



## **Application of Questionnaire Concerning the State of Conservation of Trucks and Highway BR-163 in the State of Mato Grosso - Brazil**

**Pedro Silvério Xavier Pereira<sup>1\*</sup>, Aloisio Bianchini<sup>2</sup>, Carlos Caneppele<sup>2</sup>,  
Antônio Renan Berchol da Silva<sup>2</sup>, Dryelle Sifuentes Pallaoro<sup>2</sup>,  
Rodrigo Fernandes Daros<sup>2</sup> and Rosana Sifuentes Machado<sup>3</sup>**

<sup>1</sup>*Department of Tropical Agriculture, Federal University of Mato Grosso, Cuiabá, Mato Grosso, Brazil.*

<sup>2</sup>*Department of Agronomy and Zootechny, Federal University of Mato Grosso, Cuiabá, Mato Grosso, Brazil.*

<sup>3</sup>*Agribusiness and Regional Development, SENAI Mato Grosso Technology College, Cuiabá, Mato Grosso, Brasil.*

### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JEAI/2019/v37i630285

#### Editor(s):

(1) Süleyman Korkut, Duzce University, Faculty of Forestry, Department of Forest Industrial Engineering, Division of Wood Mechanic and Technology, Beciyorukler Campus 81620 Duzce-Turkey.

#### Reviewers:

(1) Jaime Cuauhtemoc Negrete, Autonomous Agrarian Antonio Narro University, Mexico.  
(2) Kholil, Sahid University, Indonesia.

Complete Peer review History: <http://www.sdiarticle3.com/review-history/49535>

**Original Research Article**

**Received 28 March 2019**

**Accepted 13 June 2019**

**Published 21 June 2019**

### **ABSTRACT**

Grain transport losses occur due to road conditions, trucks' state of repair, types of bodies, overload, loading and transport speed. These losses, besides affecting the economy, are also considered waste of food, environmental and social aspects. The objective of this work was to collect information from the drivers, through the application of questionnaires, on the type, age and state of conservation of trucks, car bodies, roof covers and tires, as well as conservation of BR-163 highway in the state of Mato Grosso, Brazil. The study was carried out on the BR-163 highway, which is the one with the highest cargo flow for maize in the state of Mato Grosso. Interviews were conducted with approximately 500 truck drivers transporting grain cargoes of maize, in order to obtain information regarding: (a) State of conservation of the highways where

\*Corresponding author: E-mail: [pedro.sxp@hotmail.com](mailto:pedro.sxp@hotmail.com);

they travel; (b) which part of the highways the greatest grain losses occur; (c) which grain is the most lost in road transport; (d) whether the truck driver has received any specific training to avoid grain losses; (e) whether the trucker adopts any procedure to reduce grain losses; among other information relevant to the study in question. It was observed that 59.70% of the trucks are owned by the companies, the other 40.30% are owned by the driver or are not tied to any company. It was observed that 42.90% of the trucks were manufactured between 2011 and 2015, that is, they are less than 8 years old. Of the evaluated trucks 39% of the evaluated trucks are bitrens, 32% rodotrens. The predominant bodies in the transport of grain in bulk are of the bulk type and bucket, with great predominance for grain. The data indicate that 87% of the trucks and 84% of the bodies are in good or excellent condition. The grain that is most lost in transportation, according to the drivers, is corn and soy, which together account for approximately 40% of the losses. It is concluded that grain losses in corn transport are occurring mainly due to poor conservation of BR-163 in the state of Mato Grosso. Holes and trepidation are the main culprits.

*Keywords: Losses; corn grains; questionnaires.*

## 1. INTRODUCTION

A country that has an economic base for grain production faces serious problems related to logistics in harvesting periods, due to the low investment of the bodies responsible for road transport and the low storage capacity [1].

Although Brazil has a large territorial extension, where it is recommended to use the rail transportation modality, 61.1% of the modalities used for the transportation of cargo are road [2], where it is possible to notice the high losses of grains during the highways during harvest season.

According to Carvalho et al. [3], the lack of an adequate structure for the production run, coupled with a lack of consistent transportation logistics, leads to grain wastage on the roads. He also points out that the explanation for the losses goes from the bad situation of the highways to the inadequate conditions of the trucks, causing the "leakage" of a large volume of grains on the highways [3].

In view of this, it can be said that due to the lack of an efficient logistics system, the flow of grain production in Brazil is often erroneous, where the use of an inefficient modal for a given region or distance is produced, in which production is drained off [4] also noted that the formation of a new arrangement of the productive sectors by the expansion of agricultural areas was not accompanied by the expansion of the transport sector, that is, by the development of its modalities.

