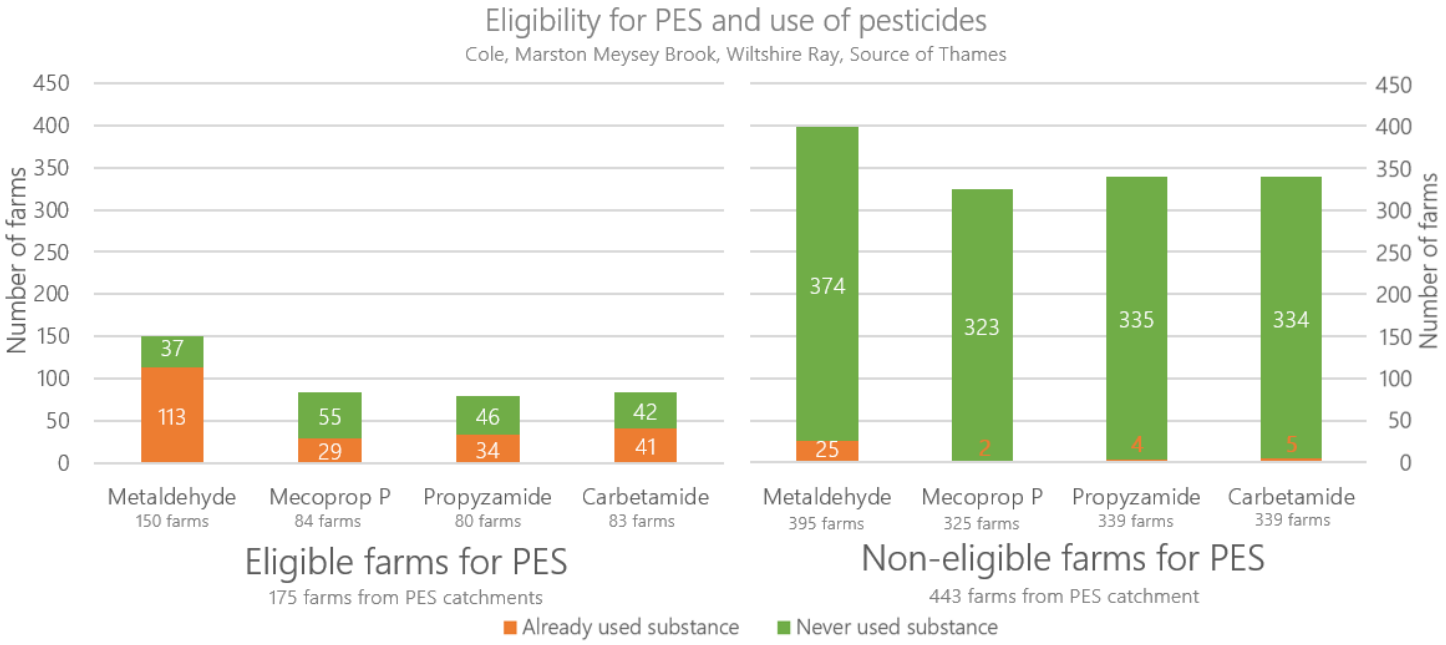


Figure 6 – Use of pesticides and eligibility to PES schemes

1.2.1.2 - Pesticides use and arable land

One assumption, on which FWAG-SW and Thames Water are relying, is that arable land is a land use especially prone to receive plant protection products. This assumption is supported by the data. The great majority of farms who used one or more of the four pesticides have arable land. In the same way, 68% of farms with no arable land have never used any of the four studied pesticides (Figure 7).

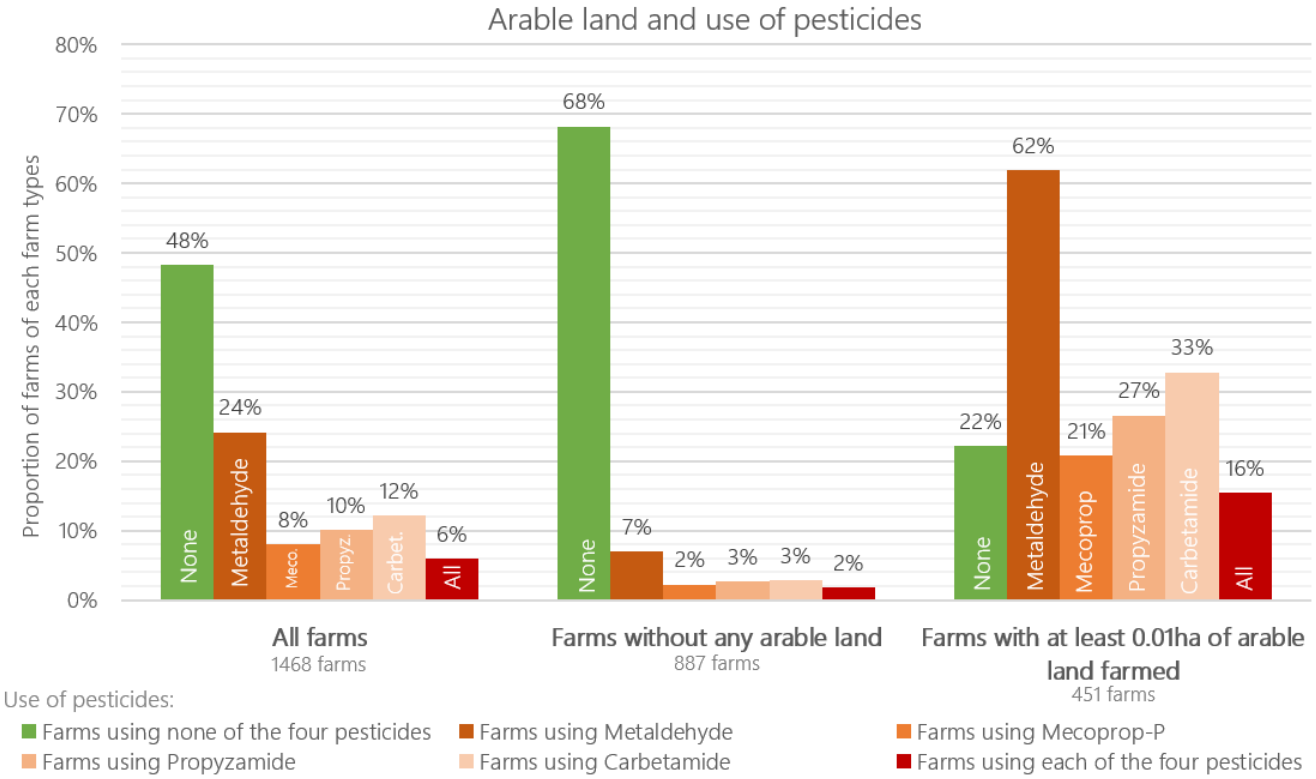


Figure 7 – Arable land and use of pesticides

More generally, cereals[1] and mixed[2] farms, characterised by a predominance of arable crops, correspond to the great majority of those using the four pesticides.

1.2.2 – Analysis of registrations

Figure 8 shows farms' registration for the year 2018 for each of the five water bodies, related to the area of arable land of these farms. It appears that, for each water body, at least 50% of farms listed as the outcome of initial walkover surveys have been considered as not relevant to be contacted according to FWAG-SW, knowing eligibility criteria. In accordance with Figure 6 and Figure 7, it appears that the number of contacted farms (registered or not registered) corresponds approximately to the number of farms having at least 5 hectares of arable land, except in the Wiltshire Ray, where the number of contacted farms corresponds to the number of all farms having arable land (Figure 8). Overall, in 2018, for the five water bodies, 27% of listed farms have been contacted and 28% of listed farms have at least 5 hectares of arable land.

