CONNECTIONS 2012: Soybean Market Scan

A Report for
United Soybean Board - CONNECTIONS 2012

November 7, 2012
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1. EXECUTIVE SUMMARY

1.1. Context

- The US continues to be a major player in global soy markets, primarily as an exporter of soybeans.
- Domestic demand for soybean meal and soybean oil remains very important, but most of the growth has been, and will continue to be, in exports of beans and of animal products based on consumption of domestic soybean meal.
- Significant opportunities have arisen in China, and this has been the focus of attention in recent years. Exports to China now account for roughly one quarter of US production. This growth is anticipated to continue as China further expands its animal production.
- US soybean and soybean meal sales to other export markets have stagnated over the past decade, and soybean oil exports have declined.
- Competition in export markets remains tough as South American soybeans and soybean products increase their market share. Brazil is the main competition in the Chinese soybean market. Brazilian and Argentine soybean meal sales compete with US exports of beans and meal to the EU market and elsewhere.
- The US animal feed market continues to be a major customer for US soybean growers, but the growth in this market has been negligible due to weak demand for meat and displacement by DDGS. That displacement may have run its course, permitting a resumption in growth for soy meal.
- However, US animal agriculture production is under pressure from a number of different quarters - e.g. environmental, animal welfare, and labor costs.
- Domestic soybean oil demand has held up due to biodiesel. Future growth will depend on having oil with improved characteristics.
- In general, in recent years soybean growers have experienced very positive financial rewards from growing soybeans. The product is subject to strong meal and oil demand factors worldwide which benefits the price of soybeans. It is anticipated that this positive environment will continue, but there is still much for the industry to work on.

1.2. Implementing the strategy

- Connections 2012 is an opportunity for USB and its industry partners to identify the most promising areas in which to work for the collective benefit of all over the next two years.
- Connections 2010 identified eight projects for collaboration and all received some amount of USB funding.
- The strategy process involves the following:
  - Defining the overall goals, which USB has already done;
  - Identifying constraints that are in the way, and opportunities that can be captured;
  - Designing the activities that form the components of the program in which each contributes towards overcoming constraints or capturing opportunities.
- The broad strategy is well defined: “Create and maintain partnerships that differentiate and increase the utilization of U.S. soy in a changing global market.”
• It is operationalized through the following strategic objectives: increasing the value of US SBM and SBO to the entire value chain, ensuring the freedom and infrastructure to operate, and meeting customer needs with quality soy products and services.
• The following graphic shows the key points of focus and action areas.

1.3. **Major issues**

1.3.1. **Creating additional supply**
• We are able to sell everything we produce at good prices.
• To improve grower profitability through volume, one has to either increase yields or expand planted area.
• Breeding is mostly in the hands of private firms, but USB and public sector research can contribute at the margins.
• There is evidence that the best available technologies for producing soybeans are not universally in use, so there is also scope for producer education to improve yields and/or profitability relative to other crops.

1.3.2. **Creating incentives to service differentiated markets**
• While commodity markets will always be the main focus, new opportunities will arise as soybeans with novel characteristics become available.
• Major varietal innovations that result in reduced production costs will be rapidly adopted. Varietal innovations that offer benefits in new markets will be adopted far more slowly. The rate of adoption will depend upon the potential price premium, and the additional costs of servicing these markets. Small market segments will be more expensive to service because of the absence of economies of scale and higher per unit cost of the investment in segregation.
• The crusher and processor environment comprises a relatively small number of large companies. These are sophisticated, well-resourced players with wide international experience. Their decisions drive much of the development in the sector. They must see potential premiums exceeding the investment and operating costs, at least in the medium term.
• Component pricing would incentivize some farmers to adopt varieties and production practices that maximize revenue under that system. But testing methods and segregation capability are not up to that challenge and demand signals are often unclear (especially for non-lipid component).
Figure 1: Key Points of Focus

**Aim:**
\[\Delta \text{US SB farmer incomes}\]

**Production**
- Breeding
- Crop management
- Ag policies
- Regulations affecting farm/ex-farm costs

**Feed**
- No. of animals
- SBM content
- Soy conc. & isolates use

**Food**
- Soy oil use
- Soy protein use

**Industrial**
- Soy oil use
- Biodiesel

**Biodiesel**
- Soy oil use

**Food beans**
- Foreign crushers and other users

**Action areas**
- Gain investment in:
  - Improved varieties;
  - Basic/applied research
  - Education/extension
  - Supportive policies

- Gain supportive regulatory framework:
  - Environmental
  - Transportation
  - Investment in infrastructure

- Communicate & change behavior:
  - Feed formulators
  - Feed companies
  - Integrators

- Research, communicate & change behavior:
  - Food manufacturers
  - Nutritionists
  - General public

- Gain supportive regulatory framework:
  - Governments and agencies

- Communicate & change behavior:
  - Biodiesel companies

- Gain supportive regulatory framework:
  - Potential investors in soy-based industrial
  - Regional & national government agencies

- Communicate & change behavior:
  - Demand for meat

- Gain supportive regulatory framework (health claims):
  - Food manufacturers
  - Foodservice

- Research, communicate & change behavior:
  - Potential investors in soy-based industrial
  - Regional & national government agencies

- Communicate & change behavior:
  - Food bean trade
  - Food bean processors
  - Consumers

- Gain supportive regulatory framework incl. market access:
1.3.3. Supporting animal agriculture in the United States

- Animal agriculture in the United States is under pressure. In particular, popular sentiment is negative, prompted by generalized observations on the components of a healthy diet, and by negative perceptions of animal husbandry practices. Consequently, growth in meat consumption per head has stalled. These negative influences may become stronger and further constrain growth in meat consumption.

- US meat exports continue to increase despite numerous market access constraints. Meat importing countries are highly sensitive to quality and animal disease issues and introduce trade barriers for both legitimate and illegitimate reasons. Consequently, there is a considerable challenge to the US meat industry to both advocate science-based trade policy rules and seek adjustments on the part of the domestic production and processing sector to meet market needs. The success of US meat exports brings benefits to soybean growers.

- Clearly, it is in the best interest of soybean growers to assist the US animal agriculture sector to fight for market access and market share. Various evaluations suggest that this is money well spent.

- The threat to continuing growth in the domestic animal agriculture sector is of considerable concern to the soybean industry. This critically important market is on the doorstep and is not subject to competition from soy-based products from other origins. However, strong competition from other protein and oil sources suggests that soybean interests need to continue to fight for their share of this feed ingredient market.

1.3.4. Ensuring product qualities that maximize market opportunities

- The intrinsic properties of soybean meal – high crude protein content and a favorable balance of amino acids – have made it the leading protein source for animal feeding. It is possible to increase protein content and/or modify the amino acid mix, but it is not clear who would capture the value from such changes. Moreover, supplementation with synthetic amino acids can be an economical alternative.

- Modification of the lipid profile has been successful in a number of cases. High oleic varieties are the latest to be commercialized. If they prove to be more profitable for growers, crushers, and refiners by better meeting customer needs, we could see other specialty soybeans follow.

- Sustainability is an important criterion for some customers. There are three critical components (a) identifying the appropriate metrics and required calculations; (b) gaining global acceptance of the calculations, and (c) communication of the outcomes (if positive or if negative, with interpretation).

- The Keystone Alliance report in July 2012 documented various criteria showing the progress of a number of key sustainability measures of US soybean production.

- Genetic modification has limited the acceptability of US soybeans and soybean meal to some non-traditional and traditional international customers.

1.3.5. Reducing or eliminating obvious constraints

- The US logistical system absorbs a portion of what customers are willing to pay for soybeans and soy products, and in some cases virtually prevents some movement due to capacity limits. Increasing the efficiency and capacity of the system will pay dividends to soybean growers.
• Foreign trade barriers facing US soybeans and products are lower than for some other US agricultural exports but are still an important problem to address, as are barriers to meat exports.

1.3.6. Differentiating US product
• It is challenging to differentiate US product quality given the wide range of influences. Differentiation should be based on the merits of the entire US supply system. The US product/service package has clear benefits to be promoted.
• Consumer perceptions of soy have been becoming less positive and more negative. It is critical that the industry project the positive science based attributes of soy and its contributions to a healthful and safe food supply.
• Competitiveness varies from year to year. Promotion packages should be prepared to be applied to situations where the US is more competitive and less competitive. The former focuses on sales, the latter on sustaining a positive image.
2. OVERVIEW AND CONCLUSIONS

2.1. Connections 2012 and Target Area Goals

The biannual Connections meeting provides an opportunity to rethink the challenges and opportunities facing the soybean industry, review the accomplishments over the two years since the last such meeting, and explore how soybean growers, their industry partners, and their associations can best work together to move the industry forward in the years ahead.

The United Soybean Board staff tasked Agralytica with the assignment of preparing a “market scan” that will serve as background and help focus the discussions at the Connections 2012 meeting. A “scan” can range from being encyclopedic at one extreme to being incomplete and superficial at the other extreme. We have tried to strike a balance that highlights key points of focus and action areas that offer the potential of activities for the common good of all in the soybean sector.

As at the last Connections meeting in 2010, participants will identify the key issues facing the sector and will explore ways of working together to address those issues. The 2010 Connections meeting identified about 20 objectives for possible collaboration and investment and then homed in on the two most promising in each of the following four topical areas: soybean oil, soybean meal, distribution channels, and freedom to operate. The group then defined concrete measurable sub-objectives, who would work on them, budget requirements, and timelines for each of the eight areas. These are summarized in Table 1 and all of these have subsequently received some degree of funding from USB.

The current Board has restructured the way in which it organizes the work of the organization. In the past, the work was mostly allocated among standing committees, like Domestic Marketing or Production Research, and among shorter-term initiatives or task forces, like the Aquaculture Initiative or the Value Task Force. Now, perhaps echoing the structure of the last Connections meeting, the Board has defined four Action Teams - oil, meal, customer focus, and freedom to operate - and four Target Areas - Domestic Opportunities, International Marketing, Supply, and Communications.

In each Target Area there are Target Area Goals that may fall under a single Action Team or under several Action Teams. For example, “D4. Quality - Ensure quantity and quality of U.S. soybeans to sustainably

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<th>Area of investment/collaboration</th>
<th>Budget</th>
<th>Timeline</th>
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<td><strong>Oil</strong></td>
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<tr>
<td>1. Continue to be cost-competitive, reliable supplier</td>
<td>$9 million</td>
<td>3 years</td>
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<tr>
<td>2. Replace current commodity soybean with high oleic variety</td>
<td>$7-15 million/yr</td>
<td>10 years</td>
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<td><strong>Meal</strong></td>
<td></td>
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<tr>
<td>1. Standardized measurement of amino acids and necessary equipment</td>
<td>$2.5 million</td>
<td>2-3 years</td>
</tr>
<tr>
<td>2. Targeted consumer education on animal ag based on trust and support</td>
<td>$ leveraging opportunity</td>
<td>Ongoing</td>
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<td><strong>Distribution Channels</strong></td>
<td></td>
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<tr>
<td>1. Comprehensive Farm to Customer Transportation Study &amp; backhaul movements</td>
<td>$3 million</td>
<td>1.5 years</td>
</tr>
<tr>
<td>2. Explore collaborative opportunities with other transportation stakeholders</td>
<td>$2 million</td>
<td>1.5 years</td>
</tr>
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<td><strong>Freedom to Operate</strong></td>
<td></td>
<td></td>
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<tr>
<td>1. U.S. Farmers and Ranchers Alliance, CFI and Common Ground</td>
<td>$5.5 million</td>
<td>Ongoing</td>
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<tr>
<td>2. Prioritizing regulatory opportunities and threats</td>
<td>$400,000</td>
<td>1 year, ongoing</td>
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Supply global markets” has components that fall under all four Action Teams, while “I4. Sound Science - Increase the awareness of globally-recognized sound science associated with U.S. soy with regard to biotech, food safety and security and sustainability” is just applicable to the Customer Focus and Freedom to Operate teams.

USB’s current activities encompass roughly two dozen Target Area Goals. At the most recent Board meeting they ranked those goals within each Target Area. The goals that were highest ranked in each area were the following:

**Domestic**
1. D4. Quality - Quantity and quality to supply global markets (Component measurement & sustainability)
2. D2. Feed - Increase value of soybean meal in domestic feed (Demand and meat export targets)
3. D5. Component value - Capture greater value for all soy sectors (Component value marketing platform)

**International**
1. I4. Sound Science - Increase awareness with respect to biotech, food safety, sustainability
2. I5. Trade barriers - Develop resources and educate foreign governments and stakeholders
3. I2. Customer Preference - Engage foreign buyers to get them to prefer and buy US soy

**Supply**
1. S1. Yield Production - Increase and capture greater portion of yield potential (research, management)
2. S5. Quantity and Quality - Increase production to sustainably supply markets (composition and management)
3. S6. Yield Research - Identify molecular pathways which enhance yield potential

**Communications**
1. C4. Leverage - Collaborate with QSSBs and value chain to ensure consistent messaging
2. C5. Customer Awareness - Grow farmer awareness of end-use customers and their needs

In light of the Board’s ranking of priorities, we paid particular attention to these twelve in conducting our market scan.

**2.2. Implementing the strategy**

**2.2.1. Purpose of the market scan**

Soybeans continue to play a critical role in the world food system as a source of both vegetable oil and protein. Demand for fats and oils and for oilseed meals is growing significantly faster than demand for grains or for other food crops like pulses, potatoes or sugar. Oilseed meal demand is driven by the strong growth in demand for livestock, poultry and dairy products as people strive for a better diet. In the case of fats and oils, government-driven renewable fuel programs have only added to the strong underlying demand stemming from the effects of economic growth around the world.

US soybean growers have benefited from this strong world demand. While the US share of world soybean output has declined as production in South America has expanded, the size of the US soybean crop continues to grow due to a combination of rising yields and increased plantings. Production has been consistently profitable in recent years.

US soybean growers contribute one-half percent of sales revenue to industry organizations that seek to improve the bottom line profitability of producing soybeans. The efforts of the United Soybean Board and state soybean organizations run the gamut from basic research, to market development, to improving the customer experience with US soy products.
Deciding how to allocate the financial resources is challenging for these organizations because there are many alternatives. Some have the potential for immediate impact while others address longer-term challenges. Some focus on domestic market opportunities while others are aimed at foreign customers. Some address the supply side, and some the demand side for soybeans, for meal, or for oil. In addition, in many cases you can only succeed if you involve other players in the system - crushers, traders, government agencies, and your customers.

Our assignment from the United Soybean Board has been to provide a “scan” of the soybean marketplace to serve as background for planning and carrying out the Connections 2012 meeting in December. It draws primarily on existing studies, rather than undertaking new research.

What is a scan? It could be anything from a complete description of the world to a mere outline of the main characteristics. In the current case, we have tried to focus on USB's key target area goals - describing what is happening in the relevant industry segment, the ability of USB and its industry partners to affect the outcome, and the priority that we think each should be given. Others will come to different conclusions about priorities, but that is part of what Connections 2012 will be about. Indeed, our own staff often did not agree.

There are a number of different ways to organize one’s thinking about priorities. USB currently has four broad strategic objectives, described in shorthand as meal, oil, customer focus, and freedom to operate. Breakout sessions at the Connections meeting will be organized around those strategic objectives. One can also think of priorities in the classical framework of supply versus demand, with the latter broken down among human, animal and industrial demand. Then there is the geographical dimension. Much of USB’s past work has been divided between domestic markets and international markets, partly for institutional reasons. We have tried to recognize each of these dimensions in our market scan.

The overall goal of USB is to improve the opportunity for profits of soybean growers. Our aim in producing this report has been twofold: to provide a review of the challenges that face US soybean growers and their customers in both domestic and international markets, and to highlight where cooperative efforts with other organizations might be most fruitful in facing those challenges.

The starting point for implementing any strategy is to fully understand the factors influencing the soybean sector and particularly those that can be modified by USB efforts. There are many critical factors that influence the success of US growers in many markets over which the USB has no influence. For example, it cannot affect the availability, quality or cost of South American soybeans, it has no impact on exchange rates that can affect relative prices, and cannot affect the level of demand for different transportation services and their prices. However, it can impact a wide range of factors that contribute to the competitiveness of US soybean growers and soybean products and hence the revenue achieved from the crop.

In very broad terms, the soybean industry has done well in recent years. However, there are a number of issues that have held back the soybean sector generally and studies of these issues have provided an opportunity to review the nature of the challenges and the extent to which they can be overcome by the activities of the USB and its stakeholders.
2.2.2. Points of focus and action

Board members ranked the Board’s 24 Target Area Goals at the July 2012 meeting, giving a good sense of the collective priorities in the domestic, international, supply and communications areas. The three leading goals in each area were as follows:

- **Domestic**
  - Quality - Ensure quantity and quality of U.S. soybeans to sustainably supply global markets
  - Feed - Increase value of soybean meal in domestic feed
  - Component Value - Capture greater value from U.S. soybeans for all sectors of the soybean community

- **International**
  - Sound Science - Increase the awareness of globally-recognized sound science associated with U.S. soy with regard to biotech, food safety and security, and sustainability
  - Trade Barriers - Develop credible resources and educate foreign governments, influencers and stakeholders to improve market access and resolve trade barriers
  - Customer Preference - Engage foreign buyers with information and tools that help impact their profitability and drive preference for U.S. soy

- **Supply**
  - Yield Production - Increase soybean yield potential and capture a greater proportion of yield potential
  - Quantity and Quality - Ensure quantity and quality of U.S. soybeans to sustainably supply global markets
  - Yield Research - Identify molecular pathways which enhance yield potential

- **Communications**
  - Leverage - Collaborate with QSSBs and value chain to ensure consistent messaging and leveraging of resources
  - Customer Awareness - Grow U.S. farmer understanding of end-use customers and their changing needs
  - Acceptance - Increase acceptance of today’s agriculture by non-ag audiences

The target area goals are presented as activities. The constraints or opportunities they address are implicit.

There is currently a strong focus on improving the quality and value of US soybeans, and communicating that to customers. Of the dozen target goals above, four are related to that objective. And of the dozen target area goals that were not ranked as highly, another four fall into that category: differentiation, branding, feed value capture, and composition.

In identifying the main areas of action, we have developed the following simplified conceptual structure. It elaborates the major areas of action of an organization involved in enhancing the incomes of soybean farmers. There are two main areas of action.

The first is to create a positive climate for soybean production. Here the focus falls on breeding research, optimizing crop management, ensuring a positive agricultural policy environment, and ensuring that the various regulations do not impede production or post-harvest processing and distribution.

The second is to improve the value of the crop and here it is necessary to undertake activities that increase the demand for soybean products included in feed, food, industrial products, and biodiesel.
Different challenges are faced for enhancing the demand for both the protein and lipid content. The value of the crop can also be increased for beans that are not crushed (primarily for food) and for beans and products that are destined for export markets.

In the following figure, those boxes within the light green shading are the key points of focus. For example, these include the number of animals on feed, SBM incorporation levels in the feed, soy oil use in various foods, etc.

On the right-hand side of the diagram, we outline the potential areas of action. These are all phrased in terms of communication tasks, although we differentiate between advocacy and market development communication. We acknowledge that in marketing terms this may not be a valid differentiation. In both cases, one identifies a target and communicates a message to bring about change. In the former case, the change one is looking for is the introduction or modification of federal, regional, or state regulations and their implementation. In the latter case, one is looking for changes in corporate or individual decisions such as investments, product formulations, or consumption. (These can overlap, as when government agencies are investing in research.) Those potential areas of action that involve mainly advocacy are in blue boxes; those involving market development are in red boxes.

