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The Production and Exportation of Arkansas Non GMO vs GMO Soybeans to China

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I. Introduction

As has been well documented, China has become one of the world's leading economic powers, with many goods sold here in America bearing the stamp "Made in China". China is also beginning to invest in American companies, including agricultural companies. For example, the state-owned company ChemChina recently acquired the Swiss seed and pesticide company Syngenta for a reported $43 billion. This represents that largest foreign purchase by a Chinese firm to date, and it is no coincidence that it involves the agricultural sector (Berger, 2016).

China, with an estimated population of 1.4 billion people, has also become a prime market for U.S. agricultural exports. Soybeans, in particular, have become a key import for China. In 2001, China joined the World Trade Organization (WTO), and since then, agricultural imports have risen dramatically (Figure 1). In 1996, China imported around eighteen million bushels of soybeans. For 2015, the country was projected to import some 1.171 *billion* bushels. This is an increase of more than *1.1 billion* bushels in just twenty years, and the majority of these come from the United States (Potter, 2015). Most of the soybeans that China imports are considered GMO (Shaotong, 2016). The reasons for this remarkable increase include the reduction in farmable acres and the problem of feeding almost a billion and a half people. Also, the Chinese people appear to have shifted in regard to their diets in recent years and are including more oils and meats than they have in the past (Du, Lu, Zhai, & Popkin, 2002). Economic factors have contributed to this increase as well. More Chinese citizens have moved into the middle class and, consequently, increased their buying potential (Wee, 2016).

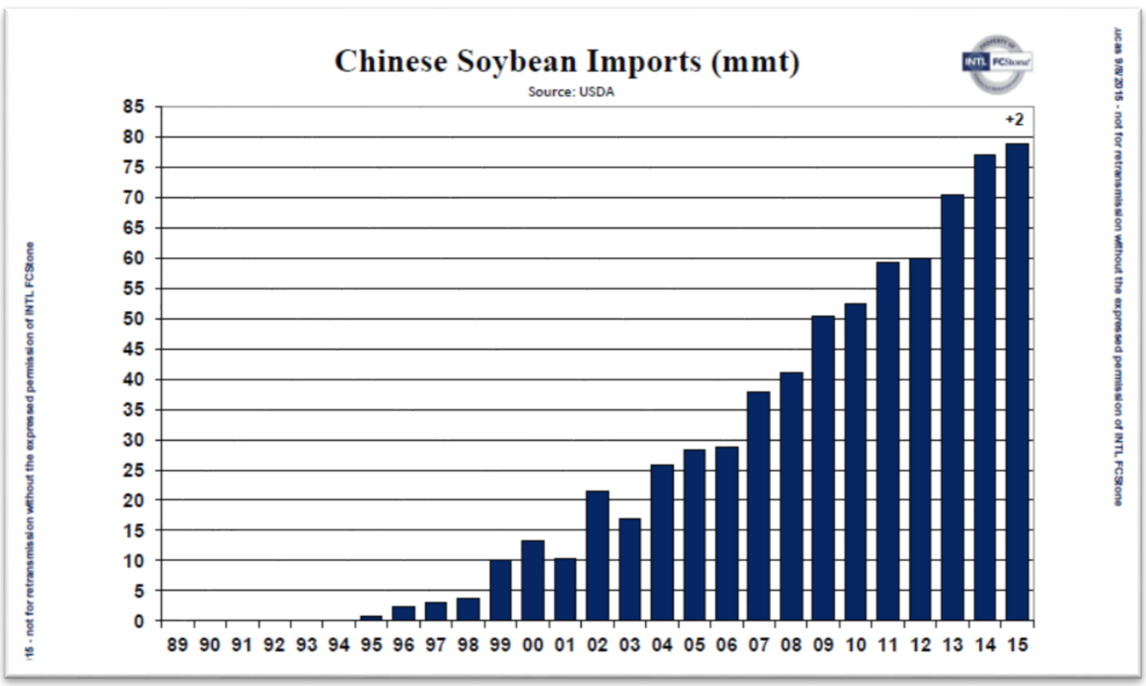

Figure 1. The rise of Chinese soybean imports. (Graph Courtesy of Dakota Mill & Grain)

In the Chinese market, soybeans are generally used to make cooking oils, tofu, soy sauce, and soymilk and provide a base for animal feed. Many consumers use soy products such as soymilk or tofu daily as a staple product. Based on all these factors, the Chinese domestic market for soybeans has great potential, but, to date, this potential remains largely untapped.

