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Voluntary transfers from the brazilian federal government: a perspective from applicants

Transferências voluntárias do governo federal brasileiro: uma perspectiva dos proponentes

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Abstract

The objective of this study is to analyze, from the perspective of the proposers, the characteristics of proposals for public agreements within the framework of the Federal Government's Voluntary Transfers. A total of 50,470 records from TED No. 939993/2022 were examined using text mining techniques in R. Sentiment analysis indicated low confidence among applicants, revealing frustration regarding the effectiveness of investments, particularly in infrastructure and rural quality of life.

Keywords: agribusiness; farmer; federal government; public-private.

Resumo

Esta pesquisa tem por objetivo analisar, sob a perspectiva dos proponentes, as características das propostas de convênios públicos no âmbito das Transferências Voluntárias da União. Foram examinados 50.470 registros da TED nº 939993/2022 por meio de técnicas de mineração de texto em R. A análise de sentimentos indicou baixa confiança dos solicitantes, evidenciando frustração quanto à efetividade dos investimentos, sobretudo em infraestrutura e qualidade de vida rural.

Palavras-chave: agronegócio; fazenda; governo federal; público-privada.

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1. Introduction

Recently, Brazil has emerged as a prominent example of increased agricultural investment driving economic growth. In 2020, the total volume of agribusiness, encompassing sales of inputs, trade, services, and production, accounted for 26.7% of Brazil's Gross Domestic Product (GDP). Specifically, the volume of agricultural production alone represented approximately 7% of GDP (Cruz; Medina; Oliveira Júnior, 2022).

The surge in Brazilian agricultural enterprises can be attributed to various factors, including the availability of land, technological advancements, environmental policies encouraging the expansion of the agricultural frontier, government support for rural modernization through subsidized credit, and political support. However, establishing this conducive environment hinges on a fundamental prerequisite: investment (Corcioli; Medina; Arrais, 2022).

This research focuses on investments in the agricultural sector via voluntary transfers from the Brazilian federal government (VTFG) allocated through public agreements signed with the Ministry of Agriculture (MAPA). The study examines public agreements resulting from successful applications submitted to MAPA by states and municipalities. A comprehensive review of empirical studies was conducted to assess the gap in the literature addressing the VTFG. Publications on this topic are practically non-existent in relevant international journals, which is why this article focused on Brazilian studies.

This article seeks to fill a gap in the literature. It analyzes the data for a more extended period than most previous studies. Although the work by Soares and Melo (2016) covers an even longer period (fifteen years), this research stands out since it not only examines data produced for many years (fourteen) but also covers a more recent period (ending in 2022). Most studies focus on exploratory bibliographic and documentary analyses.

However, the study by Luz et al. (2022) employed a different methodology, using multivariate analysis for panel data. Additionally, unlike the majority of studies, the study by Lui and Miquelino (2023) conducted a descriptive statistical analysis of the data.

This article contributes to the literature by introducing a methodology not yet utilized in studies involving VTFG: text mining, topic modeling, and sentiment analysis. These approaches extract valuable, previously unknown knowledge from textual data, revealing implicit information from unstructured texts and presenting it explicitly. They encompass advanced techniques for extracting high-quality, structured information from unstructured textual data (Ramon-Gonen; Dori; Shelly, 2023).

Another issue is that studies involving VTFG always focus their analyses on the downstream direction of resources granted through public agreements. This study

innovates by analyzing the upstream direction of these resources and observing the successful applicant's perspective, i.e., the viewpoint of those closest to the farmers who can identify the needs in a decentralized manner.

Therefore, this study adopts an approach still unexplored in the literature on voluntary transfers, examining the public agreements signed by MAPA to allocate resources of VTFG, emphasizing the perspective of applicants who entered into these agreements with MAPA.

More specifically, the unit of analysis consists of the textual information provided by the proposing entities during the preparation of the agreements, including municipalities, states, and other eligible organizations. Thus, the study does not directly assess the perceptions of the final beneficiaries of these policies, such as farmers and rural communities, but rather investigates how their demands, needs, and expected outcomes are represented by the proponents responsible for submitting the proposals. The research analyzes public agreements by considering five elements: their objects, the target audiences, expected results, the problems addressed, and the overall coherence and potential effectiveness of the agreements' activities in relation to their objects.

While absent in the literature on VTFG, understanding the applicants' perspective is essential for formulating effective public policies and strategically allocating financial resources to promote the equitable development of agribusiness in Brazil. The findings obtained in such an investigation represent an advancement in the scientific literature on resources from public agreements signed by MAPA.

This article contributes to scholarly understanding by offering structured insights into public agreements signed by MAPA allocating VTFG. These transfers provide the resources to support the development of small and medium-sized agribusinesses. The findings elucidate existing information and are expected to advance knowledge in the field, paving the way for new perspectives and insights. They offer a coherent overview of the status of the public agreements, contributing to ongoing advancements in the sector.

In contrast to prior research, this article furnishes agribusiness professionals and policymakers with current insights into the successful applicants' demands responded to by public agreements allocating resources from voluntary transfers.

2. Literature review

2.1 Voluntary transfers from the brazilian federal government

Investment plays a pivotal role in elucidating the economic success attained by Brazilian agribusiness. Grasping the mechanisms that support sustained investment is crucial

for envisioning the future trajectory of agribusiness, fostering a fairer market dynamic between major corporate entities and family farmers. Consequently, public policies geared toward fostering research, providing equipment, and subsidizing the production of small-scale farmers are imperative (Corcioli; Medina; Arrais, 2022).

In Brazil, the MAPA is pivotal in fostering agribusiness's sustainable development while ensuring its products' safety and competitiveness (Camargo; Soares, 2021). Within MAPA's organizational framework, the Secretariat of Innovation, Rural Development and Irrigation (SDI) actively engages in enhancing the innovation landscape within the agricultural sector. To fulfill this role, SDI invests in technological and operational innovation to optimize its own workforce and operational efficiency (Camargo, 2022).

Investment in Brazilian agribusiness has emerged as a cornerstone of its continued growth and prosperity. As one of the nation's most critical economic sectors, the Brazilian agricultural industry generates employment opportunities and significantly contributes to the country's GDP. Nonetheless, the enduring challenge lies in maintaining equitable investment between major agribusiness corporations and family farmers, an endeavor in which the role of MAPA is crucial.

MAPA employs various approaches in this context, one of which involves public agreements. These agreements are instruments signed by a government agency or non-governmental organization with another allied entity, documenting financial resource allocation (Corrêa; Camargo, 2024). A comprehensive understanding of financial resource allocation via public agreements is paramount for the agricultural sector. This knowledge is instrumental in formulating effective public policies and strategically allocating resources to promote equitable development across the agribusiness landscape in Brazil.

The public agreement governs the transfer of financial resources from the federal government and is formulated based on applications submitted by state, district, or municipal governmental agencies (Lopes; Almassy Junior, 2023).These applicants may include entities of direct or indirect public administration, public consortia comprising governmental agencies, and private non-profit organizations with the legal status of "civil society organizations" (OSCs).

The primary objective of the agreements analyzed in this study is to streamline the acquisition of machinery and equipment inputs intended for agricultural development. This collaboration is forged under a regime of mutual cooperation, aiming to fulfill the common interests of the involved parties (Corrêa; Camargo, 2024).