The key components of any strategy are the links between the potential areas of action and the key points of focus. The link is provided by the identification and definition of constraints and opportunities. In other words, the USB and its partners need to identify precisely who they are targeting, and what is the message to bring about the desired change. The following sections review each of these areas and identify in broad terms the nature of the constraints and opportunities and the extent to which the USB and its partners can address these to bring positive change to the economic well-being of US soybean farmers.

Another key consideration is identifying who is responsible to undertake activities that confront constraints and capture opportunities. Several of the more serious constraints are best addressed in collaboration with other state and national soybean organizations and other interest groups working for the benefit of the soybean industry. In fact, USB has defined its central strategy in terms of creating and maintaining collaborative relationships with other organizations. This is best undertaken by joining with them to identify the nature of problems, to participate in joint discussions on how best to overcome these problems, and to initiate activities that can provide solutions.

We acknowledge that the figure does not comprehensively identify all the key points of focus or potential areas of action. However, we use it to be able to clarify the main areas on which the USB and its partners should be focusing.
Figure 2: Key points of focus and action

Aim: ∆ US SB farmer incomes

Production
- Breeding
- Crop management
- Ag policies
- Regulations affecting farm/ex-farm costs

Value of crop
- Feed
  - No. of animals
  - SBM content
- Food
  - Soy conc. & isolates use
- Industrial
  - Soy protein use
- Biodiesel
  - Soy oil use
- Food beans
- Foreign crushers and other users

Action areas
- Gain investment in:
  - Improved varieties;
  - Basic/applied research
  - Education/extension
  - Supportive policies
- Gain supportive regulatory framework:
  - Environmental
  - Transportation
  - Investment in infrastructure
- Communicate & change behavior:
  - Demand for meat
- Research, communicate & change behavior:
  - Feed formulators
  - Feed companies
  - Integrators
- Gain supportive regulatory framework (health claims):
- Communicate & change behavior:
  - Food manufacturers
  - Foodservice
- Research, communicate & change behavior:
  - Potential investors in soy-based industrial
  - Regional & national government agencies
- Gain supportive regulatory framework:
  - Governments and agencies
- Communicate & change behavior:
  - Biodiesel companies
- Communicate & change behavior:
  - Food bean trade
  - Food bean processors
  - Consumers
- Gain supportive regulatory framework incl. market access:
2.3. The soybean situation

Soybeans have been a success story not only in the United States but worldwide, accounting for a rising percentage of the area committed to grain and oilseed crops. This is attributable to the combination of strong world demand for protein and oil, and the productivity improvements that have enabled soybeans to be one of the most profitable cropping options for farmers.

Figure 3: World soybean area and share of principle crops

Source: USDA PS&D

Figure 4: US soybean area and share of principle crops

Source: USDA PS&D
2.4. Supply

The supply challenge is to produce and deliver a greater quantity of soybeans and soybean products that meet customer needs while maintaining the profitability of all along the supply chain. Profitable soybean production relies on the availability of better varieties, improved crop management, and sound, supportive agricultural policies. Customer acceptability depends on the intrinsic characteristics of the soy products, and in some cases on other factors like the sustainability of production. Delivery to the customer depends on an adequate transportation system.

In each of these areas, there is much to be researched and promoted. The breeders and government departments supporting fundamental research need to continue to appreciate the importance of focusing their resources on improving the productivity and value in use of new varieties. Federal and state authorities play an important part in supporting farmers through research and extension activities. Farm policies have been adjusted to take account of national priorities and budget limitations. It is essential that policymakers appreciate the importance of a safety net for agriculture despite the current positive farm business environment. Soybean production profitability could be impacted by the imposition of regulations that do not fully take into account the efforts of many to apply good management practices.

Constraints/opportunities: There are a wide range of constraints and opportunities to be confronted that affect production:

- Ensure that those responsible in the public and private sectors for the funding of fundamental and applied breeding research are aware of industry needs and implement actions to meet those needs.
- Ensure that those responsible in the public and private sectors for the provision of fundamental research and extension are aware of the production challenges that face soybean farmers and direct resources to provide solutions.
- Ensure that those responsible in the public sector for developing and implementing policies are fully aware of the measures necessary to promote the efficiency of soybean production and its competitive position.
- Ensure that regulations affecting the use of crop inputs by soybean farmers do not constrain farmers from implementing good management practices that result in efficient, sustainable production without adverse effect on environmental goods.
- Work to educate the public and government officials about the importance of maintaining and improving the transportation network on which soy product movement relies, including waterways, railroads, and road systems.
- Continue to seek elimination or reduction of market access barriers facing US soybeans and products in foreign countries.
Supply: Invest in research to increase average yield

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One of the most direct paths to increasing the profitability of the sector is to increase the total volume that can be marketed. Research to accelerate the growth in average yields is an investment that pays off, and should be a high priority for both USB and its industry partners. But it is the partners that have the ability to actually have a significant impact.

Supply: Educate growers on best management practices

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Not all growers are aware of the best research on varieties and crop management, so there is much that could be done to raise the productivity of the average soybean grower and reduce environmental impacts. This can have a double-barrelled impact on profitability, both raising yields and reducing production costs. USB, QSSBs, universities, and USDA extension staff could all contribute.

Supply: Improve soybean composition

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Some customers would assign a higher value to a soybean with higher crude protein or oil content, or a better amino acid or lipid profile. Willingness to pay for it has been limited though, and could be a challenge to overcome.
Supply: Capture more value all along the chain

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The concept of developing a component value marketing platform to incentivize production of soybeans with higher intrinsic value to users and a better return to producers is appealing but has proven challenging to implement. It warrants continued exploration with leveraging of partnerships through the soybean chain.

Supply: Demonstrate sustainability of soybean production

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The Keystone report was a good starting point in providing measurable environmental metrics, but more needs to be done on the socioeconomic and environmental aspects of soy production to ensure that customers with sustainability concerns rate US soybeans highly. This remains a fruitful area for collaboration.

Supply: Increase freedom to operate internationally

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The logistical barriers to exporting are well known and need to be addressed if US exporters are to remain competitive in the world market. We capture the full benefit of the expansion of the Panama Canal only if other parts of the transportation infrastructure have equal capacity. That will allow us to improve competitiveness with South American producers who will also eventually benefit from the canal expansion. Access barriers in foreign markets must also be tackled.
2.5. Animal utilization

Global and domestic context

- Global meat consumption is growing rapidly. Poultry meat is growing at twice the rate of pork. Soybean meal is a well-accepted, highly regarded ingredient in global animal rations.
- The domestic US meat market offers less potential in terms of growth than the export market. The soy sector should help the US animal agriculture sector
  - overcome constraints on consumption growth;
  - fight regulations that constrain efficient responsible animal production management.
- However there is a potential for US meat exports to expand. The export market development efforts of the animal agriculture sector need to be supported.

Export markets - priorities and differentiation:

- The competitive environment has become tougher. There is potential for South American production to expand in terms of area and efficiency. The competition is tough for both the bean and the meal market.
- Most US exporters of beans and meal are international companies that originate supplies from the US, Brazil or Argentina. They see this as a strength enabling them to match market needs to available supply. They are unlikely to be strong advocates of US product differentiation. In any case, it is difficult to meaningfully differentiate US product attributes.
- There is a strong case for soybean growers to fund export market development activity that differentiates the US in terms of the attributes of the US supply system and not the specific soybean or soymeal product.
- The US remains a strong supplier of beans to China, but has lost its share in other bean markets. The US position in China needs to be consolidated in the face of intense Brazilian competition.
- Soybean Meal market competitiveness in export markets varies considerably from year-to-year. This demands flexibility in market approach from year-to-year. There is more opportunity to educate and develop new relationships in immature markets than in mature markets.
- Export market development requires the continuing development of trading relationships between US business units and potential buyers, improving market access (and fighting trade policy advantages of competitors), focusing US promotion on product/service areas where the US has advantage (container trade), and promoting the merits of the US supply system.

Meeting animal agriculture’s needs:

- Soybean breeders have the capability of producing improved varieties with enhanced value as a feed ingredient. However, there are major constraints on commercializing these products in volume. The market will determine whether component value systems will develop. The proposition must be attractive to the hog and poultry farmer, the feed mill, the crusher, and the soybean farmer. All need to continue dialogue on new product opportunities.
To encourage more rapid adjustment, assistance is required to sustain production efficiency, breeding efforts, and the development of rapid and accurate soy product quality measurement systems. Critically, all stakeholders in the sector supply chain need to understand what can be done and the potential benefits and costs of transitioning to a system where more value can be extracted from US soy products sold to animal agriculture.

**Animal agriculture: Promote more meat exports**

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As domestic meat consumption is static, the opportunities for increasing the sales of soybean meal to the domestic animal production sector depend on supporting the growth of meat exports. Meat consumption is expanding rapidly in many less-developed countries and US meat exporters need the full support of the US soy sector. The focus of support should be those animal species that are the main consumers of soy products.

**Animal agriculture: Increase soy product use in aquaculture**

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Fed aquaculture is increasing rapidly. However, growth is very limited within the United States. US soybean farmers have been effective in promoting wider use of soybean meal in aquaculture. Sales to the sector should grow as production expands. Soybean meal is limited in its application to carnivorous fish and to crustaceans. The development of close alliances with Asian companies producing soy products with higher protein content and lower anti-nutritional factors should be a priority.
Animal agriculture: Customer focus - promoting a positive image of the US animal agriculture sector

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The US meat consumer is an indirect customer of the US soybean sector. Meat consumption is growing very slowly in the US. Moreover, some vocal consumer groups apply simplistic criteria when choosing specific foods, raising concerns about the impact on health, animal welfare, and the environment, and constraining advancement of the US animal agriculture sector and its US soybean suppliers. Support to the meat industry’s efforts to overcome this constraint is essential.

Animal agriculture: Freedom to operate - ensuring regulations do not constrain an efficient, responsibly managed animal agriculture sector

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Regulation is part of the fabric of today's society where different groups have to coexist. No regulation should adversely affect those farmers’ responsibly managing livestock. Soybean farmers should assist the animal agriculture sector in supporting the development of a regulatory framework that promotes profitable animal agriculture.

Animal agriculture: Differentiate US beans and meal in domestic and foreign markets

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It is challenging to differentiate products in a market with commodity characteristics, especially when US product attributes are not necessarily superior to those from other origins and when the leading exporting organizations also originate from other countries. However, there is an important role for US soy farmers in developing a positive image for the US supply chain that increases confidence in US product. Differentiation should be based upon the positive attributes of the US supply chain - efficiency, reliability, and flexibility - as well as the specific attributes of soybeans and soy products originating from the US.
Animal agriculture: Increase value of soybean meal to animal agriculture

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Many factors affect the value of soybean meal to animal agriculture. Animal agriculture is increasingly focusing on detailed nutritional quality of its basic raw materials. Feed companies are content to purchase commodity meal and supplement the overall nutritional package with other ingredients. Soybean meal could offer much more - better protein quality and digestibility, fewer anti-nutritionals, and reduced environmental impact - but the incentives to modify the quality of soybean meal have not been developed and are currently insufficient to bring major changes in soybean or meal quality. A clear indication of the benefits to crushers, feed companies, and animal agriculture is required.
2.6. Human utilization

Soybean oil is the principle soy product consumed by humans and is a key component of the total world supply of fats and oils. Soybeans are consumed primarily in the form of tofu and other fermented bean curd products although soy milk has also become popular in recent years in some countries. Soy protein in the form of concentrates and isolates is the third main way that people consume soy. Small amounts of soy in the form of pharmaceutical or nutraceutical products are also consumed. In terms of generating a return to the soybean grower, it is the future of soybean oil consumption that will have the biggest payoff. That will be influenced both by its inherent qualities and by the general image of soy as a part of the human food supply. That image has begun to deteriorate due to a proliferation of negative commentary on social media. Some of that commentary is related to biotechnology but other strains related to health are equally troubling and need to be combatted.

Soybeans and soy protein: Soybeans have been a part of Asian cuisine for centuries and most of the world’s use of soybeans directly in preparation of food items is in Asian countries. USDA estimates food use of soybeans in selected countries at about 6% of world soybean disappearance. Factoring in use in the United States and other countries not included in the USDA estimates pushes that estimate up to about 7% of world use. While food use is growing, its share of total disappearance is gradually declining because demand for soybean meal for animal feed is growing more rapidly. Nevertheless, food use soybeans are an important niche market for US soybean growers, and identity preserved marketing channels have been developed to serve those customers, whether domestic or foreign.

The US market has historically had little sensitivity to the issue of genetic modification. Consequently, soy has been widely consumed without concern about this issue. One of the key issues for future human consumption of soy products is whether people continue to accept biotech soybean varieties as equivalent to soybean varieties developed with traditional breeding techniques. It is important for USB and its partners to continue efforts to increase awareness of sound science and the positive attributes of soy worldwide and particularly in Europe. Communication efforts must also continue here at home to counter negative commentary on soy and biotech food ingredients.

Soybean oil: Soybean oil competes at home and abroad with a variety of fats and oils. Animal fats like lard and tallow are a byproduct of meat production and their supply is not much influenced by developments in the larger vegetable oil market. In contrast, plantings of oilseed crops and oil palm are directly influenced by demand factors influencing vegetable oil prices.

Soybean oil continues to be the dominant oil in the domestic market, thanks in part to biodiesel. In 2011/12 it accounted for 55% of total disappearance of fats and oils, down from 65% a decade earlier. It was displaced by canola, palm oil, and palm kernel oil. The combined share of those three oils grew from 9.2% ten years ago to 22.7% last year. The clear trend in the domestic market is away from soybean oil. Reversing that will require giving customers a reason to prefer soy, whether those customers are the final consumer, food processors, or restaurants. High priority should be given to researching and commercializing high oleic and other specialty soybeans so that soybean oil can compete more effectively with other vegetable oils.

Pharmaceutical and nutraceutical products: Given Americans’ predilection for dietary supplements, nutraceuticals will be where the bigger opportunity lies. Bioactive ingredients like isoflavones can be key ingredients in functional foods that address chronic conditions like diabetes and heart disease. Some effort to identify and commercialize bioactive soybean ingredients may prove fruitful but it is not a high priority.
Human utilization: Increase the awareness of the sound science associated with US soy with regard to biotech, health, food safety and sustainability

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Consumer aversion to biotech soybeans is a long-term threat to the US industry that needs to be addressed if soy is to retain its generally favorable image. Other negative commentary on soybeans and health is also worrisome. The favorable attributes of US soy need to be aggressively promoted in both the domestic and international markets and social media.

Human utilization: Promote high oleic and other improved soybean oils for food use

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Food use of soybean oil continues to represent a declining share of US fats and oils disappearance while canola and palm oil gain market share. Gaining back share will require a long-term effort to provide customers with oils that meet their diverse needs.

Human utilization: Develop new pharmaceutical and nutraceutical products

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These products currently account for a tiny share of soybean demand but are high value and capable of contributing to the positive image of soy in the marketplace. Research in this area merits some degree of support, but with recognition that it will not be a major market driver.
2.7. Industrial utilization

Biodiesel is the major industrial use of soy oil. Several other industrial uses for soy are gaining traction. Soy based solvents, coatings, lubricants, and bioplastics have established markets and uses. Several of these markets have good growth potential from the established markets already served.

Soy based solvents are price competitive, equal in performance, and are safer for humans and the environment. The major driving factors for soy-based coatings are the reduction in VOC’s. Currently, the low or no VOC market tends to be niche oriented and high prices tend to be the limiting factor. Regulatory mandates may serve to open this market further.

Soy based lubricants represent a wide variety of products each with its own market. The emergence of high performance conventional and synthetic oils with higher price points makes soy lubricants more competitive. Similar price points and performance help tip the scales in favor of the bio-based alternatives in purchasing decisions.

Bioplastics have met with good success. There are two basic types of plastics, biodegradable and non-biodegradable. The market for biodegradable plastics is small but continues to make progress; however the market for non-biodegradable plastics is where the real growth is expected to happen. Some industry analysts in the plastics sector think that soy will quickly replace petroleum in non-biodegradable plastics.

Some of the newest uses with excellent market potential are soy based rubber and soy-based polyurethanes. Soy polyurethanes include foam and insulation applications. Soy foam has been in use by Ford Motor Company in seat cushions since 2008. Over 2 million vehicles have been produced with BioFoam.

New bio-based spray-on insulations compete against conventional spray-on insulations and fiberglass insulations. However, because of the manufacturing process, the safety concerns regarding carcinogenic chemicals and flammability remain the same for soy-based and conventional polyurethanes.

Soy-based rubber represents a good market opportunity. Initial testing reveals increased tire tread life. In addition, export opportunities to the EU and little in the way of manufacturing process changes mean that the industry has several incentives and low costs to adopt soy as a replacement for some of its petroleum usage.

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<td>Priority</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Biodiesel has been an important safety valve for what might have been excess soybean oil supplies as the food sector eliminated trans fats. Now the linkage to petroleum prices is a key supportive factor for the soybean oil price. Maintaining the status of biodiesel production and mandates is a high priority.
Industrial utilization: Increase industrial soybean oil use

<table>
<thead>
<tr>
<th></th>
<th>USB</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Priority</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

There are many industrial applications for various soy oil components and new ones are in the pipeline. Soy based rubber, foam and lubricants represent potentially excellent opportunities for growth. Investments in the most promising applications will likely yield long-term results.

Industrial utilization: Increase soybean meal component use

<table>
<thead>
<tr>
<th></th>
<th>USB</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Priority</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Soybean meal components are not applicable to many industrial applications. The few applications that have proven commercially usable have good environmental characteristics, but have not replaced petroleum substitutes. The limited number of applications makes expansion in this area challenging.

Industrial utilization: Promote preferences for bio-based products

<table>
<thead>
<tr>
<th></th>
<th>USB</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Priority</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Expansion of the BioPreferred program can make more soy-based products available to federal agencies. Expansion of state level programs can also have moderate impacts on the usage of soy-based products. Working with state and federal governments to expand programs can increase the variety and volume of soy-based products.
3. HOW ARE SOYBEANS DOING WORLDWIDE?

Soybeans have been a success story worldwide. While production of all oilseeds has been growing, soybeans have been growing slightly faster. In the 1990s, soybeans represented 50% of world oilseed production. Recently that share has been in the 55-60% range. A wide range of disparate supply and demand factors influences the value of the meal and the oil in the soybean. In both cases, the net effect has been very positive and this has resulted in a marked increase in the area planted to soybeans in North and South America and around the world.

3.1. Land competition

Worldwide, soybeans compete with other major field crops for land. Figure 5 shows global soybean area harvested and its share of cropland. Soybeans have become relatively more important since the 1970s. In recent years, the growth in the area harvested and relative importance has accelerated, reflecting the increasing value of the soy protein and oil components. This is a very favorable market environment for US soybean growers.

Figure 5: World soybean area harvested (million hectares) and share of all grain and oilseed area (percent)

The global soybean harvested area in the early 1970s was less than 30 million hectares and now exceeds 100 million (one hectare equals almost 2.5 acres). Soy's share of total global grain and oilseed harvested area rose from 3.7%, in 1970, to 11.4% today. This share is likely to continue to rise as animal product consumption increases with an impact on demand for animal feed ingredients like soybean meal.
3.2. Soybeans vs. other oilseeds

Demand for soybean meal and oil continues to grow rapidly worldwide as demand for animal products and fats and oils increases in response to rising incomes and aspirations. While soybean meal has encountered new competition from DDGS (Dried Distillers Grains with Solubles) in recent years, the main surge in DDGS availability is probably behind us. Soybeans will benefit from future growth in demand for vegetable protein.

