Potential for Revenue Collection with Land Tenure Regularization in Pará

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The low amounts charged for selling public land in land tenure regularization proceedings in the Brazilian Amazon may encourage new invasions of unallocated public areas, given that such low prices create expectations of profit through sale of the properties later on. Pará is one of the Amazon states exposed to this risk, since about 38% of its territory lacks land tenure definition and has been the target for crimes of invasion and illegal sales of public land.

In this issue of *The State of the Amazon*, we estimate the potential for collection with land tenure regularization in the state using two scenarios: prices currently charged by the Land Institute of Pará (*Instituto de Terras do Pará – Iterpa*) and land market prices.

We conclude that the amount charged by Iterpa is nine time less than the market value. Therefore, Pará needs to increase the amount charged for land tenure regularization in order to discourage occupation of new public areas, was well as to increase income collection by the State government to invest in ending land tenure uncertainty.

CONTEXT

In Pará, as well as in the rest of the Amazon, the low prices charged for selling public land in land tenure regularization proceedings represent financial losses for the government and a major socioenvironmental risk for the region. Such a devaluation creates an expectation of profit with the sale of the area after the land holder receives a land title. This profit expectation can stimulate new illegal occupations of public lands and lead to land conflicts. This type of land invasion generally results in illegal deforestation, a common practice for signaling the land occupation and later for claiming the land title with the land agency[1]. Thus, the low value of land can be a public subsidy for illegally deforested areas.

Pará has been targeted by gangs specializing in invading and illegally selling public lands associated with illegal deforestation, as was exposed by operations *Castanheira* (2014)[2] and *Rios Voadores* (2016)[3]. This crime of invading public land has contributed towards conflicts over land ownership and made Pará one of the leading states for land conflicts in the Amazon[4]. Two other factors contribute to the state's vulnerability on this issue. First, the lack of control over federal and state public lands without a formal allocation, which cover 38% of Pará territory[5]. The second factor is the slowness in promoting the allocation of those

areas, especially for responding to land claims from those who have legal priority for tenure regularization, such as indigenous peoples, traditional communities and small farmers. Thus, to discourage new invasions of public lands and generate revenue for accelerating the appropriate allocation of such areas, governments should increase the land price charged when selling public land for medium and large landholders.

In this *The State of the Amazon* we assess the potential revenue collection by the Land Institute of Pará (Iterpa) when selling public land. Iterpa is responsible for approximately 64% of the total non-allocated area in the state, equivalent to 24 million hectares[6]. Our estimate consider two scenarios of public land sale: i) prices currently charged by Iterpa and ii) land market prices. The difference between those prices represents the potential increase of collection for the state if the prices currently charged are adjusted to the market value.

METHOD

The sale of public lands by Iterpa occurs mainly during the processes for land tenure regularization without bidding of parcels ranging from 100 to 2,500 hectares, if the landholders comply with the legal requirements[7]. We did not obtain access to land sale requests currently being processed at Iterpa. Thus, we used the Environmental Rural Registry (CAR) dataset from March 2016 (the month we began our analysis) to select parcels with potential for land sale and to estimate the potential revenue collection with such cases.

For this estimate, we selected land parcels in CAR ranging from 100 to 2,500 hectares[8] in areas under state jurisdiction. CAR database has several overlaps among parcels, so when we observed an overlap of more than 5% between parcels in CAR, we kept only the larger parcel in the analysis. In cases of overlaps of less than 5%, we kept all parcels.

Next, we excluded parcels that cannot be sold by the government, such as those overlapping with areas occupied by traditional communities, *quilombolas* (communities of descendants of runaway slaves) and indigenous peoples[9]. However, we did not obtain spatial data of all areas with land claims from these groups, so it is possible that some of the parcels used in this analysis still have some impediment to sale. For example, we did not obtain data from Iterpa on land claims from traditional communities[10]. Finally, the CAR database does not inform whether the properties have or have not been titled. Thus, for this study, we assumed that all of the parcels selected are not titled and have potential for being regularized through sale.

In total, we selected 8,053 parcels in CAR that might be the object of land sale by Iterpa (Figure 1). The average size of the parcels is 466 hectares, with a standard deviation of 516 hectares. The majority (74%) range from 100 to 500 hectares; 21% range from more than 500 to 1,500 hectares; and only 5% have more than 1,500 up to 2,500 hectares. Those parcels account for 3.7 million hectares throughout the state.