The grain logistics in Brazil did not have the development and the expected success, being

outdated, and its main process, transportation, is with a precarious infrastructure without supporting conditions [1].

In developed countries transport losses are relatively low, due to better road infrastructure and better facilities in the field and in the beneficiation units, but when it comes to developing countries, there is a very precarious infrastructure in this sector of the grain production chain, resulting in large grain losses [5].

When analyzing the various stages of the current grain production chain in Brazil, there are some shortcomings, mainly in the stage of flow of production throughout the Brazilian territory, where significant losses occur.

A ausência de investimentos na manutenção e na conservação das rodovias nos níveis necessários contribui cada vez mais para a depreciação da malha rodoviária brasileira. Tem-se, assim, como consequência dessa falta de investimentos, do crescente volume de tráfego nas rodovias e das condições desfavoráveis que a maioria delas apresenta, o aumento do número de acidentes, com impactos preocupantes para a sociedade e para o poder público [2].

Brazil is a country with a large territorial dimension, and given the dispersion of production, the distance to the consumer markets or export ports and the deficiency of the storage network, the indices of losses tend to be higher in the post-harvest period [6].

Para avaliar a opinião dos principais usuários e realizadores do transporte de grãos, os motoristas de caminhão, o questionário é uma

maneira prática e importante para obter informações reais sobre o transporte de grãos. O questionário é um conjunto de questões, feito para gerar os dados necessários para se atingir os objetivos da pesquisa.

The objective of this work was to collect information from the drivers, through the application of questionnaires, on the type, age and state of conservation of trucks, bodywork, roof covers and tires, as well as the conservation of the BR-163 highway in the state of Mato Grosso, Brazil.

## 2. MATERIALS AND METHODS

### 2.1 Experimental Site Description

The study was carried out on the BR-163 highway, which is the one with the highest cargo flow for maize in the state of Mato Grosso.

### 2.2 Experimental Design Description

Interviews were conducted with approximately 500 truck drivers transporting grain cargoes of corn grains. This quantity of questionnaires was defined according to the flow of trucks that travel the BR-163 in Mato Grosso, being a relevant sampling for the research. In order to obtain information regarding: (a) State of conservation of the highways where they travel; (b) which part of the highways the greatest grain losses occur; (c) which grain is the most lost in road transport; (d) whether the truck driver has received any specific training to avoid grain losses; (e) whether the trucker adopts any procedure to reduce grain losses; among other information relevant to the study in question. It was important to understand the behavior of truck drivers in front of the theme, beyond what had been found in numerical data.

### 2.3 Sampling Method

Individual qualitative interviews were used in depth and observation of behaviors, always seeking to delimit the empiricism, subjectivity and the emotional involvement of researchers [7]. This research was characterized as a cross-sectional study, a method that allows to establish relations between the analytical categories and verify the conditions in which such relations are established [8]. It is an empirical investigation, a method that covers everything - planning, techniques of data collection and analysis [9]. The study was developed through qualitative field research.

According to the author cited in the reference [10], points out that the case study is one of the forms of research aimed at understanding complex phenomena, and allows an investigation that preserves the holistic and significant characteristics of real-life events.

Descriptive research aims to describe the characteristics of a particular population or phenomenon, or the establishment of relationships between variables. Standardized data collection techniques are used to study the characteristics of a group [11].

Qualitative research involves the collection of descriptive data about people, places and interactive processes through the direct contact of the researcher with the studied situation, trying to understand the phenomena according to the subjects' perspective, that is, of the study participants [12].

### 2.4 Data Analysis

The research data were collected over a given period, so it is a cross-sectional view with a longitudinal perspective [13]. Data were analysed in percentage.

## 3. RESULTS AND DISCUSSION

The questionnaire applied to the drivers had the objective of collecting information regarding the type, year and state of conservation of the trucks and highways.

It was observed that 59.70% of the trucks are owned by the companies, the other 40.30% are owned by the driver or are not tied to any company (Fig. 1). It was observed that 42.90% of the trucks were manufactured between 2011 and 2015, that is, they are less than 8 years old. The fleet is considered new, this is due to the lines of financing provided by the government that facilitated the exchange of trucks with little time of use, mainly by companies, which usually renew the fleet on average every 3 or 4 years of use (Fig. 2). According to the author cited in the reference [14], the average age of the trucks is 9.7 years old. The older fleet is used by the self-employed, whose average age is 12.7 years, followed by cooperatives with 8.7 years. The business fleet is 7.9 years old. Thus, the need for renewal of the existing fleet is added to the expansion of Brazilian agribusiness as a determining factor for the development of the grain transport Market [15].

