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

NDP NATIONAL DEVELOPMENT PLAN

Research Stimulus Fund

Final Report

'An economic analysis of the barriers to achievement of improved economic performance of the dairy farm sector' - Adopt-Tech

DAFM Project Reference No: 10/714 Adopt-Tech

Start date: 01 November 2011

End Date: 30 December 2014

Principal Coordinator and Institution:
Dr. Thia Hennessy, Rural Economy and Development Programme, Teagasc, Athenry, Co. Galway.
Email: Thia.Hennessy@teagasc.ie

Collaborating Research Institutions and Researchers:
Dr. Laurence Shalloo, Animal & Grassland Research and Innovation Centre, Teagasc, Moorepark, Fermoy, Co. Cork.
Dr. John Cullinan, School of Business and Economics, NUI Galway (NUIG).
Mr. Joe O'Flaherty, CEO, Animal Health Ireland (AHI).

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	X	5	6	7

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

Priority Area (s)	**Sustainable Food Production and Processing**

Key words: *Animal health, economic impact, best practice, knowledge transfer.*

1. Rationale for Undertaking the Research

The improved economic performance of farms and the adoption of output enhancing technologies are critical to achieving the Food Harvest 2020 target to increase dairy production by 50% by 2020. Indeed, continued improvements in the health status of Irish dairy herds are essential if the industry is to grow sustainably and retain competitive advantage in the aftermath of EU milk quota abolition. The purpose of this project was threefold: firstly, to quantify the costs and benefits of the adoption of '*best practice*' in relation to animal health, secondly, to identify the factors affecting the adoption of related herd management practices and thirdly, to make policy recommendations about effective knowledge transfer for technology adoption to primary producers, which will in turn increase the productivity and efficiency of the dairy sector. To this end, the key research questions addressed within the context of the project are set out below:

- What impact do animal health improvements have on farm-level and processor profitability? Management of mastitis and somatic cell count (SCC) were particular areas of interest here.
- What are the key management practises that improve dairy herd mastitis health and by consequence profit?
- What farm (and farmer) characteristics are important in influencing animal health? Again, the control of herd-level SCC was specifically examined.
- What are the drivers and barriers of *'best practice'* with regard to animal health at the farm level? An emphasis was placed here on mastitis management and improved breeding techniques.
- Based on the research findings, how can knowledge transfer be improved to facilitate an improvement in herd health management? A number of key recommendations were made in this regard.

2. Research Approach

- The costs relating to mastitis (i.e., elevated SCC) and the subsequent impact on farm profitability was estimated using both the Moorepark Dairy Systems Model (MDSM) and farm-level econometric models utilising Teagasc National Farm Survey (NFS) data. The on-farm impact across SCC thresholds was examined.
- The impact of mastitis on the value of milk for the wider processing sector was next evaluated using the Moorepark Processing Sector Model (MPSM). This was complemented with a meta-analysis to further explore the relationship between SCC and raw milk composition, cheese processing and cheese composition.
- Econometric models utilising NFS data were further applied to examine the factors (farm and farmer characteristics) affecting the uptake of '*best practice*' in relation to animal health, with a particular focus on mastitis management.
- Finally, the drivers and barriers of *'best practice'* with regard to animal health were identified using both quantitative (NFS) and qualitative (focus group) data collection methods. Results were then collated and used to inform recommendations for effective knowledge transfer in this regard.

