



# PROJECT PANOPTES

## MONITORING OF CREDIT OPERATIONS THROUGH GEOTECHNOLOGIES AND ARTIFICIAL INTELLIGENCE

### BRIEF CONTEXT

The Research Group on Geotechnologies and Geographic Intelligence Applied to Government Oversight at the<sup>1</sup> Serzedello Corrêa Capacity Development Institute (ISC), the higher education branch of the Brazilian Federal Court of Accounts (TCU), is developing Project Panoptes<sup>2, 3</sup>, which aims to foster the automatic monitoring of rural credit and insurance operations. Satellite imagery combined with artificial intelligence (AI) techniques has enabled the automated detection of hundreds of thousands of credit operations with signs of irregularities, involving tens of billions in BRL<sup>4</sup>. The project received technical support from researchers at the National Institute for Space Research (INPE) and involved over 118 participants from 16 organizations. This is a pioneering, foundational, and low-cost initiative that has promoted transparency and enhanced the government's oversight capacity, while also raising expectations for accountability<sup>5</sup>.

### RATIONALE FOR PROJECT PANOPTES

The project was proposed based on the following considerations:

- the importance of rural credit policy to the economy and society;

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1 The research groups associated with the ISC Research Program are formed according to the prioritized research/operation lines and thematic axes, or on demand, as applicable. These groups are regulated by ISC Ordinance 18, dated September 22, 2022. The list of active groups can be accessed on the [ISC Graduate Studies webpage](#).

2 Argos Panoptes, in Greek mythology, was a giant whose body was covered in eyes, granting him the ability to see everything.

3 The project was launched under the Annual Operational Plan (POA) of the Capacity Building Committee (CCC) of the Organization of Latin American and Caribbean Supreme Audit Institutions (OLACEFS).

4 The information was presented by the Specialized Audit Unit on Agriculture, Environment and Sustainable Development (AudSustentabilidade) in the presentation *How to oversee BRL 580 billion in rural credit using satellites and AI*, delivered at the 2025 edition of the *Somos Todos TI* (We Are All IT) event.

5 Further details are outlined in the project plan titled *Panoptes Project: monitoring of rural credit and Proagro operations through geotechnologies*, a document jointly developed by the Central Bank of Brazil (BCB) and the Federal Court of Accounts (TCU).



- the scale of public resources invested annually;
- confirmed risks of irregularities in credit operations and the Agricultural Activity Guarantee Program (Proagro);
- confirmed risks of funds being used for unlawful activities;
- confirmed risks of noncompliance with social, environmental, and climate restrictions outlined in the Rural Credit Manual;
- potential reputational risks for the National Financial System and the Brazilian State; and
- the persistent and growing gap between available technologies and those actually used by oversight and law enforcement bodies<sup>6</sup>.

The 2024/2025 Harvest Plans<sup>7</sup> together made R\$475.5 billion available for rural credit operations, and the next plan may involve even greater sums. From 2022 to 2024 alone, Proagro generated an accumulated deficit of over R\$10 billion for the National Treasury<sup>8</sup>. Numerous irregularities related to rural credit and Proagro policies have persisted for decades, despite Court Decisions by the TCU having identified weaknesses in risk management for both credit and rural insurance operations.

There are serious institutional gaps in the ability to monitor key issues, which increases the risk of public funds being misused and of unlawful activities being financed, such as land grabbing and illegal deforestation. The technological gap exposes the National Treasury to unnecessary losses and undermines the effectiveness of credit policies<sup>9</sup>. In the case of social and environmental restrictions specifically, the ineffective monitoring of risks sends a negative signal to international markets regarding the sustainability of Brazilian agriculture, which may harm the competitiveness of national products and the trade balance.

In 1983, due to the difficulty of conducting on-site inspections and the high level of fraud in rural credit and Proagro operations, INPE was contracted by Banco do Brasil to develop proofs of concept (PoCs), with support from the U.S. space agency NASA. A newspaper article from the time, illustrated with the cartoon in Figure 1 below, celebrated the positive results of the pilot tests and anticipated the broader adoption of tools to detect misuse of funds. However, contrary to expectations, the past 42 years have seen an unjustifiable

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6 As detailed in the educational material Monitoring of Rural Credit Operations through Geotechnologies.

