An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

Research Stimulus Fund

Final Report

'Understanding and Facilitating Farmers Adoption of Technologies (Agile-TECH)'

DAFM Project Reference No: 11/S/148

Start date: 01/07/2013

End Date: 31/05/2017

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Collaborating Research Institutions and Researchers: Community Knowledge Initiative, NUI Galway

Please place *one* "x" below in the appropriate area on the research continuum where you feel this project fits

Basic/Fundamental →			Applied →			Pre Commercial
1	2	3	4	5 X	6	7

Please specify priority area(s) of research this project relates to from the National Prioritisation Research Exercise* (NRPE) report;

Priority Area (s)	Priority Area I: Sustainable Food Production and Processing

Key words: Agriculture; technology; grass management

1. Rationale for Undertaking the Research

As beef and milk production accounts for almost 69% of agricultural output at producer prices (DAFM, 2011) and considering Ireland's competitive advantage lies in low-cost grass-based systems, this project set out to improve understanding of farmers' use and non-use of key technologies and management practices, especially grass management, at different performance levels. But the project also wished to go further and through a process of participatory research and training, use knowledge generated in the project to enhance the capabilities of scientists, advisors and farmers to improve the adoption of technologies on farms.

The use of many key technologies and practices (grassland, financial management and breeding) by livestock farmers is relatively low. There is also a knowledge gap about the reasons behind this low use or non-adoption, although we do know that non adoption is not a single state but may arise for a variety of economic, personal and or attitudinal reasons. Therefore, the project will seek to provide a greater understanding of the reasons around the non-adoption of technology and best practices for commercial livestock farmers. by taking a more nuanced approach to the understanding of the different states of non-adoption: this latter detail is often overlooked in the literature.

In addition to identifying the reasons underpinning the non-adoption of different technologies and practices, this project will then, through a Participatory Learning in Action (PLA) process, co-develop extension tools to be used by advisors and farmers so as to ensure that each farmer is using the optimal level of technology and best practice at each point in time, given their farm-level circumstances, in order to generate the maximum production and public good outcomes possible.

This research was needed to 1) improve our understanding of the economic, environmental and social performance of livestock farmers and how this relates to their implementation of best management practices, 2) address a knowledge gap around the reasons for the non-adoption of key management practices by livestock farmers; 3) through a PLA process co-design with scientists, farmers and advisers a set of extension tools to inform group-based extension methods such as discussion groups, 5) provide training in those extension tools and 4) provide policy and extension focused recommendations.

As a result of these project activities, in addition to knowledge generation the project explicitly focused on building human capability and knowledge mobilisation, particularly in relation to grassland management.

2. Research Approach

This applied research project used a mixed methods approach to achieve its objectives. By doing so, the project took a pragmatic approach to data generation and analysis. Such an approach was in keeping with the overall thrust of the project, which sought to ensure that project knowledge was used to help farmers make optimal use of available technologies and best practice, given their circumstances.

Specifically, the project used Principal Component and cluster analysis to carry out statistical analysis of secondary data from the Teagasc National Farm Survey to create performance typologies. The typologies were also correlated with use of key management practices (grassland, financial and breeding) and advisory contract type.

The project also generated primary data on farmers' attitudes to key grassland management practices – paddock grazing for dry stock farmers and the use of the Spring Rotation Planner for dairy farmers. Gathered through the implementation of two representative surveys of farmers the data were analysed using the Theory of Planned Behaviour. Other primary data collection, which fed into the co-design of flexible extension tools by farmers, scientists and advisors and subsequently led to training for advisors in the use of those tools, was generated through a Participatory Learning in Action (PLA) methodology implemented through focus groups and workshops.

There were several novel aspects to the mixed methods approach. First, was the use of PLA processes to co-design flexible extension templates incorporating the findings from the other analysis in the project. Second, was the training of advisors in the use of such templates within the project in order to be able to use the templates in group-based extension settings such as discussion groups. Therefore, explicitly, within the one project, a direct link was incorporated between research findings and subsequent Knowledge Transfer processes. As a result, in addition to knowledge generation the project built human capability building and enabled knowledge mobilisation/deployment. Third, was the use of national level data to examine sustainability, farm performance and management practice issues: very few studies had previously used such data. Fourth was the fact that while many social studies tend to concentrate on farmer update of newer technologies, it is not as prevalent to concentrate on the uptake of well-established technologies as was done in this project – in this case paddock grazing. The final novel element was that although primary research identified attitudinal reasons behind the non-adoption of critical technologies, additional insights on reasons for the non-adoption of technology were gained from analysis of data from the Teagasc National Farm Survey. As a result, existing knowledge was extended by using a more nuanced approach to the issue of non-adoption.

