Incentive Distortions in Commodity Markets
Lessons from the Soybean Industry

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Introduction

Historically, the production and marketing of many agricultural products has been built on a commodity-based foundation. The system for valuing commodities is based on longstanding sets of grades and standards to insure uniformity of the products moving through the value chain. As the agricultural industry evolves, there are instances where the traditional grades and standards are proving to be inadequate and are even providing distorted signals to some value chain participants.

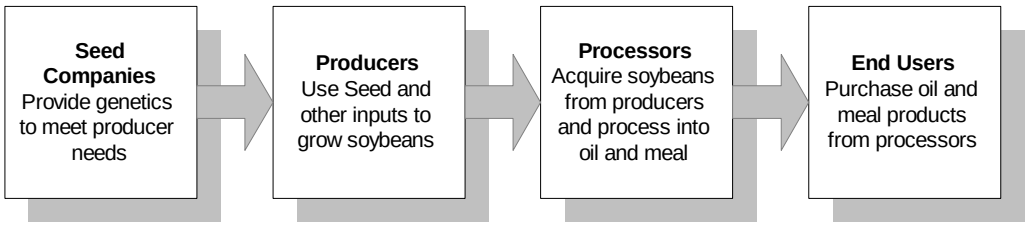
The consistency established by this system is important to users of the products further down the value chain. Grades and standards help to:

- insure that the buyer is getting what they are paying for,
- provide consistency for formulations and processes that use the product, and
- provide assurance of storability.

As a practical matter, the attributes that are used to define the grades have been limited to those that are easily measurable in the course of normal transactions. For example, soybeans are graded based on test weight (a measure of density), moisture content, foreign material, number of split beans, and discoloration. The buyer of the commodity essentially assumes that if these general characteristics are met, then the non-measured attributes will be present in sufficient amounts to meet their needs. However, this is not always the case. Further, some evolving technological advances are providing challenges to the adequacy of these long-standing benchmarks of quality.

The following is a discussion of some of the challenges being faced by the soybean industry as they evolve from a commodity-based system to one that is characterized by highly specialized products for specific end uses. The particular project underlying this discussion is to discover the impediments to quality improvement as it relates to protein content of soybeans. The following diagram is a simplified illustration of the key players in the soybean value chain.

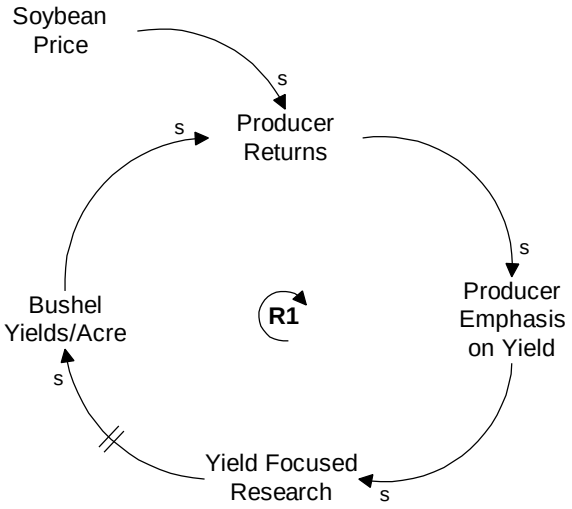
Simplified Soybean Value Chain



Coordination of quality improvement efforts is difficult in a value chain with many independent participants. In this project, meetings with participants across the chain were facilitated to define the system structure and begin to discover insights about the impact of quality improvement strategies.

Producer Goals in a Commodity System

The producer (or farmer) can increase their returns by producing more bushels on each acre of land, as long as it meets the defined grade standards. Thus, a producer's management strategies revolve around maximizing bushel yield. This need gets communicated to the seed companies who respond by breeding soybeans that provide maximum yield. The result is that yield has improved by 25-30% over the last 25 years. New genetic and biotechnology developments continue to enable increases in bushel yields while still meeting the minimum grade standards.



