"An investigation into the attitudes of dairy farmers in the Lakeland Dairies region towards the age at first calving of replacement dairy heifers"

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By

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Declaration

I declare that this thesis has not previously been submitted as an exercise for a degree at the National University of Ireland or any other University. I further declare that the work embodied in it is my own.

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Date: _____

Abstract

The aim of this study was to identify dairy farmers' attitudes and barriers towards achieving optimum age at first in calving dairy heifers, in a geographical region identified as having below-optimal performance for this metric. A structured interview process was used, derived from a health psychology approach. Forty eight commercial dairy farmers in the border-midlands region of Ireland were interviewed using the theory of planned behaviour framework. Milk production, breeding and herd fertility performance data for each herd were also collated from the national breeding database; these were analysed in conjunction with interview responses. Results indicate that farmers perceived they had the knowledge and ability to calve their replacement heifers at the target age of 24 months old, in terms of management techniques such as culling empty heifers after the breeding season, regular weighing of heifers to ensure target weights are met, minimising the number of late born heifer calves and attending regular walks and meetings to improve own technical knowledge. However, barriers were cited in relation to herd calving interval; herd EBI, perceived heifer weights at breeding and regular weighing practices. Decisions to implement practices around heifer weights were influenced by the perceived weight of the replacement heifers at breeding. (96%) of farmers surveyed believed that weighing replacement heifers at certain times of the year is a good management tool for reaching a target weight at breeding and calving down. However; only (25%) of farmers surveyed regularly weigh their replacements. The principal differences in attitude between farmers achieving target age at first calving versus those failing are management related. Farmers delaying breeding at mating start date from the perception of heifers being too light. No regular weighing of replacements throughout their life to ensure target weights for breeding is achieved. Farmer perceptions and behavioural beliefs towards breeding weight are significantly increasing the age at first calving of replacements over and above 24 months. These results indicate that further guidance is needed around the management of dairy replacements from a younger age on Lakeland farms to optimise age at first calving. There appears to be an opportunity for advisers and herd health professionals to further understand the farmer beliefs and perceptions behind certain attitudes and target communication and advice accordingly to further enhance the performance of dairy replacements in the Lakeland region through a younger age at calving. Farmers reported that they were positively influenced by the Lakeland and Teagasc joint farm development programme and regular walks and events held locally.

1. Introduction

In the social science field the impact of human factors on behaviour is widely studied using constructs such as peoples' attitudes, knowledge, beliefs, values, goals and intentions (Jaccard & Blanton, 2005). Attitude refers to a person's viewpoint or perspective on an issue and in particular is well known as an important factor in creating and changing behavioural intentions and actions (Ajzen, 2005). The term attitude is used to evaluate tendencies which can both be inferred from and have influences on cognitive beliefs, affective associations and overt behaviour (Albarracin, 2005; Kiviniemi, 2007).

This study explores the construction of farmers' attitudes and beliefs about the age at first calving of dairy replacement heifers. The study population was situated in the border midlands region of Ireland, drawn from farmers who supply milk to the Lakeland Dairies[1] cooperative. The region was selected because analysis of national benchmarking data showed mean age at first calving to be older than the national average (Irish Cattle Breeding Federation, 2015). There is a perceived problem among local extension personnel that this issue is limiting farmers' profitability. Indeed, there have been a number of studies showing the effect in herd performance and profitability of an older age at first calving (Cooke, et al., 201i5; Gabler, et al., 2012; Gould, 2013; Hossein - Zadeh 2012). However, few studies have examined the correlation between farmer attitudes and beliefs in reaching an older age at first calving.

The lifetime production and profitability of a dairy cow is influenced by her age at first calving, the interval between each calving, lactation length, and success in surviving in the herd to a new lactation. The cost of rearing replacement dairy heifers within a farm business has the capacity to absorb a significant portion of cash throughout the year. Gabler et al. (2000) found that the rearing of the dairy replacement heifers was the second largest cost after purchased feed on dairy farms at 20% of total farm costs. The productive life and utility of a dairy cow is strongly influenced by her age at first calving, calving intervals, lactation length and success in surviving to another consecutive lactation Gabler, et al. (2012). In order to minimise calving difficulty and increase animal performance it is recommended to calve replacement dairy heifers between 22 and 24 months of age (Hoffman, 1997; Gould., 2012; Cooke, et al., 2013; Heinrichs, 1993)

Duration of pregnancy is fixed and therefore the age at first calving is a function of the age of commencement of first breeding combined with the reproductive efficiency of the animal (Cooke, et al., 2013). The decision on breeding a replacement heifer is mainly based upon management and is strongly influenced by the age, weight and health of the heifer (Cooke, et al., 2013). Poor nutrition and underfeeding can have a negative impact on heifer weights, growth and subsequent performance on growth rates and later as mature cows. Underfeeding, disease and health issues are some reasons as to why heifers are delayed to first service which increases the age at first calving (Mouritis, et al., 2000). Rearing replacement dairy heifers to target body weights is critical in order to achieve maximum performance in subsequent

[1] www.lakelands.ie

lactations (Cooke, et al., 2015; Gabler, et al., 2012; Gould, 2013; Hossein - Zadeh 2012). Alternatively; heifers which are fed on a very high plane of nutrition tend to have an increased internal lipid deposition rather than skeletal growth. This has a negative effect on calving ease and may impair mammary gland development which has a negative impact on subsequent milk yield which has negative effects in heifer performance as a result (Hossein-Zadeh, 2011; Serjsen, 2005).