The project mainly focused on grass management given its crucial importance for livestock farming.

3. Research Achievements/Results

Task 2 developed a typology of Irish dairy farms based on farm performance data on profitability, environmental efficiency and social integration derived from the Teagasc National Farm Survey (NFS). The three clusters identified were 'Productive', 'Developing' and 'Weak'. Economic, social and environmental performance indicators were determined and aggregated and then used in a multivariate analysis for the identification and classification of farm types. The relationships between the clusters and grassland, breeding and financial management practices and information sources and extension supports were identified. The results indicate a clear distinction between "good" and "weak" performers, and the positive relationship between the economic, environmental and social performance of Irish dairy farms is evident. While there are many studies of sustainability, this study which uses the NFS indicators is relatively unique as only a few studies have used nationally representative datasets.

In Task 3, a survey of Beef farmers (n=382) found that the 'restricted' group (20% respondents felt 'resource constrained' in implementing a paddock grazing system despite them being knowledgeable about how to implement a paddock based system. For the 'engaged' group (56% of respondents) a higher proportion of these farmers were implementing either a partial of full paddock system. The 'partially engaged' group (23% of respondents) did not perceive a lack of resources to be problematic in implementing a paddock based grazing system. However, the cluster was characterised by their low perceived sense of possessing knowledge and understanding of paddock grazing systems. This study was innovative as it involved using psychological constructs to evaluate why beef farmers in Ireland poorly implement paddock based grazing, a long-established management practice.

Also in Task 3, a survey of dairy farmers (n=256) identified two clusters of farmers: low and high adopters of the Spring Rotation Planner (SRP). Low-Adopters of the SRP were characterised by their high sense of resource constraint (cost, labour, time) despite feeling that they were capable of implementing the grazing system. Conversely, High-Adopters were defined by a more positive attitude towards the SRP. High-Adopters perceived less resource constraints than Low-Adopters but were comparable in their sense of self-efficacy in how to implement the grazing tool. The policy recommendation is that carefully planned communication, targeted at the different farmer types, can help encourage uptake of the SRP.

The results of both studies suggest that a sense of resource constraint is a limiting factor in the adoption of grazing systems across the beef and dairy sectors.

In Task 4, Participatory Learning and Action (PLA) methods were used to understand how grass can be effectively and practically managed on beef, sheep and dairy farms with a view to developing an appropriate extension methodology. Over 60 farmers and advisers were involved in five focus groups, which were recorded, transcribed and analysed. The analysis informed subsequent design stages of the extension tool involving scientists,

specialist, advisers and graphic designers. The tool consists of a guide for 'goal setting' with farmers; a facilitation methodology for discussion groups; story boards to address social, cultural and economic issues and a template for self-evaluation of discussion groups. The extension method is presented in interactive PDF form accompanied by a customised carry bag containing the co-designed resource materials required to implement the extension method. Advisers and specialists were involved in three PLA focus groups (December 2016 and January 2017) and participated in two days of training to practice the method in May & June 2017.

For Task 5, much dissemination activity to some key end users was incorporated into their participation in Task 4 in terms of co-design activities and training in 2 workshops to Teagasc and dairy processor advisors. Other dissemination included the publication of four peer review papers and 3 conference presentations directly from Tasks 2 and 3. The papers were published in *Agricultural Systems, Land Use Policy, International Journal of Agricultural Management* and *Studies in Agricultural Economics.* Also, the project coordinator co-authored 3 other peer review publications in *The Journal of Technology Transfer*, *International Food and Agribusiness Management Review* and *The Journal of Agricultural Education and Extension* as a result of involvement with AgileTECH. There were 6 population publications/conference proceeding, one National Report and the extension tools and template package. In addition, the theoretical frameworks, methods and findings from Tasks 2 and 3, contributed in various ways to 4 other peer review publications, one presentation and one post graduate dissertation.

