ANALYSIS OF THE INFLUENCE OF THE INCOMES VARIABLES OF A GRAIN STORAGE ON THE FINANCIAL VIABILITY OF THE INVESTMENT IN MATO GROSSO, BRAZIL

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ABSTRACT

The storage of grain on farms in Mato Grosso is a competitive advantage for the producer of soybeans and corn. To evaluate the economic feasibility of building a warehouse, a proposed experiment with the intention of observing the sensitivity of the Net Present Value (NPV) of the investment, given the variation of 7 components that affect revenue, namely, distance was prepared the nearest warehouse, grain moisture, forward soybean price, spread between the forward and spot price of soybean, seasonality of soybeans, corn and seasonality of maize prices. The statistical model was developed in the form of Fractional Factorial 2 k-1, and effects calculated with Yates' algorithm. In a combined way, all demonstrated impact on the NPV of the business, pointing out that all factors can affect the results, so it's important to have a historical analysis of the factors in each region to build that such a project.

KEY WORDS
Storage, Corn, Soybean, Viability

INTRODUCTION

In 2001, Mato Grosso State in Brazil produced 10.5 million tons of soybeans and corn according to the National Supply Company (Conab). This season, 2012/13 production estimate, the these two cultures are 43 million tons, according to IMEA, an increase of 318%, putting the state first in the production of soybeans and corn 2nd crop in the country. Despite the explosion in volume, the storage capacity and logistics, does not correspond to reality and become one of the major bottlenecks for the producer at the time of trading.

With growth of 20.1% in the production of these grains in the last year (Conab), between 2010/11 and 2011/12 crop is troubling logistical conditions of the state, which does not follow the same growth rate in the crops. There is a need for policies that encourage grain producers to increase their competitiveness through the construction of a grain storage, thereby facilitating the logistics flow of soybeans and corn state, and bringing benefits to the producer.

The producer of soybeans and corn that has its own grain storage becomes competitive as well as mitigate the logistical problems of the grain harvest, you can choose to sell your product in periods of high prices. The seasonality of prices of soybeans and corn during the year directly impacts on revenue producer. Moreover, the benefits of a grain storage itself are recorded with the economy in the short freight between the fields and the storage companies, the difference between the spot and forward price, and the economy with the costs on classification of grains.

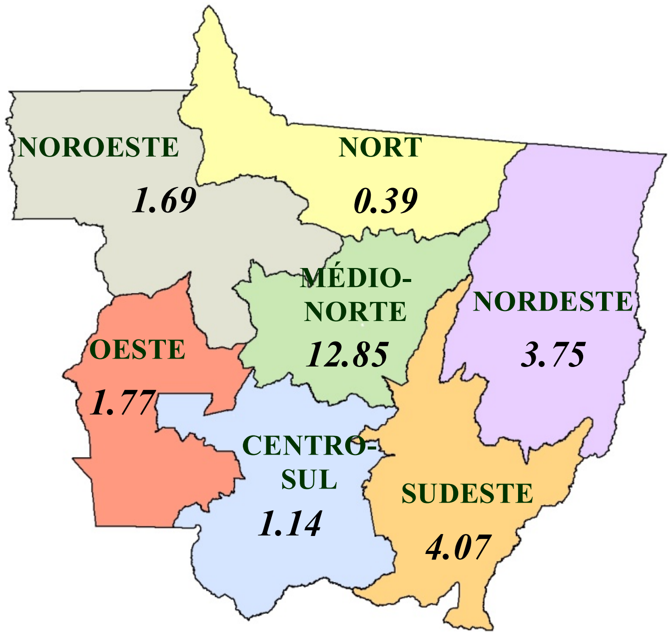
All these benefits motivate rural producers to build grain storage because increment revenue to the farmer and make the investment in building viable silos. However, it is unknown what impact each of these benefits in revenue generated by the storage and consequently on economic and financial viability of the grain storage.

The processing and storage of grain logistics are part of the flow of these commodities. According to Amaral (2007), the optimal storage capacity must be 20% greater than the volume of grain produced each season.

