Application of risk solver platform to improve soybean crushing profitability

Geovano Ceratti[1*], Jéfferson de Oliveira Costa[2], Keith Harris[1]

[1]Kansas State University - College of Agriculture, Department of Agricultural Economics, Manhattan, KS 66506 785-532-6011, United States
[2]University of São Paulo - USP, College of Agriculture "Luiz de Queiroz" - ESALQ, Biosystems Engineering Department, 11 Pádua Dias Avenue Piracicaba, 13.418-900, Brazil

*Corresponding author: geoceratti@gmail.com

Abstract

The growing number of participants in the grain market shows just how globalized this sector is in Brazil nowadays. It is difficult to note how mergers and acquisitions between local companies as major tradings and funds have been acquiring part or even the totality of Brazilian companies, like the soybean crushing company "XYZ" that acquired some assets such as crushing plants in the state of Mato Grosso, located on the center-west region of Brazil and access to 2 port terminals to export the byproducts. This work contains data from January of 2014 to September of 2017 including prices of soybean and by products, freight rates, basis at the ports and operational costs. This information comes from different sources including government and private agencies and Thomson Reuters Eikon software. This information was used to build a model in Microsoft Excel and by using the Risk Solver Platform, a powerful statistic calculator tool, to find a solution to improve "XYZ" profitability. The results of the model suggest changes in the origin of grains, reducing the volume in some locations and increasing the volume originated in other locations. After running 2 different scenarios, "XYZ" profits was increased by 1.24 million of US dollars.

Keywords: Exports; *Glycine max* L.; logistics; origination.
Abbreviations: FETHAB_State Transport and Housing Fund, FOB_Free on board, FUNRURAL_Rural Workers Assistance Fund, IAC_Instituto Agronomico de Campinas, ICMS_Circulation of Goods and Services Tax, IMEA_Instituto Matogrossense de Economia Agropecuária, SEFAZ- MT_Treasury Department of the State of Mato Grosso, USA_United States, USDA_United States Department of Agriculture.

Introduction

The soybean is a native plant of China, its scientific name is *Glycine max* and it is part of the family Fabaceae, as well as peas, beans and lentils. It is used for human food in the form of edible oil, soy sauce, soy milk, soy protein, whole grain consumption and mostly in animal feed as an ingredient that makes up the ration (Hymowitz, 1970; EMBRAPA, 2004). This oilseed is rich in protein and in minerals such as potassium, calcium, magnesium, phosphorus, copper and zinc, B vitamins such as riboflavin and niacin and also in vitamin C (boric acid), among others (Olaofe et al., 1994; Buranello, 2011). In Brazil, the soybean was introduced in the state of Bahia in the year 1882, but without much success. In 1892, it was cultivated by Instituto Agronomico de Campinas (IAC). In 1914, the crop was introduced in the state of Rio Grande do Sul, where it presented more consistent evolution (Camara, 2001; Alves et al., 2003). According to the United States Department of Agriculture (USDA) supply and demand report, released in March of 2018, Brazil is the world's second largest soybean producer with 113.00 million metric tons produced in the 2017/2018 cycle, just behind only the United States (USA) which in the same period reached a production of 119.53 million tons

(USDA, 2018). In terms of exports, Brazil is currently the world's leading exporter for the crop 2017/2018, with 70.50 million metric tons, followed by the United States, which is expected to export 56.20 million tons. The harvest survey released in March of 2018 by Companhia Nacional de Abastecimento the Brazilian National Supply Company, indicates an area of 35.04 million hectares sown soybean in Brazil for the 2017/2018 crop. The average yield of 3.22 metric tons per hectare and a total production of 113 million tons. The three-main oilseed producing states are Mato Grosso with 30.86 million tons, Paraná with 18.52 million tons and Rio Grande do Sul with 17.54 million ton (CONAB, 2018). The importance of soybean to the Brazilian economy should be underscored by the generation of jobs and income for thousands of rural producers and workers from various sectors, including the input-producing industry such as fertilizers, pesticides and machinery, the financial sector responsible for rural credit, logistics sector responsible for storage, transportation and port operations, as well as for the processing industry that transforms soybean into bran and oil. The president of the Federação da Agricultura e Pecuária de Mato Grosso do Sul (FAMASUL) quantified in July

