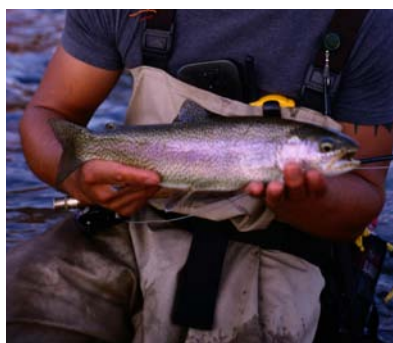


# Methionine Global Outlook:

The Next Decade

Written by:  
Dr. Giovanni Gasperoni  
Tricia Bentley-Beal

Preface by:  
Dr. Paul Aho



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Although it is risky to make predictions, particularly about the future as Mark Twain memorably pointed out, there is little doubt that the global outlook for methionine is bright. As a critical dietary supplement for livestock and poultry, methionine can be expected to grow along with the expansion of the world economy and increased meat consumption.

Methionine is particularly valuable in poultry production and therefore that industry is vital to the future of methionine. There is good news and bad news about the future production of poultry and in particular the production of chicken meat. The bad news is that the percentage growth rate of chicken production is declining. However, the good news is that the absolute growth rate is stable and chicken is highly competitive with other meats. World production of chicken meat increased at an average rate of about 2 million metric tons per year for the last two decades and will continue to increase at about the same rate in the next decade and even the one after that. Therefore, an additional 20 million metric tons of chicken production can be expected to be added during this decade and next, roughly the same amount that was added in each of the last two decades. For all meats, world production increased about 40 million metric tons in the last decade and can be expected to increase another 40 million tons in this decade.

Behind this seemingly orderly progression of total world meat production decade after decade, lies the disorder of the real world. Recessions and disease problems, of course, affect consumption significantly for a particular place or period of time. In addition; production in some countries is slowing, production in other countries is accelerating, and some meats are experiencing rapid growth while other meats experience slowing growth prospects. The devil is in the details but the overall growth is remarkably predictable.

World meat production is becoming more competitive and concentrated in larger and more vertically integrated systems. These trends increase the use of methionine as producers seek to maximize the benefits of all inputs. However, as reported in this paper, overall methionine use is lower than expected even in circumstances where its use is obviously economically beneficial and where all the details are widely known and acknowledged.

There is no question that in a perfectly rational world the use of methionine would be considerably higher. However, the most recent economic research shows that humans do not always behave rationally (this was only a surprise to economists). In addition, supply chain and political oddities make the functioning of the real world less than optimal. Nevertheless, despite all the noise in the system, the trend is, without a doubt, headed toward increased use of methionine due to both increased meat production and increasingly rational use in existing production.

*This paper provides a valuable outline of the factors which will ultimately drive the growth of methionine demand over the next decade.*

The demand for protein has risen rapidly over the past ten years and will continue to increase over the next decade. When comparing all sources of protein, poultry is the most efficient, economical source on earth. Poultry will grow at a higher rate than the protein industry as a whole over the next decade because of the lower production cost per kg and the lower consumer price point. Methionine is beneficial as a feed supplement across the spectrum of livestock production, but particularly in the poultry segment.

As the first limiting amino acid of poultry, methionine is an essential nutrient in industrial production operations. The demand for methionine is dependent upon and proportionate to the demand for protein in general, poultry in particular. Additionally, the global industry shift towards more industrialized agriculture operations positively influences the demand for methionine. In an industrialized agriculture environment, animal diets are balanced for amino acids, whereas in small farm operations they typically are not.

The graphic below details the compound annual growth rate (CAGR) of the aggregate protein industry in the previous and future decade with a comparison to CAGR in the poultry segment.

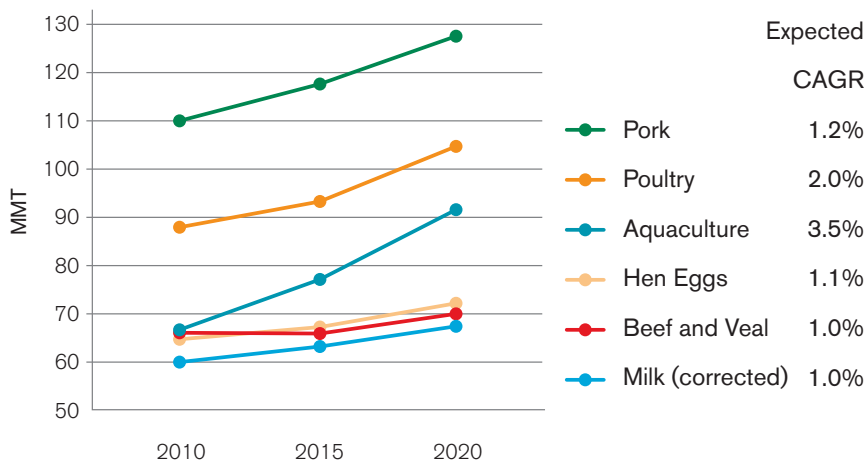
### Protein Demand: Past and Future



Source: FAO, 2010

The graph below indicates the production growth in major segments of the protein industry over the next decade.

### Global Animal Protein Production 1.6% Average Growth



Source: FAO, 2010

Raw material costs are a factor impacting both the demand and production of protein. When comparing the various segments of the protein industry, the poultry segment is less impacted by rising raw material costs, due to efficiency of feed conversion. The table below provides a comparison of feed conversion efficiency between beef, pork, poultry, dairy and aqua (tilapia/catfish).

### Average Feed to Protein Conversion Ratio

	Feed (kg)	Live Weight (kg)
Beef	5.0	1
Pork	3.0	1
Poultry	2.0	1
Aqua	1.7	1

Source: Novus Analysis, 2010

The demand for protein is primarily driven by population, income and ultimately, personal diet choice. As recently as the 1970's, vast numbers of the world's population were considered to be malnourished. This is all changing as growing middle class sectors now flourish in what were once considered "developing" regions. More people are shifting from the category of chronic lack of food to using their personal incomes to choose what they want to eat. The shift toward personal choice is driving the demand for protein.

Developing country populations and economies will continue to grow over the next decade, whereas more mature, developed countries are projected to have low growth rates. The balance of these two trends equates to continued increase in global protein demand, but at a slower pace with CAGR shifting from 2.0% over the past decade to 1.6% over the next decade. Poultry is expected to grow at 2.0% CAGR over the next decade and as a result, methionine is projected to grow at the rate of 2.0% or slightly higher. The current methionine market size is estimated to be around 685-700 KMT.