Transportation is one of the main factors of production in the economy and the main modal for the outflow of production in Brazil is the road. The cost of transport is a fundamental part of the formation of the price of goods, so the poor quality of transport infrastructure has a direct impact on society in general. The country needs constant investments in the sector in order to adapt the transport offer and the expected demands. Companies are looking for solutions to reduce logistical costs and actions to reduce operating costs and thus remain active in a very competitive and unprofitable market [16].

There are 111,743 companies in the country, 274 cooperatives and 374,929 freight carriers registered in the RNTRC [2]. With a total fleet of 1,664,866 vehicles, 1,088,358 of companies, 22,865 of cooperatives and 553,643 of freelancers.

Usually the transportation of cargo is carried out by private companies or carriers that may own fleet and own equipment or contract services directly. The decision to obtain own fleet depends on the volume of cargo; if it is high, it compensates economically for owning the means of transport [17].

Cargo transportation is also distinguished by the ownership structure of the vehicle, since a large part of the Brazilian fleet is in the hands of freelancers contracted by companies or carriers for full capacity displacement or transportation of fractional cargo, mainly for urban distribution of products. The company's own fleet can thus be

partial, which prevents the fleet from idle when demand reduces [16].

Regarding the types of trucks that travel in BR-163 in Mato Grosso, it is noted that the majority, that is, 39% of the trucks evaluated are bitrens (7 axles), 32% rodotrens (9 axles) and the rest other types of trucks such as 5 and 6 axle trucks, truck truck (3 axles) or even stump truck (2 axles) (Fig. 3). The greater occurrence of bitrens and rodotrens is justified by the reduction of transportation costs, by increasing the load capacity of these vehicles. The authors cited in the reference [18], elucidate on the problems in the modal road of loads. In Brazil, the road freight sector coexists with a series of structural problems. Among them are the informality and fragmentation of the sector, a growing fleet aged by the inability to renew, the insecurity that has as a consequence an increasing theft of cargoes, the lack of regulation and the excess capacity, which results in predatory competition and lower prices costs.

According to the [2], the number of trucks in circulation in Brazil increased 14.2% between 2012 and 2016, while the number of trucks in the same period increased 13.2% and 7.8%, respectively. The current fleet of trucks in 2017 was 1.9 million units. The average age of the trucks has gone from 10 years and 3 months in 2016 to 10 years and 8 months in 2017. In the midst of so many obvious problems, finding a solution that distracts from these obstacles, and still makes us more competitive in the market, is a logistical challenge.

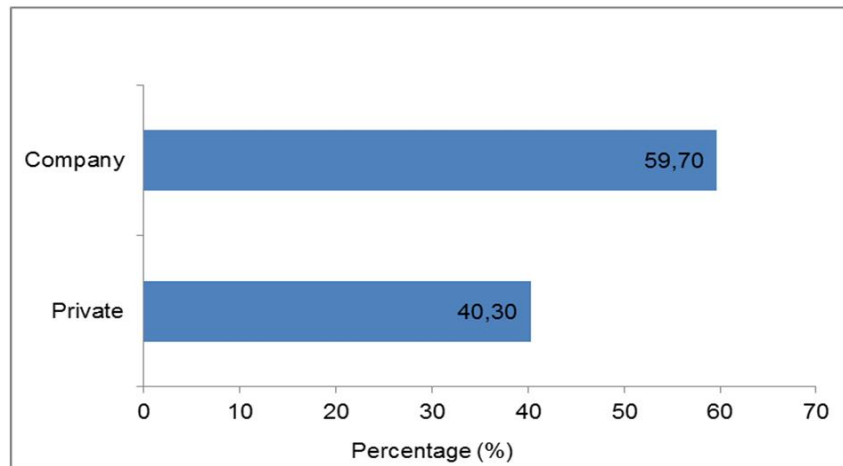


Fig. 1. Property of the truck. Mato Grosso, Brazil

The predominant bodies in the transport of grain in bulk are of the bulk type and bucket type. Among the trucks evaluated, there was a large predominance of bulk bodies, with 90.90% of the total evaluated. The other 9.10% were bucket type bodies (Fig. 4).