While the production of all the principal oilseeds had been growing steadily, soybeans have consolidated their position as the leading oilseed crop. They accounted for 54% in 2011/12 down from 59% of world oilseed production in 2009/10. Rapeseed is second with almost 14% and has remained stable over the last few years. Cottonseed and peanuts are the next most important, although their meals are of minor importance in feed use. The ‘other’ category in Figure 6 includes sunflower seed, copra and palm kernel.

![Figure 6: 2011/12 world oilseed production](source: USDA WASDE)

3.3. Soybean meal vs. other protein meals

Figure 7 and Figure 8 below illustrate the soybean dominance of protein meal supply. With its comparatively high protein content it accounts for 67% of total protein meal production (including fishmeal). Rapeseed is second with 13%. Cottonseed and sunflower meals make up similar percentages in the market, 5-7%. Palm kernel meal and peanut meals account for 2-3% each, fishmeal accounts for 2%, and copra accounts for just 1% or less.

Other protein sources are used in animal feeds such as animal by-product meals, urea, synthetic amino acids, and various cereal by-products. In addition, corn, wheat, and other energy-supplying feed ingredients also contain some protein - generally in the seven to twelve percent range. More recently, the growth of corn ethanol production has produced a substantial volume of DDGS, which has gained an increasing role in animal feeds. The availability of a consistent quality DDGS product has increased considerably as ethanol plants have recognized the importance of gaining value from the DDGS as a feed ingredient. It offers both energy and protein components and has affected soybeans’ position in the market to some degree.
3.4. **Soybean oil vs. other vegetable oils**

Palm and palm kernel oils are now the leading vegetable oils with about 36% of the market (see Figure 9). Soybean oil is second with 27%. World demand for vegetable oil continues to increase at 4.0-4.5 percent per year. Vegetable oil prices tend to move together, with palm oil as the least expensive. While Malaysia has only limited area available for expansion, the other leading producer is Indonesia, which is still expanding its output.
World demand for vegetable oil has surged due to renewable fuel subsidies and mandates, and crop producers are still adjusting to this. In the longer term, when supply catches up with demand, oil prices may return to a lower share of crush value, but this will affect high oil content seeds like rape and sunflower more than it affects soybeans.

Figure 9: World oilseed oil production by type, 2007/08 - 2011/12

Source: USDA ERS Oil Crops Yearbook

3.5. Soybeans in the world food system

Oilseeds contribute both vegetable oil and protein to the world food supply, and as noted above, soybeans are the leading oilseed. Table 1 provides a rough overview of the world’s basic food supply in 2011/12 (excluding fruits and vegetables). We compiled this from various sources, including USDA, FAO, and Oil World. We broke out animal and industrial use only where it was relevant and in a few cases we made our own estimate of the division among types of use.

Direct consumption of oilseeds by people is small at 34 million tons, compared to the 2 billion tons of cereals, root crops, and sugar that people consume. The direct consumption includes about 17 million tons of soybeans that are mostly consumed as tofu or other fermented products. Peanuts account for most of the rest.

Oilseed meal is used almost entirely in animal diets where it looms much larger, accounting for 20-25% of total concentrates fed. Of course, cattle and other ruminants consume large volumes of forage crops in addition to concentrate feeds and a wide range of food industry byproducts. Soybean meal is two-thirds of the total oilseed meal.

Vegetable oils and animal fats are an important part of the food supply as both a consumption item and a cooking medium. They are also a key input to the renewable fuel sector. Soybean oil represents about 20% of the fats and oils supply. Other oilseeds have higher oilseed content, and palm oil is a very competitive non-seed oil.
The world could get along without soybean oil, but not without soybean meal because of the major role it plays in the world protein supply. Table 3 lists the crop and animal products that supply protein to either humans or animals or both, along with their typical crude protein content in percentage terms. Those percentages are applied to the tonnages in Table 2 to get the protein available to humans and animals in the last two columns.

Animals consume about 200 million tons of crude protein via the listed products. Humans consume 264 million tons, of which about 55% is from plant products and 45% (or 117 million tons) is from livestock, poultry, and fish products. Thus, in round numbers it takes about 2 tons of protein in feed concentrates to produce one ton of protein in livestock products. Moreover, the value of soy protein depends heavily on the cost of competing vegetable proteins and the prices of the animal products that are ultimately produced.

### Table 2: World food system

<table>
<thead>
<tr>
<th></th>
<th>Human Consumption</th>
<th>Animal Consumption</th>
<th>Industrial &amp; Seed Use</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>475</td>
<td>135</td>
<td>72</td>
<td>682</td>
</tr>
<tr>
<td>Rice</td>
<td>465</td>
<td></td>
<td>465</td>
<td></td>
</tr>
<tr>
<td>Coarse grains</td>
<td>205</td>
<td>660</td>
<td>285</td>
<td>1,150</td>
</tr>
<tr>
<td>Sugar</td>
<td>165</td>
<td></td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>Root crops</td>
<td>725</td>
<td></td>
<td>725</td>
<td></td>
</tr>
<tr>
<td>Pulses</td>
<td>60</td>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Oilseeds (direct)</td>
<td>34</td>
<td></td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Soybeans (direct)</td>
<td>15</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Oilseed meal</td>
<td>265</td>
<td></td>
<td>265</td>
<td></td>
</tr>
<tr>
<td>Soybean meal</td>
<td></td>
<td>175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>155</td>
<td>3</td>
<td>25</td>
<td>183</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>34</td>
<td>1</td>
<td>7</td>
<td>42</td>
</tr>
<tr>
<td>Animal fats</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Meat</td>
<td>300</td>
<td></td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>150</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td>730</td>
<td></td>
<td>730</td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>66</td>
<td></td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3,536</td>
<td>1,068</td>
<td>388</td>
<td>4,992</td>
</tr>
</tbody>
</table>

Sources: USDA, FAO, Oil World, Agralytica

### 3.6. Exchange rates

An important determinant of US export competitiveness has been the value of the US dollar in relation to other currencies. The weakening of the dollar relative to currencies of major customers like China has stimulated demand for US soy products and supported prices. And as shown in Figure 10, the dollar has weakened against the Brazilian currency, but strengthened against competing exporters in Argentina and India, giving the latter an advantage. These large swings in exchange rates are an important market factor over which USB and its industry partners have no influence.
### Table 3: World protein

<table>
<thead>
<tr>
<th></th>
<th>Percent Protein</th>
<th>Human Consumption</th>
<th>Animal Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>13</td>
<td>62</td>
<td>18</td>
</tr>
<tr>
<td>Rice</td>
<td>7</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>Coarse grains</td>
<td>8.5</td>
<td>17</td>
<td>56</td>
</tr>
<tr>
<td>Root crops</td>
<td>1.5</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Pulses</td>
<td>22</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Oilseeds (direct)</td>
<td>36</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Soybeans (direct)</td>
<td>36</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Oilseed meal</td>
<td>40</td>
<td>0</td>
<td>106</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>44</td>
<td>0</td>
<td>77</td>
</tr>
<tr>
<td>Meat</td>
<td>20</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Fish</td>
<td>17</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>Dairy</td>
<td>3</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Eggs</td>
<td>13</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Synthetic amino acids</td>
<td>100</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Byproduct feeds</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>264</td>
<td>201</td>
<td></td>
</tr>
</tbody>
</table>

Sources: USDA, FAO, Oil World, Agralytica

### Figure 10: Foreign exchange rates

**US dollar versus leading competitor currencies (base 2005)**

Source: USDA Economic Research Service
4. **HOW ARE US SOYBEANS DOING?**

4.1. **Production**

Soybean production has been rising due mainly to increased yields. The graph below shows how production and yields move together much of the time. Both production and yields have increased significantly since the 1970’s.

![Figure 11: US production and yields, 1970-2012](source: USDA NASS)

4.2. **Share of area planted**

The acreage of principle grain and oilseed crops in the United States has been relatively stable but jumped by several million acres in both 2008 and 2012 in response to high market prices. Soybean area has stayed relatively constant the last five years at 75 - 77 million acres.

However, when one looks at the longer-term experience, it is clear that soybeans have been and continue to be a success story in the United States (Figure 12). Soybeans share of grain and oilseed area planted has grown from about 27% in the 1990s to about 35% in recent years. That would not have happened if the profitability had not been there. Whether the trend continues in the future will hinge on maintaining competitiveness relative to producers’ other crop options.
Figure 12: US soybean area harvested and share of principle crops, 2007-2012

Source: USDA WASDE PSD

Figure 13: Principle crop acreage by crop, 2007-2012

Source: USDA WASDE PSD
Corn, soybeans, and wheat comprise the majority of acreage planted for food and feed crops. Of the main staple crops, corn, soybeans and wheat, corn acreage consistently occupies the largest number of acres; over 85 million. Soybean acreage grew through 2009 and has since remained steady. Wheat acreage is down from 63 million acres since 2008.

4.3. Basis

The average cash basis has been quite variable over the past decade. Figure 14 shows the September-August average of the US farm price minus the nearby futures position. If there were a “normal” basis, one would probably say it has increased from minus 10-15 cents per bushel to minus 20-40 cents. The annual average has varied from minus five cents in mid-decade when the farm price was below $6.00 to minus more than a dollar in 2007/08 when markets became more volatile. These averages are unweighted by marketing’s but are indicative of general trends. There is considerable variability from day-to-day and week-to-week.

Figure 14: Cash soybean basis: futures price minus farm price

Because of the important role played by soybean exports, another basis indicator of interest is the difference between the US farm price and the value of soybeans at Gulf export points in New Orleans. There are 12 grain elevators near New Orleans, and they export between 115 and 120 million metric tons of grains and oilseeds annually. Of that volume, almost 25% are soybeans.

Figure 15 shows that up until the world market disruptions beginning with 2007/08, the US/Gulf basis had been mostly in the 40-60 cents/bushel range. The rise from roughly 40 cents earlier in the decade to the higher levels of recent years is probably due to the combination of higher energy costs for transportation, unusually strong export demand in some years, and the higher soybean prices that mean any losses during movement have higher value. However, to the extent that world markets determine the value of soybeans at export points, any increase in the Gulf basis comes out of farmers’ pockets.
4.4. Costs and returns

USDA’s costs and returns data provide another reading on how the soybean sector is faring. The cost information is derived from USDA’s Agricultural Resource Management Survey (ARMS). Figure 16 shows the average operating costs for US soybean producers.

Operating costs were relatively constant at $80 per acre up through 2004. From 2005 to 2008, costs rose by over 50% to $128 per acre. The major contributors to the cost increase were energy-related costs like fuel and fertilizer, and seed costs. Since 2008 prices have continued to climb, but at a much slower rate.

Figure 17 shows net revenue, using harvest period prices for valuing the soybeans produced. The difference between revenue and operating costs doubled between 2006 and 2008. In 2009 and 2010, the difference remained stable before jumping $70 per acre again in 2011. Figure 18 illustrates the changes in the difference between revenue and total costs, rather than just operating costs. This was negative or breakeven for several of the years prior to 2006, but since then has risen to a level of $115 per acre. Land rental rates (included in total costs) have risen sharply in response to the improved profitability. As in the case of operating costs, the difference between revenue and total costs eased in 2009 and 2010 before increasing to almost $130 per acre in 2011.
Figure 16: Operating costs per acre

Source: USDA ERS Commodity Costs and Returns

Figure 17: Returns per acre (revenue - operating costs)

Source: USDA ERS Commodity Costs and Returns
4.5. Share of world production and exports

The US is a major player in the soybean and soy products markets worldwide. However, the US position has changed over the last 40 years since the Brazilians began growing soybeans in the 1970’s. Today the US market share is very different. We will look at the changing market share over the last 4 years. The trends are obvious even in this short period. The estimates for 2012/13 are October WASDE figures.

The US share of soybean production fell from 38% in 2008/09 to 35% in 2011/12. US production share is projected to be 29% in 2012/13.

US soybean exports fell significantly relative to other exporters in 2011/12 and are projected to fall even further in 2012/13. The US share of exports was 45% in 2008/09 and fell to 38% in 2011/12. The share of total exports is projected to be 36% in 2012/13 between. The downward trend in market share is less pronounced in the exports of soybeans.

US SBM production has lost about 2% of market share 2008/09 and 2011/12 relative to global production. Projections show a decline to 18% of soybean meal production market share in 2012/13.

The US market share of SBM exports is falling as crush capacity in China and Argentina continues to grow. US crush mills are facing leaner margins due to foreign competition. US SBM exports are not able to compete with the enormous economies of scale from Argentina’s massive crush mills and with the cheap supply of Brazilian crushed meal. US SBM exports have accounted for about 14% of total SBM exports but this is projected to fall to 11% in 2012/13. The market for SBM is very concentrated into just a few producers in a few countries. In fact, just a few companies do most of the world’s soy crushing.
Figure 19: US share of soybean production 2008/09 - 2012/13 (est.):

Source: USDA, World Agricultural Outlook Board, World Agricultural Supply and Demand Estimates

Figure 20: US share of world soybean exports 2008/09 - 2012/13 (est.)

Source: USDA, World Agricultural Outlook Board, World Agricultural Supply and Demand Estimates
As a co-product of soybean meal, soy oil production is very similarly limited to just a few geographic locations and companies. Although soy oil is still the second most used vegetable oil worldwide, competition from inexpensive palm oil is increasing, as is the production area. The oil market will become increasingly competitive as more palm acreage come into production. The US share of SBO
production has steadily fallen as other countries bring crush capacity online, primarily Argentina, Brazil, and China.

US SBO production was 24% of the market in 2008/09. The market share of production fell to 21% in 2011-12 and is projected to fall to 17% in 2012/13.

**Figure 23: US share of world soybean oil production 2008/09 - 2012/13 (est.)**

The US share of soy oil exports tends to be less stable. The US is a major consumer of soy oil and exports surplus supplies to the world market. US consumption is driven by the market demand for salad oils, baking and frying fats, and margarine, and by the biodiesel mandates. The US export market share for soy oil was 8% in 2011/12 and is projected to fall to 7% in 2012/13.
Figure 24: US share of world soybean oil exports 2008/09 - 2012/13 (est.)

Source: USDA, World Agricultural Outlook Board, World Agricultural Supply and Demand Estimates
5. THE SUPPLY CHALLENGE

In recent years, the US sells everything it produces. Carryover stocks of soybeans and soybean oil have been comparatively lean and prices have been high. This suggests that the availability of soybeans is a key issue.

There are two ways to increase farmer profitability: increase the volume sold and increase the margin between market prices and production costs. Volume and margins are also important to crushers, exporters, and others in the value chain.

The United Soybean Board and its industry partners have focused on the supply challenge in the past and can continue to have an impact. Future soybean yields depend to a large part on breeding and seed companies but there are other issues to work on. For example:

- Farmers can be encouraged to implement best management practices;
- Product quality can be improved through changes in composition of the soybean;
- More value could be captured with payment systems that incentivize growers to produce what best meets market needs;
- Other positive US soybean attributes can be documented and certified to capture additional value in domestic and foreign markets; and
- Additional value can be captured by reducing the costs of moving the product through the supply chain to the market.

5.1. Yields

Increasing yields is the result of a twofold approach, an offensive approach to increase the genetic yield potential and a defensive approach to mitigate the environmental factors that decrease yield. Environmental factors such as weeds, insects, and limited nutrients work to decrease yield. By incorporating traits that resist these factors the genetic potential can be reached more easily.

In corn genetics, double and even triple stacked traits are now commercially available. Currently soybeans are limited to single traits. The first stacked trait soybeans are anticipated within a few years, with Monsanto’s dicamba tolerance trait stacked on Round Up Ready 2 Yield (RR2Y). An additional yield gene stack is expected to be added soon after. Of course, regulatory approvals are needed to commercialize these products.

Monsanto and other companies are reported to be developing a range of novel varieties to increase resistance to key insects and diseases Figure 25. Some of the traits in the pipeline are:

- Soybean cyst nematode resistance - SCN resistance mainly comes from a soybean line called PI 88788. Researchers have observed that PI88788 only provides resistance to certain SCN types. Future traits will control multiple SCN lines. In October 2012, scientists announced that they have identified some important keys in how three neighboring genes, Rhg1, make soybeans resistant to SCN.
- Phytophthora root rot resistance - the current generation of phytophthora resistant seeds have only one resistance gene, future versions will have multiple genes.
- Aphid resistance - the next generation of aphid control traits will have two separate genes to control the insect.
5.2. Best management practices

Achieving the genetic yield potential of a soybean is dependent on many factors. Some of these factors are influenced by environmental conditions and some are a result of management. Agronomic decisions have a significant impact on yields. Management practices can be used to maximize the genetic potential yield of soybeans.

Observers of the sector suggest that there is still considerable room for improvement of yields. Yields in the range of 60-80 bushels per acre are feasible given current breeding, technology, and management practices. Management practices seem to be the limiting factor, not the genetic potential.

A Michigan State University study was published in early 2012 that analyzed the results of a six year long soybean yield contest. The purpose of the contest was to encourage farmers to innovate with new methods and to identify key management practices affecting yield. The Michigan Soybean Yield Contest collected information about management practices from 200 entries over the six-year period. The study focused on non-irrigated soybean yields since most of Michigan soybean production is not irrigated.
Differences in management practices between the highest and lowest yields were analyzed. The key differences were: planting date; tillage; planting equipment; rotation; soybean cyst nematodes; and soil pH. Each of these can be influenced by farm management and crop husbandry. Other studies from seed companies, universities, and soy organizations support these conclusions and consequently the extension of current crop management knowledge has been a priority in the sector.

Of course, each farm location is different and crop management choices have to be made to suit local conditions. The sector has considerable knowledge available to it, and a clear priority is to ensure all understand how to implement this knowledge in their local circumstances.

<table>
<thead>
<tr>
<th>Supply: Educate growers on best management practices</th>
<th>USB</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Priority</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Not all growers are aware of the available research on varieties and crop management. There is much that could be done to raise the productivity of the average soybean grower without increasing environmental impacts. This can have a double-barrelled impact on profitability, both raising yields and reducing production costs. USB, QSSBs, universities, and USDA extension staff could all contribute.

5.3. Composition

Several of USB’s high priority target area goals involve increasing the value of either the meal or the oil component of soybeans. There is also a strong interest in capturing greater value through a component value marketing platform.

This laudable objective faces various challenges. In particular, it is worth considering the possibility that the relative values of the meal and oil components of the soybean are at some sort of equilibrium that may be hard to disturb. Despite the many changes in US and world agriculture - the rise of low cost palm oil, the renewable fuel explosion linking soybean oil and petroleum prices, the strong growth in world demand for animal products, the domestic displacement of soybean meal by distillers grains - the meal and oil shares of crush value are no different today than they were 10 or 20 years ago. The meal share has averaged 62% over the period and seldom departed more than +/-5% from that average, as illustrated in Figure 26. Clearly, the push and pull between protein and oil varies over the years.
The discussion of composition revolves first around whether one can increase the protein or meal content (or both), and second around the balance of amino acids in the protein or fatty acids in the oil. On the first count, data on the protein and oil content of US soybeans have been collected annually by staff at the University of Minnesota. The data illustrate significant regional variability in soybean protein and oil content within the United States. In Figure 27 and Figure 28, the darker blue color is higher protein or oil content and the light green color is lower protein or oil content. Protein content tends to be higher at lower latitude (south) and where there is more rain (east). Oil content is much higher in the south and lower across the north as a whole. Leaving aside the extremes, it is apparent that protein content varies regionally from 32% to 36%. Oil content ranges from 17% to 20%. And the content of both together varies from 51% to 55%, as illustrated in Figure 29. Some caution is advised in reviewing these figures. For example, recent research suggests that northerly locations such as Minnesota may have a lower crude protein, but they have a better essential amino acid profile.

