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Opportunistic Behavior in Agricultural Contracts In Brazil

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ABSTRACT: The paper examines agro-industrial contracts signed in the State of Rio Grande do Sul, southern region of Brazil. From the concept of efficient governance, it is aimed to understand and measure how the opportunistic behavior of agents manifests itself before those governance structures, considering the principle of contractual incompleteness. The fuzzy analysis logic is used as the central method. The behavioral assumption of opportunism, characteristic of the New Institutional Economy, is analyzed for contracts of rice cultivation, tobacco farming and swine farming. The fuzzy model elaborated for the measurement of the phenomenon is constituted of three categories of analysis: (a) trust, (b) references and (c) contractual safeguards. The results show that a higher level of formal contracting is associated with greater occurrence of opportunistic behavior.
Keywords: Agroindustrial Contracts, Opportunistic Behavior, Governance Structures.

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I. INTRODUCTION

Theoretical constructions around the concept of contract made important advances from the point of view of understanding reality, especially in agro-industrial environments. Using this conceptual advance, this paper focuses its investigations on the contractual phenomenon, at the same time as it seeks to condition and expand the analysis of opportunistic behavior for different contracts - based on the transactions carried out by the agents. In strictly theoretical terms, the study is based on the principle of contractual incompleteness, that is, on the notion that the contracts formulated are necessarily incomplete - even though they are designed to discourage the occurrence of opportunistic actions. In addition, it considers verifiable the Williamsonian assumption of the potential opportunistic behavior of the contracting agents. Thus, to examine the occurrence and degree of the phenomenon import from the theoretical point of view; mainly due to the absence of a definite and consolidated theoretical reason for the relationship between contract and opportunism.

A transaction - when executed in a specific contractual manner is subject to particular structural conditions, e.g different from those observed in other models or contractual circumstances. How do opportunistic practices operate in these different structural contract outlines? This central issue raises the present investigation, mainly because the theoretical contribution of the New Institutional Economy is silent on this issue. Otherwise, it is argued that these different structural conditions may promote distinct effects in terms of opportunistic behavior. The question of research is thus part of efficient governance, contributing to the identification of the phenomenon in different contractual structures. In this perspective, it lists structural elements in a comparative way, that is, it links the observed occurrence of opportunistic behavior to the contractual typologies detected in the empirical research. In theoretical terms, bilateral contracts (also called relational contracts) have some very well defined properties, such as flexibility, involvement of the parties and continuity of the relationship. On the contrary, in classic contracts, transactions are discontinuous, isolated and the identity of the agents is not important. Neoclassical contracts differ quite subtly from bilateral ones, although they differ more strongly from the classics. In view of this central theoretical proposition, of Williamsonian origin, the related question is to reveal opportunistic practices present in these contractual forms.

References to opportunistic behavior are common in academic papers on agro-industrial contracts. Recursive notes about the phenomenon in Brazil are found, for example, in productive activities of poultry, pigs and soybeans. It is observed, however, that little research is intended to evaluate it with greater property; In fact, a significant part of the scientific writings are concentrated on the dimensions of the transaction (asset specificity in particular) and governance structures designed from them. This observation justifies the conduct of this debate, that is, it emphasizes the importance of conducting studies on one of the most important behavioral assumptions built as an alternative to the mainstream and which, in general terms, has been treated and understood quite indirectly especially when using mathematical models of analysis.

1.1. Contractual Models From The Perspective Of The New Institutional Economy

The contractual models offered under the New Institutional Economy (henceforth referred as NIE) and, in particular, in the transaction costs economy, are built on institutional theoretical bases. Institutions play a central role in the NIE, notably through the formal and informal constraints they create for organizations. Among the theoretical perspectives that this approach entails, the construction of a set of specific knowledge about the contractual phenomenon is expressive. In addition, according to Brousseau & Glachant (2008: 37), the contractual approach can be considered dual in methodological terms, since it is possible to think of them in two perspectives ... the analytical tools, contracts the objects of analysis.

The NIE maintains that there are positive transaction costs that vary for different governance structures. Thus, the firm as a function of production (neoclassical) represents an interpretation devoid of meaning from the point of view of its correspondence with reality and, therefore, the contractual firm is deeply affirmed as a theoretical construct of analysis (Zylbersztajn, 2005). The origin of this theoretical approach is largely due to Coase (1937). In his work entitled The Nature of the Firm, the questioning of firm existence in a (neoclassical) world coordinated by the market opens the way for new interpretations, centered on the analysis of transaction costs and, particularly, on the "world" of contracts . In fact, Coase does not use transaction costs in this work, but exchange transaction (Sopeña & Almeida, 2014). In a well-known excerpt of his work, Coase asks:But in view of the fact that it is usually argued that co-ordination will be done by the price mechanism, why is such organization necessary? Why are there these "island of conscious power"? [...] Why is there any organization? (COASE, 1937, pp. 35, 36).

The contract economy rejects the neoclassical assumptions consolidated in the so-called Arrod-Debrew paradigm: in this construction, contracts are established or formulated by price and allocation mechanisms (contract curve with Pareto gains), a notion that has no real meaning in ignoring function of the contractual firm (ZYLBERSZTAJN, 2005; MÉNARD, 2014). The literature also maintains that contracts are incomplete, especially because (a) the contractors' (cognitive) capacity is limited and (b) the information is asymmetric. Especially in this last contractual property it is possible to identify a direct relationship with the transaction performance itself, that is, one of the agents may present undesirable behavior (a phenomenon known as moral hazard) or the transaction results in adverse selection - not effective.

For Williamson (1985), the analysis of contractual man concentrates on the proposition that the costs related to the transaction are based on behavioral assumptions potentially generating transaction costs. The limited rationality and opportunism of agents represent the two main assumptions. In parallel with the behavioral assumptions developed by the NIE, the characteristics or dimensions of the transactions refer to three specific elements; these are: specific assets, uncertainty and frequency of transactions.

For a high level of asset specificity, the hierarchy is considered as a form of governance adopted. Although, in the same case, when, they are employed in a relationship, hybrid forms (as in the case of hybrid contracts) preponderate. High levels of uncertainty also promote a tendency to hierarchy as a chosen organizational arrangement. Despite the consolidation of transaction costs as a theoretical element of analysis, the difficulty of its measurement represents, for many researchers, a gap in this research area. Yoram Barzel proposed a theoretical alternative to this question, incorporating the notion of "measurement costs" to the analysis. In this analysis perspective, the attributes of an asset or product need to be measured in order to be able to carry out a transaction. Barzel (1982), in his work to evaluate the relations between costs of measurement and organization of the markets, indicates that the ease of measurement generates the negotiation via the market. In opposite cases, hierarchy is the predominant mode. In this way a continuum is established. In the scope of measurement, its ease indicates the use of the market, its difficulty the hierarchy and, in intermediate cases, the hybrid forms of governance. Thus,

Distinct firms will form and trade with each other at junctures where output can be readily measured, but where output is difficult to measure the different steps will be performed within the firm (BARZEL, 1982, p.42, emphasis added).In this perspective, (a) assuming that all information relevant to the transaction is given, the spot market would be the alternative; (B) cases where the measurement of attributes is complex and difficult, require the adoption of hybrid structures and (c) cases where information relevant to the transaction is not present, the hierarchy prevails (SOARES; PAULILLO, 2011). The notion of efficient governance, a theoretical element that links the frequency of the transaction to the specificity of the assets represents a fundamental theoretical construct developed by Williamson. In the analysis of Brousseau & Glachant (2008, p.14):

Contractual incompleteness, and its interaction with the attributes of different types of transactional attributes, including asset specificity, complexity, and uncertainty, plays a central role in the evaluation of the relative cost of governance through market-based bilateral contracts versus governance through internal organization. Contracts may be incomplete because of the direct cost of specifying and writing contracts that anticipate all contingencies, because of "bounded rationality", which makes it unlikely that the transacting

parties can foresee all possible contingencies, and/or because of high monitoring, verification, and enforcement cost.

This particular contribution matters insofar as it couples two dimensions of the transaction to the thought of Ian MacNeil, formulator of the typology of relational contracts. Three forms of governance emerged: market governance (associated with the classic short term contract), trilateral governance (linked to neoclassical contracts) and bilateral governance (promoted from relational contracts). In these terms, (efficient) governance structures use the market for classical contracts, assuming the low asset specificity (regardless of the frequency level observed for the transaction). At the other extreme, the hierarchy prevails as a result of the high frequency and specificity of the assets (specific investments). In intermediate transactions, that is, regulated by contractual means, the specificity of the assets is not high enough to determine the hierarchy and, therefore, neoclassical (trilateral) and relational (bilateral) contracts are evidenced as efficient governance arrangements. Figure 1 illustrates the different shapes.