All of these factors are influential drivers for protein demand. Methionine demand is directly linked to the consumption demand for protein, particularly because methionine is a critical dietary supplement for livestock health, productivity and the reduction of feed costs.

This paper provides an analysis of the market drivers which will impact the demand for protein and methionine over the next decade.

#### Market Drivers

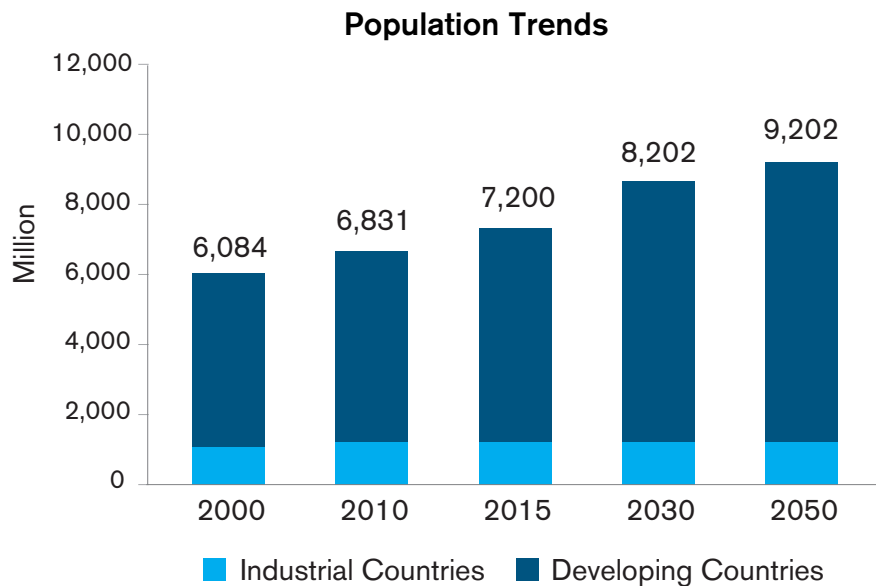
The following global factors are the major drivers for protein demand and ultimately, methionine:

- I. Population
- II. Income
- III. Choice
- IV. Raw Materials
- V. Nutrition
- VI. Genetics

## I. Population

The number of people on earth is rising by 75 million people per year (1.0% CAGR). The majority of this growth is occurring in developing countries where incomes are rising and as a consequence diets are diversifying. This growth will result in a doubling of the global demand for food by 2050.

The chart below details the pace of global population growth and highlights the fact that the greatest growth is occurring in developing countries.



Source: US Census Bureau

### Developing vs. Mature Countries

Developing countries will play an increasingly important role in the global economy and growth in food demand over the next decade. The number of people living in developing countries will increase from 80% to 84% by 2018. Mature countries have very low projected rates of population growth, 0.3% to 0.4% over 2009-2018. The projected population growth rate for the United States is the highest among mature countries, 0.8% to 0.9%, reflecting large levels of immigration.

It is important to note that developing countries are not only rapidly expanding the size of their populations, they are increasing the strength of their economies. These strengthening economies will be the engine to drive the demand for protein over the next decade.

Economic growth in developing countries is projected to average more than 5.6% annually from 2009-2018. This contrasts with the average growth in mature countries of 2.2%. Continued strong growth in China, India and the rest of Asia makes this region an increasingly important part of the global economy, with “developing” Asia’s share of the world’s GDP rising to 22% by 2018. China alone will become more than 10% of the world economy.

The table below details the CAGR for broilers in the five largest countries in the world over the next decade. These countries will represent 60% of the global growth.

### Top Broiler Consumers: 60% Global Consumption

Country	2009 Broiler Meat Consumption (MMT)	Growth Due to Population (MMT)	Growth Due to Economic Development (MMT)	2018 Projected Broiler Meat Consumption (MMT)	Per Capita Consumption (kg)		CAGR 2018
					2009	2018	
U.S.	16.75	1.10	1.35	19.20	35.90	36.50	1.53%
China	12.98	0.66	2.63	16.27	9.90	11.90	2.54%
Brazil	11.11	0.60	1.41	13.12	38.90	40.10	1.86%
Mexico	2.80	0.18	0.22	3.20	28.60	31.60	1.49%
India	2.68	0.25	0.31	3.23	2.20	2.50	2.11%

Source: FAPRI, 2010 and Novus Analysis, 2010



## II. Income

The consumption of protein can be correlated to consumer purchasing power. By 2030, 1.15 billion people will have joined the ranks of the middle class and 90% of these people will live in what are now developing countries. China and India alone will account for two-thirds of the world's middle class expansion, with China contributing 52% of the increase and India 12%.

As incomes rise and consumer choice expands, the demand for a broader food portfolio will grow, particularly for proteins such as meat, seafood and dairy products.

The chart below outlines global income levels with each income quintile representing 1.2 billion people. The link between diet diversity and income growth is clear — as per capita incomes increase, the consumption of protein rises. The inverse is true at low income levels. In the spectrum of income quintiles one to five, we can expect the growth of protein consumption to be driven by the emerging middle class, quintile number three.

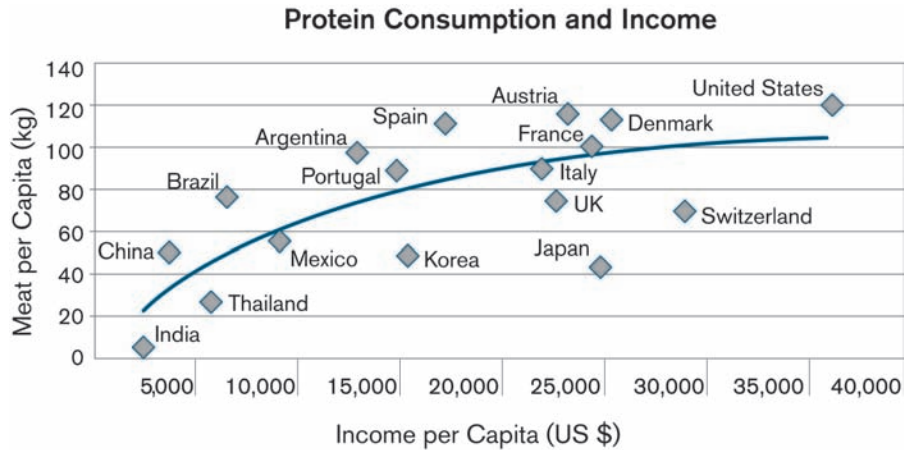
**Income Quintiles: Per Capita Income and Broiler Consumption**