In Brazil, family farmers frequently face challenges competing in the market (Silva; Gazolla; Oliveira, 2022), due to their constrained access to production equipment and infrastructure, resulting in a decline in market share compared to larger agricultural hubs (Carvalho; Gomes, 2022). In this scenario, grants acquired through public agreements play

a crucial role in enabling these small farms to boost productivity and reaffirm their significance. It is important to note that despite the small scale of each farm, Brazilian family farming collectively accounts for a substantial portion, representing 84.4% (4.4 million properties) of rural communities in the country (Berchin et al., 2019).

In practice, when a municipality requires financial resources to acquire agricultural equipment like tractors, sowing machines, or harvesters to stimulate agribusiness and drive regional development, it can apply to MAPA requesting support through an agreement. Applicants and MAPA share common interests, and engaging in public agreements to execute targeted actions proves instrumental in achieving shared objectives.

Voluntary transfers from the Brazilian federal government play a pivotal role in disbursing resources allocated through agreements facilitating the implementation of government policies to address local communities' needs. By providing resources to these farmers, the competitiveness of family farmers can be significantly enhanced. Given this context, there is a critical need for a deeper understanding of the demands from applications seeking access to resources via public agreements in the agricultural sector across diverse regions of the country.

3. Material and methods

3.1 Data source

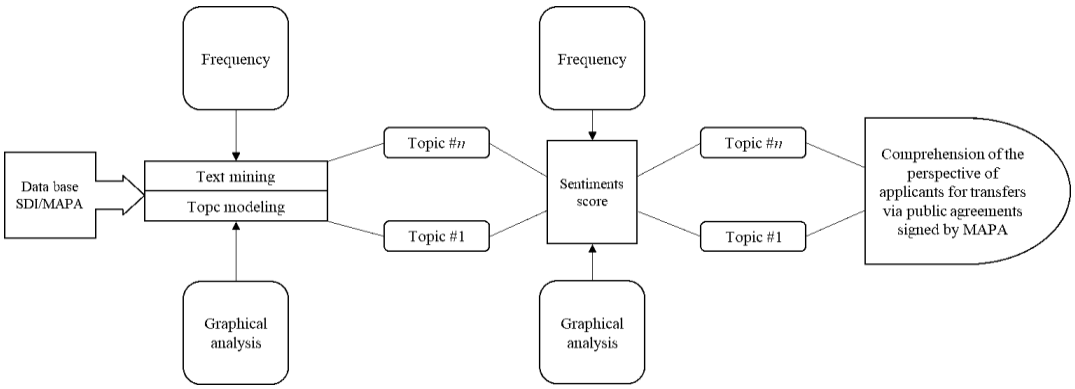
Choosing appropriate sources is paramount when conducting text mining (Moro et al., 2023). With this in mind, the research used primary data from the internal control database of the SDI, which had information about public agreements signed by the MAPA allocating VTFG to municipalities. The data were made available following the formalization of TED number 939993/2022, signed between SDI/MAPA.

The dataset consists of 10,098 observations detailing the contents of the analyzed public agreements. The observations covered five distinct elements used in the analysis of these documents, i.e., their object, the target audience, expected results, the problem addressed, and the overall coherence and potential effectiveness of the agreements' activities in relation to their objectives. Thus, a total of 50,470 excerpts referring to the five elements were extracted using text mining packages in R software.

It is important to note that these records correspond to administrative texts prepared by the proposing entities during the agreement application process. Therefore, the analysis reflects how demands, priorities, and expected outcomes are formally described by proponents and should not be interpreted as direct evidence of the perceptions or opinions of the final beneficiaries of these policies.

The study primarily focused on analyzing the descriptions of these five elements and required preprocessing and standardizing the information from the database. The analysis spanned the period from 2008 to 2022, facilitating a comprehensive examination of the regions in Brazil with the highest incidence of voluntary transfers from the Federal Government under the purview of MAPA. Justifying the adoption of an automated analysis approach, it significantly reduces the time required for manual reading and mitigates the subjectivity inherent in manual analysis. Figure 1 illustrates the procedure adopted by the study.

Figure 1: Flowchart of the research process



Source: Adapted from Moro et al. (2023).

In summary, the strategy employed in this study offers two significant advantages over manual analysis: impartiality and scalability. Impartiality involves mitigating biases inherent in human judgment when categorizing content, often necessitating multiple expert assessments to address ambiguities. Scalability refers to the procedure's capability to be replicated directly in larger samples without requiring additional human intervention (Moro et al., 2023).

3.2 Approach: text mining

Prior to the analytical procedures, the textual corpus underwent a preprocessing stage designed to improve data quality and reduce noise. This process included the removal of punctuation marks, numbers, special characters, and stop words, as well as the standardization of terms through lowercase conversion. Subsequently, the texts were tokenized and organized into a structured document-term matrix suitable for text mining procedures. These steps aimed to ensure consistency in word representation and improve the quality of topic identification and sentiment extraction.

The frequency and occurrence of specific terms or word combinations commonly associated with the researched topic were tracked (Ramos; Rita; Moro, 2019). Text mining aims to automatically and efficiently identify and analyze valuable insights or patterns in

unstructured text, providing an understanding of underlying meanings and associated implications. This facilitates knowledge exploration, uncovering previously elusive discoveries (Wang et al., 2024).

Text mining converts unstructured natural text into structured language for a database, enabling statistical analysis. This technique offers a replicable and verifiable approach, allowing researchers to analyze large-scale documents and make inferences about the dynamics and characteristics of a specific field. Techniques such as word frequency, point centrality, co-word, and word cluster analysis play prominent roles in text mining (Song et al., 2023).

The use of pre-defined textual structures relevant to the topic addresses the limitation of an indiscriminate search for all words. Moreover, words can be combined in continuous sequences commonly known as "n-grams", representing meaningful expressions that condense an expanded semantic value compared to single words. However, the subjectivity involved in determining which terms are pertinent to a given subject poses significant challenges, as a poorly defined conceptual model can distort subsequent analysis. This challenge can be mitigated by relying on expert opinion (Moro et al., 2023).

Due to the absence of a consensus in the literature regarding the objects purchased within the scope of public agreements signed with MAPA, this study adopts the methodology outlined by Ramos, Rita and Moro (2019). This methodology involves the creation of a panel of three independent experts. These experts were selected based on their involvement in MAPA research projects related to VTFG and were granted autonomy to analyze the text and reaching a consensus about the data to be examined in the topic modeling and sentiment analysis.

3.3 Approach: topic modeling

Topic modeling was performed using the Latent Dirichlet Allocation (LDA) algorithm. The procedure aimed to identify latent thematic structures based on word co-occurrence patterns within the corpus. Different topic solutions were initially evaluated and compared according to their interpretability and thematic coherence. The four-topic solution was selected because it provided a balance between analytical parsimony and the ability to distinguish substantively meaningful thematic groups within the agreements.

Topic modeling stands as an advanced statistical natural language processing method utilized in text analysis. It operates as an unsupervised machine learning technique capable of scrutinizing extensive collections of documents to pinpoint sets of words that frequently co-occur, associating them with a specific topic (Moro et al., 2023). Widely employed, it efficiently summarizes information from large masses of text (Kang et al., 2024).

Topic modeling is instrumental in comprehending and analyzing the nature of

complex issues. Its utilization in the social sciences has increased due to its capacity to provide deeper insights into vast datasets spanning extended periods (Ahmed; Khan, 2022). Among the plethora of algorithms accessible for topic modeling, the widely recognized Latent Dirichlet Allocation (LDA) was selected for this study based on its insightful outcomes in textual analysis, as highlighted by Correia, Moro and Rita (2022).