According to Conab, the state of Mato Grosso has storage capacity of 28.2 million tonnes, but this is not evenly distributed. If we analyze the capacity for macro regions, it is possible to find the deficit in storage for some regions, especially where agriculture is a recent activity, such as the North-East and Northeast regions of the state.

A work by IMEA 2013 pointed out that the current deficit storage capacity of Mato Grosso would be 25.65 million tons, and the North-East (Figure 1) is where is located the biggest deficit of storage. The institute said the current situation is critical and if nothing is done, in ten years the deficit could reach more than 50 million tons, considering the potential for production of soybeans and corn increase in the coming years.

Figure 1: Storage deficit in Mato Grosso State (million tons).



Despite this, the construction of a storage structure requires heavy investments and, even with a suppressed demand of this kind of service, the economic viability of such an investment depends on several factors. Thus, the design of experiment was carried out to analyze the influence of the factors that make up the incomes of a grain warehouse and affect the economic viability of this investment.

STORAGE ADVANTAGES

The advantages to owning a warehouse itself are cited by various authors, Junior and Nogueira (2007) and D' arce (2008) reported a suitable place to store grain after the harvest site should minimize quantitative and qualitative losses of grain, it because without exposure to weathering grains are preserved, and the harvesting operation can be better planned. Another benefit is the savings on transportation, because the harvest season, with shipping prices reach their peak. So too, the producer gains bargaining power in due course of grain trading.

Caixeta (2006) agrees with the need for structure storage in the farms, which offers the producer gains in negotiations and could avoid the immediate need to sell products after harvest. The Law of Storage regulated in July 2001, encourages new investment, increasing storage capacity, mainly in the Midwest region of the country.

With all intrinsic and tangible benefits that can bring a warehouse for grain production, as Azevedo et al (2008) concluded, this is a tool for the competitiveness of the sector, becoming an ally in the logistics chain for successful business of the producers.

Cestari and Gottardo (2008) analyzed the case of a medium-sized rural property in the State of Paraná in Brazil, and demonstrated the viability of building a warehouse of own grain, measuring revenue generation, value addition, and reporting benefits that can be granted on a property with such structure. According to the authors, to have a storage facility, the producer added more value to your final product, generating extra price of R$ 38.3 per ton when provided sale available. This producer have to pay less freight when have the warehouse ownership, adding R$ 5.0 per ton recipe. Also, could generate revenues from the sale of waste to the feed industry, which represents 3% of total grain production, being sold at R$ 220 per ton. The computation of income mentioned, demonstrated the feasibility of the warehouse to a unit of approximately 240 hectares with a payback in 5 years and 11 months, Net Present Value of R$ 44 thousands, and a rate of return on investment of 13% per year.

The feasibility of investing in a storage unit also depends on the flow of grain that is processed and stored every year. According Otonelli (2011), for a property of 130 ha is not feasible to build a warehouse itself due to the small stream, which does not pay the investment. The benefits of the warehouse in a property are remarkable, but it is necessary to evaluate the condition of payment of investment depending on the characteristics of the producer.

Cristiano et al (2006) in a study of the economic feasibility on soy farms, agrees with the idea that the benefits of investment in storage within the property have less sense for small and medium producers, comparing with a large farmer, since the total investment includes a fixed part such as dryers, conveyors, pre-cleaning machines, which features a variation reasonably low value compared to the amount invested Raser stock. Have investments considered variables are: the storer silo, the adequacy of the power grid and construction, which shows variation significant compared to the quantity stored, and can be diluted with increasing scale. The same author reported that the warehouse, in general, provides a positive net incomes for the producer. According to the author, soybeans spot can be sold up to 10 % above the value of soy forward.

METHODOLOGY

The Association of Producers of Soybean and Corn (APROSOJA), in 2008, made a survey stratifying the size of the properties of its members. According to they, in Mato Grosso state, about 51% of corn and soybean farmers have farms with less than 1,000 hectares (ha), 33% are between 1,000 to 3,000 ha, 13% are between 3.000 to 10.000 ha and 3% are above 10,000 ha. Unlike the Parana, the second largest grain producer, where only 2% of farms are over 500 ha.