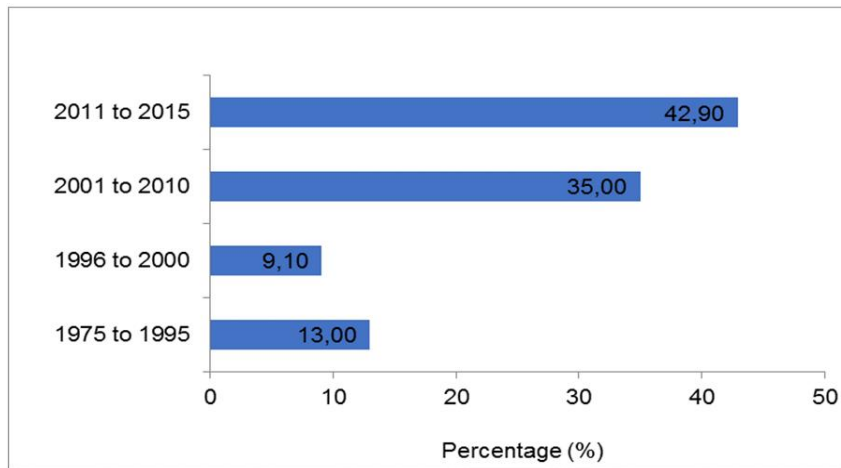
The bucket is a bodywork model widely used in construction. It is indicated for the transport of grains, rubble and earth, and is composed of a deep compartment and with high sides, so that the material does not fall during the movement.

The bulkhead is also known as "high grade" and has a reverse feature compared to the previous one. It can be used to transport grains such as corn and soybeans, as well as fertilizers and

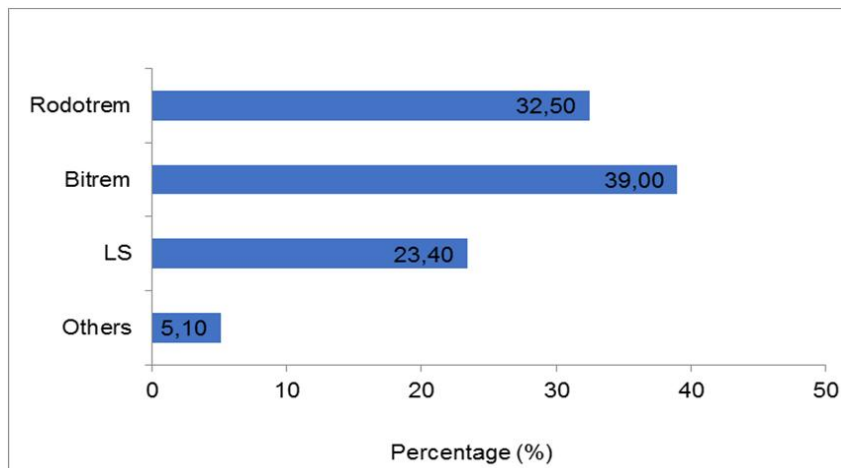
fertilizers. Its higher grids facilitate the accommodation of the items and guarantee a safe and efficient transport.

Evaluations were carried out on the state of conservation of trucks and bodies (Figs. 5, 6 and 7). The data indicate that 87% of the trucks and 84% of the bodies are in good or excellent state of conservation, and in both, the percentage of conservation considered bad was only 5%.

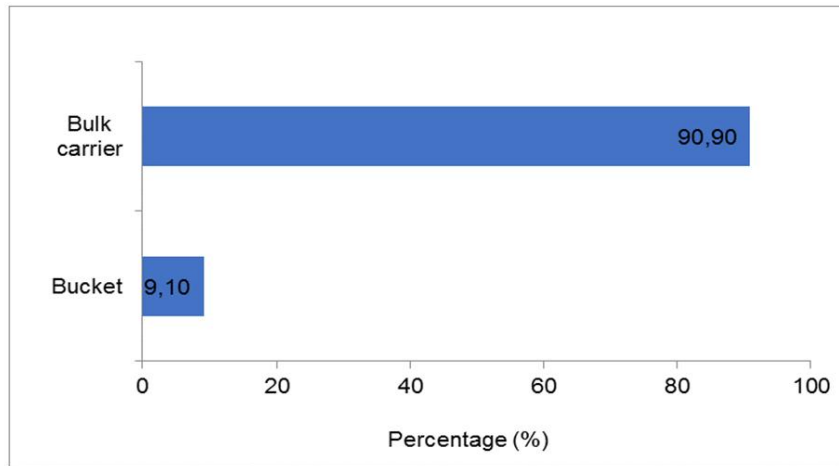
A portion of the grains is lost through the gaps between the side and the floor of the body, which can be solved by the inner lining of the same, a practice already adopted by several truckers and manufacturers of bulk bodies. Another considerable portion is lost through the upper