Unlike traditional methods, which often necessitate manual categorization or extensive human intervention, Blei, Ng and Jordan's (2003) LDA efficiently infers implicit information from unstructured text data, uncovering potential topics. Extensive research has recognized the reliability of LDA, with its application spanning diverse areas exploring scientific topics and trends (Yu; Fang; Xu, 2023). Selecting LDA is particularly suitable when document subject areas tend to converge on a central theme. Although determining values for parameters such as alpha, beta, and the number of topics is required in the settings of topic modeling analysis, establishing these values can pose a challenge. This challenge is mitigated by employing the coherence coefficient, which aids in identifying the optimal number of topics and the associated keywords for each topic (Lee; Han, 2023).

According to the study conducted by Correia, Moro and Rita (2022), the text mining process involved several sequential steps facilitated by a script for advanced text processing, encompassing cleaning, lemmatization, and topic modeling procedures using LDA. The development of the process was divided into the following stages:

1. The software relies on the following R libraries, which need to be installed and loaded beforehand: data.table, tm, tokenizers, udpipe, digest, ldatuning, text2vec, and matrix.
2. Data Import and Processing: Data is imported from an Excel spreadsheet and converted to a data.table for efficient manipulation. The text undergoes cleaning and normalization, including the removal of punctuation, numbers, and extra spaces, conversion to lowercase, elimination of common words (stopwords), and tokenization to prepare the texts for stemming.
3. Lemmatization: The udpipe model for Portuguese lemmatization is employed. A hash-based cache system enhances performance by avoiding redundant processing of already lemmatized words.
4. Creation of Corpus and Document-Term Matrix (DTM): The corpus is formed from the processed text, which is then transformed into a DTM, a numerical representation suitable for topic modeling.
5. LDA Topic Modeling: The LDA model is trained with varying numbers of topics, typically ranging from 3 to 10, to uncover the latent structure of the data. Evaluation metrics such as log-likelihood, Akaike Information Criterion (AIC),

and Bayesian Information Criterion (BIC) are computed to assist in selecting the optimal number of topics.

3.4 Approach: sentiment analysis

Sentiment analysis, also known as opinion mining or polarity classification, aims to analyze and categorize text into sentiments with specific polarity or emotions using various approaches (Zammarchi; Mola; Conversano, 2023). Following the methodology outlined by Smith and Cipolli (2022), the sentiment analysis consisted of five sequential steps:

- Environment configuration: Initially, we set up the environment of the development in R. This measure involved defining the working directory and loading the necessary libraries for data manipulation (data.table), sentiment analysis (syuzhet), parallel computing (parallel), and data visualization (ggplot2, fmsb). Additionally, RColorBrewer was employed to select an appropriate color palette for data visualization. Subsequently, the NRC Word-Emotion Association Lexicon, specifically adapted for the Portuguese language, was utilized to gather sentiments across categories such as anger, anticipation, disgust, fear, joy, sadness, surprise, trust, negative, and positive.
- Exploratory Data Analysis (EDA) for Sentiments: The EDA required loading the processed data and elaborating a short analysis, examining metrics such as minimum, mean, median, maximum, standard deviation, and coefficient of variation of sentiments by topic. The data was then pivoted and appropriately grouped for summary statistics.
- Normalization and Preparation for Visualization: The sentiment data underwent normalization to ensure comparability across different sentiments. For each sentiment, normalization was applied, centering around the minimum and scaling by the maximum of the observed data. Subsequently, the normalized data was reformatted for graphical presentation.
- Data Visualizations: Bar charts and boxplots were generated to visualize feeling distribution by topic. The data was tested for significant differences in feeling between topics using a non-parametric statistical test, which was appropriate given that the data did not meet the assumptions of ANOVA. When performing multiple tests, a Bonferroni correction adjustment was applied to control type I error.
- Radar Chart: The radar chart was constructed by calculating the maximum, minimum, and median values per topic. These statistics were then utilized to illustrate the median feeling for each topic, facilitating a direct comparison between them. The resulting graphs were saved in high-resolution PDF format

using the ggsave function.

The interpretation of the results was conducted in two complementary stages. First, the most representative terms associated with each topic were analyzed to identify the substantive content of the thematic structures. Second, the sentiment profiles associated with each topic were examined to characterize the language patterns present in the administrative records. Importantly, the sentiment analysis was interpreted as a property of the textual corpus and the institutional narratives contained in the proposals, rather than as direct evidence of the subjective perceptions of farmers or final beneficiaries.

4. Results and discussion

The initial stage involved structuring the data collected from the SDI, which pertained to the information contained within the public agreements signed by the MAPA. When accessing the SDI/MAPA database, the information contained in the following fields was selected:

- object of agreement: It is the item the municipality requested in the agreement, for example, plow, compactor, heavy harrows, mower, scale, cultivator, winch, sealer, mixer, decanter, washer, silo, pump, distributor, chainsaw, tank, truck, baler, pasteurizer, tractor, weeder, filling machine, mincer, crusher, cart, bulldozer, planer, vehicle, wagon, extractor, planter, truck body, plow harrow, backhoe loader, harvester; hydraulic grid plow, brush cutter;
- target audience: Refers to the public ultimately served by the activities and the objective of the public agreement; these actors may be farmers, rural workers, family farming, rural settlements, local markets, and consumers of agricultural products;
- problem to be solved: The purpose for which the object was chosen and the needs of the target audience, for example, fostering production, improving conditions, enhancing product and service quality, upgrading infrastructure, increasing income, reducing costs, improving quality of life, streamlining management, curbing rural exodus, providing worker training, and generating employment opportunities;
- expected results: Upon achieving the agreement's objectives, it is anticipated that the applicant will overcome challenges such as low productivity, high costs, imprecise operations, limited equipment availability, inadequate road infrastructure, poor soil quality, diminished competitiveness, unsustainable practices, water scarcity, inefficient production, outdated machinery, lack of mechanization, and technological deficiencies;

- coherence between agreement and the object: The public agreement's activities are coherent with the object it claims to address. This includes alignment regarding, for example, location, concern over environmental preservation, development of the local economy, local social gains, modernization of activities, farmers' education, and agricultural security.

4.1 Topic modeling

Topic modeling was applied to the entire dataset to comprehensively understand the prevalent themes and components across the agreements signed with MAPA. This analysis aimed to offer both a homogenized and heterogenized understanding of the agreement requests. Figures 2-5 visually represent this information. The resulting topics suggested that the agreement requests could be categorized into four distinct themes. Both quantitative and qualitative analyses were conducted to determine the optimal number of topics in the LDA model. Initially, models ranging from 3 to 10 topics were evaluated using statistical metrics such as log-likelihood, AIC, and BIC (Zammarchi; Mola; Conversano, 2023). Table 1 provides detailed results.

Table 1: Metrics for determining the number of topics

Topic	Log-likelihood	AIC	BIC
3	-5738919	11687952	12446473
4	-5584712	11382256	12150589
5	-5438995	11093539	11871685
6	-5342586	10903441	11691398
7	-5239129	10699244	11497013
8	-5157894	10539492	11347074
9	-5053749	10333920	11151314
10	-5013898	10256936	11084142

Source: Research data. Prepared by the authors (2025).