[1] Cereals: holdings on which cereals, combinable crops and set aside account for more than two thirds of the total Standard Output (DEFRA, 2014).

[2] Mixed: holdings on which arable crops account for more than two thirds of the total Standard Output (DEFRA, 2014).

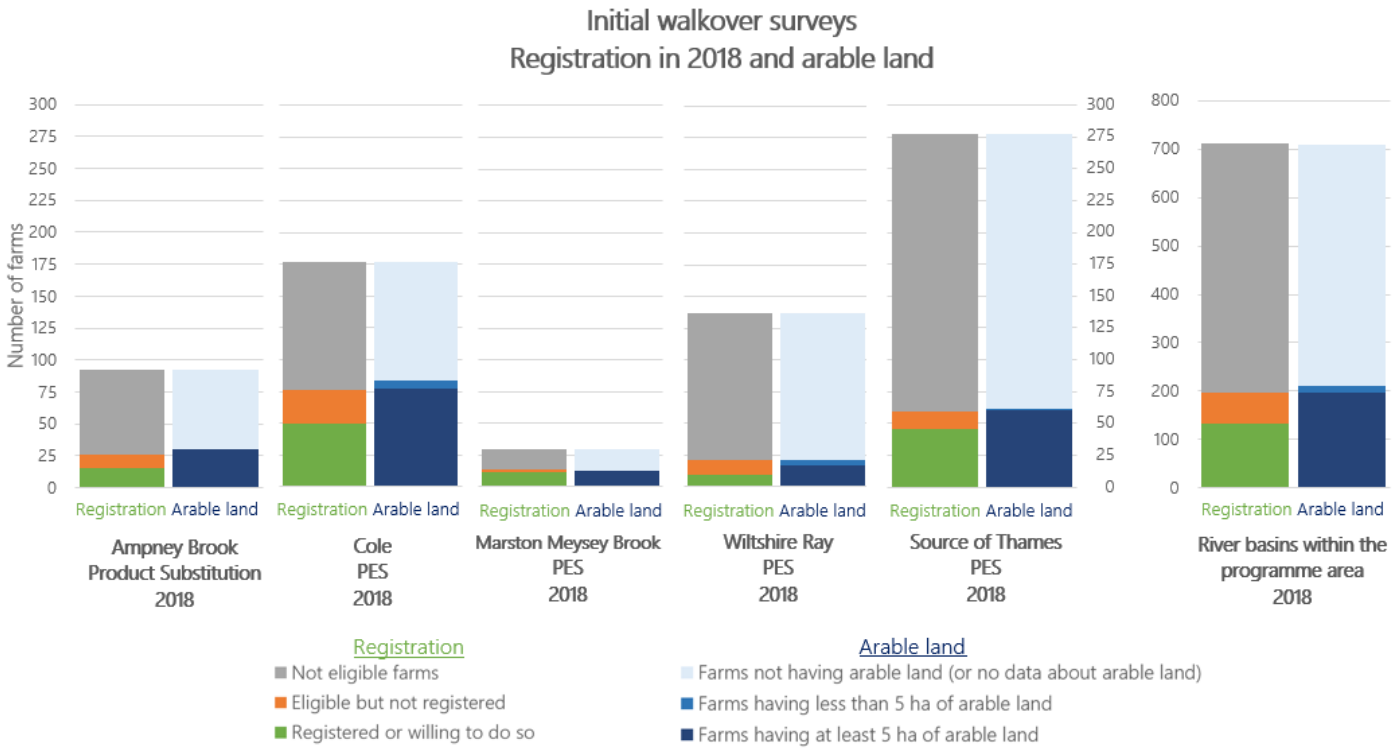


Figure 8 – Registration in 2018 related to arable land surface area

As the outcome of initial walkover surveys, 18,598ha of arable land have been listed. 67% of this area belongs to farms registered to PES or Product Substitution programmes in 2018, which represent 12,404ha according to registration spreadsheets (because of approximations, a difference of 10% is observed in comparison to payment data: 11,296ha of arable land were effectively registered in 2018). According to registration spreadsheets, 17% of listed arable land belongs to farms which have been contacted as well but have not registered (because they cannot or they did not want to) (Figure 9). Among the 16% of arable land belonging to farmers who have not been contacted, 71% (2,176 ha) belongs to farms that are potentially eligible for PES. Among these 2,176 ha of suitable arable land, 47% (1,033ha) belongs to farmers who have declared to have already used metaldehyde. Thereby, 1,033 ha of arable land, farmed by 16 different farmers, can potentially be registered in the future. This corresponds to 5.6% of all listed arable land. Except this surface area, FWAG-SW should add other farms to the list if an increase of the registered area of arable land in the catchment is needed.

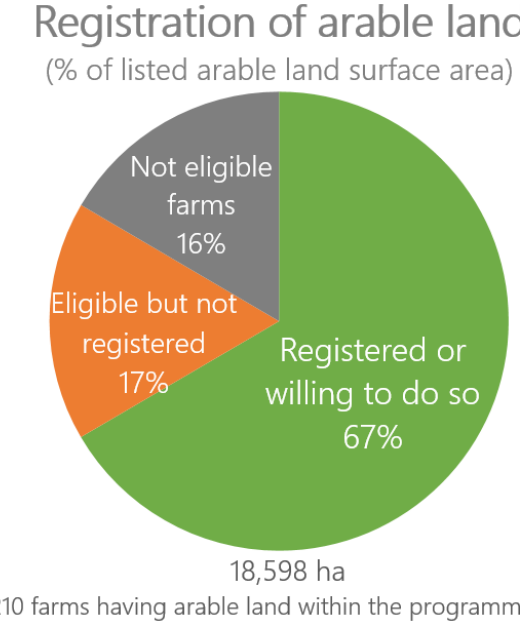


Figure 9 – Registration in 2018 of listed arable land in water bodies within the programme area

2 – ANALYSIS OF REGISTERED FARMS

In order to guide FWAG-SW's future seeking for farms likely to register to PES or Product Substitution programmes, the following section will focus on features of registered farms; other listed farms will be studied only for comparison.

In the previous section, it has been highlighted that the great majority of contacted farms were eligible to PES (and Product Substitution) programme (Figure 5). The criteria of eligibility to PES correspond to specific features of registered farms: non-organic farms with land in arable rotation in water bodies. The next section considers the other features of these registered farms.

2.1 – General description

2.1.1 – Business type and farm type

Farm businesses represent the great majority of farms listed upon walkover surveys, but domestic holdings represent also 11% of listed farms. None of these domestic holdings have been contacted in order to register to schemes. Almost all registered farms for which data are available are farm businesses, with only one forestry (0.9%) and one equine businesses (0.9%).