A single component pricing system might imply that soybean prices in the northern states should always be 5-10% lower than in parts of the Midwest and south. But that has not been the case. There are many factors on both the supply and demand side that affect local prices, and these are summarized in the cash basis. One could certainly apply component pricing at the local level by starting with a weaker basis and adding premiums for higher protein or oil content. Thus far, there has been little trade or crusher interest in moving in that direction, partly because of segregation issues, and perhaps because they undoubtedly find some profit opportunities in the current system that might disappear with component pricing. However, it is a concept that merits continued investigation.
Figure 27: Crude protein content variation

Figure 28: Crude oil content variation
Figure 29: Protein + oil content variation

2006 - 2010 5-Year Average - Sum, Protein + Oil

Figure 30: Long-term trends in meal and oil content

Historical Protein, Oil, and Seed size (1986-2011)
Figure 30 illustrates that US protein and oil content have been falling in recent years. The figure also illustrates that an elevation in one major component of the soybean usually results in the fall of the other.

Modification of the amino acid or lipid profile and reduction of the anti-nutritional factors can also add value. Soybean meal composition has not received much attention from breeders; critically, the challenge of successfully commercializing modified meal products is much greater.

If one looks at the world agricultural system as a whole, it may well be that the relative values of carbohydrates, proteins, and lipids are somewhat fixed. As we observed in Section 3.5 the crude protein in the world animal feed supply comes not only from soybean and other oilseed meals but also from wheat and coarse grains, various grain and meat byproducts, and synthetic amino acids. The latter include lysine and methionine, the two main limiting amino acids in conventional feeds.

World production of synthetic lysine is over 800,000 tons and methionine is over 400,000 tons. These are significant quantities. The lysine content of soybean meal and corn is 2.7% and 0.24%, respectively. Therefore, the total lysine in the soybean meal fed worldwide is 4.7 million tons, and in coarse grains about 1.6 million tons. The calculations are similar for methionine. The ability to supplement standard concentrate feeds with these synthetic amino acids is thus quite significant. Depending on prices, supplementation may be more efficient than trying to increase particular amino acid levels in the soybean.

On the oil side, however, there has been considerable research and a range of novel GM events promise a range of oils with different characteristics over the next decade (Figure 31). Indeed, more has been achieved with modification of the lipid content and much more is anticipated.

**Figure 31: Pipeline of Biotech events and novel trait releases for quality/food traits**
Some breeding programs have focused on characteristics that are critical in some narrow utilizations. For example, Schillinger Genetics has been developing varieties that are appropriate for carnivorous fish. These have high crude protein content, and low trypsin inhibitor and oligosaccharides. The challenge here is gaining these characteristics without yield drag and a very high cost of procuring beans.

Supply: Improve soybean composition

<table>
<thead>
<tr>
<th>Ability to influence</th>
<th>USB</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Some customers would assign a higher value to a soybean with higher crude protein or oil content, or a better amino acid or lipid profile. Willingness to pay for it has been limited though, and consequently breeders have given it a relatively low priority. Efforts should continue in this area but with priorities determined by market needs and technical feasibility.

5.4. Value capture

The development of novel GM breeding technologies and advances in the science of genetics increase the options for modification of soybean composition. While the soybean has valuable components, there are many attributes to improve on - modify the lipid profile, change the amino acid profile, increase the level of amino acids, reduce the anti-nutritional factors, etc..

But there are many challenges in commercializing the products of these breeding innovations and transitioning to a system where the value of individual components is increased to improve the value of soybeans as a whole. Implicit in this concept is a transition from a single commodity market to one in which differentiated products are supplied to users with specific needs.

To some extent, this has happened already for a number of smaller specialty markets. For example, premiums are paid for identity-preserved (IP) non-GM soybeans, food soybeans, organic soybeans, or specialty varieties grown to meet other niche markets. For example, according to SunOpta price premiums are as follows: food grade $4-$10+/bushel, non-GMO - $2+/bushel, Organic - $14-$16+/bushel with further costs of logistics, cleaning, and special handling adding $1-$2/bushel. These premiums have changed over time as commodity beans have become more profitable to produce and demand for specialty beans has increased. In 2000, non-GMO premiums were less than $0.30/bushel. Premiums will continue to reflect the profitability of growing commodity soybeans and the strength of demand.

But can more value be captured by transitioning the large volume commodity markets to more differentiated channels for beans, meal, and oil? The case of specialty soybeans underlines the point. The incentive that brings about change comes from the market. Before they will pay a premium, all the players along the value chain must see an advantage that offers them a higher margin. When these margins are evident, change will take place.

For example, for high oleic soybeans to be a success, all involved in the value chain must see advantage. Food service operators must identify benefits that will translate into benefits for the crusher and refiner and result in premiums for soybean growers to ensure that soybean supplies will be forthcoming. This premium must compensate farmers for the higher risk of the new variety and for any potential yield drag. If the net benefits are large enough, users will buy more of it or pay more for it, and farmers will grow

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Agralytica
more of it. Ultimately, if the net benefits are high enough, and are recognized by a large enough part of the industry, high oleic soybeans could become the new commodity standard quality.

It is easier for the crushers to identify premium opportunities for the lipid component than the protein component, as oil users buy one component - the oil. Soy oil users have specific requirements and the value of a lipid innovation is relatively easy to identify. For example, the vegetable oils with omega-3 content will be of considerable interest to aquafeed companies currently using fish oil.

But can you expect differentiation extending to the protein fraction? The soybean comprises many components, each of which is attractive (or unattractive in the case of anti-nutritional factors) to different users. No one group of soymeal users will get all that they want, and inevitably, because of unit value considerations, oil yield and quality will come first. The crusher will decide which beans to purchase based on margin opportunities either by blending or by segregating. In making, this decision they will be weighing up the relative commercial merits of each policy - the cost of measurement and product segregation, the opportunity cost of margin opportunities foregone, and potential for gaining the extra value from the market.

As we understand it, there is only one organization processing commodity soybeans that pays premiums based on an assessment of oil and (at times) crude protein content. AGP has paid an oil premium of a few cents to encourage producers with higher oil content to sell to them. The company considers these incentives have been successful as the oil content is their primary objective. The quality measurements made on each load also serve to provide support in their efforts to maintain companywide quality standards. Other crushers have not followed AGP’s lead but it serves as an ongoing example of the concept.

It is clear that producers need to pursue every opportunity to increase the total value of the soybean. In theory, the commodity approach does not maximize the producer’s revenue, which is why component pricing has appeal. However, in a complex soybean value chain, there are many practical challenges to extracting the highest possible value for each of the soybean components. Clearly, the market will determine the nature of change. However, dialogue among parties in the soybean value chain can focus on key issues and serve to illustrate the potential benefits of market-driven product differentiation. To be successful, key players in the value chain need to continue to review alternatives, and ongoing investment is required to develop appropriate rapid quality measurement methods. And, of course, breeders have to continue to see advantages in developing traits that enhance quality as well as those that increase yield or reduce production costs.

<table>
<thead>
<tr>
<th>Supply: Capture more value all along the chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
</tr>
<tr>
<td>Priority</td>
</tr>
<tr>
<td>Ability to influence</td>
</tr>
</tbody>
</table>

The concept of developing a component value marketing platform to incentivize production of soybeans with higher intrinsic value to users and a better return to producers is appealing but has proven challenging to implement. It warrants continued exploration with leveraging of partnerships through the soybean chain.
5.5. **Sustainability**

5.5.1. **The concept**

‘Sustainability’ is an elusive concept. The term is widely used, often ambiguously. Over the last two decades, various definitions have been proposed and rejected by different interest groups many times. Today it has renewed significance, especially as many corporations have chosen to identify Corporate Social Responsibility objectives, many of which reference ‘sustainability’.

Sustainability on the farm is one of many important sustainability issues. The Keystone Alliance for Sustainable Agriculture this year published its second study on agricultural sustainability. Its definition of sustainable agriculture confirmed the heart of the concept and underlined the many challenges of measurement. Their definition was meeting the needs of the present while improving the ability of future generations to meet their needs, focusing on outcomes such as:

- Increasing agricultural productivity to meet future needs;
- Improving the environment, including water, soil, and habitat;
- Improving human health through access to safe, nutritious food; and
- Improving the social and economic well-being of agricultural communities.

Estimates of future demand for agricultural commodities indicate a need to double agricultural production in order to meet the expected demand from a growing, and increasingly wealthy population with an appetite for dairy products, meats, and fresh fruits and vegetables. Increasing production capacity to meet future demand poses some challenges. To do so in a way that is compliant with the above stated goals makes it even more challenging.

The study focused on a broad overview of factors and readily available data to establish some basic measurements to be used to quantify and analyze changes in sustainability. For example, the study analyzed trends in the in the environmental and socioeconomic performance of commodity crop systems since 1980. Metrics captured the historical trend of various crops, including soybeans, in order to establish a baseline from which to establish progress. The analysis covered data from 1980 through 2011.

5.5.2. **Positive changes in soybean ‘sustainability’**

Overall, the study showed positive results for soybean production – certainly confirming sustainability attributes that can figure prominently in US soybean market development programs.

According to almost every single measure, soybean production has become more sustainable. Soybean production increased 96%, and yield (bushels per planted acre) increased 55%. Efficiency measures capture the change in inputs/resources used over the same period. Land use per bushel fell 35%, soil erosion dropped 66%, the amount of irrigation water applied fell 42%, energy and fuel use per bushel fell 42%, and the production of greenhouse gasses fell 41%.

A measure of sustainability success is also shown through resource use per acre. Soil erosion decreased 41% per acre (mainly during the first half of the study period), the amount of irrigation water applied decreased 9%, energy use 6%, and greenhouse gas emissions fell 8%.

Total resource usage is mixed, but for obvious reasons. Total land under soybean cultivation increased 24% while total soil erosion decreased 28%. As more acreage was irrigated, total irrigation water increased 271% while using less per bushel and less per acre and achieving better yields. Total energy use increased 11%. Greenhouse gas emissions rose from 38.1 billion pounds in 1980 to a peak in 2004 of 49.3
billion pounds, only to fall to 34.9 billion pounds by 2011. Recent years were marked by a slight increase in total soil erosion.

Table 4: Field to Market soybean summary

<table>
<thead>
<tr>
<th>resource area</th>
<th>indicator</th>
<th>percent change* 1980-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>entire period (%)</td>
</tr>
<tr>
<td>crop yield</td>
<td>total production</td>
<td>↑ 96</td>
</tr>
<tr>
<td></td>
<td>bushels per acre</td>
<td>↑ 55</td>
</tr>
<tr>
<td>land use</td>
<td>total planted</td>
<td>↑ 24</td>
</tr>
<tr>
<td></td>
<td>acres per bushel</td>
<td>↓ -35</td>
</tr>
<tr>
<td>soil erosion</td>
<td>total tons</td>
<td>↓ -28</td>
</tr>
<tr>
<td></td>
<td>tons per acre</td>
<td>↓ -41</td>
</tr>
<tr>
<td></td>
<td>tons per bushel</td>
<td>↓ -66</td>
</tr>
<tr>
<td>irrigation water</td>
<td>total volume</td>
<td>↑ 271</td>
</tr>
<tr>
<td>applied</td>
<td>volume per irrigated acre</td>
<td>↓ -9</td>
</tr>
<tr>
<td></td>
<td>volume per bushel</td>
<td>↓ -42</td>
</tr>
<tr>
<td>energy use</td>
<td>total BTU</td>
<td>↑ 11</td>
</tr>
<tr>
<td></td>
<td>BTU per acre</td>
<td>↓ -6</td>
</tr>
<tr>
<td></td>
<td>BTU per bushel</td>
<td>↓ -42</td>
</tr>
<tr>
<td>GHG emissions (CO2 equivalents)</td>
<td>total pounds</td>
<td>↑ 13</td>
</tr>
<tr>
<td></td>
<td>pounds per acre</td>
<td>↓ -8</td>
</tr>
<tr>
<td></td>
<td>per bushel</td>
<td>↓ -41</td>
</tr>
</tbody>
</table>

*Percent results are based on a least squares trends analyses from 1980-2011

However, measurement criteria vary and US soybean producers remain in an ongoing battle on the validity of including Indirect Land Use in sustainability criteria. The battle with EU regulators over the calculations for the ‘sustainability’ of biodiesel manufactured from soy oil is ongoing. The definition of ‘sustainability’ and the criteria used in measurement will remain critical to market access to the EU and potentially other markets.

5.5.3. Environmental impacts - nitrogen and phosphorus

The Field to Market report did not review impacts of soybean production off the farm. Fertilizer runoff from agricultural land can contain high levels of nitrogen and phosphorus. The nitrogen and phosphorus runoff makes its way into rivers and streams and eventually the ocean. This nutrient rich runoff causes a dead zone in the Gulf of Mexico.

Dead zones are an oxygen depleted (hypoxic) layer of ocean water caused by the emergence of large algae blooms in the summer. Bacteria in the water consume the waste from the algae, the dead algae, and oxygen in the water. Nitrogen and phosphorus enter the Mississippi River Basin watershed from point sources (i.e. sewage plants) and nonpoint sources (i.e. runoff of fertilizers, soil erosion, and animal wastes). The various watersheds within the Mississippi River Basin drain the leading crop and animal agriculture regions in the US. Agricultural sources, particularly corn and soybean cultivation, are
identified as leading contributors of excess nitrogen and phosphorous entering the watershed (although not the only sources).

Map 1 illustrates the impact of nutrient enrichment on state watersheds. Illinois, Tennessee, and Mississippi are some of the worst offenders. Efforts to modify farmer management practices in the highly impaired areas would greatly contribute to a solution to the dead zone problem. Other areas of high impairment could be targeted as well.

Map 1: Number of impaired waters

Data from 2009 and 2012 show that the dead zone in recent years is now smaller than the decade average. Some part may be attributable to improved management practices, although other factors may be involved such as the 2012 drought.

Different areas contribute to each nutrient in differing amounts. Phosphorus input is spread across many states in the Corn Belt region with no one state having a large-scale contribution, but rather localized pockets within several states. However, according to a 2009 USGS report, very high levels of nitrogen are generated from just three states: Indiana, Illinois, and Iowa. Map 2 from the USGS shows how much the individual watersheds contribute to the overall phosphorus and nitrogen content in the Mississippi River Basin.
Researchers from the University of Illinois and Cornell University have attributed the main cause to the combination of tile drainage systems in conjunction with intensive corn and soybean row cropping. They concede that the amount of fertilizer used on each acre today is the same as it was in 1980, even though corn and soybean yields per acre have risen dramatically over the past 30 years. The problem is believed to be caused by drainage tiles allowing the nutrients to move very quickly away from the fields to ditches and streams so that plants cannot absorb them.

Several management strategies have been identified to reduce these impacts such as precision application of fertilizers, adjusting the timing of application, improved design of drainage systems, and adoption of practices such as conservation tillage, cover crops, and terraces. Many of these initiatives also have an added benefit of using fewer resources, thus lowering input costs.

5.5.4. Soybean performance on socioeconomic measures

The Field to Market study analyzed several measures of social and economic performance. These included debt/asset ratio, return above variable costs, non-fatal illness and injury, fatalities and labor hours. Again, soybean production showed positive gains.

The debt to asset ratio is useful for determining the portion of farm assets that are financed through debt. Farms with high ratios may be too highly leveraged and at risk for default. The debt to asset ratio has improved (decreased) by 37% in the last 30 years. A return above variable costs is a useful measure to ascertain the potential profitability of alternative strategies to use available resources and inputs efficiently. Naturally, this is affected by a wide range of factors including domestic and global market developments and the availability of new technologies. Consequently, this measure fluctuated, depending on market conditions and the uptake of novel technologies such as new soybean varieties.

While safer work environments may come at a cost to productivity and efficiency, the benefits are immeasurable. Fortunately, the increase in the use of machinery and the fewer hours and number of workers required has contributed to improvements in farm safety. Fatalities decreased 32% over the period analyzed, while on-the-job injuries fell 55% for all crop-producing farms. Labor hours to produce soybeans fell 66% per acre and 74% per unit of production.
5.5.5. Research and development to sustain progress

The positive changes in soybean sustainability represent an important defense against unnecessary regulation. Implementing sound, responsible management practices underlines the need for freedom to operate. Also, responsible management practices can sustain profitability both in the shorter and longer term. Clearly, ongoing research and development is required to sustain the progress attained as new challenges are faced.

<table>
<thead>
<tr>
<th>Supply: Demonstrate sustainability of soybean production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
</tr>
<tr>
<td>Priority</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The Keystone report was a good starting point in providing measurable environmental metrics, but more needs to be done on the socioeconomic aspects of soy production to ensure that customers with sustainability concerns rate US soybeans highly. This remains a fruitful area for collaboration.

5.6. Freedom to operate

Two major constraints limit the ability of US exporters of soybeans and products to serve foreign customers. One is the deterioration in the US transportation network which raises costs and reduces soy competitiveness. The second is the barriers to trade with foreign countries.

5.6.1. Transportation system

The US is one of the largest grain and oilseed producers in the world. Although no longer the largest producer, US soybeans and meal are still a vital part of animal agriculture feed programs in many countries. The US benefits from an efficient, comprehensive, and well-established transportation network. Bridges, roads, railroads, inland waterways, locks and dams, canals, ports, and the associated fleets of rolling or floating stock all play an important role. Soybeans travel distances averaging over 1,000 miles to reach export nodes with the average distance for barge movements estimated at 1,153 miles. Barges and inland waterways represent the most efficient mode of transportation for bulk shipments of commodities such as soybeans. However, this network has been in service for many decades and will deteriorate without continuing investment. To some extent, this well-developed inland transport system compensates for higher production costs in the United States than in Brazil, the leading competitor.

Ocean transportation costs are mainly a function of the distance involved from port to port. US exports out of the Gulf and PNW have a distance advantage, and thus a cost savings advantage, over Brazilian ports. The PNW ports are much closer to the Asian markets but soybeans must be hauled more than 1,000 miles from production areas by rail.
Rail transportation

A recent report by the Soy Transportation Coalition concluded that a lack of rail competition and high rail rates could constrain US exports of soybeans and soy products\(^2\). It noted that rail rates for soybeans per ton/mile are rising and that they are higher than for corn.

The report noted that in 2009, 26% of soybeans, 45% of SBM, and 73% of SBO was moved by Class 1 rail. Non-Class 1 railroads originated approximately 8% of total soybean and soy product volume. Most of the soybeans (68%) moved by rail are transported to grain terminal ports in the Pacific Northwest where it is exported to Asian markets. Since 2007/08, China has absorbed approximately 90% of the exports from the PNW grain terminals. There are also significant movements to New Orleans for export, and direct rail shipments to Mexico.

