

## Impact case study (REF3)

<b>Institution:</b> University of Nottingham		
<b>Unit of Assessment:</b> 6; Agriculture, Veterinary and Food Science		
<b>Title of case study:</b> Changing industry practice towards using co-products as high performing dairy cattle feeds leading to increased co-product sales, milk yields and farm incomes		
<b>Period when the underpinning research was undertaken:</b> 2010 - 2016		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Professor Phil Garnsworthy	Professor of Dairy Science	1980 - present
<b>Period when the claimed impact occurred:</b> 2013 - ongoing		
<b>Is this case study continued from a case study submitted in 2014? N</b>		
<p><b>1. Summary of the impact</b></p> <p>By evaluating co-product feedstuffs, researchers at the University of Nottingham (UoN) have played a pivotal role in influencing practice change within the UK dairy feed industry to provide soya alternative, sustainable protein sources. Compositional and nutritive values determined by UoN for the co-products domestic wheat dried distillers grains with solubles (w-DDGS) and rapeseed meal sold by subsidiaries of AB Agri, have been used throughout the industry following the UoN research. UoN trials demonstrated the efficacy of using w-DDGS in dairy cattle feed. AB Agri sales of domestic w-DDGS subsequently increased from 200,000t to 400,000t per annum between December 2013 and 2018 generating sales of [redacted] and reaching 80% of UK dairy farms. A novel rapeseed meal (NovaPro) was launched in February 2019 with marketing supported by UoN research outcomes, leading to sales of [redacted]. The use of NovaPro on 10% of dairy farms has led to substantial increases in milk yield and income, resulting in an estimated GBP29,284,892 increase in cumulative farm income between February 2019 and December 2020.</p>		
<p><b>2. Underpinning research</b></p> <p>In 2017 in the UK 2,880,000t of soyabean and meal was imported for use in animal feed from South America and other countries (UK Roundtable of Sustainable Soya: <a href="#">Baseline Study 2018</a>). However, rising import costs and environmental concerns over soya production have encouraged the animal feed industry to investigate alternative protein sources for the UK market. In addition, there is increasing pressure from retailers and consumers who are demanding more responsibly sourced products. Co-product feeds are secondary products produced from arable crop and food processing that would not otherwise be used in the food chain. Co-products, such as dried distillers grains with solubles (DDGS) and rapeseed meal, offered potentially cost effective and sustainable alternative protein sources to soya, however considerable uncertainty existed with respect to the nutritive potential of these alternative protein sources. To maximise the potential of these co-products as high performing animal feeds and to formulate diet rations correctly, information on their nutritional value was therefore needed alongside investigation of their alignment to the dietary requirements of farmed animals.</p> <p>Professor Garnsworthy is a world-renowned expert in dairy nutrition, with over 40 years of research experience analysing nutritional strategies for optimising milk production (quantity and quality), dairy cow reproductive function and nutritionally-influenced environmental outputs, from a range of core and co-product feed sources (1,2). The specific potential for incorporating co-products in dairy cow diets was analysed in comparison to contemporary commercial nutritional compositions (3). This demonstrated that diets with high proportions of co-product inclusion can deliver high milk yields while providing environmental benefits from lower emissions (3). A key project, funded under the UK government's Department for Environment, Food &amp; Rural Affairs (DEFRA) Sustainable Livestock Production LINK Programme (ENBBIO, 2010-2014), sought to evaluate the benefits of feeding livestock co-products from the UK bioethanol industry (4,G1). The competitive funding was awarded to a consortium of 25 partners, including Prof Phil Garnsworthy from the University of Nottingham (UoN), alongside colleagues from University of Manchester, Scotland's Rural College, and industry partners from all sectors of the UK bioethanol, and livestock and arable industries</p>		