7 Harvest Plan and Family Farming Harvest Plan.

8 Court Decision No. 2,493/2024 – TCU – Full Court.

9 The information in the last two paragraphs was presented by AudSustentabilidade during the presentation How to oversee BRL 580 billion in rural credit using satellites and AI, delivered at the *Somos Todos TI* event.



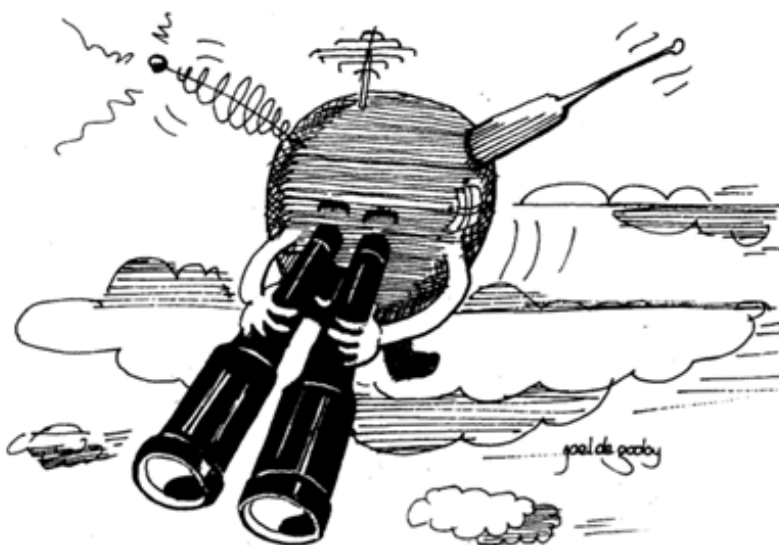
and growing disconnect between low-cost technological capabilities and their actual implementation.

**Figure 1 – News article from O Estado de São Paulo**

The satellite takes pictures of the farms, and the bank's technicians find out who borrowed the money but didn't invest it in farming.

*By Fernando Yassu.*

## **Banco do Brasil will have a spy satellite**



Source: Godoy (1985).

Since 1983, dozens of operations have been launched by the Federal Police (PF) involving rural credit and Proagro, such as Operation Golden Boys, Operation Turbocred, and Operation Planta de Crédito in 2022. According to the Federal Police, in the Golden Boys operation alone, the fraud amounted to R\$35 million<sup>10</sup>.

It is important to note that around 2 million rural credit operations are conducted each year; that these operations are geographically dispersed and often take place in remote areas; that there are financial incentives to use the subsidized funds for areas other than those stated in the contracts; and that the financed assets are largely ephemeral (the period between planting and harvesting for most crops ranges from 90 to 150 days). To ensure effective oversight, this context requires nationwide automation of monitoring efforts. Although this need is widely

<sup>10</sup> Further details on the operations can be found at the news link provided in the references section of this text.



recognized, at the start of Project Panoptes, the Central Bank of Brazil (BCB) and several other institutions within the National Financial System (SFN)<sup>11, 12</sup> faced long-standing barriers to operationalizing such automation<sup>13</sup>.

The situation described – marked by a significant, persistent, and growing gap between the low-cost technology available and the rudimentary tools actually used by the entities responsible for credit oversight<sup>14</sup> – prompted the TCU to develop a project with two main goals: *i)* to adapt existing technologies, and *ii)* to build large-scale monitoring capacities.

The TCU has experience automating the detection of risk typologies in social security databases, civil service benefit records, and public procurement systems, as exemplified by the ALICE robot (*Análise de Licitações e Editais*), which conducts automated monitoring of public tenders and bidding notices. However, the technical challenges of automation increase significantly when the databases contain spatial components, and become even more complex when satellite imagery must be integrated<sup>15</sup>. Due to both the relevance and technical complexity involved, Project Panoptes was incubated within the Research Group on Geotechnologies and has been supported by resources from international cooperation agreements.

## OBJECTIVE OF PROJECT PANOPTES

Project Panoptes seeks to adapt technologies and create favorable conditions for expanding the use of geotechnologies by the federal public administration<sup>16</sup>, including the incorporation of satellite imagery from various constellations into the monitoring of rural credit and Proagro<sup>17</sup>

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11 Law No. 4,829 of November 5, 1965 establishes that the responsibility for monitoring rural credit operations lies with the lender (financial institutions and credit cooperatives). It is the responsibility of the Central Bank of Brazil (BCB), within its supervisory role over the National Financial System (SFN), to ensure that financial institutions comply with the regulations governing rural credit.