3. Research Achievements/Results

- The **economic impact of mastitis on farm level profitability** was estimated using multiple methods, both the Moorepark Dairy Systems Model (MDSM) and panel data econometric models utilising Teagasc NFS (NFS) data.
    - The MDSM analysis demonstrated that as bulk tank somatic SCC increased, milk production was reduced and the proportion of the herd culled due to mastitis increased. As SCC increased, milk receipts decreased; as a result, total farm receipts were also lower with higher SCC thresholds. In addition, as SCC increased, total farm costs increased as more cows were treated and proportionately more cows were culled. As a result, as SCC increased from ≤100 ('000 cells/mL) to >400 ('000 cells/mL), net farm profit decreased by €19,504.
    - The NFS econometric models found that for farms with a SCC of >400 ('000 cells/mL) there was a 2% reduction in productivity (milk yield per cow) compared to the average. In addition, a fall in SCC from 400 ('000 cells/mL) to 300 ('000 cells/mL) for an average herd size of 55 cows resulted in an annual improvement in gross margin of €1,045 or €19 per cow. This figure although lower than the profit differential derived from the MDSM analysis (€52) is based on observed data across a cross-section of dairy farms of all sizes and levels of profitability. This was the first Irish study to use herd-level nationally representative data and to employ panel data econometric techniques, allowing for the control of the effects of unobserved farm-level heterogeneity (i.e., differences across farms). In so doing, the independent effect of SCC on both yield and margins could be isolated.
- The MDSM and Moorepark Processing Sector Model (MPSM) were used to estimate the **economic impact of mastitis for industry** (farm and processors) on milk value per litre independent of the effect of mastitis on milk volume. The impact for Ireland was further informed by a meta-analysis of relevant international research. The analysis showed that as SCC increased the production quantities reduced. An increase in SCC from ≤100 ('000 cells/mL) to >400,000 ('000 cells/mL), saw a reduction in net revenue of 3·2% per annum (E51·3 million) which corresponded to a reduction in the value of raw milk of E0·0096 (cents/l).
- Having validated the productivity and profitability gains achievable from improved animal health at the herd level, the **factors influencing mastitis management** and SCC control were then worthy of exploration. Econometric modelling techniques and NFS data were utilised for this purpose and a key finding from the analysis was the relative importance of farmer behaviour in this regard. According to the models utilised, farmer participation in agricultural training, contact with an extension agent and the undertaking of milk recording resulted in an overall SCC reduction of 25% for the average herd. The analysis found that farmers who undertook agricultural training were ten times more likely to monitor milk quality through milk recording compared to those who hadn't. Similarly, those farmers in contact with an extension service and who also participated in a dairy discussion group were seven times more likely to engage in milk recording. The analysis also

found that a number of other characteristics of the farm are shown to be significantly associated with reduced SCC at the herd level, including utilisation of eProfit monitoring, AI breeding techniques and extended grazing season. Such findings demonstrate the effectiveness of both extension and training programmes geared towards animal health and, in line with previous international research imply that there is an important role for the extension agent, veterinary advisor and other stakeholders in influencing farmer behaviour with regard to animal health and technology adoption.

- A further element of the research involved the identification of farm-level **drivers and barriers to the adoption of *'best practice'*** with regard to mastitis and breeding management using both quantitative (NFS survey) and qualitative (focus group) data collection techniques. Results indicate that the economic gain resultant from improved animal health and mastitis control was overwhelmingly recognised by farmers. Interestingly, almost three-quarters reported that they had learned from previous experience with the disease and had subsequently changed their management practices. In line with the international literature the *'stick'* is found to be better than the *'carrot'* in incentivising farmers to improve animal health, i.e., in this instance, farmers report that a penalty imposed on milk with a high SCC is more effective than a bonus offered for milk with a lower cell count. Regression analysis indicated that those farmers who reported good awareness of the link between animal health and profit and had adequate knowledge of mastitis management techniques, were more likely to undertake practices such as milk recording and separating high cell count cows from the rest of the herd during milking. Conversely, the relationship between farmers' attitudes to animal health and their actual behaviour with regard to hygiene related practices such as wearing of gloves and teat cleaning was not as clear. As a result, a number of interesting issues arise in identifying barriers to the uptake of *'best practice'* in this regard. These include the possibility of '*routine inertia*', i.e., perhaps farmers tend not to deviate from the routine developed around mastitis prevention until there is an indication of infection. To this end farmer behaviour could be considered as reactionary as opposed to precautionary. This finding was also reflected in information garnered through the focus groups undertaken to complement the survey analysis. However, it should be noted that despite this, based on discussions at the focus groups there is a certain amount of *'routine creep'*, where farmers adjust what they do in response to what is accepted as *'best practice'* among their discussion group, for example. To this end, the importance of *'learning by sharing'* through such fora has been validated in this analysis. The qualitative component of this research confirmed that in managing their farms, farmers are making decisions about the particular bundles of technologies and practices they use, on the basis of various trade-offs in terms of time implications, convenience, effort, impact on overall farm profitability, what has worked in the past, and what is considered the norm in terms of their peers. These decisions are made in a context of uncertainty and downstream supply chain signals and incentives, and the current situation in terms of health status on their farms.