In the United States, soybeans are one of the two largest production crops by acreage, ranking just behind corn, but just ahead of wheat. In 2014, close to four billion bushels of soybeans were harvested in the U.S, with between forty and fifty percent of these being exported. This means that around 1.8 billion bushels are sent out of the country. China is the largest export market followed by Mexico, Indonesia, and Japan (American Soybean Association, n.d.). The U.S. soyfood market has also seen tremendous growth in the past few years. In 2013, the U.S. retail soyfoods industry totaled $4.5 billion. The food bar category was the leading segment in this industry with revenues of $1.6 billion. This segment has also experience rapid growth (17% CAGR since 2011) (Soyfoods, 2014). The vast majority of soybeans grown in the U.S. are considered to be genetically modified (GMO). These are typically bioengineered to be herbicide-resistant such as the popular Roundup Ready soybeans. In recent years, however, conventional or Non GMO soybeans have actually been growing in popularity as a crop. These are developed through traditional plant breeding and do not include the bioengineering component that GMOs have. One reason for this growth in popularity is an increase in demand by consumers for these kinds of products. The overall Non GMO consumer market in the United States reached $200 billion dollars in 2014 and is expected to grow by 65% between 2014 and 2019. Just in the United States, there are estimated to be 2,000 Non GMO product launches per year, and by 2019, worldwide Non GMO sales are expected to reach one trillion dollars. The United States makes up about a third of this market with the majority of the market being dominated by Europe and Asia (Lukovitz, 2015).

China clearly has a need for high quality soybeans and soy products to meet rising consumer demand. The United States has the capability and infrastructure in place to meet this demand, and Arkansas, specifically, has a strong soybean production industry, which will be discussed in more detail later. While there are still significant markets for GMO soybeans, this paper will discuss the challenges associated with the Non GMO market as well as the benefits for Arkansas farmers seeking to capitalize on this opportunity.

II. Chinese Market Potential for Non GMO soybeans

The most recent estimates have the population of China at around 1.4 billion people. Obviously, this creates a need for a significant and stable food supply, but, in addition to the high population, China has also seen an increasing population shift from rural to urban areas. For example, at the end of 2013, the population of urban areas had increased by around twenty million from the year before, and the population of rural areas had decreased by around thirteen million. While the economic opportunities of urban areas have enabled many Chinese people to move into the middle class, this has left fewer people in the rural areas to do the agricultural work (Roberts, 2014). This shift has contributed to the reduction of Chinese agricultural production so much that government officials estimated in 2014 the country’s grain production would fall below domestic consumption requirements for the first time ever (Wright, 2014). This decrease means that China will need to place further importance on the import market to fill domestic demands.

Besides the size and shifting of the population, China also faces real problems with their soil health, more specifically, with soil contamination. Many soils in China have been found to be contaminated with heavy metals such as nickel, cadmium, and arsenic due to the increased industrialization throughout the country (Duggan, 2014). While this increase has been an important part of China’s economic growth, the consequence has been a decline in the nation’s cropland. According to a report by China’s Ministry of Environmental Protection, more than sixteen percent of their soils exceeds the nation’s pollution standards, and the percentage of contaminated arable (e.g. productive) land is closer to twenty percent. A top government official estimated that over eight million acres of land is now contaminated and could possibly be withdrawn from food production. The country is attempting to "rehabilitate" the land, so that it can be used for agricultural production again but this process will take time, and the country will have to seek other sources to meet the country's needs (Duggan, 2014). This has created a tremendous opportunity for the Arkansas soybean industry and Arkansas farmers.

III. Arkansas Soybean Production

Agriculture, which includes both animal and crop production, remains one of the largest industries in the state of Arkansas. There are roughly fifty thousand row-crop farms in the state, comprising some thirteen million acres of highly productive farmland. Eight million acres are devoted to the state's principle crops which include soybeans, rice, cotton, corn, hay, wheat, and grain sorghum (Natural Soybean and Grain Alliance, 2014). Of this, around 3.3 million acres are devoted annually to soybean production, ranking Arkansas 10th nationally in this regard (Arkansas Soybean Promotion Board, 2014). Soybean production contributes about $1.7 billion to the state's economy annually.