Research has shown that the optimum age at first calving for dairy replacement heifers is 24 months of age (Gould, 2012; Gabler, et al., 2000). Farms which has managed to reduce the age at first calving in dairy heifers to 24 months have shown significant benefits in terms of reducing rearing costs and subsequent fertility, milk yield, health and performance as mature cows (Pirlo, 2000). Older age at first calving may have an influence on calving difficulty in dairy heifers as calving difficulty is affected by the dam's maturity, condition score and pelvic width (Mee, 2008).

There is evidence that only 43% of dairy replacement heifers calve down at 24 months in the Lakeland Dairies region (ICBF, 2016). The remaining 57% of dairy replacement heifers calve down above 26 months of age. This later age at first calving adds a significant extra cost of heifer rearing, estimated at €5.5 million annually across Lakeland milk suppliers. Only 12% of dairy replacement heifers in the Lakeland region are bred from AI sires (ICBF, 2016).

Analysis of herd milk, breeding and fertility benchmarking data can provide numerical figures and trends but does not give any indication of underlying farmer attitudes or beliefs that are influencing farm management practices and decisions. In this study a sample of dairy farmers were interviewed about their attitudes, beliefs and practices. A second data set was collected from individual farm herd performance reports from the Irish Cattle Breeding Federation database (ICBF, 2016); interview answers were then analysed in conjunction with individual herd performance data.

2. Theoretical Orientation

A series of one-to-one structured interviews were conducted with a sample of individual farms across the Lakeland region including qualitative and quantitative structured questions. The interview schedule was informed by the "*Theory of planned behaviour*" (T. Rehman, 2007). The theory of planned behaviour (Ajzen, 2009) assumes that peoples' behaviour originates from their intentions to perform a specific behaviour. Attitude, which is a summary evaluation of the behaviour of interest and concerns the individuals like or dislike of the behaviour and ideas of the goodness or badness of the behaviour is a central construct of the theory of planned behaviour (Grube, et al., 1994). However the theory of planned behaviour model stipulates that to generate an intention to perform a specific behaviour. A positive attitude towards behaviour is not enough. The individual need to hold a perception those others in his/her social network support the behaviour and the individual also needs to feel that he/she can influence and control the behaviour (Ajzen, 1991).

Broadly the three main components in this theory are:

- Behavioural belief: This is the attitude towards certain behaviour. The belief that behaviour will lead to a certain outcome, for example, a farmer feels that by choosing high EBI bulls to use on the herd the herd quality will improve.
- Normative beliefs (Subjective norm): This is the belief that certain individuals or individuals within a group think a person should or should not perform a specific behaviour. For example, a farmer may believe his/her Vet may think it is important for them to regularly weight replacement dairy heifers to check weights.
- Control belief (perceived behavioural control): This is an individual's belief towards their own ability to perform behaviour, for example, how able a farmer is to calve replacements at the correct weight and age on his/her farm.