Quintile	Income per Capita (US \$)	Broiler per Capita Consumption (kg)	Where Populations Live	How These Populations Live and Eat
1	30,000	26	US, Europe, Japan	<ul style="list-style-type: none"> <li>• Possess 70% of World's Income</li> <li>• Consuming Processed, Value-Added Food Products</li> </ul>
2	8,000	19	Russia, Asia, Europe	<ul style="list-style-type: none"> <li>• Represents Established Middle Class of Mature Economies</li> <li>• Consuming Fresh or Frozen Cold Chain Food Products</li> </ul>
3	3,500	9	China, India, Middle East, Latin America	<ul style="list-style-type: none"> <li>• Emerging Middle Class of Developing Economies</li> <li>• Consuming Both Wet and Cold Chain Food Products</li> </ul>
4	1,500	4	Africa, Asia, Latin America	<ul style="list-style-type: none"> <li>• Visibly Impoverished Populations of Slow Growing, Poor Countries</li> <li>• Consuming Food from Wet Markets</li> </ul>
5	730	2	Asia and Sub-Saharan Africa	<ul style="list-style-type: none"> <li>• Abject Poverty</li> <li>• Chronically Undernourished</li> </ul>

3rd Quintile will Represent Greatest Sector of Growth

Source: Dr. Paul Aho and Novus Analysis, 2010

The chart below further illustrates the correlation between the level of protein consumption and income.



Source: FAO, 2009

Preference also plays an important role in the correlation between protein consumption and income. Two examples of this impact demonstrated in the graph above are Brazil and Japan.

In Brazil, per capita income is relatively low, yet the per capita protein consumption is relatively high. This is because there is a strong cultural preference for a meat-intensive diet in Brazil.

In Japan, we see the inverse of Brazil — high incomes and low meat consumption driven by cultural preference. In general, the Japanese diet is low-protein with a strong emphasis on starches, particularly rice and noodles. When consuming protein, the Japanese have a dominant preference for fish.

The health of a country's economy has a direct impact on food spending patterns. When an economy is unhealthy, food buying power for the poor decreases in an extreme way. The effect on the poor versus wealthy population is more drastic because lower income consumers spend more of their money on food (50% of income for poor consumers vs. 10% for wealthy consumers). As economies suffer in a region, protein consumption decreases sharply, particularly among the poor.

The graph below represents income elasticity of meat across a variety of economies ranging from mature to developing.

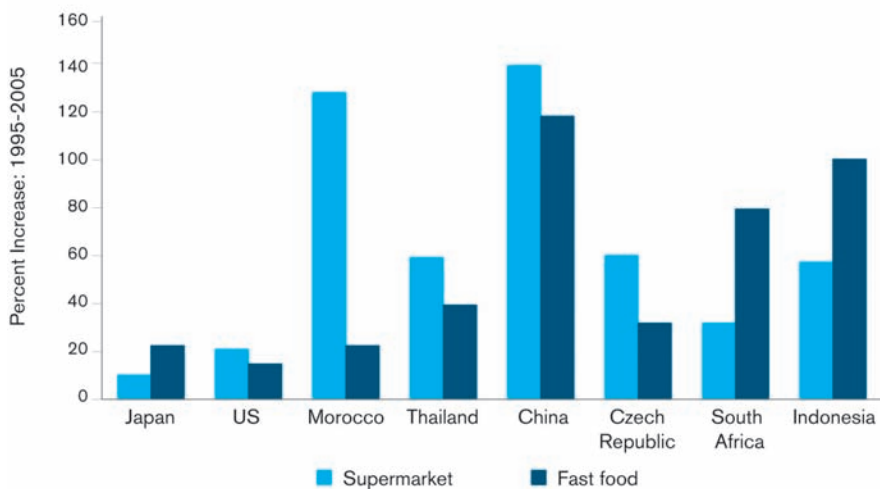
Country	Income Elasticity of Meat
Denmark	0.26
Canada	0.30
Portugal	0.47
Argentina	0.55
Mexico	0.63
Bangladesh	0.78
Nigeria	0.84
<b>WORLD</b>	<b>0.61</b>

Source: FAO, 2009

## Consumption Patterns and Income

In addition to exploring how protein consumption increases as incomes rise, it is important to examine how diets will diversify and where consumption will increase in the world. Diversification of diet applies to both expanding the components of a diet and to the sophistication of the food products consumed. As incomes increase, so does consumer preference for food products that are more convenient in both preparation and access. To illustrate this pattern, the chart below follows the cultural shift toward buying prepared or value-added food products in restaurants and supermarkets.

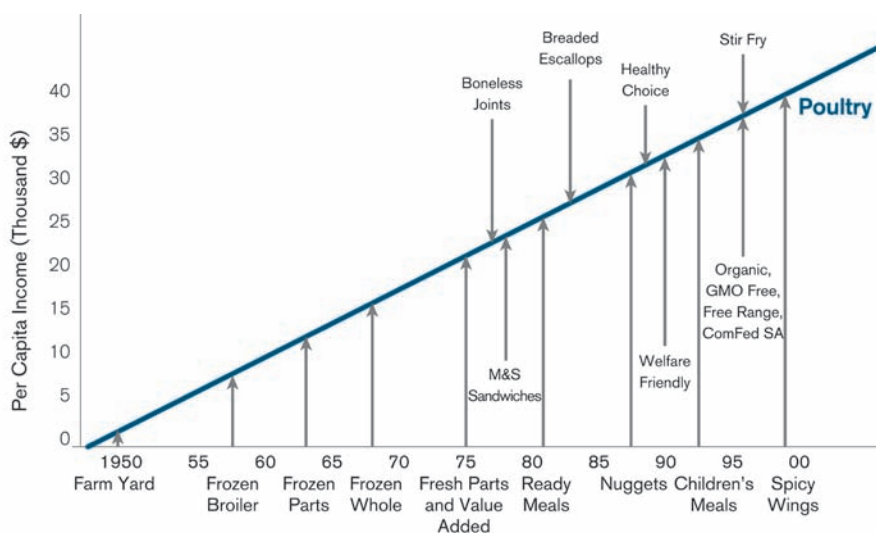
### Consumption Pattern Shift: Supermarkets and Fast Food



Source: Euromonitor International, 2006

The graph below illustrates the trend towards purchasing foods with a greater level of preparation as countries develop and incomes increase.

