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VALORAÇÃO DO PASSIVO AMBIENTAL EM ÁREAS SOB RESTRIÇÃO ECOLÓGICA DE IMÓVEIS RURAIS DECRETADOS

DEODATO DO NASCIMENTO AQUINO[1]

[1] Perito Federal Territorial, Engenheiro Agrônomo – Doutor em Engenharia Agrícola, Instituto Nacional de Colonização e Reforma Agrária – INCRA, Rua Monsenhor Furtado, 2397 - Panamericano, Fortaleza - CE, 60441-750. ORCID 0000-0002-2736-5136, deodato.aquino@incra.gov.br.

RESUMO: A valoração econômica de passivos ambientais, constitui-se em um conjunto de métodos e técnicas cuja finalidade é estimar valores monetários dos recursos vegetais suprimidos ilegalmente por atividades antrópicas. O objetivo deste trabalho é apresentar uma proposta metodológica, com uso de geoprocessamento, para estimar a valoração do passivo ambiental sobreposto em áreas de Reserva Legal e de Preservação Permanente nos imóveis rurais desapropriados, por interesse social, para fins de reforma agrária e/ou regularização de territórios quilombolas. A área estudada compreende um imóvel rural abrangido por Território Quilombola no município de Pacajus, Ceará. Utilizou-se dados topográficos planialtimétricos, obtidos junto a missão SRTM para o cálculo da declividade do terreno. Na estimativa do passivo ambiental, empregou-se ferramentas de sensoriamento remoto, imagens vetoriais do projeto MapBiomas e geoprocessamento, no software livre Q.GIS. A proposta metodológica demonstrou ser de fácil operacionalidade, além de praticidade e eficiência na estimativa do valor do passivo ambiental sobreposto em áreas de Reserva Legal e de Preservação Permanente de imóveis rurais avaliados para reforma agrária e/ou regularização de territórios quilombolas.

Palavras-chaves: reforma agrária, engenharia de avaliações, geotecnologias.

VALUATION OF ENVIRONMENTAL LIABILITIES IN AREAS UNDER ECOLOGICAL RESTRICTIONS OF DECREED RURAL PROPERTIES

ABSTRACT: The economic valuation of environmental liabilities consists of a set of methods and techniques whose purpose is to estimate the monetary value of plant resources illegally suppressed by human activities. The objective of this work is to present a methodological proposal, using geoprocessing, to estimate the valuation of environmental liabilities overlapping in areas of Legal Reserve and Permanent Preservation in rural properties expropriated, for social interest, for the purposes of agrarian reform and/or regularization of quilombola territories. The area studied comprises rural property covered by Quilombola Territory in the municipality of Pacajus, Ceará. Planialtimetric topographic data obtained from the SRTM mission were used to calculate the slope of the terrain. In the estimation of environmental liabilities, remote sensing tools, vector images from the MapBiomas project and geoprocessing in the free software Q.GIS were used. The methodological proposal proved easy to implement, in addition to being practical and efficient in estimating the value of the environmental liability overlapping in areas of Legal Reserve and Permanent Preservation of rural properties evaluated for agrarian reform and/or regularization of quilombola territories.

Keywords: agrarian reform, assessment engineering, geotechnologies.

1 INTRODUÇÃO

The technical inspection and assessment reports, which support expropriation for social interest, consider, in addition to the technical agronomic aspects, the socioenvironmental characteristics, thus establishing the viability of the property for the implementation of agrarian reform settlement projects. Therefore, in the assessment of rural properties by Federal Agrarian Experts at the National Institute of Colonization and Agrarian Reform (INCRA),

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the deduction of environmental liabilities from the total value of bare land (VTN) must be considered. The Federal Court of Auditors (TCU), in Ruling No. [1,262], already stated that the INCRA had the right to receive the property unharmed (without environmental liabilities), to obtain recovery of the environmental liabilities from the expropriated party or to be reimbursed for the amounts spent on environmental recovery or, even, to deduct the amount corresponding to the reimbursement from the value of the expropriation so that the compensation would be fair, as required by the constitution (Reis, 2019).

The publication of the Forest Code in 1965, and more recently the New Forest Code, Law 12.651 of May 25, 2012, defined, in its article 4, the areas considered permanent preservation (APPs), in which there can only be interventions in very special cases of public utility and/or social interest. In addition to the mandatory conservation of vegetation in APPs, the ordinance also defines the portion of the property that must be maintained or managed as a legal reserve (RL), with the function of ensuring the sustainable economic use of the natural resources of the rural property, assisting in the conservation and rehabilitation of ecological processes and promoting the conservation of biodiversity, as well as the shelter and protection of wild fauna and native flora (Brazil, 2012).

The economic valuation of environmental assets/liabilities therefore consists of a set of methods and techniques, the purpose of which is to estimate monetary values (prices) for environmental goods and/or resources. In this context, it is important to highlight that the recent update of NBR 14.653--3, in 2019, which addresses the valuation of rural properties and their components, began to consider the value of environmental assets and liabilities in the composition of the total value of rural property.