- This research provided insights for the effective communication of knowledge transfer/exchange with regard to animal health and technology adoption more generally, resulting in the design of ten headline **recommendations**, informed by the numerous helpful comments received from extension colleagues and AHI; these are listed below:

    1. Knowledge transfer should continue to target the *'Hard to Reach'* farmer, this remains a key challenge.

    2. Knowledge transfer should be personalised and provide a realistic frame of reference to the farmer, it should be easily identifiable and should not be conflicting or contradictory.

    3. Knowledge transfer relating to animal health should distinguish between *'best practice'* for both intervention and prevention and differentiate the message for both groups. Understanding the process by which farmers recalibrate their management strategy, and the intervention points around which this is likely to happen, is important in order to provide appropriately timed and configured knowledge transfer support.

    4. Knowledge transfer should centre on learning and maintain a focus on measuring '*best practice'* indicators including financial performance. The success of initiatives such as CellCheck and EBI (Economic Breeding Index) were aided by their specific and implementable recommendations and measurable outcomes.

    5. Effective knowledge transfer should take account of factors influencing technology and practice implementation as well as adoption rates, including time constraints and adequate knowledge of practices.

    6. Knowledge transfer should be results driven as long-term gains of particular management decisions or actions may often be difficult to appreciate.

    7. In tailoring knowledge transfer multiple extension methods (personal contact, newsletter, social media etc.) should be utilised to target as broad a range of farmers as possible.

    8. Cross collaboration and co-operation with stakeholders and service providers is important to ensure a consistent extension message, the success of such an approach is reflected in the CellCheck programme.

    9. Lessons for knowledge transfer and exchange can be learned from experiences in other countries, i.e., relevant examples include programmes such as *InCalf* and *Countdown 2020* in Australia and *Healthy Udder* and *Healthy Hoof* in New Zealand.

    10. Knowledge transfer and exchange should be targeted more broadly than solely to farmers, for example, the inclusion of spouses or successors in discussions around animal health management etc. may be beneficial as the *'learning by*

sharing' format has generally proven successful through discussion groups with peers.

4. Impact of the Research

The undertaking of this type of research is important given that improvements in animal health, breeding and milk quality are essential if the Irish dairy industry is to grow sustainably and retain a competitive advantage in a post-quota environment, most especially in the manufacture of high value dairy products. From a consumer perspective, superior animal health results in enhanced animal welfare, improved food safety and better product quality. In addition, this research has demonstrated that improvements in productivity and profitability are beneficial to both producers and processors. The demonstration of the economic gains achievable from improved dairy herd health is important in order to reduce the costs of disease, particularly as disease related costs are not always recognised due to sometimes hidden effects. An explanation of (avoidable) disease related costs is also central to successful knowledge transfer and extension as outcome based measures tend to be particularly effective.

Results from the analysis underline the importance of herd management factors in improving animal health at the farm-level. This is an important finding since it suggests that farmer behaviour is as, or more, important in controlling animal health performance than physical infrastructure, implying an important role for the extension agent and herd veterinary advisor amongst others. An understanding of the potential drivers and barriers of animal health '*best practice'* was acquired through this work and the role of extension agents and practitioners in facilitating farmer *'learning by sharing'* validated. Insight into the design of knowledge transfer best practice was also gained which should help to further shape policy and address the key challenge of how best to engage with those farmers whose behaviour remains sub-optimal with regard to animal health management. Arising from this work, acknowledgement of the importance of farm structural factors and the individual needs of the farmer in the provision of knowledge transfer is critical and the complexity of communication in this regard is recognised. Furthermore, aligning knowledge transfer with industry and relevant stakeholders is also recognised as being essential for the continued sustainable growth of the agricultural sector.