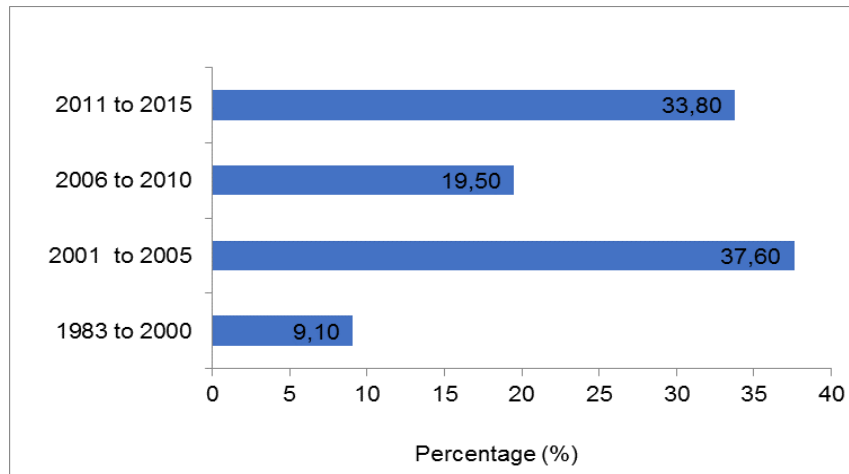
**Fig. 2. Year of manufacture of the truck. Mato Grosso, Brazil**



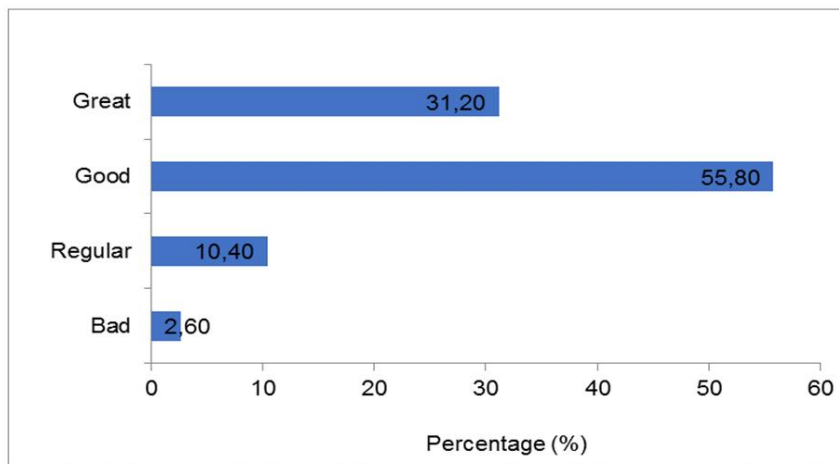
**Fig. 3. Type of truck. Mato Grosso, Brazil**



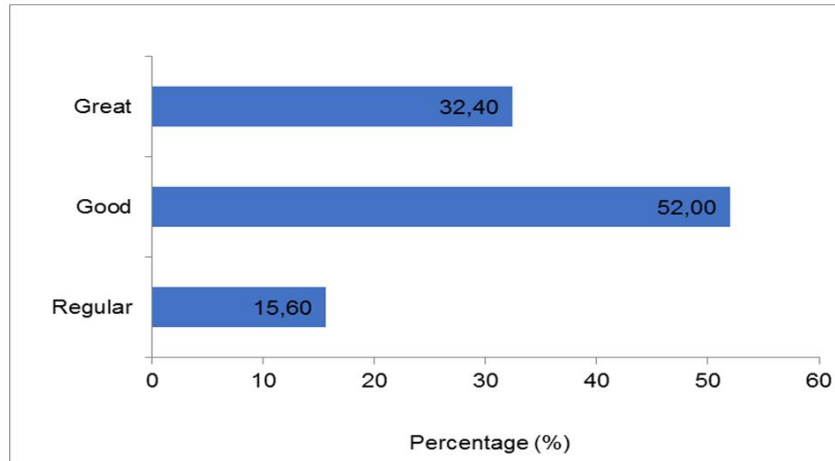
**Fig. 4. Type of body. Mato Grosso, Brazil**