Therefore, this work aims to develop a methodological proposal based on the use of geoprocessing in the evaluation of environmental liabilities overlapping the areas of legal reserves (RLs) and permanent preservation areas (apps) of rural properties expropriated for social interest purposes for agrarian reform and/or the regularization of quilombola territories.

2 MATERIALS AND METHODS

The rural property studied has an area of 13.5406 ha and is called “irregularly shaped land”. The property is located in the administrative district of the municipality of Pacajus, in the metropolitan mesoregion of Fortaleza, approximately 48 km from the capital of Ceará. According to the phytoecological classification for the state of Ceará, proposed by the Ceará Institute of Economic Research and Strategy (IPECE), the region where the property is located is classified as a complex. vegetation of the coastal zone. It has a mild semiarid hot tropical climate and subsumed a hot tropical climate with an average annual rainfall of 791.4 mm and average temperatures between 26° and 28°C. According to a thematic soil map at a scale of 1:600,000 (Jacomine; Almeida; Anjos, 1973), in accordance with the current Brazilian Soil Classification System (SiBCS) (Santos *et al*., 2018) and endorsed by *onsite observations*, it is clear that in the area of the farm studied, the Dystrophic Yellow Argisol (Pad) soil class predominates.

The planialtimetric topographic data (digital terrain model - DTM) of the study area for calculating the slope (%) and subsequent characterization of the relief were obtained from the website of the United States Geological Service (USGS - Earth Explorer) of NASA on August 15, 2024. The *datum* was converted to SIRGAS-2000, Zone 24S, via the free *software* Q.Gis 3.34, which is accessed in the C-band database with better spatial resolution (approximately 30 m or 1 arc second).

With respect to the estimation of environmental liabilities, which are economically valuable obligations resulting from environmental damage or noncompliance with environmental legislation (ABNT, 2019), a proprietary methodology was used on the basis of the use of remote sensing and geoprocessing tools in a free geographic information system (GIS), Q.GIS version

3.34.8. For this purpose, vector images from the MapBiomas Project were used.

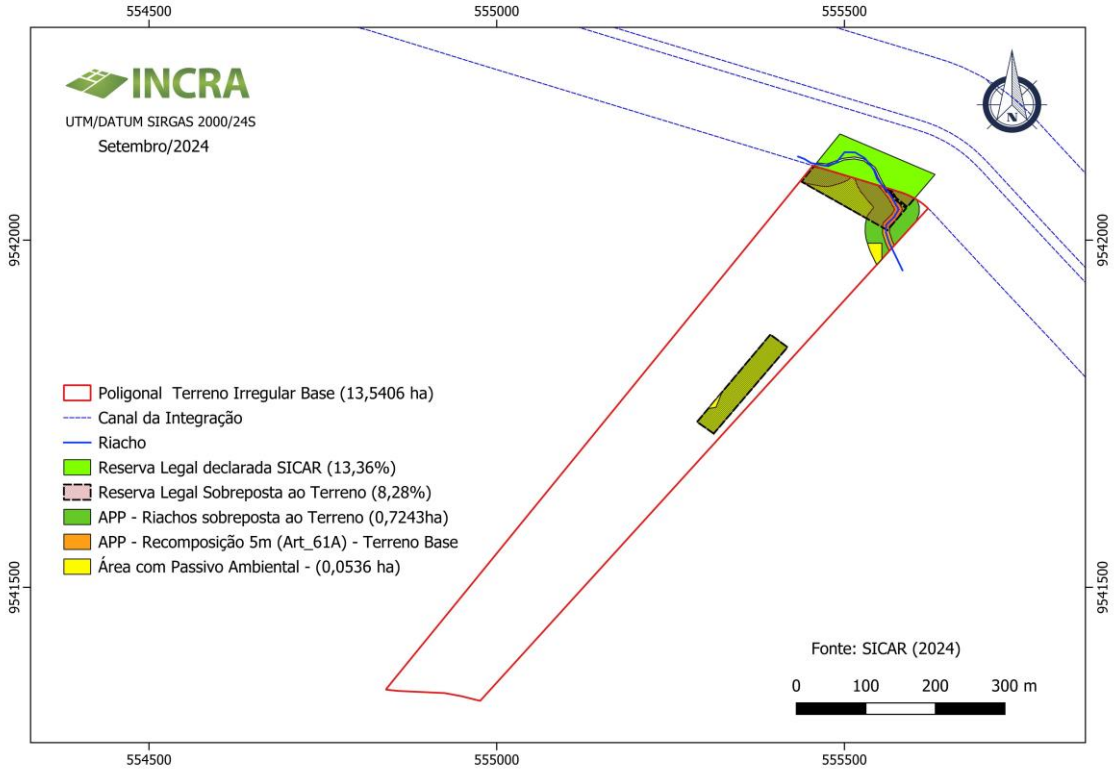
The land use and occupation images for the municipality of Pacajus, referring to the years 2008 and 2022, were obtained from the *Google Earth Engine platform*. These images have a spatial resolution of 30 m, referring to "Collection 8" of MapBiomas (MapBiomas, 2024). From the digital processing of these images, in the QGIS 3.34 *software*, thematic maps with remnants of native vegetation and consolidated areas for the years 2008 and 2022 were obtained. The anthropized features found for the studied terrain included urbanized areas, nonvegetated areas, water bodies, perennial crops and mosaics of uses. The update for the year 2024 occurred after overlaying the 2022 image on the *background made available by Google Satellite, the QuickMapServices* extension of Q.GIS version 3.34.8. The use of the image from the year 2008 is due to it being the year of publication of federal decree no. 6,514, of July 22, 2008, which began to serve as a reference to characterize the consolidated rural area.