To calculate the potential revenue collection with the sale of such 8,053 parcels, we considered the net profit, in other words, the revenue obtained with the sale of the parcel after subtracting the expenses incurred by Iterpa in the sale process. We considered two scenarios in this analysis: i) the land prices currently charged by

Iterpa, in other words, the so-called Bare Land Value (*VTN* for its Portuguese acronym) with rates applicable under Resolution no. 01/2015 of the State Council for Agricultural, Agrarian and Land Tenure Policy (Cepaf); and ii) the average market value (MV)[11].

Next, we applied two discounts provided by law: i) a 30% discount for properties that conserved 80% or more of forest cover[12]; and ii) a 20% discount for lump sum payment[13]. In the latter case, we considered lump sum payment in half of the cases, based on information from Iterpa of how often landholders choose this payment option[14]. We applied a resampling method to select the cases that received the 20% discount and to estimate the average amount collected with a 90% confidence interval in each scenario[15]. Appendix I details the methodology used in this study.

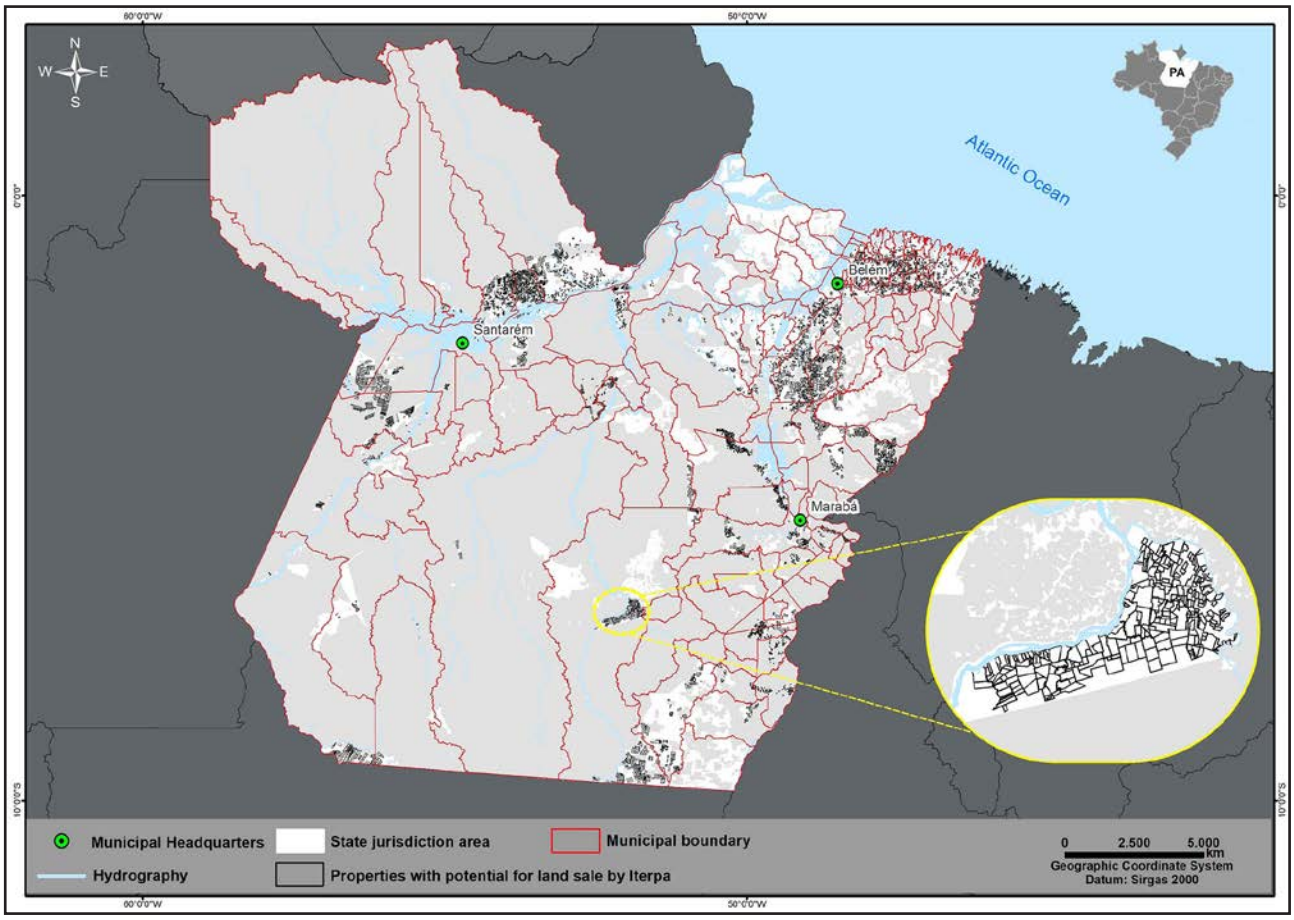

Figure 1. Location of the 8,053 parcels potentially eligible for sale by Iterpa in Pará identified in this study