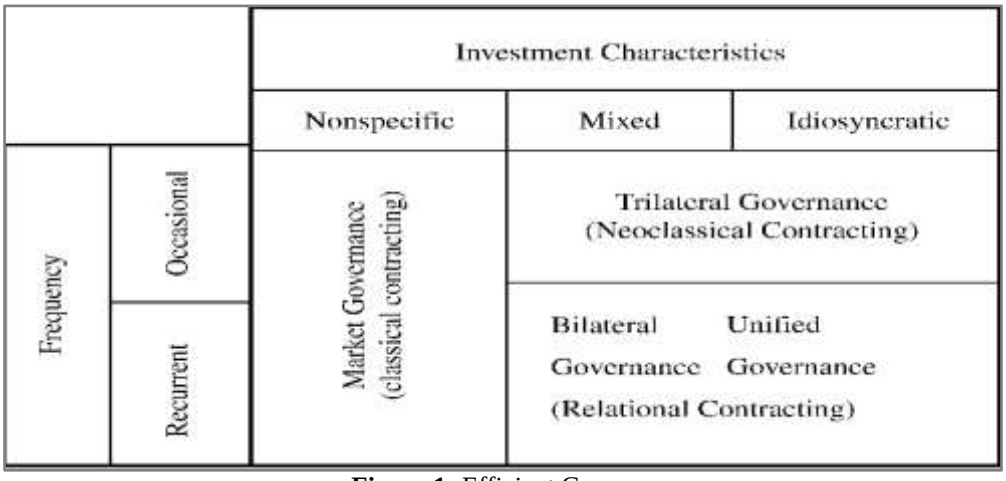

Figure 1: Efficient Governance

Source: adapted from Williamson (1985, 2012).

These conclusions indicate the fact that in classic contracts there is no continuity of the relationship, nor strong commitment among faceless agents. On the contrary, in neoclassical contracts (intermediate classification of the typology), the relationships are long lasting and flexible because of the greater specificity of the assets in relationship. Finally, in relational contracts, frequency and specificity matter in the contractual relationship (idiosyncratic investments). In addition, the long-term sustainability of the relationship is desired by the contractors.

1.2. Opportunism as a behavioral assumption

The discussion of opportunism stems from speculation about the search for self-interest of agents (WILLIAMSON, 1985). This element, according to the author, varies in intensity, through obedience (weak form of self-interest), simple self-interest (semi weak) and opportunism (strong) - configuration is directly related to transaction costs. The search for self-interest with greed or deceit is the central conceptualization used to demarcate the opportunistic behavior of agents (individuals who, in this case, have fewer principles). Nevertheless, subtle forms of fraud are considered more frequent and closer to reality. Oliver Williamson considers the actions of lying, stealing or cheating as blatant or revealed forms of opportunism, noting, however, that asymmetry of information is an active component and present in those practices.

Opportunistic practice may occur ex ante contracting (before agents sign a contract) or ex post (stage of contract execution), cases of moral hazard (NIESTEN; JOLINK, 2012). In the understanding of these authors, opportunism in the NIE only makes sense when perceived in a contractual relationship. In addition, they consider that in the presence of specific assets and behavioral uncertainty, hybrid contractual forms are preponderant. The level of trust present in the relationship would also reduce the inclinations of opportunistic behavior: The behavioral assumption of opportunism is relevant within TCE, not as an attribute of economic actors per se, but as an attribute of economic actors in a contractual relation. Contracting parties take into account what information may be valuable for themselves and for the other contracting party, and consequently they may disguise or distort this information. The opportunity for opportunistic behavior by the other contracting party leads the parties to devise protective governance structures. […] When asset-specific investments characterize the transactions, matters change substantially. When uncertainty increases, specific

transactions are better organized in the hybrid form, and with even larger degrees of behavioral uncertainty, the match with internal organization is more efficient. Other studies emphasize the role of trust and commitment between the parties to a contractual relation in mitigating the opportunistic inclinations of the contracting parties (NIESTEN; JOLINK, 2012, p. 5-7).

This thesis bases the existence of alternative forms of organization, surpassing the perspective of the neoclassical market. If promises were made, self-executing agreements and full access to the rules guaranteed, there would be no alternative way of governance in the world of organizations. The author therefore supports an interpretation that differs from that used by neoclassical economics. It works with simple, semi strong or smithian self-interest, while that presupposes opportunism as a problematic source and generates transaction costs. In distinguishing both approaches, Williamson argues that, with no surprises in the economic activities of the neoclassical model, economic issues are essentially turned to technological issues, and there is no problematic behavior that can be attributed to the deviation of rules between human actors (WILLIAMSON 1985 , 44).

Figure 2 organizes four contractual cases or constraints submitted to the different levels of opportunism and rationality of the agents. Williamson seeks to demonstrate extreme combinations between utopia and reality.

		Limited rationality condition	
		Absent	Present
Opportunism condition	Absent	(1) Happiness	(3) Hiring - General Clause
	Present	(2) Comprehensive Contracting	(4) Serious Contractual Difficulties

Figure 2: Behavioral Assumptions and Contracting.
Source: adapted from Williamson (1985).

By the exposition, in three cases (1, 2 and 3) there are no contractual problems, especially in case 1, considered by the author as utopian. In case 4, that is, when one assumes the limited rationality of agents and the presence of opportunism, contractual difficulties are detected. The reality would correspond to this perspective, especially because, in this particular type, there are complex and problematic issues of contract management and the emergence of transaction costs.

II. METHOD

In order to measure opportunistic behavior in contractual relationships, Fuzzy analysis logic is used. The adoption of a quantitative study is part of a disturbing question: the measurement and formalization of the concepts of the New Institutional Economy. The argument that these concepts lack formalization is perceived in many writings. Thus, unlike the "elegance of" Neoclassical Economics, the Transaction Costs Economy is "accused" by some authors of a lack of mathematical formalism or analytical stringency. Although this question is not intended to be addressed, it is intended to indicate it as existing. The level of analysis refers to the contractual relationship formed between rural producers (agricultural production unit) and food processor (industrial unit) - in classic contracts of organic agriculture, neoclassical farming and relational swine farming. Three categories of analysis are chosen as a way of interpreting agent behavior, as well as specific subdivisions for each case. Table 1 presents the following categories: trust, references and precaution. The first category of analysis used - trust - was previously proposed in a study by Reys et al (2010). For those authors, the possibility of quantitative evaluation (measurement) of sources of transaction costs - as in the case of opportunistic behavior, is possible and desirable through the fuzzy approach.

The category called references is used here as a means of analyzing how the interviewed agent observes the other agents in their business environment. It is, therefore, a more comprehensive category that, when proposed for the analytical set, allows to bring the interviewee's vision about the contracts carried out parallel to his. Finally, the importance given by agents to precaution or safeguards, elements that are notorious in the formation of contracts, aims to establish the agents' understanding of the possibility of violating clauses.

Analysis Categories	**Elements of empirical investigation**
Reliability	· Business relationship history
	· Expectations regarding full compliance with the contract
References	· Professional references of the agents (external reputation)
	·Follow-up of other transactions (indicative)
Precaution	· Importance of the adoption of safeguards and contractual guarantees
	· Importance of the existence of alternative projects / substitutes

Table 1: Opportunistic behavior of agents - categories of research analysis

Source: Author's elaboration.

Table 1 lists two main elements for each analytical category. The exploration of these elements, either through open interviews or by scale of measurement, allows, in the first two cases, the respondent to answer the questions based on his own experience and perception about the behavior of the other contractor. Thus, farmers were asked about agroindustry / food processor and these, on the former. The third category of analysis operates in the sense of ascertaining the importance that the agent gives to precaution. The reliability category has been analyzed through the history of the relationship between the contracting parties and the expectation of each party as to full contractual compliance. By references we mean the agent's perception of the behavior of the other party with its peers - which can be understood as a categorical form of external reputation. Finally, the term precaution was used to designate how much each party considers important to protect itself from the risk of opportunism. It is presumed in this question that the greater the agent's expectation of opportunism, the greater will be the importance given to safeguards, and the more committed he will be in designing alternatives to the original project.

