INSTITUTO NACIONAL DE PESQUISA DA AMAZÔNIA – INPA

PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA

INFLUÊNCIA DA QUALIDADE DE GOVERNANÇA AMBIENTAL NO DESMATAMENTO NOS MUNICÍPIOS DA AMAZÔNIA LEGAL

LILIAN FERNANDES OLIVEIRA DIAS

Manaus, Amazonas

Fevereiro, 2014

LILIAN FERNANDES OLIVEIRA DIAS

INFLUÊNCIA DA QUALIDADE DE GOVERNANÇA AMBIENTAL NO DESMATAMENTO NOS MUNICÍPIOS DA AMAZÔNIA LEGAL

Willian Ernest Magnusson

Dissertação apresentada ao Instituto Nacional de Pesquisas da Amazônia como parte dos requisitos para obtenção do título de mestre em biologia (Ecologia).

Manaus, Amazonas
Fevereiro, 2013

RELAÇÃO DA BANCA JULGADORA

Eduardo da Silva Pinheiro – Aprovado

Hiroshi Noda – Aprovado

Paulo Maurício de Alencastro Graça - Aprovado

Sinopse:

Foi estudado a influência da qualidade de governança ambiental no desmatamento dos municípios da Amazônia Legal com o objetivo de compreender e quantificar os seus possíveis impactos. A governança ambiental foi medida entre os períodos de 2001 a 2011.

Palavras-chave: Amazônia Legal, Governança, Governança ambiental, Desmatamento.

DEDICATÓRIA

Dedico este trabalho ao meu marido David Valentim Dias, que me acompanhou e incentivou durante esses dois anos.

AGRADECIMENTOS

Várias pessoas foram indispensáveis para meu sucesso na academia. Meus pais que financiaram meus estudos até a faculdade, sobretudo minha mãe que por diversas vezes me surpreendeu com um livro novo. Meus professores que sempre me incentivaram a estudar, em especial professora Júnia que me ensinou a amar biologia, professora Ramaldes que inúmeras vezes me pagou a condução para ir a escola, professora Marlene por ser divertida e sempre me dizer que eu "iria além" e minha orientadora da faculdade Dra. Tania Gonçalves dos Santos que me iniciou na pesquisa e propiciou um ótimo ambiente de trabalho. Agradeço ao Dr. Willian Ernest Magnusson a confiança e paciência, e por me aceitar me orientar mesmo em um trabalho nada convencional. Agradeço meu avô Antônio (in memoriam) por me incentivar desde meus três anos dizendo que eu seria importante, enquanto me segurava no colo e apresentava a todos que via.

Agradeço ao Instituto Nacional de Pesquisas da Amazônia – INPA, por me dar suporte estrutural para desenvolvimento da minha pesquisa e a Fundação de Amparo a Pesquisa do Amazonas, por financiá-la.

RESUMO

Atualmente tem se discutido que a mensuração de governança em escalas menores do que global poderia ser uma importante ferramenta de gestão. Uma vez que os estudos atuais são conduzidos em uma escala global, e usam métodos caros. No presente estudo, avaliamos se a governança reportada em municípios da Amazônia está relacionada à redução do desmatamento. A atividade econômica (EA) afetada por governança geral (G) positiva (G = 0,81 1,19 * EA, F1, 98 = 77,36, p <0,001). Governança ambiental (por exemplo) não foi afetada de forma significativa (p = 0,43) pelo desmatamento (anterior a 2000) (PD), mas aumentou de forma significativa (p <0,001) com a governança geral (G) (EG = -0,29 + 0,04 DP + 0,98 * OG , F2,97 = 42,6, p <0,001). O desmatamento não foi significativamente relacionada com a governança ambiental (p = 0,82). O único efeito indireto de magnitude significativa foi o efeito da densidade de reservas florestais em desmatamento recente através do desmatamento (anterior a 2000), que foi fortemente negativa (-0,49). É possível avaliar ações relatadas para promover a governança municipal por meio de dados oficiais. No entanto, não é o suficiente para assumir que a governança geral ou governança ambiental em nível municipal, como refletido nas estatísticas oficiais, conservação benefícios ambiente. Na verdade, mesmo a nível dos Estados-nação, em que a maioria quantificação de governança tem sido feita, parece que a relação entre governança e preservação do meio ambiente é apenas uma suposição, porque estamos cientes de nenhum estudo que suporta essa hipótese quantitativamente