including four sector boards of the Agriculture & Horticulture Development Board (AHDB), AB Agri, AB Vista Feed Ingredients and Marks and Spencer. The consortium sought to test the hypothesis that DDGS, a protein rich co-product produced from the bioethanol industry, was comparable to soya in terms of nutritional profile, cost per unit of production and livestock production performance. Specific focus was on DDGS co-produced using wheat as feedstock (w-DDGS) sourced from two new bioethanol plants within the UK, established in 2010 (Ensus) and 2013 (Vivergo). UoN were the sole research contributor to the ruminant portion of the project delivering all of the ruminant trials (6 in total). The specific aims of the UoN ruminant research were to: a) provide comprehensive nutritional values (metabolisable energy values, as well as dry matter and nitrogen degradability coefficients) for UK and EU w-DDGS; b) determine optimal inclusion levels of w-DDGS in dairy cattle diets; c) identify routes to improving nutritional value of w-DDGS through process modifications in biorefineries to improve animal performance. The research established that: a) w-DDGS metabolisable energy and protein degradation were not significantly different to soya for dairy cattle (4); b) w-DDGS can be included in diets for dairy cattle up to 20% of the total diet without detrimental effects on cow performance or health and with improved nitrogen use efficiency (4); c) that drying conditions and proportion of solubles in w-DDGS were key manufacturing process factors that affect degradability characteristics and nutritional value when fed to livestock (4).

Subsequently, in 2016, UoN were commissioned by AB Connect (AB Agri subsidiary), to evaluate the benefits of feeding dairy cows a novel co-product from a UK rapeseed oil plant. The product, NovaPro, is new to the feed market as it is manufactured using a novel process. The product is a rumen protected rapeseed meal, a protein source that is resistant to degradation in the rumen in order to pass in the lower gastrointestinal tract and provide essential amino acids – ‘rumen bypass protein’. The specific aims of UoN trial were to: a) provide comprehensive nutritional values for NovaPro; b) determine rumen degradation characteristics of NovaPro, conventional rapeseed meal, conventional protected rapeseed meal, and soyabean meal; c) compare performance of dairy cows fed on balanced diets containing these protein sources. The study established that NovaPro’s amino acid profile was superior to that of soya, but that NovaPro had a lower protein and higher oil content (5). Secondly, NovaPro supplied a similar quantity of rumen bypass protein as soya and the digestibility of the bypass protein in NovaPro was higher than for other protected rapeseed co-products (5). The feeding studies demonstrated that cows yielded more milk (1.7l/cow/day) when fed on NovaPro than when fed on soyabean meal, which was specifically attributed to the superior amino acid profile of rapeseed compared with soya (5). Furthermore milk urea levels were reduced in cows fed NovaPro (5).

### 3. References to the research

University of Nottingham UoA6 staff are **bold**.

#### Underpinning references:

1. **Sinclair, K., Garnsworthy, P., Mann, G** and Sinclair, L. (2014) Reducing dietary protein in dairy cow diets: implications for nitrogen utilization, milk production, welfare and fertility. *Animal*, 8(2), 262-274. DOI: 10.1017/S1751731113002139
2. Balmford, A., Amano, T., Bartlett, H., Chadwick, D., Collins, A., Edwards, D., Field, R., **Garnsworthy, P.**, Green, R., Smith, P., Waters, H., Whitmore, A., Broom, D.M., Chara, J., Finch, T., Garnett, E., Gathrone-Hardy, A., Hernandez-Medrano, J., Herrero, M., Hua, F., Latawiec, A., Misselbrook, T., Phalan, B., Simmons, B.I., Takahashi, T., Vause, J., zu Ermgassen, E., Eisner, R. (2018). The environmental costs and benefits of high-yield farming. *Nature Sustainability*, 1(9), 477-485. DOI:10.1038/s41893-018-0138-5
3. **Wilkinson, J.M. and Garnsworthy, P.C.** (2017) Dietary options to reduce the environmental impact of milk production. *Journal of Agricultural Science*, 155, 334-347. DOI: 10.1017/S0021859616000757
4. Environmental and nutritional benefits of bioethanol co-products (ENBBIO). ENBBIO Consortium Project Report (2015) <http://tiny.cc/8fymqz>
5. **Garnsworthy, P.C., Saunders, N., Goodman, J.R.,** and Marsden, M. (2021). Evaluation of rumen protected rapeseed expeller (NovaPro) as an alternative to soya

bean meal in dairy cow diets. *Animal Feed Science and Technology*, 273.