From a production standpoint, the state average for soybean yield is normally around forty bushels per acre, and, in 2014, there was a record fifty bushels per acre observed. (UARK Cooperative Extension Service). These yield averages include both irrigated and non-irrigated acres. Soybeans on irrigated acreage consistently reach 60-70 (or more) bushels per acre, and the number of irrigated acres in the state is steadily increasing. Soybeans production occurs in 41 of the state's 75 counties with the majority in the eastern part of the state known as the Delta. There is also a limited amount of soybean acreage in the Arkansas River Valley (between Little Rock and Fort Smith) and the Red River Valley in Southwest Arkansas (Arkansas Soybean Promotion Board, 2014). The vast majority of soybeans grown in the state are considered GMO, with estimated percentages being from 90%-94% of the acres grown. The two major GMO varieties grown in the state are the Roundup Ready and Liberty Link varieties. However, the Non GMO and specialty soybean acreage is steadily on the rise in the state, and the emergence of premium markets, such as the Chinese domestic market, could have more farmers in the state migrating towards these varieties.

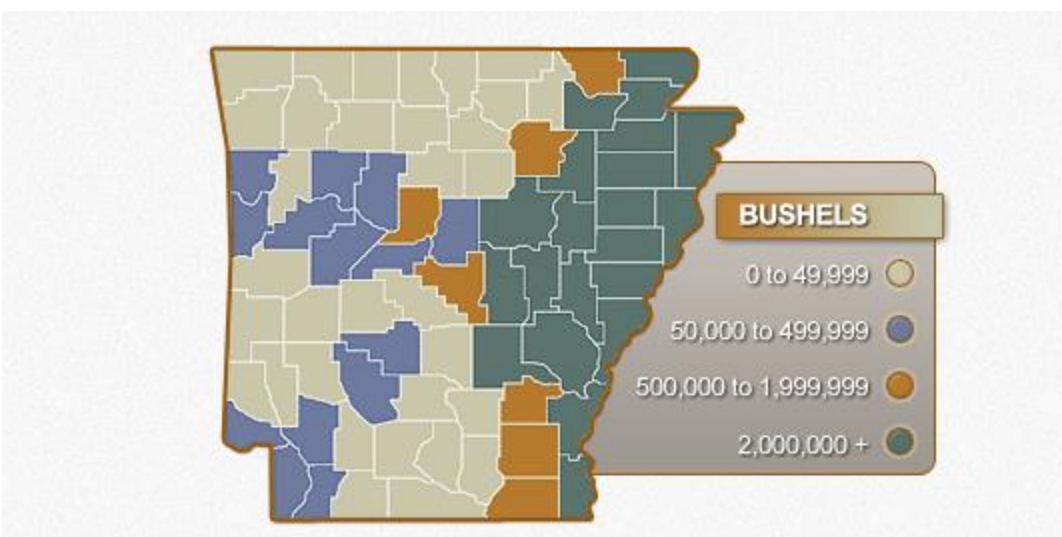

Figure 2. Distribution of soybean acreage in Arkansas. (Picture courtesy of the Arkansas Soybean Promotion Board)

IV. The Production of Non GMO Soybeans

Because soybean production has shifted heavily towards GMOs in the last fifteen years, there are challenges, both real and perceived, for farmers when they try to switch to Non GMO or specialty soybeans. While these challenges are, in reality, somewhat minimal, farmers must have the tools necessary to make an effective transition and real economic incentives to make this a viable opportunity.

a. Production and Harvest of GMO vs Non GMO Soybeans

For production, there is actually little difference between the GMO and the Non GMO or conventional soybeans at the farm level. The planting, irrigation, and harvest are very similar for both types of soybeans. The major difference is the weed control programs, which will be detailed further in the section below.