Based on the size of typical properties of soybean and corn in Mato Grosso, this study structured similar to the reality scenarios. To make the scenarios close to reality, the deterministic variables, as previously collected with agents of the productive chain of soybeans and corn, were randomized in a model of probabilistic simulation.

Seven income components of a grain store were chosen to test these items which impact on the economic viability of the investment, in this case the viability indicator used is the Net Present Value (NPV). Steakholders storage believe that these components are deterministic for the investment decision in a grain store.

A. Distance from the closest grain storage: it is a practice in the market selling soybeans to withdraw at own storage, equivalent to those paid by product delivered in units of the purchasing price trades. Thus there is a short freight savings for those who have the next production area storage unit.

B. Grain moisture: With a self storage unit, the producer will not be penalized with discounts offered by commercial storage for grain outside the standard, both soybean and corn. However, this economic analysis we considered the costs of the standardization process, but the moisture that is usually discounted by commercial storage was recorded as a gain in revenue to the producer.

C. Price of forward soybean: is the value of the grain to be commercialized a posteriori and this has been delivered, processed and stored by a company in trade.

D. Differential forward and spot price: there is a difference between the prices of soybeans spot and forward. The soybeans available is that which the producer has already processed or delivered within the established quality standards. The difference between these prices usually exceed the costs of processing and storage also reflecting determine the relationship of supply and demand of the period, as in the case of soy forward, the volume has already deposited is considered part of the market share by the trading company recipient.

E. Seasonality of soybean: A producer has its own grain storage can sell soybeans in periods of high prices.

F. Seasonality Corn: How the same case of soybeans, corn can be sold in periods of high price because the producer has the option of storing the produce in the grain storage.

G. Price of corn: corn is traded in dollars per bag and no deferral in the price received, as in the case of soybeans.

In addition to the above factors, there are a series of factors that may influence the viability of the investment, and if tested would generate an extensive experiment. Therefore, the design of experiment was designed in the form of Fractional Factorial 2 k-1, where k is the factor of the revenue number to be evaluated, ie k = Seven: A, B, C, D, E, F, G.

Each factor was set at two levels, high and low, described in Table 1. Factors table were simulated deterministically.

Table 1. Variables tested in the experiment

Factors	A	B	C	D	E	F	G
Units	*km*	*%*	*R$/sc*	*R$/sc*	*R$/sc*	*R$/sc*	*R$/sc*
Low Level	10	0%	35	0	1%	1%	10
High Level	100	100%	60	4	7%	15%	20
Average	55	50%	47,5	2	7%	14%	18,75
Standart Derivation	22,5	25%	11,69	1	16%	37%	5,06

To bring them to reality a probabilistic simulation based on the methodology of Monte Carlo was performed. This was one of the first methods developed for probabilistic simulation. Thus, the values are closer to what might happen in reality, based on the average of the variables, and the standard deviation. Thus, it was possible to enter into risk analysis, environmental variables and elements of uncertainty (Nascimento; Zucchi, 1997).

For this, we raised the mean, standard deviation and amplitude of factors. Para find the specific values of the variables for each test performed within the experiment, an equation was made using a normal distribution with a standard deviation of one-twentieth of the amplitude value being found random around the limits, upper and lower, generated by the Microsoft Excel random algorithm. The formula below illustrates the operation.

$$x = F^{-1}\left(p \middle| \pm Lim, \frac{A}{20}\right)$$

Where:
x: $random\ value\ generated$;
F^{-1}: $inverse\ function$;
p: $probabilistic\ variable$;
Lim: variable limit;
A: Amplitude of the variable;

After obtaining random variables, the experiment was run was 2^{7-1} round, which in this case generate 64 experimental units:

$$2^{7-1}/\,2 = 64$$

Therefore, results 64 Net Present Value (NPV), divided into two blocks were obtained. To calculate the effect of factors on each experimental unit was used the Yates algorithm and thus the Analysis of Variance (ANOVA) of the results was performed.