ABSTRACT

It has been argued that measuring governance at scales smaller than global could be an important management tool. However, current studies are conducted on a global scale, and use expensive methods. In the present study, we assess whether the reported governance of Amazonian municipalities is related to reductions in deforestation. Economic activity (EA) affected general governance (G) positively (G = 0.81 +1.19 * EA, $F_{1, 98}$ = 77.36, p < 0.001). Environmental governance (EG) was not affected significantly (p = 0.43) by deforestation (before 2000) (PD), but increased significantly (p < 0.001) with general governance (G) (EG = -0.29 + 0.04 PD+0.98*OG, $F_{2,97}$ = 42.6, p <0.001). Deforestation was not significantly related to environmental governance (p = 0.82). The only indirect effect of significant magnitude was the effect of the density of forest reserves on recent deforestation through deforestation (before 2000), which was strongly negative (-0.49). It is possible to assess reported actions to promote municipal governance through official data. However, it is not enough to assume that general governance or environmental governance at the municipal level, as reflected in the official statistics, benefits environment conservation. In fact, even at the level of nation states, at which most quantification of governance has been undertaken, it seems that the relationship between governance and environment preservation is only an assumption, because we are aware of no study that supports that hypothesis quantitatively

SUMÁRIO

APRESENTAÇÃO

A dissertação foi elaborada como parte dos requisitos para a obtenção do título de mestre em biologia (Ecologia) pelo Instituto nacional de Pesquisas da Amazônia -I NPA. O estudo procurou quantificar governança e governança ambiental a nível de municípios da Amazônia Legal, e se possível determinar a relação entre governança e desmatamento no período de 2001 a 2011

A dissertação é composta por um capítulo em forma de artigo. O artigo aqui apresentado segue as normas da revista PLOS ONE.

OBJETIVO

o objetivo do presente trabalho foi determinar se possível quantificar governança em nível de município com as informações disponíveis em estatísticas oficiais e, se for possível, determinar qual a relação entre governança e taxa de desmatamento nos municípios amazônicos na última década.

_____

Dias, L.F.O; Dias, D.V. & Magnusson, W.E.

Influência da qualidade de governança ambiental no desmatamento nos municípios da Amazônia Legal

1 INFLUENCE OF ENVIRONMENTAL GOVERNANCE ON DEFORESTATION IN

2 MUNICIPALITIES OF THE BRAZILIAN AMAZON

3 Lilian F.O. Dias[1], David V. Dias1, William E. Magnusson1

4 1 CBIO, Instituto Nacional de Pesquisa da Amazônia, Manaus, Brasil.

5 **ABSTRACT**

6   It has been argued that measuring governance at scales smaller than global could be an important

7 management tool. However, current studies are conducted on a global scale, and use expensive

8 methods. In the present study, we   assess whether the reported governance of Amazonian

9 municipalities is related to reductions in deforestation. Economic activity (EA) affected general

10 governance (G) positively (G = 0.81 +1.19 * EA, $F_{1, 98}$ = 77.36, p < 0.001). Environmental

11 governance (EG) was not affected significantly (p = 0.43) by deforestation (before 2000) (PD),

12 but increased significantly (p < 0.001) with general governance (G) (EG = -0.29 + 0.04

13 PD+0.98*OG, $F_{2,97}$ = 42.6, p <0.001). Deforestation was not significantly related to

14 environmental governance (p = 0.82). The only indirect effect of significant magnitude was the

15 effect of the density of forest reserves on recent deforestation through deforestation (before 2000),

16 which was strongly negative (-0.49). It is possible to assess reported actions to promote municipal

17 governance through official data. However, it is not enough to assume that general governance or

18 environmental governance at the municipal level, as reflected in the official statistics, benefits

19 environment conservation. In fact, even at the level of nation states, at which most quantification

20 of governance has been undertaken, it seems that the relationship between governance and

21 environment preservation is only an assumption, because we are aware of no study that supports

22 that hypothesis quantitatively

INTRODUCTION

The concept of governance has gained international attention during the last decade due to recognition of the need to explore the borders between state and society (31).The concept of governance is basically that the state is not the only authority that establishes rules, and that dialog among public entities, economic agents, and stakeholders is necessary for the welfare of society as a whole. Governance is the way in which power is exercised in the management of social and economic resources of a country with the aim of development (23, 25). Governance is a diffuse concept, so that it can be applied to different areas, such as business administration (corporate governance), the application of resources of information technology in public administration and public policy organizations (e-governance), or ways to combat bribery and corruption of public officials (public governance). Environmental governance is the institutional framework of rules, institutions, processes and behavior that affect the way in which powers are exercised in the sphere of political relations or actions related to the ecological system (24). Goals supported by governance are considered to be more enduring (5), and debate about governance of forests, especially tropical forests, has become intense, both within Brazil and internationally (43).