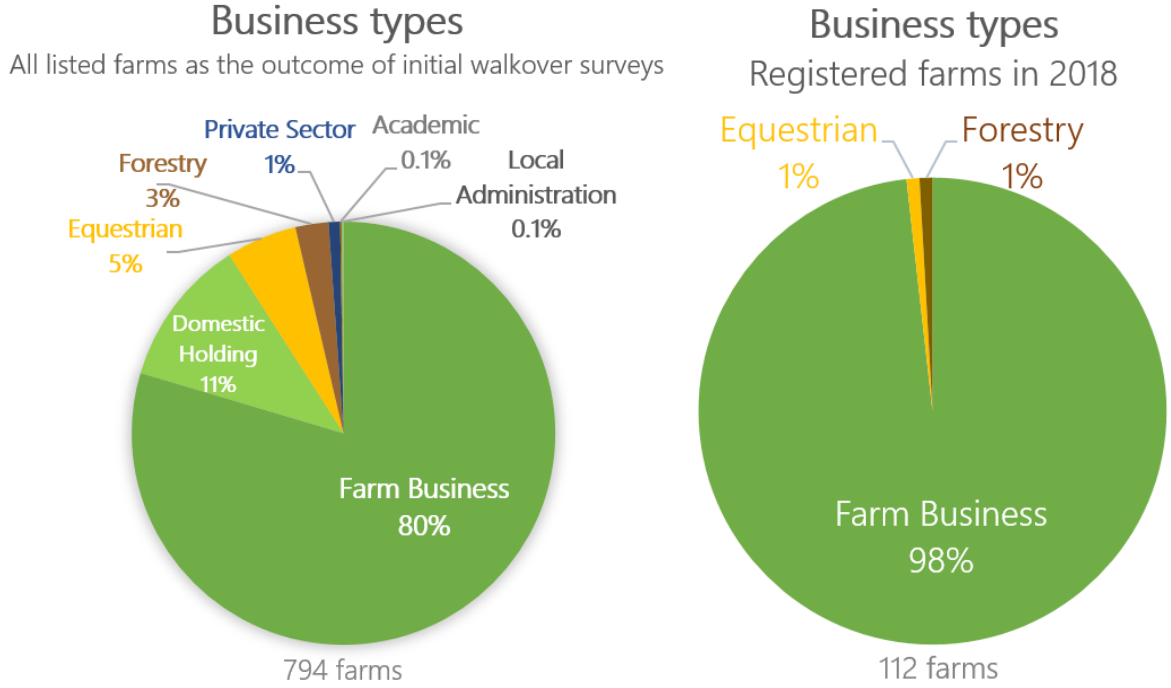


Figure 10 – Business types of registered farms in 2018, compared to business types of all listed farms as the outcome of walkover surveys

The type of farm is defined according to the agricultural production, which represents at least two thirds of the farm Standard Output. The great majority (86%) of farms having registered in 2018 for which data are available corresponds to the ones having a significant part of arable land (cereals and mixed farms) (DEFRA, 2014). Some lowland grazing livestock and dairy farms are also registered; most of them are using metaldehyde and are characterised by a small area of arable land. Cereals and mixed farms are also the most likely to accept to register after being contacted by FWAG-SW (74% of cereal farms and 55% of mixed farms agreed to register after being contacted, while only 43% of "others", 38% of lowland grazing livestock farms and 18% of dairy farms agreed to register after being contacted).

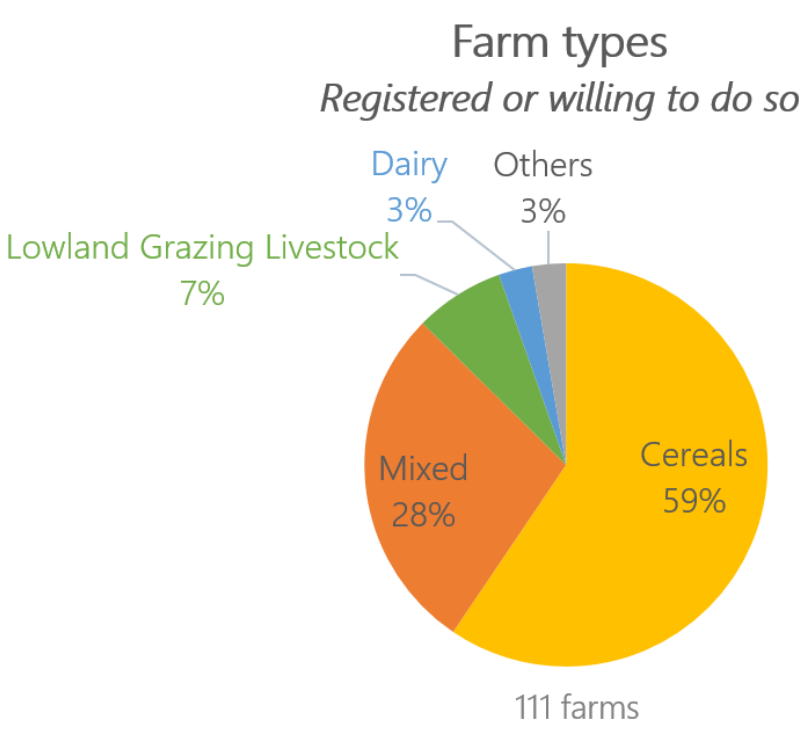


Figure 11 – Distribution of farm types characterising registered farms in 2018

Moreover, the proportion of farms involved in Agri-Environment Schemes seems to be more important among registered farms; 66% of registered farms (66 farms) are involved in AES schemes, while only 48% of all listed farms (449 farms) at the end of initial walkover surveys are involved in an AES scheme.

2.1.2 – Agronomists advice

The majority (76%) of registered farmers for which data are available receive advice from agronomists, while only 27% of all listed farms as the outcome of walkover surveys have agronomists' advice. Agronomists providing advice could have an influence on the registration of the farmer. In Figure 12, the influence of the independence of agronomists on registration of contacted farms is represented for each water body involved in PES schemes.

On average, 72% of agronomists chosen by registered farms are considered not independent, while proportions of independent and non-independent agronomists are equal for contacted farms having not registered. Concerning registered farms only, three agronomists' companies are representing 53% of all agronomists chosen by registered farms (*Agrii* for 21% for farms, *Hutchinsons* for 19% of farms, and *Procam Chemega* for 13% of farms). One independent agronomist company is also representing a significant part of agronomists among registered farms (*Alex farms*, chosen by 13% of registered farms). According to Figure 12, farmers following the advice of independent agronomists are more likely to be not interested in registering or to be interested without being eligible to the programme, since the proportion of independent agronomist is higher for not registered farmers than for registered farmers. At the Upper Thames catchment scale, the relation between independence of agronomists and registration of contacted farmers appears to be significant according to a Pearson's Chi-squared test (independence of observations, total number of observations above 20, not any expected frequencies below 5 and p-value of the Chi-squared test inferior to 0.05) (Figure 12). This observation suggests that, from a Thames Water perspective, independent agronomists should be more informed about these projects and possible alternatives to metaldehyde slug pellets; a communication campaign targeting independent agronomists could be implemented in the future.