In Arkansas, both GMOs and Non GMOs have a relatively wide planting window from early April through late June depending upon the area of the state and whether the soybeans are part of a double crop system where the soybeans are planted behind winter wheat. Typically for early plantings, the seed of both types is treated with insecticides and/or fungicides due to the cooler nighttime temperatures that can provide a more favorable environment for certain soilborne pathogens and insects. (Ross & Grimes, 2014).

The seeding rate is also an important factor and may differ based on factors such as field conditions or the maturity group of the soybean. In Arkansas, the general seeding rate for both GMO and Non GMO soybeans is about 150,000 seeds per acre which should result in a final plant population of around 130,000 plants per acre.

When planting, farmers will either plant on flat ground or raised beds. Raised beds are elevated above furrows on either side to facilitate row irrigation and proper drainage, especially during periods of heavy rains (Crop Profile for Soybeans in Arkansas, 2005). Flat planted soybeans are usually planted on precisely sloped fields so that irrigation water can be 'pushed' across the field under a flood irrigation system. While it is not as common in Arkansas, pivot irrigation may also be used with either a center or "walking" pivot. Some soybeans are also grown under dry land conditions where irrigation is entirely dependent upon rainfall, though the number of acres irrigated using this method are declining (Crop Profile for Soybeans in Arkansas). Both GMO and Non GMO soybeans respond similarly to these different irrigation practices.

The biggest difference and challenge regarding the production of GMOs and Non GMOs is the weed control programs. Most GMO soybeans in Arkansas are considered to be "Roundup Ready" or 'Liberty Link' varieties. These soybeans have been bioengineered in the laboratory to be resistant to the herbicides Roundup or Liberty. With these varieties, farmers will spray Roundup or Liberty over the field after the plants emerge to control a wide range of weeds. However, in the past few years, this has become less effective as herbicide-resistant weeds have developed, most notably a strain of Roundup-resistant pigweed which has become a dominant weed in the Delta of Arkansas and other states. To control these resistant weed types, farmers have begun to incorporate other herbicides into their early weed control programs as well as "spiking" midseason Roundup applications with more traditional herbicides. This has resulted in increased production costs for GMO soybeans. For Non GMOs, a more traditional herbicide program is used with a higher emphasis on a clean start with effective pre-plant and pre-emergence weed control management. Currently, these programs can be just as cost effective as the Roundup programs because of inability to control the resistant weed types using only Roundup and Liberty products. In addition to herbicide programs, a farmer may also use proper water management, row spacing, and crop rotation to help control weeds.

Depending on the market requirements, one of the most important aspects of Non GMO soybean production is minimizing the GMO contamination in the harvested crop. Some markets mandate only a certain minimal amount of GMO contamination be present, or the beans could be rejected. Because of this, the crop management efforts have to be designed to minimize this contamination throughout production, storage, and shipping. In fact, this issue of keeping GMOs and Non GMOs separated to maintain the purity of the final product will be discussed often in later sections.

For harvest, the farmer will need to make sure that the equipment is clean (free of GMO beans). This can be done by manual cleaning of the combine and other equipment, or by moving into a Non GMO field directly after harvesting a crop such as rice. Cutting rice self-cleans the equipment, and rice contamination is not an issue because Arkansas rice is Non GMO and because rice grains are easily separated from the soybeans during cleaning and handling. For both GMO and Non GMO soybeans, harvest takes place once the beans reach a certain moisture content. The combine operator will make sure that the combine is set to maximize the yield while adequately separating the beans from the stems, leaves, and other plant matter while causing minimal damage to the beans themselves. After harvest, the beans can be either stored on-farm or in a public storage facility (University of Arkansas Division of Agriculture, 2000).

b. Storage of GMO vs Non GMO Soybeans

After harvest, the soybeans will either be moved to an elevator for sale or to a storage facility for safekeeping. At this stage, GMO soybeans and Non GMO soybeans may possibly need be kept separated if the farmer wishes to sell his Non GMOs into premium markets like the one being described in this paper. In addition to separation, the storage bins and facilities may need to be inspected and cleaned to ensure minimal GMO contamination. These inspections may include conveyors, augers, and any additional miscellaneous equipment that will come in contact with the beans. A dedicated Non GMO storage facility, which only deals with Non GMO or similar crops, is better equipped to handle this than a standard facility that deals primarily with crops like GMO soybeans and corn. Once in the storage bins, the beans need to be preserved to maintain quality. This can be done by using forced air and venting systems, for example, to keep the beans within a particular moisture range (University of Arkansas Division of Agriculture, 2000).