This diagram illustrates how emphasis on yield has been successful in increasing returns per acre. The producer emphasizes yield characteristics in the seeds that they purchase. Seed companies respond by focusing their research on yield to better meet their customer's needs. Over time, yield increases coupled with current market prices enhance the producer's returns.

Processor Returns

Whole soybeans have little value as feed ingredients or for other uses. The primary role of processors is to "crush" whole soybeans in order to derive soybean oil and protein in the form of soybean meal. There are established markets for both of these derivatives which serve as the raw materials for further processing. Thus, returns to the soybean processor are driven by the oil and protein content of the soybeans, even though these attributes are not a part of the grading standards.

Historically, the oil and protein content of soybeans have averaged around 19% and 35% respectively. However, there is a fairly wide variation in oil and protein content between depending on where the beans were grown, the weather conditions during the year, and the variety characteristics. These variations can have a significant impact on the value of the products that can be derived from a bushel of soybeans. This value can be quantified by computing the amount of oil and meal that can be derived from a bushel of soybeans and assigning a value to each—referred to as the Estimated Processed Value or EPV. The following table illustrates a range of EPVs for soybeans with different combinations of oil and protein content in soybean samples collected from a single crop year in Central Illinois.

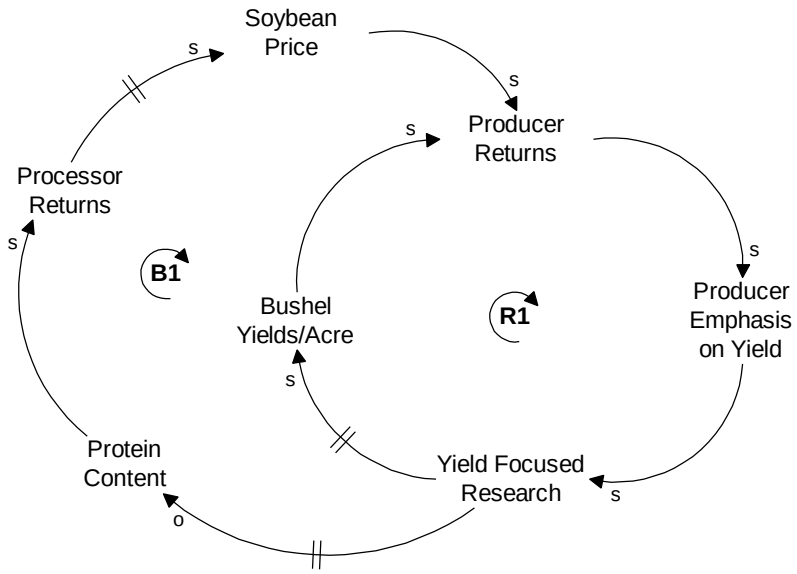
			Estimated Processed Value	
	Protein %	Oil %	$/Bushel	$/Acre
Overall Mean	34.78	19.36	8.43	461.92
Std. Deviation	1.30	0.69	0.14	23.82
Maximum	38.11	19.94	8.67	503.74
Minimum	32.88	17.37	8.13	426.72
Range	5.23	2.56	0.54	77.02

As this table illustrates, there is a wide range of value to the processor for soybeans that all fall within the grade standards used as the basis of pricing soybeans. Processors generally have little control over the oil and protein content of the soybeans that they purchase. Recall that a key driver of protein and oil content

in the soybeans is the variety of seed used, which is selected by the producer. This leads to an obvious disconnect in the system, where producers are focusing on maximizing yield while processors desire a balance between yield and protein and oil content.

An Unintended Consequence

The genetic makeup of soybeans is a complex system that must be kept in balance. Increases in one desired attribute may come at the expense of another. For example, let's focus on the protein component of the soybean. There tends to be an inverse relationship between bushel yields and the protein content in the soybean. Thus, a quest for bushel yields has gradually lowered the protein content in some varieties of soybeans. The result is that the farmers are achieving their goal of maximizing yields, but the processors and end-users are getting less value from each of those bushels. This is illustrated in figure 2.



