

Compositional Variation and Soybean Value in a Commodity or a Component Based Market System*

Note: It is recommended that the following “pages”, that are part of this series, be reviewed prior to reading this one:

- ***“Average Protein and Oil at 13 percent Moisture: Crop Year 2018”
and***
- ***“Estimated Processor Value (EPV): Crop Year 2018”***

As efficient as U.S. agriculture has become, there are still opportunities for further improvement. One area of potential opportunity lies in the fuller capture of existing inherent value through improved management systems.

Soybeans are presently traded as commodities. A foundation of commodity markets is the assumption of product uniformity; that is all product is similar in value associated characteristics. Previous pages indicated that this is not the case with soybean composition.

In the following narrative, we will further look at soybean protein and oil variation within the NASS 2018 sample set and its value implications within the context of the current commodity market system for soybeans. We will then compare this to a Component Market System in which soybean values are based on the actual pounds of protein and oil within a bushel of soybeans.

Addressing Variation in a Commodity Market

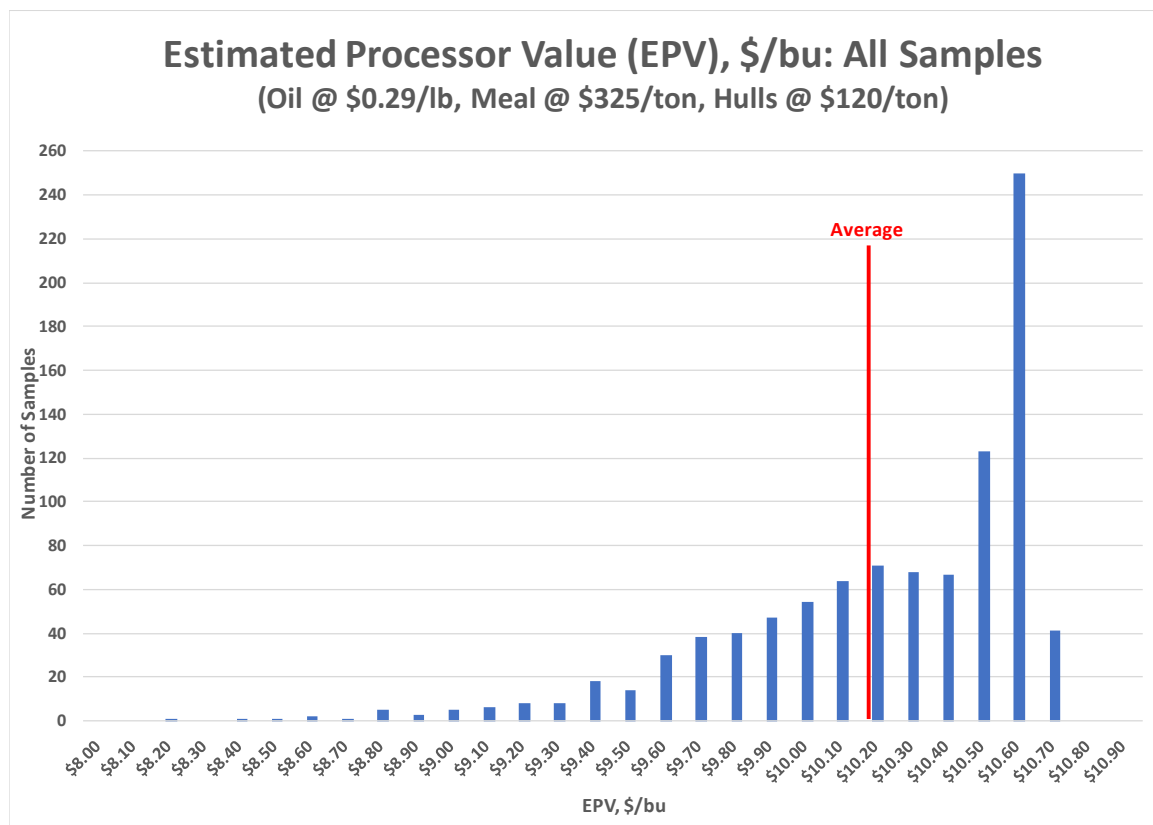
If the economic implications of observed variation within a Commodity market are relatively small, then there is little need to factor variation into the decision-making process. When the economic implications of variation are significant, then variation becomes a factor that must be addressed. As illustrated in the previous *“Estimated Processor Value (EPV): Crop Year 2018”* page, a considerable range in soybean commodity product value can be attributed to observed variation in soybean protein and oil. Now we will further explore some implications associated with such observations within the context of our current Commodity Market and later consider them within the context of a theoretical Component Based Market System.