2013 that 37% of jobs in Brazil have a direct or indirect link with agribusiness (Scot, 2014). The commercialization of soybean occurs through cooperatives, grain merchants, chemical/fertilizer input companies, grain brokers, industry and merchandisers. The risk involved in the commercialization of the production explains the three possible commercialization situations: 1) Make a forward cash sale, where the flat price is fixed today with a buyer, for future delivery of the merchandise; 2) To hedge the price of the merchandise by selling a future contract; 3) Do absolutely nothing, acting as speculator, hoping that prices will not fall at the moment of sale (Marques et al., 2006; Oliveira and Alvim, 2017). On one hand, the impressive production and exports of this oilseed and its byproducts, it is possible to perceive the relevance and attractiveness of Brazil in the global market, which justifies the entry of new companies, mainly multinationals, in the soybean origination, processing and export market. On the other hand, the fact that many companies exit the market due to high competitiveness resulting in, insignificant or even negative margins, bad operational and financial practices, difficulties in adapting to the current market conditions of the commercialization complex. Additionally, the lack of knowledge and analytical tools that help identify logistics bottlenecks has an impact on the industry's performance (Spera et al., 2014; Reis and Leal, 2015; Oliveira et al., 2016; Forssell and Lankoski, 2018).

Logistics bottlenecks can be noted in the Para's state where there are 65 kilometers of dirty road between Novo Progresso and Moraes de Almeida, two municipalities located on the way where soybean are transported from the state of Mato Grosso to the ports located in the northern Brazil. Freight prices reach twice the price considering the same distances in other Brazilian States. The transportation problem is so serious that in 2017 trucks got stuck in the road because of heavy rains during the harvest season and there was a 20 km traffic congestion. The Brazilian army was called upon to supply water, food and control the traffic jam (Lopes et al., 2017; Teixeira, 2018). "XYZ" is a soy crusher, subsidiary of a Japanese corporation that just acquired crushing facilities in Mato Grosso State and is trying to understand the market and improve the profitability in the short-term. Their operation has six origination regions and they are able to export soymeal and soy oil through two ports. The objective of this thesis is to provide answers for questions that will help "XYZ" board of directors better understand the soybean market in Mato Grosso/Brazil so they might make informed decisions to improve the company`s performance. The questions to be answered are: What are the logistical and commercial bottlenecks faced by the company XYZ? What strategy that can be adopted and implemented in the short-term to improve "XYZ" profitability in the first year? What are the other feasible strategies that can be adopted by "XYZ" in the mid and long-term to minimize the risks, maximize the use of assets and keep improving profitability?

Results and discussion

Scenario 1 on risk solver

As a result simulation of scenario 1 calculated by the formula SUMPRODUCT that considers the flow between notes multiplied by the cost (in the case of inputs and crushing costs) or revenue (sale of byproducts), XYZ obtained a total profit of BRL 60,893,000.00 which is approximately \$19.77 million considering the currency average rate along the period of study. The Lucas do Rio Verde crushing facility was supplied with 100,000 tons originating locally, 250,000 tons of soybean from Sorriso, and 150,000 tons of Campo Novo do Parecis. The model indicates that all the volume of soybean meal and degummed oil produced in Lucas do Rio Verde should be exported through the port of Barcarena. Meanwhile, the Primavera do Leste facility was supplied with 100 thousand tons originated locally, 200 thousand tons of soybean from Rondonópolis, 200 thousand tons from Canarana. The model indicates that all the volume of soybean meal and degummed oil produced in Primavera do Leste must be exported by the port of Paranaguá. Both soybean crushing facilities operated with total capacity and there was no export of soybeans without being industrialized. Table 1 shows the results of the first scenario including the flow between nodes. Columns "From" and "To" identify the origin and the destination of the soybean and byproducts. The "Cash Flow" column representing the cost of inputs delivered to de crushing facilities, the crushing costs and the revenue obtained by selling soymeal and soyoil. All possible flows from the locations where XYZ originates soybeans to the soybean crushing plants or ports are considered.