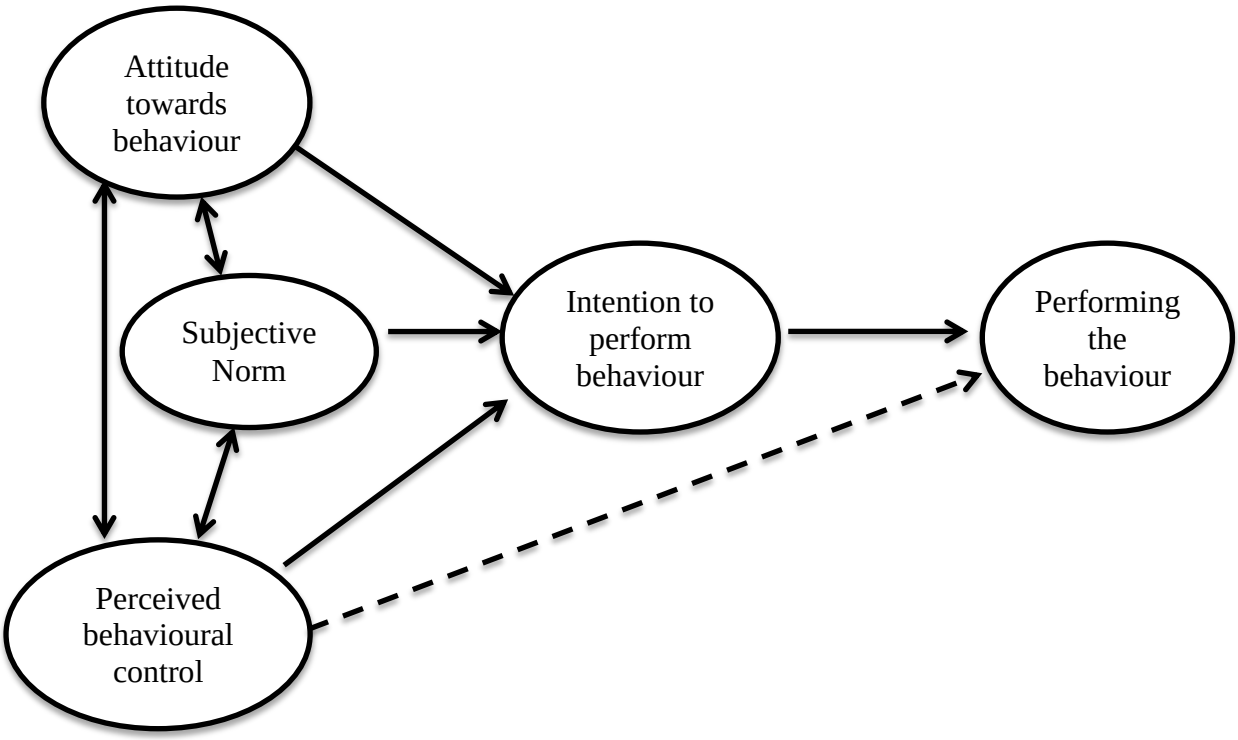

Fig 1. Schematic representation of the Theory of Planned behaviour (Ajzen, 1991)

This model has been successfully applied to the development of behavioural change programmes for human health-associated behaviours, such as hand hygiene practices and sun protection measures (Godin., et al 1996; White., et al 2015). Similarly with animal health associated behaviours around conditions such as dairy cow mastitis (Jansen, et al., 2010). Potentially the theory of planned behaviour could be used to assess the barriers towards age at first calving of dairy replacements in the Lakeland region. Therefore the aim of this study was to use structured interviews derived from the theory of planned behaviour to identify the attitudes and beliefs towards a younger age at calving of dairy replacement heifers in the Lakeland region.

3. Methodology

3.1 Population:

The population of interest was dairy farmers in the Lakeland dairies region. The sampling frame used to identify the potential participants was the Lakeland dairies supplier database. Interviews were conducted on a one to one basis and details were manually recorded by the same researcher to ensure consistency.

3.2 Participant selection

Farmers were randomly selected from the Lakeland region counties Westmeath, Offaly, Cavan and Monaghan. The purpose of the random selection process was to use a maximum variation approach (Bryman, 2012). A selection of forty eight dairy farmers was chosen from the database.

3.3 Farmer Interviews

Farmers selected were offered a farm visit by the Teagasc-Lakeland joint programme adviser in relation to the performance of their farm. At the end of the meeting permission was granted by the farmer to complete a structured interview on the attitudes and beliefs around age at first calving of dairy replacements. The interviews were designed to follow a structured approach and were conducted using the same interview guide for all interviewees. A pilot study involving five dairy farmers was conducted prior to the main study to ensure all questions could be easily answered and understood by the farmer. Participants were first asked general questions about themselves, herd size, land type and when they commenced farming.

Participants were then asked questions from the interview which consisted of a series of open and closed questions. The theory of planned behaviour (Ajzen., 1991) was used to guide the development of the questions and support analysis of the data along with other relevant literature. Questions were used to capture the knowledge and attitudes of farmers towards the age at first calving. Open-ended questions were used to encourage the participants to share relevant information on the topic such as measures of farm success, target weights of replacement heifers at breeding and calving down. Open ended questions included: “In your opinion what makes a farmer successful?” Open-ended questions evoke longer answers that retrieve information from the respondent by using their own words (AbuSabha, 2013) Closed-ended questions require specific answers or yes/no statements (AbuSabha, 2013). Closed – ended questions were used to retrieve answers on the questions represented in **Fig 2** and **Fig 3.** Closed questions included: “What weight are your heifers at breeding?” “What weight are your heifers at calving down?” “If you have a light heifer at breeding will you give her an extra period of time to catch up on weight?” “Do you weigh your replacement heifers regularly?” “Calving replacement heifers at 30 months of age suit your system?” “If I can’t get a good heifer in calf I will cull her?” “My heifers are too light to be bred at fifteen

months?" "If I can't get a good heifer in calf I will cull her?" "High EBI bulls will improve the quality of my herd?" "I know what criteria to use when selecting bulls for my herd by using the EBI system?" These questions required a yes or no answer from the participant. The questions were formulated to capture the respondents' implicit beliefs. Closed questions allowed obtaining a model of the decisions actually taken and the closing of the question marks the end of the decision making process (Xiong & Seligman, 2011).

The survey respondents were divided into three groups as the basis for analysis of the survey data. The groups were divided on the basis of (A) whether or not they believed that 24 months was the optimum age to calve replacement heifers; and (B) whether their herd data indicated that they were achieving greater or less than 90% of replacement heifers calving between 22 and 26 months. This resulted in three groups for comparison and these are shown in **Table 1** below. Group 1 had calving practices that were consistent with their beliefs. Group 2 believed that 24 months was the optimum age for calving but were failing largely to achieve this while Group 3 did not believe that their heifers should be calved at 24 months.

Table 1: Criteria for group division

	Group 1 - 24A	**Group 2 - 24T**	**Group 3 - 30A**
Number of respondents (N=23)	21	18	7
Believe 24 months is optimum age for calving heifers (N=18)	Yes	Yes	No
% of heifers calved between 22-26 months (N=7)	95%	58%	42%

4. Results

Key herd performance indicators were first examined to explore the differences between the three groups. **Table 2** below shows that there are statistically significant differences between the three groups in terms of herd performance.