DOI:10.1016/j.anifeedsci.2021.114816. [delayed output]

#### **Underpinning grants:**

G1. Environmental and nutritional benefits of bioethanol co-products (ENBBIO). Sponsor: Defra, 2010 – 2014, LK0697. GBP726,186. Awarded to 25 industry and academic partners, UoN ruminant work PI: Phil Garnsworthy

G2. Measurement of Rumen Degradation of Protein Sources. Sponsor: AB Connect (AB Agri subsidiary), 2015 – 2016. [redacted]. PI: Phil Garnsworthy

G3. Response of lactating dairy cows to soya alternatives, using rumen protected proteins. Sponsor: AB Connect (AB Agri subsidiary), March 2016 – August 2016. [redacted]. PI: Phil Garnsworthy

#### **4. Details of the impact**

Researchers at the University of Nottingham (UoN) played a key role in changing practice in the UK dairy feed industry. Specifically, UoN research has demonstrated that wheat and rapeseed co-products are viable protein sources, and hence are suitable substitutes for soya in dairy cattle feed. Nutritional composition values determined by UoN research for wheat DDGS (w-DDGS) and a new rapeseed meal (NovaPro) (sold by AB Agri) are now used throughout the dairy feed industry. As a direct result of the UoN findings and subsequent dissemination of the results to relevant industry stakeholders, domestic w-DDGS use as animal feed increased from 200,000t to 400,000t per annum between December 2013 and 2018. By 2018, this 400,000t of w-DDGS accrued [redacted] in sales revenue and was fed to approximately 80% of the UK dairy herd. After launch in February 2019 NovaPro accrued [redacted] in sales revenue, and the use of NovaPro on 10% of dairy farms led to an increase of GBP29,284,892 in cumulative farm income between February 2019 and December 2020.

#### **Nutritional composition values are included in industry technical datasheets and informed industry practice**

Results generated by UoN research, during the ENBBIO project (4) and comparative dairy cow feeding trials (5), established definitive reference values for nutritional parameters for UK and EU w-DDGS and a new rapeseed co-product (NovaPro), respectively. These products are marketed as EU Wheat DDGS, British Wheat Distillers and NovaPro, for use in ruminant livestock feed rations (a,b). The feed products are sold by Trident and KW, both subsidiaries of AB Agri, the largest domestic supplier of protein/energy feeds into the UK animal feed market (a). The reference values (b) established by UoN included metabolisable energy values, as well as dry matter and nitrogen degradability coefficients, routinely used in the dairy industry to calculate metabolisable protein supply to ruminants (4,5). Technical datasheets, published by KW on the individual feed product profile webpages, were modified between 2015 and 2018 to include the UoN generated reference values, with these datasheets directly citing UoN data (a,b).

The technical datasheets (b) are crucial to the industry as they are used by UK animal nutrition consultants, feed companies and farmers to formulate diets accurately to maximise animal performance and efficiency. Consequently these essential industry relevant data, underpinned by robust UoN research, are now available for dairy cattle nutritionists in the UK to make informed decisions on the inclusion of w-DDGS and/or NovaPro as alternatives to soya within dairy cow diets, and to adapt feed formulations accordingly. Mole Valley Farmers (MVF) is the UK's second largest ruminant feed supplier and Kite Consulting is the leading dairy consultancy. MVF and Kite Consulting service 15% and 50% of UK dairy sector respectively. Both companies use the w-DDGS and NovaPro technical datasheets (b) to formulate feed rations for their clientele (c,d). MVF stated "*the technical information on the [w-DDGS and NovaPro] datasheets provided by [UoN], is seen as independently verified and trusted. This is crucial as it is important to understand with confidence the value of various protein sources based on their detailed nutrient composition*" (c). Kite Consulting have incorporated the information from the NovaPro technical datasheet, including data from the UoN research, into their feed database (d).