In possession of two different vectorized thematic images, namely, the *Shapefile* of the remaining feature of native vegetation in 2008 (MapBiomas/2008) and *the shapefile from the* anthropized area feature in 2024, the thematic map of the environmental liabilities was obtained, that is, the vegetation removed without due authorization, as well as those with authorization for continuity and in need of recomposition, as regulated in Art. 61A of Law 12.651/2012.

3 RESULTS AND DISCUSSION

There was moderate suppression of native vegetation between 2008 and 2024 (Figure 1) in areas under environmental use restrictions of the "irregularly shaped land" property; therefore, an area of suppressed native vegetation overlapping the permanent preservation area (APP) and RL (legal reserve) of approximately 0.0536 ha was detected (Figure 1).

Figure 1. Calculation of environmental liabilities in areas with restrictions on the environmental use (APPs and RLs) of the property "Irregularly Shaped Land" – Pacajus/CE



Therefore, considering that this is a rural property with an area of up to 1 (one) fiscal module, a consolidated area of 0.1041 ha was found in the APP along natural watercourses, with the obligation to restore the respective marginal strips by 5 (five) meters, counted from the edge of the regular riverbed. Article 61-A of Law 12651/2012 provides for the restoration of the respective marginal strips along watercourses for rural properties below 4 (four) fiscal modules, which may be accomplished through the natural regeneration of native species or through human intervention.

With respect to the assessment of environmental liabilities, the need for isolation by fencing and the restoration of native vegetation via the technique of total seedling planting was considered, given the need to quantify the monetary value measured for isolating the area with fences to prevent the entry of animals and allow the regeneration of degraded areas. Therefore, this represents the value of the environmental liability that should be deducted from the total VTN obtained for the property, as established in the INCRA Land Acquisition and Judicial Expertise Manual (Incra, 2006).

In Brazil and other countries that have recently changed their constitutions, the right to a balanced environment and a healthy quality of life has become a fundamental right and, as such, requires the ordinary legislator to structure a microsystem of environmental law capable of responding to the new demands of contemporary society (Souza, 2001). One of the first references to the issue of environmental liabilities in rural properties, which even guided the definition of environmental liabilities itself, was the determination of the portions of rural properties whose use should be restricted or protected. The Land Acquisition and Judicial Expertise Manual adopted by the INCRA addresses the issue on item 6, page 87, as the "recovery of degraded areas of legal reserve and permanent preservation."

For the restoration of the degraded area in the APP and RL areas, it is proposed that the amount required to isolate the area with fences and subsequent restoration of native vegetation by the technique of total planting of seedlings, to prevent the entry of animals and allow the natural regeneration of degraded areas, given that a remnant of suppressed native vegetation was found in the APP and RL areas, between 2008 and 2024. Therefore, the value for such safeguards was estimated at R$ 1,069.21 (one thousand, sixty-nine reais and twenty-one centavos) - (0.0536 ha × R$ 19,948.00/ha), with total planting of seedlings with a scenario and environmental conditions unfavorable to the development of native vegetation (Tymus *et al*., 2018). Therefore, this is an amount that must be deducted from the VTN to be paid by the property owner.

Therefore, in the process of evaluating rural properties via INCRA, environmental liabilities are synonymous with degraded areas within RL (Legal Reserve) and APP (Permanent Preservation Area). Therefore, the obligation to repair the damage is on the property owner and may be transferred to the successor, of any nature, in the case of transfer of ownership of the rural property.

4 CONCLUSIONS

The proposed methodology proved easy to implement and practical and efficient in estimating the value of environmental liabilities by geoprocessing techniques in permanent preservation areas (APPs) and legal reserves (RL) of rural properties evaluated for agrarian reform and/or the regularization of quilombola territories.

The methodology used complies with the ABNT NBR 14653-3 standard - Rural Property Assessment, and in accordance with the INCRA Land Acquisition and Judicial Expertise Manual.

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