In 2008, the top origination terminals for Class 1 rail movements of soybeans were (in descending order): Sioux Falls SD, Grand Forks ND, Lincoln NE, Grand Island NE, Minneapolis MN, Fargo ND, Omaha NE, Aberdeen SD, Des Moines IA, and Champaign IL. The top destinations were Portland OR, Seattle WA, and New Orleans LA.

Although corn and soybeans have similar growing areas and travel a similar distance by rail (1,156 vs. 1,063 miles), they have significantly different rates. Soybean rates averaged $0.03078 versus $0.02990 per ton-mile for corn in 2008.

Revenue to variable cost (R/VC) ratios measure the profitability and reasonableness of rail freight charges. The Surface Transportation Board (STB) uses R/VC to regulate rates if it is determined that the ratio equals or exceeds 180%. R/VC ratios below 180% are not subject to STB jurisdiction. The STC study\(^5\) estimated that 41% of soybeans, 23% of SBM, and 33% of SBO moved at R/VC ratios that equal or exceed 180% and should be subject to STB jurisdiction. However, due to issues with the testing of reasonableness of rates using STB’s tests, only a small fraction of the movements would be able to obtain rate relief under the guidelines in place in 2009. Of the soybean movements in 2008, 59% were estimated below 180% R/VC and 41% were above R/VC, but only 7% had rates that would be considered unreasonable according to the STB.

According to Informa, railcar loadings have been changing for the last fifteen years to a more efficient system and rolling stock. The industry is transitioning to larger cars, longer hauls, and more cars per train to move soybeans. As the soybean production area moved north and west away from major rail nodes, efficiency measures have been implemented to remain competitive with barge movements to export points. Average haul distances increased from 800 miles in 2002/03 to 900 miles in 2009/10. New rolling stock is built with higher capacity than older models. The larger capacity cars exceed 5,000 cubic feet and can handle more than 100 tons per car.

Apart from a continuous need to monitor and press for rate changes, several issues need attention. Rail movements are limited to the availability of track to make a haul. Generally, this is not a problem as there are alternatives to get around these constraints. Making fewer runs with more and larger cars does much to alleviate these constraints. However, these constraints can be limiting factors over certain routes. High transit routes with high build/replacement costs can be a source of potential problems. Mountain passes represent this concept best. Stampede Pass over the Cascades is one of only 3 rail passes to serve the PNW, mainly the Seattle, Tacoma and Portland ports. BNSF closed the pass in the 1980s, but reopened in it the 1990s as a relief valve for the increased traffic to and from the PNW ports. The other two passes allow for much higher carrying capacity in that they can accommodate double stacked container cars. Seattle Port commissioner Bill Bryant said the Stampede Pass train tunnel must be

\(^2\) 2010 Evaluation of US Railroad Movements of Soybeans & Soy Products
reconfigured to allow double stacked train cars to facilitate the increased volumes. This change would allow the lighter loaded containers to be stacked vertically instead of longitudinally and that car length can be replaced with a bulk car.

With increased yields and production, increased volumes out of the PNW are anticipated even if the share of volume decreases after the Canal Expansion opens. The ports in the PNW are a vital part in maintaining and expanding US soybean exports. Rail rates from growing areas to the ports represent one of the biggest parts of transport to the PNW. Maintaining and upgrading train routes will play a critical role in achieving competitive rail rates.

**Waterway transport**

The USDA reports that 58% of US soybean exports in 2011 were shipped from the Gulf ports and 90% of that arrived via barge coming down the Mississippi. A study commissioned by the soybean checkoff estimated volumes for the Mississippi and major tributaries in 2010:

- Upper Mississippi: 236 million tons
- Ohio: 49 million tons
- Illinois River: 24 million tons

According to the Army Corps of Engineers, navigation outages due to unscheduled maintenance and mechanical failures have increased from 25,000 hours in 2000 to 80,000 hours in 2011 on the Ohio River alone. Also, it has been estimated that the Panama Canal expansion would more than double the draw area to the US navigable waterways and divert some soybean movement from PNW to the Gulf ports. This competition should have an impact on rail rates. However, there is concern that this increased volume will increase the strain on locks and dams resulting in more unscheduled maintenance and mechanical failures, delaying shipping.

The current Panama Canal configuration masks problems in US waterway systems. The Panama Canal expansion will expose weaknesses in the US waterway system as additional volume shifts to cheaper alternative export routes through the Gulf of Mexico and the Panama Canal.

The Panama Canal expansion is set for completion in October 2014. In order to utilize the efficiency gains of New Panamax size vessels, US waterways must also be able to accommodate the new draft depth of a fully loaded New Panamax vessel. However, a limiting factor is the channel depth on the lower Mississippi from Baton Rouge south. Funding issues have delayed and limited dredging efforts to maintain the necessary 45 ft draft depths, reducing loaded tonnage.

Draft depths are also important for most US ports. Only two US ports, Norfolk and Baltimore, are currently capable of handling New Panamax size vessels, although work is in progress in most major ports. Docks, channel moorings, grain elevators, cranes, and other equipment will need to be upgraded in order to load the new vessel sizes. Some ports (e.g. Savannah and Seattle) have taken delivery of ship-to-shore (STS) cranes and STS elevators capable of loading and unloading the new vessels.

The Panama Canal expansion can only increase the potential for Gulf exports if Mississippi waterway weaknesses and port depths are addressed.
Map 3: US intermodal transport map, flows to major export points, and crusher locations for soy.

Panama Canal

A study by Informa\(^3\) analyzed the impacts of the Panama Canal expansion. The Panama Canal is a crucial route for US soybeans. It handles 44% of total US soybean exports. The expansion will increase the competitiveness of US soybeans; however, it will also increase the competitiveness of rival exporters.

In 2002, nearly 65% of grains and soybeans moved through the Center Gulf. Rapid growth of demand in the Asian markets shifted the supply route to railroads through the PNW. In 2010, less than 50% of the grain and soybean exports left through the center Gulf port terminals. Exports from the center Gulf will continue to recede slightly over the short term. After the Panama Canal expansion, export volume and share through the center Gulf are expected to rise and achieve levels last seen in 2001/02. Exports out of the PNW should remain high and even grow while the share falls or stagnates.

The opening of the canal will shift the geographic draw. According to the Mid-America Freight Coalition, shipments by train through the PNW currently have a cost advantage as far east as Michigan and Ohio, even extending into parts of the eastern neighboring states. After the canal opens and shipping costs begin falling, the cost advantage will shift westward. Producers in Michigan and Ohio will find it cheaper to ship out of the Gulf through the Canal.

Exports from Brazil take one of two sea routes depending on the origination port and destination. Exports from the northern ports of Santarem, Itacoatiara, and Belem to Asia take advantage of the shortest route through the Canal. The southern and middle ports sail straight east around and around the southern tip of Africa to Asian markets. Exports from Argentina to the Asian markets typically sail south around Cape

\(^3\) Panama Canal Expansion: Impact on US Agriculture., Informa Economics, September 2011
Horn and west across the Pacific. Exports from all ports in the Americas to the European and eastern bloc countries sail across the Atlantic.

Brazil will find it more difficult to capitalize on the advantages afforded by the expansion project. Port facilities in Brazil are small, congested, and do not have adequate equipment to load current Panamax size vessels in an efficient manner. To load New Panamax size vessels, upgrades will be necessary to loading equipment, and draft depths. This will take a long time to complete. The Canal Expansion will not affect Argentine exports.

The US currently has a slight advantage in shipping costs relative to Brazil. As the canal expansion comes online and shipping costs begin falling, the advantage for US soybeans should increase. In the short term, Brazilian exporters will not be able to use the New Panamax size vessels without new port channels and loading equipment at the ports.

**Ocean shipping**

Ocean transport is likely to play a major role in all global trade initiatives. Port to port distance is a major contributor to the final price of goods traded on the world market. As shown in Table 5, the US is well located to serve many of these markets from the Gulf, west, and east coasts.

**Table 5: Ocean Shipping Routes**

<table>
<thead>
<tr>
<th>Destination: Shanghai, China</th>
<th>Distance (nm)</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNW, US</td>
<td>5,042</td>
<td>Pacific</td>
</tr>
<tr>
<td>New Orleans, US</td>
<td>9,958</td>
<td>Via Panama Canal</td>
</tr>
<tr>
<td>Parana, Br</td>
<td>10,953</td>
<td>Around the cape of Africa</td>
</tr>
<tr>
<td>Belem, Br</td>
<td>10,842</td>
<td>Via Panama Canal</td>
</tr>
<tr>
<td>Bahia Blanca, Arg</td>
<td>10,819</td>
<td>Around Cape Horn (S. Am)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Destination: Barcelona, Spain</th>
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<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norfolk, US</td>
<td>3,871</td>
<td>Atlantic</td>
</tr>
<tr>
<td>New Orleans, US</td>
<td>5,040</td>
<td>Atlantic</td>
</tr>
<tr>
<td>Parana, Br</td>
<td>5,012</td>
<td>Atlantic</td>
</tr>
<tr>
<td>Belem, Br</td>
<td>3,803</td>
<td>Atlantic</td>
</tr>
<tr>
<td>Bahia Blanca, Arg</td>
<td>6,088</td>
<td>Atlantic</td>
</tr>
</tbody>
</table>

<table>
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<tr>
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<th>Distance (nm)</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNW, US</td>
<td>7,354</td>
<td>Pacific</td>
</tr>
<tr>
<td>New Orleans, US</td>
<td>11,993</td>
<td>Via Panama Canal</td>
</tr>
<tr>
<td>Parana, Br</td>
<td>8,562</td>
<td>Around the cape of Africa</td>
</tr>
<tr>
<td>Belem, Br</td>
<td>9,485</td>
<td>Around the cape of Africa</td>
</tr>
<tr>
<td>Bahia Blanca, Arg</td>
<td>8,792</td>
<td>Around the cape of Africa</td>
</tr>
</tbody>
</table>

Source: Agralytica and PortWorld.com

**IP beans via container**

The intermodal transportation system is an ideal tool for handling identity preserved soybeans. A container can be loaded with the IP soybeans or SBM and sealed on the farm or at a specialized loading facility. That container can then be shipped by truck, rail, or ship to any point on the globe without ever being subjected to possible contamination. Container traffic from Asian countries to the US is much
higher than the traffic from the US to Asia but containers frequently return empty, providing backhaul opportunities.

A new type of IP, called “soft IP”, is becoming popular. Customers who want a specific trait or high quality soybeans but are not necessarily concerned about strict tolerances may opt for this type of identity preservation; e.g. clean #1 soybeans or high oleic soybeans. As specific traits become more available this type of identity preservation is expected to become more common.

The infrastructure for handling container shipments is well developed in the United States. However, the availability of intermodal transfer stations is limited in some soybean production locations. These intermodal transfer points are critical to maximizing the opportunities arising from the excellent container transport infrastructure available to US exporters.

**Brazilian transportation infrastructure**

While there are several important transportation infrastructure constraints in United States, these are relatively minor compared with the challenges faced by Brazilian exporters of beans and meal.

Brazilian soybean production potential remains considerable in inland states. The main soybean-producing region of Mato Grasso is located inland; the center of Mato Grasso is about 1,000 miles or more from major export points. There are primarily two ways to reach export points, north to Santarem or south to Paranagua or Porto Santos. Santarem is a relatively small port 1,000 miles from the center of Mato Grasso. The Cargill facility there can direct load Panamax and New Panamax sized vessels, although there are some draft limitations. Highway access to this port has been improved and its handling and storage capacity is being upgraded to support increased volumes.

The more widely used route is south to Paranagua (1,260 miles), Santos (1,140 miles) or several smaller ports in close proximity. Paranagua is reached by truck but is often heavily congested during peak export periods resulting in extensive delays for trucks and vessels. Santos is serviced primarily by rail. Trucks deliver soybeans to Ferronorte's interior grain terminals where they are transported down to Santos via rail. Ferronorte is often chronically short of rail cars during harvest season and so the excess volume flows to ports by truck. In addition, the grain handling capabilities are inadequate given the volume of the soybean harvest.
A third route exists, northwest, to Porto Velho. Although it is currently poorly developed, it may become relevant in the near future. Access is via paved roads and soybeans are loaded onto barges and shipped to the Itacoatiara bulk-handling terminal on the Amazon River where they are loaded directly onto Panamax size vessels. The barge journey is a distance of 1,100 miles. This route faces draft restrictions at Barra Norte at the mouth of the Amazon River and currently lacks port facilities to handle increased volumes of soybeans. New storage and handling facilities are planned.

It is widely recognized that the major limiting factor for Brazilian soybean exports is its transport infrastructure. The major soybean production regions are accessible by road, but many are in poor condition which takes a heavy toll on truck transportation costs. Its rail network is limited and insufficient to meet current demand. Recent investment to expand the Ferronorte lines in the south and to increase rolling stock have not been sufficient to alleviate backlogs and chokepoints. In addition, lack of competition from competing rail lines results in only marginal savings over trucking costs according to Informa 2012. This margin has held despite the 10-15% increase in trucking costs per year.

Analysis of the planned infrastructure projects reveals an array of upgrades to roads, ports, and rail networks. Since the rail networks are private, they do not rely solely on public funding. However, large-scale road projects and most port projects require public funding. In 2007, Brazil introduced a growth acceleration program (PAC) and laid out plans for investment of US $306 billion until 2010 to solve social, energy, water, and infrastructure deficiencies. PAC 2 was announced in March 2011. PAC 2 is a continuation of PAC, and planned investments total US $582 billion until 2014. PAC was less than
successful, achieving only 63% completion of projects according to government sources. Critics claim less than only 14% of the money was invested and few projects have been effectively finished.

In 2014, Brazil will host the World Cup and in 2016 Rio de Janeiro will host the Olympic Games. This means significant investments in and around Rio de Janeiro and other major cities must be undertaken for a myriad of issues in order to meet the requirements of being host cities. Soybean farmer groups are already complaining about the diversion of funds intended for road, rail, and port improvements in the interior, to projects related to the World Cup and Olympics. The outcome is an infrastructure capacity growth trajectory that is lower than the potential soybean production trajectory. This will maintain the current US transportation advantage for a few years longer than might otherwise have been the case.

After the Panama Canal expansion, the US should be able to capitalize on the lower cost to transport bulk commodities to Asia using New Panamax vessels. Brazil will continue to experience chronic transport congestion at harvest time. Currently, vessels wait several days, and a week or more during harvest, to get dock space. Improvements are likely to be delayed until after the Olympics in 2016, two years after the Panama Canal expansion.

The true value of the US infrastructure is the availability of alternatives in the event of chokepoints. Brazilian transporters do not have the same options. Brazilian exporters have a very limited number of options for moving soybeans to export points. Choke points can severely cripple the logistical movement of grains from the interior to export points. In short, Brazil will have to make do with its current mix and capacity of transport modes, at least in the short run to 2016.

Currently US soybeans have one significant advantage over Brazilian soybeans because of US transportation infrastructure. But the United States needs to capitalize on the Panama Canal expansion now and plan for the transportation gap to narrow in the future. Ultimately Brazil will sort out its infrastructure problems. Its economy is growing rapidly, and resources will be available to resolve the many issues that constrain efficient transport to export destinations. The US industry must be prepared for this and work on many other areas to improve its overall competitiveness.

5.6.2. Market access barriers in foreign countries

Gaining better access to soybean and product markets around the world has been a key focus of USB market development programs. Agralytica has periodically prepared grain and oilseed market access indexes for a group of cooperators. Table 6 below shows the market access indexes as of the end of 2011 for selected countries for soybeans, meal, and oil. Higher scores indicate better access for that commodity in that country. Market access scores are computed based on:

- Tariffs;
- Other price measures like import fees, customs charges, taxes, etc.;
- Quotas;
- Other quantity measures like import licensing, monopoly purchasers, etc.; and
- Technical or procedural measures that make trade more difficult, expensive, or risky like customs procedures, sanitary and phytosanitary regulations, corruption, etc.

In addition, the scores are weighted by the actual tonnage of each commodity imported by each country. In Table 7, soybeans, SBM, and soy oil were compared to wheat, corn and DDG. The averages by country and by commodity were calculated by weighting scores by the actual tonnage of domestic disappearance in each country. Soybeans and SBM had significantly higher access ratings than any other category studied except DDG. Soy oil scored about the same as wheat and corn.
Generally, tariffs are low because many countries have acceded to WTO conventions. However, in the wake of WTO accession, many countries simply resort to technical barriers to regulate trade. Phytosanitary laws are frequently used as a way to regulate imports, even from a preferred trading partner. Another frequently used way to regulate trade is the use of taxation, port charges or import fees and licenses to deny imports or to raise the price of imported goods to a price above the prevailing local price. Corruption is also a major concern in most third world countries and accounts for many of their low scores. However, many of these countries are dependent on imports of foodstuffs, and generally have low tariffs and relatively few other barriers to trade. Since these constraints are a product of the national government policies, they cannot easily be affected from the outside. By comparing various competing proteins and feed sources, we can better target where marketing efforts will have the greatest impact.

Higher world prices and supply constraints for grain and oilseeds contributed to a general loosening of barriers to trade in 2011. However, the nature of these barriers makes them easy to adjust at will. One of the greatest barriers to trade is concern over genetically modified commodities. In the reality of tight supplies and high prices for soy products, acceptance of these products is becoming more palatable, even to a small degree in the EU.

The countries that consistently scored the lowest access ratings across all soy commodities include the EU-27 bloc of countries, Romania, Russia, India, Brazil, Colombia, Venezuela, and Ecuador. The EU stance against GMOs effectively eliminates the vast majority of American products, although this stance is beginning to soften. Russia and India have protectionist policies in place in addition to extensive corruption. The South American countries use Brazilian and Argentinian beans. The proximity and the MERCOSUR trade preference provide a substantial cost savings over other sources.

The North America Free Trade Agreement has been highly beneficial for US soybean farmers. Canada and Mexico are two of our largest soy export markets. Logistically it is very easy to export soybeans, SBM, and SBO to Mexico. Very little SBO is exported to Canada, but a great deal of meal is.

Pursuit of improvements in access to foreign markets should continue to be a key component of the freedom to operate objective.
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<td>63.0</td>
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</tbody>
</table>

**Weighted average** | 58.7  | 57.8 | 65.3    | 56.2| 65.4| 64.7|

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Soybean Market Scan
Prepared for: Connections 2012
Supply: Increase freedom to operate internationally

<table>
<thead>
<tr>
<th></th>
<th>USB</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to influence</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Priority</td>
<td>High</td>
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The logistical barriers to exporting are well known and need to be addressed if US exporters are to remain competitive in the world market. We capture the full benefit of the expansion of the Panama Canal only if other parts of the transportation infrastructure have equal capacity. That will allow us to improve competitiveness with South American producers who will also eventually benefit from the canal expansion. Access barriers in foreign markets must also be tackled.
6. ANIMAL UTILIZATION

6.1. Meat and fish consumption

Soybean meal is an important contributor to the protein requirements of global animal agriculture with a focus on monogastric animal feeds (poultry and hogs).

In global terms, pork is the largest meat group representing 40% of total beef, pork, poultry meat, and sheep meat production. Poultry represents 31%, cattle 24%, and lamb 3%. However, poultry meat production is expanding at roughly 4.5% per annum; this is twice as fast as pork (2.1%), and beef (1.7%).