**Fig. 5. Year of manufacture of the body. Mato Grosso, Brazil**



**Fig. 6. State of conservation of the truck. Mato Grosso, Brazil**



**Fig. 7. Body condition. Mato Grosso, Brazil**

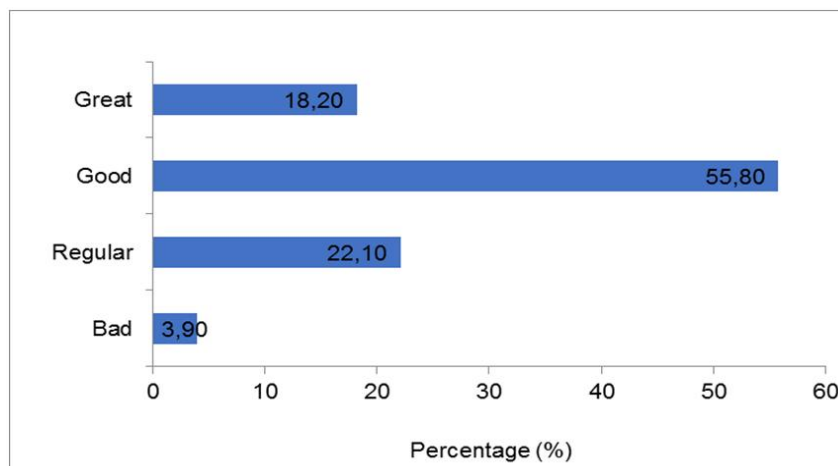
part of the body, due to the inadequate and uneven wrapping resulting from manual activity which often requires speed. Obviously, these losses are influenced by the quality of the pavement where the truck travels, since the trepidation and the holes are decisive in the grain escape when the load is not completely sealed inside the body [15].

At the time of the interview, the state of conservation of the tarpaulin and the tires was observed, where the interviewees said that the tarpaulin used in the truck bodies was in excellent or good condition, which was also confirmed in loco (Fig. 8) as well as the state of conservation of the tires, which presented in

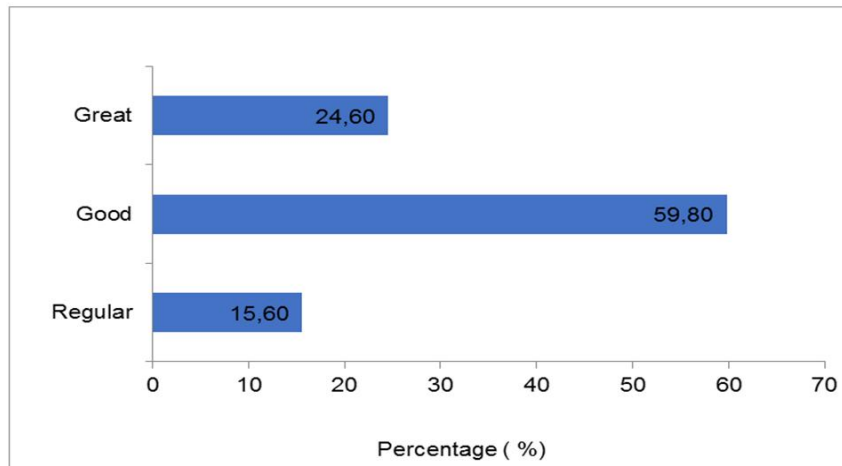
59.80% of the response as in good condition (Fig. 9).

The operating costs of transport services are influenced by the insufficient state of conservation of these infrastructures. These costs arise from frequent occurrences of tire, wheel and suspension failure, for example, the need for more intensive vehicle maintenance and increased fuel consumption, among others [2].

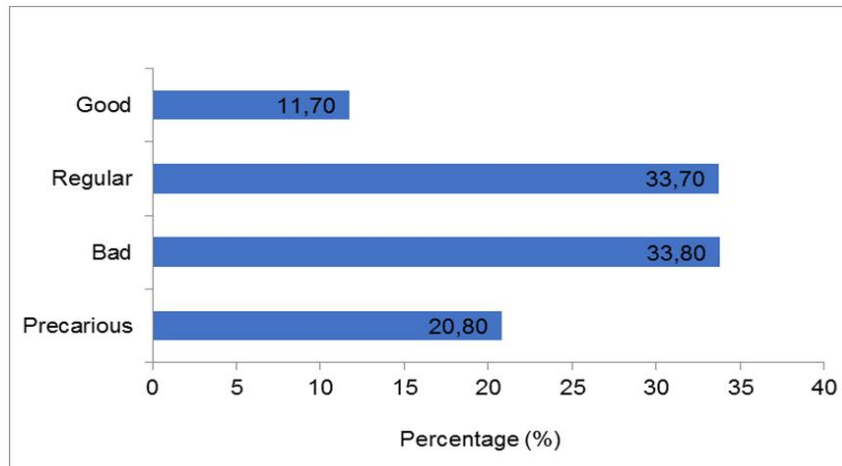
The state of conservation of the roads proved to be a problem to be solved, since 88% of the interviewees affirmed that the lack of conservation of the roads is the predominant factor for the losses of grains, being the place of holes and trepidation where it is lost more (Figs. 10 and 11).