### **Providing evidence of the efficacy of w-DDGS and influencing uptake, to reduce reliance on soya**

The DEFRA funded ENBBIO project on w-DDGS was aligned to UK animal feed industry requirements and provided confidence to stakeholders across the sector, including bioethanol companies (eg. Ensus & Vivergo), animal production levy body AHDB, major UK feed companies (eg. AB Agri), retailers (eg. M&S) and DEFRA, that bioethanol co-products can be used as an alternative to soya with no detrimental effects on animal production **(4)**. UoN results from the evaluation of bioethanol co-products as high performing animal feeds for dairy cows were disseminated to the industry through a comprehensive final report published in March 2015 **(4)**. Outcomes from the ENBBIO project were disseminated further through a farmer facing summarised report by AHDB Dairy in September 2015, focussing on the UoN dairy trials **(e)**. Furthermore, two key knowledge transfer events were arranged (Future of Feeds Conferences, at Stoneleigh & Nottingham, March/April 2015) to disseminate results to project stakeholders and the wider industry. The project received widespread media coverage, for example, in a 2016 trade article for Feednavigator.com, the Head of Technical at AB Connect, the feed division of AB Agri Ltd, stated *“There is no doubt that the ENBBIO work has given the feed industry the confidence to feed wheat DDGS to livestock at significant quantities, knowing that it is a safe and cost effective feed source that delivers good nutritional value and is able to reduce the use of soy across all species while maintaining performance”* **(f)**. Increased industry confidence in feeding bioethanol co-products as an alternative to soya was demonstrated by the volume of w-DDGS AB Agri subsidiaries sold into the domestic animal feed market. By 2018 sales of domestic w-DDGS reached 400,000t per annum in the UK **(a)** as demand for the product increased as a consequence of the above media coverage and dissemination events; these sales represent a 100% sales increase in w-DDGS from December 2013 **(a)**. AB Connect (AB Agri subsidiary) estimated that by 2018, this 400,000t per annum volume of product resulted in [redacted] in cumulative sales revenue for the company and was fed, either as straight feed or in compound feed, on at least 80% of UK dairy farms **(a)**. AB Connect attributed this significant increase in w-DDGS to the UoN research, stating that *“The [UoN] research was a key influence in the significant uptake [of w-DDGS ...] within the dairy industry from 2013. Due to the robust research in dairy cattle led by Professor Garnsworthy we were able to gain significant market traction with our domestic w-DDGS products as an alternative to soya in an exceptionally conservative market”* **(a)**.

### **Supporting the launch of NovaPro, resulted in increased milk production and income for UK dairy farmers**

In response to growing retailer and consumer interest in supply chain traceability and lifecycle carbon foot printing, between 2011 and 2019 RCMA Group (a global commodities trading business) invested GBP25,000,000 into a new rapeseed processing plant (Stratford-upon-Avon, UK) to produce NovaPro and rapeseed oil ([AgriTrade News article](#), February 2019). NovaPro is a new rapeseed meal product, its unique selling point is that it is resistant to rumen degradation and so can deliver higher quantities of digestible protein and energy. The new plant, that opened in February 2019, only processes UK-grown, farm-assured rapeseed and has capacity to produce up to 60,000t rapeseed meal each year using a novel process ([AgriTrade News article](#), October 2018). The product is produced by Yelo Enterprises Ltd (a member of RCMA Group) and distributed by Trident and KW. To instil industry confidence and encourage uptake of the new product, independent research trials commissioned by AB Connect were conducted at UoN in 2016 **(5)**. The key benefits identified through the UoN research featured prominently on the Yelo and Trident websites from 2018 **(g,i)**, as well as in a technical data sheet produced by Yelo **(g)**. This supported the sales and marketing of NovaPro when it was officially launched in February 2019. Prof Garnsworthy was invited to the official product launch in his capacity as an *‘independent, well renowned speaker’* **(h)** to provide animal feed suppliers in the UK with relevant information from the independent trials.