The Table 2 shows the identification of each origination spot, crushing plant and destination port on the column "Nodes", the name of each facility on the column "Location", the "Supply/Demand" column identifying the availability of goods in the origination points and also the export capacity in each of the ports and the column "Flow" showing that 100% of the available volume is being used on XYZ operation. When the Risk Solver model calculates the best strategy for the soybean crushing enterprise, it has a feature called sensitivity analysis that allows the board of directors to make a decision. The XYZ decision makers can also realize the impact of unnecessary or excessive transportation. In regards to the origination in Sorriso for example, where the soybean to be processed travel 66 km to the factory in Lucas do Rio Verde and then again takes this route to the port of Barcarena. At the moment that the commercial team decides where to originate, they must pay close attention to the details of local availability of raw material, existing competition, and seasonality of marketing in order to avoid paying twice the freight because of the raw material coming and going back on the same route. Correa and Ramos (2010) studied the situation and prospects of Brazilian road transport for the outflow of soybean from the Midwest and concluded that the modalities of waterway and rail transportation are the most efficient, due to the energy efficiency and the greater productivity to the movement of higher density loads over longer distances, which results in lower circulation costs. As many multinationals (mainly of Asian origin) acquire stakes or the totality of agribusiness companies, XYZ also focused only on the foreign market as a destination for soybean meal and soybean oil. The exports of the soybean complex in Brazil have a main window of opportunity between February and September when there is availability of raw material in the market and, between October and January when the winter corn occupies the ports.

Table 1. Results of the first scenario including the flow between nodes.

Lower Bound	Flow (MT)	Upper Bound	Node	From (Origin)	Node	To (Destination)	Cash Flow (BRL/MT)
0	0	9999999	1	Sorriso	7	P. do Leste In	-1,036.09
0	250000	9999999	1	Sorriso	8	L. do Rio Verde In	-983.77
0	0	60000	1	Sorriso	11	Paranagua's Port	-67.97
0	0	60000	1	Sorriso	12	Barcarena's Port	-37.27
0	200000	9999999	2	Rondonopolis	7	P. do Leste In	-1,067.93
0	0	9999999	2	Rondonopolis	8	L. do Rio Verde In	-1,106.29
0	0	60000	2	Rondonopolis	11	Paranagua's Port	-85.21
0	0	60000	2	Rondonopolis	12	Barcarena's Port	-157.66
0	200000	9999999	3	Canarana	7	P. do Leste In	-1,042.32
0	0	9999999	3	Canarana	8	L. do Rio Verde In	-1,050.08
0	0	60000	3	Canarana	11	Paranagua's Port	-39.72
0	0	60000	3	Canarana	12	Barcarena's Port	-16.13
0	0	9999999	4	C. N. do Parecis	7	P. do Leste In	-1,036.11
0	150000	9999999	4	C. N. do Parecis	8	L. do Rio Verde In	-1,007.45
0	0	9999999	4	C. N. do Parecis	11	Paranagua's Port	-67.99
0	0	9999999	4	C. N. do Parecis	12	Barcarena's Port	-72.87
0	0	9999999	5	L. do Rio Verde	7	P. do Leste In	-1,033.36
0	100000	9999999	5	L. do Rio Verde	8	L. do Rio Verde In	-981.50
0	0	60000	5	L. do Rio Verde	11	Paranagua's Port	-65.80
0	0	60000	5	L. do Rio Verde	12	Barcarena's Port	-46.95
0	100000	9999999	6	Primavera do Leste	7	P. do Leste In	-1,030.17
0	0	9999999	6	Primavera do Leste	8	L. do Rio Verde In	-1,082.02
0	0	60000	6	Primavera do Leste	11	Paranagua's Port	-71.21
0	0	60000	6	Primavera do Leste	12	Barcarena's Port	-119.90
250000	500000	500000	7	P. do Leste In	9	P. do Leste Out	-61.62
250000	500000	500000	8	L. do Rio Verde In	10	L. do Rio Verde Out	-55.46
0	500000	500000	9	P. do Leste Out	11	Paranagua's Port	1,151.53
0	0	500000	9	P. do Leste Out	12	Barcarena's Port	1,103.58
0	0	500000	10	L. do Rio Verde Out	11	Paranagua's Port	1,108.28
0	500000	500000	10	L. do Rio Verde Out	12	Barcarena's Port	1,127.89
Total Profit (BRL)							60,893,000.00