Table 2. Statistical performance differences between farmer groups

	24A	24T	30A	
EBI	92[a]	67[b]	24[c]	**
Fertility SI	39[a]	27[a]	-3.5[b]	**
Protein %	3.48[a]	3.35[b]	3.27[b]	**
Fat %	4.33[a]	4.12[b]	4.01[b]	**
KgMs/Cow	426[a]	421[a]	382[b]	*
Litres sold/Cow	5295	5471	5094	NS
6 week CR	76[a]	58[b]	48[b]	**
Calving Interval	372[a]	386[b]	412[c]	**
Milk Kg PTA	-16[a]	27[b]	71[b]	**
C/Litre 2016	28.2[a]	27.1[b]	26.6[b]	*

The Economic Breeding Index (EBI) is a single figure profit index aimed at helping farmers identify the most profitable bulls and cows for breeding dairy herd replacements. It comprises of information on seven sub-indexes related to profitable milk production. These are; (1) Milk production, (2) Fertility, (3) Calving performance, (4) Beef Carcass (5) Cow Maintenance (6) Cow Management and (7) Health. The economic values in the index are based on data collected from Irish Dairy Farms and the Dairy Industry. The table shows that the EBI in Group 1 is considerably higher than the other two groups. This indicates group 1 farmers have a behavioural intent to use the highest EBI sires every year to use on their herd for genetic improvements. This is also evident in Table 2 as group 1 are significantly ahead of groups 2 and 3 in terms of milk fat % and protein % which are the key determinants of milk price received from the co-op.

Table 3. Herd milk data from interviewed farmers

N = 48	Mean	Minimum	Maximum	Standard deviation
Herd Size	99	37	230	46.55
Milk Yield per cow (L)	5,345	3,734	8,358	931
Fat (%)	4.2	3.65	4.85	0.26
Protein (%)	3.4	3.05	3.73	0.15
Milk solids per cow (Kg)	418	285	584	70.26
Average milk price received 2016 (C/L)	27.54	24.80	30.80	1.44
Total milk sold (L)	524,359	156,883	1,154,086	238,825

Table 4. Herd fertility characteristics of surveyed Lakeland dairies milk suppliers

N = 48	Mean	Minimum	Maximum	Standard Deviation
Calving Interval (Days)	384	344	438	22.13
% calved between 22-26 months	72	9	100	30
Spring 6 week calving rate (%)	65.4	1	96	32.3
Herd EBI (€)	72.5	-31	127	36.54
Fertility Sub - index (€)	28.2	-50.3	58.4	24

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4.1: Beliefs and Attitudes towards Herd Performance

The farmer survey explored beliefs and attitudes towards a number of key management practices and compared these across the three groups. These are presented in three sections. The first deals with behavioural beliefs and attitudes regarding the selection and management of replacement heifers. The second deals with normative beliefs regarding what it means to be a good or successful dairy farmer and the third deals with control beliefs, in terms of whether the respondents feel that their circumstances make it hard for them to achieve best practices.

There is a wide range in performance between surveyed farms. **Table 3** shows the minimum kilograms of milk solids sold per cow is (285kg) and the maximum (584kg). Minimum milk protein on surveyed farms (3.05%) and maximum (3.73%). Maximum average cents per litre received for milk in 2016 in (30.8c/l) and minimum (24.8c/l). There is a significant difference between groups in **Table 2.** Group 24A are selling 426Kg of milk solids compared to groups 24T and 30A at 425kg and 382 respectfully. Calving interval in 24A is 372 days compared to 386 and 412 days of 24T and 30A respectfully. Herd EBI is also significantly different between groups as 24A are €25 on average ahead of 24T and €68 ahead of 30A.

Attitudes towards age at first calving as shown in **Fig 2** show that 4% of the interviewed farmers believe that calving heifers at 30 months of age suits their system in comparison to 24 months at calving. (96%) of farms believe that calving replacement heifers at 22 – 26 months of age is the correct thing to do. According to **Table 4** on average 72% of heifers calve at 22-26 months of age within the survey population. Individual groups were analysed further as shown in **Table 1** only 58% and 42% of heifers calved at the target age in groups 24T and 30A respectively.

The attitude of (86%) of farmers believed it was a good idea to weigh replacement dairy heifers at certain times of the year however only (25%) of farmers interviewed regularly carried out the task. (93%) of farmers interviewed believed that high EBI bulls would improve the quality of their herd however average fertility sub –index for group 24T and 30A was (€27) and (-€3.5) respectively. (79%) of farmers were confident in choosing the correct bulls to make improvements to their herd, however herd fertility and milk solids per cow in groups 24T and 30A were significantly below group 24A which highlights a divide in management techniques and beliefs.