Suitable storage facilities are a key component for a successful program to move soybeans to the proper markets, in this case, the export market to China. On-farm storage is rising in popularity as an option for many farmers. These facilities can be used to hold grain at a reasonable cost while markets develop or the commodity markets rebound. In the last few years, Arkansas farmers have become more interested in having their own on-farm storage facilities. They have increased their on-farm storage capacity by 52% in the last decade alone. This amounts to a capacity increase of around seventy million bushels (Shumate, 2014). The federal government has even created a loan program to help farmers increase their storage capacity. This program is called the Farm Storage Facility Loan Program (FSFL) and is facilitated through the Farm Service Agency (FSA) of the United States Department of Agriculture (USDA). Under this program, a farmer can obtain a low-interest loan of up to $500,000 to build or upgrade their storage facilities. This loan must be approved by the local FSA county committee before construction can begin.

Another option for Arkansas farmers is to use a public storage facility (Farm Service Agency, 2014). Public storage in Arkansas is required to be licensed, either with the Arkansas State Plant Board or the federal government, and many facilities are licensed by both. In Arkansas, licensing is required under the Arkansas Public Grain Warehouse Law (Arkansas license) and the United States Warehouse Act (federal license) (Circular 4, 1983). Applying for a license is optional under the federal law, but those who choose to do so must comply with the USDA standards established by the law (Farm Service Agency). There are around 110 federally licensed grain warehouses in the state of Arkansas and around 40 that are licensed by the state. These facilities provide some 281,000,000 bushels of grain storage capacity. (Cartwright, 2014). A reasonable estimate for grain storage costs, depending on the condition, is around ten cents per bushel per month.

c. Shipping of GMO vs Non GMO Soybeans

After the beans are stored and the proper market is identified, the final stage of the process is the transport of the beans to a final destination, which in this case is China. At this stage, it is once again crucial to maintain the separation of the types and minimize GMO contamination if the beans are to be sold as Non GMO. This is because of different country requirements for GMO contamination levels. For instance, China's government regulations stipulate that a soybean shipment labeled as Non GMO must have *zero* percent GMO contamination, or the entire shipment can be seized by the authorities. To do this, the authorities will collect small samples out of random bags in the shipment. The samples are sent to a lab for a DNA analysis, and, if the sample reveals any GMO contamination, the shipment could be rejected. The prevalence of GMO soybeans in the United States makes it hard to guarantee a 100% GMO-free shipment, so this stresses the importance of making sure the purity of the Non GMO soybeans is maintained throughout the entire process-from planting, to harvest, storage and shipping. With GMO soybeans, separation is not an issue because the different GMO varieties are generally blended and shipped in bulk. In comparison, Non GMO soybeans are generally shipped in smaller quantities in containers. These differences are important to understand the various challenges and potential solutions involved with shipping to China.

Transportation of soybeans from the U.S. to any international market, such as China, typically begins with the beans being transported to a rail yard. In fact, rail transportation is responsible for moving the majority of the country's dry bulk commodities. The most prominent rail yard for Arkansas producers is in Memphis, Tennessee, and from this point soybeans can be moved to almost anywhere in the nation for international shipment. Generally, the beans are loaded into hopper cars which hold between 80 and 90 metric tons each and, for greater efficiency, the cars are combined into "unit trains" of 100-120 cars. Bulk soybeans, especially in a state like Arkansas, may also be shipped via river barge. In fact, an estimated 70% of soybean production in the United States has access to waterways that can handle at least some of the shipping. In Arkansas, the Arkansas River provides an excellent means for barge shipping of soybeans. When there is direct access, it actually costs less per ton-mile to ship soybeans by barge as opposed to rail. Whether by rail or by barge, once at port, the beans are normally loaded onto a bulk carrier or, more specifically, a self-trimming bulk carrier (STBC), which is the most common ship used to transport grains to other countries. These are preferred because of their design, which includes a 45 degree slope for the bulkheads that helps prevent empty spaces from developing in the sides of the hold. They are also the most economical because the holds are easier to clean, and there are no special unloading requirements (U.S. Soybean Export Council, 2006).