Table 8: Global meat production (3 yr av. 2008/10), MMT

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>% of total</th>
<th>% Annual growth</th>
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<tbody>
<tr>
<td>Beef</td>
<td>64</td>
<td>24%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Pork</td>
<td>107</td>
<td>40%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Poultry</td>
<td>83</td>
<td>31%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Lamb</td>
<td>9</td>
<td>3%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Total</td>
<td>265</td>
<td>100%</td>
<td>2.7%</td>
</tr>
</tbody>
</table>

Source: USDA

One-half of global beef production is in the Americas and 56% of pork production is in Asia. Meanwhile poultry meat production is more widely spread with 45% in the Americas and 33% in Asia. China represents 9%, 14%, and 47% of global production of cattle poultry meat and pork respectively. These proportions have changed little in the last decade despite the rapid growth in Chinese pork production.

The US is a very large meat market, primarily serviced by the domestic animal production sector. This feed ingredient opportunity sits on the doorstep of US soybean growers.

As shown in the figure below, on a per capita basis, the US consumes three times the global average of meat. However, the anticipated growth in US meat consumption is small. Furthermore, the expansion of meat consumption in the US is constrained by some consumer resistance. Consumer attitudes to meat are less positive than they were. Total US meat consumption peaked in 2007 at 55 billion pounds (25 million metric tons) and has fallen each year since. In 2012, consumption it is anticipated to fall again to 52 billion pounds (23.6 million metric tons). In 1976, US consumers consumed 91 pounds of beef per person. In 2012, is forecast to fall to 52 pounds. US pork consumption has not declined as seriously as beef. However, in recent years it has trended downward slightly, and is now below the average levels of the 1980s and 1990s at 44 pounds. However, growth in poultry consumption has compensated, although even that has flattened out in recent years at around 70 pounds per head per annum.
Any growth in the US animal production sector is likely to come more from servicing a growing demand for meat as global population increases and higher incomes enable more people to consume higher levels of animal protein. The figure below indicates the rapid rate of growth forecast for less developed countries, and the high rates of growth anticipated for poultry meat consumption. Based on this premise of growing foreign demand for meat, it is prudent for US soybean growers to assist the development of US meat exports. This will help maintain domestic demand for soybean meal.

In addition, US soybean producers can pursue growing markets for soybeans and soy meal in countries that have rapidly expanding animal agriculture industries.

The US has a very small aquaculture sector that is insignificant in global terms. It imports a very high proportion of its total fish and crustacean supply. Aquaculture and fed aquaculture in particular are both expanding rapidly as total demand increases and the supplies available from marine harvests are constrained by controls on overfishing.
It is prudent for the US soybean growers to pursue opportunities in supplying the growing global market for aquafeed.

### Animal agriculture: Promote more meat exports

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<tbody>
<tr>
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<td>High</td>
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<tr>
<td>Priority</td>
<td>High</td>
<td>High</td>
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As domestic meat consumption is static, the opportunities for increasing the sales of soybean meal to the domestic animal production sector depend on supporting the growth of meats exports. Meat consumption is expanding rapidly in many less-developed countries and US meat exporters need the full support of the US soy sector. The focus of support should be those animal species that are the main consumers of soy products.

### Animal agriculture: Increase soy product use in aquaculture

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<tr>
<td>Priority</td>
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Fed aquaculture is increasing rapidly. However, growth is very limited within the United States. US soybean farmers have been effective in promoting wider use of soybean meal in aquaculture. Sales to the sector should grow as production expands. Soybean meal is limited in its application to carnivorous fish and to crustaceans. The development of close alliances with Asian companies producing soy products with higher protein content and lower anti-nutritional factors should be a priority.
6.2. What needs to be done in US market to enhance opportunities?

Some groups of US consumers apply simplistic criteria when choosing specific foods. Consequently, demand for meat from much of US animal agriculture has been constrained by concerns about the impact of some meats on health, and production methods on animal welfare, and the environment. Each of these issues constrains the advancement of the US animal agriculture sector and its US soybean suppliers.

Furthermore, US animal agriculture faces a continuous challenge from various regulations that influence their operations. Some of these regulations address consumer concerns, while others are implemented on false premises and without understanding the implications for animal agriculture and the cost to the community.

US crushers have been under pressure as capacity utilization fell because of the increase in the export of soybeans and displacement of soybean meal by DDGS.

There is little serious pressure from foreign soybean or soybean meal competition in the US market. However, US crushers recognize that the success of US animal agriculture depends to a large extent on the cost and performance of feed.

The US animal agriculture sector relies on US soybean growers and the US crushing sector to supply a protein meal that represents good value.

The soybean crushing industry has a major responsibility in transmitting market signals to soybean producers. It is a crucial intermediary. The crushers can also provide incentives to soybean farmers to encourage the production of soybeans that meet market requirements.

So far, crushers have used this facility prudently, understanding that location and seasonal variation in environmental conditions can strongly influence quality. They can recommend/require the growing of specific varieties that meet processing and market needs, but they have not introduced any payment system that incentivizes quality.

The crushers have the technical capability to influence the quality of soybean meal supplied to the animal agriculture sector. In doing this, the crushers call upon a massive reservoir of experience. They understand the factors that influence both protein digestibility and the level of anti-nutrients. As we understand it, the appropriate knowledge and technology is available to ensure that soybean meal quality can meet the requirements of different animal agriculture sectors.

As animal agriculture becomes more sophisticated in a highly competitive environment, its feed requirements become more specific. Consequently, swine and poultry producers seek feed rations that meet the specific needs of their animals (age, breed, market outlet targeted etc.). The task of formulating feeds to meet the specific needs of these target animals has fallen to the feed industry. They have been content to take a standard commodity and to enhance its value by incorporating other ingredients and supplements.

This approach allows crushers to extract economies of scale by producing a commodity rather than a differentiated product for different customers. Crushers have not seen any advantage in differentiating their soybean meal, with attributes that would increase its value in different utilizations.
6.3. What is the nature of competition?

While the US soybean industry has experienced high prices over recent seasons, there are some darker clouds on the horizon.

South American competition is becoming much more potent and their prospects for enhancing their position look very strong for both soybeans and meal.

South American production has the potential to increase, especially in Brazil on virgin cerrado lands. Their production efficiency has improved as they understood the challenge of growing on new soils with improved genotypes. Their crushing sector has the benefit of having significant economies of scale, and considerable new investment. Their expansion into foreign markets has provided considerable experience of international trading and they are now plugged in to the distribution network that supplies foreign markets. Brazil currently has a logistical handicap as the infrastructure from internal terminals and

<table>
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<tr>
<th>Animal agriculture: Customer focus -promoting a positive image of the US animal agriculture sector</th>
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<tbody>
<tr>
<td><strong>Ability to influence</strong></td>
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<tr>
<td>High</td>
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The US meat consumer is an indirect customer of the US soybean sector. Meat consumption is growing very slowly in the US. Moreover, some vocal consumer groups apply simplistic criteria when choosing specific foods, raising concerns about the impact on health, animal welfare, and the environment, and constraining advancement of the US animal agriculture sector and its US soybean suppliers. Support to the meat industry's efforts to overcome this constraint is essential.

<table>
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<tr>
<th>Animal agriculture: Freedom to operate - ensuring regulations do not constrain an efficient, responsibly managed animal agriculture sector</th>
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<tbody>
<tr>
<td><strong>Ability to influence</strong></td>
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<td>Low</td>
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Regulation is part of the fabric of today's society where different groups have to coexist. No regulation should adversely affect those farmers' responsibly managing livestock. Soybean farmers should assist the animal agriculture sector in supporting the development of a regulatory framework which promotes profitable animal agriculture.
Soybean Market Scan
Prepared for: Connections 2012

crushers remains sub optimal although it is clear that these constraints will be overcome within the next few years. Argentina has chosen to capture as much product value as possible domestically by implementing differential export taxes that provide incentives to crush soybeans in Argentina and export the meal and oil. Argentina is the market leader in the global soybean meal market. Neither Argentina nor Brazil benefits from soy product export promotion agencies.

India is also a competitor in the soybean meal market. Its crushing sector supplies a high domestic demand for oil leaving soybean meal that exceeds its domestic animal agriculture requirements. While the Indian animal production is relatively low, recent developments have seen a rapid expansion of a more sophisticated poultry sector as demand for animal protein has grown among certain groups. Indian government policies have occasionally interfered exports of excess soybean meal on global markets to keep domestic prices low.

US soybean and soybean meal exporters will experience greater competition in the future. The main response to this competition clearly lies in producing and processing soybeans cheaper. However, market development activities can enhance the value of the US product/service package. They can help buyers understand that the US product/service package can be delivered on time, can have a consistent quality, and that any issues that threaten the integrity of the US product/service package can be easily resolved.

There are also certain attributes of the US product/service package that can be clearly differentiated. In particular, the US IP system can deliver specialty beans efficiently to any potential user in a foreign country, US grading standards are transparent and administered with integrity, the US can call upon technical assistance to resolve a wide range of processing issues, the US can help customers generate higher demand for their products. However, all have to recognize that the soybean and soybean meal markets are driven by commodity economics. Product differentiation is challenging in a commodity market and price is the major decider of who buys what from whom and where.

6.4. Which export markets to focus on?

US competitiveness varies from year-to-year depending on the availability of supply from different origins. In years when US product is uncompetitive there will be considerable deadweight promoting US attributes. Consequently, export promotion has to be flexible. In years when the US is competitive, it will need to communicate messages that sustain durable positive images of the US supply chain and its products. In years when it is less competitive, it can emphasize support for specific US sales efforts.

6.4.1. Beans

Where does the greatest potential lie for expanding the use of US soybeans and soy products in foreign animal agriculture?

Inevitably, China dominates the export perspective. US exports of soybeans has risen dramatically over the last 20 years as Chinese demand for meat, particularly pork, has grown encouraging rapid development of its own hog industry. The Chinese pork industry continues to grow and its future depends on imported soybeans and soybean meal. No one can ignore this growth, nor the continuing range of opportunities selling into the Chinese market.

However, the growth in exports of soybeans to China has been accompanied by a contraction in the sales to other destinations. Sales to traditional customers such as Japan and Taiwan are both on a slow decline. This pattern is almost identical for Brazil. Also it has experienced a rapid increase in sales of soybeans to China and a decrease in sales to other destinations since the early 2000s. Such has been the attraction of the Chinese market.
6.4.2. Meal

China is a bean market and consequently, soybean meal exporters have to find other markets. The largest meal markets are the EU and Asia. Argentina has been winning market share in both regions, with the help of its differential export tax advantages. The US has a relatively low share of global trade in soybean meal (less than 15%), although in recent years they have expanded slightly.
6.4.3. Processor/exporter key decision-makers

Exports are executed by the processor exporters. Their main concern is handling the risks associated with trading and efficient deliveries to meet purchase obligations. US exports are in the hands of a relatively small number of companies and they respond to market incentives. In general, the main incentive is price, and this outweighs the importance of quality, although clearly minimum standards must be met.

Export sales depend on supply availability from competing origins, the level of demand for soybeans, particularly from China, the situation in the domestic market for soybean meal given the increased availability of DDGS, and the margins available for sale of soyoil.

Argentina and Brazil have a strong hold on EU and Asian meal markets. The US has advantages in sales of meal across the border to Mexico, to the Philippines where customer loyalty to US is very high, and where specialized service, such as transport in containers, is required. The relative US competitiveness can vary each year depending on the availability of competing meal from Argentina and Brazil. Some years the US is not competitive.

6.4.4. US farmer role in export market development

A recent study commissioned by USSEC reported that meal processors/exporters believe they provide customers with quality products from each of the main origins - from the US, Argentina and Brazil. Their reputation depends on this. They also consider multi-country origination is a positive feature of their service to customers. The incentive to promote US soy relies on the individual managers responsible for US business units. They are keen to ensure US price competitiveness to maintain their throughput and margins. This also applies to soybean exporters as they are the same companies.

US growers have a strong incentive to promote US product in foreign markets, even if this may not be the priority of the major grain and oilseed trading companies. What can be done in a market that is largely driven by commodity market forces?

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\(^5\) HighQuest, Audit and Analysis of US Processors’ Portfolios, 2011
The study of meal processors/exporters\(^6\) highlighted several key areas in which the US business units of the exporter processors needed assistance from US soybean farmer organizations. While these comments referred to meal, they also represent the view of those exporting soybeans.

- **Strengthening trading relationships:** Trading relationships can be assisted by working closely with the exporting companies and organizing events that bring together US business units and potential buyers. Trade conferences were considered very helpful in developing personal relationships, although it is difficult to establish these to help US exporters without opening the door for the development of personal relationships with exporters with different or neutral origination objectives.

- **Improving market access:** This can include combatting trade policies that unfairly restricting access to markets or those that assist other countries. The global grain and oilseed exporters are unlikely to be fighting hard against the latter if they also get benefit as exporters from that country. Consequently, US soy interests have to lead this fight.

- **Focusing US promotion on product/service areas where the US has advantage:** Clearly, other countries cannot match the access of the US to global container routes and infrastructure. Here the US product/service package can be clearly differentiated.

- **Differentiating US dehulled meal product value:** Work to differentiate US meal was appreciated by US dehulled soybean meal processor exporters; however, their views were heavily qualified by recognition that international customers’ buying decisions are based on price over quality.

The latter raises the question: to what extent can the US differentiate US product in export markets?

### 6.5. Can US differentiate US beans and US meal?

To sustain a policy of differentiation of US soybean or soybean meal attributes there must be clear benefits in the US product. If these differences can be quantified, such a policy will bring some benefits. Differentiation based on product quality is challenging. The quality of the end product depends on the interaction of many factors - genotype, crop husbandry, environment, or processing. Some control is feasible, but some quality influencing interactions are not.

On the farm, soybean quality is determined by a range of factors. These range from variety, soil nutrients, weather conditions, soil type and moisture holding characteristics, fertilizer use, the previous crop, and latitude. Consequently, US soybeans can vary depending upon the individual farm with individual region they were produced. These quality differences can be managed by careful blending of supplies from different locations by the major handlers of soybeans for export and for crushing. Consequently, except for Identity Preserved soybeans, it is difficult to differentiate unless the broad average quality of blended US beans or meal is higher in some dimension.

Processing also influences quality. Processing methods (particularly the application of heat and the duration of heating) influence the availability of digestible protein and the presence of anti-nutritional factors. It is unlikely that a standard US soybean meal product emerges from crushing company plants in United States, let alone in countries that buy US soybeans for processing.

The basis of comparing the quality of different origins is open to challenge. Studies have shown that crude protein levels do not correspond to protein quality in terms of digestibility and performance depends on the level anti-nutritional factors and other minor constituents.

\(^6\) Op cit.
Therefore, perhaps it is no surprise that studies that compare the nutritional benefits of soybeans and soybean meal from different origins often produce conflicting results.

There is some evidence that US quality is deteriorating. The Illinois Soybean Association cooperation with the Japan Oilstuff Inspectors’ Corporation illustrates clearly that both protein and oil levels have been declining over the period 2002 to 2011. Moreover, data from the same source suggests that Brazil regularly has higher crude protein levels on average than the United States.

There have been many studies that have reviewed the quality of US soybeans and soybean meal. In general, the conclusion one can draw is that US soybeans are about average to above average quality in terms of oil and crude protein content. In general, the US position relative to other origins will vary, sometimes above, and sometimes below the average. However, generalizing again, the quality of soybean meal originating from US crushing plants tends to be generally higher than average. However, without major change in the US system of commercializing soybeans or soybean meal, it is challenging to claim strong merits for differentiation based on product quality alone.

6.6. What do we needed to do to improve our market position?

Marketing is not necessarily about differentiating empirically measured differences. Identical automobiles may sell better in one part of the US, because of preferences based on the country of design and manufacture. Similarly, the same car painted metallic gray as opposed to plain gray also can sell at a premium that does not represent the difference in cost of applying a metallic coating as opposed to an ordinary paint. While this may sound like smoke and mirrors, there are genuine preferences that underlie perceptions of value held by all buyers.

Consequently, it is clear that any differentiation has to encompass the image of the entire US soybean value chain and with it broader positive perceptions of US agriculture and the US in general. According to economic theory, this type of differentiation is not feasible in a commodity market as all products in the commodity market are assumed identical. But in the real world, commodities are not necessarily identical - each is charged with supplementary positive or negative value because of the emotional
context in which the products are viewed. Creating this supplementary positive value of US soybeans is
the responsibility of all those connected with the economic performance of the US soybean industry.

We conclude that differentiation relies on generating a positive image of the US supply chain more than
the technical capabilities of the product. However, the approach needs to be adapted to certain market
situations.

6.7. Which markets to focus on?

The level of understanding of soybean meal and its contribution to animal agriculture and aquaculture is
high in very mature markets such as the EU and Japan. Foreign crushers in mature markets that have
purchased different origins are more likely to make decisions based on price and experience.

The level of understanding and confidence will be lower in countries with less mature animal agriculture
value chains. Here, there will be more potential to develop relationships that provide assurance about US
quality standards and levels of service.

Markets can rapidly transition to maturity when there is a clearly identified need and substantial volumes
are handled to meet that need. Such is the case of China. Here market need has stimulated substantial
imports and major changes have taken place in the structure of the industry and its major players. US
soybean growers have played an important part in supporting this transition and ensuring that the US has
an important place in this rapidly transitioning market. Again, the best way to do this is by giving solid
assurances about the very high status of the US soy supply system.

Historically, the US has been able to promote the use of a product in a new market as it is the market
leader. In this situation, greater use of the product will result in more advantage for the market leader.
That situation has changed in many markets given the advances made by South American producers.
Consequently, promoting use of a product is no longer prudent unless you can strongly differentiate your
product/service package.

6.8. Improving the value of US meal to animal agriculture

The soybean community fully understands the positive and negative attributes of soybean meal as an
ingredient in feeds. Clearly, the positives far outweigh the negatives, as soybeans and soybean meal are
one of the most widely used protein sources in global animal production.

However, what does the future hold? Will soybean meal continues to be a commodity with a broad
standard quality similar to that seen today?

We know that plant breeders can manipulate characteristics to modify the nutritional contribution of the
soybean for animal production. However, is there sufficient demand for the soybean meals produced
from these soybeans? Can the current commodity-based system transition into a more segregated system
that supplies differentiated products to meet specific feed ingredient requirements?

Much will depend on the cost. The feed company must be sure that the added revenue from selling its
feed will be greater than the extra costs buying the improved meal from the crusher. In turn, crushers
must be sure that they will gain revenue to provide extra margin over the likely higher costs of
purchasing, segregation and processing. In turn, the grower will not grow the variety unless it promises
higher returns than other alternatives.
Ultimately, the market will supply the answer. If needs are strong enough, demand will be created to generate supply. An example is found in Brazil. Two companies saw the opportunity to supply European salmon aquaculture with non-GMO 60% protein concentrate. They invested in non-GMO supplies and high-volume SPC plants to focus on producing a specialized product for the salmonid industry with low anti-nutritional factors and how to supply the bulk of that market. Others are adopting similar strategies. Can this be extended to meet the nutritional requirements of other species?

A major challenge starts with the breeding. Novel characteristics must be produced without significant yield drag. Also, meal quality objectives must not compromise oil objectives (or vice versa).

Another challenge lies in the technology available to rapidly identify and measure critically important nutritional characteristics, an essential prerequisite for component pricing. While various wet chemistry methods are in use, neither provides procedures that facilitate rapid measurement of a range of relevant quality characteristics. Near infrared (NIR) technology offers promise, but it still is not widely applicable throughout the supply chain.