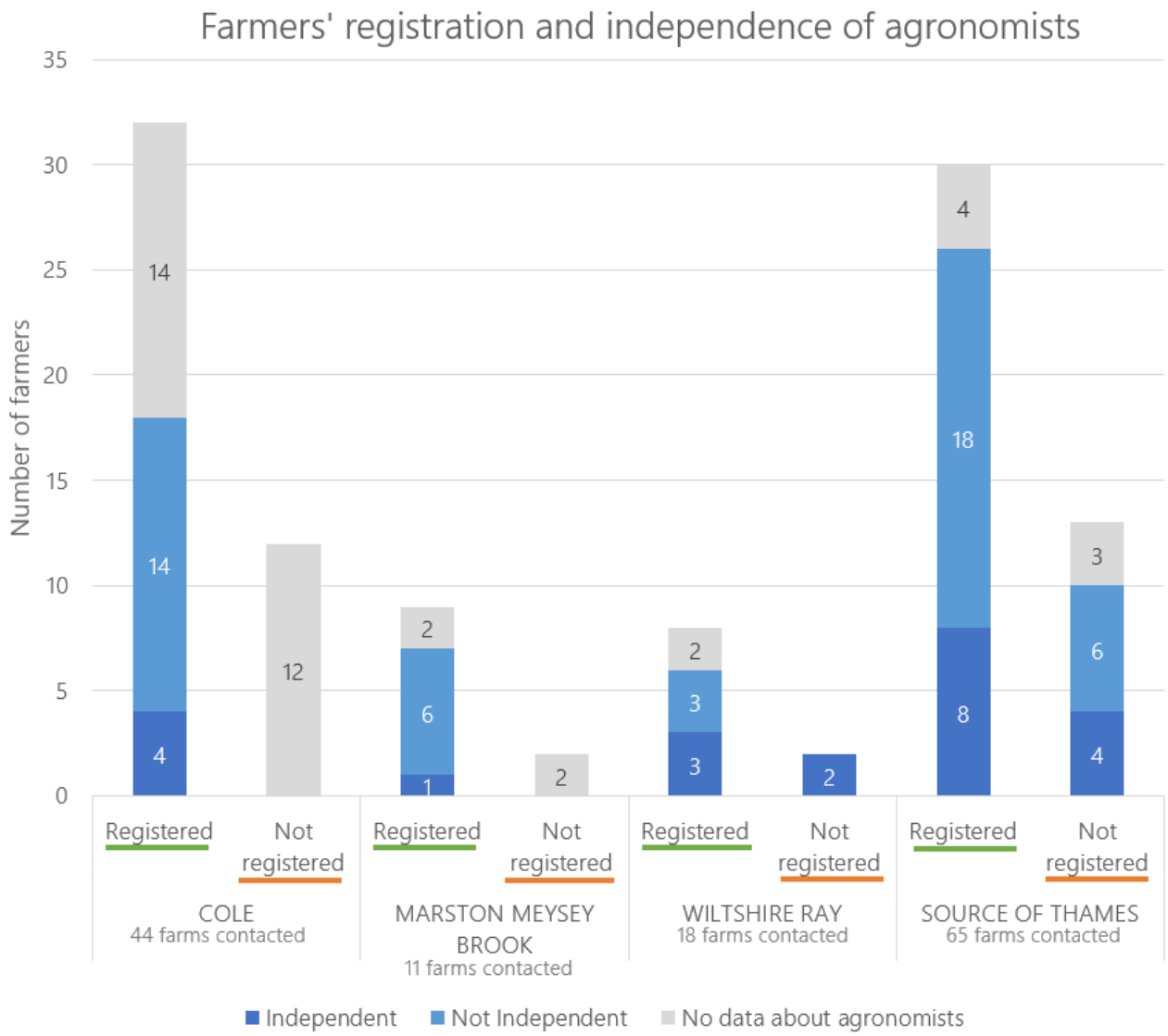


Figure 12 – Farmers' registration in 2018 and independence of their agronomists

2.2 – Management of slugs and snails during the "high-risk" season

Post-season surveys are submitted to registered farmers each year after the "high-risk" season. Farmers provide information about crop rotation, slug pressure and management of slugs and weeds. The next section looks at the issue of slug pressure and how farmers assess this.

2.2.1 – Criteria for application of slug pellets

Registered farmers decide to apply pellets according to different criteria. 65% of the 37 registered farmers are relying on observation of slug damage. The majority of registered farmers are also relying on advice from agronomists for applying pellets, which confirms the importance of these agronomists and their position on slug management. Slug traps are used by only 32% of registered farmers to assess slug risk. However, 22% of registered farmers decide to always apply pellets, assuring that there are always slug issues on their crops. Nevertheless, most of these farmers who always apply pellets are still considering other criteria such as observed slug damage; only one farmer always applies slug pellets without considering observation and advice according to post-season surveys (Figure 13).

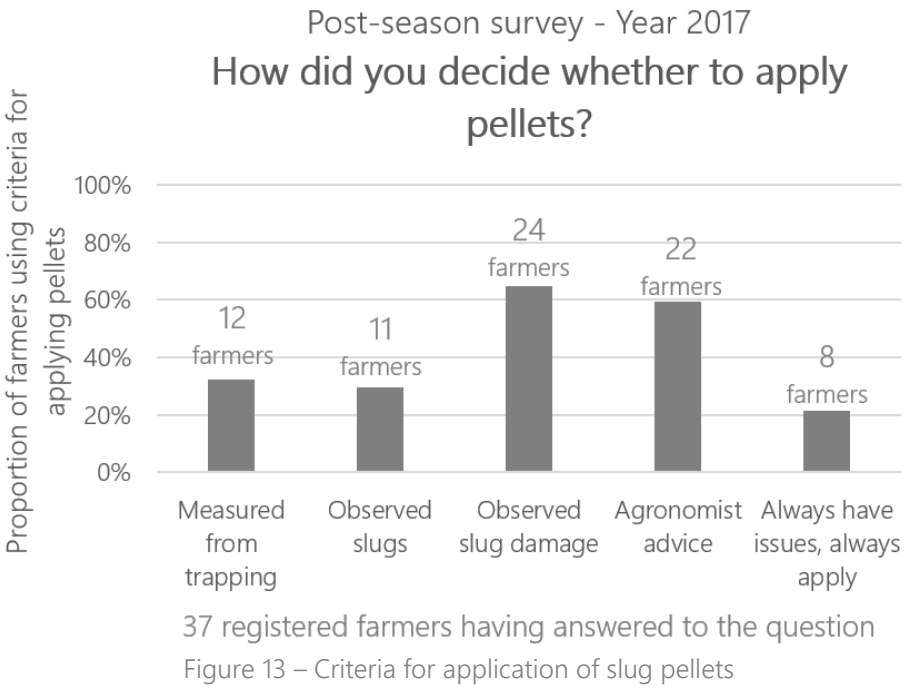


Figure 13 – Criteria for application of slug pellets

2.2.2 – Use of molluscicides by registered farmers in PES schemes

Before registering, few farms did not use any molluscicide according to results of initial walkover surveys. Only three farms were using only ferric phosphate to manage slugs and snails, and the great majority were using metaldehyde slug pellets (Figure 14).