RESULTS

We estimated that the potential collection (net profit) for Iterpa with the sale of 8,053 properties selected in this study would be nine times less than the collection based on market value. The average collection based on governmental values is R$ 1.1 billion (90% confidence interval of R$ 1.101 billion to R$ 1.108 billion) and the average collection estimate using the market value is R$ 10.06 billion (90% confidence interval of R$ 10.04 billion to R$ 10.09 billion).

The difference between the average values for the two scenarios is in fact a potential public subsidy for holders of public land and an income loss for the State on the order of R$ 9 billion, since the government chooses not to collect that amount by charging below market prices (Figure 2). On average, that would be a subsidy of R$ 2,384 per hectare or R$1.1 million per property. In addition, this price difference demonstrates that Iterpa does not comply with the state legislation, which determines that the government should use the land market as a base to regulate the prices for selling public land[16].

The greatest differences between the market value and the amount charged by Iterpa were found in municipalities in the Santarém and Paragominas regions, where the average prices per hectare (without applying the discounts provided in the law) correspond to only 8% and 7% of the market value respectively (Table 1). The smallest difference was observed in the islands region, where the hectare charged by Iterpa corresponds to 70% of the average market value.

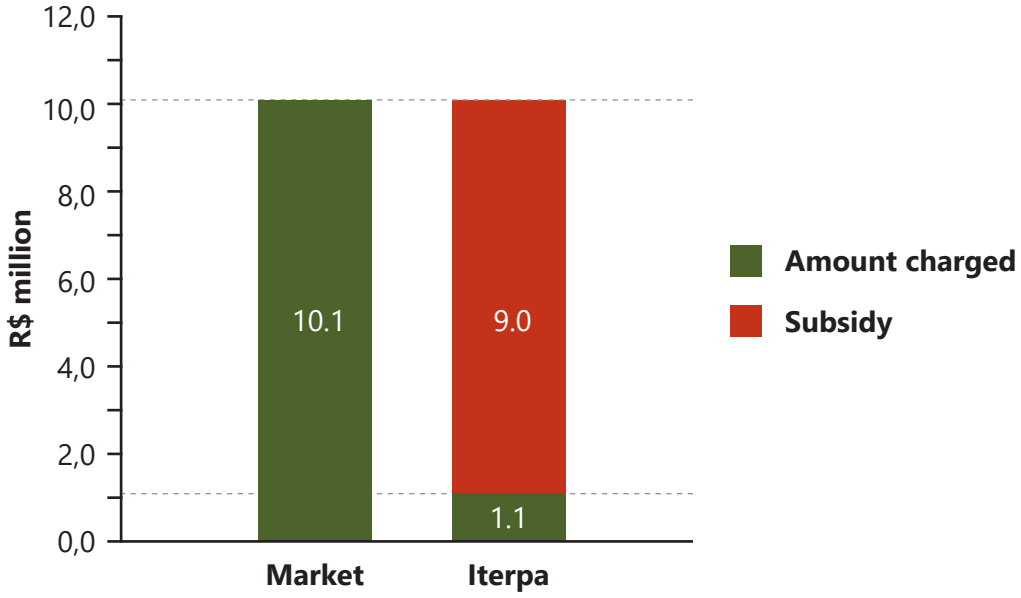

Figure 2. Comparison between the potential collection and subsidies in public land sale of 8,053 properties in Pará, based on the prices charged by the land market and by Iterpa in 2016

Table 1. Comparison between average prices per hectare for 8,053 properties, by region, according to the prices charged by Iterpa and by the land market in Pará in 2016

Region of the state	Iterpa value/hectare (R$)	Market value/hectare (R$)	Iterpa value in relation to the market value (%)
Santarém Region	219	3.077	7
Paragominas Region	357	4.600	8
Redenção Region	438	3.439	13
Belém Region	423	1.850	23
Island Region	167	240	70

If Iterpa practiced market value when selling public land, the institute would collected enough funding to respond to priority land claims that are currently delayed and awaiting financial resources. For example, the recognition of *quilombolas* territories often requires indemnity payments for private properties overlapping the *quilombola* area. As of 2016, there was a demand for R$ 5 million for indemnity payments in those cases, but Iterpa claimed not having enough funding to cover that amount[17].