The Fuzzy logic[1] is characterized as a suitable quantitative tool for this purpose, especially for its ability to analyze vague or imprecise questions (VELLASCO, 1999), resulting from responses with these characteristics (linguistic variables) that are characteristic of human thought (BARIN, et al. Al, 2010). As an alternative to the conventional theory of sets, which determines if an element x belongs to a particular set or class ($x \in A$ or $x \notin A$), Fuzzy sets allow us to model certain phenomena with greater approximation and relativization (degrees), obtaining multivalued results which better approximate those realities (MARRO, 2010).

The central reference that justifies the application of fuzzy logic is therefore to quantitatively measure the knowledge of specialists when it is imprecise or ambiguous for the quantitative understanding of the researcher (GONÇALVES, 2011). The treatment of a linguistic variable in fuzzy models has its own qualitative value (its particular linguistic term) and quantitative by the notion of pertinence expressed by a function (MAGNAGO, 2005). Figure 3 illustrates the above arguments.

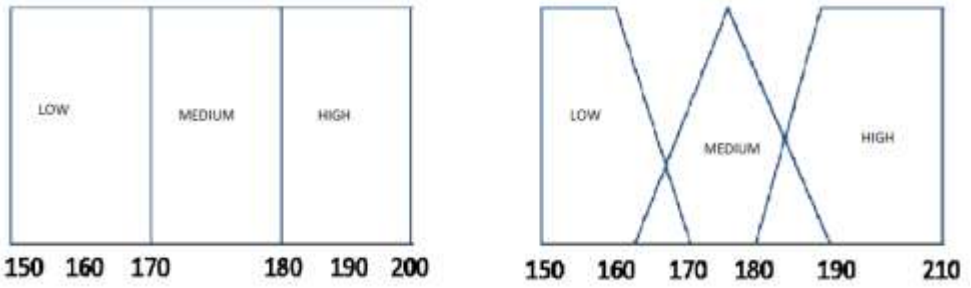

Figure 3: Degrees of Relevance in Classical and Fuzzy Sets

Source: adapted from MARRO (2009).

It is realized that in the three graphical sets of the classical theory (graphic representation to the left of the figure), the elements cannot belong to more than one of the three sets presented (low, medium or high). In Fuzzy logic, on the other hand, degrees of pertinence (truth or "partial truth") are allowed (graphic to the right of the illustration) and elements may belong to more than one class - implicit notion of partiality (GOMIDE et al., 1995; 2001). The four main components (fuzzyfication, rules, inferences and defuzzyfication) of the computational operation are the result of input elements that generate, at the end of the process, numerical outputs (crisp or exact) or final results of the implemented model.

Classical or binary sets (expression 1 with bivalent condition) do not present the pertinence degrees $\mu(x)$ indicated in the second expression. Results in classical sets, therefore, are characterized by being extreme; As in the examples: true / false, on / off, high / low, full / empty and yes / no. Below the expressions:

$$f(x) = \begin{cases} 1 & \text{if, and only i, } x \in A \\ 0 & \text{if, and only if, } x \notin A \end{cases} \qquad (1)$$

[1]Lofti Zadeh is considered to be the precursor of fuzzy logic, especially since the publication of his 1965 article entitled Fuzzy Sets: Clearly, the "class of all real numbers which are much greater than 1," or "the class Of beautiful women, "or" the class of tall men, "does not constitute classes or sets in the usual mathematical sense of these terms. Yet, the fact remains that such imprecisely defined "classes" play in the important role in human thinking, particularly in the domains of pattern recognition, communication of information, and abstraction (ZADEH, 1965, p.338).

$$\mu(x) = \begin{cases} 1 & \text{if, and only if, } x \in A \\ 0 & \text{if, and only if, } x \notin A \\ 0 \leq \mu(x) \leq 1 \ \forall x \mid x \text{ parcially in } A \end{cases} \qquad (2)$$

The classical theory, therefore, assumes that f (x): U → {0,1}, that is, only 0 or 1 (GOMIDE, et al, 1995). The degree of membership μA (x) for the fuzzy approach is represented in expression 3 below. In it, the membership interval [0,1] indicates that, when 0, x ∉A; when 1, x ∈ A and, in addition, values between 0 and 1 represent the notion of bias (or degrees of pertinence). For Marro (2009, p. 3), this mathematical property defines fuzzy sets and makes a given sentence partially true and partially false. Moreover, the same element may have degrees of pertinence other than 0 for more than one fuzzy set.

The function of pertinence implies, therefore, to solve for a given universe of answers U a fuzzy set A defined by rules determining the pertinence of each element to values of the interval [0,1] (OLIVEIRA, 2014) Indicated in expression 3:

$$\mu_A: U \rightarrow [0,1]. \qquad (3)$$

Once the relevance function is defined, the data are distributed in a tabular form, thus representing the different degrees adopted in the study. The Mamdani system of data analysis, used in this study, uses the minimum operator for input values and the maximum operator for the aggregation of rules (REYS, et al, 2011). In it, besides the fuzzyfication and adoption of fuzzy rules,
the defuzzification process is employed in determining the numerical results of the research. Thus, one has to:
a) fuzzyfication → determination of the function of pertinence, establishment of rules (IF, AND, OR and THEN) and fuzzy ensembles. Crisp clusters are transformed here in the nebulous sense, that is, with the definition of gradual boundaries (OLIVEIRA, 2014).
b) defuzzification → numerical output or output using the centroid technique (COG), based on the notion of center of gravity, mass or area (CA) - for the region of the fuzzy set. The defuzzification (expression 4 below) is represented as follows (MARRO, 2009, p.11). It should be noted that the result can be understood as a weighted average in expression 4:

$$C_{OG} = \frac{\sum_{x=a}^{b} \mu(x).x}{\sum_{x=a}^{b} \mu(x)} \qquad (4)$$

According to Oliveira (2014), parameters are important in determining the pertinence function, especially since trapezoidal (four parameters), triangular (three parameters) type functions, among other less frequent functions in the literature. Thus, in addition to the triangular and trapezoidal functions (recurrent in most studies), other pertinence functions are used. The choice of such functions depends directly on the object of study. A somewhat intuitive example is pertinent here: if, depending on the object of study to be modeled, minimal changes occurring in continuous variables entail or represent important conceptual changes, a function of pertinence in the form of a curve may be more advantageous in terms of explanation of the Than a trapezoidal function, for example. Thus, other functions are often used by researchers in the field, such as the Gaussian function or the bell function.

In the analysis of the data collected, each input variable x (measured by the categories of confidence analysis, references, precaution) generated inferences for the output variable y (directly related to opportunistic behavior).
The general structure of the model employed, therefore, obeys the following scheme offered in Figure 4. In it, three input variables, submitted to the set of rules (Opportunistic_Rules) defined in the fuzzy project, give rise to exits on the opportunistic behavior of the agents (Comp_Oportunista).

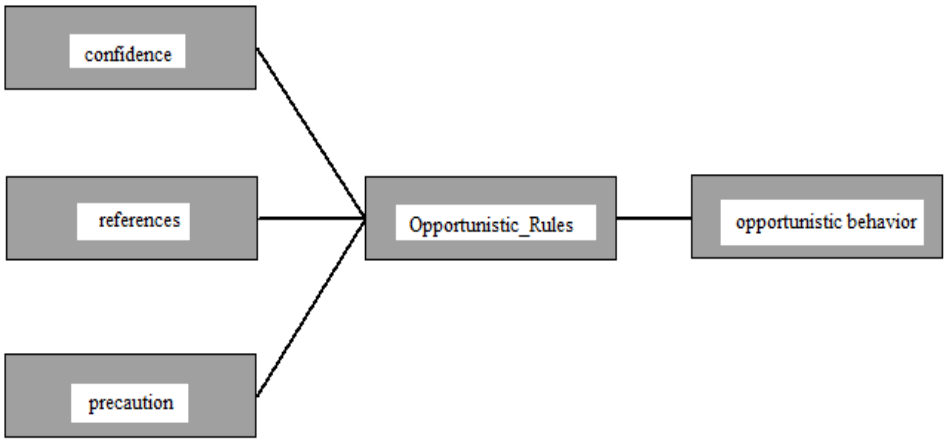

Figure 4: Fuzzy design

Source: InFuzzy Software.

From the previous notes, sentences of type "IF x, THEN y", called rules, have been defined. If x is the preceding element and y, the consequent, and starting from the three categories of analysis of the work, represented in Table 3 below, the relationships between categories were established to the extent of a matrix composed by 27 rules. Of course, diverse combinations of the above give different intermediate results between the possible extremes presented in the model, forming different interpretations about the opportunistic actions of the agents[2]. The scale of measurement adopted for the test used values [0,1] for a domain expressed in (10) centimeters, allowing the measurement of the degree of opportunism of the agents based on the research.