For the following illustrations involving EPV, the pricing scenario presented within the *“Estimated Processor Value (EPV): Crop Year 2018”* page is utilized. For the reader’s convenience, the prices utilized are presented again.

Prices used for Estimated Processor Value (EPV) Calculation

	<u>Unit</u>		<u>\$/Unit</u>
Soybean Oil	\$/lb	\$	0.29
Soybean Meal, HiPro	\$/ton	\$	325.00
Soybean Mill Run (Hulls)	\$/ton	\$	120.00

To aid in the following illustration, EPV values for the entire sample set are presented below using a Histogram format.



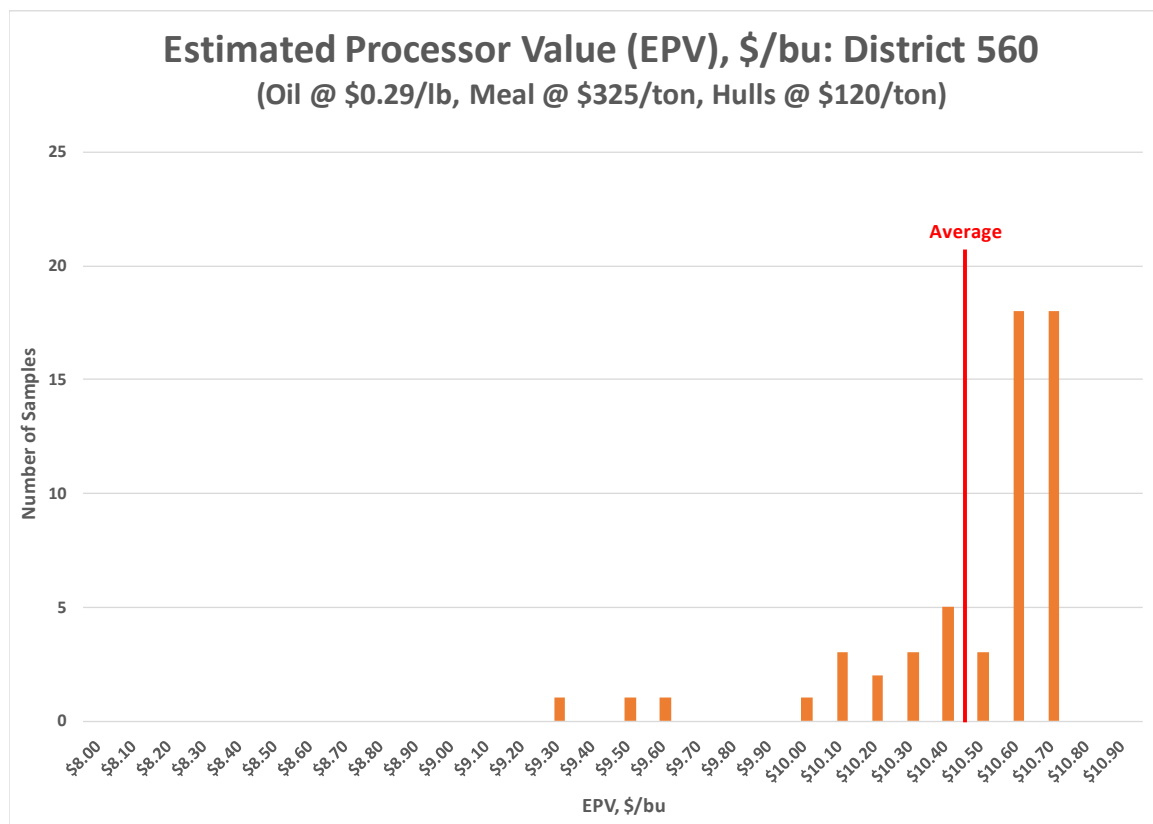
“Risk Discount” associated with Unknown Compositional Variation:

To cover costs and also allow for a profit, a processor must pay some amount less than EPV for the soybeans being purchased. If a processor is establishing a bid for soybeans based on an average EPV value of \$10.17 per bushel (shown as a red line above), they will be overpaying for some soybeans and underpaying for others. As long as the aggregate of all purchases match the average value, they will be alright pricing off of the average value.