Notes: Columns "From" and "To" identify the origin and the destination of the soybean and byproducts. The "Cash Flow" column representing the cost of inputs delivered to de crushing facilities, the crushing costs and the revenue obtained by selling soymeal and soyoil.
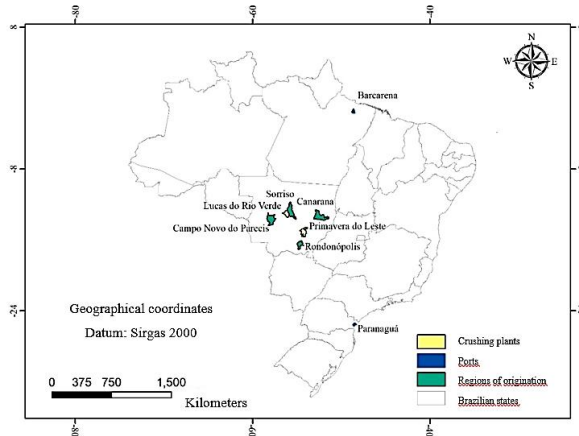

Fig 1. XYZ infrastructure: Crushing Plants, Port Terminals and Origination points.

Table 2. Identification of each origination spot, crushing plant and destination port (Scenario 1).

Nodes	Location	Flow (tons)	Supply/Demand (tons)
1	Sorriso	-250000	-250000
2	Rondonopolis	-200000	-200000
3	Canarana	-200000	-200000
4	Campo Novo do Parecis	-150000	-150000
5	Lucas do Rio Verde	-100000	-100000
6	Primavera do Leste	-100000	-100000
7	Primavera Do Leste in	0	0
8	Lucas do Rio Verde In	0	0
9	Primavera Do Leste Out	0	0
10	Lucas do Rio Verde Out	0	0
11	Paranagua's Port	500000	500000
12	Barcarena's Port	500000	500000

Notes: On the column "Nodes", the name of each facility on the column "Location", the "Supply/Demand" column identifying the availability of goods in the origination points and also the export capacity in each of the ports and the column "Flow" showing that 100% of the available volume is being used on XYZ operation.

Table 3. Results of the second scenario including the flow between nodes.

Lower Bound	Flow (MT)	Upper Bound	Node	From (Origin)	Node	To (Destination)	Cash Flow (BRL/MT)
0	0	9999999	1	Sorriso	7	P. do Leste In	-1,036.09
0	250000	9999999	1	Sorriso	8	L. do Rio Verde In	-983.77
0	0	60000	1	Sorriso	11	Paranagua's Port	-67.97
0	0	60000	1	Sorriso	12	Barcarena's Port	-37.27
0	200000	9999999	2	Rondonopolis	7	P. do Leste In	-1,067.93
0	0	9999999	2	Rondonopolis	8	L. do Rio Verde In	-1,106.29
0	0	60000	2	Rondonopolis	11	Paranagua's Port	-85.21
0	0	60000	2	Rondonopolis	12	Barcarena's Port	-157.66
0	200000	9999999	3	Canarana	7	P. do Leste In	-1,042.32
0	0	9999999	3	Canarana	8	L. do Rio Verde In	-1,050.08
0	0	60000	3	Canarana	11	Paranagua's Port	-39.72
0	0	60000	3	Canarana	12	Barcarena's Port	-16.13
0	0	9999999	4	C. N. do Parecis	7	P. do Leste In	-1,036.11
0	150000	9999999	4	C. N. do Parecis	8	L. do Rio Verde In	-1,007.45
0	0	9999999	4	C. N. do Parecis	11	Paranagua's Port	-67.99
0	0	9999999	4	C. N. do Parecis	12	Barcarena's Port	-72.87
0	0	9999999	5	L. do Rio Verde	7	P. do Leste In	-1,033.36
0	100000	9999999	5	L. do Rio Verde	8	L. do Rio Verde In	-981.50
0	0	60000	5	L. do Rio Verde	11	Paranagua's Port	-65.80
0	0	60000	5	L. do Rio Verde	12	Barcarena's Port	-46.95
0	100000	9999999	6	Primavera do Leste	7	P. do Leste In	-1,030.17
0	0	9999999	6	Primavera do Leste	8	L. do Rio Verde In	-1,082.02
0	0	60000	6	Primavera do Leste	11	Paranagua's Port	-71.21
0	0	60000	6	Primavera do Leste	12	Barcarena's Port	-119.90
250000	500000	500000	7	P. do Leste In	9	P. do Leste Out	-61.62
250000	500000	500000	8	L. do Rio Verde In	10	L. do Rio Verde Out	-55.46
0	500000	500000	9	P. do Leste Out	11	Paranagua's Port	1,151.53
0	0	500000	9	P. do Leste Out	12	Barcarena's Port	1,103.58
0	0	500000	10	L. do Rio Verde Out	11	Paranagua's Port	1,108.28
0	500000	500000	10	L. do Rio Verde Out	12	Barcarena's Port	1,127.89
Total Profit (BRL)							64,703,000.00