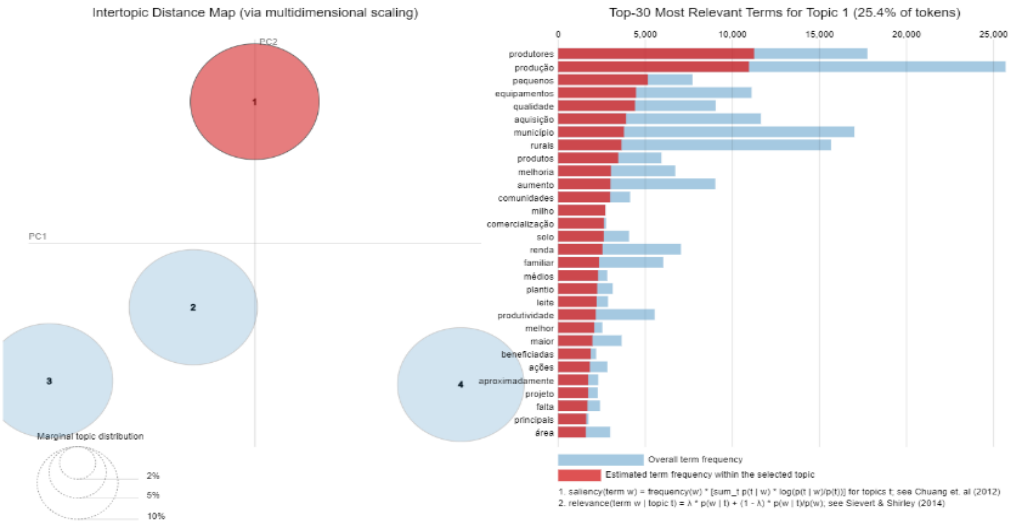
This visual examination revealed the presence of four distinct and well-defined clusters without significant overlap. However, this characteristic was not maintained for models with 5 to 10 topics, where considerable overlap between clusters was observed. Thus, while quantitative metrics may advocate for models with fewer topics, qualitative analysis and the clarity in distinguishing clusters indicate a preference for a four-topic structure as the most interpretable and informative. The decision to opt for four topics aligns with the principle of parsimony, emphasizing simplicity and clarity in modeling. Consequently, a final model with four topics was chosen to strike a balance between statistical precision, interpretability, and simplicity.

Topic 1 focuses on issues related to marketing, encompassing public agreements

targeted at commercializing agricultural products on a small and medium scale. Examples include agreements concerning the cultivation and marketing of corn and the production and sale of milk. Figure 2 provides a detailed illustration of the characteristics associated with Topic 1. It is worth noting that the database adopted was built in Brazilian Portuguese. Therefore, some terms in Figures 2, 3, 4, and 5 are displayed in this language. This measure aims to preserve the linguistic coherence between the database and the text mining representations.

Figure 2 illustrates that Topic 1 occupies the upper end of the multidimensional scale map, distanced from the other topics, with its characteristics predominantly linked to production and commercialization issues. When examining the 30 most relevant words associated with this topic, "farmers" and "production" emerge prominently. However, the blue line notably intersects with the red line, indicating a strong interaction between these words and other topics, thereby blurring their association with Topic 1.

Figure 2: Multidimensional map and relevant terms of Topic 1



Source: Research data. Prepared by the authors (2025).

The words most strongly associated with Topic 1 include "small", "products", "communities", "corn", "commercialization" and "medium". These terms characterize the focus of Topic 1 on marketing issues, signifying agreements intended to address the farmers' marketing needs, with funds primarily allocated to enhance their product trading process. Small and medium-sized farmers need support in trading their products, which may encompass investments in vehicles such as trucks, tractors, specialized machinery for production flow, communication channels with demanding markets, and investments in raw materials acquisition.

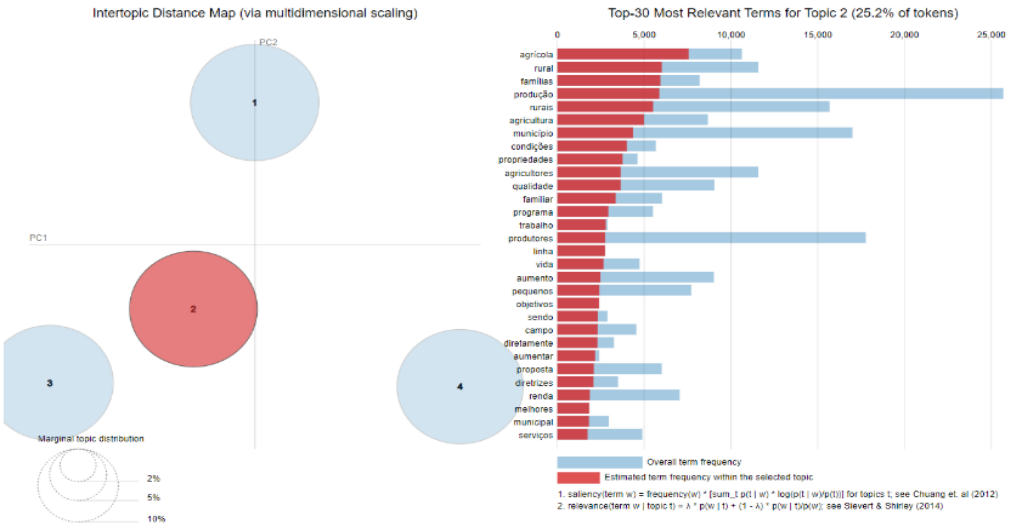
The findings of the study by Lui and Miquelino (2023) corroborate the

characteristics attributed to Topic 1. The authors highlight significant increases in resources allocated to areas such as acquiring tractors and machinery and participating in market fairs throughout the historical series examined in their research. They also assert that financing policies targeted at small-scale farmers strongly encourage the acquisition of this equipment.

Topic 2, as depicted in Figure 3, pertains to public agreements aimed at enhancing the conditions of the farms and the rural workers' labor environments, and overall quality of life. When examining the position of Topic 2 on the multidimensional scale, it is clear that it occupies the bottom of the map, situated closest to the center, indicating its high degree of interaction with other topics. Consequently, its primary characteristic pertains to public agreements, as elucidated by Knorek, Rocha and Sczminski (2015), who assert that public policies often stem from grassroots demands.

In a democratic state committed to social welfare, governmental agencies discern the populace's primary needs and respond directly to these demands. Typically, state interventions manifest through policies aimed at ameliorating living conditions or resolving visible challenges that remain unaddressed by the market or the community. All four topics examined in this study demonstrate social objectives inherent to their characteristics. However, Topic 2 emerges as the most directed towards this purpose, focusing primarily on addressing social issues within its agreement requests.

Figure 3: Multidimensional map and relevant terms of Topic 2



Source: Research data. Prepared by the authors (2025).

The keywords emblematic of this topic, distinct from others, include "agricultural", "rural", "families", "agriculture", "conditions", "properties", "work", "better", and "increase". Prioritizing conditions of the properties and enhancing the quality of life for farmers should

be paramount considerations in all public-private partnerships and governmental policies entailing local financial investment. Thus, agreements are invaluable legal mechanisms for fostering social development, facilitating collaboration between governmental agencies, and actualizing citizens' constitutional rights (Hachem, 2013).

Topic 3, depicted in Figure 4, centers on agricultural issues, specifically family farming, machinery utilization, promotional strategies, and support mechanisms designed to strengthen the families. The words that stand out, characterizing Topic 3, are: "farmers", "agricultural", "development", "activities", "family", "sector", "machines", "promotion", "agriculture", "support", "local", "inputs" and "incentive". Topic 3 occupies the bottom left quadrant of the multidimensional map and closely interacts with Topic 2, indicating its pronounced social orientation and emphasis on family farming within its agreement requests.