Most studies of governance are conducted on a global scale, because the complex variables that compose governance are hard to collect, making it difficult to operate on smaller scales (12). Governance is reflected by many variables, and the World Bank considers hundreds of individual measures in order to evaluate the various dimensions of governance (53). The indicators are selected to reflect perceptions of governance in the public and private sectors, in non-governmental organizations, as well as the perception of hundreds of citizens and companies, and are quantified through surveys and questionnaires.

To create a database of information coming from many different sources in a reasonable

46 time frame, it is necessary to use techniques of automatic data collection. Public databases can be

47 rich in information (30), but their assessment must be systematic and careful in order to ensure

48 adequate depth and coverage (41). Although governance is usually compared among nations,

49 measurements on a local scale could be useful management tools, since many problems, such as

50 transparency, corruption potential, lack of equity, and access to technology and media, occur on

51 a local scale (39).

52   Although deforestation is affected by many factors, such as colonization policies in the

53 past (29, 28), migratory processes and investment in infrastructure (16,7), logging (15), ranching

54 (4), agrobusiness (2), and previous infrastructure, which produces spatial autocorrelation of

55 deforestation (46, 47), governance is considered an important tool for avoiding deforestation (48).

56 However, few studies have related quality of governance to deforestation rates. Those that have,

57 focused on scales larger than municipal, but concluded that increase in the quality of governance

58 tends to be associated with a decrease in deforestation rates (50, 52).

59   It is often claimed that municipal participation is imperative for fighting deforestation.

60 The municipality represents the smallest sphere of government in Brazil, and has relative

61 autonomy in finance, politics, and management. This autonomy, although not representing auto-

62 sufficiency, affects formulation and implementation of public policies (22). Deforestation in the

63 Amazon reflects the socioeconomic parameters of each municipality (29).

64   Municipal governments have responsibilities for environmental management, some of

65 which are exclusive and some of which are common to other governmental spheres. Therefore,

66 local official statistics can reflect, albeit indirectly, the governance of the municipality. It is

67 important to distinguish between measures of governance available to decision makers and

68 effective governance. Measures of governance available from official sources (reported

69   governance), such as those used by the World Bank, may not be reflected in effective governance.

70   It would obviously be best to measure effective governance with detailed studies in each political

71   unit (countries in the case of the World Bank studies or municipalities in the case of this study).

72   However, this option is presently too expensive to be used in the development of public policies,

73   especially as effective governance may change from one year to the next. In this study, we

74   evaluate whether reported governance in Amazonian municipalities is related to reduction of

75   forest clearing, which is a major objective of governance in the Brazilian Amazon (35, 33).

76   **MATERIAL AND METHODS**

77   STUDY SITE

78   The Amazon biome (Figure 1) is present in nine South American countries, with 69% in

79   Brazil (1). This study included 780 municipalities of the Brazilian Legal Amazon, which

80   comprises the Brazilian States of Amazonas, Roraima, Pará, Amapá, Acre, Rondônia, Mato

81   Grosso, Tocantins, and Maranhão.

82

83   **Figure 1. Brazilian Amazon.** Boundaries of (lines) and capitals (black dots) of the municipalities

84   of the Brazilian Amazon.

85

86   There is no generally accepted method of evaluating governance for municipalities, so we

87   adjusted our methods to reflect those use by the World Bank for evaluating governance in nation

88   states. The World Bank divides governance into six dimensions (Table 1). In this study, we sought

89   official statistics that reflected as much as possible those dimensions.

90

91   **Table S1. Dimensions of governance and indicators collected.** Dimensions of governance

92 established by the World Bank, their definitions and indicators collected from official stats.

93

94   Indices of governance not directly related to environmental issues, which hereafter will be

95 referred to as reported general governance, and environmental governance in the municipalities

96 were obtained from the data provided by IBGE (Brazilian Institute of Geography

97 andStatisticshttp://www.ibge.gov.br/home/estatistica/economia/perfilmunic/defaulttab1_perfil.s

98 htm). The surveys conducted by IBGE covered information regarding social indicators, human

99 rights, municipal management, housing, health, education, sanitation, and environment, among

100 others. In this study, we used data from the 780 municipalities in the Legal Amazon collected

101 between 2001 and 2011.