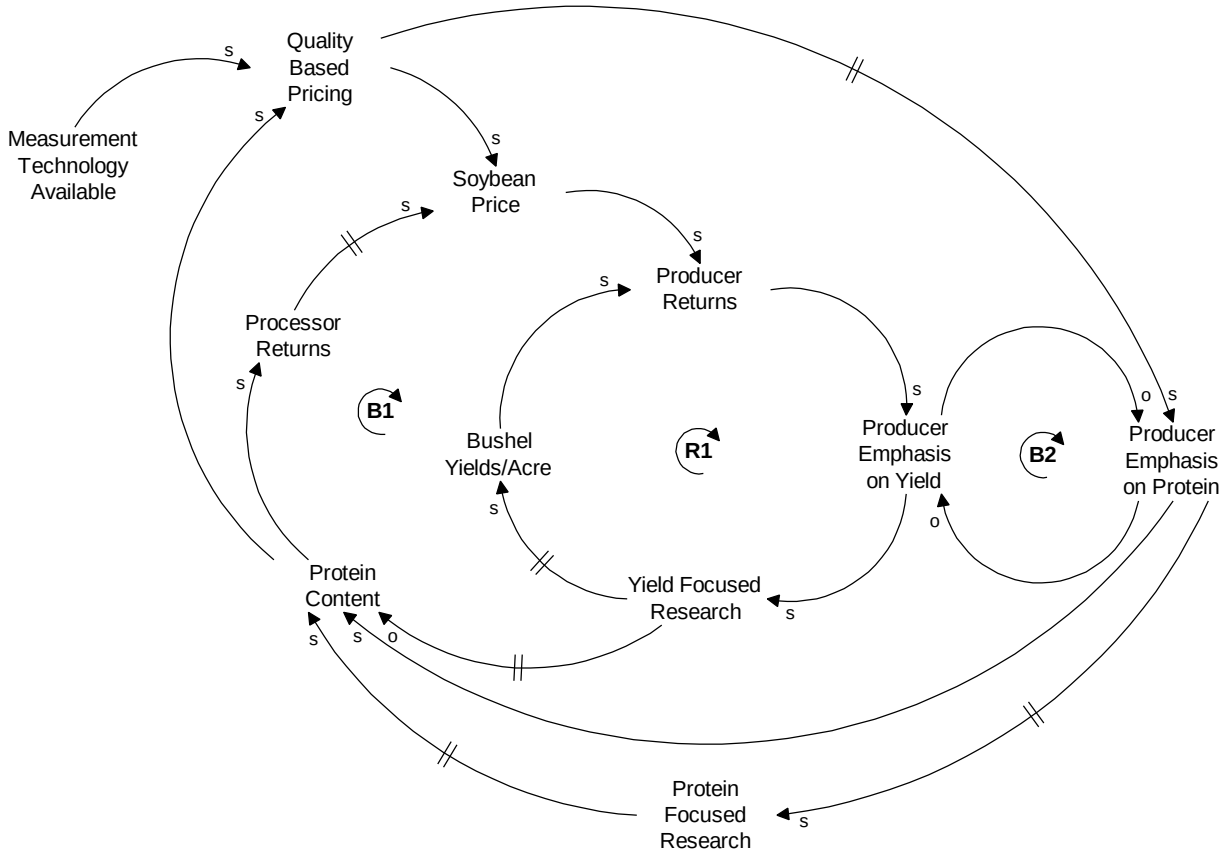
The focus on yield opposes the level of protein in the beans. However, returns to the processor (or other end users) are a function of the protein content. Over time, the lower protein content impacts the price of soybeans since it has less value to the end user. Lower prices pressure producer returns and actually increase the need for higher yields to keep returns from eroding further.

Another key impact of the lower quality over time is that it opens the door for competing sources of protein. The soybean industry is constantly pressured by alternative sources of protein and oil. There is little room for reduction in quality before end users switch to other sources, putting additional downward pressure on the price of soybeans.

Technology: The Cause and the Cure

In some ways, technology is the cause of this problem in that genetic improvement technologies were used to improve absolute bushel yields—often at the expense of protein content. At the same time, there appears to be the potential for developing soybean varieties that can achieve somewhat higher yields without sacrificing protein content. However, since protein content is not currently a driver of the producer's decision with regard to which variety selection, improvement is unlikely. The challenge is to get everyone in the value chain focused on the attributes that really matter to the end users.