Besides the *quilombola* territories, another legal priority under the Pará State Constitution is tenure regularization of landholdings of up to 100 hectares[18]. In such cases, the state must donate the area to the small landholders that meet the legal requirements[19]. However, in 2016 Iterpa had a total budget of R$1.2 million allocated for reducing uncertainty of land tenure, including answering to small landholders claims[20]. Such a budget is seven thousand times less than the amount that Iterpa would collect if the 8,053 properties were sold based on market prices. Therefore, adopting market land prices in the sale of public land to medium and large landholders would directly benefit the stakeholder groups that are supposed to be the priority in land tenure regularization. One caveat in this case is that regularization processes at Iterpa tend to be slow. For example, Iterpa issued, on average, 457 titles from 2012 to 2016[21]. If that rate were maintained, it would take seventeen years to issue land titles for the 8,053 properties analyzed in this study, assuming that all of the landholders on these cases meet the requirements for tenure regularization. Thus, besides increasing the prices practiced for the land sale, Iterpa also needs to accelerate the analysis of the land sale requests[22].

Finally, the devaluation of public land by Iterpa reflects a problem shared with other land agencies that charge amounts far below market value when selling public land. For instance, a 2017 study revealed that the Legal Land Program (*Terra Legal)* - from the federal government - provides an average subsidy per property ranging from R$ 746 thousand to R$ 823 thousand when selling public land in the Brazilian Amazon[23]. Increasing the amount charged in public land sale could discourage new illegal and speculative occupations of public areas, because it would drastically reduce the profit expectations in the future sale of the titled parcel.

SUGGESTIONS FOR PUBLIC POLICY

Considering the results presented above, we recommend:

Adoption of market value in public lands sale. This study has demonstrated that the Pará State Government offers billions in subsidies for landholders occupying public lands, failing to collect funds for meeting the legal priorities for land tenure regularization. To eliminate such a problem and, at the same time, discourage new illegal and speculative occupations of public lands, Cepaf, the governmental body responsible for determining the value of bare land, should replace the values adopted in Resolution 01/2015 with market values. This change would comply with the state law that demands public land prices based on the rural land market.

Increase transparency and disseminate data on the land titling cases. This study used a CAR dataset to estimate of how much Iterpa could collect through sale of public land. For a more precise evaluation, Iterpa should comply with the law of access to public information (Law 10.627/2011) and disclose the data from each parcel applying for land regularization through sale and from those cases already sold, including shapefiles and data on prices charged per case.

REFERENCES AND NOTES

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1 L.J. Alston; G.D. Libecap & B. Mueller. 2000 *Land reform policies, the sources of violent conflict, and implications for deforestation in the Brazilian Amazon*, 39 J. Environ. Econ. Manage. 162–188.

2 Brasil. 2014. Operação Castanheira combate grilagem de terras and crimes ambientais. Available at: https://goo.gl/MB7rGQ

3 Affonso, Julia; Coutinho, Mateus & Macedo, Fausto. PF deflagra Rios Voadores contra desmatamento and grilagem de public lands. Estadão. June 30, 2016. Available at: https://goo.gl/Cz4uoH. Access on: 05 Jan. 2018.

4 According to data from the Pastoral Land Commission (CPT), Pará is in second place in number of land conflicts in the Brazilian Amazon from 1997 to 2016, losing only to Maranhão. In 2016, the CPT recorded 110 land conflicts in the state, a 41% increase in relation to 2015. More information in CPT. Conflitos no Campo Brasil 2016. Goiânia: CPT, 2017. Available at: https://goo.gl/2hvUwF. Access on: 05 Jan 2018.

5 Brito, B.; Cardoso Jr., D. 2015. Regularização Fundiária in Pará: Afinal, qual o problema? Belém: Imazon. Available at: https://goo.gl/wn4268.

6 Area calculated by Imazon using data from the Brazilian Forest Service (2016), Terra Legal (2016), Funai (2016), ISA (2017), ICMBIO (2017), Incra (2016).