If the processor is unfortunate, and ends up consistently obtaining soybeans below the average after paying the higher average price, they risk substantial loss. This represents a risk that needs to be factored into the price they are willing to pay for the soybeans that they intend to process. One way to address this is to factor a “Risk Discount” into the price offered for soybeans and subtract this from the Average value.

One statistical descriptor of variation is Standard Deviation. The range represented by the Average \pm 1 Standard Deviation is intended to encompass approximately 68% of the total population. Thus, if one subtracts 1 Standard Deviation from the average and uses this to establish the starting point for determining the price offered for soybeans, one risks overpaying for soybeans only 16% of the time. Conversely, using this approach results in underpaying for soybeans 84% of the time. The EPV Standard Deviation for the entire set of samples in this illustration is \$0.33/bushel.

The above chart is for the entire sample set and would thus be expected to reflect a high level of compositional variation due to the geographic range involved. Presented below is a chart for a single district, Arkansas District 60 plotted using the same EPV, \$/Bu scale used in the above chart. For this district, the Average EPV, shown again as a red line, was \$10.43/bushel and the Standard Deviation was \$0.31/bushel. (Note: The calculation of Standard Deviation factors in the number of observations involved.)



The structuring of a Risk Discount will vary by processor and business environment. Whether it is called a Risk Discount or described and addressed in some other manner, it is an important business consideration. Competitive business factors will tend to temper the level of Risk Discount that a processor will be able to extract. Whether it is -1 Standard Deviation from the Average or some other calculation will depend upon the processor's business philosophy and the business environment in which they are operating.

Since the "Risk Discount" is ultimately passed down the value chain toward the farmer, it is probably the farmer who ultimately pays the cost in the form of a lower price per bushel of soybeans.

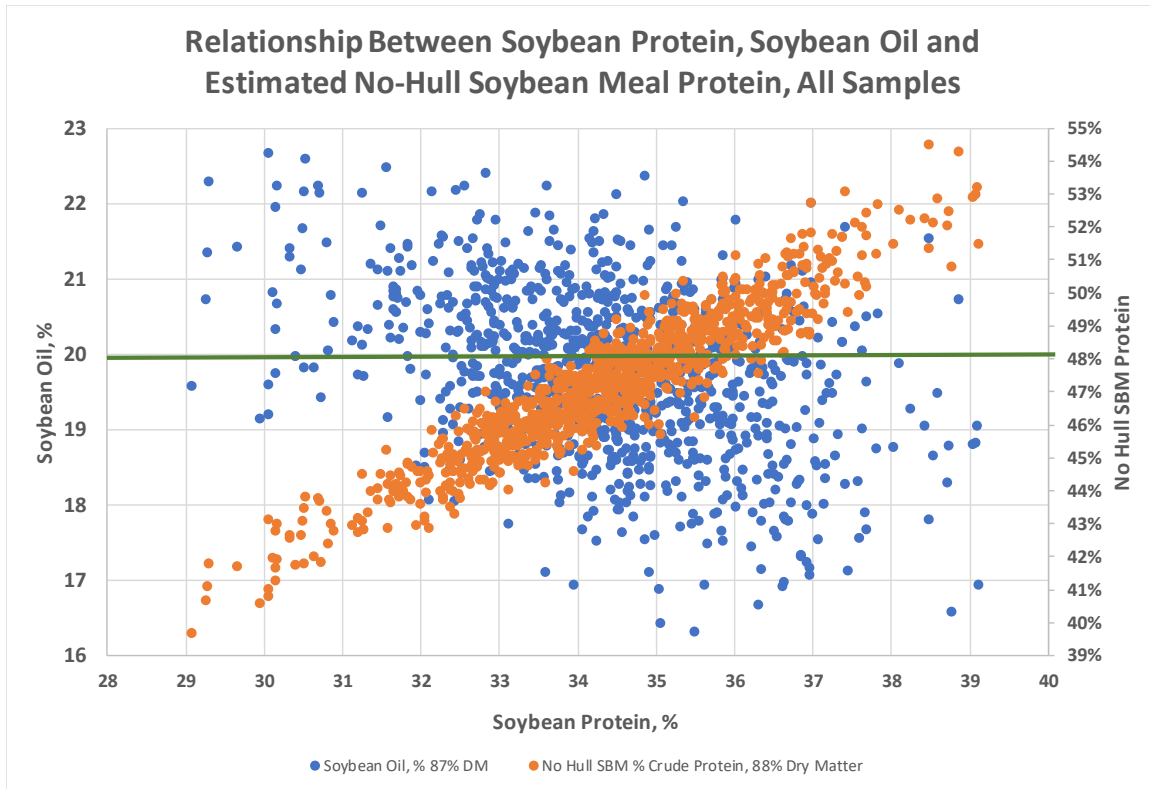
Establishment and Enforcement of Product Specification Thresholds:

One way to address compositional variation in a Commodity Market setting is to establish "Guaranteed Level" thresholds. Such thresholds may be minimum levels, such as in the case of Crude Protein in meal, or maximum thresholds such as that for Crude Fiber and Moisture in meal. A penalty is then assessed when the threshold is not met.

In the case of meal Crude Protein, Trading Rules allow for a meal low-protein penalty that is two times the market price per unit of protein. This penalty is applied to the difference between the guaranteed and actual crude protein level in the meal when the analyzed level falls below the minimum protein threshold. (To allow for analytical variation, a tolerance of 0.5% protein is allowed before the penalty is assessed.) The market price per unit of protein is calculated using the actual price paid for the given shipment of soybean meal and the associated protein guarantee.

The following chart displays the relationship between **soybean** Crude Protein level (horizontal axis) **soybean** Oil level (blue marks and left vertical axis), and the estimated Crude Protein level in "No-Hull" meal (brown marks and right vertical axis). A solid green line emanating from the right "Estimated No-Hull Meal Crude Protein" axis is anchored at 48% Crude Protein. Any meal with protein levels below the solid green line would be eligible for the low-protein penalty unless it fell within the 0.5% protein tolerance mentioned above. When the low protein meal penalty is activated, the value of the soybeans become proportionally less.

No premium is currently provided for in the trading rules when soybean meal exceeds 48% crude protein. However, soybeans capable of producing protein higher than this threshold are especially valuable to processors since they allow for the inclusion of greater levels of hulls in the meal.



The often-cited inverse relationship between soybean protein and oil is somewhat evident as soybean protein increases. However, oil level, within a given protein range appears to vary considerably. This has implications for overall soybean value in terms of not only the amount of oil extracted from a bushel of soybeans but meal quantity and protein level as well.

Both soybean protein and oil levels are factors in determining the level of protein in meal. The more oil in a soybean, the fewer pounds of meal produced. If two soybeans have the same level of protein, but different levels of oil, the soybean with higher oil will produce meal with higher protein since the same amount of protein is averaged over fewer pounds of meal. This is evident in the above chart where different levels of SBM crude protein are associated with the same level of soybean protein.

Commodity Market Illustration:

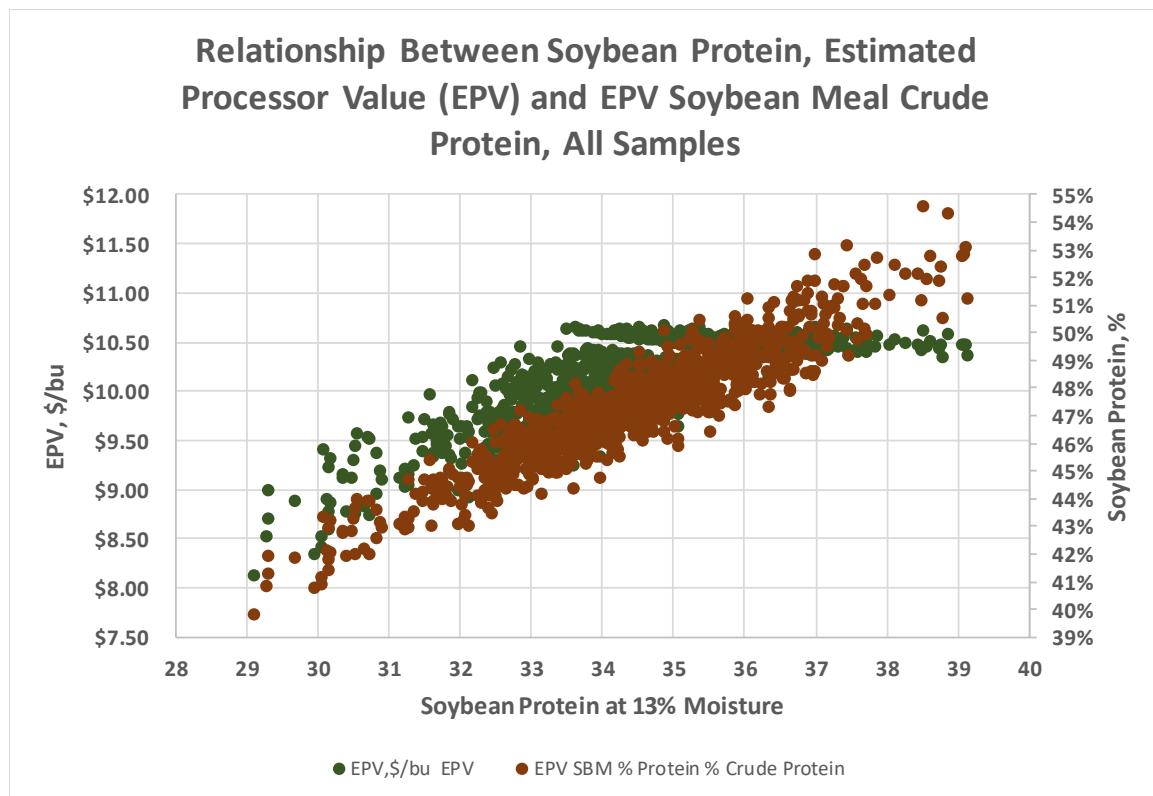
The next chart presents the relationship between Soybean Crude Protein, EPV Meal Protein and the Estimated Processor Value (EPV) using the previously presented prices.

As soybean protein level approaches the point at which 48% protein meal can be produced, the slope for the EPV plot tapers off. Prior to this point the 2X low

protein meal penalty has been a drag on total product value. As meal protein continues to rise, resulting in the potential to produce meal above 48% protein, hulls can be included until the Maximum Crude Fiber threshold is reached. After this point, protein levels can no longer be diluted with hulls and higher than guaranteed meal protein levels are the result. Since higher than guaranteed levels of meal protein are not currently rewarded by the commodity market, the higher protein meal is traded the same as 47.5% protein meal.

If feasible at a given location, soybeans capable of producing higher than guaranteed levels of meal-protein may be blended with soybeans that would otherwise produce meal below the protein guarantee as long as the Crude Fiber level remains below 3.5%. Otherwise, the protein value of soybeans producing meal above 48% protein is not rewarded by the commodity marketplace.

Again, note the range in EPV, \$/bu. as well as SBM protein level for a given level of soybean protein.



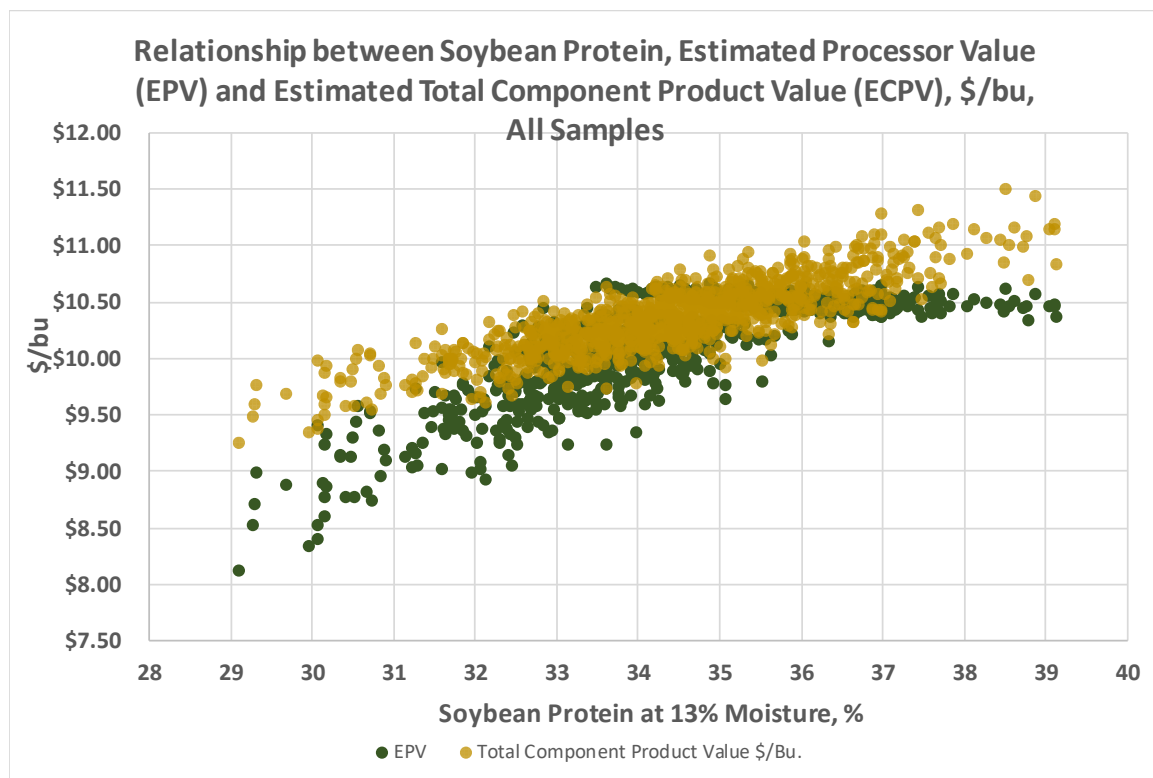
Component Market Illustration:

In a Component Market system, soybeans would be valued based on the actual pounds of oil and protein that they contain. Estimated Total Component Product

Value (ECPV) for each soybean is plotted on the following chart in addition to EPV.

The primary difference between EPV, which is intended to correspond to the current commodity market, and ECPV as used here lies in how meal value is determined. With EPV a 2X penalty is applied if meal protein is below 47.5% and no credit is given to protein levels above guarantee. As a result, EPV plateaus at higher soybean protein levels while exhibiting a greater downward trend at lower protein levels.

While the 2X protein penalty punishes lower protein soybeans, there is also little incentive for higher protein soybeans. In an ECPV market system, buyers would know how many pounds of protein they are buying and pay on the basis of actual pounds of protein received. This would eliminate the need for a severe low protein penalty and reward higher protein soybeans.



While a Constituent market would require the ability to measure composition at each transaction point within the value chain it would significantly reduce the risk associated with compositional variation since composition would be determined and communicated as part of the transaction process.

Since buyers would have a clearer picture of what they are purchasing, penalties and discounts associated with unknown compositional characteristics could be reduced or eliminated. Elimination of the low protein 2X discount could allow for

a higher price being paid for low protein soybeans. At the same time, higher protein soybeans should also command a higher price. These two factors result in a more linear value trend in the above chart for ECPV as opposed to that for EPV.

Not captured in the above charts is the impact of Risk Discounts associated with not knowing the actual composition of soybeans prior to purchase. If the actual composition of what is being purchased is known, it could be argued that discounts associated with the risk of unknown composition would no longer be necessary.

Better Management of Compositional Diversity: The Opportunity

Compositional variation and associated differences in economic value have significant implications for how prices are established for the U.S. soybean crop, both nationally and locally. The economics associated with this variation helps to describe the opportunity associated with better management of compositional variation.

There are two major considerations to the better management of compositional diversity:

- Those that may lend themselves to greater control
- And those beyond practical control

The inclusion of compositional characteristics as a selection criterion when considering which seed to plant represents an example of one approach for exercising greater control over composition. Other agronomic practices may also represent an opportunity for controlling composition and need to be further explored.

The grower's ability to control certain environmental factors is beyond practical control. For characteristics beyond practical control, the best approach is to better manage differences at and after harvest through measurement and handling.

U.S. soybeans and their products must constantly compete with other sources of the components that end-users need and value. In a competitive environment, the most efficient system tends to have an advantage. Better management of compositional diversity represents an approach for improving the overall efficiency of the U.S. soybean franchise. The type of Market System utilized by soybean value-chain participants has an important role in this process since the Market Signals it provides influences behavior up and down the value-chain.

Adding and/or capturing greater value from the U.S. soybean crop through the better management of compositional diversity would contribute to the overall vitality of the soybean value-chain and thus represents an opportunity for all participants. The first step is to recognize the extent to which an opportunity exists and then work together to create a system that allows for the capture of additional value and its equitable sharing.

The farmer has an important role in this process to the extent that they can better control and/or manage the composition of their soybean crop. To the extent that the farmer is willing and able to actively participate in this creation of value, it represents an opportunity for them as well as all other value chain participants.

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