For Non GMO specialty soybeans, as mentioned above, containers are more often utilized for shipping rather than bulk carriers. Primarily, this is because of the better tracking capability and the potential separation necessary to minimize or eliminate GMO contamination. The most common size for containers is the twenty-foot equivalent unit (TEU) and the forty-foot equivalent unit (FEU). The beans would be loaded loose (in bulk) or in specified paper bags (Figure 3) into a container (Figure 4) at the storage facility and then hauled by truck to the rail terminal. The container would then be loaded onto a train, just like a standard intermodal shipment, and be taken to the port. Before use, the containers should be inspected for cleanliness, especially if food grade, Non GMO soybeans are involved, and sealed to prevent tampering of the shipment. Once at the port, the container is loaded onto a typical container ship and moved to an international port, like those in China.

Figure 3. Bags of Arkansas grown, Non GMO specialty food grade soybeans loaded into a container ready for shipment to China (December, 2015).

Figure 4. Tractor trailer hauling a container with Arkansas grown, Non GMO specialty food grade soybeans ready for shipment to China (December, 2015).

In addition to the stringent contamination regulations of the Chinese government, there are additional complexities for shippers and importers involving customs and paperwork. For this project, I was able to interview an employee from a Chinese company that is actually involved with importing Non GMO soybeans from Arkansas into the Chinese domestic market. This company has been working with state entities and organizations in Arkansas to develop this specialty soybean market. In late 2015, the company actually made a successful trial transportation of Arkansas specialty soybeans from Arkansas to China. I was able to ask this employee a series of questions about what were, from their perspective, some of the difficulties and challenges with importing Non GMO soybeans from Arkansas. From their perspective, customs and regulations are the biggest challenges when importing Non GMO soybeans. From a regulatory standpoint, the Chinese regulations are more difficult to deal with than those on the U.S. side, and this is actually the most time consuming part of the process. To import Non GMO soybeans, an importing company has to obtain certificates from several different government departments in China. This is all in addition to the paperwork on the U.S. side such as bills of lading, certificates of origin, certification statements (for Non GMO soybeans), phytosanitary certificates, and the various other documents that may be necessary (U.S. Soybean Export Council, 2006). They also mentioned, once again, requirement that all shipments labeled as Non GMO soybeans be 100% Non GMO with no contamination whatsoever. For this process, the beans must be inspected, sampled, and tested for contamination. This takes a considerable amount of time. For example, the trial shipment from Arkansas left the state in early December, arrived in China about six weeks later, and passed customs in February. While future shipments should go smoother, the company admits that this process needs to be more streamlined. In spite of this, the company believes that Non GMO soybeans present an excellent opportunity for their company, and that the quality of the Non GMO soybean varieties here in Arkansas will make them very popular in the Chinese market.

V. Impacts of this Opportunity

a. Impact on the farmer

For farmers, growing Non GMO specialty soybeans is a sound decision as long as market opportunities continue to grow and develop. For example, farmers may earn a premium of up to $2 per bushel above the price for commodities, like GMOs, for their specialty soybeans, and with the continuing emergence of the Chinese market, there could be even more demand for an already expanding market (Hoskins, 2014). Depending on the Non GMO variety, a farmer can also get beans with similar yields and quality to the GMO varieties. Some Non GMO varieties provide market specific opportunities. Soybeans that are developed with specific traits such as ultra-high protein are a good example of this. These varieties can have lower yields than GMO varieties, but the lower yields are typically offset by the higher premiums attached to these specific traits. As better Non GMO soybean varieties with higher yields and higher quality are developed for these emerging markets, the differences for production between GMO and Non GMO crops will only continue to decrease.

For farmers, seed costs are also generally cheaper for Non GMO crops than for GMOs, and the overall production costs are very favorable for Non GMOs. Depending on the purity level sought, storage can potentially be an added expense, but, overall, costs should be very comparable, especially if a dedicated Non GMO storage facility is used. The biggest challenge for farmers is actually making the commitment to transition from GMOs to Non GMOs, considering the field management required to minimize GMO contamination. From this standpoint, farmers will have to overcome their own attitudes regarding GMOs and Non GMOs for widespread adoption to occur. This is largely related to the now longstanding GMO programs such as Roundup Ready soybeans. Even with minimal change, transitions can still be difficult, but Arkansas farmers are generally adaptable, resourceful, and willing to switch to new crops if the market opportunities are there.

b. Impact on Intermediaries (storage, trucking, etc.)