RESULTS

The analysis of variance found 64 results, and from the results, only 7 were significant. Table 2 is the results of the ANOVA.

The result expresses that the interactions between the factors of the experiment are more significant than the factors when tested alone . In this case , only the F factor , the seasonality of the price of corn , was significant in the absence of other factors .

Significant interactions are interpreted as follows:

1. AB: Combining the distance from the closest warehouse (A) and grain moisture (B) is a significant interaction for the cash flow .
2. AC: Interaction distance commercial warehouse (A) and the price of forward soybean (C), impact on the viability of the warehouse. This means that the greater the distance from the warehouse and the higher the value per bushel of soybeans, it becomes more feasible to build the warehouse.
3. BC: Interaction between grain moisture (B) and the price of forward soybean.
4. AD: The combination of the distance of the commercial warehouse (A) and the differential forward and spot price of soybean (D).
5. BD: Interaction between grain moisture (B) and the differential forward and spot price of soybean.
6. EG: Combining the gain with the seasonality of the price of soybeans (E) and the price of corn (G).
7. F: Gain with the seasonality of the price of corn alone impacts the viability of investment in storage.

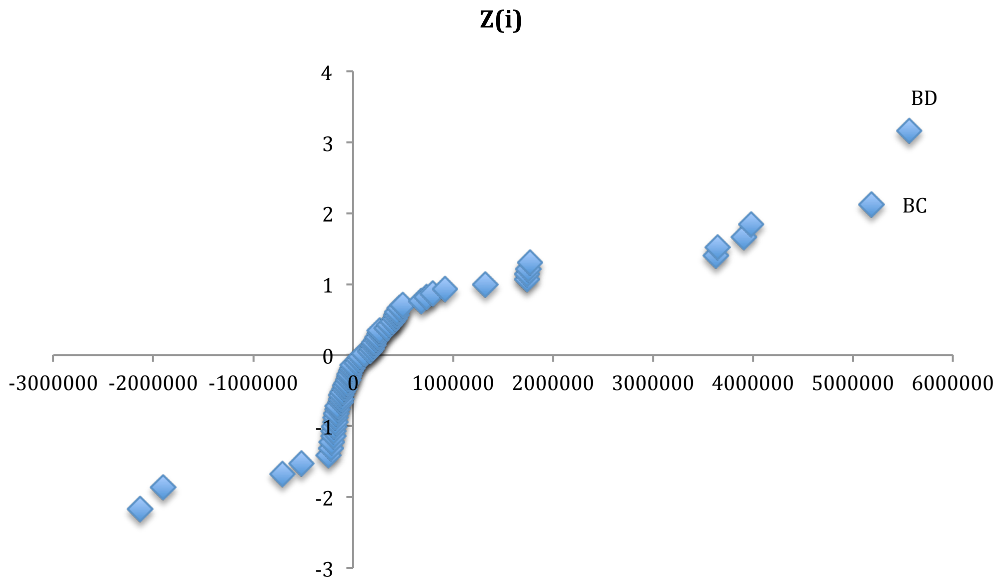
Table 2 Analysis of Variance.