Reliability: Low			
	Precaution		
References	***Low***	***Medium***	***Alta***
Good	Low	Medium	High
Medium	Medium	Medium	High
Bad	High	Very High	Very High
Reliability: Medium			
	Precaution		
References	***Low***	***Medium***	***High***
Good	Low	Medium	Medium
Medium	Medium	Medium	Medium
Bad	Medium	Medium	High
Reliability: High			
	Precaution		
References	***Low***	***Medium***	***High***
Good	Very Low	Very Low	Low
Medium	Low	Medium	Medium
Bad	Low	Medium	High

Table 2: Categories of analysis and fuzzy rules / controller

Source: Author's elaboration.

The answers obtained, in the range of 0 to 10, were submitted to the different degrees (*valor atribuído*) of pertinence (*pertinência*) for the elaboration of the fuzzy analysis. The parameters adopted for the sets related to the analysis categories, that is, the fuzzy descriptive system, obeyed the structure below. In it, the parameters for fuzzyfication are arranged in the trapezoidal function, that is, with four parameters determined[3]. The choice

[2]Considering the three variables and their consequent combinations (3 ^ 3), 27 rules were generated. The distribution of the combinations is as follows: Very Low: 2 cases; Low: 5 cases; Average: 13 cases; High: 5 cases and Very High: 2 cases.

[3]In fact, although the parameters of low and medium conditions use three parameters in their composition (left ramp and right ramp), the graphical result matches with trapezoidal functions. In order to insert the input variables into the model (In Fuzzy software) the four variables (a, b, c, d) cannot have decreasing values in their order, that is, a <b <c <d (POSSELT, 2014).

of the trapezoidal function was due, above all, to the fact that a range of values may assume a unitary degree of "truth", that is, with pertinence equals 1.

Posselt (2014, p 30) properly characterizes this peculiarity of the function: one of the characteristics of a trapezoidal function is the fact that a range of values assume the possibility of 100% veracity. Below the parameters used in the model:

Reliability, References and Precaution (0 to 10 assigned values)
Low - Left Ramp (0, 3, 4.5)
Medium- Trapezium (3, 4.5, 5.5, 7)
High - Right Ramp (5, 5, 7, 10)

Figure 5 illustrates the parameters used for the Reliability category. Considering the equal importance attributed to the study variables, the other categories have the same distribution. Thus, the input variables "References" and "Caution" were operationalized in the same way.

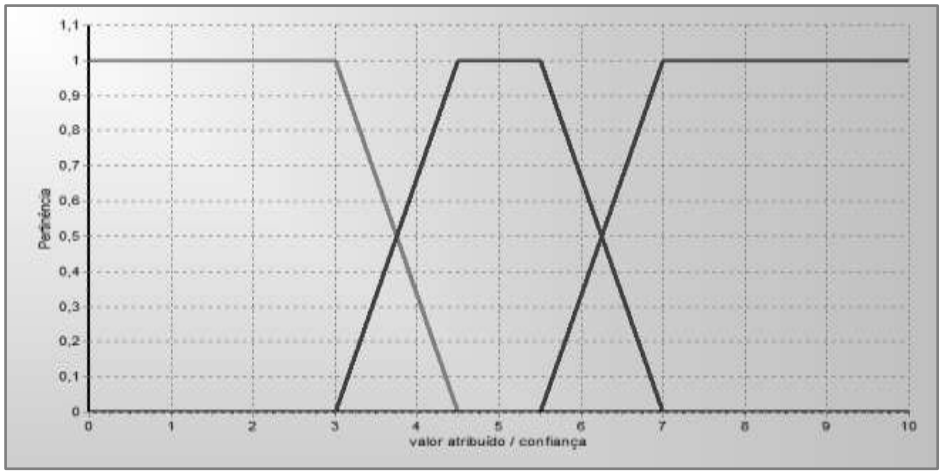

Figure 5: Parameters used in the analysis categories - Fuzzy Descriptive System.
Source: Research data.

Regarding the output variable of the model, that is, at the level of opportunistic behavior detected, the following parameters were adopted:

Opportunistic behavior (0 to 10 assigned values)
Very low - Left Ramp (0, 1,5, 2,5)
Low- Trapezium (1.5, 2.5, 3.5, 4.5)
Medium- Trapezoid (3.5, 4.5, 5.5, 6.5)
High- Trapezium (5.5, 6.5, 7.5, 8.5)
Very high - Ramp Right (7.5, 8.5, 10)

Figure 6 graphically shows the descriptive system of the variable output.

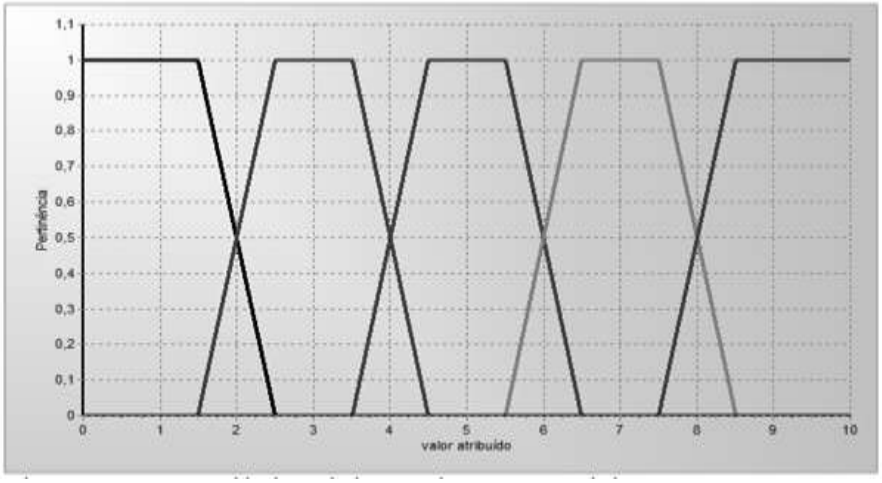

Figure 6: Parameters used in the analysis categories - Fuzzy Descriptive System
Source: Research data.

The operationalization of these rules differs for each research question (input) and is enhanced by the use of computational tools. In addition, controllers can assume complementarities of the type "IF (x) AND (z), THEN (w)". For a range of responses from 0 to 10, in a universe U, assuming 0 (low opportunism) and 1 (high opportunism), the composition of the membership function becomes the center of the analysis. The quantitative data analysis procedure was based on the use of InFuzzy Software, developed by the University of Santa Cruz (UNISC) and filed at the National Institute of Industrial Property (INPI).

III. RESULTS

3.1. Case 1: Swine breeding

The study of the contractual relationship established between JBS and rural producers points to a partnership system, with formal contracts drafted in these terms. The contract has full characteristics of a relational contract. The data obtained by the fuzzy model scale are presented below. In them, the perception of agroindustry agents about the opportunistic behavior of rural producers is interpreted through the analysis categories of the study. Interviews conducted with food processing agents (PA) demonstrate the values assigned to each category of analysis, the fuzzy outputs generated in the defuzzification and, finally, the interpretation of the results in terms of opportunistic behavior.

Table 3: Values Assigned To Different Categories Of Analysis - JBS (Case-Fuzzy)

Type	Reliability	References	Precaution	*Fuzzy outputs*	Opportunistic Behavior
PA 1	*9,30*	*9,70*	*8,10*	*3,000*	*Low*
	9,50	*4,60*	*8,30*	*5,000*	*Medium*
PA 2	*8,50*	*8,20*	*10,00*	*3,000*	*Low*
	8,90	*1,80*	*9,20*	*7,000*	*High*

Source: primary research data.

The data allows us to observe the existence of opportunistic behavior in the fullness of records. The minimum classification is "low" opportunism, with "medium" and "high". There is, therefore, no occurrence of "very low" levels in the data set, which would imply assuming their non-existence - given the center of gravity used. In the first two data sequences (PA 1), the interviewee presents indexes that generate outputs between low and medium opportunism. In the second set of data (PA 2), the sequences range from low to high. Figure 7 illustrates the lower fuzzy output, "low" opportunism.