7 The requirements are: i) proof of permanent residence and effective land use activity for a minimum period of five years; ii) not being the owner, occupant or holder of another rural area, except for those areas acquired through sale; ii) proving the productive and social use of the parcel; iv) area free from other people's legitimate land claims; v) complying with the environmental legislation; vi) not being the beneficiary of land concession by the government; vii) being up to date with the payments of the occupation fee demanded by the state law (article 7, paragraph 2, items I to VII of State Law 7,289/2009).

8 Properties up to 100 hectares may be donated when they meet legal requirements. As for regularization of properties above 2,500 hectares, that depends on previous authorization of the National Congress (article 28 of State Decree 2,135/2010 and article 49, item XVII of the Federal Constitution/1988, respectively).

9 According to Article 8, items I to IV of State Law 7,289/2009, public land sale is prohibited in: i) areas occupied or claimed by traditional communities; ii) parcels under judicial dispute in which Iterpa or the State of Pará are parties; iii) parcels with land conflict as of the date of the land sale initial request; iv) areas allocated for forest concessions.

10 Iterpa does not disclose data on areas claimed by traditional communities on the internet or in its Annual Report nor it responded to Imazon's request for such information. Imazon also was unable to get information on parcels under judicial dispute in which Iterpa or the State of Pará are parties and on parcels with land conflict, since Iterpa does not have such data spatialized.

11 We calculated the average land price using data from: FNP. Anualpec 2016, p. 251. Informaecon: São Paulo, 2016.

12 Article 7, paragraph 6 of State Law 7,289/2009.

13 Article 7, paragraph 7 of State Law 7,289/2009.

14 Information obtained from an interview with Iterpa employees in 2017.

15 We used the bootstrap method to estimate the amount collected. Of the 8,053 properties, we made a random selection of 50% of the cases to apply the 20% discount for lump sum payment. Next, we added up the amounts to be collected for each parcel in order to obtain the total amount to be collected. We repeated this simulation a thousand times. From the total of one thousand final amounts for collection, we extracted the average amount and the 5th and 95th percentile. With this information, we obtained the average amount of collection for the 8,053 properties with a confidence interval of 90%.

16 Article 7, paragraph 1 of State Law 7,289/2009.

17 Information obtained by interview with Iterpa employees in 2016.

18 Article 6, letter d of the Pará State Constitution.

19 To receive a donation, the land claimers must meet the following requirement: i) having made the land productive with their work and that of their family; ii) not being the owner, occupant or holder of another rural area; iii) proving permanent residence and effective farming for a minimum period of 1 (year); iv) having as their main economic activity agriculture or ranching, agro--industrial and/or extractive use in the claimed parcel; v) the area must be free from other people's legitimate land claims ; vi) complying with the environmental legislation; vii) not being the beneficiary of land concession by the government (article 28, items I to VI of State Decree 2,135/2010).

20 In 2016 Iterpa applied R$1.2 million for environmental and land use planning actions. Iterpa. Relatório de gestão 2016. Iterpa. Belém, 2017.

21 The amounts were obtained from the annual Iterpa management reports for 2012 to 2016 by adding up the number of land regularization titles in rural areas per municipality issued annually by Iterpa. The reports are available at: https://goo.gl/E6s6wx.

22 For an analysis of the reasons for delay in the land tenure regularization procedures at Iterpa and recommendations for improvement, see: Brito, B.; Cardoso Jr., D. 2015. Regularização Fundiária no Pará: Afinal, qual o problema? Belém: Imazon. Available at: https://goo.gl/wn4268.

23 Brito, Brenda. 2017. Nota Técnica sobre o impacto das novas regras de regularização fundiária na Amazônia. Imazon. Available at: https://goo.gl/HHBtLT. Access on: 05 Jan 2018.

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APPENDIX 1

Methodology for calculating scenarios for potential collection with the sale of public lands by Iterpa

INTRODUCTION

We used two scenarios to calculate the potential profit from financial collection with the sale of public lands in Pará: i) Profit at bare land value (LVTN for its Portuguese acronym), which represents the amount charged by Iterpa at present; and ii) Profit at market value (LVM for its Portuguese acronym). The calculations were based on the following formulas:

Scenario 1:

$$LVTN = VTN + TO + CP + CAgra - (CPe + CDi + CT)$$

Scenario 2:

$$LVM = VM + TO + CP + CAgra - (CPe + CDi + CT)$$

Where:

VTN = Bare Land Value

VM = Market Value

TO = Occupancy Rate, which is a type of rent charged for the period the landholder has occupied the property before receiving title.

