Managing risk in an agribusiness supply chain

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Abstract

The coexistence of innovational and traditional products in a supply chain brings uncertainties and risks related to decisions. This research study identifies the factors that results in these risks and which decisions are more critical to be taken and affect the whole supply chain management.

Keywords: Supply chain, Risk, Innovation, Conventional soybean, Supply strategies.

Introduction

Brazil is the second soybean producer in the world. In 2013, soybean production in Brazil was 81.4 millions t (Conab 2013). Of this total, about 83% was originated from genetic modified seeds (GM), and the other 17% from conventional seeds (Monsanto 2013). The coexistence of GM and conventional soybean markets results in two supply chains from producers to consumers and brings different forms of risks. While GM bean is primarily used for biofuel, feed, and to some extent for protein ingredients in certain markets, conventional soybean has its destination exclusively for food ingredients. The trend in the last years shows that conventional soybean will become even scarcer but will subsist due to the existence of its consumer market. This scenery of conventional soybean scarcity is creating difficulties for companies that process it in order to produce soybean protein (textured and isolate form) for human consumption. Since the rate between the total amount of GM and conventional soybean productions in Brazil has not yet achieved a stationary level along the years, it can be identified a lack of equilibrium in the system, from producer to consumers, what brings inherent risks for each actor. The introduction of GM varieties in the soybean production chain and the consideration of what innovative is and what traditional is present some interesting particularities. When the GM soybean varieties were
introduced, they were the innovation. At that time the conventional soybean production was predominant in Brazil. The new product had a very strong appeal to the producers due to its resistance and adaptability to aggressive environments. From that time on producers started a pushing process of GM bean to the downstream actors. It should be observed that differently to what happens with innovative products markets, mainly in electronics, this innovative product (GM soybean) has not entirely replaced the previous product (conventional soybean). Even if considerably reduced, the market of conventional soybean products still exists with some characteristics of an innovative product.

Broadly categorized, potential supply chain risks include delays, disruptions, forecast inaccuracies, systems breakdowns, intellectual property breaches, procurement failures, inventory problems and capacity issues. Each category has its own drivers and mitigation strategies (Chopra and Sadhi 2004). Supply chain risk disruption is a subject that has increasingly attracted the attention of researchers and practitioners in different industries. The problem of these disruptions is not only related to not receiving the goods and materials expected, but these disruptive events can also significantly and negatively impact the financial bottom line with possible effects even reflected in the stock market (Craighead et al. 2007; Hendricks and Singhal 2005). Supply chain risk disruptions are unplanned and unanticipated events that disrupt the normal flow of goods and material within a supply chain.

The present work is exploratory and aims to be the starting point for a future decision model for conventional soybean supply. The focus of this study will be the risks that producers and SPUs are subjected to due to this unstable equilibrium between conventional and GM. Based on the risks identification, it will be discussed the best alternative to mitigate them. So, the question that is posed by this work is: “Based on the decisions necessarily taken by the actors of the supply chain and the risks involved, what is the main strategy to avoid a disruption in the supply of conventional soybean for a processing industry?” The importance of this work resides in the presentation of a broad view of the involvement in the conventional soybean supply chain for a SPU. The situation here studied refers to a disruption risk rarely studied, that is, the reduced offer of a product due to the coexistence of “innovative” versus conventional product. To accomplish this work, a simplified supply chain composed by four actors will be considered. These four actors are: conventional soybean producers; soybean protein ingredient processing industry (SPU); food industry and final consumers. The main source of data to this work was obtained through a soybean processing unit in Southern Brazil and soybean producers in Central Brazil.

The present work has the following structure. Firstly it will present some theories regarding risks disruptions and strategies to avoid these disruptions. Secondly it will discuss the origin of the risks that threats this supply chain, the role of two actors cited above, and the main decisions taken by these actors that originate the risks. Thirdly it will propose some strategies based on the most critical aspects that must be considered by SPU managers.
Theoretical Background

Risk disruptions in supply chain

Every organization needs to obtain goods and services in order to carry out its objectives and goals. Risk exists in obtaining these items, whether it is explicitly acknowledged and managed, investigated in a cursory manner, or ignored altogether (Zsidisin et al. 2004). Increasing demand for good/service performance and variety, combined with more complex good/service and process technologies, has led to increasingly complex goods and services (Harland et al. 2003). Supply risk involves the potential occurrence of events associated with inbound supply that can have significant detrimental effects on the purchasing firm (Zsidisin 2003). According to Harland et al. (2003), supply risks have increased due to various dimensions of complexity impacting on supply networks, like outsourcing, business opportunities due to globalization, and e-business.