Current grading standards are largely a function of what attributes could be measured accurately and efficiently. With new measurement technologies like near infrared (NIR) spectrometers, it is becoming practical to efficiently and accurately measure protein and oil content in raw soybeans when they are delivered to the buyer. These and other technologies will make it possible to measure attributes that correspond more directly with the value to the users of the products. Figure 3 illustrates how adding this technology can provide the information needed to send the proper signals through the entire value chain to increase quality as it relates to protein content.



Measurement technology will enable quality-based pricing, which will send strong signals to the producer about what is important to the end users. Over time producers will increase their emphasis on protein, balancing it with their emphasis on quantity yields (B2). Improvement in protein content will come in two "waves". First, there will be a short term increase as producers focus on selecting from the pool of varieties that are already available. Second, as seed companies get the signal that producers want soybeans with higher protein, they will begin to focus their research on protein attributes. Over time, these new varieties will become available to the producer and will lead to the second wave of improvement.

Important Time Lags and Other Impediments

While this depiction of the changes that are needed seem pretty straightforward, there are some significant impediments to rapid change in the industry. First, production agriculture is very risky business. Using radically new varieties on a significant portion of acres can have devastating financial consequences if it does not grow well in a particular region. Even progressive producers will be slow to replace tried and true varieties with untested ones.

Changing the focus of genetic research is also a slow moving process. While technology is reducing the amount of time needed to make genetic progress, it still takes years to develop and fully test a new variety. Further, a seed company is not going to focus their efforts on enhancing a specific quality attribute until they have strong demand from their customer, the producer.

As we work to discover these linkages and possible strategies for improving quality, it becomes apparent that the "people factor" is probably one of the most important aspects of the system. Quality improvements in a value chain with many players will require some degree of trust and a common vision about its purpose and goals. Both are lacking in the current system.

Over time, the relationship between the producer and the processor has become adversarial in the sense that producers want to sell high and processors want to buy low. Producers often feel that the processors are taking advantage of them, especially when they see seemingly unexplained fluctuations in prices offered or when they are subject to discounts for not meeting quality standards. Processors tend to be very secretive about what goes on within their walls and use price signals as the sole means of communicating with the producer. The result has been a lack of trust in the relationship between the producer and processor that has endured generations. The implementation of revised quality standards supported by new measurement technologies will not succeed unless these "lack of trust" issues are addressed as well.

The fact that producers are generally oblivious to how processors are impacted by the varieties that they plant is evidence of a lack of a common vision. Processors are equally as oblivious to the challenges faced by the producers. At the same time, end users are discovering new ways that they can improve efficiency and efficacy of their products if they can start with soybeans and soybean products that have specific attributes. The industry is facing a tremendous challenge in getting themselves aligned to be more responsive to the end user. System thinking tools provide a powerful way to bring the various participants together to help address these challenges.

Where to From Here?

In this article, we have explored only one of many important relationships. Dynamic simulation models have been developed to help discover and examine key linkages within the soybean value chain. These models are being integrated with economic research to help quantify the value of quality improvements. These results are being used as the foundation for ongoing educational efforts to help establish a common vision and to build trust across the value chain.

Achieving these goals will continually be challenged as the tools and needs of the industry change. New technology will allow us to measure things that we do not even recognize as important today. Genetic advances will allow us to grow soybeans with attributes designed for specific end uses. Consolidation of the players within the industry will be driven by, and will drive change in the relationships that exist across the value chain. These dynamic challenges that will require tools that can help build an understanding of how to better align the value chain to meet the end user needs. The models and insights that have been developed will need to be continually examined, tested, and revised to keep current and provide ongoing insights.

Finally, these challenges are not unique to the soybean industry. Like the rest of the world, the agriculture sector is in the midst of revolutionary change. Virtually every agricultural product value chain, from livestock to cotton, is going through similar challenges.