CP = Procedural Costs, which are amounts paid by the landholder to cover Iterpa's administrative costs at each phase of the proceeding to assess the land title request. Cepaf's Resolution 01/2015 establishes the procedural costs.

CA = Agrarian Costs, which are amounts paid by the landholder to cover the field inspection costs of Iterpa's proceeding to assess the land title request. Cepaf's Resolution 01/2015 establishes the agrarian costs.

CPe = Personnel Cost, which is the amount Iterpa spends on human resources throughout each proceeding to assess the land title request, considering staff salary and time dedicated for each case.

CDi = Per Diem Costs, which cover Iterpa's staff costs in field inspections demanded in the proceeding to assess the land title request.

CT = Cost of Transportation, which is the cost with fuel used in field inspections.

CALCULATION OF REVENUE

a. Bare Land Value (VTN)

According to the rules in force at Iterpa, the Bare Land Value (VTN) for each property is defined by the following formula:

$$VTN = (VrT * IFa * IFb * IFc * IFd) * Sr$$

Where:

VrT= Reference Land Value established in Cepaf's Resolution 01/2015 for each municipality. The values are readjusted annually, so in this study we considered the values in force in 2017. When a parcel is located in two municipalities, we followed the method adopted by Iterpa, which considers the VrT of the municipality that has the largest share of the property.

IFa= Distance Index from the parcel to the municipality headquarter where it is located or to the closest municipality headquarter, according to Table 1. We calculated the distance to the closest municipal headquarter using circumference radius.

Table 1: Distance Index

Distance	Index
Up to 15 km	0.950
Above 15 km up to 30 km	0.860
Above 30 km up to 50 km	0.770
Above 50 km	0.680

IFb = Access to parcel index, which indicates the main type of access to the parcel. According to Iterpa staff, the predominant category is "Road – unpaved rural road," to which an index of 0.75 is applied. Because of that, we used this index for all of the properties.

IFc = Period of occupation index, which considers the time the landholder has occupied the parcel. According to Iterpa staff, most of the cases fit in the "greater than and equal to 10 years" category. We choose this category as a standard in our assessment and applied an index of 0.45 for all parcels.

IFd = Area dimension index, given by the formula:

IFd = 0,0571 x Area/Fiscal Module + 0.3129

Fiscal Module is a measure used to calculate the size of properties in Brazil. When the IFd result was a fractioned number, we rounded it, since the Cepaf's Table only presents whole numbers. For parcels located in two municipalities, we used the Fiscal Module with the highest value, following Iterpa's orientation.

Sr = Parcel's size in hectares (ha).

b. Market Value

We used the average market value by region according to Anualpec (2016) (Table 2).

Table 2. Market price for land (hectare) by region of Pará (Anualpec, 2016)

Region	Municipalities	Amount (R$/ha)
Santarém	Alenquer, Almeirim, Altamira, Aveiro, Belterra, Brasil Novo, Curuá, Faro, Itaituba, Jacareacanga, Juruti, Medicilândia, Mojuí dos Campos, Monte Alegre, Novo Progresso, Óbidos, Oriximiná, Placas, Prainha, Rurópolis, Santarém, Terra Santa, Trairão, Uruará and Vitória do Xingu.	3,077.00
Redenção	Abel Figueiredo, Água Azul do Norte, Anapú, Bannach, Bom Jesus do Tocantins, Brejo Grande do Araguaia, Canaã dos Carajás, Conceição do Araguaia, Cumaru do Norte, Curionópolis, Eldorado dos Carajás, Floresta do Araguaia, Itupiranga, Jacundá, Marabá, Nova Ipixuna, Novo Repartimento, Ourilândia do Norte, Pacajá, Palestina do Pará, Paraupebas, Pau-D'Arco, Piçarra, Redenção, Rio Maria, Santa Maria das Barreiras, Santana do Araguaia, São Domingos do Araguaia, São Félix do Xingu, São Geraldo do Araguaia, São João do Araguaia, Sapucaia, Senador José Porfírio, Tucumã and Xinguara.	3,439.00
Paragominas	Breu Branco, Cachoeira do Piriá, Dom Eliseu, Goianésia do Pará, Ipixuna do Pará, Nova Esperança do Piriá, Paragominas, Rondon do Pará, Tailândia, Tomé-Açú and Ulianópolis.	4,600.00
Ilhas	Bagre, Baião, Cametá, Gurupá, Limoeiro do Ajurú, Melgaço, Oeiras do Pará, Portel, Porto de Moz and Tucuruí.	240.00