(92%) of farmers believed that their replacement dairy heifers are not too light to be bred at 15 months of age while (8%) believed that their heifers would be too light to breed. (96%) of farmers surveyed believed that weighing replacement heifers at certain times of the year is a good management tool. However; only (25%) of farmers surveyed regularly weigh their replacements. When the question was asked to the farmers on their perceived target weight at breeding the answers were recorded and individual group average perceived weights presented in **Table 5.** Group 24A on average believed that if their heifers were (327kg) live weight at mating start date they would breed them. Group 24T believed their heifers needed to be (342Kg) and group 30A believed that they needed their heifers to be (368Kg) before

they would breed. (58%) of farmers said they would not keep dairy replacement heifers born after the middle of March. This was an effective question to examine the attitude towards late born dairy heifer calves on their farm which will inevitably have a higher chance of being lighter than their earlier born counterparts.

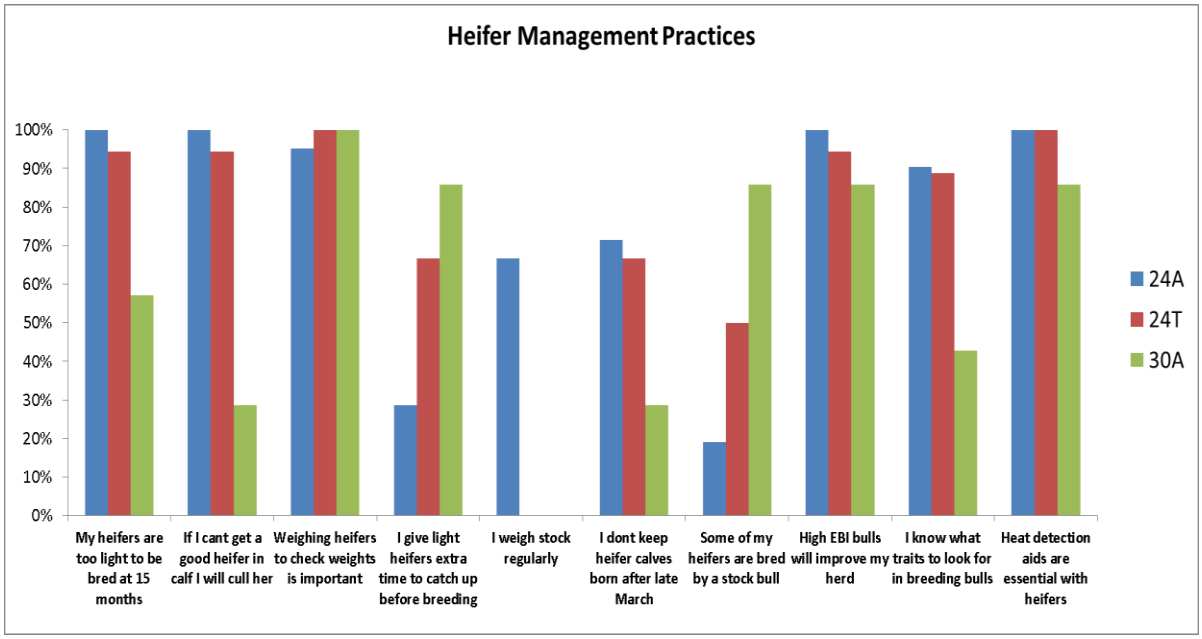
When farmers were asked the question about giving lighter replacement heifers an additional period of time to "catch up" with her contemporaries in terms of breeding weight (52%) of farmers believed they would allow an extra period and (48%) said they would not and breed regardless. Interestingly (25%) of surveyed farmers regularly weigh replacement heifers and (75%) do not. This result indicates that 75% of farmers are making breeding decisions for their replacement dairy heifers on perceptions. These farmers are allowing their own perception and beliefs of the weight of replacement heifers to determine their age at calving in comparison to (48% of farmers who said they would breed regardless at mating start date on average (327kg). Group 30A are calving (42%) of dairy replacement heifers between 22 and 26 months and they believe replacement heifers need to be on average 368kg at breeding. This group are grossly underestimating the cost of rearing a heifer to calve at 30 months of age and are overestimating the required weight for breeding in comparison to group 24A at 327Kg. Group 24T are failing to calve a higher percentage of heifers at the correct weight partly due to the belief of allowing a delayed interval between mating start date and breeding for their lighter heifers. This is pushing the average age of replacements calving down over and above 24 months as can be seen in **Table 1.** These beliefs and perceptions of (52%) of farmers surveyed are significantly adding to an older age at calving combined with the fact that only (25%) of farmers have measurable data for their replacements through recording regular weights.

The mean kilogrammes of milk solids per cow for the group is (418kg) per cow. Mean litres sold per farm for the group is (524,359 litres) which is above the Lakeland dairies average of 350,000 litres. In 2016 individual groups 24A, 24T and 30A sold (426kg), (421kg) and (382kg) respectively per cow. Average calving interval for three groups is (372), (386) and (412) days. Extended calving intervals above 365 days reduce milk revenue per cow (Patton, 2012). Longer calving intervals are being driven by poor fertility and heat detection on the 24T and 30A farms. The 24T and 30A farms are behind 24A in terms of farm performance as a herd and at age of first calving. The attitudinal questions in **Fig 1** and **Fig 2** tell a different story to the data collected from each individual farm surveyed. This data has highlighted the gap that has appeared between perception and reality with 48 dairy farmers in the Lakeland region. These farmers believe that they are operating their system correctly and to the best standards in terms of milk solids, age at first calving, spring 6 week calving rate, litres per cow and grassland management.