It is clear that soybean breeders have the capability of producing improved varieties with enhanced value as a feed ingredient. However, there are major constraints on commercializing these products in volume. The market will determine whether component value systems will develop. The proposition must be attractive to the hog and poultry farmer, the feed mill, the crusher, and the soybean farmer. All parties need to continue dialogue on new product opportunities.

To encourage more rapid adjustment, assistance is required to sustain production efficiency, breeding efforts, and the development of rapid and accurate soy product quality measurement systems. Critically, all stakeholders in the sector supply chain need to fully understand what can be done and the potential benefits and costs of transitioning to a system where more value can be extracted from US soy products sold to animal agriculture.

| Animal agriculture: Meal - Increase value of soybean meal to animal agriculture |
|-----------------------------------------------|-------------|-----------------|
| Ability to influence | Low | High |
| Priority | High | High |

Many factors affect the value of soybean meal to animal agriculture. Animal agriculture is increasingly focusing on detailed nutritional quality of its basic raw materials. Feed companies are content to purchase commodity meal and supplement the overall nutritional package with other ingredients. Soybean meal could offer much more - improved protein quality and digestibility, fewer anti-nutritionals, and reduced environmental impacts - although the incentives to modify the quality of soybean meal have not been developed and are currently insufficient to bring major changes in soybean or meal quality. A clear indication of the benefits to crushers, feed companies, and annual agriculture farmers is required.
7. HUMAN UTILIZATION

Soybean oil is the principle soy product consumed directly by humans and is a key component of the total world supply of fats and oils. Soybeans are consumed primarily in the form of tofu and other fermented bean curd products although soy milk has also become popular in recent years in the United States and a few other countries. Soy protein in the form of flour, concentrates and isolates is the third main way that people consume soy. Small amounts of soy in the form of pharmaceutical or nutraceutical products are also consumed. In terms of generating a return to the soybean grower, it is the future of soybean oil consumption that will have the biggest payoff. That will be influenced both by its inherent qualities and by the general image of soy as a part of the human food supply. That image has begun to deteriorate due to a proliferation of negative commentary on social media. Some of that commentary is related to biotechnology but other strains are equally troubling and need to be combatted.

7.1. Soybeans

Soybeans have been a part of Asian cuisine for centuries, as a fresh vegetable (edamame), as snack nuts, or in the production of tofu and other fermented bean curd products. For selected countries, USDA estimates food use of soybeans and the total in 2011/12 was 15.4 million metric tons, or about 6% of world soybean use. Of that amount, China accounts for 9.3 million, Indonesia for 2.6 million, and Japan for 1.0 million tons. Other Asian countries account for most of the balance. The amount has been growing by about two percent per year. In the United States and a few other countries the growing market for soy dairy beverages has added to demand for soybeans for human use. If one adds estimated food use of soybeans in the United States, Canada, the EU and a few other non-Asian countries, total world use is probably between 17 and 18 million tons, or almost 7% of world soybean disappearance. However, it represents a slowly declining share of total soybean use because the demand for soybean meal for animal feed is growing more rapidly.

Supplying soybeans for food use was long ago identified as an opportunity for specialist niche growers. The US industry recognized that supplying food use soybeans is a market opportunity and separate “identity preserved” (IP) supply channels have been developed to deliver specific varieties of soybeans best suited to various uses. These IP categories include organic, food grade, non-GMO, and other specialty soybeans. Containerization ensures that soybeans for food use do not include any GM or non-organic material when destined for markets that are sensitive to those criteria.

Specialty IP soybeans generally command price premiums. One reason for these higher premiums is the separate transport pathways these beans must take in order to not be mixed with non-IP beans. These beans cannot be shipped abroad in bulk carriers. The load sizes are too small and the risk of contamination from other beans is too high. The use of containerization for IP beans makes sense for small volume, high value soybeans and SBM sold to niche markets.

The supply of and demand for soybeans in a global market are varied and by nature, very dynamic. High commodity prices for conventional soybeans have offered farmers a good rate of return. IP crops command a price premium but at an elevated risk level. Higher expected rates of return with less risk on conventionally farmed soybeans have pulled most US growers in that direction. This trend is evident in the steadily decreasing organic acreage in the United States. In fact imports of IP organic soy have been rising because the US supply of IP organic soy is insufficient to supply domestic demand. IP organic soy is mainly used in foods for human consumption, the majority going to the natural foods industries.
7.2. The future of GM crops

One of the key issues for future human consumption of soy products is whether people continue to accept biotech soybean varieties as equivalent to soybean varieties developed with traditional breeding techniques. Here we discuss the prevalence of biotech varieties and how they are being viewed by consumers in the United States and Europe. In the US, GMO concerns are growing while in some other parts of the world concerns seem to be decreasing. Even in the EU, it is apparent that GMOs are no longer considered the ultimate evil they once were. Many scientists and consumers are ready to accept the introduction of GMOs into the food supply. Political activists and most public officials are still opposed because a few activists are able to sway the political climate to a position of safety.

7.2.1. Worldwide adoption

Biotechnology adoption continues to grow worldwide at a steady rate. Land area planted with biotech seeds increased by 8% in 2011 over 2010. Developing countries grew fifty percent of the global biotech crops. Acreage in less developed countries is expected to exceed industrialized nations’ in 2012. The US is the worldwide leader in biotech crops, producing approximately 43% of the total biotech crops, and has an average adoption rate of 90% across the principle biotech crops. Within the US, adoption of GM soybean varieties has stabilized at about 93%.

According to the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), in 2010, 29 countries planted commercialized biotech crops. An additional thirty-one countries, for a total of 60, have granted regulatory approvals for biotech crops for import for food and release since 1996. Turkey approved biotech crops for import beginning in 2011. In the world, 1,045 approvals have been granted for 196 events for 25 different crops. The US has the most events approved, followed by Japan, Canada, Mexico, South Korea, Australia, Philippines, New Zealand, European Union, and Taiwan. Maize has the most events approved with 65, cotton (39), canola (15), potatoes, and soybeans (14 each). An herbicide tolerant soybean event, GTS-40-3-2 has the most country approvals of any event at 25, followed by MON810 with approvals in 23 countries.

Many studies have been done verifying the benefits of biotech crops. Benefits include:

1) Increased productivity - Increased productivity promotes food security, self-sufficiency, and economic benefits to farmers.
2) Conserve biodiversity - Biotech crops use less land meaning less deforestation and loss of habitat for indigenous species.
3) Help to alleviate poverty and hunger - Increased farmer margins, lower input costs, more production, higher yields, and lower food prices all contribute to increased economic prosperity.
4) Environmental footprint - Biotechnology reduces the carbon footprint of agriculture, reduces pesticides, reduces petroleum usage and dependence, and water usage.
5) Mitigation of climate change - Tillage and spray practices through reduced fuel usage and soil carbon sequestration reduce the carbon footprint.

7.2.2. Opposition to biotech

The United States

The US market has historically had little sensitivity to the issue of genetic modification. Consequently, soy has been widely consumed without concern about this issue. In fact, US consumer perception of soy products has mostly been positive and a wide range of products is available today with soy protein as an ingredient. Historically, soy had been seen almost exclusively as a meat substitute or extender in the form of soy vegetable protein (SVP) but in more recent years its use in food products has been more
diverse, reflecting its useful functional properties. It is an excellent source of dietary protein as it contains all of the essential amino acids.

In 2012, the issue of labeling foods for biotech content came to the fore as a ballot initiative in California. As a result, California voters were asked to vote in November on whether foods derived from biotechnology should be labeled as such. The measure, Prop 37, was officially certified following a signature gathering campaign. The ballot initiative would have required the labeling or reformulation of thousands of grocery products. It would also have prohibited advertising processed foods including biotech ingredients as “natural”.

A coalition of agriculture, food, consumer, and business groups opposed the initiative because of increased costs throughout the food chain to relabel products derived from GMO’s and the high probability of unjustified fears and confusion in the public. In addition, opponents noted a likelihood of subsequent lawsuits at taxpayer expense, which could have been significant.

Relabeling would involve quantifiable tangible costs related to supply chain origin identification for most foods, whether raw or processed, derived from biotechnology. The main problem is not necessarily the tangible costs; rather it is the unquantifiable costs of fear, confusion, and controversy. The supply chain of commodity ingredients and processed foods would have had no choice but to comply with the mandates by the scheduled implementation deadlines. Manufacturers of processed foods would have had a choice whether to comply with the new labeling mandates or reformulate products.

The very act of labeling produces differentiation in the mind of the consumer, who is largely unaware of the amount and extent of ingredients from GM crops in foods. By most estimates, approximately 70% of the foods in a grocery store would need to be relabeled because they contain such ingredients. The recent episode over mechanically separated and disinfected beef products known in the meat industry as lean finely textured beef (LFTB) and boneless lean beef trimmings (BLBT) demonstrates the negative reaction in consumers that occurs when an uninformed public is given misleading information about foods that are considered safe by all established scientific principles. A furor ensues that drowns out the facts. The food industry was justifiably very concerned. Much of the corn produced in the US is GM, but it would be rare to find many consumers who know this or aware of how long many foods have contained GM ingredients. The very fact of labeling would likely cause undue fears and confusion in consumers who suddenly find that their favorite morning cereal “now” contains GMO’s.

Proponents of the labeling initiative insisted that the purpose was to allow consumers who wish to avoid GM to make an informed choice. Critics point out that there are thousands of voluntarily labeled non-GMO products in the marketplace and consumers who wish to avoid GMO’s are informed. Critics also further noted that since the non-GMO consumer is able to make informed choices the only logical reason to mandate labeling of GMO derived foods is to cause fear and confusion in the general public to drive at least some of them toward non-GMO foods by labeling the differentiation.

Fortunately, Prop 37 went down to defeat with a decisive majority of California voters opposing it. But the issue will probably not go away. Pro-labeling initiatives are being planned for a number of states.

**European Union**

The European Union has a history of taking a hard stance against biotechnology products, namely banning foods and commodities that are derived from biotech. However, in the last few years that stance has begun to weaken somewhat in the face of positive scientific studies, higher grain prices, and evidence of higher greenhouse gas emissions and lower yields for conventional varieties. Generally, the scientific
communities in the EU see the benefits of biotech grain and oilseed production. However, consumer opinion is still strongly against biotech food ingredients.

Recently, US and EU trade policy discussions have begun to get underway and will have to address the issue further in order to forge a proposed trade agreement between the two economies. Agricultural exports of certain crops from the US to the EU are effectively blocked by health and safety measures related to GMO’s.

Despite the prevailing consumer and political opinions regarding GMOs, universities and biotech companies in Europe have continued to research the viability and safety of GM crops. Over 100 applications were submitted in 2009 but numbers have been falling since then. Field trials in Europe for biotech crops have dwindled drastically in every country except for Spain. The number of release experiments had decreased to 41 as of May 2012, and of those, 30 were from Spain. Of the total, 10 relate to the development of plants with new or improved traits.

In 2011, EU farmers planted 114,490 hectares of Bt corn (MON810), up 26% from 2010. Six countries planted Bt corn; Spain, Portugal, Czechia, Poland, Slovakia, and Romania. Spain planted 85% of the total Bt corn. A field trial of 17 hectares of Amflora, a GM potato variety, was planted, but activists destroyed the crop.

Early in 2012, Monsanto and BASF pulled out of the EU market citing a lack of acceptance and a constrictive regulatory regime. BASF has suspended development of GM crops and plans to move the entire plant science arm to Raleigh, NC. Monsanto has decided not to sell any more MON810 biotech corn, named “Yieldguard”, in the EU even though a November 2011 court decision overturned the ban on sales. France is still pushing an EU-wide ban on MON810.

BASF labored for 13 years to obtain the EU approval in 2010 of cultivation of its Amflora potato, which is intended to provide high quality starch for industrial usage. Because of activist threats of violence, test fields were put under constant guard. Nevertheless activists destroyed the crops. It was believed that the Amflora and Yieldguard approvals would mark a turning point in the GMO debate. A European Commission proposal to allow member states to decide on GMO issues has also failed to make any headway.

In an interview with EurActiv, Chief Science Advisor to the European Commission, Anne Glover, stated that “There is no substantiated case of any adverse impact on human health, animal health, or environmental health, so that’s pretty robust evidence, and I would be confident in saying that there is no more risk in eating GMO food than eating conventionally farmed food”. She asserted that scientific evidence needs to play a stronger role in policymaking in the EU and that those opposed to GMOs should respond with evidence to substantiate their claims.

In October 2011, 41 Swedish biologists sent an open letter to environmentalists and politicians speaking out on the need to revise European legislation to allow the adoption of GM crops using science-based assessments. A group of UK scientists endorsed the statement. A University of Reading study in 2011, (“Impacts of the EU regulatory constraints of transgenic crops on farm income”) estimated the economic impact of growing GM crops where there is agronomic need or benefit; farmer margins would increase by US $575 million-$1.2 billion. As new transgenic events come to market and are adopted, given the low level of approval and growth of biotech in the EU, the revenue forgone will increase.

Policies in the European Union have a fairly direct impact on approaches taken by other governments around the world. It is important for USB and its partners to continue efforts to increase awareness of
sound science and the positive attributes of soy worldwide and particularly in Europe. Efforts must also continue here at home to counter negative commentary on soy and biotech food ingredients.

### Human utilization: Increase the awareness of the sound science associated with US soy with regard to biotech, health, food safety and sustainability

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Consumer aversion to biotech soybeans is a long-term threat to the US industry that needs to be addressed if soy is to retain its generally favorable image. Other negative commentary on soybeans and health is also worrisome. The favorable attributes of US soy need to be aggressively promoted in both the domestic and international markets and social media.

7.3. **Soybean oil**

#### 7.3.1. World vegetable oil situation

Soybean oil competes at home and abroad with a variety of fats and oils. Animal fats like lard and tallow are a byproduct of meat production and their supply is not much influenced by developments in the larger vegetable oil market. In contrast, plantings of oilseed crops and oil palm are directly influenced by vegetable oil prices. And there are some vegetable oils - corn and cottonseed - that are essentially byproducts of other areas of commodity demand.

There are two main products from the oil palm: palm oil and palm kernel oil. Palm kernel is a higher value oil with specialty applications. Palm oil can be further fractionated into palm olein, a liquid oil, and palm stearin, a solid fat.

Table 9 shows world production and consumption of the major vegetable oils. Palm oil, soybean oil, and rapeseed (canola) oil account for 75% of world vegetable oil production. Palm oil leads with 34% of world production. Soybean and rapeseed oils account for 27% and 16% respectively. US soybean growers once viewed palm oil solely as a threatening competitor but now take a more nuanced view. Palm and soybeans are in some ways complementary products because while demand for oilseed meal and vegetable oil is growing at similar rates, soybeans have low oil content relative to other oilseeds. Without palm oil the world would be looking more to oilseeds with higher oil content like canola and sunflower, and less to soybeans.

Palm oil is the most traded oil in the market by a large margin. In 2005, soybean oil was replaced by palm oil as the most consumed oil by humans. Palm oil is produced primarily in Indonesia and Malaysia. These two countries account for 87% of world palm oil production. Soy oil and palm oil prices are highly correlated (.968) and have become coupled to petroleum prices as a result of renewable fuel programs around the world. Generally, palm oil is slightly cheaper than soy oil as shown in Figure 38, although part of that difference is transportation related.
World demand for edible oils and biodiesel has been growing rapidly and will continue to do so. FAPRI-CARD projects demand growth through 2020 of 16% for rapeseed, 19% for soy, and 31% for palm oil. Thus palm oil will further increase its market share.
7.3.2. US vegetable oil situation

Soybean oil continues to be the dominant oil in the domestic market, thanks in part to biodiesel. In 2011/12 it accounted for 55% of total disappearance of fats and oils, down from 65% a decade earlier. It was displaced by canola, palm oil, and palm kernel oil. The combined share of those three oils grew from 9.2% ten years ago to 22.7% last year. Most of that displacement occurred over the last six years as concern over trans fats caused food manufacturers and the food service industry to replace hydrogenated soybean oil with other oils. Looking only at edible use, soybean oil’s share fell from 65% to 50%. This is visible in Figure 39 where soy methyl ester makes up the difference between total soy oil disappearance and food use.

The clear trend in the domestic market is away from soybean oil. Reversing that will require giving customers a reason to prefer soy, whether those customers are the final consumer, food processors, or restaurants. Innovations in bioengineering have the capability to enhance soybean oil qualities. Specialty oils are oils that have been engineered for specific desirable qualities, generally for human consumption. Three promising candidates in the development pipeline are high oleic, omega-3, and high stearic soybeans.

High-oleic soybeans are the newest specialty seed type for soybean oils. The 2012 crop was the first year of commercially produced high-oleic soybeans. High-oleic soybean oil is high in monounsaturated fats but also low in polyunsaturated fats. This combination makes for a healthy food for human consumption and a shelf stable product. In addition, it has no trans fats. High-oleic oil is very resistant to heat and excels in processes that require high heat. High-oleic soybean oils score high on the oxidative stability index and also have low-linolenic qualities.

![Figure 39: US fats and oils share of disappearance](Image)

Soybean oil is one of a handful of sources of omega-3 polyunsaturated fatty acids. Although fish is the preferred source of omega-3s, the ALA acid chain in soy is the primary source of omega-3s in American diets. A new soy genotype has been produced that has SDA (stearidonic acid) which is readily converted
to EPA and DHA. Efforts are also underway to produce strains with increased EPA and DHA omega-3 fatty acids.

Research and development into breeding new strains with high-stearic fatty acid content is also underway. Evidence has shown that stearic acid is cholesterol neutral compared to other saturated fatty acids. High-stearic oils will be stable and neutrally flavored and serve as an option for applications requiring more solid fats, like for baked goods.

High priority should be given to researching and commercializing these specialty soybeans so that soybean oil can compete with the canola and other high oleic oils.

### Human utilization: Promote high oleic and other improved soybean oils for food use

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Food use of soybean oil continues to represent a declining share of US fats and oils disappearance while canola and palm oil gain market share. Gaining back share will require a long-term effort to provide customers with oils that meet their diverse needs.

#### 7.4. Pharmaceutical and nutraceutical products

One of USB’s Target Area Goals is to identify growth opportunities for the use of soybean components in high-value, low-volume pharmaceutical and nutraceutical applications. Soybeans contain the isoflavones daidzein and genistein which are types of phytoestrogen. Soy lecithin is also produced as a byproduct of oil refining and has some pharmaceutical applications.

Given Americans’ predilection for dietary supplements, nutraceuticals will be where the bigger opportunity lies. Bioactive ingredients like isoflavones can be key ingredients in functional foods that address chronic conditions like diabetes and heart disease. Some effort to identify and commercialize bioactive soybean ingredients may prove fruitful.

### Human utilization: Develop new pharmaceutical and nutraceutical products

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These products currently account for a tiny share of soybean demand but are high value and capable of contributing to the positive image of soy in the marketplace. Research in this area merits some degree of support, but with recognition that it will not be a major market driver.
8. INDUSTRIAL UTILIZATION

The industrial applications for soy are dominated by the applications for soybean oil. About 95% of the industrial applications come from the lipids; meal components account for about 5%. Of the oil uses, by far the largest category is biodiesel, currently accounting for about 70% of industrial soybean oil usage. Figure 40, using 2009/10 estimates from the USB Market View Database, provides a good sense of the relative importance of the various industrial utilizations.