102   The presence or absence of those factors was determined using data obtained from the

103 IBGE website (27). The values of presence (1) or absence (0) were summed in order to obtain the

104 final value for governance, which potentially ranged from zero to 23.

105   For environmental governance, we considered only governance indicators related to

106 environmental management. These were organizations or actions that are designed to affect

107 environmental quality or the extent of Forest cover. Environmental governance was quantified

108 through presence or absence of the following institutions: environmental council, municipal fund

109 for the environment, availability of resources specifically for the environmental sector,

110 environmental licensing of local impacts, river-basin committee, management of solid waste,

111 management of urban rainwater, municipal council for sanitation, and legislation about selective

112 waste collection.

113   As for governance, data were obtained from the IBGE website (27). The values of

114 presence (1) or absence (0) were summed to produce a final value for environmental governance,

115   which potentially ranged between zero and 9.

116   The World Bank uses a system of questionnaires to evaluate expert opinion on the relative

117   importance of each indicator and weights individual indicators accordingly. This system is

118   subjective and difficult to reproduce for municipalities. Therefore, we used a Bayesian

119   hierarchical analysis to attribute weights to individual indicators to maximize their relationship

120   to deforestation. This allowed us to evaluate whether a weighting system would change our

121   conclusions (more details in SI2).

122   GDP (Gross Domestic Product) is the most commonly used indicator to measure economic

123   activity. It reflects wealth production in a location, and indicates the capacity of the economy to

124   generate jobs (51). The economic activity index consisted of the GDP annual value for each

125   municipality, obtained from IBGE website (26). Other indicators, such as the Human

126   Development Index (HDI), that include historical factors and economic effects confound the

127   results of effective governance.

128   The areas that were deforested in each municipality were obtained from the PRODES

129   (Program to calculate deforestation in the Amazon) database, in the INPE (National Institute for

130   Space Research) website (40)

131   The areas covered by state and federal reserves were obtained from shape files of

132   conservation units and Brazilian municipalities available in the MMA (Ministry of Environment)

133   website (36). The extent of official state and federal roads was obtained from georeferenced

134   vector layers of highways and towns in Brazil available in the DNIT (National Department of

135   Infrastructure and Transportation) website (14). The values for roads and reserves were

136   transformed into density by dividing the total area of the municipality by the area occupied by

137   reserves and total length of roads.

138   The factors that affect deforestation are spatially correlated. Deforestation usually occurs

139   in scattered patches, such that municipalities included in the same patch have similar levels of

140   deforestation. Therefore, the information from municipalities close to each other is often not

141   independent, and such lack of independence compromises statistical analyses (32).

142   In order to minimize this problem, spatially close municipalities with similar

143   deforestation were clustered using the K-means clustering algorithm. The clustering parameters

144   were latitude and longitude of the municipal headquarters and deforestation. The municipalities

145   were clustered into 100 groups, which was the number considered to be the minimum to maintain

146   confidence in the statistical analyses (Figure 2).

147   Simple regression coefficients among variables do not take into account the direct and

148   indirect effects of predictor variables. Path analysis was used to quantify indirect effects. This

149   procedure estimates the magnitude of the effects of predictor variables on comparable scales

150   through standardized regression coefficients and allows the assessment of effects of one variable

151   that propagate through intermediate effects of other variables.

152

153   **Figure 2. Supermunicipalities of Brazilian Amazon.** Sites for municipalities (black dots), and

154   supermunicipalities (red dots) formed after grouping.

155

156   **RESULTS**

157   Economic activity (EA) affected reported governance not directly related to

158   environmental issues, which hereafter will be referred to as reported general governance (RGG),

159   positively (RGG = 0.81 + 1.19 * EA, $F_{1, 98}$ = 77.36, p < 0.001), and road density (RD) was

160   significantly related (p = 0.01) to economic activity (RD = 0.6 -0.6 * EA, $F_{1, 98}$ = 6.4, p = 0.01).

161   Road density ($p < 0.001$) and forest-reserve density (FRD) ($p = 0.0002$) had negative relationships

162   with deforestation (before 2000) (PD): (PD = 1.02 -0.74 * RD -0.54 * FRD, $F_{2,97} = 14.0$, $p <$

163   0.001).