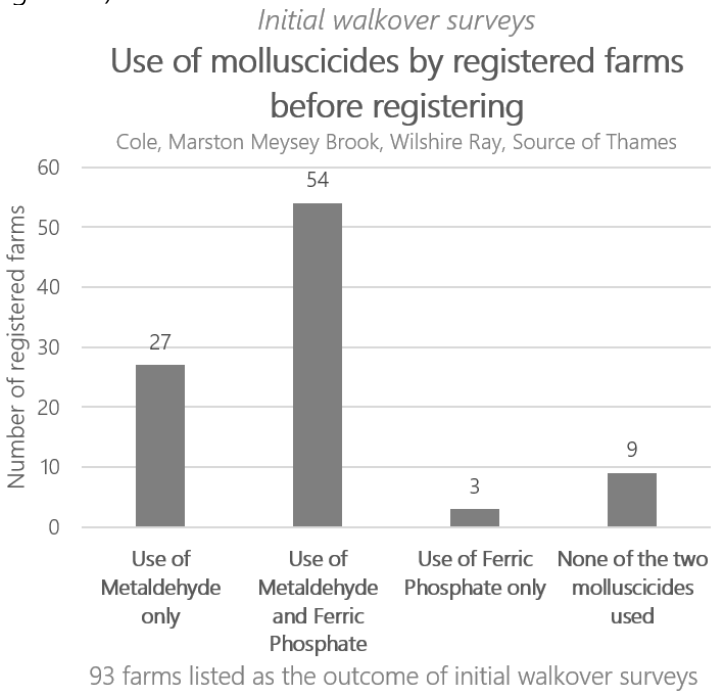


Figure 14 – Management of slugs and snails with slug pellets by registered farms before registering

According to post-season surveys, only 5% of registered farms have used only metaldehyde to manage slugs and snails after having registered in 2018 (compared to 29% before registering), and 33% only used ferric phosphate in 2018 (compared to 3% before registering). Thereby, farmers seem to be more confident in ferric phosphate; between 2016 and 2018, the proportion of farmers using only ferric phosphate to manage slugs and snails has significantly increased, according to post-season surveys (Figure 15).

Because the extent of damage from slugs on crops is dependent on the weather, and more especially on rainfall, the next figure compares rainfall with the use of molluscicide. If the weather seems to not have a significant influence on the choice of slug pellets used, it seems that the choice to apply or not slug pellets

depends on rainfall. Indeed, in 2017, a year characterised by wetter weather, the proportion of farmers having chosen to not apply pellets is significantly lower than for the two other years. Moreover, farmers are more likely to have reported high slug pressure for this wetter year than in 2018. Nevertheless, 2016 was a dry year for which a significant slug pressure has been reported (Figure 15). Slug pressure depends also on crop rotation: some crops are more sensible to slugs, which is demonstrated by specific trapping thresholds (e.g 4 slugs per slug trap for winter cereal crops, and 1 slug per trap for potatoes crops) (The Metaldehyde Stewardship Group, 2017). Therefore, slug pressure and the choice to apply or not slug pellets seem to depend on rainfall and crop rotation.

The choice of the active ingredient has evolved overtime. According to post-season surveys, most of registered farmers think that ferric phosphate is as effective as metaldehyde, even those who were sceptical before using it. Thereby, the acquisition of knowledge about ferric phosphate by farmers and their agronomists has increased its use in the water bodies concerned. The main disadvantage of ferric phosphate is the higher price compared to metaldehyde, but metaldehyde mitigation projects offset the cost difference.

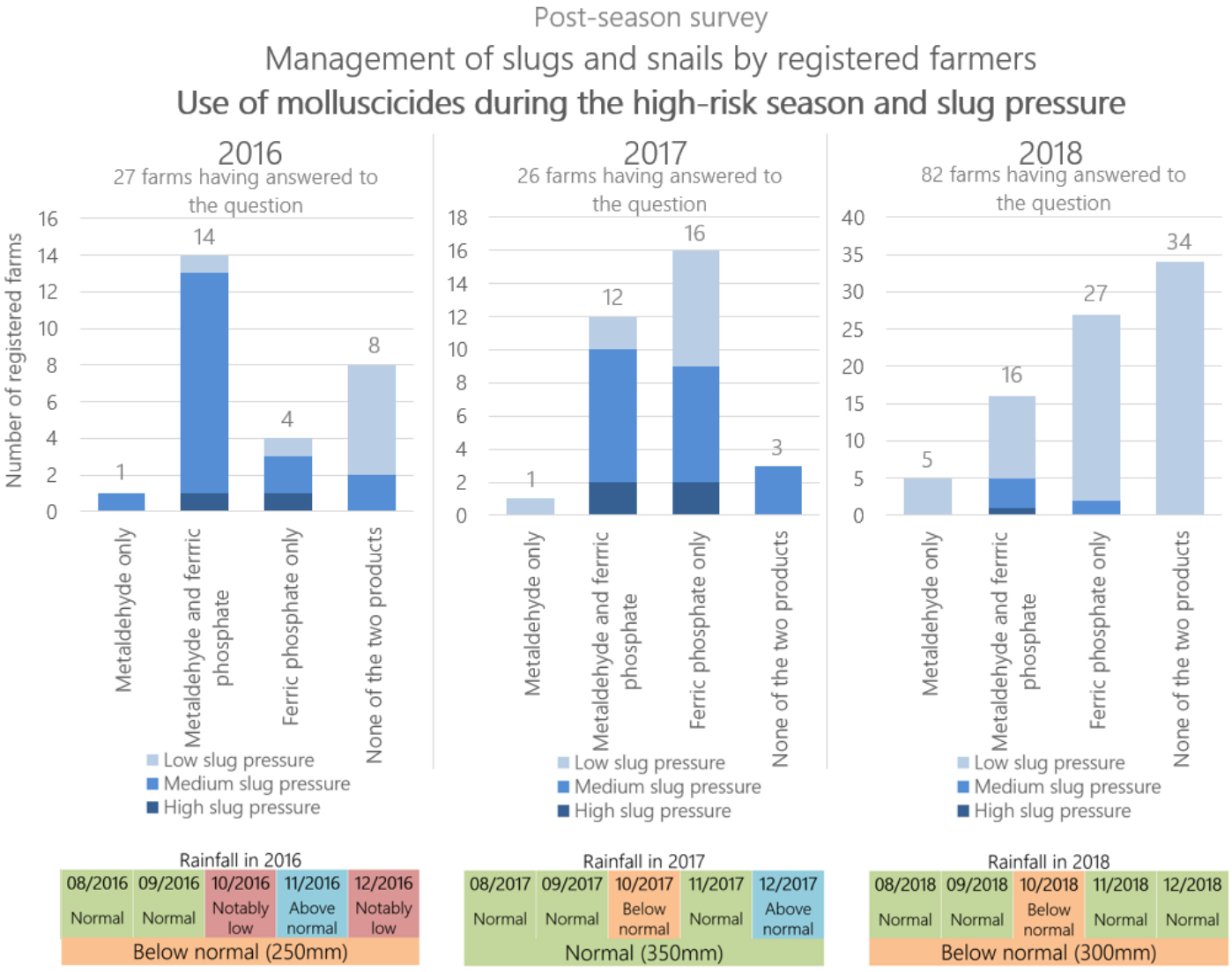
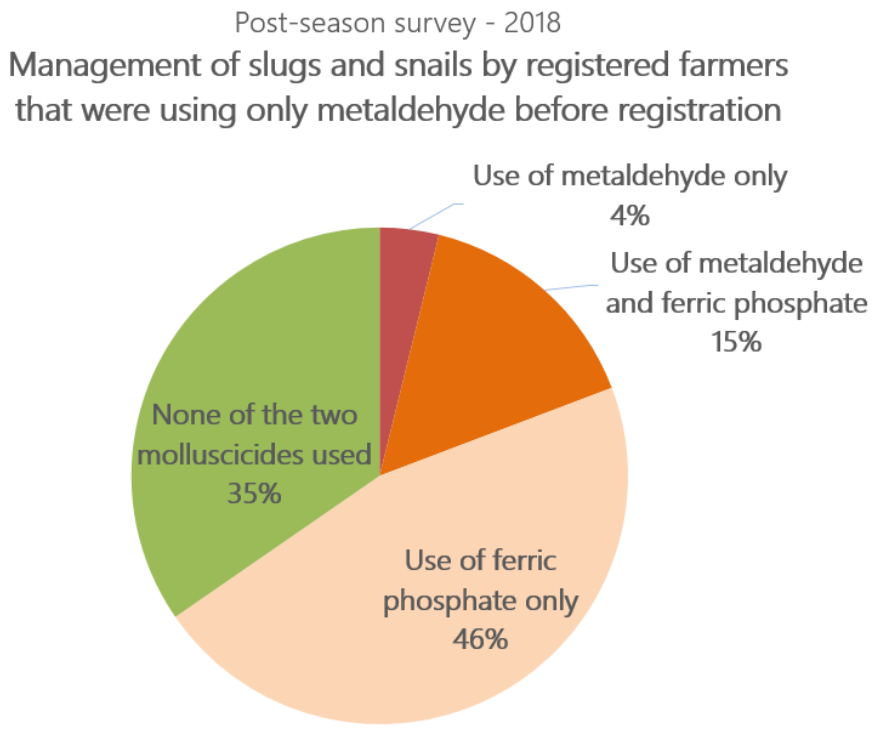