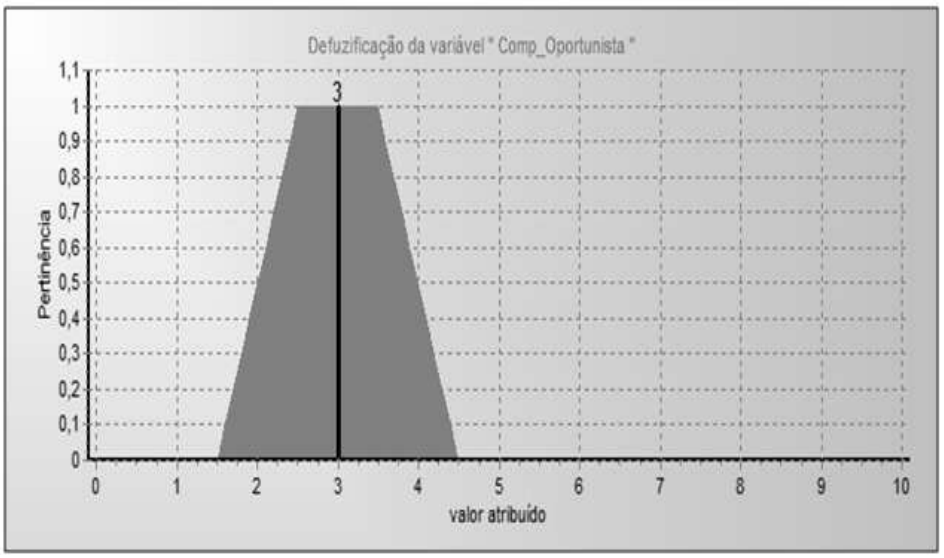

Figure 7: Fuzzy set: PA Swine - minor output

Source: survey data.

The high behavior (exit 7,000), found in one of the sequences, rivals another sequence obtained with the same interviewee (exit 3,000). Figure 8 shows the graphic resolution found for the largest output.

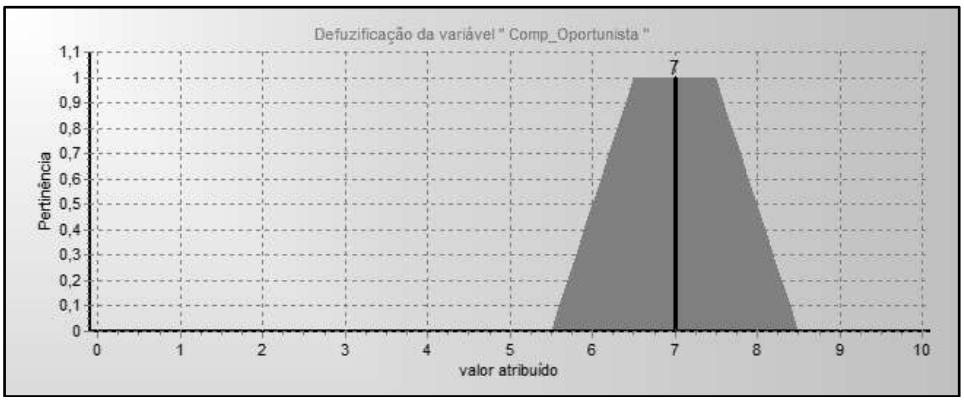

Figure 8: Fuzzy set: PA Swine - larger output.

Source: survey data.

The level of producer confidence is notably high. Precautionary actions are also characterized in the operations performed by JBS. The "references" category, on the other hand, varies between the sequences of responses. This data arrangement generated different fuzzy inferences for the case, although the "low" opportunism option is present in the indication of both respondents (first data sequence of each PA). Even with these variations, it is possible to conclude that there are opportunistic practices on the part of the pig farmers. As discussed in the next section, this practice becomes more potent when analyzed for agribusiness behavior. Results of the fuzzy analysis for rural producers are below.

Table 4: Values attributed to the different categories of analysis - JBS integrated rural farmer's view (case-fuzzy)

Type	Reliability	References	Precaution	Fuzzy Outputs	Opportunistic Behavior
PR 1	*4,70*	*0,30*	*0,20*	*5,000*	*Medium*
	6,60	*0,10*	*0,30*	*3,574*	*Low*
PR 2	*1,70*	*2,00*	*8,30*	*9,005*	*Very High*
	8,20	*1,30*	*4,10*	*4,426*	*Medium*
PR 3	*2,30*	*5,00*	*2,70*	*5,000*	*Medium*
	5,60	*5,70*	*8,30*	*4,835*	*Medium*
PR 4	*8,60*	*7,70*	*0,60*	*0,995*	*Very High*
	6,20	*7,80*	*0,20*	*2,165*	*Low*
PR 5	*6,60*	*5,50*	*9,00*	*5,000*	*Medium*
	6,60	*2,30*	*7,60*	*7,000*	*High*

Source: primary research data.

With the exception of one of the respondents (PR 2), the other respondents presented consistent answers to each other following questions applied. "Very low" opportunistic behavior was obtained only in one of the PR 4 producer sequences. With the exception of the PR 4 record, it is observed that the view that the pig farmers have of JBS is linked to the presence of opportunistic practices. Figure 9 shows the graphical resolution of the largest fuzzy output obtained in the study.

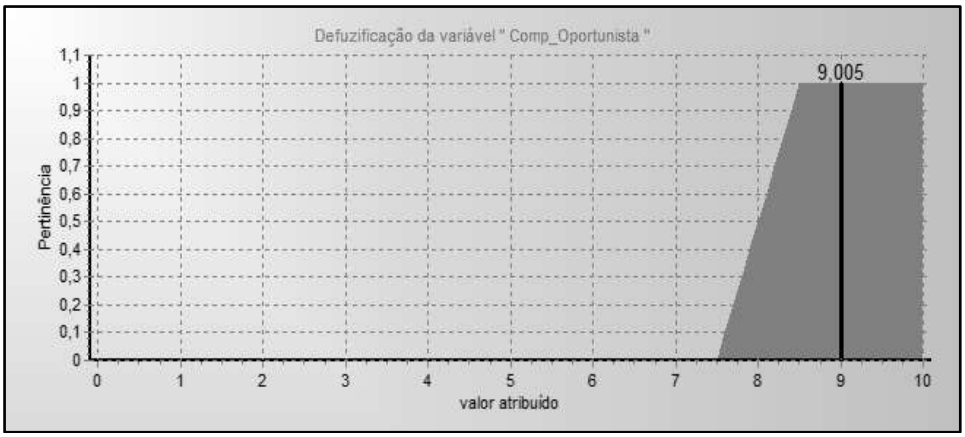

Figure 9: Fuzzy set: PR Swine - larger output.

Source: survey data.

Figure 10 shows one of the smallest outputs of the data relationship, guided by the expression "low". Producer PR 4, in this case (2,165), expresses his high confidence in the agroindustry, the high indexes of references he has and the low importance given to the adoption of safeguards.

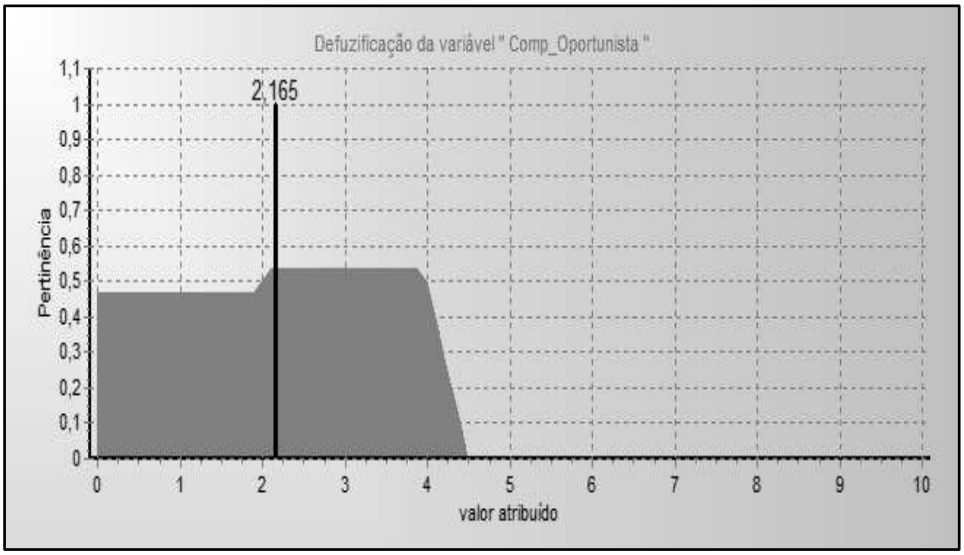

Figure 10: Fuzzy set: PR Swine - second sequence with smaller output.
Source: survey data.

Of the ten outputs generated, in the different sequences, the classification of "medium" opportunistic behavior prevails, with five registers. Thus, the following distribution could be observed about the opportunistic behavior of JBS: seven sequences between "medium" and "very high" versus only three below "medium". The results indicated here are more expressive in terms of opportunism than those obtained by the analysis of agroindustry.