Notes: Columns "From" and "To" identify the origin and the destination of the soybean and byproducts. The "Cash Flow" column representing the cost of inputs delivered to de crushing facilities, the crushing costs and the revenue obtained by selling soymeal and soyoil.

Table 4. Identification of each origination spot, crushing plant and destination port (Scenario 2).

Nodes	Location	Flow (tons)	Supply/Demand (tons)
1	Sorriso	-250000	-250000
2	Rondonopolis	-200000	-200000
3	Canarana	-100000	-100000
4	Campo Novo do Parecis	-50000	-50000
5	Lucas do Rio Verde	-200000	-200000
6	Primavera do Leste	-200000	-200000
7	Primavera Do Leste in	0	0
8	Lucas do Rio Verde In	0	0
9	Primavera Do Leste Out	0	0
10	Lucas do Rio Verde Out	0	0
11	Paranagua's Port	500000	500000
12	Barcarena's Port	500000	500000

Table 5. Soybean Prices (BRL per 60-kg-bag) in Mato Grosso State.

	Canarana	Campo Novo do Parecis	Lucas do Rio Verde	Primavera do Leste	Rondonopolis	Sorriso
Mean	59.25	58.66	58.89	61.81	63.36	58.66
Minimum	48.90	47.75	47.80	49.40	50.30	47.50
Maximum	82.60	85.00	84.40	88.70	90.20	85.00
Std Deviation	6.79	7.55	7.91	7.94	8.05	7.93

Silva (2012) analyzed the agents involved in the soybean production chain, in the municipality of Sapezal (near to Campo Novo do Parecis) state of Mato Grosso, using information to understand how the market works in the west region of Mato Grosso. He concludes that this municipality has a large production and export of soybean but there are no cooperatives operating in the municipality and there are no large-scale processes of industrialization. The impact of a lack of industrialization affects the economic growth of that region, creation of new jobs and collection of taxes, compared to a scenario with aggregation of value of this raw material for Brazil.

Scenario 2 on risk solver

As a result simulation of Scenario 2 calculated by the formula SUMPRODUCT, XYZ obtained a total profit of BRL 64,703,000.00, which is approximately $21 million considering the currency average rate along the period of study (Table 3). In this new scenario, there is a reduction of 100,000 tons of soybean originated in Canarana and also a reduction of 100,000 tons of origination in Campo Novo do Parecis to Lucas do Rio Verde and Primavera do Leste which increase the origination by 100,000 tons of soybean for each location.

The Table 4 shows the flow of goods between regions, according to their availability. The Scenario Two has a profit of BRL 64,703,000.00, BRL 3.81 million higher than Scenario one. Considering the average currency rate along the period, the profit increased by approximately $1.23 million on the second Scenario, which indicates that a decision should be make in favor of the second scenario.

Materials and methods

Soybean prices and origination regions

The first pieces of information needed for this thesis is the soybean prices. The Instituto Matogrossense de Economia Agropecuária (IMEA) provided the database in a spreadsheet including prices of soybean collected on a daily basis in the municipalities of Canarana, Campo Novo do Parecis, Lucas do Rio Verde, Rondonópolis, Primavera do Leste and Sorriso, all located in the state of Mato Grosso. The database used covers a period from January 6, 2014 until September 29, 2017 and the prices are in Brazilian Reais per 60-kg-bag, a measure used by most farmers to sell their production. IMEA has its data collection personnel in the field but also an internal team that collects data from all over the Mato Grosso state through telephone calls, chats and email. Based on this data series it is possible to estimate the average, minimum, maximum and standard deviation. For the construction of the Risk Solver tool objective of this project the average prices from January 6, 2014 to September 29 of 2017 was considered. This is because the "XYZ" profile is to buy what it consumes in a short period of time and do not take any physical position such as a long basis to carry the beans for further months. "XYZ" does not take financial positions such as oil share and board crush on the commodity exchange, to guarantee the crushing facility's margins. Taking the example of Rondonopolis, prices varied from BRL 50.30 and 90.20 along the period studied. This wide range is due to the exchange prices on Chicago Board

of Trade but also because of the local basis related to the supply and demand.

