Today's Feed Industry and Perspectives on its Future

The Alltech Global Feed Survey was established in 2011 to better estimate world feed tonnage and production trends. Now, with five years of data collected, there is a more accurate depiction of where the feed industry is today. As global disposable income increases, consumers have developed a palate for protein, and, over the past five years, the feed industry has delivered. Results from the 2016 Global Feed Survey released by Alltech estimates international feed tonnage now at 995.6 million metric tons, a two per cent increase over last year and a 14 per cent increase since Alltech first published results.

The analysis of five-year trends showed growth predominantly from the pig, poultry and aqua feed sectors and intensification of production in the African, Middle Eastern, Latin American and European regions. The Global Feed Survey assesses the compound feed production from 131 countries through information obtained in partnership with local feed associations and Alltech's sales team, which visits more than 32,000 feed mills annually. The 2016 survey showed that poultry feed has the leading market share and is growing faster than any other species, with 47 per cent of total global feed manufactured specifically for broilers, egg layers, turkeys, duck and other fowl. This year's survey also confirmed that corn and soya bean meal are the standard feed ingredients globally.

The top 10 feed producers in the world remained the same: China, the United States, Brazil, India, Mexico, Spain, Russia, Germany, Japan and France. As a region, Europe saw the most growth, up 10.5 million tons over last year, with the largest contributions coming from Russia, Turkey, Belarus and Poland. Down two per cent from last year, China still holds the title of leading feed producer in Alltech's annual Global Feed Survey with 179.93 million tons manufactured throughout the country's 8550 feed mills. However, this is the third year the world's leader has reported a consolidation of its feed tonnage production into a smaller number of feed mills.

The number of feed mills in the United States and Brazil, the second and third largest markets, also declined. The US produced 173.73 million metric tons from 6012 feed mills (6718 mills in 2014) and Brazil manufactured 68.7 million metric tons from 1556 feed mills (1698 mills in 2014).

Other notable regional and species statistics from the 2016 Feed Survey include:

- Europe's 5545 feed mills, with Russia's contributions, augmented their production by 4.5 per cent in 2015 compared to the previous year. The Middle East demonstrated a 7 per cent decrease with 21.44 million tons from the region's 719 mills. Africa, North America and Latin America were up four, two and three per cent, respectively. The Asia-Pacific region's growth was relatively flat at less than one per cent.
- Pig feed production was down two per cent, with 253.53 million tons. Aqua, with 35.47 million metric tons, is down five per cent this year; although outside of China this figure seems to relate to more accurate data collection and not a specific decline, especially given that aqua has been a grower, up 19 per cent overall in the past five years. Equine feed, at 8.22 million tons, declined two per cent compared to 2014.
- Poultry feed production continues to surge with a six per cent increase, now at a total 463.69 million metric tons. Ruminant feed was also positive with 201.30 million tons, a three per cent increase. Pets are up four per cent at 22.59 million tons.

The future of the feed industry will evolve based on a rapidly growing global population, changing social-economic climate with an increasingly involved consumer and the constant pursuit of greater efficiency. The increase in population and GDP suggests demand for both cereal grain and meat protein will continue to increase. So, what might the future of the industry look like in order to accommodate these objectives? At this point, the cost of feed demonstrates a need for companies to re-evaluate and improve feed efficiency. Advancements in raw materials may result in novel feed stocks that change the entire approach to feed formulation. This is no longer a concern only for monogastric animals. The inexpensive feed options traditionally given to ruminants are limited, and the future alternative is a carefully formulated feed aimed for greater efficiency in monogastrics and ruminants.

As the modern consumer has reached a new level of political and commercial involvement, there will be increased demands on the feed industry to stand accountable for their role in the food chain. As companies continue to be more consumer-oriented, their environmental footprint will grow, as well as their focus on sustainability. Greenhouse gas emissions and the environmental impacts of animal production will all be considered, and will push feed mill and farm efficiency forward.

Consumers are becoming more selective in purchasing meat, milk and eggs, questioning what their animals eat and how they are kept. They see the feed mill as integral to the food chain and in influencing human diet, which has now developed into a culture that wants to know exactly what medicines, practices, supplements and feedstuffs go into the animals they consume. Food safety continues to be a serious concern as today's feed may contain hazards, such as heavy metals, high dioxin levels,

polychlorinated biphenyls (or PCB's) and mycotoxins. All of these toxins have the potential to enter the food chain via animal feed. Analytical systems have been developed to quantitatively and qualitatively detect the presence of such hazards in feed. Over time, these methods will become more sophisticated and provide more rapid results, allowing the industry and government to react to ensure food safety. Food quality will continue to be a priority for many consumers and companies, putting it at the forefront of feed manufacturing. Concerns about food safety and quality at every stage in feed production will drive companies to be increasingly more transparent. Government regulations, such as the Food Safety Modernisation Act in the US, will enforce risk-based preventative animal food safety systems.

In the future, feed systems are likely to become even further intertwined with information technology, eventually allowing for a flow of detail throughout the steps in the food chain when farm, feed mill, processing plant and consumer are connected. In this way, feed availability will be able to mirror demand and, in doing so, dramatically increase efficiency and reduce waste.

Widespread digitalisation will lead to on-farm measurements and monitoring done in real time. This includes automated monitoring devices sending continuous, real-time data on body weight, feed and water consumption, temperature and humidity, and feedback for improving efficiency of animal production and welfare, while limiting waste. Systems in place for measuring environmental gases, excretion on land and other biological and chemical parameters will be useful in documenting the effects of nutrients on animal health, thus providing insight for necessary changes in diet strategy. Such measurements will also contribute to increased on-farm biosecurity.