12 The Federal Court of Accounts (TCU) is responsible for overseeing the actions of the BCB, while both the TCU and the Office of the Comptroller General (CGU) are tasked with verifying the proper use of public funds in rural credit and under the Proagro program.

13 Issues related to the geodetic coordinates of the polygons (*glebas*) indicating the location of credit investment further exacerbated the situation.

14 This situation is described in the project plan titled Panoptes Project: monitoring of rural credit and Proagro operations through geotechnologies, a document jointly developed by the BCB and the TCU.

15 Raster-type data and other grid-based spatial information.

16 For this purpose, geographic information systems and satellite imagery are used.

17 The technologies have been tested using microdata from operations involving controlled funds. These data are public but can be expanded to encompass all rural credit operations.



operations. The appropriate use of spatial data is a mandatory requirement for integrated monitoring systems that combine land tenure, climate, environmental, and phenological datasets.

## GUIDING PRINCIPLES OF PANOPTES

Panoptes has been developed based on the following principles: *i)* integration of efforts among government, academia, and civil society organizations; *ii)* broad reuse of educational content, analytical techniques, and code (scripts); and *iii)* prioritization of free, open-source, or low-cost technologies.

The integration of efforts among government, academia, and civil society is made possible through the participation of staff from financial institutions, credit cooperatives, public universities, oversight and law enforcement agencies, public research institutes, and nonprofit organizations.

Broad reuse is ensured by making all developed output available<sup>18</sup> to both the public sector and society at large via online platforms such as GitHub, Kaggle, and YouTube. All materials are licensed to allow further development over time by other actors, provided they are used for non-commercial purposes<sup>19</sup>.

In the methodological component of Panoptes, free, open-source, or low-cost technologies were prioritized – such as the services provided by INPE, as well as satellite imagery made freely available by NASA and the European Space Agency (ESA). Proprietary technologies may be used supplementally when they provide exclusive and necessary features<sup>20</sup>.

## TARGET AUDIENCE AND INSTITUTIONAL PARTNERS

Between September 2023 and April 2025, the project received contributions from 118 participants representing a wide range of institutions, including: **banks:** Banco do Brasil (BB), Brazilian Development Bank (BNDES), Caixa Econômica Federal (CEF), Banco do Nordeste (BNB); **credit cooperatives:** Credicoamo; **public universities:** University of São Paulo (USP), Federal University of Minas Gerais (UFMG), Federal University of Goiás (UFG); **oversight and law enforcement agencies:** TCU, Federal Police (PF), Central Bank of Brazil (BCB), Ministry of Justice and Public Security (MJSP), Brazilian Institute of Environment and Renewable Natural Resources (IBAMA); **public research institutes:** Brazilian Agricultural Research Corporation (Embrapa); **civil society organizations:** MapBiomass and Climate and Policy Initiative (CPI).

18 Except when related to confidential or sensitive information.

19 Attribution-NonCommercial-ShareAlike 4.0 International License (CC BY-NC-SA 4.0).

20 For example, high- or very-high-resolution imagery will not be acquired. Proprietary software, such as ArcGIS, will also not be used whenever avoidable.



## PHASES OF PANOPTES (2023-2027)

The project has been structured into three phases. In phase 1 (2023-2024), the INPE team – comprising four researchers – developed the general process for automating the monitoring system, designing a step-by-step flow that now serves as the system’s “backbone” integrated with technologies available at the institute. In addition to supporting audits related to credit, the project carried out four proofs of concept (PoCs) to validate the methods for detecting misuse of funds. These trials were technically supported by UFG, INPE, the MapBiomass network, and the MJSP’s Brasil MAIS program.

In phase 2 (2025-2026), the lead researchers are mapping the main risks associated with rural credit and Proagro, focusing on those that can be automatically monitored through geotechnologies. This phase involves the systematization, prioritization, and dissemination of risk-related data. Current topics include “territorial and land governance” and “adverse weather events<sup>21</sup>.”

In phase 3 (2027), the team will develop a prototype<sup>22</sup> of a cloud-based technological infrastructure to monitor the priority risks identified in phase 2. To avoid duplication of efforts, this phase will test the technical feasibility of a unified solution capable of generating centralized alert signals that can be used by multiple actors, such as the Federal Police and the Federal Prosecution Service (MPF). At the end of phase 3, the prototype’s results will be evaluated in terms of cost, capabilities, and limitations<sup>23</sup>.