4.2 The selection and management of replacement heifers

Respondents were asked if they believed a series of statements regarding the selection and management of replacement heifers were true or false. **Fig 2**. Below shows the statements and compared the percentage of respondents who believed the statements to be true across the three groups

Fig 2. Attitudinal questions based on behavioural beliefs.



As shown in **Fig 2**. Farmers were asked if "High EBI bulls would improve the quality of their herd?" (93%) of farmers believed that high EBI bulls would improve the quality of their herd and (7%) disagreed. Mean herd EBI for the group of surveyed farmers was (€72.5) with the maximum EBI (€127) and the minimum (-€31). Average EBI for groups 24A, 24T and 30A were (€92), (€67) and (€24) respectively. (79%) of farmers surveyed believed that they were confident enough to select bulls from the EBI system based on the traits that needed improvement such as fertility and milk in their herd. (21%) of farmers surveyed believed that they were not confident enough to pick bulls which they needed to improve the required herd traits such as fertility or milk solids. (91%) of surveyed farmers believed that it was important to use some form of heat detection when breeding replacement heifers. (87%) of farmers believed that heat detection was not too difficult for them to carry out on their farm and (13%) believed that heat detection was too difficult to carry out as they were too busy.

The mean six week calving rate for the farmer group is (65.4%) with the maximum (100%) and minimum (1%). These figures would suggest that farmers surveyed had a high level of awareness with technologies such as heat detection, the EBI system and herd calving patterns from previous research carried out by Teagasc. However individual analysis on groups 24A, 24T and 30A highlight a significant difference between milk solids per cow, six week calving rate, herd EBI and fertility sub index in **Table 2**. Group 30A are significantly behind in fertility sub-index at (€-3.5) in comparison to 24A and 24T (€39) and (€27) respectively. These figures suggest that there is a slower rate of genetic gain on 30A farms and a lower

level of selection intensity for traits such as fertility, milk protein and fat. Overall (93%) of farmers believe that high EBI bulls will improve the quality of their herd, data in **Fig 2** suggests differently with (7%) disagreeing with EBI and (21%) of farmers believe that they are not confident enough to select the required bulls to improve traits in their herds. The overall result in terms of breeding decisions may be neglected on some of the 30A farms. A higher level of advice and explanation around the factors for consideration when breeding for improved traits is required for the 30A and 24T groups. These farms believed that they knew what decisions to make around breeding but in reality did not as they are behind in terms of herd EBI, milk fat and protein percentages for the year which can be seen in **Table 1.**

Table 5. Comparing herds that weigh heifers versus herds not weighing

	Weighing	**Not Weighing**
My heifers are too light to be bred at 15 months	0	13%
If I can't get a good heifer in calf I will cull her	100%	79%
If my heifers are a bit light I will give extra time to catch up	17%	71%
I don't keep heifer calves born after late March	58%	65%
Average Herd size	137	86
Milk solids per cow 2016	444	408
Mean weight at first insemination	332	346
Weight at calving	501	519

According to **Table 4** (96%) of farmers surveyed believed that regular weighing of replacements at certain times of the year was a very useful management tool to monitor heifer growth rates and weights. Only (25%) of farmers regularly weigh their heifers which proves that (75%) of farmers are estimating breeding weights and purposely delaying the age at breeding due to a perception of the animal being light at mating start date. **Table 5** highlights (71%) of farmers not regularly weighing replacements will delay breeding as they feel heifers are too light to be served. (13%) of farmers also believed that their replacements are too light to be served at 15 months of age to achieve and age at first calving of 24 months. The farmers that are regularly weighing believe that they would breed a replacement if she was on average (332kg) which is lower than the group which are not weighing at (346kg). There are a higher proportion of empty heifers retained on the farms which are not weighing replacements. (29%) of these farmers kept heifers that did not go in calf after the breeding season. This has a direct effect on age at calving as they are retained and re-bred to fit into the system the following year calving down at 36 months of age.

The farmers which are not weighing have a smaller herd size on average of 86 cows compared to 137 cows on the herd which are regularly weighing replacements. Performance per cow between farms that are regularly weighing heifers and those that are not have a difference of 408Kg milk solids per cow compared to 444kg milk solids per cow in 2016. It may be suggested that labour is an issue on the farms which are not regularly weighing heifers and performance is suffering as a result across the farm coming from calving pattern, grassland management and replacement heifer performance within the herd.