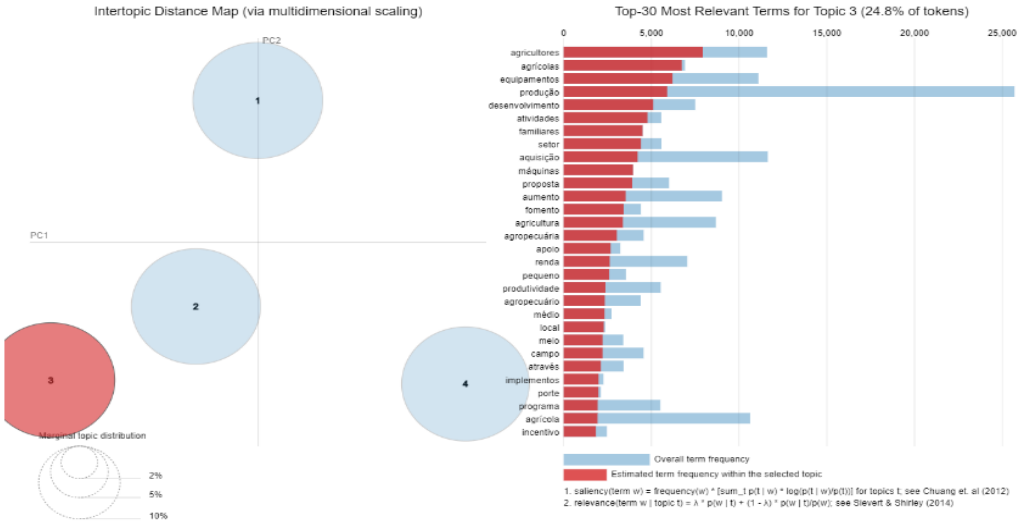
The primary characteristic of this topic revolves around family farming, a concept that, according to Cordeiro et al. (2023), lacks consensus in the literature. However, the Food and Agriculture Organization of the United Nations (FAO) High-Level Panel of Experts on Food Security and Nutrition defines family farming as predominantly comprising small farmers. However, classifications may vary based on local and regional factors when designating a rural property as a family farm.

The research conducted by Knorek, Rocha and Sczíminski (2015) illustrates the practical implementation of VTFG in the context of family farming. Through their study, the authors highlight two specific territories that received voluntary transfers to support initiatives to stimulate economic growth, safeguard rights, enhance citizenship, and upgrade infrastructure to foster the development of family farming and the respective territory.

Topic 3 underscores the significance of family farming as a focal point in public agreements, as elucidated by Cordeiro et al. (2023). Family farming conscientiously utilizes scarce resources to generate agricultural income that often exceeds the family organization's costs. In Brazil, family farming plays a pivotal role in producing food for the population's consumption, encompassing small farmers, traditional communities, agrarian reform settlers, foresters, aquaculturists, extractivists, and fishermen.

However, the lack of financial or material resources, whether due to inadequate credit supply or the absence/deficiencies of public policies, imposes significant constraints on the operational capacity of modern family farming and, particularly, its ability to remain competitive in an increasingly aggressive and demanding market (Cordeiro et al., 2023).

Figure 4: Multidimensional map and relevant terms of Topic 3



Source: Research data. Prepared by the authors (2025).

Finally, in Topic 4, as depicted in Figure 5, public agreements are forged to secure road enhancements, access routes, production flow, machinery and infrastructure maintenance, vehicle rehabilitation, and logistical structure improvements. In Figure 5, the predominant word is “roads”, which is exclusively associated with Topic 4.

Other noteworthy terms characterizing this topic include “drainage”, “vicinal”, “maintenance”, “population”, “transport”, “power”, “equipment” and “access”, among others. Topic 4 occupies the lower right quadrant of the multidimensional map, which concentrates on the issues related to machinery maintenance and logistical and infrastructural concerns.

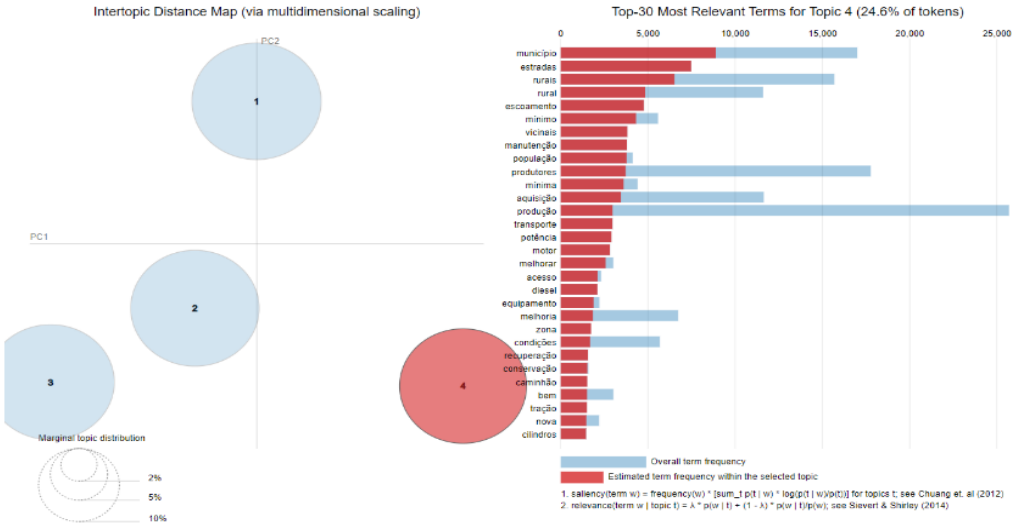
Aligned with the findings depicted in Figure 5, the research conducted by Soares and Melo (2016) reveals a significant concentration of VTFG allocated to city capitals, which is expected given the higher demand for infrastructure and greater technical capabilities to execute agreements in these areas. In essence, the greater the number of VTFG in metropolitan regions, the larger the need for investment in infrastructure (Soares; Melo, 2016).

Knorek, Rocha and Sczminski (2015) delved into the infrastructure needs of family farming for territorial development, emphasizing how VTFG serves as a supportive model for agricultural production, facilitating the economic inclusion of actors, particularly family farmer cooperatives.

According to Bijos (2018), VTFG emerged as a strategic funding mechanism. Therefore, it is understandable that mayors seek additional resources from federal and state agencies to invest and cover capital expenditures, including road paving, acquisition of vehicles and ambulances, agricultural machinery, healthcare equipment, and infrastructure

and sanitation projects.

Figure 5: Multidimensional map and relevant terms of Topic 4



Source: Research data. Prepared by the authors (2025).

The findings highlighted by Lui and Miquelino (2023) provide valuable insights into the features of Topic 4. The authors underscore a notable surge in resource allocation across sectors such as market fairs, agricultural defense, equipment, and local roads over the study period (2008 to 2021), a trend that aligns with the observations in this research.

Lui and Miquelino (2023) emphasize that public agreements aimed at equipping farms and maintaining local roads involve allocating resources to local agencies to procure machinery, such as tractors and backhoes (Lui; Miquelino, 2023).

4.2 Sentiment analysis

According to Fadhli, Hlaoua and Omri (2023), a wealth of research on sentiment analysis and emotion recognition indicates a complex area extensively explored in the literature. In addition to capturing positive and negative sentiments, this lexicon enables the evaluation of terms associated with eight basic emotions: four negative emotions (anger, disgust, fear, and sadness) and four positive emotions (anticipation, joy, surprise, and trust) (Zammarchi; Mola; Conversano, 2023).

- Positive: The data shows that positive sentiments prevail across all topics, with higher averages compared to negative sentiments, indicating an overall positivity in the analyzed data. However, there is a relatively high coefficient of variation, particularly in topic 1, suggesting substantial variation in responses.
- Negative: While the average negative sentiment is notably lower than the

positive sentiments, it remains significant. The standard deviation is considerable, indicating considerable variation in the intensity of negative feelings.