3.2. Case 2: rice cultivation

The contract established in the purchase and sale transaction of rice - whether made directly with the industry, or through a brokerage firm, presents minimal elements of formality. Its central characteristics denounce a classic contract. The scale of the fuzzy model, based on the data collected, established the fuzzy outputs indicated in Table 5. The opportunistic behavior of the rice producers is very low.

Table 5: Values assigned to the different categories of analysis - view of the food processor Josapar (case-fuzzy)

Type	Reliability	References	Precaution	Fuzzy Outputs	Opportunistic Behavior
PA 1	*10,00*	*10,00*	*0,80*	*0,995*	*Very Low*
	10,00	*9,60*	*3,40*	*1,051*	*Very Low*
PA 2	*10,00*	*8,90*	*0,30*	*0,995*	*Very Low*
	10,00	*9,70*	*0,20*	*0,995*	*Very Low*

Source: primary research data.

High levels of confidence, positive references and low levels of precaution indicate, through fuzzy analysis, very low results in terms of opportunistic behavior. The graphical representation of Figure 11 shows the fuzzy set obtained for the first data sequence, from the interpretation of the food processor.

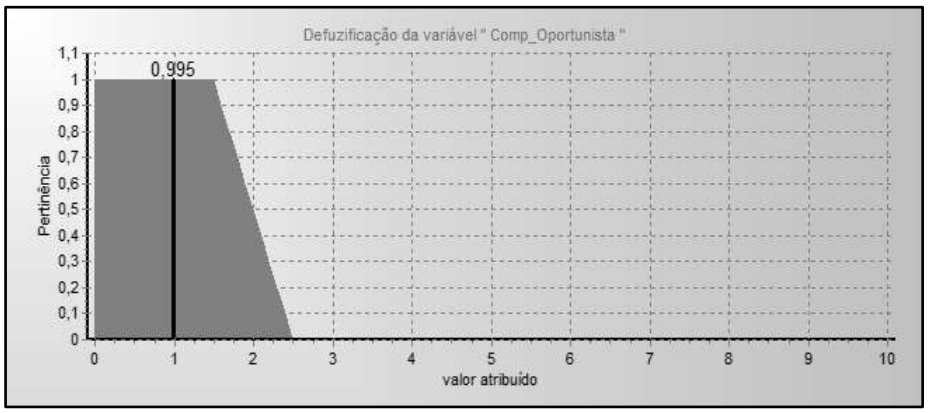

Figure 11: Fuzzy set: PA Rice - first data sequence
Source: survey data.

The centroid defuzzification resulted in a very low level of opportunistic behavior. Thus, it suggests that, in the view of the food processor, the rural producer does not present significant opportunistic behavior. A very similar result can be observed in the following figure, where the producer's opportunistic behavior is again evaluated by the food processor.

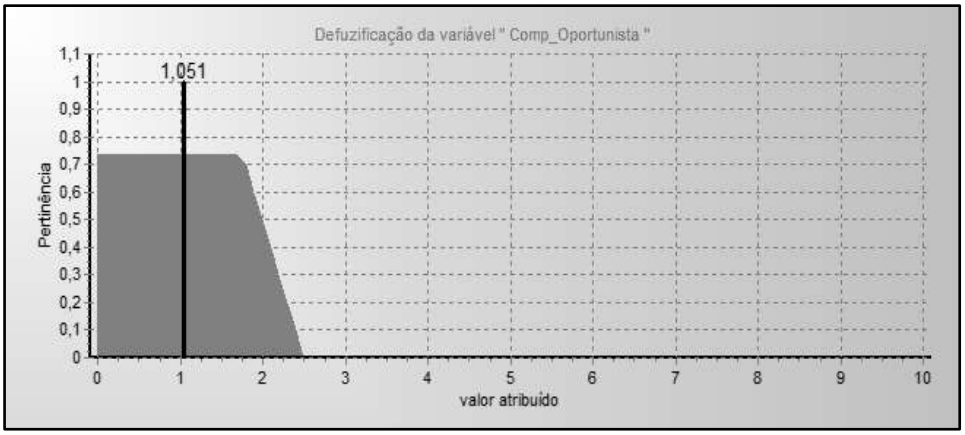

Figure 12: Fuzzy set: PA Rice - second data sequence
Source: survey data.

It can be seen, therefore, that the data obtained in the industry are uniform and indicative of a very slight tendency towards opportunism on the part of the rice farmers who negotiate with it. Similarly, as elucidated in the following section, producers' perceptions exempt the industry from opportunistic actions that may be supported by analysis. Results of the fuzzy analysis are given below in Table 6. The records reveal the vision of the five rural producers (PR) interviewed, in different data sequences.

Table 6: Values assigned to different categories of analysis - rural farmer's view (case-fuzzy)

Type	Reliability	References	Precaution	Fuzzy Outputs	Opportunistic Behavior
PR 1	9,00	9,00	0,10	0,995	Very Low
	9,00	9,00	1,90	0,995	Very Low
PR 2	10,00	10,00	0,00	0,995	Very Low
	10,00	10,00	0,00	0,995	Very Low
PR 3	10,00	10,00	0,00	0,995	Very Low
	10,00	10,00	3,10	1,009	Very Low
PR 4	10,00	10,00	0,00	0,995	Very Low
	10,00	10,00	0,00	0,995	Very Low
PR 5	**10,00**	**10,00**	**0,70**	**0,995**	**Very Low**
	10,00	**10,00**	**1,20**	**0,995**	**Very Low**

Source: primary research data.

The classification obtained in the analysis of the data is - for all the interviewees and in different sequences, of a very low opportunistic behavior. Thus, rice farmers consider that the Josapar industry is reliable.

In addition, they have good references of the company and do not adopt expressive safeguards when doing business with her. Figure 11 below illustrates the centroid fuzzy set of 0.995.

3.3. Case 3: tobacco farming

The complexity of the production scenario is reinforced in the existence of formal agreements between producers and industries. Specifically regarding the integration contract conducted with the JTI - the particular object of this research - it is possible to perceive a high degree of formality that tries to sustain the relationship as a system of partnership. Thus, at least in the contractual-formal context, the integrated production system is characterized. From the different sequences obtained, it is possible to observe fuzzy outputs that vary between low and medium opportunistic behavior.

Table 7: Values assigned to the different categories of analysis - food processor view (case-fuzzy)

Type	Reliability	References	Precaution	Fuzzy Output	Opportunistic behavior
PA 1	7,50	7,10	10,00	3,000	Low
	7,50	6,00	9,00	4,300	Medium
PA 2	5,30	6,00	9,10	5,000	Medium
	7,70	6,30	6,20	3,014	Low

Source: primary research data.

The data demonstrate broad synchrony. The amplitude of fuzzy outputs determines levels of opportunistic behavior present between low and medium. A small increase in fuzzy results was observed in the interviewed PA 2 when the first data sequence was compared. In the second sequence of questions, the tendency is reversed, with fuzzy outputs of 4,300 in PA 1 and 3,014 in PA 2. Although the perception of the interviewees indicates the presence of opportunistic practices due to the contractual counterpart, it is not possible to suggest a high behavior to the tobacco farmers (maximum 5,000). Within the categories, it is possible to see that the JTI managers demonstrate trustworthiness in the integrated ones. With the exception of the first sequence of responses of PA 2 (5.3), all other responses assumed values above 7.50. The same can be observed regarding the references that they have of their integrated ones, since no answer was less than 6,00 in the used scale. Finally, numerical elevation is observed when the category of precaution is analyzed.
The fuzzy result of the first data sequence is represented graphically by Figure 13 below.

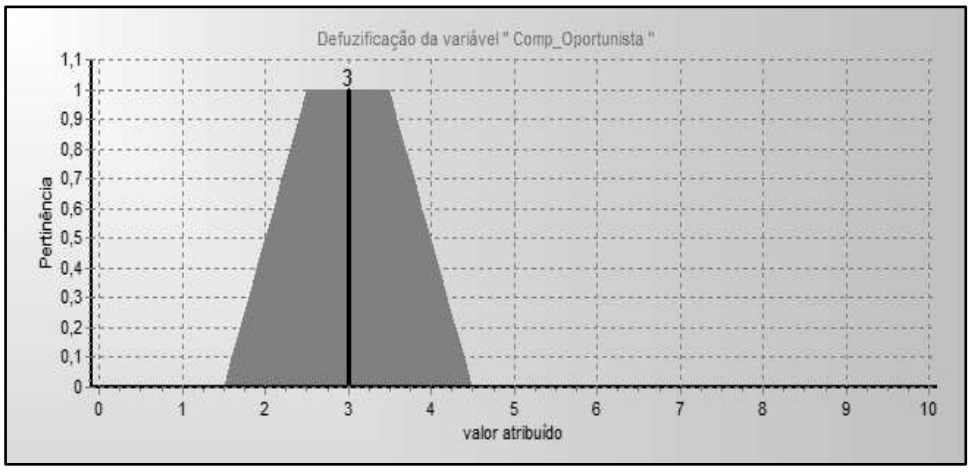

Figure 13: Fuzzy set: PA Smoke - first data sequence and smaller fuzzy output
Source: survey data.