4. **Impact of the Research**

The deliverables in Tasks 2 and 3 have directly impacted the science base and deepened the skills set of early career social science researchers in the agri-food sector. All the CRO's who worked on this project moved onto longer term contracts helped in no small way by the time they spent on the AgileTECH project. In addition, this project improved the scientific community's knowledge of commercial farmers' motivations surrounding technology and best practice adoption. In particular, it relatively uniquely used nationally representative datasets to examine the relationship between different dimensions of sustainability, management practices and farm performance. In addition, the project provided new evidence on the unexplored areas of the non-adoption of the established technology of paddock grazing for beef farmers: exploration of such established technologies is often overlooked in research. Evidence was also provided in relation to the newer technology of the Spring Rotation Planner for dairy farmers. These two technologies were chosen as they are deemed critical for improving performance in the respective sectors.

The project then went further and through the application of participatory scientific methods, used that and other project knowledge to help upskill advisors and provide them with co-designed extension tools, developed during the project, to help affect change for farmers. In the sense that advisors (both public and private) and farmers are end users

of the knowledge created in this project and benefit from it, they also helped shape that knowledge generation and mobilisation. Crucially, the co-designed tools developed during the project are available for other uses within existing (public and private) Knowledge Transfer programmes. Therefore, the value added from this project to the wider community of advisor and farmer end users is maximised.

For farmers, this applied research project promoted the optimal use of technology and best practice on farms by incorporating farmers in a learning process to identify/adopt/adapt the most appropriate technology and best practice for them to use. By doing so, helps optimise their output, efficiency and profitability given their circumstances.

There is a clear message for policy makers and extension providers that tailored knowledge dissemination may assist in greater uptake of the management practices among dairy and drystock farmers. The heterogeneity in attitudes of different types of farmers to the practices means that carefully planned communication, targeted at the different farmer types, can help encourage a positive change in farm management practices towards the SRP and paddock grazing respectively. We cannot expect farmer with different characteristic to adjust to similar policies and/or have similar practice adoption patterns. Therefore, for policy to be effective, distinct groups need to be targeted.

Overall, from a science, methodology and extension tool perspective, this project has impacted the sector's capabilities to optimise grassland management practice use.

4(a) Summary of Research Outcomes

(i) Collaborative links developed during this research

The project created new collaborative links between Teagasc, NUIG and the Centre for Participatory Strategies. In addition, through the PLA process researchers, farmers and advisors (public and private) collaborated to co-design extension tools to be used in group settings to help improve on-farm grassland management. More broadly, as this project unfolded, its findings informed the Irish case studies and cross visit process of the H2020 AgriSPIN project in October 2016 (which the project coordinator was involved with).. This project had 14 partners from 11 countries. One of the Irish cases proposed in that project by the Agile-TECH project coordinator was the Greenacres programme with a focus on paddock systems, enabling synergies between the DAFM-funded and H2020-funded projects.

(ii) Outcomes where new products, technologies and processes were developed and/or adopted

The extension template generated by the project is new. It is a research-informed (grassland science) technique that is sociologically designed to be engaged with positively by, and 'user friendly' to, farmers. Advisers and specialists, from Teagasc and the dairy cooperative sector, received specialist training in the method and are using the method.

The project also facilitated social sciences researchers to build expertise in the translational, action research theories and methods necessary to support effective transfer of knowledge generated by agricultural production science to farm-level practice. In particular, collaborations with subcontractors' skills in participatory action research methodologies and with a graphic designer and artist were particularly beneficial. Experience gained through the project has influenced the design of social science research that is now funded by three Horizon 2020 projects within Teagasc's Rural Economy and Development Programme.

(iii) Outcomes with economic potential

Improved management of grass on farms improves farm profitability. Teagasc estimates that if grass utilised were to be increased by one tonne DM/ha/year, the benefit to dairy farmers would be €181/ha and €105/ha to drystock farmers. Grass utilised (measured in tonnes DM/ha) can be increased on farms by either increasing the amount of grass grown and/or improving the utilisation rate. How much grass is grown is influenced by soil fertility, sward composition (ryegrass/clover content of swards) and grassland management decisions (including measurement). The utilisation rate is influenced by grazing infrastructure, grazing management and grassland measurement.

(iv) Outcomes with national/ policy/social/environmental potential

The typologies developed in this project are a tool to assist policy makers in identifying patterns in farm performance with a view to formulating more targeted policies, and to help agricultural innovation support service providers to better target their services and programmes. The results indicate a clear distinction between "good" and "weak" performers, and the positive relationship between the economic, environmental and social performance of Irish dairy farms is evident.