## RESULTS OF PHASE 1 (2023-2024)

The general proposal was structured to demonstrate how INPE products and services – such as the Brazil Data Cube, Web Land Trajectory Service (WLTS), and Web Time Series Service (WTSS) – can be integrated into the monitoring of rural credit. Within this context, the “backbone” of the automated analysis process at the gleba level (land parcel) was developed, based on rural credit microdata publicly available on GitHub.

Hundreds of hours of educational content were delivered and made available on YouTube. Additionally, interactive computing environments were created, including eight Jupyter Notebooks with annotated code, published on Kaggle to facilitate the practical application of the methods developed.

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21 According to the Methodology for the Construction of Irregularity Typologies, leveraging the knowledge derived from the development of such typologies yields greater benefits for oversight in large-scale data analysis projects, such as continuous audits, integrated audits, or those conducted through platforms for irregularity risk assessment.

22 A prototype is a preliminary and functional version of a product or system, created to test concepts, features, or design before final development. It serves to validate ideas, identify improvements, and detect issues in the early stages of the process – thus reducing risks and costs.

23 As of May 2025, only part of the funding for phase 3 had been secured. The execution of this phase will depend on the acquisition of additional resources.



Furthermore, the Research Group on Geotechnologies provided technical support to the Sustainability Audit Unit (AudSustentabilidade) during a 2025 audit on rural credit. This support enabled the analysis of millions of credit operations involving controlled funds between 2021 and 2024. It also allowed the unit to better understand the potential of geotechnologies and to assess the gap between the potential use of such technologies and their actual use by auditees.

Four proofs of concept (PoCs) were carried out to assess the feasibility of automatically monitoring misuse of funds, *i.e.*, situations in which subsidized resources were contracted but not properly employed. Given the technical and methodological complexity involved, the PoCs were conducted in partnership with leading institutions. All analyses incorporated some form of artificial intelligence technique.

The PoCs varied in objectives, technologies, methodologies, focus areas, target assets (such as wheat, corn, pasture), and spatial-temporal scope. Approximately 240,000 credit operations were analyzed. Depending on the PoC, indications of irregularities ranged from 0.7% to 26.6%. The suspicious operations identified in the process amount to over R\$2.5 billion in funds.

Examples of results from three of the four PoCs are illustrated below. Figure 2 presents, as part of the findings from the PoC conducted by UFG, a not-uncommon scenario in which credit intended for pasture restoration was used instead to clear native vegetation. Figure 3, one of the outputs of the PoC conducted by INPE, shows an unsupervised classification – performed by artificial intelligence – of land use within a parcel. Figure 4 displays an automated report<sup>24</sup> on indications of irregularities based on the percentage of non-emergence of crops<sup>25</sup>, which was part of the outputs supported by the MJSP.

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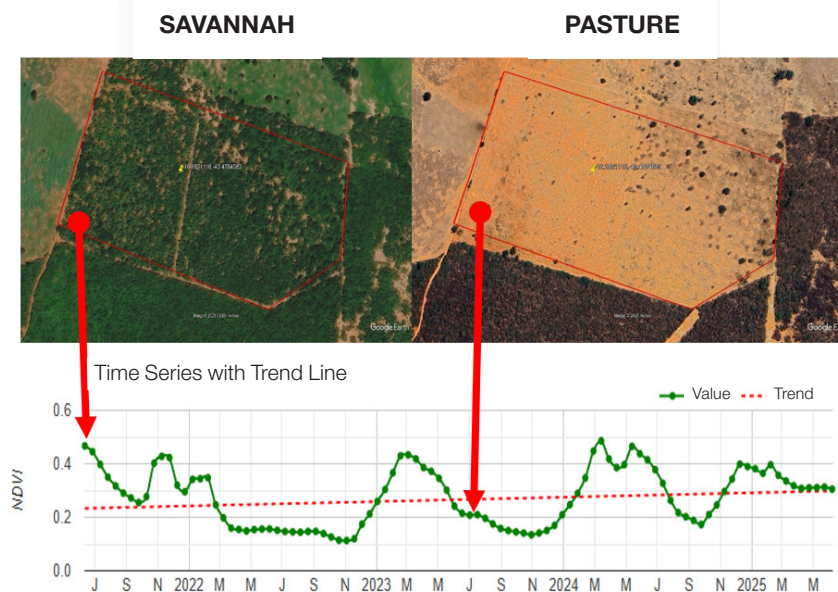
24 This is a pilot project that has not yet been put into production or run at scale.