According to Kleindorfer and Saad (2005), there are two broad categories of risk affecting supply chain design and management: risk arising from the problem of coordinating supply and demand and risk arising from disruptions to normal activities. Supply chain disruptions are unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain (Kleindorfer and Saad 2005). Supply chain disruptions and the associated operational and financial risks represent the most pressing concern facing firms that compete in today’s marketplace (Craighead et al., 2007). Supply risk or the likelihood of supply disruptions is emerging as a key challenge to supply chain managers (Trkman and McCormak 2009). According to Tang and Tomlin (2008), there are at least six major types of supply chain risks that occur regularly: supply risks, related to the management of few or a sole sourcing, what brings cost risks and commitment risks; process risks, related to fluctuations of quality and capacity; demand risks, related to volume and mix of products; intellectual property risks, related to leaking of manufacture practices and design secrets; behavioral risks, what deals with reduction of the level of visibility and control; and political/social risks, what represents the influence of other actors out of the supply chain.

On the other hand, risks associated to supply chain may be divided in material flow risk, financial flow risk, and information flow risk (Tang and Musa 2011). The main reasons for material flow risk are single sourcing risk, sourcing flexibility risk, supplier selection/outsourcing, supply product monitoring/quality and supply capacity. Financial flow risk involves the inability to settle payments and improper investment. The common risks are exchange rate risk, price and cost risk, financial strength of supply chain partners, and financial handling/practice. Information flow risk involves demand, inventory status, order fulfillment, product and process design changes and capacity status. The risks associated to that are information accuracy, information system and disruption, intellectual property, and information outsourcing risk. Craighead et al. (2007) studied why one supply chain disruption would be more severe than another. The severity of a supply chain disruption can be defined as the number of
entities (or nodes) within a supply chain network whose ability to ship and/or receive goods and materials has been hampered by an unplanned unanticipated event. The study of Craighead et al. (2007) showed that there are some aspects of a supply chain that make it more prone to less or more severe disruption, as supply chain density, complexity, and node criticality.

**Supply chain risk mitigation strategies**

Every supply process that involves risks must have mitigation measures to avoid its materialization. Supply chain design objectives have extended even further to include supply chain security, risk, and sustainability dimensions (Speier et al. 2011). Different studies with different focus have been done on how to minimize risks. Fisher (1997) and Lee (2004), considered the solution from the side of a correct design of the supply chain strategy. With a correct supply chain design aligned with product characteristics (Fisher 1997) or production needs (Lee 2004) these risks can be minimized. The supply chain complexity of industry supply chains coupled with product risk levels require firms to much more proactively and aggressively assess risk and implement appropriate supply chain design capabilities (Speier et al. 2011).

The choice of the right supply chain strategy helps to avoid supply chain disruptions. It is necessary to understand the product demand type and the necessary characteristics of the supply needed to maintain operation at an effective level (Lee 2002). By understanding the variety and interconnectedness of supply chain risks, managers can tailor balanced, effective risk-reduction strategies for their companies (Chopra and Sadhi 2004). If a wrong supply chain is established since the beginning, the possibilities of problems and disruptions are much bigger. As it was seen before, behind the discussed concepts of innovative and functional products there is the whole line linking suppliers to vendors. If product/market needs, as fast responses from suppliers in innovative products cases, are not complied, the possibilities of disruptions are bigger. So, with the “right” strategy since this beginning point already reduces the scope of the possible disruptions.

Lee (2002) classifies four types of strategies based on initiatives and innovations to deal with uncertainties that bring risks to a supply chain: efficient supply chain, risk-hedging supply chain, responsive supply chains, and agile supply chain. These strategies must be harmonized with the production need that is aligned with the demand type of the product. For Tang and Tomlin (2008), the strategies for reducing supply chain risks must take into consideration that there are two common measures of risk: the likelihood of the occurrence of an undesirable event, and the negative implications of the event. To reduce the negative implications of certain undesirable events one can develop mechanisms by considering the triple A principles introduced by Lee (2004): alignment, adaptability, and agility. Lee (2004) developed the concept of the triple A based on the conclusion that speed and low cost are not anymore the only determinants for the success of a supply chain. According to Tang and Tomlin (2008), alignment creates incentives for better performance. Christopher and Lee (2001) argue that greater visibility and control improves quality and allows managers to make their supply chains more responsive.
and manageable. Free exchange of information has been found to be highly effective in reducing the risk of supplier failure. Early design collaboration is another way to reduce supply uncertainties. Supplier hubs have also been used by manufacturers to reduce the supply risks of their manufacturing lines (Lee 2002). Craighead and al. (2007) postulate that the supply chain mitigation capabilities of recovery and warning can moderate the impact that supply chain density, complexity, and node criticality have on supply chain disruption severity.