### As Countries Develop, Diets Diversify



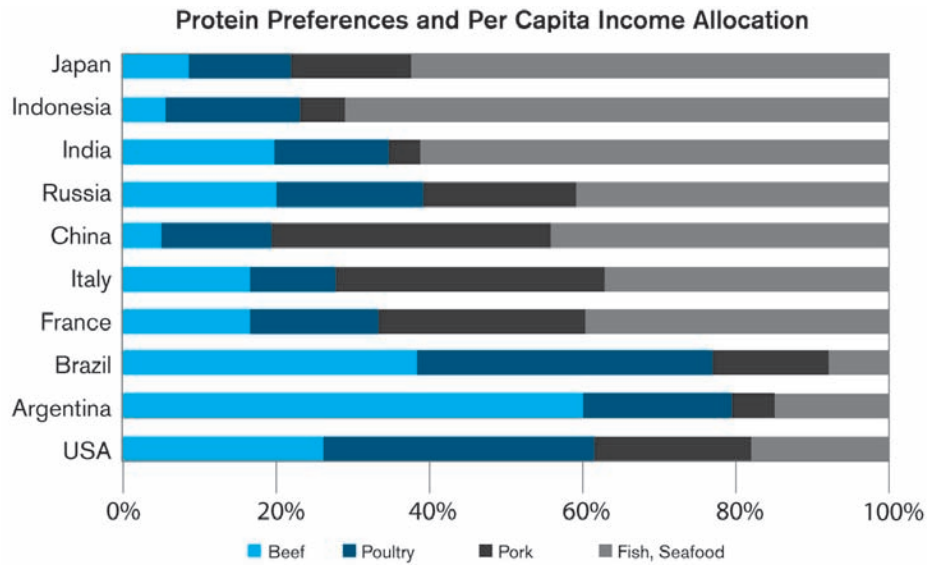
Source: FAPRI, 2007

Developing countries will drive the growth of protein demand over the next decade. The explosive growth of developing countries will be balanced by the slow growth of mature economies; nevertheless growth will be constant. As consumers transition to the higher income segments (quintile 3 and above), they will increase the diversity of their diets. This will drive the steady growth of protein demand and ultimately, methionine inclusion.

### III. Choice

Food preferences vary widely around the world, particularly in relation to protein. For example, in Eastern Europe the top protein preference is poultry, but travel to Argentina and beef is the clear preference. Varied protein preferences translate to different growth patterns in methionine consumption by world area.

The chart below outlines protein preferences in selected countries based on per capita income allocation.



Source: FAPRI, 2008 and Novus Analysis

We have established that countries with populations shifting toward income quintile three will lead protein demand over the next decade. The map below illustrates some countries in the world with a large percentage of their populations emerging as income quintile three, who also have large consumer populations with a preference for poultry. These countries will be key to the growth of methionine over the next decade.

### Emerging Middle Class Populations with a Preference for Poultry



Source: Dr. Paul Aho, 2010

## IV. Raw Materials

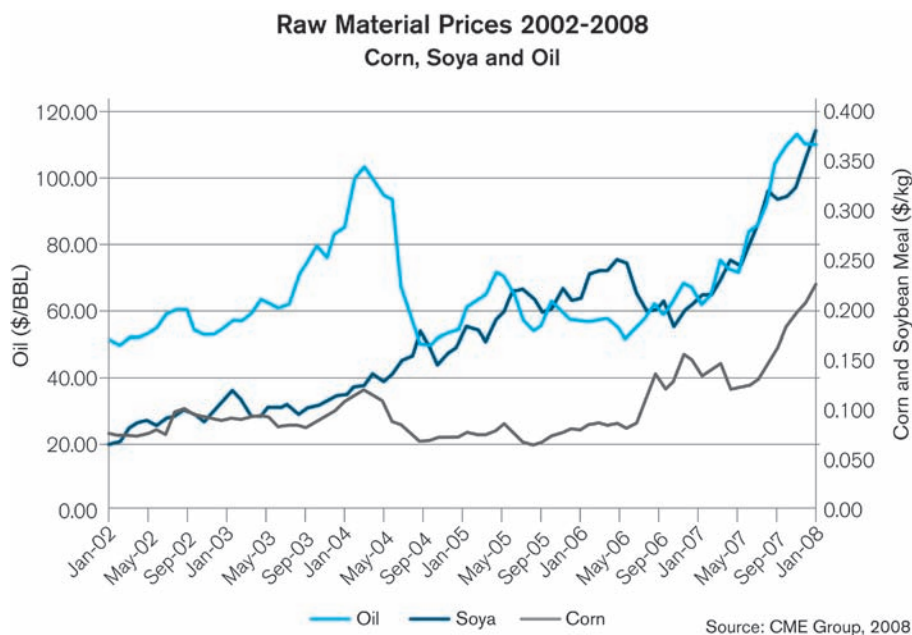
### A Decade of Volatility

Since early 2002, fluctuations in production, trade and stocks of agricultural commodities have been unusually large. Over this period, an index of monthly-average world prices of wheat, rice, corn and soybeans rose 237%, then declined 40% and in late 2009 stood at about 115% above the January 2002 level.

From January 2002 to mid-2007, the price index of these four commodities rose 79%. A number of factors contributed to this increase:

- Strong global economic growth and rising per capita incomes stimulated demand. Slower trend growth for crop yields were followed by weather-reduced harvests in a number of major producing regions in 2006 and 2007, constraining production.
- Rising energy prices increased costs of production, processing, transportation for agricultural products and also stimulated production of biofuels.
- The value of the U.S. dollar declined, which put upward pressure on commodity prices denominated in dollars.
- The allocation of U.S. corn stocks toward ethanol production rose from 10% in 2002 to 31% in 2008.

The graph below illustrates the volatility in raw material prices over the past decade.



In mid-2007, some exporting countries began imposing export restrictions in the hope of controlling their own domestic inflation. These actions further reduced exportable supplies in the global marketplace. Some importing countries became anxious about their ability to obtain supplies and adjusted their policies to facilitate more imports. The result was an additional short-term boost in global demand and further upward pressure on world commodity market prices.

From January 2002 to their individual peaks in 2008, prices rose more than 250% for corn, nearly 300% for soybeans, 330% for wheat and over 400% for rice. Livestock protein production adjusted based on these shifts in raw material prices. Record high prices of these raw materials led to a sharp, short-term reduction in the production of livestock.