Defuzzyfication points to a low level of opportunistic behavior, with output of 3,000 in the first data sequence. Figure 14 below demonstrates an intermediate level for the result set, with 4,300 on the defuzzification for the second PA 1 sequence.

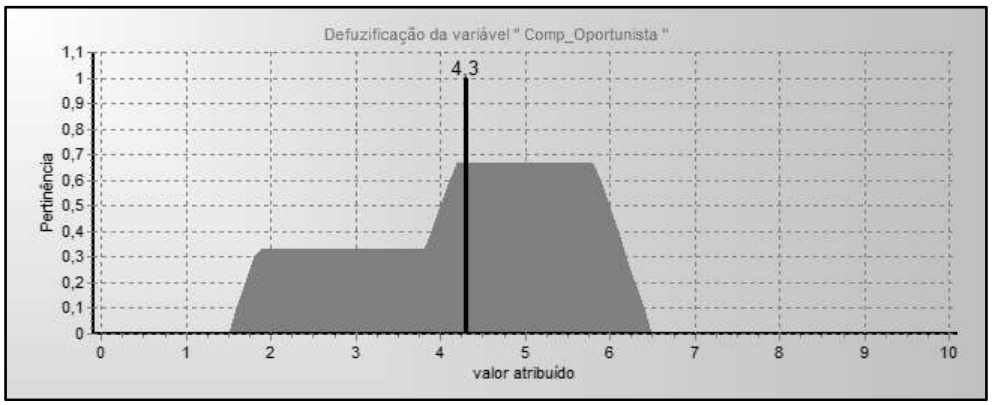

Figure 14: Fuzzy set: PA Smoke - second data sequence

Source: survey data.

More expressive defuzzification results appear in the analysis of sequences obtained from the second interviewee (PA 2). In it, the opportunist behavior of the tobacco farmers assumes fuzzy output value of exactly 5,000, that is, medium opportunistic behavior. Figure 15 graphically shows the result.

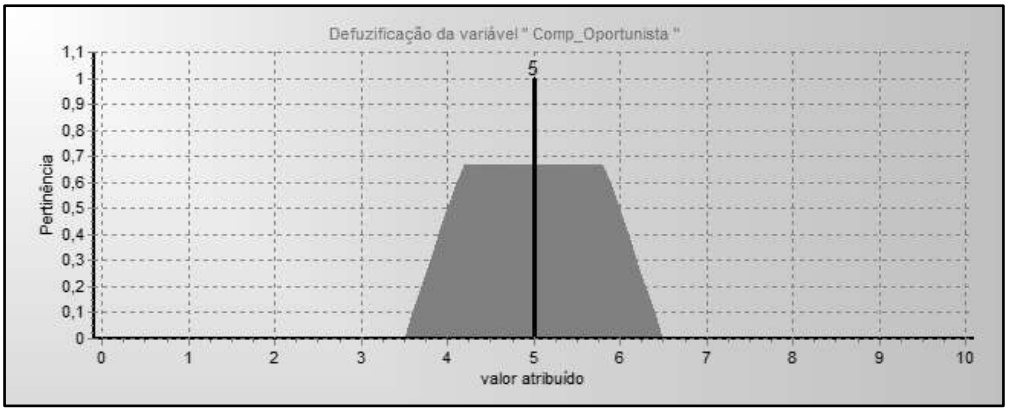

Figure 15: Fuzzy set: PA Smoke - third data sequence

Source: survey data.

Finally, a value of 3.014 obtained in the defuzzification of the fourth sequence points to a low opportunistic behavior on the part of the tobacco producers integrated to JTI. Figure 16 shows the result showing the second lowest output of the data set obtained with the field survey.

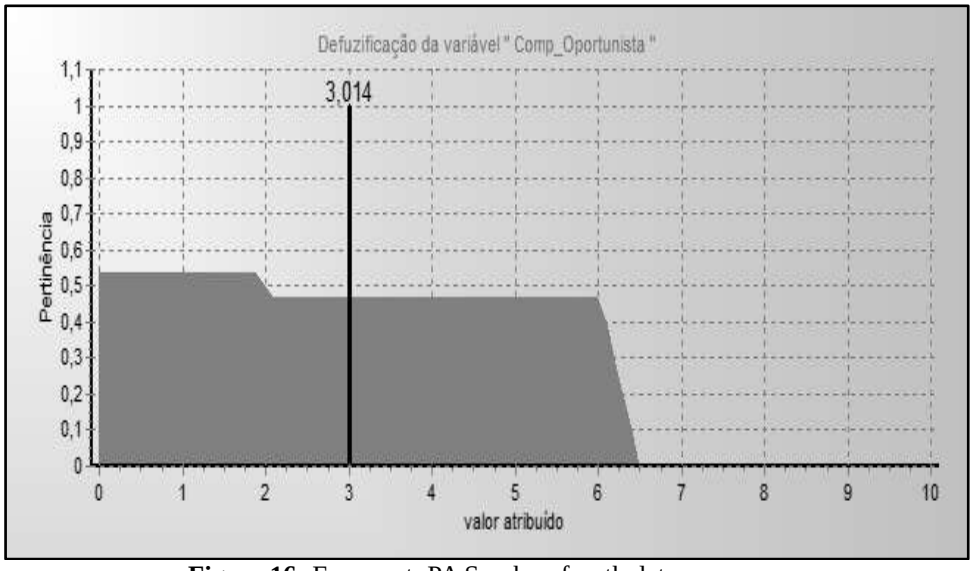

Figure 16: Fuzzy set: PA Smoke - fourth data sequence

Source: survey data.

The presence of opportunistic practices on the part of the local smokers is verified in the fuzzy analysis. The empirical results regarding the perception that the integrated tobacco producers have of JTI's performance are recorded in Table 8. In terms of frequency, of the ten observed records, the following distribution was generated: in one of the cases the opportunistic behavior of JTI is considered very high. For five sequences of responses, it is average. In the other four records they are low.

Table 8: Values assigned to different categories of analysis - rural farmer's view (fuzzy-case)

Type	Reliability	References	Precaution	Fuzzy Outputs	Oportunistic behavior
PR 1	3,40	0,90	9,80	8,371	Very High
	6,30	7,90	6,10	3,015	Low
PR 2	5,10	5,60	6,20	5,000	Medium
	8,20	9,90	8,10	3,000	Low
PR 3	8,20	8,10	8,90	3,000	Low
	9,90	7,00	7,70	3,000	Low
PR 4	5,50	6,00	7,40	5,000	Medium
	5,00	5,00	3,10	5,000	Medium
PR 5	4,30	5,10	8,10	5,306	Medium
	6,00	5,00	9,10	5,000	Medium

Source: primary research data.

The case concerning producer PR 1, in its first sequence, departs from the set. In that set of responses, the low confidence levels and references add to the high importance given to precaution, which results in an exit of 8.371. The fuzzy output represented in Figure 17 illustrates the fuzzy set and its defuzzification.