There are many approaches to manage risk pointed out by Khan and Burnes (2007). These approaches include a closer working relation with suppliers, purchasing partnerships, supplier quality/auditing/certification programs, supplier improvement programs, multiple sources of supply versus single source, inventory management, communication and early involvement of suppliers in strategic decisions, use of buffers, strategic alliances, risk sharing/knowledge transfer, focus on core competence, product differentiation, entrepreneurial/risk taking and proactive supply management. There are different perspectives for each of these approaches, making difficult to be sure that a strategy will be a consensus by all.

Through a research made by Kleindorfer and Saad (2005), some principles were identified from industrial risk management and supply chain literature. First, internal supply chain integration and optimization must precede any inter-firm interface. Then, diversification reduces the risk, as sourcing options, logistics and operational modes. It is important to have in mind that the robustness to risk disruption in a supply chain is determined by the weakest link in the chain. It must be also considered that there is a tradeoff between extreme leanness on one hand and robustness and reliability of the supply chain on the other. The price to operate in a lean way, with low inventories, also can cause more vulnerability to the system. Collaborative sharing of information and best practices among supply chain partners is essential in identifying vulnerabilities and in preparing for and executing effective crisis management.

**Analysis of the risks for the conventional soybean supply chain**

**Risks related to the soybean producers**

The introduction of GM varieties represented a solution for some problems that farmers were facing, especially with herbicide spent and loses prior to the harvest. GM soybean production is cheaper and presents a bigger yield than conventional soybean. This explains the massive migration from conventional to GM in the last 10 years. On the other hand, Silveira and Resende (2010) show that this financial benefit does not confirm everywhere in the country. According to their study in a region in Southern Brazil, the royalties paid and the seeds’ cost eliminate this GM financial gain. This is especially true for soybean produced in small properties.

The risks that producers are subjected to are basically three. The first risk is related to the money they can get with their crop. Soybean, as a commodity, has its price defined through the CBOT (Chicago Board of Trading) plus a basis that is a parcel dependent on where the soybean
will be delivered. This does not happen in the case of non-GM soybean. In this case, this product is detached from its commodity profile and assumes more a product subjected to regional offer and demand equilibrium. That means, besides the CBOT and the basis, the companies that want to buy non-GM soybean also have to pay a premium. That means the non-GM price is higher than GM price, and this difference increases with the reduction of non-GM soybean available for sale. This is a determinant factor for the farmer to decide to plant non-GM instead of GM. Since the demand for non-GM continues and the offer reduces, the price can cover the production risks and loses that have been an advantage of the GM soybean. This is the most important decision of the farmer and affects the availability of non-GM soybean for the processing units.

The second risk that conventional soybean producers are subjected to is the contamination of their products with GM varieties. According to Fuscaldi et al. (2011) the coexistence of these two varieties (GM and conventional) causes problems to the actors of this supply chain mainly due to the nonexistence of legal regulations to manage this coexistence. According to the authors, the contamination between these varieties can happen in different moments: production, harvest, transport, warehousing and processing. According to Leitão (2009), the soybean producers are obliged to pay royalties when the contamination level by transgenic beans is over 5%. These royalties must be paid over the total batch, and not just of the GM percentage. This risk is a big menace not only to those producers that have two fields, one for GM and one for conventional, but also for those that share facilities with others or even have neighbors that cultivate GM.

The third risk is related to the logistics of deliveries. Usually, the freight paid to transfer the soybean from the farmer’s facility to the processing industry is a cost from this last one. For this reason, the logistics risk of the farmer is limited in this work to the silos occupation. The main non-GM region in Brazil is the State of Mato Grosso, in the center of Brazil. This state also produces others crops, as corn. When a soybean sale is performed, the farmer has the interest to remove as soon as possible the soybean that was sold from his facilities. The main reason for that is because the same silos that were used to keep the soybean will be used to keep corn. The harvest of these two cultures happens in different times of the year. The crop of soybean takes place between February and April and the crop of corn between July and August.