High raw material prices and a reduction in livestock production were accompanied by slowing world economic growth and then a global recession. In 2008 and 2009, world agricultural production responded to high prices and good weather with large harvests. During the last half of 2008, total world use of bulk commodities, including feedstocks for biofuel production, continued to rise but global stocks of grains and oilseeds still rebounded 27%. As a result, crop prices fell from their peaks.

## Biofuels

### Biofuel Production Around the World: 2009-2018

**EU.** The EU has established a mandate that renewable fuel sources account for 10% of the transportation sector's energy use by 2020. The USDA projections assume that the EU increases its domestic oilseed production and its imports of oilseeds and vegetable oil from countries in the former Soviet Union (FSU) and non-EU Europe to boost biodiesel production. The EU is also projected to import biofuels, especially biodiesel from Argentina and ethanol from Brazil. Nevertheless, only 60% of the mandate is assumed to be achieved from annual-crop feedstocks by 2019, with ethanol's share of biofuel use growing from 28% today, to 35% by 2019.

**Brazil.** Sugarcane is the feedstock for nearly all of Brazil's ethanol production. In southern Brazil, some land has shifted from grain and oilseed production to sugarcane. The projections assume that this trend continues, but at a slower pace. Biodiesel production is also projected to expand, using soybean oil as the feedstock.

**Canada.** Canadian biodiesel production, mostly from rapeseed oil produced in the Prairie Provinces, is projected to more than double during the next half decade. Ethanol production is also projected to expand, but not as rapidly.

**Argentina.** Argentina's production of biodiesel is assumed to more than double during the projection period. Currently, nearly all biodiesel production is exported, most of it to Europe. However, Argentina initiated a 5-percent-biodiesel mandate for their domestic market in January 2010 and the domestic use of biodiesel is assumed to grow rapidly from a small base. However, by 2019 about two-thirds of its production will still be exported.

**Non-EU Europe and the former Soviet Union.** This region is assumed to respond to the EU's increasing demand for biodiesel by expanding rapeseed production. In the FSU, rapeseed production more than doubles during the projections. Some of the production gains are destined for export to the EU, either as rapeseed oil or as rapeseed for crushing in the EU.

**China.** In 2008, about 3 million tons of corn was used to produce fuel ethanol in China. China has implemented policies to limit the expansion of food-grain-based ethanol production for transportation fuel use, and is now focusing on the use of non-grain feedstocks such as cassava.

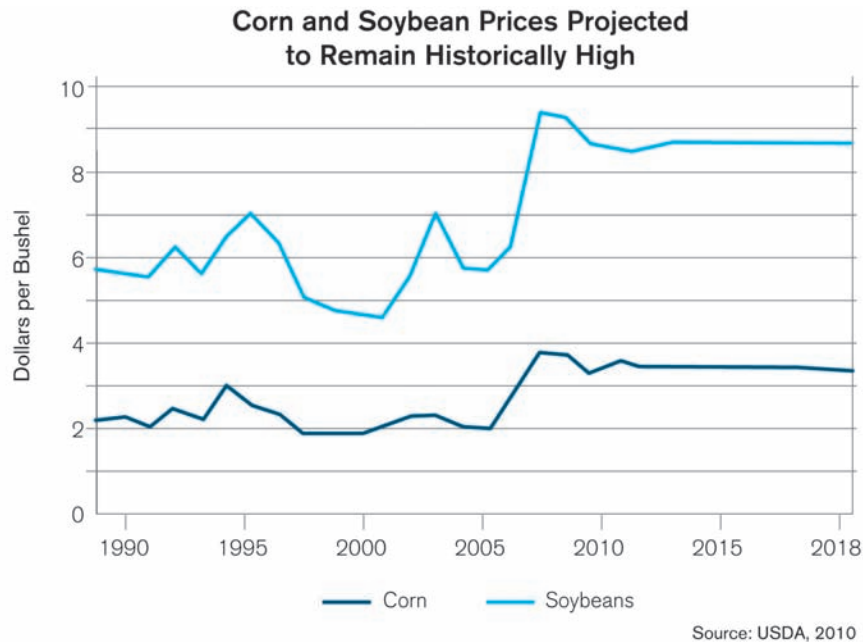
USDA, 2010

## The Next Decade

Increasing population and income levels in developing countries will also increase the demand for grains and oilseed products. Food consumption and feed use will be particularly responsive to income growth in those countries, with movement away from staple and/or traditional foods toward an increased diversification of diets. Demand from developing countries will be further reinforced by population growth rates that are nearly twice those of mature countries.



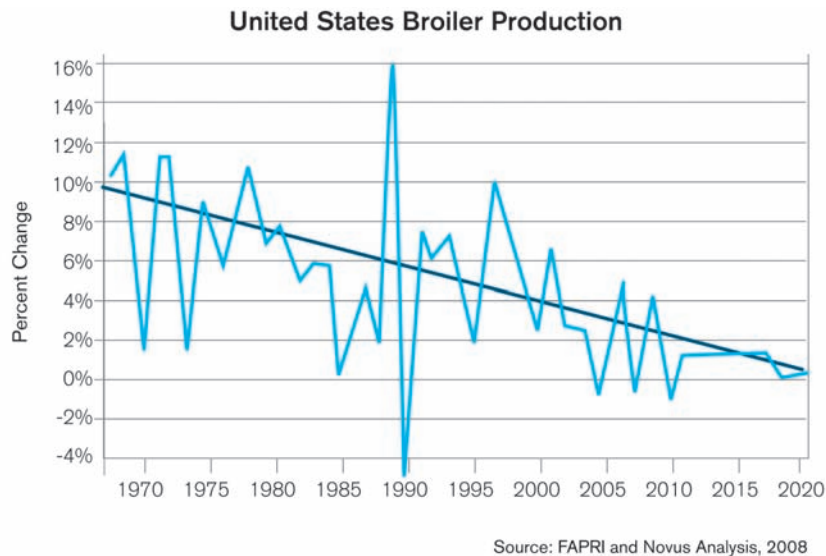
Agricultural prices are estimated to remain above pre-2006 levels. Over the next decade there will be an increase in demand for grains, oilseed and livestock products. Furthermore, energy prices will remain high and biofuel production will continue to grow. These combined factors contribute to higher agriculture prices, the graph below illustrates these projections for corn and soybeans.