The locations mentioned above represent the soybean origination regions that are destined for crushing facilities or ports. It was considered that the company purchases constant volumes throughout the study period, buying the same monthly volume, without keeping long term stocks.

In table 7 it is possible to understand the local price ranges across the period and the price differences between the municipalities. Also, the competitors in the municipality will make the efforts to originate volumes of soybean that is nearby their facilities. This approach will prevent its competitors from buying the available soybean in XYZ`s origination regions. The lack of soybean stocks in the second half of the year during the intercrop period forced XYZ to seek grains in other locations, increasing the freight costs.

Crushing facilities

XYZ has two soybean crushing plants located in the municipalities of Primavera do Leste and Lucas do Rio Verde, highlighted in yellow on the map shown below. Each of these facilities had an annual processing capacity of 500 thousand tons, totaling a consumption of one million tons if both factories worked at maximum capacity.

XYZ also exports through the ports of Barcarena located in the state of Para and Paranagua located in Parana State, both highlighted in blue on the map. The origination regions are highlighted in green and represent the municipalities of Sorriso, Lucas do Rio Verde, Canarana, Campo Novo do Parecis, Primavera do Leste and Rondonopolis. All of the origination areas and crushing plants are located in the state of Mato Grosso (Fig 1).

According to Masiero Engineering Company, the soybean must go through the processes of cleaning, weighing, rupturing, peeling, thermal conditioning, lamination and extrusion for the best performance of the extraction to produce soybean meal and oil (Masiero, 2017).

Foreign exchange (USDBRL)

The costs to crush the soybean and fobbings in ports were also considered in the proposed Risk Solver model that will be present on a further chapter and discussed in detail. Usually the producers and merchants deliver the goods at a port terminal and the exporter is in charge of the fobbings costs but, in order to calculate the prices, market considers free on board (FOB) price (which is the goods loaded at the vessel) minus the fobbing costs to avoid the bureaucracy of having to take care of more documents and services.

Fobbings costs include all services from the truck arrival at the port terminal to load the goods in the vessel having it FOB. To detail what fobbing costs are, it starts by the product being unloaded at the terminal, taking samples for quality analysis, cleaning the grains or byproducts by using a sieve machine (if necessary), fumigation, loading in the vessel and issuing the custom documents. It is a common market practice for these costs to be calculated in US dollars per metric ton. To convert dollarized prices to Brazilian Reais, the average rate in the period was BRL 3.0812 per US dollar according to the daily PTAX settlement from January 6, 2014 to September 29, 2017 (BCB, 2017).

Crushing costs

In consultation with several professionals in the commercial and operational areas of soybean crushing facilities in the state of Mato Grosso, it was possible to estimate the crushing costs (fixed and variables) for each of the XYZ facilities. These costs include labor, electric and furnace power, inputs used in the degummed oil extraction process, depreciation, and insurance.

Each region has particularities such as the cost of labor that varies according to geographic location and the availability of skilled labor. Other variables for the composition of the crushing cost are the type of the facility, equipment, technology used and the energy matrix adopted. The matrix in some cases can be propane but most of the facilities use wood which is abundant in Mato Grosso. Considering all of the above, a cost of $20.00 per metric ton for crushing in Primavera do Leste and $18.00 per metric ton for crushing in Lucas do Rio Verde is estimated.

The crushing plant yields the proportion of 780 kg of soymeal (78%) and 185 kg of degummed oil (18.5%) for each ton of soybean. The remaining 35 kg (3.5%) represent hull, losses of weight during the crushing process and impurities that can be sold in the local market for animal feed, so this percentage was not considered as a loss at the time of sale.