The analysis identified the critical drivers of the use of paddock grazing among drystock farmers and the spring rotation planner by dairy farmers. For the former, the analysis identifies three cohorts of drystock farmers with regards to the implementation of a paddock-based grazing system - the Restricted, the Engaged and the Partially Engaged - with the restricted group particularly unlikely to uptake the grazing practice. For dairy farmers, the results suggest disparity between dairy farmers' perceptions of the SRP with significant differences in attitudes towards the planner between High-Adopters and Low-Adopters. Two clusters of farmers were elicited from the analyses based on farmers' beliefs about using the SRP.

The policy/extension recommendation following from this is that tailored knowledge dissemination may assist in greater uptake of the respective practices among dairy and drystock farmers. The heterogeneity in attitudes of different types of farmers to the practices means that carefully planned communication, targeted at the different farmer types, can help encourage a positive change in farm management practices towards the SRP and paddock grazing respectively.

The results identified the importance of resources capacities and the priorities/goals of the different clusters of farmers and the varying levels of constraint felt by farmers with regards to their ability to adopt the SRP or paddock grazing. These findings need to be reflected in innovation support providers' services and programmes and approach to farmers.

4 (b) Summary of Research Outputs

(i) Peer-reviewed publications, International Journal/Book chapters.

Acceptable Format: ***Walsh, D.R., Murphy, O., Cosgrave, J. (2008). Echinococcosis - an international public health issue. Research in Veterinary Science 774, 891-902.***

John J. Hyland, Kevin Heanue, Jessica McKillop, Evgenia Micha (2018) Factors influencing dairy farmers' adoption of best management grazing practices, Land Use Policy 78 (2018) 562–571

John J. Hyland, Kevin Heanue, Jessica McKillop, Evgenia Micha (2018) Factors underlying farmers' intentions to adopt best practices: The case of paddock based grazing systems, Agricultural Systems 162 (2018) 97–106 https://authors.elsevier.com/c/1WX15,70zHVXiw

Jessica McKillop, Kevin Heanue & Jim Kinsella (2018) Are all young farmers the same? An exploratory analysis of on-farm innovation on dairy and drystock farms in the Republic of Ireland, The Journal of Agricultural Education and Extension, 24:2, 137-151, https://doi.org/10.1080/1389224X.2018.1432494

Evgenia Micha, Kevin Heanue, John J. Hyland, Thia Hennessy, Emma Jane Dillon and Cathal Buckley (2017) Sustainability levels in Irish dairy farming: a farm typology according to sustainable performance indicators, Studies in Agricultural Economics, 119, 62-69, https://doi.org/10.7896/j.1706

Kelly, E, Heanue, K., O'Gorman, C. and Buckley, C. (2016) High rates of regular soil testing by Irish dairy farmers but nationally soil fertility is declining: Factors influencing national and voluntary adoption, International Journal of Agricultural Management, Volume 5 Issue 4

O'Donoghue, C and Heanue, K. (2016) The Impact of Formal Agricultural Education on Farm Level Innovation and Management Practices, *Journal of Technology Transfer, 43, 844–863* https://doi.org/10.1007/s10961-016-9529-9

Cathal O'Donoghue, Alistair McKinstry, Stuart Green, Reamonn Fealy, Kevin Heanue, Mary Ryan, Kevin Connolly, JC Desplat, Brendan Horan, Paul Crosson (2016) Developing a Big Data Analytical Solution to Low Farmer Engagement with Financial Management, *International Food and Agribusiness Management Review,* Vol.19, Issue A, pp.131-154

(ii) Popular non-scientific publications and abstracts including those presented at conferences

Macken-Walsh, A. (2017) The Influential Farm Adviser, Rural Connections, The European Rural Development Magazine, European Network for Rural Development, Spring 2017

Macken-Walsh, A. (2016) Influencing Farmers' Decisions: a sociologist's view. Invited keynote presentation to the 5th European Forum for Farm and Rural Advisory Services (EUFRAS) meeting / 55th IALB conference, June 2016

Macken-Walsh, A. and O'Dwyer, T. (2016) Discussion Groups: Five Key Ingredients for Success, Irish Farmers' Journal, April 2016.