- Joy and Anticipation: These emotions exhibit relatively high averages, indicating commonly expressed sentiments. As indicated by the coefficient of variation, the variation is moderate, suggesting a reasonable consistency in expressing these emotions.
- Anger, Disgust, Fear, Sadness, Surprise: These sentiments have lower averages compared to sentiments of joy, anticipation, positive, and negative. Surprise has the lowest coefficient of variation overall, suggesting consistency in expressing this sentiment among respondents.

Table 2 presents statistical information derived from sentiment analysis of the collected data, providing insights into its behavioral patterns. Table 2 illustrates that the standard deviation across all sentiments and topics is relatively high, implying a wide dispersion in individual responses. This indicates that while general trends can be identified, there is significant variation in individual experiences or perceptions.

Particularly for sentiments with low averages, such as disgust and surprise, the coefficient of variation is relatively high. This could be attributed to these emotions being less common or more extreme, possibly influenced by outliers. Since all available data (population) is used, the result is conclusive, and no statistical test is necessary to identify the differences between groups.

Following topic identification, sentiment analysis was conducted to characterize the emotional content associated with each topic. The procedure relied on a sentiment lexicon that classifies words according to categories such as anger, anticipation, disgust, fear, joy, sadness, surprise, trust, positive sentiment, and negative sentiment. Sentiment scores were aggregated for each topic, allowing comparisons of the prevalence and intensity of sentiment-related expressions across thematic groups.

Table 2: Statistics of sentiment analysis for each topic

Topic	Sentiment	Min	Average	Median	Max	Stand dev	Coeff var
1	anger	0	2.2194	2	10	1.502814	1.47683
1	anticipation	0	2.929066	3	11	1.831134	1.599591
1	disgust	0	1.65061	2	7	1.194459	1.38189
1	fear	0	2.163972	2	10	1.538237	1.406787
1	joy	0	3.382382	3	16	2.144132	1.577507
1	negative	0	5.458924	5	21	3.050436	1.789555

1	positive	0	13.383042	13	32	5.418349	2.469948
1	sadness	0	2.598482	3	13	1.714658	1.515453
1	surprise	0	1.326955	1	6	1.158266	1.145639
1	trust	0	7.483339	7	23	3.348262	2.234992
2	anger	0	2.06612	2	10	1.453637	1.421345
2	anticipation	0	3.106612	3	10	1.74882	1.776405
2	disgust	0	1.613532	1	6	1.242537	1.298578
2	fear	0	2.550999	2	8	1.657412	1.539147
2	joy	0	3.861609	4	13	1.997772	1.932958
2	negative	0	5.711943	5	18	3.182815	1.79462
2	positive	1	13.913378	14	31	4.63268	3.003311
2	sadness	0	2.550487	2	9	1.799541	1.417299
2	surprise	0	1.296258	1	7	1.08575	1.193883
2	trust	0	7.6694	7	21	3.007833	2.549809
3	anger	0	2.528131	2	9	1.631406	1.549663
3	anticipation	0	3.319873	3	10	1.825264	1.818845
3	disgust	0	1.584846	1	7	1.266406	1.251452
3	fear	0	2.729129	3	9	1.734969	1.573013
3	joy	0	3.517695	3	17	2.039811	1.72452
3	negative	0	5.992287	6	20	3.546902	1.689443
3	positive	2	13.861162	14	32	5.056176	2.741432
3	sadness	0	3.121597	3	13	1.939321	1.609634
3	surprise	0	1.167877	1	7	1.100465	1.061257
3	trust	1	7.563521	8	20	3.193851	2.368151
4	anger	0	2.03228	2	8	1.555452	1.306553
4	anticipation	0	2.969437	3	12	1.936672	1.533268
4	disgust	0	1.374313	1	8	1.220741	1.125802
4	fear	0	2.239354	2	11	1.715427	1.305421
4	joy	0	3.106113	3	15	1.969731	1.576923
4	negative	0	4.892514	4	21	3.220477	1.519189
4	positive	0	12.386676	12	31	5.220214	2.372829
4	sadness	0	2.500343	2	11	1.889056	1.323594
4	surprise	0	1.211195	1	7	1.142405	1.060215
4	trust	0	6.416896	6	18	3.091854	2.07542

Source: Prepared by the authors (2025).

Furthermore, the analysis of Table 2 leads to the conclusion that Topic 1 exhibits the highest averages for both positive and negative sentiments, suggesting that this topic may be polarizing or elicit strong emotional reactions. Topic 2 displays a minimum positive

sentiment score of 1, making it the only topic where positive sentiment does not start at 0. This could indicate a generally positive trend or a lack of response neutrality.

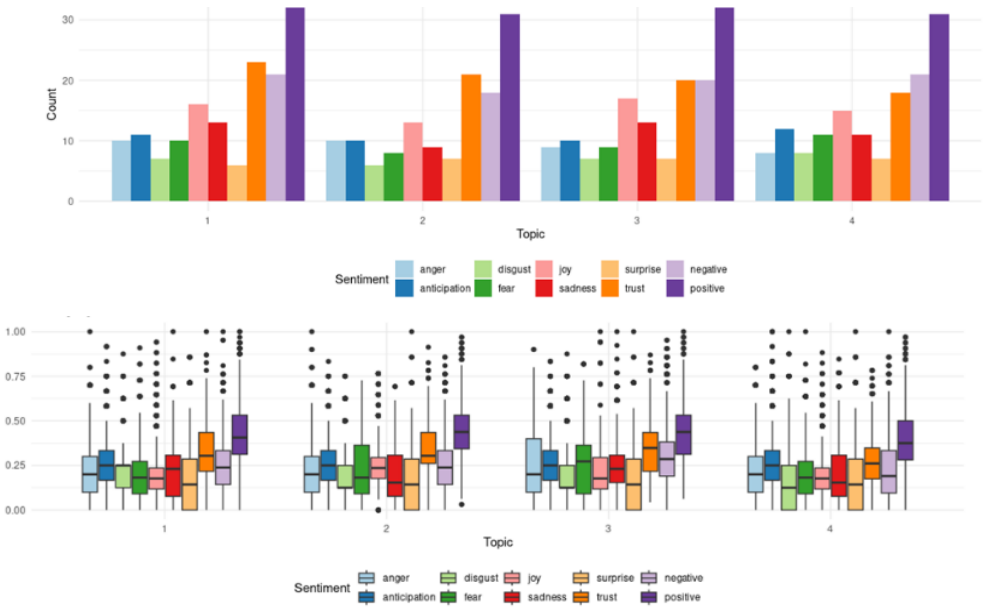
Topic 3 demonstrates a relatively high average for sadness compared to the other topics, hinting at potentially darker or emotionally heavier content. Lastly, Topic 4 has the lowest average for negative emotions, implying that it is the least polarizing or least likely to provoke negative reactions compared to the other topics.

4.3 Analysis by topic

Each topic was analyzed and characterized according to the sentiment analysis results. Figure 6 presents the emotional profile of the topics, helping to understand the motivating emotion behind each topic.

Figure 6 depicts the distribution of sentiment scores across the four identified topics. Higher median values indicate a stronger association between a given sentiment and the textual content assigned to each topic. The figure allows a comparative assessment of the sentiment profiles associated with the thematic structures identified through topic modeling.

Figure 6: Sentiment analysis by topic



Source: Research data. Prepared by the authors (2025).