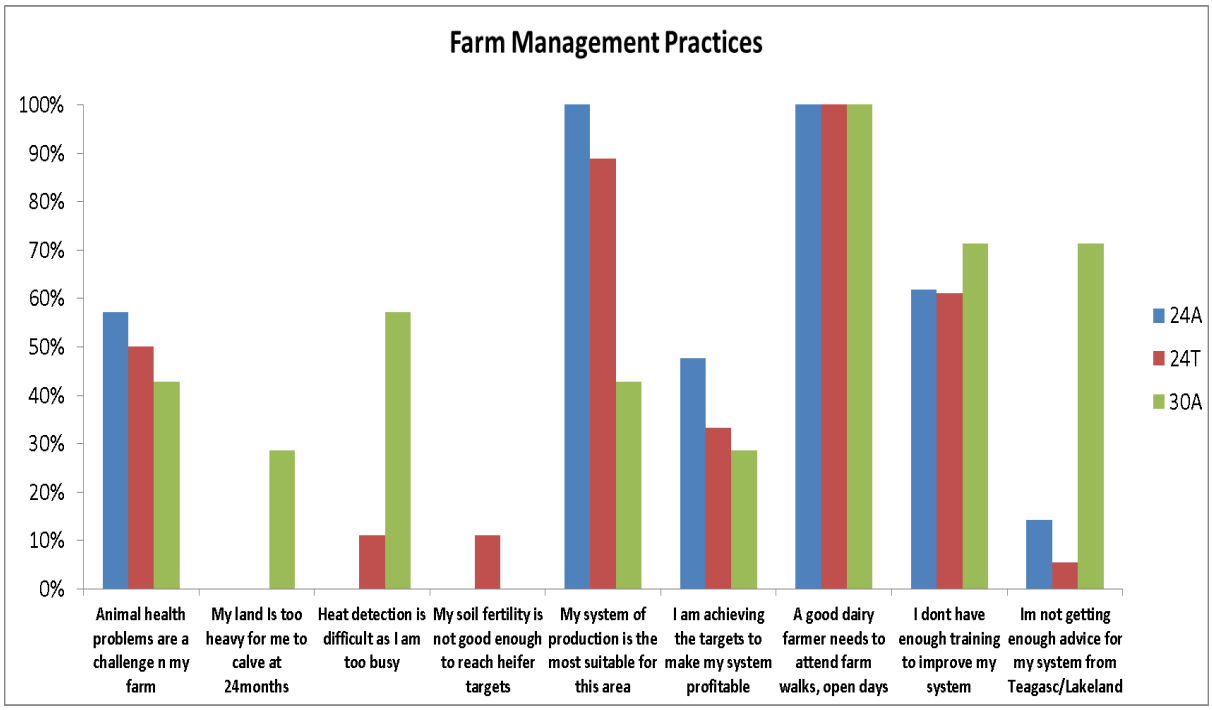
Farmers were asked the perceived cost of rearing a replacement heifer to calve at 24 months of age and at 30 months of age. Answers in **Table 6** show that there is a division in perceptions and beliefs when it comes to rearing replacement heifers in terms of cost and weights for age. Groups 24A, 24T and 30A believed on average it costs (€1,019), (€1,141) and (€921) to rear a dairy replacement to calve at 24 month of age. When asked the perceived cost of an older age at calving, groups 24A, 24T and 30A believed it would cost on average (€1,395), (€1,500) and (€1,135) respectively. This data indicates that group 24A and 24T were very aware of the cost of rearing a replacement heifer at certain ages from work carried out by (Gould, 2012). Group 30A believes that it only costs €1,135 to calve an older heifer for their farms from data in **Table 6**. Previous work by (Gould, 2012) has shown that it costs on average €1,300-€1,500 to rear a replacement to calve above 24 months of age. The farmers in group 24A and 24T are significantly closer to the cost of an older age at calving in comparison to 30A. In summary groups 24A and 24T are more aware of the rearing costs associated with an older age at calving and as a result are calving a higher proportion of their replacements at the target age as can be seen in **Table 1.**

(39%) of farmers surveyed believed that they were achieving production targets in order for their system to be profitable while (61%) of farmers believed they were not hitting the targets to be profitable. Taking a wider view, innovation is generally seen as an important driver of economic performance (Crepon, et al. 1998; OECD, 2013) thus supporting our findings from **Table 2** where group 24A have innovated through high EBI AI sires and calving over 90% of replacements at the target age. However, it must be remembered that this does not necessarily imply causation and there is some uncertainty whether lack of profitability hinders innovation or whether lack of innovation hinders profitability (Islam, et al., 2013).

4.3 Control beliefs

Respondents were asked if they believed a series of statements regarding the restrictions or limitations of their own farm situation were true or false and also about their knowledge and advisory support needs. These statements can be related to control beliefs and perceived behavioural control (Azjen, 2006) in terms of the whether farmers believe that they can or cannot achieve certain thinks in their circumstances. **Fig 3**. Below shows the statements and compared the percentage of respondents who believed the statements to be true across the three groups