Risks related to the processing unit

The two different groups of industries studied in this work (SPUs and food processing industries) are under different risks. The SPU is in direct contact with the farmer or his/her representative. For this reason, some decisions of this one reflect directly over this industry in term of risks. The first is the decision to produce GM or non-GM. The second is the price asked. The third is the deliverance logistics. To the SPU, three main factors affect its supply: the price paid for the soybean, the receiving logistics and the grain quality. The first decision already discussed before is about the availability of the non-GM, or PI, soybean. If the farmer decides not to produce non-GM beans, the SPU will have a hard time to get this product. The risk in this case is very clear:
supply disruption. This risk has increased along the years due to the scarcity of the product. A derived risk is the price paid for the soybean. As a basic economic rule tells us, less product, higher price. If the company does not plan its purchases in advance, it risks remain without product or paying a price for non-GM soybean higher than what was planned about the final cost of the product. According to data received from SPU units, the price paid for the raw material (in essence, soybean), constitutes 60% of the total product cost (for isolate protein products). As a result, an increase in the price of the non-GM soybean will affect directly and in a big scale the final product cost and, if this cost can not be redirected to customers (what are mostly the cases), the margin will be reduced. Also associated with the price of the soybean are last minute purchases. This happens especially when there is an increase in the demand of soybean protein. When this happens, the SPU must seek with urgency the amount of soybean to comply with this increase. Since this has not been done with anticipation, the price paid will be understandably higher. Sometimes, even the quality of the soybean may be affected.

The second risk, also related to the producer, is the receiving logistics. The interest of the farmer is to deliver this soybean as soon as possible. To the SPU, on the other hand, the challenge is to receive and stock this. Since the majority of SPU does not have enough capacity to store all the necessary product for the year, they usually receive the soybean in lots. Many times, the SPU processes both, GM and non-GN, since the market exists for both. The process is done separately, but both products are offered by the SPU. In this case, the logistics related to the deliveries need to be even more restricted. When the SPU does not have different receiving points for non-GM and GM, the one that is used must be periodically cleaned. For this reason, in the case of SPU with just one reception point, the receiving of non-GM and GM is alternate. The third risk refers to the quality of the soybean. The amount of damaged beans is critical to the processing yield. The less damaged beans in the lot, the higher will be the yield, what represents thousands of dollars to the SPU. Yield can be understood as the amount of soybean necessary to produce a certain amount of soybean protein. Due to the scarcity of the product, and if there was not a timely purchase plan, many times the SPU is confronted between being out of product or accepting a soybean lot that will result in a low yield, and consequently a higher cost and, again, affecting the margin of the company.

The food processing industry that uses soybean ingredients as raw material also has its risks. Since this industry sells product directly to the consumer, the demand of its products GM or non-GM depends very much on the perception the consumers have over transgenic products. Unless there is some explosive news about damages to the health caused by GM products, the tendency is a smooth growing participation of this market. It is also relevant to say that non-GM products carry with them an overprice that comes from the producer. Since non-GM soybean is more expensive to SPUs, the price of these ingredients is also higher for this processing unit and so on until the final market. The decision an industry takes to produce non-GM or GM product depends on the market where this company is inserted and the financial benefits that it has selling one or another product. This industry also is under the risk of selling a non-GM product.
contaminated by GM. In this case, the risk exists not due to a decision of this company, but due to a fail in its supply.

**Discussion: Proposed strategies to avoid non-GM soybean supply risk disruption**

The peculiar situation that non-GM soybean has in Brazil makes necessary a strategy to the SPU to deal with supply disruption risks. As stated by Chopra and Sadhi (2004), by understanding the variety and interconnectedness of supply chain risks, managers can tailor balanced, effective risk-reduction strategies for their companies. The first step, consequently, is to recognize where these risks are and build a strategy to deal with them. According to what was researched, the SPUs are subjected to the risks pointed out by Kleindorfer and Saad (2005), that means, risks arising from the problem of coordinating supply and demand, and risks arising from disruptions to normal activities. It can also be identified the risks mentioned by Tang and Tomlin (2008) related to having few or a sole sourcing, demand risks, related to volume and mix of products and process risks, related to fluctuations of quality and capacity. Also can be identified financial flow risks due to price variation and sudden production volume changes (Tang and Musa 2011).