Figure 15 – Management of slugs and snails by registered farms in 2016, 2017 and 2018

To emphasise the changes in farmers' behaviour, the management of slugs and snails led by the 27 registered farms, which were using exclusively metaldehyde-based slug pellets before registering (Figure 14), have been studied further in Figure 16. The figure shows that only one farm (4%) has not changed its management and has kept using only metaldehyde in 2018. Moreover, almost half of these farms were using exclusively ferric phosphate in 2018 and 35% have not used any molluscicide. Thereby, after at least a year of registration to PES schemes, 96% of farms have changed their behaviours in terms of management of slugs and snails, in implementing more sustainable practices (Figure 16).



26 farms having answered to the post-season survey
(Cole, Marston Meysey Brook, Wiltshire Ray and Source of Thames)

Figure 16 – Management of slugs and snails by registered farmers that were using only metaldehyde slug pellets before registration

2.2.3 – Management of slugs and snails by farmers registered to product substitution trial

In the Ampney Brook, where the product substitution trial is implemented, farmers are encouraged to use ferric phosphate instead of metaldehyde. In that water body, only one farm is supposed to keep using metaldehyde if needed, as part of the swales trial.

According to the initial walkover survey, all of the registered farms in the Ampney Brook in 2018 for which data are available (10 farms) have used metaldehyde before registering, but not exclusively, because most of them (8 farms) have also used ferric phosphate-based slug pellets. Almost all registered farms have not used metaldehyde from 2016 to 2018, and have only used ferric phosphate-based slug pellets: only one of the 13 farms registered in 2018 has used metaldehyde, and 11 of the 13 registered farms have used ferric phosphate in 2018. However, the number of farms having answered to the question is quite low, and farmers that were using metaldehyde, and that have not used any slug pellets from 2016 to 2018, would not be registered to trial (because farmers can claim for funding only if they have effectively used slug pellets during the "high-risk" season) (Figure 17).

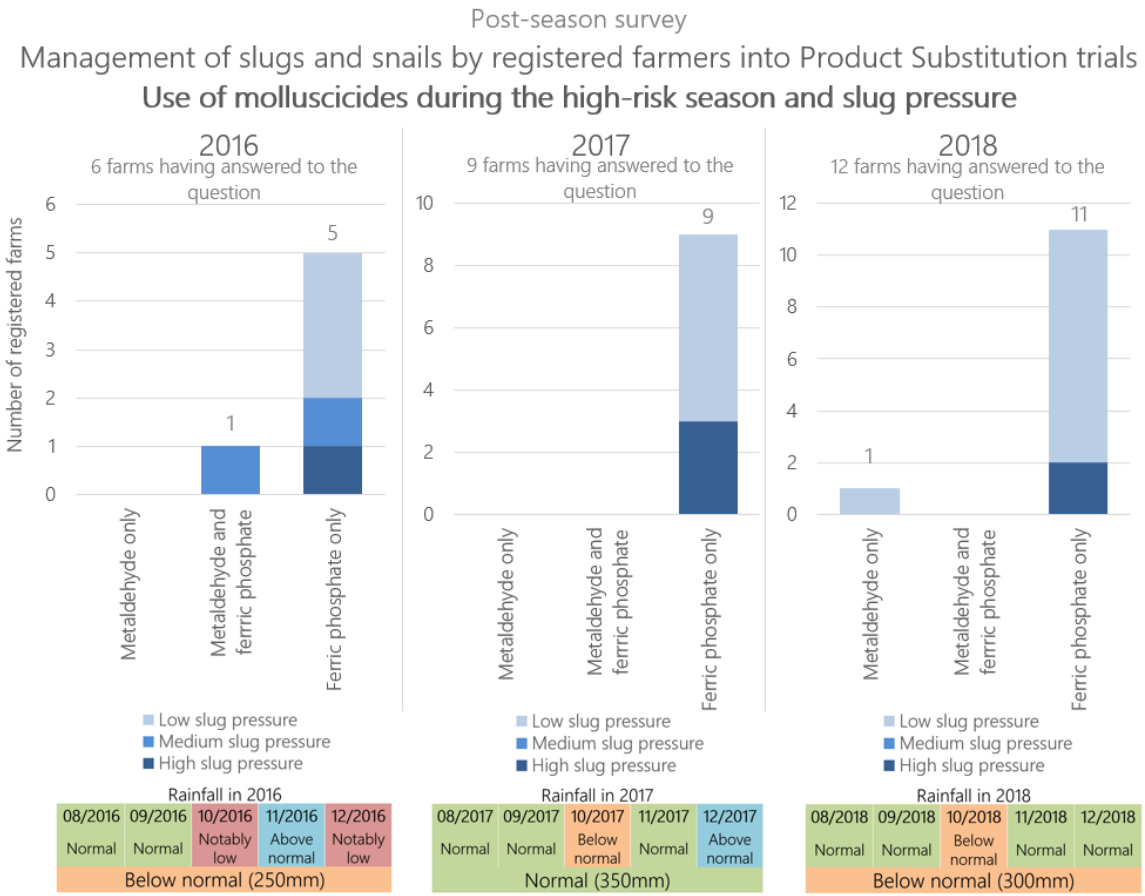


Figure 17 – Management of slugs and snails by farmers registered to Product Substitution trial

2.2.4 – Use of herbicides by registered farmers

PES schemes, which consider only the management of slugs and snails, seem to not have a significant effect on the use of herbicides by farmers. Indeed, the use of carbetamide and propyzamide are very similar before and after registration to schemes (Figure 18). However, the number of answers is low, and data are not available for the 2018 "high-risk" season and for the use of mecoprop-P, another active ingredient studied in walkover surveys. Moreover, active ingredients are not necessarily identified by farmers who are more familiar with commercial names of these herbicides. Nevertheless, if a decrease in the use of these active ingredients is needed, a specific programme, applying to these herbicides, should be implemented.