Freight rates and distances

Once the soybean is purchased, it is necessary to add the freight cost between the respective regions of origin and one of the two crushing facilities and from the facilities to the respective ports where the products will be shipped to the foreign markets. For the calculation of the freight rates, the database was provided by IMEA's weekly, of data collection is process. This database leads to an average freight cost of BRL 0.0924 per ton per kilometer, equivalent to $0.03 per ton per kilometer.

Soymeal and oil prices

In order to calculate the sales value of soybean processing by products, this research considers that one thousand tons of soybean can produce 780 kg of soymeal and 185 kg of the soy oil. The volume of byproducts produces is converted back to the price of soybean and finally multiplied by the USDBRL rate.

In the conversion to the soybean base, where the average price of soymeal and oil is multiplied by the percentages produced of 78% and 18.5% respectively, and then multiplied by the exchange rate where the average price in Paranaguá is $ 1,312.83 per ton. This was the price used in the tool developed as a reference of sale, discounting the freight of the factories from the port of Paranaguá.

The conversion of the 78% of soymeal and the 18.5% of the oil was used again in the conversion to the price of soybean multiplied by the USD quotation added to the differential basis of Barcarena over Paranaguá. Thus, the average price in Barcarena at the soybean base was $1,318.49 per ton and will be used as a sales reference, discounting the freight from the crushing plants to this port.

Taxes

Regarding taxation on the soybean crushing operation, there is exemption of some taxes. An example of the tax exempt is the Circulation of Goods and Services Tax (ICMS) that is not applied to soymeal and soyoil that are destined for export. The same rule applies to soybean which are purchased for export in grain.

The ordinance 67 of the Treasury Department of the State of Mato Grosso (SEFAZ- MT) of May 31, 2005, exempts the incidence of ICMS on export operations, stimulating commercial activities and in Brazil. Other taxes such as State Transport and Housing Fund (FETHAB) and Rural Workers Assistance Fund (FUNRURAL) are charged by the farmers who sell soybean to the industry (Sticca, 2008).

Building the model in microsoft excel

Once the data is collected, a logistic bottleneck identification matrix was built in "Microsoft Excel" where the raw material and final product prices are inserted, as well as the use of some formulas that supply the data used by the Risk Solver (Ragsdale, 2016; Ceratti, 2018).

The "Risk Solver Platform" uses Monte Carlo methods and other risk tools to enable robust and automatic decision-making optimization using stochastic programming. The developer also points to the use of Risk Solver to build models and obtain results for critical planning moments, especially those involving uncertainty (Solver, 2018).

Conclusion

The use of the Risk Solver tool made it possible to make changes to the origination strategy impacting the company's total profit in BRL 3.81 millions, only by modifying the 20% place of origin of the soybean demand by XYZ Corporation.

By examining two scenarios with real data of Mato Grosso, the board of directors of XYZ corporation now are able to understand how the logistic bottlenecks affect their operation and because of the long distances between origination and crushing facilities to the ports.

The research results express the current situation of new entrees in the Brazilian soybean crushing market and express the realities of companies that buy regular monthly input volumes to run operations.

High freight rates, availability of inputs, price/basis pattern along the year are factors can negatively affect the operation of XYZ Corporation.

The fastest strategy to be implemented was to find origination regions with availability of soybean and able to deliver the inputs to the plants at a reduced price. By maximizing the use of current assets, XYZ directors are able to choose the strategy that immediately improved the company's results.

The objective of this research was accomplished by using the Risk Solver Platform and the data base to add the necessary information to XYZ's decision makers, helping them to understand the market they are dealing with and reach better company performance in the short term.

References

Alves BJ, Boddey RM, Urquiaga S (2003) The success of BNF in soybean in Brazil. Plant soil. 252 (1): 1-9.

BCB – Banco Central do Brasil (2017) USDBRL. Available in: <http://www.bcb.gov.br/pt- br#!/busca/ptax.>. Accessed October 2017.

Buranello RM (2011) Sistema privado de financiamento do agronegócio. 1st ed. Quartier Latin do Brasil, São Paulo, SP.

Camara GMS (2001) Introdução ao agronegócio da soja. 2nd ed. Fealq, Piracicaba, SP.