Among the approaches to manage risk pointed out by Khan and Burnes (2007), the following are relevant when considering the non-GM supply chain. A close working relationship with suppliers and purchasing partnerships seem a right way to go when dealing with a product that presents low offer and whose quality is a crucial factor besides price. An initial step is to have reliable numbers about non-GM soybean production and in which areas this product can be obtained. The scarcity of this product makes necessary an early approach between industry and producer. Early design collaboration is a way to reduce supply uncertainties (Lee, 2002). The recommendation is that contracts be signed well before start sowing the fields. Many times, a long partnership is the best way to go. In this case, crucial aspects must be aligned, as the parameter for future price negotiation and delivery schedule.

As discussed in the previous section, quality (low damaged grains) is an important factor for a good yield in the industry. For this reason, it must also be performed regularly supplier quality/auditing/certification programs and supplier improvement programs (Khan and Burnes 2007). A long partnership also brings advantage in this point. The farmer who already knows what he is expected to deliver can control the quality of the grain already in the field and anticipate any future problem. Even if this farmer will not be able to improve any damage caused by bad weather conditions, the industry can be better prepared to deal with these grains and review the negotiations terms. The aspect of multiple sources of supply versus single source is also a polemical point (Khan and Burnes 2007). As with any product, multiple sources gives the security in case of supplier breakdown. On the other hand, it can represent a sign of trust and the disposition to develop a strong partnership. In the case of non-GM soybean, few suppliers may shape a group where trust can positively deal with some practical problems as quality and delivery schedules. As Tang and Tomlin (2008) stated, alignment creates incentives for better performance and gains of improvement initiatives. This is achieved by exchanging information and knowledge between the partners, what is better obtained when dealing with few partners.
As Kleindorfer and Saad (2005) pointed out, there is a tradeoff between extreme leaness on one hand and robustness and reliability of the supply chain on the other. The price to operate in a lean way, with low inventories, may cause more vulnerability to the system. The main non-GM soybean fields in Brazil are in the center of the country, what takes about 5 days for trucks to supply with grain the processing units in the south of the country. The connection between farmers’ facilities to the main road is also subjected to weather conditions, especially in long raining seasons. All these factors make essential the existence of a buffer in the SPU to deal with eventual supply delays.

Conclusion

The purpose of this article is to identify the risks that the actors of the non-GM soybean supply chain are subjected to and propose a strategy to a soybean processing unit (SPU) to avoid supply disruptions. As was seen, due to the increasing scarcity of this product, the actors are taking individual decisions that may not prove consistent along the years. What is aimed is a collaborative strategy that makes the pillars of non-GM supply more consistent and stabilized in order to reduce the uncertainties.

Based in what was studied and verified with soybean producers and SPUs, there are some critical points that must be addressed to establish a strategy to deal with this supply. The main factor for farmers are the market existence, the price and the delivery schedule. For the SPU, the main factors are the price, the delivering schedule and the quality. There were also been identified some limitations and uncertainties for these actors, as storage capacity and price fluctuations. Only a strategy that aligns all these points will have success. The best strategy is the one that is based in early sales contracts that takes in consideration what the farmer expects to receive for his crop and when to deliver it. The SPU is interested in having a scenario for the price, the deliveries according to its storage capacity and a quality previously accorded in terms of damaged beans that will not affect negatively its processing yield. It was verified that the non-GM market cannot work anymore as an demand-offer market whose purchases occur punctually along the year. If conducted in this way, the SPUs will have strong financial loses that will affect its margin and impact in its processing yield due the acceptation of bad quality beans.

This work has its limitations. First, it was performed in just one country and, consequently, subjected to its characteristics. The group of farmers consulted were mainly from Mato Grosso state. A broader sample, including farmers from Paraná, another state that has non-GM soybean can be further researched. The same happens with SPUs. A future study may consider SPUs located in other parts of the country, closer to Mato Grosso production, what reduces enormously the distance between farmer-industry and, consequently, reduces the probability of disruptions risk due to delays. Finally, recognizing that market creates the demand, future studies can focus more the consumer side, evaluating the market behavior related to soybean products and the evolving consumer preference between non-GM and GM products.
References