Treatments	Code	Cof. Reg	SQ	GDL	MQ	Fcalc	Signif.
1	AB	662.312	28.074.068.974.345	1	28.074.068.974.345	0,8748604	Significativo
2	CD	101.488	659.184.937.934	1	659.184.937.934	0,0205419	
3	EFG	459.046	13.486.304.245.539				
4	CE	210.789	2.843.658.124.315	1	2.843.658.124.315	0,08861572	
5	DFG	115.234	849.854.631.528				
6	DE	246.956	3.903.176.608.350	1	3.903.176.608.350	0,12163305	
7	CFG	397.278	10.101.087.575.706				
8	ACF	195.965	2.457.752.006.879				
9	BCF	342.251	7.496.684.578.955				
10	ADF	219.825	3.092.669.752.519				
11	BDF	216.944	3.012.150.174.058				
12	AEF	- 77.822	387.602.928.519				
13	BEF	- 99.558	634.349.525.628				
14	BG	- 22.368	32.020.616.445	1	32.020.616.445	0,00099784	
15	AG	- 42.386	114.980.125.049	1	114.980.125.049	0,00358308	
16	ACG	1.824.604	213.067.564.624.619				
17	BCG	1.813.728	210.534.930.701.691				
18	ADG	1.989.275	253.261.842.215.035				
19	BDG	1.954.598	244.509.036.075.679				
20	AEG	- 89.543	513.153.930.126				
21	BEG	123.506	976.235.879.638				
22	BF	- 52.861	178.835.126.578	1	178.835.126.578	0,00557296	
23	AF	- 108.848	758.266.141.096	1	758.266.141.096	0,02362953	
24	FG	25.908	42.959.441.622	1	42.959.441.622	0,00133873	
25	CDE	- 12.605	10.168.064.150				
26	ABE	- 90.052	518.993.653.941				
27	E	132.691	1.126.849.663.392	1	1.126.849.663.392	0,03511554	
28	ABD	56.546	204.638.820.909				
29	D	37.312	89.097.547.720	1	89.097.547.720	0,00277651	
30	ABC	95.547	584.272.615.619				
31	C	- 79.269	402.146.013.831	1	402.146.013.831	0,01253191	
32	AC	886.983	50.351.291.548.362	1	50.351.291.548.362	1,56907611	Significativo
33	BC	2.592.755	430.232.363.940.449	1	430.232.363.940.449	13,4071501	Significativo
34	AD	876.494	49.167.445.149.428	1	49.167.445.149.428	1,5321844	Significativo
35	BD	2.782.074	495.355.788.537.001	1	495.355.788.537.001	15,436564	Significativo
36	AE	- 84.120	452.870.877.838	1	452.870.877.838	0,01411262	
37	BE	- 111.363	793.709.661.448	1	793.709.661.448	0,02473404	
38	BFG	- 34.723	77.162.836.170				
39	AFG	- 40.300	103.939.480.311				
40	F	869.065	48.337.531.877.755	1	48.337.531.877.755	1,50632217	Significativo
41	ABF	- 948.850	57.620.295.426.146				
42	CDF	- 1.065.435	72.649.750.868.206				
43	EG	869.676	48.405.572.517.790	1	48.405.572.517.790	1,50844249	Significativo
44	CEF	- 17.107	18.729.978.312				
45	DG	- 96.719	598.688.935.068	1	598.688.935.068	0,01865669	
46	DEF	84.047	452.087.233.702				
47	CG	166.963	1.784.113.771.595	1	1.784.113.771.595	0,05559759	
48	G	- 669	28.638.094	1	28.638.094	8,9244E-07	
49	ABG	- 124.692	995.083.090.232				
50	CDG	18.044	20.838.550.048				
51	EF	- 63.119	254.979.052.610	1	254.979.052.610	0,0079458	
52	CEG	- 58.142	216.349.988.267				
53	DF	133.756	1.145.004.446.320	1	1.145.004.446.320	0,03568129	
54	DEG	- 5.816	2.165.058.395				
55	CF	- 95.590	584.799.135.167	1	584.799.135.167	0,01822385	
56	BDE	232.082	3.447.165.265.765				
57	ADE	- 258.868	4.288.811.566.701				
58	BCE	- 354.778	8.055.536.064.383				
59	ACE	366.556	8.599.251.301.428				
60	BCD	102.160	667.950.390.226				
61	ACD	- 59.627	227.541.416.949				
62	B	- 25.615	41.990.880.658	1	41.990.880.658	0,00130854	
63	A	179.633	2.065.143.902.641	1	2.065.143.902.641	0,06435521	
64	Erro		1.123.141.950.515.980	35	32.089.770.014.742	1	

By transforming the probability of the results (Pi) in a distribution of experimental errors around the mean (Zi), one can observe the factors with significance for the experiment, as shown in Chart 1.