Region	Municipalities	Amount (R$/ha)
Belém	Abaetetuba, Acará, Ananindeua, Augusto Corrêa, Aurora do Pará, Barcarena, Belém, Benevides, Bonito, Bragança, Bujaru, Capanema, Capitão Poço, Castanhal, Colares, Concórdia do Pará, Curuçá, Garrafão do Norte, Igarapé-Açú, Igarapé-Miri, Inhangapi, Irituia, Mãe do Rio, Magalhães Barata, Maracanã, Marapanim, Marituba, Mocajuba, Moju, Nova Timboteua, Ourém, Peixe-Boi, Primavera, Quatipuru, Salinópolis, Santa Bárbara do Pará, Santa Isabel do Pará, Santa Luzia do Pará, Santa Maria do Pará, Santarém Novo, Santo Antônio do Tauá, São Caetano de Odivelas, São Domingos do Capim, São Francisco do Pará, São João da Ponta, São João de Pirabas, São Miguel do Guamá, Terra Alta, Tracuateua, Vigia and Viseu.	1,850.00

c. Occupancy Rate

The Occupancy Rate is based in the following formula:

TO = 0.005 x Time of Occupation x VTN or VM

In this formula, the time of occupation is given in years. We considered the time of occupation to be equal to five years for all parcels, because the Iterpa legal department understands that the government's right to charge the Occupancy Rate expires after five years. We calculated the Occupancy Rate for each of the two scenarios of this study: in the first, we calculated it over the Bare Land Value (VTN); in the second scenario, we calculated this rate based on the Market Value (VM).

d. Procedural Costs

The Procedural Cost is directly proportional to the number of Fiscal Modules on the parcel (Table 3). Iterpa readjusts the values charged per fiscal module every January. In this study, we used the amounts updated in January 2017.

Table 3. Procedural Costs according to Cepaf Resolution 01/2015 (amounts updated in January 2017)

N.º	Type of cost	Amount (R$)
1	Assigning the proceeding identification number	91.37/fiscal module
2	Preparation of the Public Notice for land sale	38.09/fiscal module
3	Preparation of Public Notice for sale approval	38.09/fiscal module
4	Analysis of the Economic Use Plan	91.36/fiscal module
5	Analysis of the parcel georeferencing	45.68/fiscal module
6	Reanalysis of the parcel georeferencing	45.68/fiscal module
7	Registry survey	45.68/fiscal module
8	Plotting the parcel in Iterpa's land title database	45.68/fiscal module
9	Decision of the Technical Department	45.68/fiscal module
10	Initial analysis of the Legal Office	45.68/fiscal module
11	Decision of the Legal Office	45.68/fiscal module
12	Definitive cartographic registry	45.68/fiscal module
13	Issuance of definitive land title	45.68/fiscal module

e. Agrarian Costs

We interviewed Iterpa employees[1] to estimate the number of employees and days necessary for performing the field activities included in the Agrarian Costs. Based on the interviews, we excluded two activities from this calculation: i) Inspection of the Economic Use Plan (PAE), because this item is no longer legally required; and ii) Inspection of Demarcation, since this activity is done together with the regular (*in situ*) inspection. Table 4 presents the estimated costs for each activity, considering the multiplication between the cost per employee, the number of employees and the workdays. The final cost of R$ 1,918.71 represents the sum of the total estimated cost for each activity and was adopted as the standard for all parcels in the analysis.

Table 4. Agrarian Costs (CAgra)

Agrarian Costs	Cost (R$) per employee	Number of employees	Work days	Amount (R$)
Demarcation/ Georeferencing	365.47	1	3	1,096.41
***In situ* Inspection**	274.10	1	3	822.30
Total				**1,918.71**

CALCULATING ITERPA'S EXPENSES

a. Personnel Cost

The Personnel Cost is the amount that Iterpa spends on human resources in each proceeding for assessing a land title request. To find this amount, we proceeded in the following manner: i) we interviewed employees from different departments at Iterpa[2] to obtain information about daily time of work and salaries of all of the institute's employees involved in each activity included in the Procedural Cost and Agrarian Cost Tables[3]; ii) we interviewed Iterpa employees to identify the time dedicated to a given task per employee[4]; iii) we calculated the labor cost of each employee for Iterpa by multiplying the daily time of work, salary and time dedicated to the task. Thus, we reached a fixed amount for all parcels of R$ 4,730.79.