For the intermediaries, such as the storage and transportation companies, the economic impact of these Non GMO soybeans will depend upon the quantity, premium attached and the type of facility. Economically, the quantity and premiums for these Non GMO soybeans must be acceptable to the intermediaries as well as the farmers. For storage, the cost differential, if any, will depend upon whether or not the storage facility is a *dedicated* Non GMO storage facility or a facility that generally stores GMOs. If a dedicated facility is used, then the costs for storage will be very similar for each type. There may be slight differences based on capital or labor costs, but in general, the costs should be relatively similar. If, however, there is additional time and labor needed to clean and/or inspect a facility to minimize GMO contamination before moving Non GMO soybeans into the facility, this will add additional costs. There is also, potentially, an opportunity cost related to the stored quantity. For example, a standard storage facility will usually be able to consolidate GMO soybeans to fill a bin because there is no need to separate them. However, because of the separation required with Non GMO soybeans, the facility cannot consolidate these beans. So, as an example, if a storage facility has a 100,000 bushel bin but only forty thousand bushels worth of Non GMO soybeans, there will be an opportunity cost associated with the sixty thousand bushels of bin space not being utilized. For these reasons and others, standard storage facilities may not be willing to store Non GMO soybeans long term. However, there are several dedicated Non GMO facilities currently in Arkansas that can service these opportunities.

For the intermediate transportation modes, Non GMO soybeans can pose financial issues that are similar to the storage challenges, primarily because of the inability to bulk and transport the beans efficiently. Modes of transportation such as rail and barge depend upon economies of scale, and the quantities of Non

GMO specialty soybeans grown do not yet make this a consistent possibility. However, similar to the production and storage, it depends on the premium available to the intermediary. A high enough premium can make even a smaller shipment worth the effort. It is likely that trucking will come into play more because of the increasing utilization of containers for Non GMO soybean shipments. With trucking, there are also potentially issues such as highway weight limits, which could limit the transport of fully loaded forty-foot containers.

d. Impact on Shipper and Importer

When considering shipping costs, the real difference does not have to do with the beans being Non GMO or GMO but with the quantity purchased and the chosen shipping route. Moving forward, it appears that shipping soybeans in containers will become a viable option for shippers and importers. The cost of bulk shipping has continued to rise over the last several years and the equipment and technology associated with containers have steadily improved. One benefit of shipping soybeans in containers is eliminating the movement of empty containers *back* to Asia. Currently, more than half of the containers that are shipped to the United States from Asia are returned empty. This means that there is a great opportunity for U.S. exporters to utilize these containers for other products like soybeans. This is good for both exporters and importers. For example, it can cost around $935 to send an empty container back to Asia, but if the container is filled with soybeans, then the cost will decline to a more reasonable $200 for the return shipping (Figure 5) (USSEC).