This is the first Irish study to use nationally representative herd-level data in investigating the productivity and profitability gains of animal health best practice with regard to mastitis and the role of agricultural education and extension in improving farmer behaviour in this regard. In addition, for the first time, using data from a number of sources including ICBF the total impact of SCC reduction on the Irish dairy industry (farm and processor sector) was calculated, demonstrating the sectoral wide benefits of animal health improvement. The findings with regard to the impact of mastitis on farm profitability is of much relevance to farmers and on a practical level

the CostCheck calculator allows for the estimation of mastitis related costs on individual farms.

Results from the research are highly relevant for a broad range of stakeholders and for the design of future policy in this area and a wide range of policy relevant outputs have been delivered under this project. Results have been disseminated successfully through a number of fora including academic and popular publications as well as academic and national stakeholder conferences, workshops and seminars.

4(a) Summary of Research Outcomes

(i) Collaborative links developed during this research

Positive relationships have been created within the context of this project and valuable insights gained from interaction with stakeholders including farmers, extension colleagues, ICBF, AHI and processors and fellow researchers in NUIG.

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

n/a

(iii) Outcomes with economic potential

This research has demonstrated the potential improvements in productivity and profitability beneficial to both producers and processors which are possible through enhanced animal health.

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

The undertaking of this type of research is important given that improvements in animal health, breeding and milk quality are essential if the Irish dairy industry is to grow sustainably and retain a competitive advantage in a post-quota environment, most especially in the manufacture of high value dairy products.

4 (b) Summary of Research Outputs

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

Peer-reviewed publications

Dillon, E.J., Hennessy, T. and Cullinan, J. (2015). "Measuring the economic impact of improved control of subclinical mastitis in Irish dairy herds." *The Journal of Agricultural Science.* DOI:10.1017/S0021859614001178

Dillon, E.J., Hennessy, T. and Cullinan, J. (Forthcoming). "Examining the role of agricultural education and extension in influencing best practice for managing mastitis." *The Journal of Agricultural Education and Extension.*

Geary, U., Lopez-Villalobos, O'Brien, B., Garrick, D.J. and Shalloo, L. (2014). "Estimating the impact of somatic cell count on the value of milk utilising parameters obtained from the published literature." *Journal of Dairy Research, Vol. 18.*

Geary, U., Lopez-Villalobos, O'Brien, B., Garrick, D.J. and Shalloo, L. (2013). "Examining the impact of mastitis on the profitability of the Irish dairy industry." *Irish Journal of Agricultural and Food Research Vol. 52.*

Geary, U., Lopez-Villalobos, N., Begley, N., McCoy, F., O'Brien, B., O'Grady, L. and Shalloo, L. (2012). "Estimating the effect of mastitis on the profitability of Irish dairy farms." *Journal of Dairy Science, Vol. 95.*

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

Popular publications

Dillon, E.J., Hennessy, T., Cullinan, J. and Heanue, K. (2015). "The Economics of Milk Quality." T*Research,* Vol. 10, No.1, Spring 2015.

Geary, U., Shalloo, L., O'Brien, B., McCoy, F. and O'Grady, L. (2011). "Mastitis and farm profitability." *TResearch*, Vol. 6, No. 4, Winter 2011.

Conference presentations

Dillon, E.J. Hennessy, T and Howley, P. *" Exploring the role of farmers attitudes in influencing animal health best practice"* accepted for presentation at the 89th Annual Conference of the Agricultural Economics Society, University of Warwick, United Kingdom, April 13th-15th 2015.

Geary, U., O'Brien, B. and Shalloo, L. *"Examining the impact of mastitis on the profitability of the Irish dairy industry."* Animal Health Ireland Conference, Cork, 23rd October 2013.

Dillon, E.J. and Hennessy, T. *"Measuring the impact of improved animal health practices on the economic efficiency of Irish dairy farms."* 87th Annual Conference of the Agricultural Economics Society, University of Warwick, United Kingdom, April 8th-10th 2013.

Geary, U. *"Mastitis Control: why, what and how?"* Teagasc National Dairy Conference, Tralee, 20th November 2012.

