## Extended Abstract
## Please do not add your name or affiliation

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| **Paper Title** | **A bioeconomic analysis of the impact of genotype and nutrition of high yielding dairy cows in grass-based systems** |

**Abstract prepared for presentation at the 96th Annual Conference of the Agricultural Economics Society, K U Leuven, Belgium**

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| **Abstract** | ***200 words max*** |
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| The intensification and expansion of dairy production at farm level can be achieved in a number of ways. Increasing output per cow is a means of facilitating sustainable expansion on a fixed land area as land is the most limiting input on Irish farms. The two principal methods by which output per cow can be increased are genetic improvement and strategic supplementation with concentrates. A bioeconomic farm level model for high yielding dairy systems was developed to examine the potential impacts of alternative genetic and nutritional strategies on farm performance. The linear programming model optimised farm net margin and served to identify the combination of genotype and nutritional strategy most profitable at farm level. Data for the model was derived directly from research trials carried as part of the Nutrigen project. A strategy, which is characterised by moderately high levels of supplementation, high pasture allocation rates and moderately high genetic merit was found to be the optimal strategy given the model constraints. | |



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| **Keywords** | Dairy Systems, Linear Programming |
| **JEL Code** | Q12<br>see: www.aeaweb.org/jel/guide/jel.php?class=Q) |


| **Introduction** | ***100 – 250 words*** |
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Irish dairy production has experienced steady and consistent growth since the abolition of the European Union's milk quotas regime in 2015 (Ramsbottom et al. 2020). Expansion within the industry, while facilitated by the abolition of quotas, has been underpinned by increases in cow numbers as well as improvements in individual dairy cow productivity. Between the years of 2015 and 2017, the 29% increase in milk production at farm level was attributed to a 10% increase in milk output per cow, a 17% increase in herd size or cow numbers and a 2% increase in stocking rate (Ramsbottom et al. 2020). Further growth and development at farm level can be achieved by adjusting several key factors including increasing herd size, increasing stocking rate, acquiring additional land and increasing production per cow through genetic improvement or improved nutrition (Ruelle et al. 2018a) (UCD, 2021). For many Irish farm businesses land is the most limiting input and therefore increasing output per cow is a means of facilitating sustainable expansion on a fixed land bank as higher outputs are achieved with the same level of land and animal resources. The two principal methods by which output per cow can be increased are genetic improvement and strategic supplementation. The Nutrigen project was established in 2015 with the aim of evaluating the effect of genetic merit and

nutritional strategy on dairy cow performance in high output systems of production in Ireland (DAFM, 2020). As part of this project an economic comparison of alternative high output systems was conducted.

| **Methodology** | ***100 – 250 words*** |
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A bioeconomic farm level model for a typical high yielding dairy systems was developed to examine the potential impacts of the investigated genetic and nutritional strategies on farm performance. The linear programming model optimised for farm net margin and served to identify the combination of genotype and nutritional strategy most profitable at the farm level. Data for the model was derived directly from the research trials which investigated various combinations of genotype and nutritional strategy. As part of the wider project there were 4 trials being conducted at the UCD Lyons research farm which consisted of 16 alternative high output production systems for consideration. A net margin calculation for each of the systems was carried out and is used by the model to identify the optimal system. This data was supplemented predominately by data from the Lyons research systems herd and also from a combination of national data sources (CSO and Teagasc NFS), literary sources and expert opinion. Sensitivity analysis was also carried out to examine the impact on the optimal solution of variation in the assumptions made around key production inputs and outputs including fertiliser price, milk price, concentrate price and milk yield. A land area of 40 hectares is assumed, as well as the farm having 1.74 labour units available. The farm is also assumed to be in eligible for derogation under the EU Nitrates Directive with a limit of 250kgs of nitrogen per hectare.

| **Results** | ***100 – 250 words*** |
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The most profitable system on a per cow basis was one that involved feeding high concentrate levels to cows that were high yielding in late lactation. However, a system that involved feeding low levels of concentrates to low EBI cows was identified as the optimal solution as this system allowed for a larger herd size. The model output optimised a total farm net margin of €90,367.955 and a total herd size of 99.8 cows. Sensitivity analysis was conducted varying the prices for fertiliser, concentrate feed and the milk price upwards and downwards in line with recent historical price fluctuations. Varying the fertiliser and concentrate feed prices did not lead to a change in the optimal system, however under lower milk price assumptions combining high concentrate feed levels with high yielding late lactation cows is the optimal system.

| **Discussion and Conclusion** | ***100 – 250 words*** |
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The optimal combination of genotype and nutritional strategy for a high output seasonal grass-based milk production system was identified by the model as a low level of concentrate feeding and low genetic merit. However, these parameters are considered low only relative to the alternative strategies. On a wider farm scale, the genetic merit of the optimised strategy is considered high compared to the genetic merit of the national average performance (O'Sullivan et al. 2020a). Similarly, the level of concentrate feeding is considered high when compared to the national average herd and similar to other high output systems (O'Sullivan et al. 2019a).