### Livestock Production and Commodity Volatility

Short-term production volatility in protein markets will continue to be an ongoing reality. This volatility will be caused by many factors, including the price of raw materials. Looking historically and into the next decade, the overall trend for protein production is growth. Volatility may create drastic shifts in demand year over year but the relative CAGR is steady growth across ten year increments.

The graph below highlights the volatility of broiler production (1970-2020) and demonstrates the expected 2.0% CAGR beyond 2009.





Raw materials are projected to settle at a new, higher price level. Over the next decade, producers will look to technologies related to optimized nutrition and genetics that will support them in gaining the most from their investment.

## Raw Material Quality and Amino Acid Digestibility

Amino acid supplementation is critical to formulating nutritious animal diets in industrialized operations around the world. Amino acids are particularly important in areas of the world where there is variance in the digestibility, quality and type of feed ingredients. In developing countries, producers are often forced to create diets based on a limited selection of low quality feed ingredients. It is typical in these regions for feed ingredients to lose nutritional value due to aging and the associated challenges, including the presence of mycotoxins (exacerbated in tropical climates).

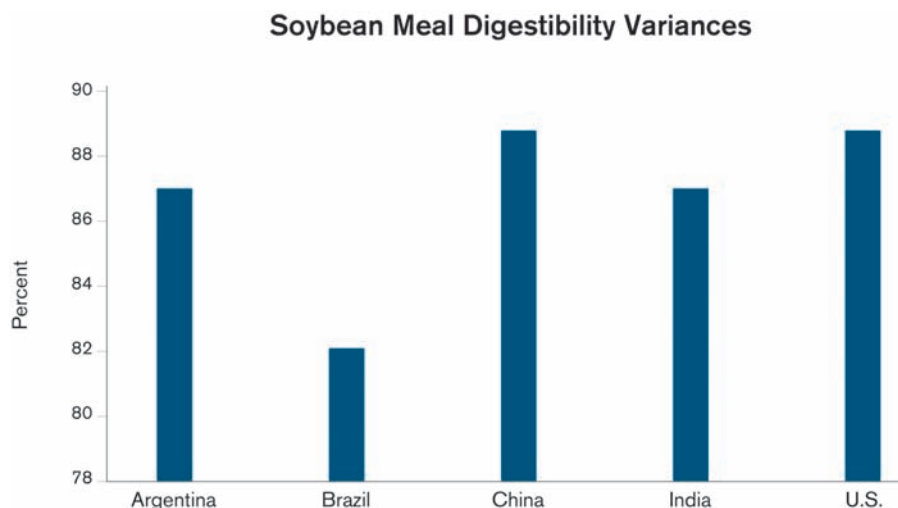
Another element of variability is the use of alternative ingredients, for example cassava or sorghum. Alternative ingredients are often less digestible than corn-soy diets and require high levels of amino acid inclusion to achieve nutritional balance. Finally, the digestibility of raw materials can vary based on the source country due to differences in growing conditions and processing technologies.

### Soybean Meal Digestibility Variances Among Major Producing Countries

Soybean meal accounts for approximately 62% of the protein ingredients used in diets of all food-producing animals. The world's soybean crop is being raised primarily in 5 countries: U.S. (42%), Brazil (24%), Argentina (16%), China (8%) and India (3%). It is important for producers to understand that there can be variation in raw material quality and composition between producing countries. Growing conditions and processing technologies to which raw materials are exposed have an effect on the digestibility of amino acids. A study conducted by the University of Illinois (2005) highlighted this fact, using soybean meal as an example.

Soybeans were obtained from the five leading soybean-producing countries (Argentina, Brazil, China, India and U.S.) and processed into soybean meal under uniform conditions. The results of the study indicated that soybean meal from Argentina (average, 87%) and Brazil (average, 82%) were less digestible than the soybean meals produced in China (average, 89%), India (average, 87%) and the U.S. (average, 89%). These differences in true amino acid digestibility among countries might offer a competitive advantage to producers with knowledge of the highest quality soybean meals available on the market.

The graph below highlights digestibility variances between leading soybean meal producing countries.



Source: University of Illinois, 2005

## V. Nutrition

### **The Importance of Balanced, Nutritional Livestock Diets**

A strategic approach to nutrition is critical for producers working to keep their livestock healthy and productive. Feed ingredients are an enormous investment to the producers' business operation, up to 70% of total operating costs. Nutritional strategies can help to protect and maximize this investment.

Challenges which can be managed directly through nutrition include:

- Optimizing Feed Utilization
- Minimizing Structural Problems
- Optimizing Feed Costs
- Enhancing Reproductive Performance
- Reducing Feed-Borne Pathogens
- Supporting Optimal Digestive Health
- Preventing Feed Toxins
- Creating Enhanced Food Solutions

### **The Economics of Synthetic Amino Acids and Least Cost Formulation**

When assessing the "value" of synthetic amino acids and using least cost formulation software, it is always useful to consider the shadow price. For synthetic amino acids, the shadow price indicates the price at which the amino acid will be dropped by the least cost formulation and replaced with amino acids sourced from protein ingredients such as soya, meat/bone meal and fishmeal. Therefore the gap between the actual price and the "shadow price" could indicate the "opportunity cost" that a synthetic amino acid represents.

As an example, compare the shadow price for lysine and methionine using a standard diet from the U.S. The shadow price for both synthetic amino acids is higher than their actual price. This indicates that in both cases, synthetic amino acids are cost efficient. Synthetic amino acids allow us to formulate poultry diets with greater efficiency and at a lower overall formulation cost than if we were to rely on protein ingredients alone.

Looking at the shadow price assures us that synthetic amino acids are truly cost effective. Synthetic amino acids allow us to formulate our overall diets more efficiently and the alternative amino acid source would mean higher overall diet costs.

### **Formulating for Amino Acid Digestibility**

Aside from cost, formulating with synthetic amino acids provides a higher level of digestibility to animal diets. Protein ingredients have inherent variation in amino acid levels and hence digestibility. Through the use of synthetic amino acids producers can be assured of a greater consistency in performance and feed efficiency.

**Livestock Nutrition and Production Costs**

Feeding animals is the largest overall input cost in an industrial livestock production environment. For example, when the average per kg cost of growing a chicken is 89¢, 58¢ are allocated for feed ingredients and 31¢ are allocated for all other production costs.

The price of amino acid inclusion in relation to the total cost of production is very small. In the case of the average per kg cost of growing a chicken (89¢), methionine accounts for 1¢ of the per kg investment. The efficiency of feed to protein conversion varies drastically among livestock segments. Poultry and aqua are by far the most efficient segment from a production perspective. The graph below summarizes estimated production costs for the U.S., Brazil, Thailand and the EU.