25 Emergence, one of the initial stages in a plant's life cycle, refers to the moment when the seedling (young plant) breaks through the soil surface and becomes visible, marking the end of germination and the beginning of autonomous growth.



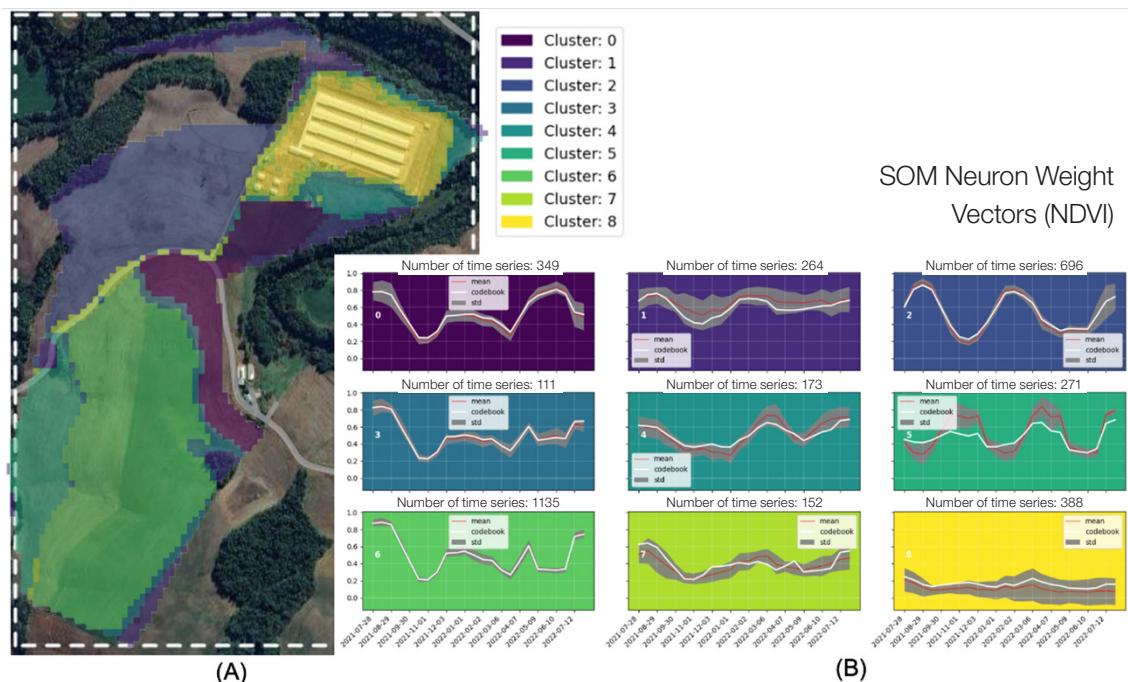


**Figure 2 – Detection of rural credit being used for illegal deforestation (PoC conducted by UFG)**



Source: Mesquita and Ferreira (2025).