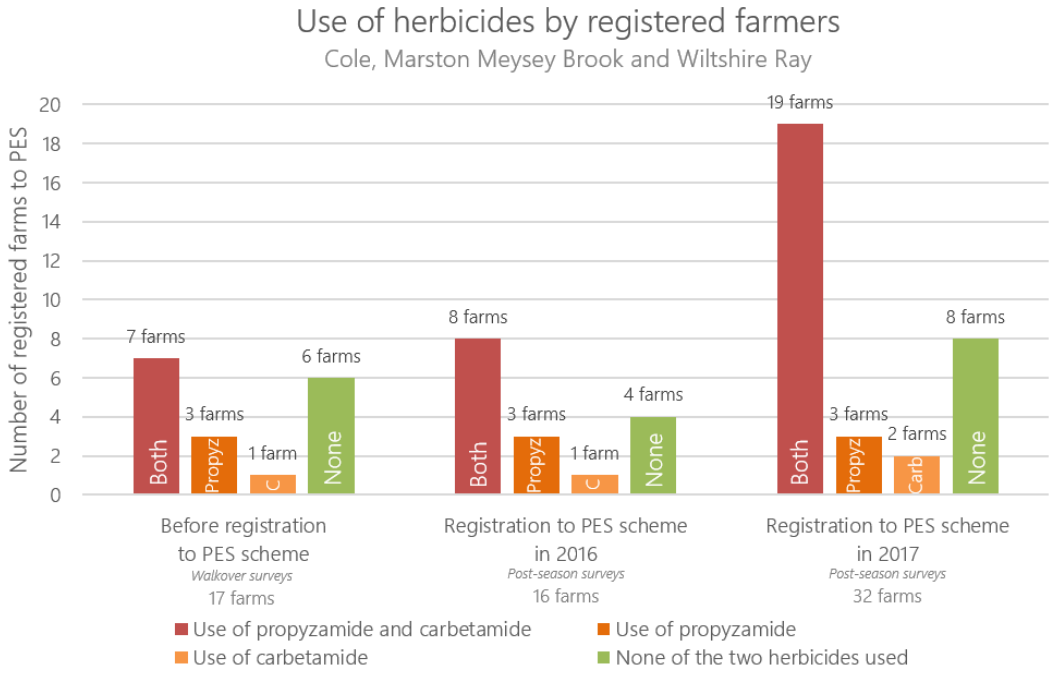


Figure 18 – Use of herbicides by farmers registered to PES schemes in 2016 and 2017

3 – FURTHER POSSIBILITIES FOR REGISTRATION TO PES SCHEMES

In order to determine future possibilities for registration within the four water bodies involved in PES schemes, comparison between registration of farms and their eligibility to PES was studied further. It appears that if the majority of farms registered to PES schemes are fulfilling criteria of eligibility to PES, 14 farms which are not suitable for PES, according to criteria of eligibility, have registered too. However, most of them are part of other eligible farms; there is not any arable land or temporary grassland included in arable rotation located on some tributaries, but holdings, which are registered to schemes, would have non-organic arable land on other tributaries of the water body, and would be actually eligible. In addition, because most of data have been collected during initial walkover surveys, some changes could have occurred since the first year of implementation of the programme in water bodies, and some farms, previously unsuitable for PES, would have become eligible.

In terms of future registration, 32 eligible farms may not be contacted. There are also 46 eligible farms for PES that have been contacted but without leading to registration (Figure 19). For the eligible ones, farmers having declined to register in 2018 could potentially be interested in 2019, depending on their crop rotation (cultivation of oilseed rape for instance). Therefore, it could be relevant to contact some of them again in 2019.

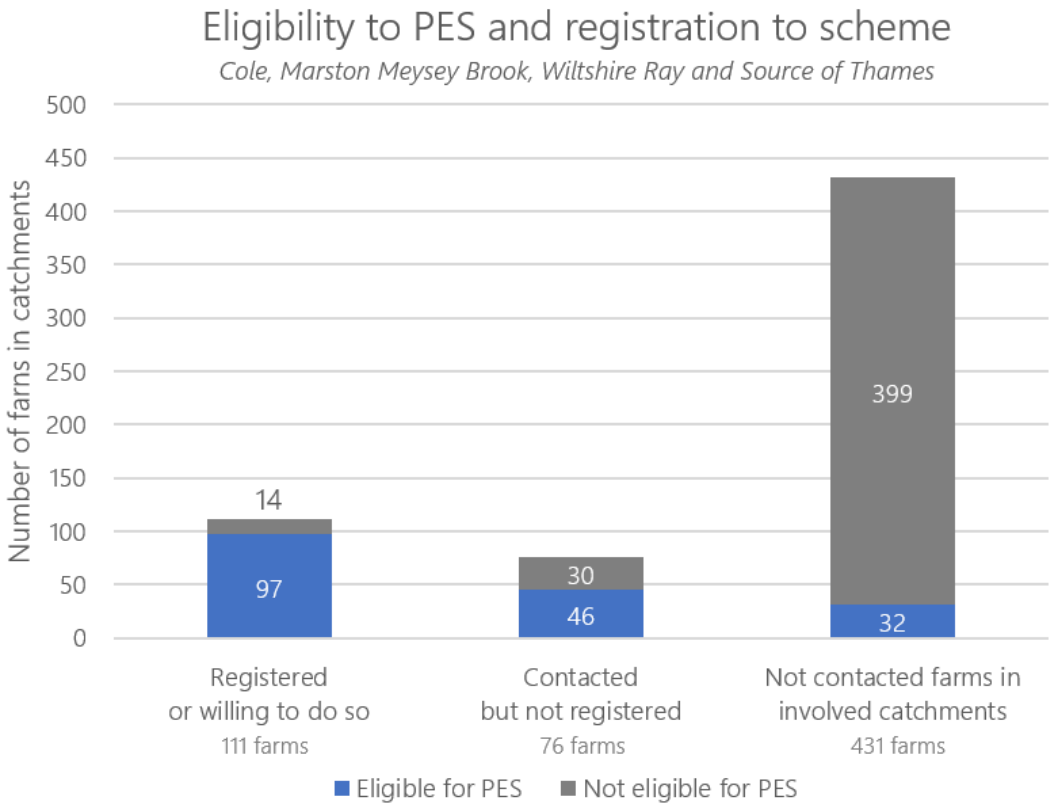


Figure 19 – Eligibility to PES and registration to scheme for the year 2018

Concerning the use of metaldehyde by registered farms, it appears that the proportion of registered farms using metaldehyde has decreased from 2016 to 2018 in all water bodies. This could be explained by the receipt of advice from agronomists and advisors, or by the proposed ban of metaldehyde from spring 2020 in Great Britain (DEFRA, 2018). This could have encouraged farmers to reconsider their management of slugs and snails. The proportion of registered farms using metaldehyde has been especially high in the Cole (in 2016 and 2017), which could contribute to explaining the measured metaldehyde concentration above 0.1µg/L recorded in 2017 for this water body. This proportion has decreased in 2018. Nevertheless, it could be relevant for advisors to insist on the advantages of alternative management of slugs and snails with these 22 farmers who kept to use metaldehyde in 2018, in order to achieve clean drinking water.