Ceratti G (2018) XYZ Corporation: utilizing risk solver platform to improve soybean crushing profitability. Doctoral dissertation, Manhattan, Kansas, EUA: Kansas State University.

CBS - Columbia Business School (2018) Available in: <https://www8.gsb.columbia.edu/rtfiles/student_support /RSP-Install-Verify- 20132.pdf>. Accessed March 2018.

CONAB - Companhia Nacional de Abastecimento (2018) Available in: <http://www.conab.gov.br/OlalaCMS/uploads/arquivos/1 8_03_13_14_15_33_grao_ marco_2018.pdf >. Accessed March, 2017.

Correa VHP, Ramos P (2010) A precariedade do transporte rodoviário brasileiro para o escoamento da produção de soja do centro-oeste: situação e perspectivas. Available in: <http://www.mt.gov.br/historia>. Accessed February, 2018.

EMBRAPA-Empresa Brasileira de Pesquisa Agropecuária (2004) Tecnologias de produção de soja: região central do Brasil. Available in: <www.cnpso.embrapa.br/producaosoja/SojanoBrasil.htm >. Accessed September, 2017.

Forssell S, Lankoski L (2018) Shaping norms. A convention theoretical examination of alternative food retailers as food sustainability transition actors. J rural stud. 63: 46-56.

Hymowitz T (1970) On the domestication of the soybean. Econ bot. 24 (4): 408-421.

Lopes H dos S, Lima R da S, Leal F, Nelson A de C (2017) Scenario analysis of Brazilian soybean exports via discrete event simulation applied to soybean transportation: The case of Mato Grosso State. Res transp bus mana. 25: 66-75.

Marques PV, Mello PC de, Martines FJG (2006) Mercados futuros e de opções. 1st ed. Série didática, Piracicaba, SP.

Masiero LC (2017) Óleos e gorduras. Available in: <http://www.oleosegorduras.org.br/arquivos/sbog/objeti vos/preparo-graos-soja-para- extracao.pdf>. Accessed March, 2018.

Olaofe O, Adeyemi FO, Adediran GO (1994) Amino acid and mineral compositions and functional properties of some oilseeds. J agr food chem. 42 (4): 878-881.

Oliveira AL de, Alvim AM (2017) The supply chain of Brazilian maize and soybeans: the effects of segregation on logistics and competitiveness. Int food agribus man, 20 (1): 45-61.

Oliveira FC de, Coelho PHM, Sousa Neto MI de, Almeida AC de S, Santos FL de S, Oliveira JP de M, Campos AJ de (2016) Logistics and storage of soybean in Brazil. Afr j agric res. 11 (35): 3261-3272.

Ragsdale CT (2016) Spreadsheet modeling and decision analysis - A practical introduction to business analytics. 1st ed. Cengage Learning, Boston, MA.

Reis SA, Leal JE (2015) A deterministic mathematical model to support temporal and spatial decisions of the soybean supply chain. J transp geogr. 43: 48-58.

Scot C (2014) Canal rural – Scot consultoria. Available in: <http://www.canalrural.com.br/noticias/agricultura/agron egocio-responde-por-dos- empregos-brasil-diz-riedel-28382>. Accessed October, 2017.

Silva A de (2012) Análise da cadeia produtiva da soja de Sapezal/MT. Thesis agroscience, Curitiba, PR, Brazil: Universidade Federal do Paraná.

Solver (2018) Risk solver. Available in: < https://www.solver.com/risk-solver%C2%AE- platform>. Accessed February, 2018.

Spera SA, Cohn AS, VanWey LK, Mustard JF, Rudorff BF, Risso J, Adami M (2014) Recent cropping frequency, expansion, and abandonment in Mato Grosso, Brazil had selective land characteristics. Environ res lett. 9 (6): 064010.

Sticca RM (2008) Tributação nas operações de exportação e de pré-pagamento á exportação. 1st ed. Fealq, Piracicaba, SP.

Teixeira GP (2018). Estadão. Available in: <http://economia.estadao.com.br/noticias/geral,na-rota-da-soja-caos-logistico- continua-mas-muda-de-lugar-em-2018,70002211859>. Accessed March, 2018.

USDA - United States Department of Agriculture (2018) USDA. Available in: <https://apps.fas.usda.gov/psdonline/app/index.html#/ap p/advQuery>. Accessed March, 2018.