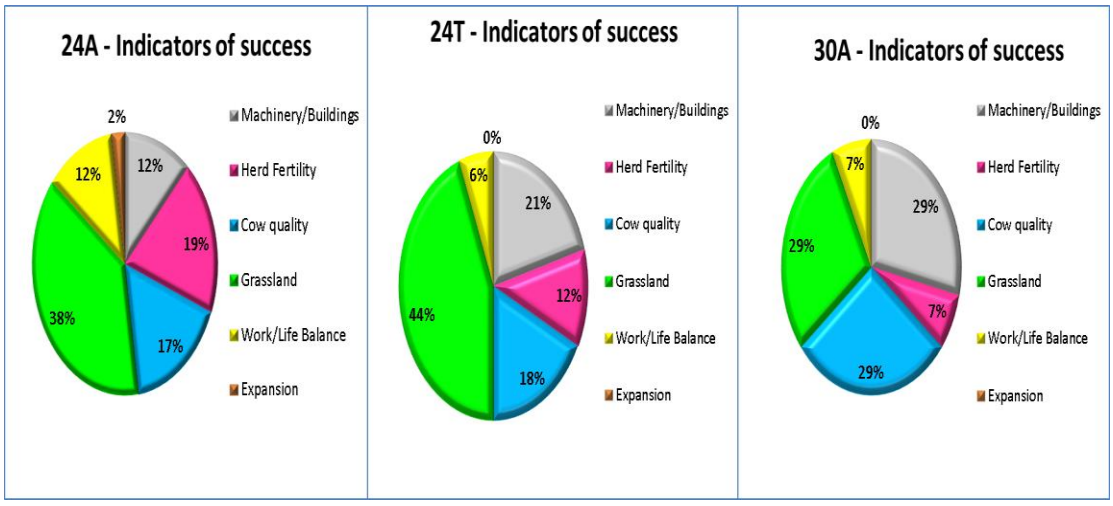
Fig 3. Attitudinal questions based on social norms



4.4: Normative beliefs and social norms

Respondents were asked what they believed to be an indicator of farm success when they looked at another farmer in the area and this was used as a proxy for normative beliefs as can be seen in **Fig 4.** Below compared the percentage of farmers in each group who mentioned specific indicators

Fig 4. Indicators of farm success.



Surveyed farmers were asked on what they believed to be an indicator of farm success when they looked at another farmer in the area. Group 24A had a strong emphasis on grassland

management, herd fertility (which also included six week calving rate, empty rate and late calving cows), cow quality (which included EBI, milk fat % and protein %), work – life balance and herd expansion. Group 24T had a lower emphasis on herd fertility and similar emphasis on grassland and cow quality but had a higher interest in machinery and buildings as an indicator of success. Group 30A had a higher interest in farm buildings and machinery as an indicator of success by another farmer. Work –life balance, herd fertility and herd expansion did not feature highly in the 30A group.

There is a decline in intangible factors such as expansion, work – life balance and herd fertility when we move from group 24A to group 24T and 30A. The 24T and 30A farms do not value on farm efficiencies which have been developed through management and planning in groups 24A such as a high spring six week calving rate, high milk solids per cow and a work – life balance. This indicates that farmers in groups 24T and 30A do not look at their dairy farm in the same light as group 24A in terms of an operational business. These farms put a higher value on tangible assets rather than intangible assets such as on-farm efficiencies. There is a higher proportion of farms in groups 24T and 30A which believe that having a new tractor, jeep or shed are indicators of success by another farmer at (21%) and (29%) respectively.

Table 6. Perceived heifer rearing costs and weights at key stages of growth

Group	24A	24T	30A	
Perceived cost of calving heifers at 24 months of age	€1,019	€1,141	€921	NS
Perceived additional cost over 24 months of age at calving	€1,395[a]	€1,500[a]	€1,135[b]	*
Perceived weight of heifers at breeding (Kg)	327[a]	342[b]	368[c]	**
Perceived weight of heifers calving down (Kg)	508	518	532	NS

24A: Calving >90% of heifers at 22-26 months of age

24T: Calving <90% at 22-26 months and believe that they are calving replacement heifers at 24 months.

30A: Disagree with 24 months at calving and calve their heifers at 30 months of age

Discussion and Conclusions

Using the theory of planned behaviour framework to assess the farmer attitudes and beliefs towards an age at first calving has enabled the identification of barriers and preventions to a younger age at first calving of dairy heifers. This insight enables a deeper understanding of what additional strategic approaches are needed to further assist farmers to adopt additional measures in ensuring a higher proportion of their replacement heifers calve at 24 months of age. It is unlikely that this data could be collected by questionnaires. This study has identifies that some farmers feel they are calving a large proportion or all of their replacements at 24 months of age however there are some barriers of on farm practices which are restricting this taking place and farms as a result have the perception that their replacements are calving at the correct weight and age.

It is apparent that some dairy farmers in the region are making judgements about the weights of their replacements at certain times of the year especially at breeding. This perception of weights at breeding is derived from their own personal experience and tacit knowledge. (25%) of farms surveyed regularly weigh replacement heifers at certain times of the year; however (96%) of surveyed farmers believed it would be a good idea to weight heifers regularly. Farmers may be more likely to rely on their own perceptions if they do not trust the source of advice on certain practices (Palmer, et al., 2009). There is a perception by some farmers throughout the structured interviews that an all or nothing approach is required with some of the attitudes towards reducing the age at first calving such as regular weighing, not keeping late born dairy heifer calves after March, using high EBI bulls to improve the quality of the herd, culling empty heifers after a breeding season and using heat detection during the breeding season.

Animal health advisers and agricultural advisers have a key role to play as they are perceived to have best knowledge and practice about the subject matter although not always utilised (Ruston, et al., 2016). One of the key assumptions underlying the theory of planned behaviour is that the decision making process is rational (Azjen., 1991) Additionally farmers need to be educated by agricultural advisers to make the correct management decisions on their own farms at certain times of the year in order to minimise the age at calving to 24 months. Knowledge transfer mechanisms need to target the 24T and 30A farms across the region to motivate farmers into making correct decisions based on scientific evidence.

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