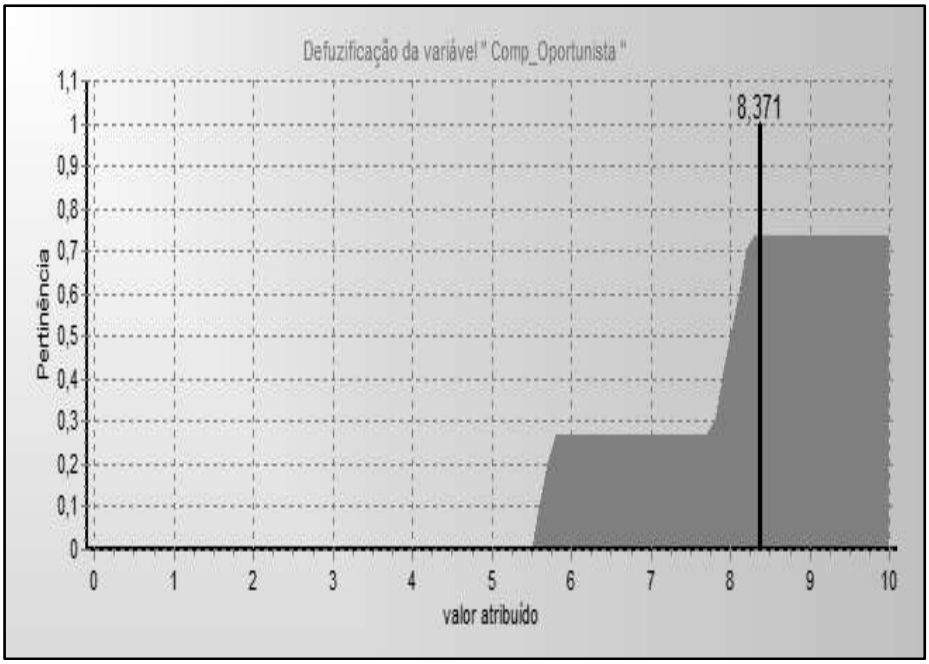

Figure 19: Fuzzy set: PR Smoke - greater output

Source: survey data.

For the same interviewee, in a second series of questions, the perception reveals itself as of low opportunistic behavior, according to Figure 18.

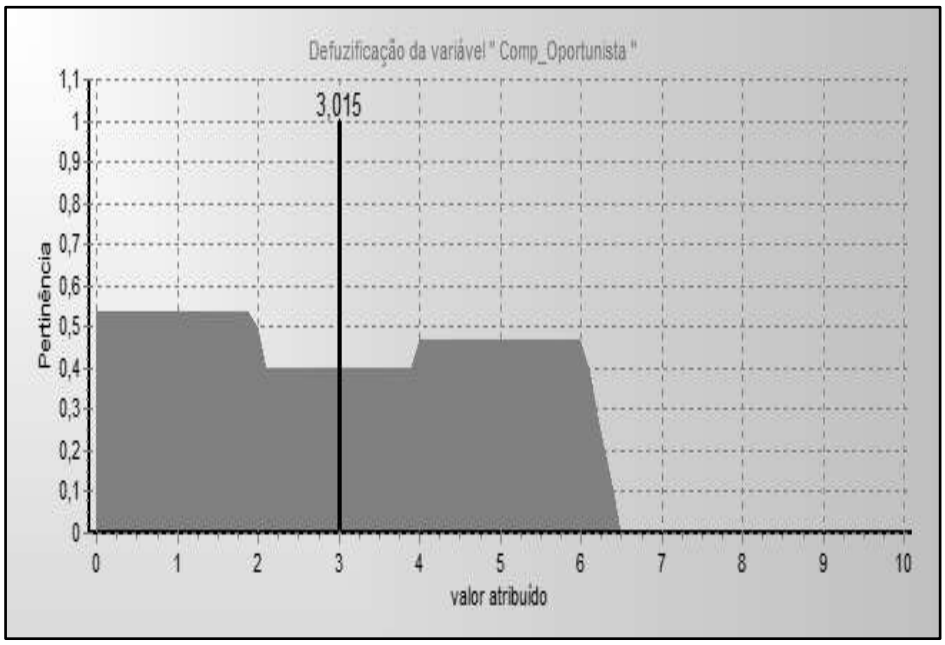

Figure 18: Fuzzy set: PR Smoke - lower output of PR 1
Source: survey data.

In the other registers, the conceptions are more regular, with results that vary between low (fuzzy outputs of 3,000) and medium (fuzzy outputs of 5,000). For the latter group, only in the first sequence of PR 5 a slight variation is observed, resulting in a fuzzy output of 5.306, as shown in Figure 19 below.

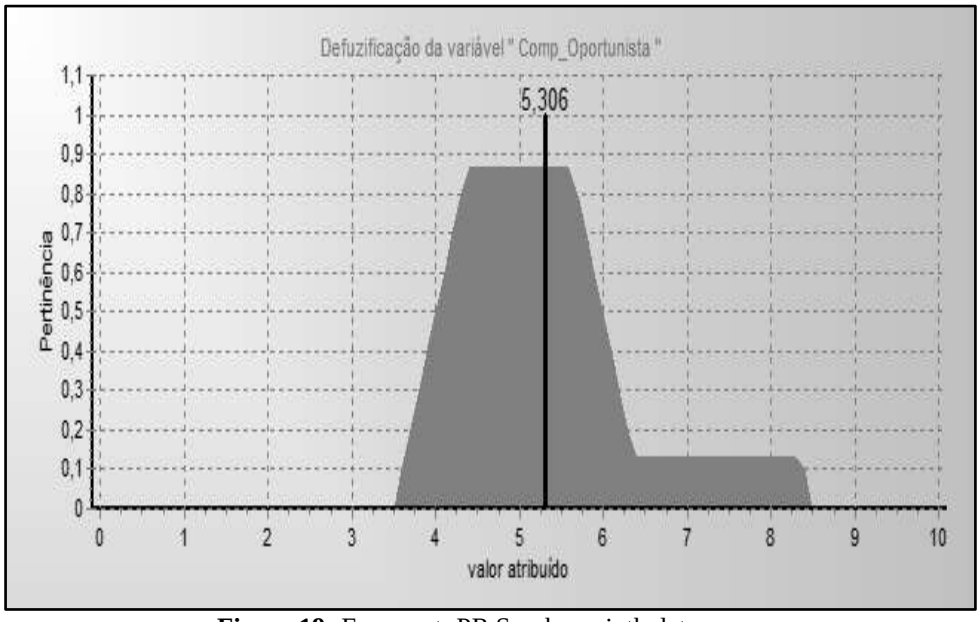

Figure 19: Fuzzy set: PR Smoke - ninth data sequence
Source: survey data.

The perception of the members about the level of opportunism present in the JTI conduct is registered predominantly between the low and middle levels. In a way, the data are equivalent to those obtained from JTI.

IV. CONCLUSION

The analysis of the results showed that, when compared to the contractual typology offered in the scope of the New Institutional Economy, they present elements of conformity with such models, as shown in Figure 20.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Specificity of Assets</td></tr>
<tr><td>Absent/Low</td><td>Medium</td><td>High</td></tr>
<tr><td rowspan="2">Frequency</td><td>Occasional</td><td rowspan="2">• Rice

(Classical contracts area)</td><td colspan="2">(Neoclassical Trilateral contracts area)

Tobacco •</td></tr>
<tr><td>Recurrent</td><td colspan="2">(Relational Bilateral contracts area)

Swines •</td></tr>
</table>

Figure 20: Contractual typology: classification of agroindustrial contracts by the Williamsian view of efficient governance.
Source: Adapted from Williamson (1985, 2012).

Contracts analyzed in the rice industry are characterized by having only an occasional frequency of transactions, with absence of specific assets in relationship. In opposition to these characteristics, swine integration contracts register high frequency and high level of specific assets in relationship. In tobacco integration contracts, an average level of specific investments in relationships added to a low frequency - characterizing the agreement as a neoclassical contract. It should be noted that this conclusion is due to two conditions: (a) the results obtained in the field work and (b) the relative constitution of each contract. In the latter case, both frequency and asset specificity were evaluated in relation to the set, that is, each case in relation to the others - given the manifest inexistence of a formal metric for both attributes.

The central objective of the study, to empirically test the behavioral assumption of opportunism against the results obtained under the analyzed contracts, was reached. Opportunism is a phenomenon verified, therefore, in different agroindustrial contracts. As a result, contracting does not represent a fully sufficient resource to resolve opportunism in productive agreements, even when the notion of efficient governance is considered. In addition to the occurrence of opportunistic actions, the empirical results indicate that the structural elements of each contractual type converge to condition the agents' behavior. Thus, the observed opportunistic practices differ in their occurrence and intensity, especially when the contractual model distances itself from the classical contracting. Transactions characterized by uncertainty, frequency and specificity of assets generate greater contractual formality, however, increasing the scope for opportunistic actions - given the inherent contractual incompleteness they face and the wide range of clauses they create. A dilemma between hiring and opportunism is thus evident.

Consistent with the previously highlighted dilemma, contracts regulated by the spot market are, therefore, less affected by the phenomenon of opportunism. Although different opportunistic actions are possible in such contracts, an analysis conducted solely from the NEI framework does not allow for diverse conclusions - since research categories impose severe analytical constraints. This characteristic of NEI is due to its analytical rigidity, especially as to the typological sense that it tries to sustain in its theoretical models.

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