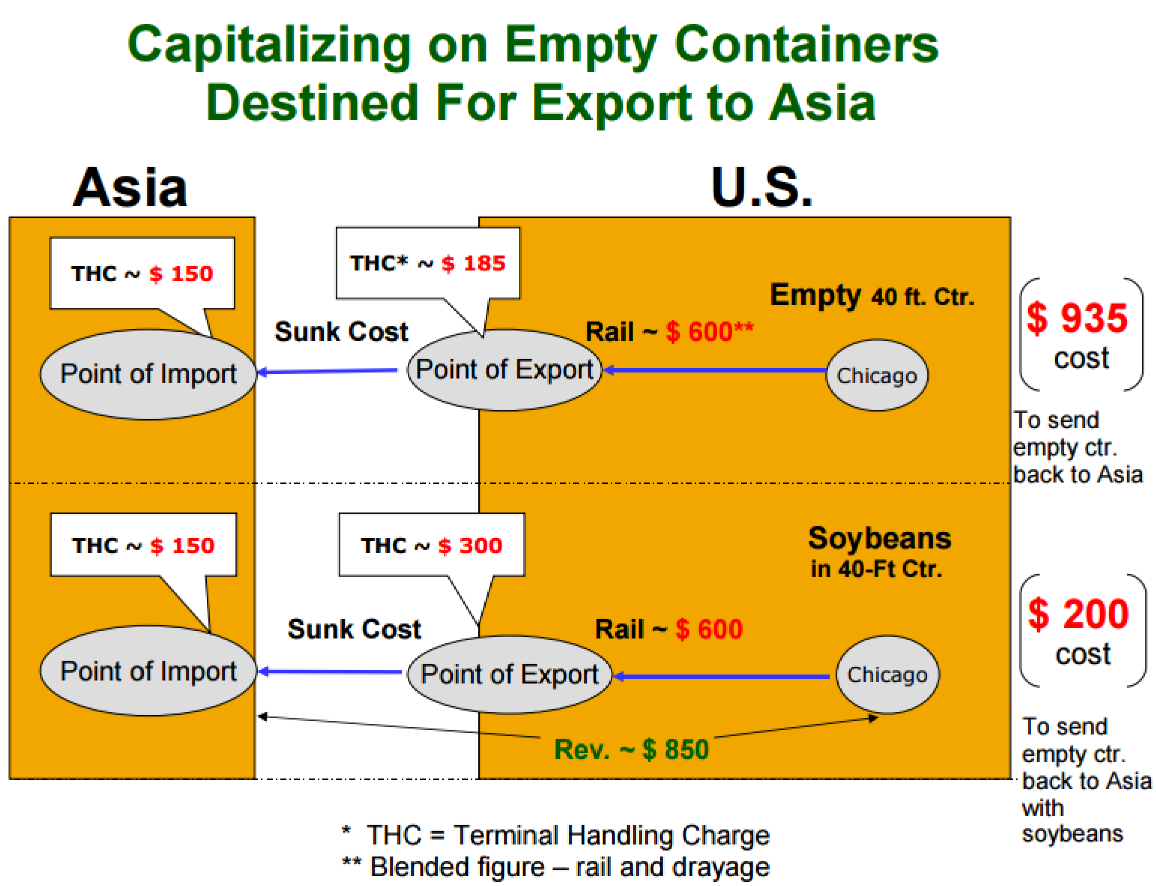

Figure 5. Schematic of potential utilization of containers for shipping of Non GMO soybeans (Courtesy of the USSEC – "Containerized Shipping for Soy Products")

Using containers also leads to a more transparent supply chain for the importing company. Container shipments are far easier to trace from their point of origin compared to bulk shipments, where all the beans may simply be loaded into the hold of the ship (Clott, Hartman, Ogard, & Gatto, 2014). This is an important benefit in today's markets where consumers are becoming increasingly concerned about where their products are from, how they are grown, and/or how they are processed. Buyers will also have more flexibility with purchasing because of the smaller shipment sizes (McFarlane & Saul, 2014). In addition, this will help companies with inventory holding costs due to the ability to adjust inventory when demand fluctuates. For example, if a company is limited to ordering bulk soybeans, they have little choice but to accept the full shipment, even if demand suddenly declines. Holding inventory costs money, and the smaller, more flexible container shipments associated with shipping Non GMO soybeans will be beneficial for businesses in the future, particularly for smaller, more nimble companies that are looking to take advantage of emerging markets.

VI. Conclusion

In conclusion, a significant market exists in China for Non GMO specialty soybeans, but this market remains largely untapped. There are challenges just like any new venture, but also companies and organizations working to solve these issues and take advantage of this new opportunity. Arkansas farmers are in an excellent position to capitalize on this emerging market. With the increasing demand and improved Non GMO varieties, Arkansas farmers are in a great position to be the first movers in this region. With the growing number of dedicated Non GMO storage facilities and the prime access to highway, rail, and river transportation, Arkansas has also prepared the necessary infrastructure to serve an export market. If the average Chinese consumer accepts these products, Arkansas farmers can certainly help fill this market. With suppressed prices in the overall commodity markets, this also appears to be an opportunity with great economic potential for the farmers of Arkansas as well as a high quality food product for the Chinese to meet their consumption needs.

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