Figure 6 depicts the distribution of sentiment scores across the four identified topics. Higher median values indicate a stronger association between a given sentiment and the textual content assigned to each topic. Topic 1 exhibits relatively high anticipation, joy, and trust levels, indicating that these sentiments are more frequently represented in the

corresponding administrative narratives.

Lastly, Topic 4 displays the highest levels of anger and negativity, implying potentially conflicting or problematic content. Additionally, anticipation and trust are notable in this topic, possibly indicating a proactive or defiant attitude toward the negative issues identified. In comparison, each topic unveils a distinct emotional landscape, reflecting the complexity and variety of content and elements covered.

Figure 6 also illustrates that Topic 1 exhibits a more concentrated distribution of positive sentiments, such as joy and trust, with fewer outliers, indicating a consistent optimistic tone. Outliers in sentiments such as anger and fear suggest sporadic episodes of more negative content or tension. The presence of outliers across several sentiment distributions deserves particular attention. Because the dataset consists of administrative descriptions prepared by different proposing entities, extreme values may reflect specific proposals emphasizing particular local challenges or priorities. Rather than being treated solely as statistical anomalies, these observations may indicate the existence of highly differentiated territorial demands that are not fully captured by average sentiment measures. Therefore, the outliers reinforce the heterogeneity of the proposals included in the database.

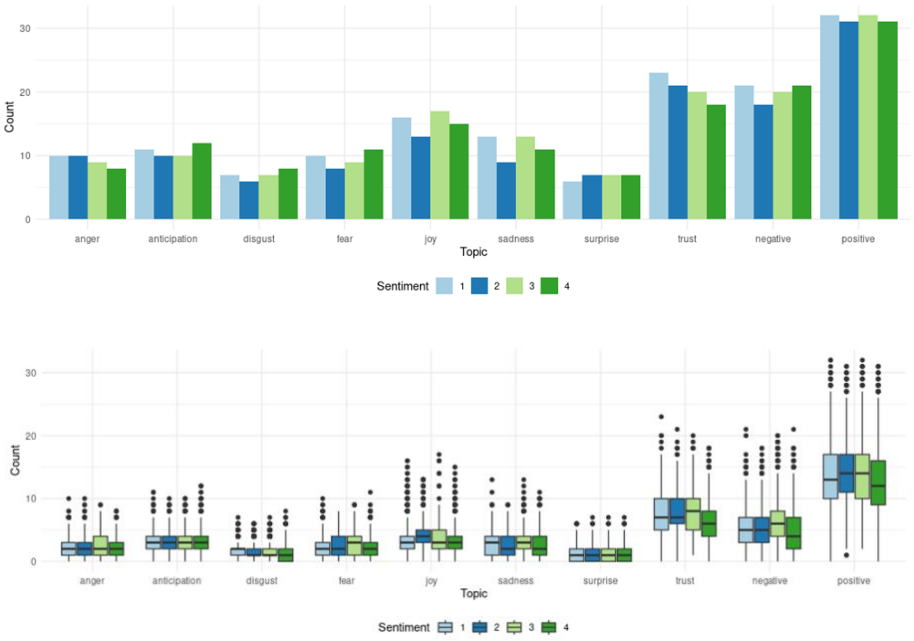
In Topic 2, we observe widespread surprise and negativity, for example, as indicated by elongated interquartiles and numerous outliers. This may reflect marked variation in how content is perceived or in the emotional intensity it evokes. Topic 3 displays considerable variation in sentiments such as joy and trust, but with lower medians than in Topic 1, suggesting an optimistic view but with a certain inconsistency or diversity of opinions. Finally, Topic 4 exhibits a significant dispersion in negative emotions and anger, with a high median in negative feelings, highlighting consistent adverse sentiments. However, trust also has a relatively high median, albeit with a large dispersion, which may indicate a defiant or resilient response to negative content.

Figure 7 illustrates the sentiment analysis by topic to characterize the sentiments surrounding the issues of each topic. Figure 7 clearly shows that anger is more prominent in Topic 4, suggesting content that participants may perceive as more provocative or frustrating. Anticipation is strong across all topics but particularly high in Topic 1, indicating a sense of expectation or hope. Disgust appears moderately in all topics, with a lower presence in Topic 1. Fear is consistently low across all topics, indicating that it may not be a primary emotion in any of them. Joy is quite high in Topic 1, which, combined with high anticipation and trust, reinforces the idea of a positive outlook.

Sadness remains relatively low across all topics, indicating that it is not a dominant emotion in any discussion. Surprise shows little variation across topics, suggesting that the elements of surprise are evenly distributed. Trust is more evident in Topic 1 and, to a lesser

extent, in Topic 4, which may indicate a more assertive and confident attitude toward the topics covered in these discussions. Negative feelings are more pronounced in Topic 4, further supporting the observation that this topic contains elements that provoke anger or frustration. Positive feelings are strongest in Topic 1, reaffirming that this topic is associated with more positive and optimistic emotions. In comparison, Topic 1 stands out as the most positive, while Topic 4 is characterized by stronger negative sentiments. Topics 2 and 3, although they have their particularities, tend to exhibit a less extreme emotional profile.

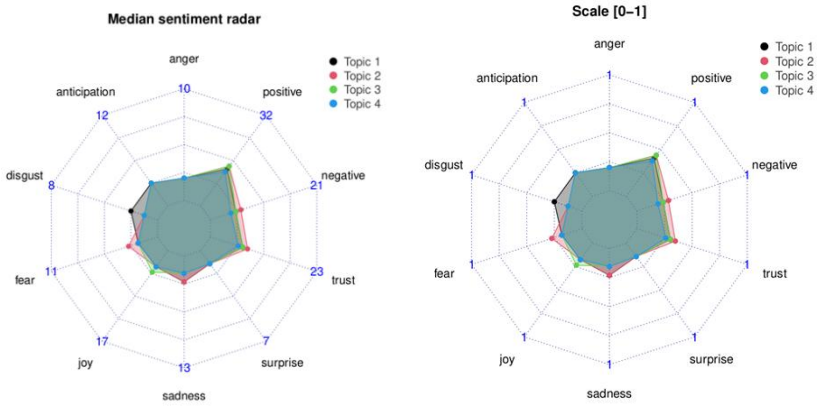
Figure 7: Sentiment analysis by topic



Research data. Prepared by the authors (2025).

Finally, the graphical analysis of the studies concludes with the median sentiment radar graphs and the scaled median sentiment radar, shown in Figure 8.

Figure 8: Median sentiment radar



Source: Research data. Prepared by the authors (2025).

In line with what was presented in Figure 8, the conclusions for each of the four topics are:

1. Topic 1 (Black): Exhibits a harmonious balance among all emotions, with positive sentiments and trust boasting the highest median values. This suggests an overall favorable perception of the content within this topic.
2. Topic 2 (Pink): Demonstrates a comparable structure to Topic 1, albeit with slightly lower median values for positive sentiments and trust, accompanied by slightly higher median values for negative sentiments. This implies a somewhat more discerning or varied perspective on the content covered.
3. Topic 3 (Green): Displays a marginally greater emphasis on negative sentiments and a diminished median for positive sentiments compared to Topic 1. However, a notable level of trust remains, indicating a nuanced viewpoint.
4. Topic 4 (Blue): Presents the highest medians for negative and lowest for positive sentiments. Additionally, trust is lower compared to Topic 1, reflecting a more negative or critical stance toward this topic.

The radar chart provides a multidimensional representation of the median sentiment values for each topic. Larger extensions along a specific axis indicate a stronger presence of that sentiment within the corresponding topic, allowing a comparative assessment of the emotional profiles associated with the identified thematic structures.