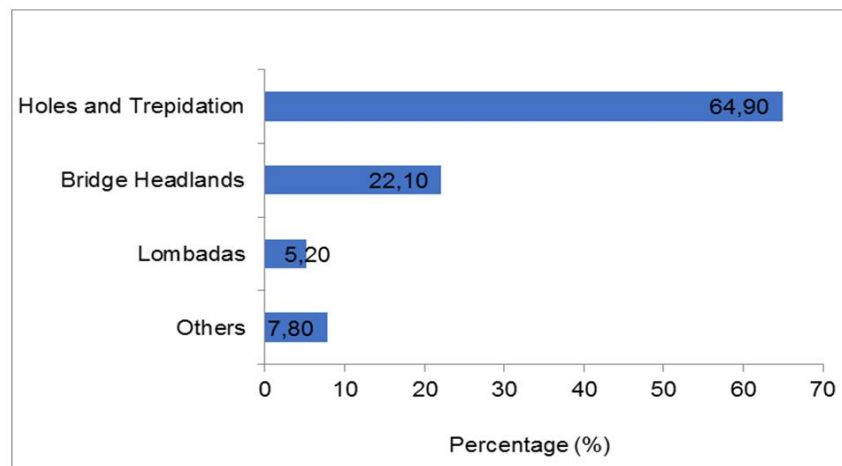
**Fig. 8. Canvas conservation status. Mato Grosso, Brazil**



**Fig. 9. Tire condition of the tires. Mato Grosso, Brazil**

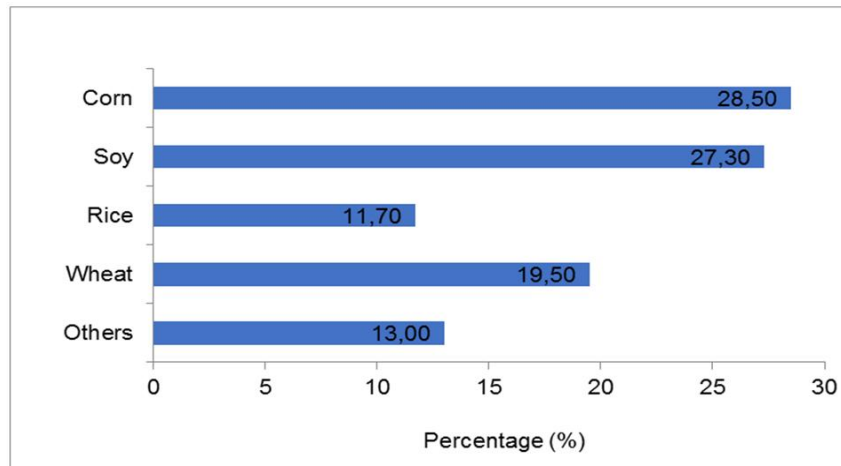


**Fig. 10. Conservation status of Highway BR-163. Mato Grosso, Brazil**



**Fig. 11. Locations of greater loss of corn grains on Highway BR-163. Mato Grosso, Brazil**





**Fig. 12. Product most lost in transportation on Highway BR-163. Mato Grosso, Brazil**

The lack of investments in the maintenance and maintenance of roads at the necessary levels contributes increasingly to the depreciation of the Brazilian road network. As a consequence of this lack of investment, the increasing volume of traffic on the highways and the unfavorable conditions that most of them present, the increase in the number of accidents, with disturbing impacts on society and the public power [2].

In a country where road transport is the main means used for transportation, its roads are expected to be in a good condition to generate more competitiveness in the flow of its products. Brazil has 1,720,607 km of roads, with only 213,229 km of paved roads, about 12.4%, according to a CNT survey that surveys the conditions of Brazilian roads since 1995 [2].

Holes and road irregularities can cause the truck's cargo bay to shake. This trepidation causes the grains to oscillate and to move, and in case of bodywork failure, the grains have to pass and fall [15].

During the interviews, it was asked which grain is most lost in transportation, according to the driver's opinion, corn and soybean together account for approximately 40% of the losses (Fig. 12).

In the Brazilian scenario, one of the most cultivated grains is corn. Only during the 2016/2017 harvest, a production of 92 million tons was estimated, being considered the largest production in the history recorded in the country [19]. However, the lack of logistics infrastructure

faced by the country in the post-harvest stages of this production makes the country less competitive due to the losses that occur especially in transport and storage processes [20].

In this context, transport conditions and distances play an important role in influencing the magnitude of post-harvest food losses, since long distances and poor transport modes lead to even greater losses [20].

#### 4. CONCLUSION

Based on the results of the questionnaires, it is concluded that grain losses in maize transportation are mainly due to poor conservation of BR-163 in the state of Mato Grosso. Holes and trepidation are the main culprits.