As we look at new and more precise technologies to address nutritional challenges, it is clear that our views on nutrition, feed manufacture and feeding practices will continue to evolve. This will be reflected in the activities and structure of the global feed industry. We see these changes taking place today as research and commercial applications focus more on modelling the dynamics of nutrient digestion, balance and utilisation, moving away from feeding practices based on the simple nutrient composition. As we develop more advanced technologies for controlling digestion and nutrient utilisation, traditional ways of formulating feeds based on compositional analyses will play a less important role defining feed formulation. These fine control mechanisms will be coupled with our ability to collect information about all aspects of the food chain and will define a new level of proactive precision feeding. It will be necessary to discard some of the time-honoured ways of describing nutritional value. This will open the door for use of new feed ingredients, long-term nutritional conditioning and other novel supplement strategies. The outcomes will include improved production efficiencies, better maintenance of animals and more sustainable production.

Nutrigenomic approaches will become standard for understanding both nutritional and environmental factors hindering production efficiency and welfare. This information will afford a new level of precision in feed formulation and livestock production. Nutrigenomics is key to understanding the impacts of different nutrients on gene expression and providing the basis for more rational genetic selection. Subsequently, feeds will be closer to achieving genetic potential by targeting genes involved in animal growth rate, disease prevention and meat quality. Results from these studies will identify anti-nutritional activity and define feeding strategies that take advantage of the natural conditioning processes

associated with prenatal and perinatal feed management practices.

The feed mill itself will become "smarter" with the use of near-infrared signature management technology, or NIR. This will allow for the analysis of incoming raw materials in real time, allowing reformulation of the diets on a minute-by-minute basis to ensure consistency of each batch. Additionally, rapid in vitro digestion modelling systems will provide new ways of defining the true nutritional value of raw materials as well as the final feed products leaving the feed mill. These advanced systems can be used to define nutrient interactions and provide more accurate descriptions of nutritional values. Precision modelling and real-time decisions resulting from the evaluation of greater amounts of information will allow the feed industry to address issues associated with sustainability, as well as minimise waste and the environmental impact from animal production. In the end, such technologies have the capability to provide a more objective feedstuff value for the interested buyer (Gill 2003).

Today a typical, western feed mill producing 100,000 tons of feed might involve 1.5-3 people. In a country like China, the same feed mill would require the labour of 45 individuals. This trend toward greater labour efficiency will continue so that future feed mills can be fully automated and a single person can run a relatively large feed mill alone. As the feed mill's quality control systems continue to improve via automation of each of the different steps of production, traceability will allow larger volumes to be transported and tracked while decreasing the necessary labour. Not only does this provide a greater level of efficiency, but the increase in precision and data collection will increase exponentially. In the future, there is potential to apply artificial intelligence to analyse data and make immediate adjustments based on system inputs. Advancements are likely to occur in the pelleting process so that what is now considered an art might become more of a science. By controlling more of the parameters involved in pelleting and cooling, there is opportunity to reduce costs, improve feed quality and assure food safety.

The rate at which any of the aforementioned solutions are adopted by the industry is dependent on the challenges it faces. The immediate approach of the feed industry, however, is to improve animal performance characteristics, minimise feed costs and maximise feed production efficiencies. Above all, feed digestibility and feed conversion require attention. Ingredients are now being explored for their capacity to effectively improve feed conversion. One possible ingredient that could become commonplace to feed formulation is algae: a source of protein, oils, pigments, vitamins and starch. Emerging technology positions algae to become a major, nutritionally rich biomass and it is already known as a prime source of DHA Omega-3 fatty acids.

A novel array of feed additive enzymes will also become critical components of feed. Supplemental enzymes, now commonly used to improve the nutritional value of most commercial feeds, will become more functional under a variety of feed manufacturing conditions and feed system strategies for different animal species. Solid state fermentation (SSF) will be used for growing enzymes directly on feedstuffs. SSF makes it possible to produce a custom enzyme cocktail that can be used for improving digestion of feed stuffs, which enhances animal health, performance and profitability.

While the debate persists over what is driving the seemingly unstoppable rise of antibiotic-resistant microbes, alternatives to antibiotics and products capable of reducing the risk of antibiotic resistance transfer through the food chain are clearly required. Bacteria develop resistance to new derivatives rapidly, therefore, alternative strategies must be considered to combat bacterial resistance. A better understanding of the ecology of antibiotic resistance is required, which could lead to the development of new intervention strategies.

The future focus of the feed industry will be to verify the products' ability to meet consumer demands of safety and sustainability, while still becoming more efficient and productive in order to feed the nine billion people of 2050. Consolidation of the existing feed mills will continue and advanced technologies will increase automation and real-time measurements so that verification is not dependent on the honesty of the supplier. Transparency, traceability and responsibility will become a cornerstone of the industry. Analytical technologies, such as NIR, advanced in vitro fermentation modelling, nutrigenomics and bioinformatics will intervene in feed formulation so that nutritional value is defined and feed formulation and feed manufacturing is no longer an "art" but a more precise science. Similar technologies will be in place to detect contaminants and allow a new level of food safety. To achieve increased animal performance while minimising feed costs, new nutritional strategies, such as novel raw materials and feed additives, will be employed to optimise feed conversion and digestibility.

Aidan Connolly is Alltech's chief innovation officer and vice president of corporate accounts, responsible for the commercialization of Alltech's global research in addition to corporate account strategy. His expertise is in branding, agriculture and international marketing, and he is an adjunct professor of marketing at University College Dublin and China Agricultural University. He is a board member of numerous agriculture industry boards and federations, and is well-known for his annual survey and report assessing the world's feed tonnage and trends.

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