Geary, U., Begley, N., McCoy, F., O'Brien, B., O'Grady, L and Shalloo, L. "Estimating the impact of mastitis on the profitability of Irish dairy farms." British Cattle Veterinary Association (BCVA) Congress 2011, 24th-26th November. Southport, U.K.

(v) National Report

CostCheck – The Mastitis Cost Calculator. Moorepark Animal & Grassland Research and Innovation Centre, Teagasc, Fermoy, Co. Cork. Compiled by: Una Geary, Laurence Shalloo and Finola McCoy in consultation with the CellCheck Technical Working Group

(vi) Workshops/seminars at which results were presented

Dillon, E.J. and Hennessy, T. *"Farmer uptake of animal health best practice - the role of knowledge transfer."* Presentation made at Animal Health Ireland Economics Working Group Seminar, Teagasc, Portlaoise, 10th December 2014.

Dillon, E.J. and Hennessy, T. *"An economic analysis of the barriers to achievement of improved economic performance of the dairy farm sector."* Presentation made at workshop with dairy extension specialists, Teagasc, Moorepark, 17th November 2014.

Geary, U., Begley, N., McCoy, F., O'Brien, B., O'Grady, L and Shalloo, L. The impact of mastitis on the profitability of Irish dairy farms. Animal Health Ireland, Economics Workshop, Teagasc, Ashtown, 2nd July 2013.

(vii) Intellectual Property applications/licences/patents

n/a

(viii) Other

Based on this research, a mastitis cost calculator was developed to allow for the estimation of financial losses caused by mastitis at the farm-level. The calculator (a Microsoft Excel based tool with a user friendly interface) can

be used by farmers to help understand the impact of mastitis on farm-level profitability. It was developed by Teagasc Moorepark in consultation with the CellCheck Technical Working Group and can be downloaded from the Teagasc and Animal Health Ireland websites: http://www.agresearch.teagasc.ie/moorepark/docs/costcheck.xls or http://www.animalhealthireland.ie

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 REDP	1	0.16
Teagasc Moorepark	1	0.32
NUI Galway	1	0.09
Total	**5**	**0.57**

7. Researchers Funded by DAFM

Type of Researcher	Number	Total Time contribution (person years)
Post Doctorates/Contract Researchers	2	3.59
PhD students	-	
Masters students	-	
Temporary researchers	-	
Other	-	
Total	**2**	**3.59**

8. Involvement in Agri Food Graduate Development Programme n/a

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

9. Project Expenditure

Total expenditure of the project: €283,160.42

Total Award by DAFM: €268,756.59

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

Breakdown of Total Expenditure

Category	Teagasc Athenry	Teagasc Moorepark	NUI Galway	Animal Health Ireland	Total
Contract staff	€130,327.52	€96,365.40	-	-	€226,692.92
Temporary staff	-	-	-	-	-
Post doctorates	-	-	-	-	-
Post graduates	-	-	-	-	-
Consumables	-	-	-	-	-
Travel and subsistence	€531.01	€975.97	€1,352.58	-	€2,859.56
Sub total	€130,858.53	€97,341.37	€1,352.58	-	€229,552.48
Durable equipment	-	-	-	-	-
Other	€2,653.15	-	-	-	€2,653.15
Overheads	€33,196.37	€17,420.28	€338.15		€50,954.79
Total	**€166,708.05**	**€114,761.65**	**€1,690.73**	**-**	**€283,160.42**

10. Leveraging

Summarise any additional resources'/funding leveraged by this award from other sources e.g. Additional Staff, National/EU funding secured, EI Commercialisation Fund, etc. n/a

11. Future Strategies

Two further journal papers are being finalised for peer reviewed publication and a presentation of these findings was made at the UK Agricultural Economics Society conference in April 2015 where it was well received.

Following this project the research team were well placed to compete for and successfully secure EU FP7 (seventh framework programme) funding for a project on the development of sustainability indicators. The FLINT project uses knowledge developed through this stimulus project on issues of animal welfare measures and farmers' willingness to adopt

'best practice' measures to further our scientific knowledge on measuring and improving the sustainability of European farming.