164   Reported environmental governance (REG) was not significantly affected ($p = 0.43$) by

165   deforestation (before 2000)(PD), but increased significantly ($p < 0.001$) with the reported general

166   governance (RGG): (REG = -0.29 + 0.04 * PD + 0.98 * RGG, $F_{2,97} = 42.6$, $p < 0.001$).

167   Deforestation (D) was related significantly ($p = 0.004$) and negatively with road density

168   (RD), significantly ($p < 0.001$) and positively with deforestation before 2000 (PD), significantly

169   ($p = 0.007$) and positively with forest reserve density (FRD), but was not significantly related to

170   reported environmental governance ($p = 0.82$) or economic activity (EA) ($p = 0.32$): (D = 0.08 −

171   0.13 * RD + 0.91 * PD + 0.09 * FRD + 0.01 * REG − 0.11 * EA, $F_{5,94} = 400.4$, $p < 0.001$).

172   Path analysis indicated that indirect effects on deforestation between 2001 and 2010 were

173   generally very low in comparison with the direct effects, and that most indirect effects had path

174   coefficients (PC) lower than 0.1 (Figure 3). Economic activity had indirect positive effects on

175   deforestation through general governance and environmental governance (path coefficient 0.01).

176   It also had a slightly higher indirect positive effect through the effect of road density on

177   deforestation (0.07). Nevertheless, the indirect effect of road density on current deforestation

178   through deforestation (before 2000) was positive (0.08). Road density had a minor indirect

179   negative effect through deforestation (before 2000) and environmental governance (-0.003).

180   General governance had a positive effect on deforestation through environmental governance

181   (0.011). The indirect effect of deforestation (before 2000) on deforestation through environmental

182   governance on deforestation was positive, but very low (0.0004). The indirect effect of forest

183   reserve density through deforestation (before 2000) and environmental governance was also very

184 low (-0.0002).

185   Overall, the only indirect effect of significant magnitude was the effect of forest-reserve

186 density on recent deforestation through deforestation (before 2000), which was strongly negative

187 (-0.49).

188

189 **Figure 3: Flowchart of the analysis results.** Each arrow represents a path and its associated path

190 coefficient. Asterisks represent statistically significant relationships in simple or multiple

191 regression tests ($P < 0.05$).

192

193 **DISCUSSION**

194   Governmental institutions have much information available to use in both internal

195 operations and provision of services (13). Nevertheless, data on general governance and

196 environmental governance in municipalities were inconsistently published, reducing the quality,

197 and complicating access to the information. The survey forms used by IBGE varied among years,

198 so in this study it was necessary to develop automated data-search methods on the internet to

199 obtain information within a reasonable time frame. Despite the difficulty of access, indicators that

200 reflect the quality of municipal public management are essential for effective planning, since they

201 allow monitoring of economic and social development in the municipalities (49). Also, it is only

202 possible to assess the effectiveness of governance actions if they can be quantified.

203   The strong positive relationship between economic activity and reported governance was

204 similar to the relationship reported in the literature for units larger than municipalities and for

205 models derived from cellular automata. This is most likely due to the fact that most political

206 decisions made in Brazil target strong economic growth (10, 8). Municipalities that are more

207 urbanized and more economically developed usually have more environmental problems, even

208 though they have more governmental institutions responsible for the environment (38). In the

209 Legal Amazon, economic activity is strongly linked to land use (17), which results in public

210 policies to regulate it (44).

211   The relation between reported governance and reported environmental governance also

212 behaved similarly to what is reported in the literature and in models of cellular automata in units

213 larger than the municipality. Maintaining a system of economic progression demands

214 environmental policies that make it possible. This system tends to reduce the ability of the sectors

215 responsible for environmental issues to influence public policies (21).

216   The road network is responsible for most of the outflow of Amazonian products (18).

217 Roads could enable economic activities with negative environmental impact. The roads can give

218 access to migrants and entrepreneurs with different levels of economic resources. This increases

219 the value of the land, stimulating real-estate speculation and, consequently, expansion of

220 deforestation (19). However, at the municipal level, economic activity had a weak negative effect

221 on roads, possibly because data collected on economic activity do not reflect the profit obtained

222 from illegal activities conducted in municipalities of the Legal Amazon, or because we evaluated

223 only official roads.