Investments in the maintenance and conservation of highways and trucks, control of the growing volume of traffic on the highways, and a reduction in the number of accidents, which will consequently impact on the confidence and security of truck drivers, are necessary and of great importance.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Carvalho DC, Tonial E, Vachia GD, et al. Análise logística de redes de transporte de grãos no território Brasileiro. In: Congresso Internacional De Administração; 2012.

- Ponta Grossa, PR. Anais do Congresso Internacional de Administração de. 2012;1-6.  
Available:[http://www.admpg.com.br/2012/d\\_owen.php?id=2718&q=1](http://www.admpg.com.br/2012/d_owen.php?id=2718&q=1)  
[Acesso em 15/05/2016]
2. CNT - National Confederation of Transport. CNT survey of highways 2018: management report Brasília; 2018.
  3. Maciel, Marcondes. Grãos estrada afora Diário de Cuiabá, Cuiabá, Ed no 12788, 15 ago; 2010.  
Available:<http://www.diariodecuiaba.com.br/detalhe.php?cod=377099>  
[Acesso em: 17/04/2016]
  4. Borges GR, Araujo F, Solon AS. Desperdício de soja nas estradas: Análise de perdas of regiões sudeste e Centro-Oeste. In: Encontro Nacional De Engenharia De Produção, 2013, Salvador, BA. Anais do XXXIII Encontro Nacional de Engenharia de Productions. 2013;2.  
Available:[http://www.abepro.org.br/biblioteca/enegep2013\\_TN\\_STO\\_177\\_009\\_22552.pdf](http://www.abepro.org.br/biblioteca/enegep2013_TN_STO_177_009_22552.pdf)  
[Acesso em 16/02/2018]
  5. Kumar K, Kalita P. Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries foods. Basileia. 2017;4.
  6. Ojima, Andréa Leda Transporte de grãos por rodovias gera prejuízos Notícias Agrícolas, Campinas, 08 ago; 2008.  
Available:<http://www.newswiki-english-solutions.com.br/noticias/logistica/34085-transporte-de-graos-por-rodoviagera-prejuizos.html#.V9Q2HWgrLIV>  
[Acesso em: 20/05/2019]
  7. Minayo MCS. (Org.) Pesquisa social: Teoria, método e criatividade Petrópolis: Vozes; 2001.
  8. Hunt JR, JGSJR, Osborn RN. Fundamento de Comportamento Organizacional. 2. ed. Porto Alegre; 1999.
  9. Richardson RJ. Pesquisa social: Métodos e técnicas. 3. ed São Paulo; 2009.
  10. Yin R. Estudo de caso planejamento e métodos. Porto Alegre: Bookman; 2005.
  11. GIL, Antônio Carlos. Como elaborador projetos de pesquisa São Paulo: Atlas; 2010.
  12. Godoy ASA. Pesquisa qualitative and effective use of Empresas. Revista de Administração de Empresas, São Paulo. 1995;35(4):65-71.
  13. Creswell JH. Projeto de pesquisa: Métodos qualitativo, quantitativo e misto. 3. ed Porto Alegre: Artmed; 2010.
  14. National Land Transport Agency - ANTT. National Register of Freight Carriers - RNTRC in numbers; 2011.
  15. Tsiloufas SP, Pellegrini SP, Freire CM, Neves RRV, Kaminski PC. For solution: No transportation process: Sistema de proprietary automation. São Paulo: Escola Politécnica da Universidade de São Paulo, Universidade de Tecnologia de Delft. 2011;17.
  16. Cotrim, Fernando, et al. Otimização do transporte rodoviário carga: I have a problem with the odds that no transport is transported to the transport of Brasil. Curitiba: Fundação Dom Cabral; 2018.
  17. Ballou Ronald H. Gerenciamento da cadeia de suprimentos/logística empresarial. Porto Alegre: Bookman; 2006.
  18. Figueiredo Kleber Fossati, Fleury Paulo Fernando, Wanke Peter (Org.). Logistics and supply chain management: Planning the flow of products and resources. São Paulo: Atlas; 2006.
  19. CONAB - National Company of Supply. Acomp crop breeding grains Safra 2018/19 - Fourth survey, Brasília. 2019;6:1-118.  
Available:<https://www.conab.gov.br/info-agro/safras/graos/boletim-da-safra-de-graos>  
[Accessed on: May 21 2019]
  20. Aulakh Jaspreet, Regmi Anita. Post-harvest food loss estimation-development of consistent methodology Agricultural & Applied Economics Associations. 2013;4-6.

© 2019 Pereira et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://www.sdiarticle3.com/review-history/49535>