Since its launch in February 2019 NovaPro has already reached 10% dairy sector market penetration **(a)**; Trident and KW sold [redacted] of NovaPro to the dairy industry accruing



[redacted] in sales revenue (a). Extrapolating the data from the UoN research (5) herds using NovaPro will have benefited from substantial increases in milk yield and hence income. AB Connect calculated that feeding NovaPro increased Margin Over Purchased Feed (MOPF) by GBP0.28 per cow per day (j). Based on the increase in MOPF achieved through feeding NovaPro (above), and 10% dairy sector penetration, the current nationwide cumulative farm business performance (income) was estimated to have increased by GBP29,284,892 between February 2019 and December 2020 (k). As a direct result of UoN research, the animal feed and livestock industries now have high confidence in NovaPro as a high performing dairy cow feed that can be used as an alternative to soya. MVF described the UoN research as a “*fundamental piece of work*” that “*alleviated potential concerns around recommending an alternative protein source to [their] dairy farm clients*” (c). The level of milk fat and milk protein in the milk influences milk price for the majority of dairy farms in the UK. If milk fat declines this has a direct negative impact on farm income and profitability. It was a major concern for MVF in the initial evaluation of NovaPro that milk fat content could be negatively affected. The UoN research “*gave [MVF] confidence that milk quality, in particular milk fat, would not be reduced*” and “*there would be no associated impact on [client] income from feeding [NovaPro]*” (c). This was a key factor in MVF’s decision to add NovaPro to their product portfolio offered to their customers (c). The robust evidence base, provided by UoN research, also influenced Kite Consulting’s decision to include NovaPro in their feed portfolio (d). Kite Consulting stated “*[we] have benefitted from [Professor Garnsworthy’s] research as we have been able to expand our feed portfolio [...] in turn enabling our clients to have an increased choice of non-soya feed [and a simplified diet formulation]. It is unlikely that we would have chosen to add NovaPro to our portfolio of recommended feeds without the findings of the research carried out by [UoN]*” (d).

### **Summary**

Pivotal research conducted by UoN has increased industry confidence to replace soya with domestic co-products as the main protein source in dairy cow feed. UoN research data were included in technical datasheets for various co-products, which are essential to formulate feed rations and are used across the animal feed industry. Increased confidence within the dairy farm community was demonstrated by the increase of UK sourced w-DDGS sold to farmers and feed manufacturers by AB Agri subsidiaries from 200,000t to 400,000t between December 2013 and 2018, and the successful uptake of a new domestic rapeseed meal product (NovaPro) launched in February 2019. The benefit of increased milk yield achieved through switching to NovaPro, resulted in an estimated GBP29,284,892 increase in cumulative farm income between February 2019 and December 2020. AB Agri stated “*The [UoN] research behind both products has ensured that confidence in co-products has filtered through to buyers within the dairy industry, leading to successful uptake of both products*” (a) resulting in cumulative sales revenue of [redacted] (a).

### **5. Sources to corroborate the impact**

- a. Testimonial from the Commercial Director of AB Connect (AB Agri subsidiary) (November 2020) [PDF]
- b. EU Wheat DDGS, British Wheat Distillers and NovaPro technical datasheets published by KW [PDF]
- c. Testimonial from the Head of Nutrition of Mole Valley Farm (November 2020) [PDF]
- d. Testimonial from a Managing Partner of Kite Consulting (November 2020) [PDF]
- e. [AHDB report summarising ENBBIO outcomes for dairy farmers](#) (September 2015) [PDF]
- f. Feed Navigator article, ‘[Report has boosted UK industry confidence in distiller’s grains as feed source](#)’ (September 2016) accessed 31<sup>st</sup> October 2019 [PDF]
- g. Yelo [website](#) and NovaPro datasheet, accessed 14<sup>th</sup> August 2019 [PDF]
- h. Head of Innovation at AB Connect (AB Agri subsidiary) invites Professor Garnsworthy to speak at NovaPro launch (email)
- i. Trident [website](#) information about NovaPro, accessed 7<sup>th</sup> February 2020 [PDF]
- j. [Trident presentation at UK Dairy Day](#) includes NovaPro MOPF (September 2019) [PDF]
- k. Estimated increase in dairy farm business income from feeding NovaPro 2019/20 [PDF]