![Figure 40: Soybean component industrial utilization 2009/10, (mt)](source: USB Market View Database)

The petrochemical market has been less volatile lately, but will face increasing pressure as the world’s economies recover. The market environment and the government response have also been affected by geopolitical considerations, and particularly the extent to which the United States is dependent upon supplies of hydrocarbons from countries that are politically unstable and generally unfriendly to US interests.

In addition, there are various environmental and economic arguments that strongly influence this market. In particular, many developed countries in the world have developed a response to global warming and its impact on climate change, implementing a range of policies to reduce man-made emissions that are harmful to the quality of the atmosphere. Although policies designed to combat man-made environmental degradation took a back seat to the more pressing economic situation for the last few years, the political climate will likely turn back to environmental issues in force.

Governments have already introduced policies that benefit industrial feedstocks and raw materials that are less harmful to the environment than hydrocarbon alternatives. US government incentives for the production of renewable fuels such as bioethanol and biodiesel, and the introduction of the BioPreferred program are examples of policies that confront climate change and energy and environmental objectives.

Apart from biodiesel, the traditional industrial utilizations of soy oil are lubricants, plastics, solvents, paints, and coatings. Substantial strides are being made with each, although their viability depends on...
the regulatory environment, the cost of major competitive feedstocks (mainly hydrocarbons), and the technological advances made to improve functionality and reduce costs. More recently there have been promising developments in use of soybean oil in production of polyurethane foams and rubber. We review below some of the advances in these major categories of industrial products. We also review the BioPreferred government program implemented by USDA that provides incentives for the use of renewable, environmentally friendly, bio-based products.

### 8.1. Biodiesel

In January 2012, an EPA regulatory filing said that palm-oil biodiesel does not meet greenhouse gas emissions standards. Biodiesel refiners and oil companies may not use palm oil biodiesel to meet the fuel mandates. Competition from palm oil for use in biodiesel production in the US has ceased to be an issue, at least for now. The biodiesel tax credit has not been extended beyond 2012, but in September the EPA raised the biodiesel mandate to 1.28 billion gallons for 2013.

Biodiesel has been an important safety valve for what might have been excess soybean oil supplies as the food sector eliminated trans fats. Now the linkage to petroleum prices is a key supportive factor for the soybean oil price. Maintaining the status of biodiesel production and mandates is a high priority.

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Biodiesel is classified as an “advanced biofuel” which means that it meets or exceeds the 50% threshold for lifecycle greenhouse gases. This ensures that it can continue to receive the benefits of the Energy Independence and Security Act. Currently, biodiesel relies heavily on government mandates to ensure a market. Federal and state mandates to use biodiesel and some state tax concessions affect its competitive position, although much of the industry remains shut down. These policies have failed to propel biodiesel use in the US to levels that many in the industry had anticipated. The industry is resigned to the fact that in the short term, markets must be distorted by subsidies and other concessions to ensure that production growth is reestablished.
There are a number of reasonable premises for distorting market incentives in favor of biodiesel. For example, it may have a more acceptable emission profile, it has the potential to reduce reliance on imported hydrocarbons, hydrocarbon extraction is subsidized, and, markets may be poor at allocating resources over longer periods because of the lack of sound information upon which to base individual resource allocation decisions.

Figure 41 shows the amount of biodiesel required under the EISA and EPA mandates and US biodiesel consumption. In 2010, consumption was about 500 million gallons, less than half the EPA mandated amount of 1.15 billion gallons. Consumption in 2011 was very close to the EPA mandated production of 800 million gallons. Based on data through August it looks like the 2012 total will reach 1 billion gallons.

Figure 42 shows biodiesel production, consumption and net exports. From 2001 to 2006, almost all production was consumed domestically, and very little was exported. In 2006 production increased but consumption began to level off. The excess supply of biodiesel was exported. When the $1-per gallon tax credit ended in 2009 biodiesel production went into a free fall. Production and consumption continued to fall until 2011 when the tax credit was reinstated. Production and consumption suddenly changed course dramatically, and tripled in size by the end of 2011. It is evident that without government action to support biodiesel production the market demand is very small. In addition, both production and demand are now very close and exports have dropped off significantly. These movements illustrate just how dependent the biodiesel market is on subsidies and/or mandates.
Figure 42: Biodiesel production, consumption, and net exports, by year, 2001-2011

High oleic soybean oil from the newest soybean genotype may be an improvement over current biodiesel feedstock. Some of the biggest challenges to soy biodiesel are oxidative stability and cold flow performance. Oxidative stability is the amount of time the fuel can be stored before becoming unstable. Current biodiesel has a relatively high oxidative reactivity that compromises the shelf life of biodiesel. Cold flow performance refers to the coldest temperature fuel can properly operate in. At low temperatures, soy derived biodiesel can gel or crystallize and cause engine damage.

Oleic acid is a monounsaturated fatty acid that balances the tradeoff between cold flow performance and shelf stability. Oleic acid has lower crystallization temperatures and retains a relatively low oxidation rate, giving biodiesel made with high-oleic soy oil improved cold weather properties.

The utilization of soy oil in the biodiesel industry is uneconomic without subsidy or mandates. In addition, other feedstocks have sometimes proved more competitive while the industry operates at low capacity. Its future depends on continuing mandates enforced by EPA regulations. As such, national biodiesel production levels of one billion gallons are assured. While biodiesel is accepted as an advanced biofuel, under current language in the legislation it may not be able to compete with other alternative advanced biofuels to exploit the full advantage of the advanced biofuels mandate. Considerable additional subsidies and credits would be required to push biodiesel production above the mandated level (unless the EPA just keeps increasing that level). While the general financial environment is hostile to public expenditure, the arguments for biofuels remain powerful. Expansion of the volume of biodiesel produced should benefit a widely available, convenient feedstock such as soy oil. The product will be consumed as long as biodiesel is competitively priced with diesel.

8.2. Other industrial products

Although there are several thousand products on the market that use soybean components, there are only a few that may have a significant market impact. Most products will likely remain specialty or niche
products for quite some time. Trying to decide which ones have the greatest market potential is often difficult, especially when price will be as important a factor as functionality. However, we believe soy rubber represents one of the most promising products made from soy.

8.2.1. Rubber

Ford Motor Company, Bridgestone, and Goodyear are leading the charge into soy based rubber tires. Developments are underway that could help customers and the environment with the introduction of soy based rubber compounds and elastomers or plasticizers.

World consumption of rubber is greater than 25 million metric tons. Rubber products make up things like pneumatic tires, transmission belts, conveyor belts, hoses, rubber wheels, footwear, elastomeric seals, roof liners, and membranes.

There are several established uses already in the rubber industry for soy. Vulcanized soy oil is used as an extender and rubber substitute. Epoxidized soy oil is used as a plasticizer and stabilizer in plastics and rubber.

The primary focus of the latest research and development is the use of soy in rubber tires for passenger vehicles. There are several advantages to using soy. Tests have shown that soy based rubbers have a longer tread life, by about 10%. The process for making soy-based rubber is more efficient, potentially reducing pollutants. In addition, the use of soy oil will reduce dependence on petroleum for rubber production.

Bridgestone has developed a soy-based tire for farm tractors. Soybean oil constitutes more than 10% of the tire. Goodyear has also announced that it is planning to swap out the petroleum for soy oils in their tires and could be selling soy based tires by 2015. The company expects to cut petroleum purchases by more than 225,000 barrels a year.

A quick calculation based on Goodyear's estimates of soybean replacement of petroleum shows that the replacement would be about 10.7 million gallons of petroleum. Since the process is very similar to vulcanize both oils, a similar amount of soy oil would be needed; 10.7 million gallons.

Ford Motor Company scientists have engineered new rubber compounds using soy. The new compound is capable of replacing 25% of the petroleum in the manufacturing of passenger vehicle components. Ford scientists say that soy products could replace up to 26% of the petroleum used in all automotive applications.

Traditional rubber tire manufacturing involved using polycyclic aromatic components. The primary oil has traditionally been Distillate Aromatic Extracts, a highly aromatic oil. The EU has banned high aromatic oils due to suspected carcinogenic effects. Only tires with low levels of Polycyclic Aromatic Hydrocarbons are allowed to be imported into the EU. Soy oil is being used as a replacer for these highly aromatic oils. New tires containing low polycyclic oils, like soy, will be allowed into the EU.

8.2.2. Polyurethane foams

Ford is also a pioneer of using soy polyols (biOH) in the polyurethane foam in car seats and headliners. Biofoam, as Ford has named it, is currently in more than 2 million Ford vehicles. In addition, some soy polyurethane foam has found its way into furniture. Typical concentrations of soy replacement of the petroleum components are 5%, although up to 20% may be used without degrading performance.

However, there are some concerns by consumer groups over polyurethane foam. Traditional polyurethane foam is 2/3 polyurethane and 1/3 isocyanate, a known carcinogen. Polyurethane foam is very flammable.
and requires special highly toxic flame-retardants. Soy foam is made the same way as traditional foam, with up to 20% of the polyurethane replaced with soy. Due to the polyurethane content, the soy foam requires the same flame retardants and contains the same level of isocyanates. In addition, soy poly foam degrades at the same rate as regular foam. These concerns over soy foam may be a limiting factor in their increased usage.

8.2.3. Bio-based lubricants

The world market of lubricants and greases is not growing in the way normal markets expand. Although overall volume is expanding, it is doing so at a much slower rate than other indicators. The main driving force behind this are the emergence of an expanding market segment of high value oils with superior lubricity and much longer drain intervals. The superior performance and resulting longer drain intervals have a side effect of lowering total volume. Many customers are switching to these superior lubricants because of the increase in machine life and reduction in maintenance downtime they offer. Soybean oil is well poised to take advantage of this trend into superior lubricants.

Soybean oil can be used as the base in a wide range of lubricants, food grade oils and greases hydraulic fluids, metalwork fluids, total-loss lubrication and wire rope oil. The alternative to bio-lubricants is mineral oil based lubricants. Mineral oil is the traditional base; it is less expensive than bio-lubricants and is generally perceived as a better product. Many different companies and research institutions are working to improve bio-lubricants because they are better for the environment, safer, and cheaper to clean up. However, the research is still in the early stages and there are many hurdles that must be overcome to make bio-lubricants more competitive.

The biggest market potential is the use of soy in engine oils. Soy-based crankcase oil would use a significant amount of soybean oil and make a good alternative because of its high viscosity index and low volatility, however, the thermal and oxidative instability of soy oil are a major challenge to overcome. The market potential of soy oil is very high as an emerging market of high performance oils gains market share. Soy crankcase oil would also be biodegradable, making it much more environmentally friendly. Soy oil as an engine oil replacement still represents a potential market that has not yielded significant progress yet. Research is still underway.

High oleic oil soybeans have been identified as having superior qualities for biosynthetic oils. Research and development by BioSynthetic, in collaboration with USDA, has produced a new class of bio based synthetic oils that meet or exceed the highest quality and performance conventional oils on the market. High oleic trials are underway with commercial introduction planned for 2014.

8.2.4. Bioplastics

According to The Freedonia Group’s Bioplastics study, demand for bioplastics is expected to reach 550 million pounds by 2016. There are two types of bioplastics, biodegradable and non-biodegradable. Currently biodegradable plastics have a larger market share than non-biodegradable plastics. However, the non-biodegradable plastic sector is growing at a fast rate and is expected to surpass the biodegradable sector in the near future. Non-biodegradable plastics are made from biomass and are chemically identical to their petroleum counterparts. Since they are chemically identical, market acceptance is forecast to occur rapidly.

According to the BioPlastics Council, worldwide usage of bioplastics was 850,000 metric tons in 2011. Projections indicate 3.7 million metric tons will be used in 2016. The North American market used 300,000 metric tons in 2011, and is expected to grow to 1.2 million metric tons by 2016.
8.2.5. Solvents

The solvent market demand in the US is estimated to be 50 million pounds in 2011. The environmental solvents sector is increasing, largely due to increases in environmental and regulatory pressures to reduce ozone depleting substances (ODS), volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). The EPA regulates solvents in the US. Solvents must meet requirements in the Clean Air Act, Clean Water Act, and the Toxic Substance Control Act. These regulations have encouraged the research and development of "green solvents".

There are market opportunities for higher value, green solvents. Methyl soyate is the main base for solvents made from soybeans. It is commonly used in cleaning and removal of paints, coatings, inks, adhesives, resins, graffiti and asphalt, as well as printing ink. Soybean oil makes a good solvent because it has good solvency, releases low VOCs, is non ODC and HAP, as well as nonflammable. It has low toxicity, low odor, is easily biodegradable and is competitively priced.

Unlike many of the other industrial uses for soybean oil, soy-based solvents are comparable in quality and price when compared with their mineral counterparts. According to the USB, methyl soyate prices in July 2012 were $0.85 per pound. Pricing from 2007 shows similar results long term. Soy based solvents perform as well as or better than conventional petroleum solvents and are well poised to gain market share.

8.2.6. Paints and coatings

Soy oils are used to make soy alkyd resins for interior and exterior solvent-based applications. As paints have become faster drying, and easier to use and clean-up, the ways in which soy oils can be used have expanded. Now soy oils act as additives (i.e.: binders, co-monomers and oligomers). Soy methyl esters are also used in paints and coatings. They are binders and solvents in oil and water-based systems. They work well on porous surfaces and contain low VOCs.

USB is funding projects that will produce technological advances to improve soy oil paint and coatings. The industry ranks these technologies as follows, in order of importance: waterborne, radiation curing, high solids system, powder coatings and conventional solvent-based systems.

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Maintaining the status of biodiesel production and mandates is a high priority. There are many industrial applications for various soy oil components and new ones are in the pipeline. Soy based rubber, foam and lubricants represent potentially excellent opportunities for growth. Investments in the most promising applications will likely yield long-term results.

8.3. Soybean Meal, Isolates, & Concentrates

Soybean meal components are limited in industrial applications. The USB reports that only about 55,000 mt were used in industrial application in 2009/10. Most research and products revolve around
applications for soybean lipids. Soybean proteins have found some use in adhesives, particularly wood adhesives, wood fillers, and textile fibers. In wood products, soy based adhesives show superior performance and economics. Following WWII, soy based adhesives were largely replaced by petroleum based adhesives. Efforts to reestablish soy adhesives in manufactured wood products are ongoing.

The majority of wood adhesives are formulations of either urea or phenol and formaldehyde, UF and PF. The target areas for adhesives revolve around reducing formaldehyde emissions and reducing costs associated with rising petroleum prices. The processes for making urea and phenol are based on petroleum. As petroleum prices rise, the costs of urea and phenol rise. However, soybean oil has been coupled with petroleum prices for the last 4 years and SBM prices have historically been highly correlated with SBO prices. Although decoupling could occur under certain circumstances, it is likely that SBO prices will remain coupled to petroleum and thus, to SBM prices. The issue of reducing formaldehyde emissions however is an excellent way to drive forward growth of soy-based adhesives even if the economics of replacing petroleum are not superior.

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Soybean meal components are not applicable to many industrial applications. The few applications that have proven commercially usable have good environmental characteristics, but have not replaced petroleum substitutes. The limited number of applications makes expansion in this area challenging.

**8.4. Bio preferred program**

**8.4.1. Federal**

The BioPreferred program is operated through the USDA and is part of a larger federal initiative called Environmentally Preferable Purchasing (EPP). It promotes the sale of renewable, environmentally friendly bio-based products. There are currently 2,200 participating manufacturers and distributors of biobased products throughout the US. There are 77 BioPreferred product categories. The latest proposed rules for the BioPreferred program include an additional 12 categories of products. Upon approval of the new categories, government contractors and agencies will be offered more than 2,300 products for preferred purchasing consideration. BioPreferred products must contain a minimum of 25% of renewable material.

In addition to the BioPreferred program, the USDA also has a voluntary “USDA Certified Biobased Product” labeling program. To be certified, the product must meet the specific BioPreferred program requirements or must be 51 percent biobased.

Federal agencies are required to consider purchasing BioPreferred products, but if the price is deemed too high or the performance is not equal to mineral oil counterparts, then they are exempt from the requirement. As an example, given that the price of bio-lubricant based hydraulic fluid is $15.00 per gallon and its mineral-based counterpart is only $9.50 per gallon, it is plausible that most federal
agencies are not purchasing many BioPreferred products. However, no mechanism is in place to track the amount of BioPreferred products purchased by government agencies, so it is impossible to know for sure.

National initiatives to promote industrial use of both soy oil and soybean meal components have made steady progress, although there have been disappointments along the way. The most positive achievement has been the establishment of a group of enthusiasts in most of the major candidate soy utilizations. It is clear that industrial uses will continue to face major challenges in the face of competition from hydrocarbon and other vegetable oil sources. More recently, the tighter link between soy oil and energy prices has negated efforts to promote lower cost solutions. There remain technical challenges to overcome in several major areas. The greatest success has been achieved in partial replacement of hydrocarbon polyols for use in the production of polyurethane, and soy protein use in polyester resins and adhesives, the latter prompted by restrictions on the use of formaldehyde. Methyl soyate use in solvents also shows promise.

The utilization of soy oil in the biodiesel industry is uneconomic without subsidy or mandates. In addition, other feedstocks have proved more competitive while the industry operates at low capacity. Its future depends on continuing mandates enforced by EPA regulations. As such, national biodiesel production levels of one billion gallons are assured. While biodiesel is accepted as an advanced biofuel, under current language in the legislation it will not be able to compete with other alternative advanced biofuels to exploit the full advantage of the advanced biofuels mandate. Considerable additional subsidies and credits would be required to push biodiesel production above the mandated level. While the general financial environment is hostile to public expenditure, the arguments for biofuels remain powerful. Expansion of the volume of biodiesel produced should benefit a widely available, convenient feedstock such as soy oil. The product will be consumed as long as biodiesel is competitively priced with diesel.

8.4.2. State and local governments

Environmentally preferable purchasing hereafter referred to as EPP, are programs that give preference to products that are more environmentally friendly than traditional counterparts are. Many state and local governments have implemented at least a basic level of purchasing environmentally friendly products modeled and named after the federal initiative. Since the programs often vary by entity, a review of these programs is not feasible given the number of entities involved; however, some generalizations can be reported.

EPP programs seek to align purchasing decisions with the best value taking into account factors such as price, performance, and environmental impacts. Under most programs, purchasers are allowed some room in making this decision and weight environmentally friendly products higher even if the cost is higher. However, cost and performance are not sacrificed in order to obtain an environmentally friendly product. Guidelines for price difference are established as well as performance standards.

EPP programs are not a magic bullet. Many programs are vague in their allowances; others only allow a few specific products, and others may only apply to certain agencies within the influence of the allowance. In addition, purchasers can choose to ignore the allowance of purchasing an environmentally friendly product. While opportunities exist here, the sheer number of state and local entities to try to influence can be overwhelming. Efforts to influence any of these entities to adopt EPP programs may not work and even if they do, the purchasers may not be willing to embrace EPP. The final limiting factor is the local availability of products that may fit in to the purchasing allowances. Many entities give preference to local or in-state companies. Additionally an out of state availability will incur shipping costs that may tip the buyers decision in favor of conventional products.
Ultimately, the ability to influence adoption and implementation of purchasing across so many entities is not possible except in broad measures, mostly at the state level. Then there is the problem of the individual decisions of the purchasers and the availability of products.

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Expansion of the BioPreferred program can make more soy-based products available to federal agencies. Expansion of state level programs can also have moderate impacts on the usage of soy-based products. Working with state and federal governments to expand programs can increase the variety and volume of soy-based products demanded.