**Estimated Production: Cost per Live Kg**

Per Live Kg	U.S.	Brazil	Thailand	EU
Chick Cost	\$ .11	\$ .09	\$ .09	\$ .15
Grower Cost	\$ .11	\$ .10	\$ .08	\$ .14
Feed Ing.	\$ .58	\$ .57	\$ .75	\$ .84
Catch & Haul	\$ .03	\$ .04	\$ .04	\$ .04
Other	\$ .04	\$ .04	\$ .04	\$ .05
Total	\$ .89	\$ .85	\$ 1.02	\$ 1.25

Source: Agristats, November 2008

Due to variances in the length of production cycles and the efficiency of conversion, there are significant differences among livestock segments in relation to grain and water consumption. In a comparison to beef, dairy and pork, poultry is the most efficient from the perspective of production requirements.

**Average Production Requirements:  
Beef, Dairy, Pork, Poultry**

Animal	Grain to 1 kg Protein (kg)	Water to 1 kg Protein (liters)	Production Cycle (days)
Beef	5.0	15.4	18 months
Pork	3.0	5.0	180 days
Poultry	2.0	3.6	40 days

Source: Dr. Paul Aho, 2010

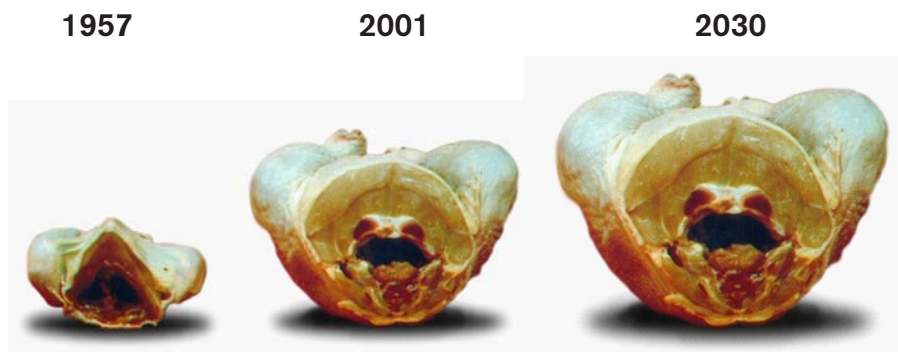
It is important to note that the data above, related to feed/protein conversion and production requirements, is based on average performance in an industrialized operation setting. In developing countries where small farm operations are still common and widespread, conditions are variable, infrastructure can be limited, raw materials are often low quality and animal nutrition programs are not optimized due to lack of resource. The level of industrialization of an operation directly and drastically impacts animal performance. It would not be typical to see the level of performance described above in a small farm operation.

## VI. Genetics

In 1988 the average weight of a broiler was approximately 2 kgs, today the average weight is nearly 3 kgs. Broiler weights are projected to continue to increase yearly over the next decade at a rate of 0.06%. This is important from a per kg of protein/per squared meter ratio as related to operating costs for industrialized production environments.

Weight increases have been achieved through the strategic application of genetic technologies and nutritional supplementation, which enable livestock to reach their maximum weight potential. Proper nutrition and amino acid supplementation are fundamental to achieving genetic potential.

The photograph below illustrates the genetic improvements in poultry over the past four decades and projected into the future.



Source: Havenstein, et. al, Journal of Poultry Science 2003 and Novus Analysis.

The ongoing improvement in broiler weights over the past 20 years has been dramatic. Additionally, average broiler hatchability, an indicator of reproductive performance, has continued to improve over the past decade. Producers look to genetics and nutrition technologies for improved growth rates, feed conversions and meat yields.

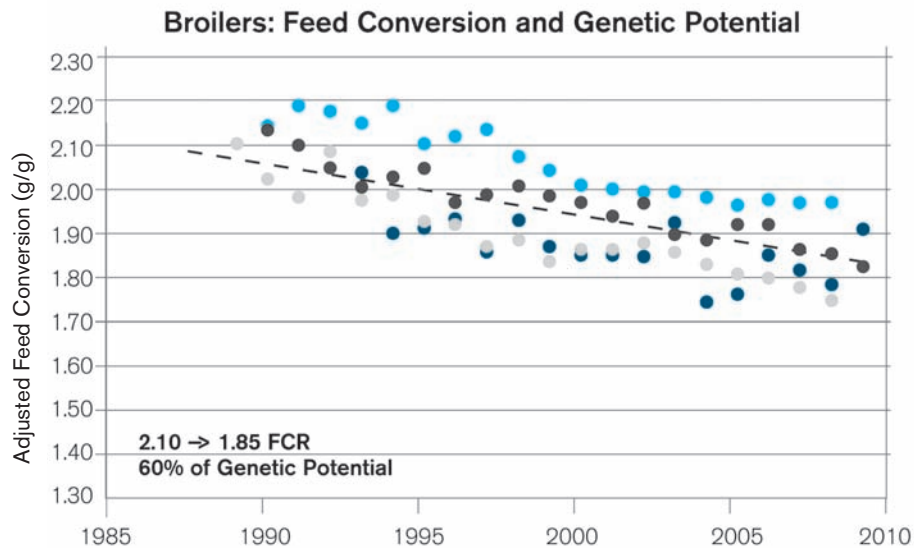
In the 1960's through the 1980's, most of the focus of genetics technology in the broiler industry was on selection programs with criteria that were relatively easy to measure, including: egg production, hatchability, growth rate and feed conversion. As economies around the world have matured and consumer preferences have changed over the past decade, genetic technologies have shifted toward programs to support the demand for food service and processed food products.

Over the past 15 years, the production time for a broiler to reach 2.3 kg live weight has decreased by more than a week. Birds reach target weights 16.3% sooner than they did in 1992. The broiler industry continues to gain an additional day of improvement every two years.

Despite the great leap forward in genetic technology, the poultry industry has not come close to achieving the full genetic potential of broilers.

Strategic nutrition combined with quality genetics, are the key to achieving an animal's full potential. Today broiler producers are not maximizing animal health, financial investments or profitability.