4.4 Discussion of results per topic

Studying the perspective of successful applicants regarding public agreements holds significant importance. It offers insights that delineate the profile of agribusiness

investments facilitated by MAPA through VTFG allocations.

Segmentation by topic is a valuable method for illustrating the nuances of public agreements. Topic 1, centered around marketing issues and referring to agreements aimed at the commercialization of agricultural products on a small and medium scale, showcases notable levels of anticipation, joy, and trust. These sentiments suggest a potentially optimistic and hopeful tone alongside a concentrated distribution of positive emotions, indicating a consistent upbeat outlook.

Therefore, the agreement proposals suggest that proponents frame marketing and commercialization challenges as important priorities for small and medium-sized producers. The results indicate that these investments are presented by applicants as viable solutions to local commercialization constraints.

Topic 2 refers to public agreements aimed at enhancing the conditions of the rural properties, working environments, and the farmers' overall quality of life. However, it was characterized by considerable levels of surprise and negative emotions, hinting at content that may be perceived as unexpected or contentious. This variability in perception or emotional response intensity suggests a slightly critical or diversified view of the content covered.

The sentiment patterns associated with proposals concerning working conditions and quality of life reveal lower levels of confidence regarding the expected outcomes of these investments. Consequently, the administrative narratives analyzed suggest uncertainty regarding the expected improvements in farm conditions and quality of life. The applicants have expressed concerns about the potential positive changes that this form of investment may bring to the territory.

Subsequently, Topic 3 delves into matters concerning family farming, machinery utilization, and various forms of support and encouragement for the advancement of these families. The topic is marked by a darker or emotionally weighty content, hinting at a positive outlook, albeit with some degree of inconsistency or diversity of opinions. While it exhibits a slightly higher prominence of negative sentiments, it still showcases a notable amount of trust, indicating a mixed perspective.

In proposals related to family farming development, trust-related sentiments appear less pronounced, suggesting uncertainty regarding the expected contributions of these investments. The sentiment patterns associated with these proposals reveal a less optimistic assessment of developmental and mechanization-related expectations.

Moving on to Topic 4, which represents the public agreements' logistical issues, it was observed that the topic is the least polarizing and elicits fewer negative reactions than the other three. However, it exhibits a significant dispersion in negative emotions and anger,

highlighting the consistent presence of adverse sentiment. This indicates a defiant or resilient response to negative content. Anger is more prominent in Topic 4, suggesting that participants may perceive the content as more provocative or frustrating, characterized by stronger negative sentiments.

Textual records reveal a predominance of negative sentiment regarding issues such as obtaining road improvements, access roads, production flow, machinery maintenance, and flow structure maintenance, as well as machine and vehicle recovery. Sentiment analysis indicates frustration in descriptions related to disillusionment concerning logistical issues. Initially, the proponents indicate that this investment could improve infrastructure. However, the sentiment patterns identified in these texts suggest dissatisfaction regarding the expected effectiveness of such interventions.

Beyond the characterization of the topics, the findings provide insights into how institutional demands are formulated within the context of voluntary federal transfers. The prevalence of themes related to commercialization, family farming, quality of life, and infrastructure suggests that proposing entities tend to frame their requests around concrete and immediately observable local needs. This finding reinforces the argument presented in the literature that voluntary transfers function as instruments through which local governments and organizations seek to address territorial development challenges and compensate for limitations in infrastructure, productive capacity, and market access. In this sense, the agreements analyzed do not merely represent funding requests but also constitute institutional narratives that translate local priorities into administrative demands capable of attracting federal resources. The results therefore contribute to understanding how public policy needs are formally articulated by proponents within the voluntary transfer system.

5. Conclusion

Resources from VTFG allocated via public agreements signed by the MAPA directly impact Brazilian farmers. This study presents the findings of research focused on understanding the perspective of successful applicants regarding these public agreements, analyzing how they are characterized across five distinct elements: the object of the agreement, target audience, expected results, problem to be solved, and the coherence between the agreements' activities and their object.

The analysis relied on primary data collected from the internal control database of the SDI of MAPA. The database uses data mining techniques to gather information on MAPA's public agreements that allocate resources from VTFG to Brazilian municipalities.

Using text mining packages in R software, over 50,470 comments representing five

different perspectives were extracted. This process was followed by a word selection procedure involving a total of seven steps, resulting in the compilation of a frequency table with over 3,000 words, each occurring 20 or more times across all comments. Subsequently, topic modeling was conducted to classify these words based on their characteristics, identifying four distinct topics. Finally, sentiment analysis was performed for each topic, leading to numerous discoveries.

The study revealed that the proposals submitted by applicants frequently frame public agreements allocating VTFG as mechanisms to address challenges related to commercialization, infrastructure, family farming, and rural development. The sentiment patterns identified in the administrative texts suggest varying levels of confidence regarding the expected outcomes of these investments, particularly in relation to working conditions, quality of life, family farming support, and logistical infrastructure. These findings should be interpreted as characteristics of the institutional narratives contained in the proposals and administrative records rather than as direct evidence of the perceptions or experiences of farmers and other final beneficiaries.

In terms of theoretical contributions, the study delved into a crucial phase from the applicants' perspective: the upstream view of public agreements, an aspect largely unexplored in the existing literature. Secondly, the utilization of textual analysis, employing robust tools for processing large volumes of data, yielded clear and direct insights into the field, enhancing decision-making based on a comprehensive set of factors.

The findings also contribute to the understanding of how local actors formulate and justify demands for federal resources through public agreements. By revealing the thematic structure underlying these proposals, the study highlights the institutional mechanisms through which local development priorities are translated into formal requests submitted to the federal government.

Methodologically, topic modeling and data mining represent the future of research across various domains, offering advantages over traditional questionnaire-based approaches (Moro et al., 2023). Moreover, access to data from the SDI provided a unique source that was essential for the analysis of VTFG in Brazil. The wealth of textual information gathered enriches the depth of analysis facilitated by the chosen analytical tools.

The analyzed agreements vividly reflect the inherent needs of the beneficiary community, which is challenging to grasp solely through qualitative or quantitative primary data research. Such methods often convey the subjective viewpoints of participants. By focusing on the content of the public agreements, this research effectively captures sentiments and emotions without susceptibility to partisan political bias, governmental influences, union affiliations, participants' ideological leanings, socioeconomic backgrounds, or other factors that could potentially impact the accuracy of analyses and compromise the

reliability of results from the successful applicant's perspective.

At an empirical level, this study underscores the importance of understanding how local demands are formally translated into requests for federal resources through public agreements. By identifying the thematic structures and sentiment patterns present in administrative records, the research contributes to a better understanding of how proponents frame territorial needs, justify investments, and communicate expected outcomes within the voluntary transfer system.

An important contribution of this study lies in demonstrating the potential of text mining, topic modeling, and sentiment analysis techniques for examining large-scale administrative datasets in the public sector. Rather than focusing on direct perceptions collected from beneficiaries, the proposed approach enables the investigation of how institutional actors formulate demands, describe local challenges, and justify requests for public resources. This perspective expands the analytical possibilities available for studies on public policies, rural development, and intergovernmental transfers.

Moreover, the insights gleaned from the analysis offer valuable guidance to public authorities on how to proceed, highlighting the need for up-to-date information. Both public authorities and academia stand to benefit empirically from this investigation, which informs decision-making regarding communication strategies, contracting approaches, and the alignment of investments with identified needs.

Looking ahead, future research endeavors could extend the findings of this study to an international context, providing an opportunity to map the knowledge generated from the discussions herein and compare it with the perspectives of farmers engaged in public-private partnerships on a global scale.

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