Micha, E., and Heanue, K. (2015) Profiling farm systems according to their sustainable performance: a case study of the Irish dairy and livestock sectors, 89th Agricultural Economics Society Conference, Warwick, UK, 13-15 April 2015

Micha, E., Heanue, K., Dillon, E and Hennessy, T. (2015) Identification and Classification of Irish Beef Farming Systems: A Multivariate Analysis of Sustainability Indicators, 8th Annual Conference of the EuroMed Academy of Business, Verona, Italy, 16 September 2015

Heanue, K., (2015) A farmer perspective: Farm level practice adoption is more than a binary activity, European Seminar on Extension and Education 2015, April 29th, Wageningen University, Netherlands.

(iii) National Report

Macken-Walsh, A., Connolly, K., Gibson, M., Heanue, K., McCarthy, D., O'Donoghue, C., Watson, C. (2015) Teagasc's eProfit Monitor: rationale, farmer uptake, and prospects, Teagasc internal report, March 2015.

(iv) Workshops/seminars at which results were presented

n/a

(v) Intellectual Property applications/licences/patents

n/a

(vi) Other

Macken-Walsh, A., O'Reilly de Brún, M., de Brún, T., Beecher, M., Kelly, P., Horan, B., Creighton, P. (2017): *AgileTECH: a co-designed extension resource for managing grass at farm-level* (available here)

5. Scientists trained by Project

Total Number of PhD theses: n/a

Total Number of Masters theses: n/a

6. Permanent Researchers

Institution Name	Number of Permanent staff contributing to project	Total Time contribution (person years)
Teagasc	2	0.648
NUIG	1	0.037
Total	**3**	**0.685**

7. Researchers Funded by DAFM

Type of Researcher	Number	Total Time contribution (person years)
Post Doctorates/Contract Researchers	4	2.083
PhD students	1	0.103
Masters students		
Temporary researchers		
Other		
Total	**5**	**2.186**

8. Involvement in Agri Food Graduate Development Programme

Name of Postgraduate / contract researcher	Names and Dates of modules attended
	n/a

9. Project Expenditure

Total expenditure of the project: €190,053.21

Total Award by DAFM: €199,463

Other sources of funding including benefit in kind and/or cash contribution(specify): €n/a

Breakdown of Total Expenditure

Category	Teagasc	NUIG	Name Institution 3	Name Institution 4	Total
Contract staff	94,638.25				94,638.25
Temporary staff					
Post doctorates					
Post graduates		2016.00			2016.00
Consumables					
Travel and subsistence	2,782.36				2,782.36
Sub total	97,420.61	2016.00			
Durable equipment					
Other	1,114.71	7,441.74			8,556.45
Sub-contracting	57,100.36				
Overheads	24,355.15	604.80			24,959.95
Total	**179,990.73**	**10,062.54**			**190,053.27**

10. Leveraging

The AgileTECH project helped secure Teagasc's involvement in the H2020 project, AgriSPIN (value of €107,250 to Teagasc).

11. Future Strategies

The extension tool developed in the project is available for use by advisors. Moreover, the process to develop those tools within the Agile-TECH project will be used to develop similar tools focused on other practice change/adoption issues many of which will be part of H2020 projects.

The project has deepened the capability of early career social scientists focused on the agricultural sector to apply social psychology models such as the Theory of Planned Behaviour to improve understanding of agricultural technology adoption. The task outputs and outcomes provide a strong foundation for future research projects exploring the adoption of other agricultural technologies and practices.

The overall approach taken in this project is a template which is very applicable to the topic of farmers and climate change issues and, therefore, could form the basis of future proposals with that challenge in mind. Future research could also focus on an evaluation of the impact of co-designed tools in actually optimising farmer use of best of management practices: this is a research gap. Funding at either national or EU level could be pursued.

The classification of farms into typologies based on their sustainability performance in this project limits itself to the quantitative aspects of sustainable performance scores using the Teagasc National Farm Survey indicators. Further research could seek to explain the reasons behind those scores and explore the social implications.

12. Consent to Publish Final Report on the DAFM Website and/or Through Other Dissemination channels

I consent to this report being made available to the public, through the Department's website and other dissemination channels.

Yes X No ☐

13. Declaration

I declare that the information contained in this final report is complete and true to the best of my knowledge and belief.

Kevin Heanue

Signed: _____ Project Coordinator

Date: March 27th 2020