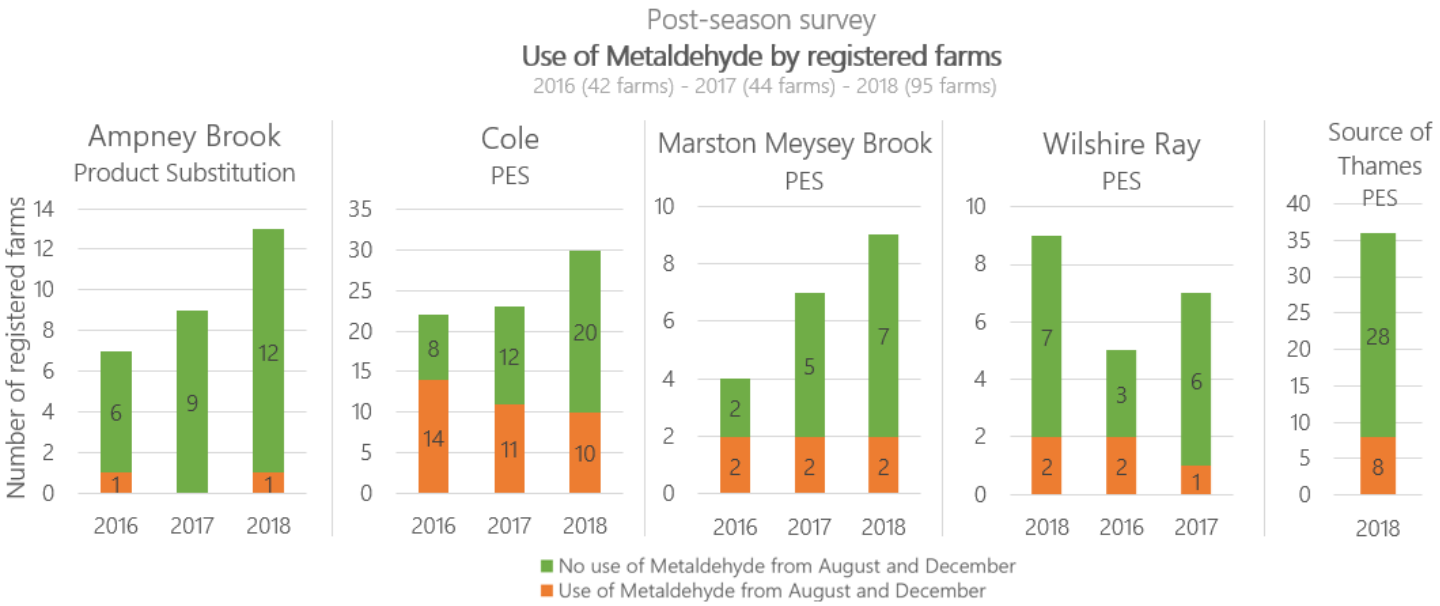


Figure 20 – Use of Metaldehyde by registered farms in water bodies

CONCLUSION

Since the beginning of the implementation of the programme in 2015, the number of registered farmers has increased, with the increase of the number of water bodies involved in the programme. Registered area to PES schemes has increased by 51% between 2017 and 2018.

The implementation of the programme has evolved according to the water body and the year of implementation: the methodology for calculating subsidies, and levels of subsidies, which have decreased with the increase of the area registered. In spite of the changes in the methodology of calculation, most of farmers who have been interested in the programme at the start, have retained their registration to schemes.

Only half of the farms listed as the outcome of walkover surveys were suitable for PES schemes or Product Substitution trial and have been contacted by FWAG-SW. A typical registered farm would be a farm business with arable crops accounting for at least two thirds of the Standard Output (cereal of mixed farms), following advice from agronomists, using metaldehyde to manage slugs and snails and using herbicides to manage weeds.

The number of non-contacted farms potentially suitable for PES or Product Substitution appears to be low. Thereby, if an increase of the number of farms registered is needed, FWAG-SW could contact again some eligible farms having not registered; indeed, because of potential changes in crop rotation (e.g. addition of winter cereals or oilseed rape crops), some of these farms could become interested in registering. Including these farms in one programme which aims to achieve metaldehyde mitigation could help to reduce metaldehyde concentration in water bodies at the minimum.

Bibliography

AgroBase UK. *Active materials*.
Retrieved from https://agrobaseapp.com/united-kingdom/pesticides/active-material

DEFRA. (2014). *Farm Classification in the United Kingdom*.
Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/365564/fbs-uk-farmclassification-2014-21oct14.pdf

DEFRA. (2018). *Restrictions on the use of metaldehyde to protect wildlife.* Press release.
Retrieved from https://www.gov.uk/government/news/restrictions-on-the-use-of-metaldehyde-to-protect-wildlife

Environment Agency. (2019). *Water situation: national monthly reports for England*.
Retrieved from https://www.gov.uk/government/publications/monthly-water-situation-national-reports-for-england-2016

European Commission. *EU Pesticides Database*.
Retrieved from http://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=homepage&language=EN

Thames Water. (2018). *Smarter Water Catchments*.
Retrieved from https://corporate.thameswater.co.uk/-/media/Site-Content/Thames-Water/Corporate/AboutUs/Protecting-our-environment/Smarter-water-catchments/Smarter-Water-Catchments.pdf

Thames Water. (2019). *Payment for ecosystem services - A farmer's guide*.

The Metaldehyde Stewardship Group. (2017). A guide to Integrated Pest Management and slug control.

University of Hertfordshire - UK. *Pesticide Properties Database*.
Retrieved from https://sitem.herts.ac.uk/aeru/ppdb/en/index.htm

Appendices

Appendix 1 – Detail of payment categories given by Thames Water under PES schemes

		PES implementation the Upper Thames		
		2016 Registered area: Whole holding in water bodies	2017 Registered area: Arable land	2018 Registered area: Arable land
Cole	*Water quality payment**	£663	£8,678	£6,329
	*Water quality bonus***			£6,000
	*First registration bonus****	£1,400	£600	£300
	*Early adopter payment bonus*****	£800		
	Total payment	£2,863	£9,278	£12,629
Marston Meysey Brook	*Water quality payment*	£465	£2,474	£1,683
	Water quality bonus		£2,000	£2,000
	First registration bonus	£600	£200	
	Early adopter payment bonus	£500		
	Total payment	£1,571	£4,674	£3,683
Wiltshire Ray	*Water quality payment*	£682	£503	£527
	Water quality bonus		£1,500	£1,750
	First registration bonus	£1,000		
	Early adopter payment bonus	£550		
	Total payment	£2,232	£2,003	£2,277
Source of Thames	*Water quality payment*			£5,603
	Water quality bonus			£6,000
	First registration bonus			£2,400
	Early adopter payment bonus			
	Total payment			£14,003
PES in the Upper Thames	*Water quality payment*	£1,810	£11,655	£14,142
	Water quality bonus		£3,500	£15,750
	First registration bonus	£3,000	£800	£2,700
	Early adopter payment bonus	£1,850		
	Total payment	£6,666	£15,955	£32,592

**Water quality payment: payment calculated as presented in Table 1, potentially deducted with penalties (one twelfth of the payment deducted for each of the twelve samples showing a concentration of metaldehyde above 1µg/L;*

***Water quality bonus: a £250 bonus given to all registered farmers belonging to a water body for which every weekly sample has shown a concentration of metaldehyde below 0.1µg/L;*

**** First registration bonus: a £100 bonus given to farmers for their first year of registration;*

*****Early adopter payment bonus: a £50 bonus given to farmers having registered in 2016.*

Appendix 2 – Monthly rainfall during "high-risk" seasons

High-risk season	2016	2017	2018
August	Normal 50mm	Normal 75mm	Normal 50mm
September	Normal 50mm	Normal 75mm	Normal 50mm
October	Notably low 25mm	Below normal 50mm	Below normal 50mm
November	Above normal 100mm	Normal 75mm	Normal 75mm
December	Notably low 25mm	Above normal 100mm	Normal 75mm
Total rainfall during the high-risk season	Below normal 250mm	Normal 350mm	Below normal 300mm

Source: Environment Agency, 2019