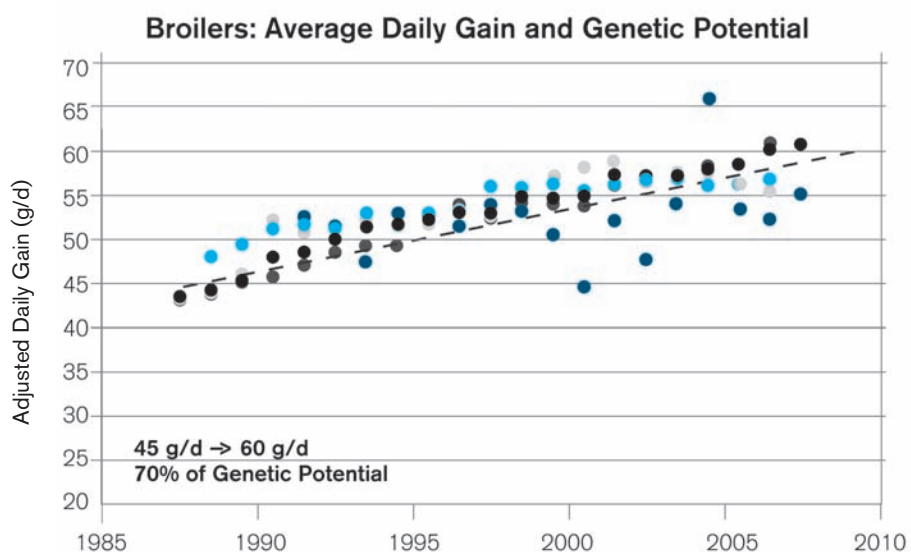
The graph below illustrates the fact that, based on a sampling of industrial operations in major poultry producing countries, only 60% of the feed conversion that is genetically possible is being achieved.



Source: Aviagen, 2010

Nutrition strategies related to the optimization of amino acid balance and feed conversion can help close the gap and bring animals closer to their genetic potential.

The graph below, based on a sampling of industrial operations in major poultry producing countries, illustrates that 70% of genetic potential in relation to average daily gain in broilers is being achieved.



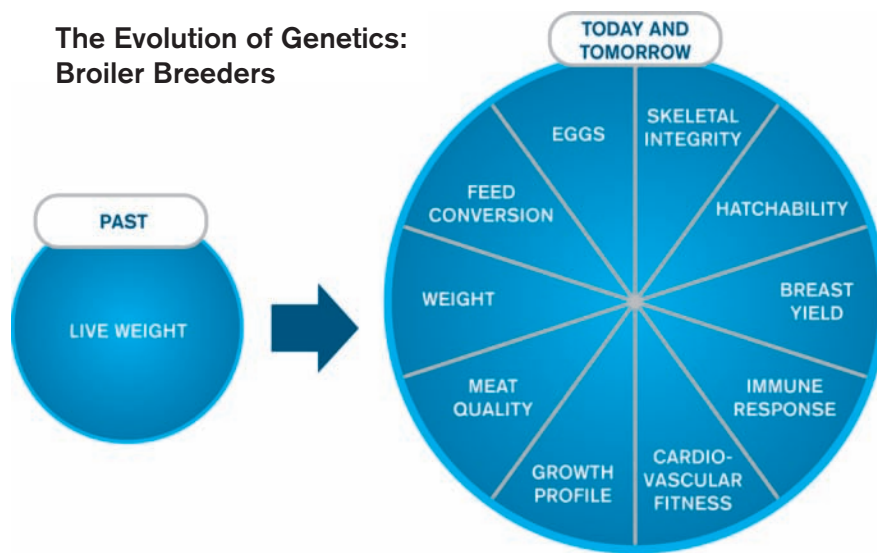
Source: Aviagen, 2010

## Over the Next Decade

Geneticists today are leveraging new technological tools to create industry solutions around challenges including poultry health, feed conversion efficiencies and meat yields.

A combination of genetics and nutrition have taken the protein industry a long way over the past decades in regards to increased protein output through increased weights. Over the next decade, livestock weights will continue to increase, as will the addition of strategic genetic applications that will further increase the efficiency of protein production by solving common business problems.

The graphic below illustrates the work of geneticists today as they move towards strategic applications that will solve business problems while continuing to increase weights.



Source: Aviagen, 2010

The demand for protein has risen rapidly over the past ten years (CAGR 2.0%) and will continue to grow over the next decade (CAGR 1.6%). Poultry will grow at a higher rate than the protein industry as a whole over the next decade, at around 2%.

The demand for methionine is proportionate to the demand for protein, poultry in particular. As a result, the methionine market will grow at a rate of 2% or slightly higher over the next decade. The total methionine market is projected to increase from the current size of 685-700 KMT to 870-890 KMT by 2018.

Poultry is the most efficient and economical source of protein on earth. When comparing nutrition strategies, there is no better alternative than the use of synthetic methionine to support poultry's growth over the next decade.

### Market Drivers

The following global factors are the major drivers for protein demand and ultimately, methionine:

- |               |                   |
|---------------|-------------------|
| I. Population | IV. Raw Materials |
| II. Income    | V. Nutrition      |
| III. Choice   | VI. Genetics      |

### Population: Increasing

The number of people on earth is rising by 75 million people per year (1.0% CAGR). The majority of this growth is occurring in developing countries where incomes are rising and as a result diets are diversifying. This growth equates to a doubling of the global demand for food by 2050.

### Incomes: Increasing

The consumption of protein can be correlated to the purchasing power of the population. By 2030, 1.15 billion people will have joined the ranks of the middle class and 90% of these people will live in what are now developing countries.

### Choice: Increasing

As incomes rise and consumer choice expands, the demand for a broader food portfolio will grow, particularly for proteins such as meat, seafood and dairy products.

## **Raw Materials: More Stable, Higher Price**

Agricultural prices are projected to remain above pre-2006 levels during the coming decade as a result of the increasing world demand for grains, oilseeds, livestock products, continuing high energy prices and further growth in biofuels production.

## **Nutrition: Critical to Sustainable Business**

The importance of nutritionally balanced livestock diets becomes very important as producers work toward strategies to maximize the return on investment for feed ingredients and to meet the growing global demand for protein at affordable costs.

## **Genetics: Increasing Efficiency**

Through the next decade livestock weights will continue to increase as nutritionally improved and balanced diets are optimized for current and future breeds. Nutritional strategies will reduce the gap between current and potential performance, as geneticists continue to select for more efficient traits.

## **Conclusion**

Global protein production will follow global protein consumption. The fastest growing segments of the protein industry are poultry and aqua, due to their production efficiency and accessible price points. Growth of these segments will consequently drive the consumption of amino acids, particularly methionine.