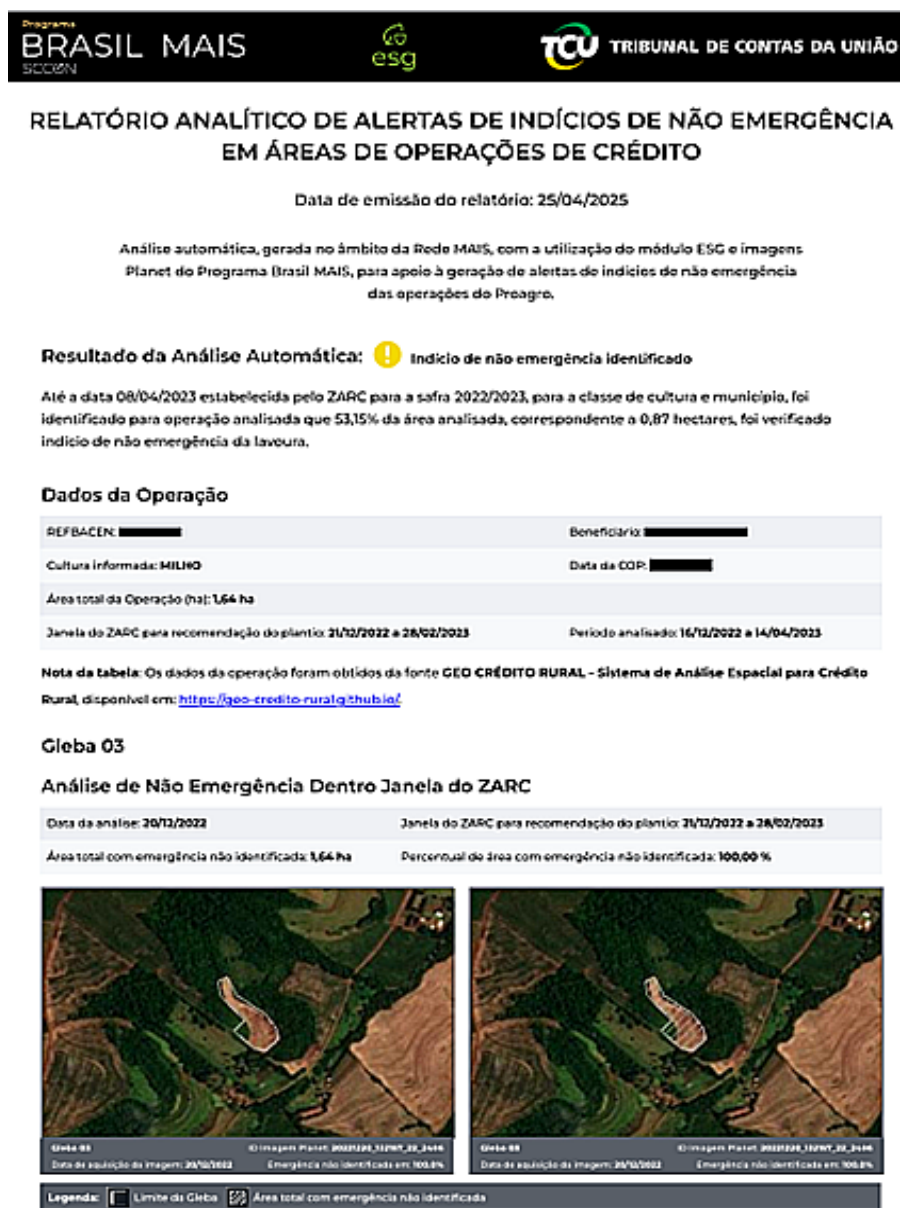
**Figure 3 – Automated classification of land use types within a parcel (PoC conducted by INPE)**



Source: Queiroz *et al.* (2024).



**Figure 4 – Automated report on non-emergence of crops  
(PoC supported by the Ministry of Justice and Public Security – MJSP)**



Source: MJSP (Brazil, 2025b).

Another important outcome of phase 1 was the development of effectiveness metrics for agricultural policies that rely on rural credit. Among the subsidized-interest funds<sup>26</sup> allocated to pasture restoration between 2019 and 2024, only 26.8% of the financed areas showed signs of improved pasture vigor. In other words, no evidence of policy effectiveness was observed in 73.2% of the cases analyzed.

<sup>26</sup> Or “controlled funds”, according to terminology adopted by the Central Bank of Brazil (BCB) and the National Financial System (SFN).



The results obtained in phase 1 of Panoptes are ready to be applied to the monitoring of approximately half a trillion Brazilian reais per harvest year. Furthermore, there is potential to enhance these outcomes and broaden the scope of the PoCs, which would make it possible to increase the detection rate of irregularities and significantly raise accountability expectations among auditees.

## TECHNICAL AND FINANCIAL SUPPORT FOR THE PROJECT

Since 2016, under the leadership of the TCU, the Organization of Latin American and Caribbean Supreme Audit Institutions (OLACEFS) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) have been promoting the use of geotechnologies through both technical and financial support. These efforts enabled the development of several successful projects, including Panoptes.

Phase 2 of Project Panoptes has been funded with resources from German technical cooperation, through the Sustainable Brazilian Finance (FiBraS) II project, implemented by GIZ in partnership with the Central Bank of Brazil (BCB) and the Ministry of Finance (MFAZ).

The total resources allocated to the project – including both phase 1 and phase 2 (2023-2026) – amount to approximately USD 110,000<sup>27</sup>. Of this total, an estimated 97% has been financed through international cooperation funds.

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<sup>27</sup> Part of the funds was received in euros and converted into U.S. dollars using the exchange rate in effect on September 9, 2024.



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