In short: the transformation of data into z values causes them to pass directly represent the experimental errors, which makes it possible to study their distribution around the mean, allowing calculate the probability of this distribution is normal. This is done by assessing the degree of compliance or adjustment between the two distributions: the standard normal experimental and mathematical (or theoretical Gaussian distribution).

Graph 1. Distribution of experimental errors (Zi).



Analyzing the items with significance, it is observed that the BD interaction has a greater influence on the NPV, this because its regression coefficient is the higher of the significant interactions. Thus, the combination of high grain moisture and the difference between the prices of the counter and soy are available for determining viability. It is important to clarify that these two factors observed alone do not guarantee the economic viability of the investment, but the combination of both.

Among the most striking significant interactions are the factors BC, and that means that moisture grain and soybean prices together carry much weight on the feasibility.

The experiment is useful to guide the farmers who want to invest in storage, it shows what are the main factors that have greater influence on the cash flow. Moreover, the good warehouse management, managing the sales price of grains and humidity is crucial to the return on investment.

CONCLUSIONS

All observed generated important factors for decision making of producers results. Observing the influence of factors on the revenue from producer facilitate the decision to accept or reject it investment. For example, if the producer has problems with high moisture at harvest and the region there is a high differential in the price of the counter and available, soy chances are investing in storage feasible.

The result showed that there is a rule to be followed in decision making, being prudent regional historical analysis of how the combined factors behave as the result.

REFERENCES

AMARAL, D. Capacidade de armazenamento da safra brasileira está abaixo do nível desegurança. Nordeste Rural: Noticias do Campo. Publicada em 02/12/2007 Disponível em:<http://www.nordesterural.com.br/>. Acesso em: 18 de Abril de 2008.

AZEVEDO, L. F. et al. A capacidade estática de armazenamento de grãos no Brasil. XXVIII Encontro Nacional de Engenharia de Produção. Rio de Janeiro, RJ, Brasil, Outubro de 2008.

CAIXETA, J. V. A logística do escoamento da safra brasileira. Especial Agro Cepea, Julho de 2006. Disponível em:cepea.esalq.usp.br/especialagro/EspecialAgroCepea_7.doc

CONAB. Companhia Nacional de Abastecimento. Séries históricas. Disponível em: http://www.conab.gov.br/conteudos.php?a=1252&t=2

CONAB. Companhia Nacional de Abastecimento. Sistema nacional de cadastro de unidades armazenadoras. Disponível em: http://sisdep.conab.gov.br/consultaarmazemweb/

CRISTIANO, C. A., RODRIGUES, S. F. & SOUZA, P.J. Viabilidade econômica do armazenamento de soja em propriedade rural. Análise Econômica, Faculdade de Ciências Econômicas, UFRGS. Ano 24, n 26, Março de 2006.

D'ARCE, M. A. B. Pós Colheita e Armazenamento de Grãos. Depto. Agroindústria, Alimentos e Nutrição ESALQ/USP. (artigo). Disponível em: http://www.esalq.usp.br/departamentos/lan/pdf/Armazenamentodegraos.pdf. Acesso em:14 de Abril de 2008.

GOTTARDO, F. A. & CESTARI, H. JR. Viabilidade Econômico-financeira de implantação de um sistema de armazenamento de grãos: um estudo de case em uma média propriedade em Campo Mourão – PR. Revista em Agronegócios e Meio Ambiente, v. 1, n.1, p. 55-76, jan./abr. 2008.

JUNIOR, S. N. & NOGUEIRA, E. A. Centrais Regionais de Armazenagem como apoio àComercialização de Grãos: Panorama do Mercado Agrícola. Instituto de Economia Agrícola.Informações Econômicas, SP, V.37, n.7, Julho de 2007.

OTONELLI, D. Condições de viabilidade da implantação de uma unidade de armazenamento de grãos em uma propriedade rural no município de Redentora – RS. Universidade Regional do Noroeste do Estado do Rio Grande do Sul, Unijuí, 2011.

NASCIMENTO, A. M.; ZUCCHI, A. L. *Modelos de simulação.* São Paulo, Universidade de São Paulo, 1997. 40 p. Monografia – Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo, 1997.