However, the Personnel Cost may be larger, due to the following factors: i) we did not consider the expenses with infrastructure at Iterpa headquarters for each employee (such

[1] Employees from two departments: the Coordination for Agrarian and Land Title Activities (CAF) and the Coordination for Registry and Georeferencing of Rural Properties (CGIR).

[2] The sectors interviewed were: Service and Control Management (GAC), Coordination for Documentation and Information (CDI), Legal Office (DJ), Georeferencing Management (Geo 1), Cartography and Geoprocessing Management (GCG), Coordination for Agrarian and Land Title Activities (CAF), Coordination for Registration and Georeferencing of Rural Properties (CGIR), Land Title Regularization Management (GRF), Directorate for Agrarian Development and Land Title Management (DEAF) and Documentation Management (GDA).

[3] For outsourced services, we adopted salaries paid by Iterpa in similar positions (e.g. to define the cost of employees that assign the proceeding identification number (an outsourced activity), we considered the salaries of employees who work as secretaries at Iterpa.

[4] This amount is different from the daily workload for the employee, because it would be the fraction of the workload that the employee uses for executing the task in the regularization process.

as water, electricity and rent); ii) in many cases Iterpa first needs to register the public parcel in the state's name before selling it for third parties, but we did not consider the personnel costs with this process; iii) many cases undergo reworking, meaning that the proceeding returns to the previous sector for revising or finalizing the activity.

b. Per Diem Cost

Based on information provided by employees from different departments at Iterpa[5], we estimated the amount spent on per diems during field inspections. To do that, we considered the number of employees and days necessary for the field work and we reached a fixed amount for all parcels of R$ 1,950.00.

c. Transportation Cost

We calculated the transportation cost as follows: i) we estimated the distance between Iterpa head office in Belém and each rural parcel and multiplied the distance by two for a round trip; ii) we estimated the average amount of fuel used by the Iterpa pick-up trucks in running the distance calculated for each property (distance to property ÷ kilometers traveled per fuel liter); and iii) we multiplied the estimated amount of fuel by the price of diesel in the municipality using information from the National Petroleum Agency (ANP for its Portuguese acronym)[6]. When ANP did not supply the diesel price for a given municipality, we adopted the average diesel cost for the municipalities in the same region[7]. For example, in Belém region, ANP informed only the diesel costs for Abaetetuba and Castanhal municipalities, so we used the average of those two cities for all of the others in the same Belém region.

DISCOUNTS APPLICABLE TO THE VALUE OF THE PARCEL

State legislation provides two possibilities for a discount on the final value of the parcel:

a. Forest conservation: 30% discount for parcels that conserve the Legal Reserve and Permanent Preservation Area[8]. We applied such a discount to parcels that complied with a legal reserve of 80%, meaning, that presented 80% of the parcel's area or more under forest cover, according to Prodes data up to 2015.
b. Lump sum payment: 20% discount due to lump sum payment[9]. In this case, we applied the discount for 50% of the 8,053 parcels in our dataset, according to information from Iterpa employees regarding the frequency of cases with lump sum payments.

[5] The departments are: the Coordination for Agrarian and Land Title Activities (CAF) and the Coordination for Registration and Georeferencing of Rural Properties (CGIR).

[6] Agência Nacional de Petróleo (ANP). Available at: <http://anp.gov.br/preco/prc/Resumo_Por_Estado_Municipio.asp>. Access on: 04 Apr. 2017.

[7] Region of the municipalities considered the FNP classification available at: FNP. Anualpec 2016, p. 251. Informaecon: São Paulo, 2016.

[8] Article 7, paragraph 6 of Law 7.289/2009.

[9] Article 7, paragraph 7 of Law 7.289/2009.

CALCULATION OF THE POTENTIAL FOR FINANCIAL COLLECTION IN SCENARIOS 1 AND 2

To calculate the potential for financial collection considering the Bare Land Value and the Market Value, we applied the discounts for forest conservation and lump sum payment in the two scenarios. In the case of lump sum payments, we performed one thousand drawings to choose the 50% of properties that would receive the 20% discount. At the end of each drawing, we added the profit obtained for each parcel, in both scenarios. In each scenario, based on the total profit amount for each of the thousand drawings, we obtained the average amount, the 5th and 95th percentile of collection amount for the 8,053 properties, with a confidence interval of 90%. In other words, there is 90% of confidence that the collection values for the 8,053 parcels are between the 5th and the 95th percentile.