224   Deforestation in the Amazon is associated with road construction (20). Nevertheless, one

225 model of deforestation indicated that, if the construction of roads was made within a scenario of

226 effective governance, deforestation could be reduced by 62% for the Brazilian Legal Amazon,

227 and 55% for the basin as whole (48). At the municipal level, we did not find a relationship between

228 road density and deforestation between 2000 and 2010. There was also a negative relationship

229 between road density and deforestation (before 2000). Data collected about the road network

230   included only state and federal roads, and did not quantify informal roads, which might have

231   contributed to underestimation of extent of the road network in the Legal Amazon and,

232   consequently, the deforestation caused by it. More studies about these relationships are needed,

233   since the roads that are planned by public authorities are potentially part of governance, and may

234   have little effect on deforestation compared to roads associated with the informal economy.

235   There was a negative relationship between the density of forest reserves and the

236   deforestation that occurred up to the year 2000, as the implementation of reserves limits the area

237   to be deforested (37). However, the lack of infrastructure needed for reserve operation (fiscal

238   agents, cars, access ways, etc.) added to an inefficient justice system and to market incentives for

239   continuing exploitation, can make this relationship weak and positive in the long term. This was

240   observed in the relationship between forest reserve density and deforestation in municipalities of

241   the Legal Amazon between the years of 2001 and 2011 in this study, and also the studies by

242   Machado *et al.* (34), Azevedo & Saito (6) and Almeida *et al.* (3).

243   The indices used here to describe governance and environmental governance had no

244   significant effect on deforestation. It is possible that official data do not effectively reflect

245   governance. However, the assessment of governance at higher levels, such as among nation states,

246   is made through official data (9), and the verification in loco of 780 municipalities would be

247   economically impracticable.

248   The absence of a strong effect of reported governance on deforestation possibly results

249   from the fact that the main activities causing deforestation in the Legal Amazon are associated

250   with illegal activities, which are often difficult to detect with data obtained from official sources.

251   The assessment of governance has usually been made at the level of countries, in which the

252   institutions that propagate governance activities are distant from the activities that governance

253   should repress. Local residents and their representatives in municipalities affected by

254   deforestation may oppose creation of reserves or the implementation of restrictive environment

255   policies. The absence of effective environmental policies may bring immediate benefits (jobs in

256   agricultural and extractive industries, fisheries, etc.), and these benefits are likely to be more

257   important for local people than concerns about deforestation (42, 11, 45).

258   It is generally assumed that degradation of the environment is a function of governance.

259   However, it is just as likely that the relationship is the inverse. When there is little environmental

260   degradation, there is little pressure on government agencies to implement environmental

261   governance. Degradation of environmental conditions leads to demands on local government to

262   implement governance actions that will be reflected in official statistics. Therefore, it may be that

263   governance actions generally come too late to avoid environmental degradation, such as

264   deforestation.

265   It is possible to assess actions to promote municipal governance through official data, and

266   reported governance may have effects on environmental concerns other than deforestation.

267   However, it is not enough to assume that governance or environmental governance at the

268   municipal level will benefit environment conservation, and studies must be undertaken to evaluate

269   the relationship between governance and every environmental aspect that governance is supposed

270   to improve. In fact, even at the level of nation states, at which most quantification of governance

271   has been undertaken, it seems that the relationship between governance and environment

272   preservation is only an assumption, because we are aware of no studies that support that

273   hypothesis quantitatively. It may be that reported governance reflects more attempts by people to

274   recover environmental quality that they have lost, rather than a mechanism to avoid

275   environmental degradation.

REFERENCES

282   1. Ab'Saber, A. (1977). Zoneamento ecológico e econômico da amazônia: questões de escala e

283 método. Estudos avançados.

284 2. Alencar, A.; Nepstad, D.; Mcgrath, D.; Moutinho, P.; Pacheco, P.; Vera Diaz, M.; Soares

285   Filho, B. (2004). Desmatamento da Amazônia: indo além da "emergência crônica".Instituto de

286 PesquisaAmbiental da Amazônia.89p.

287   3. Almeida, A. N; de et al. (2013) Efetividade do aumento da área de reserva legal por meio de

288 instrumento legal na taxa de desmatamento da Amazônia Brasileira. Floresta Ambient.   vol.20,

289 n.2, pp. 143-148. ISSN 2179-8087.

290 4. Amaral, E. F. do; Borges, K.; Valentim, J. F.; Michelotti, F.; Araújo, E. A. de; Sá, C. P. de.

291 (2000).Populações   rurais   e   tendências   de   uso   dos   recursos   naturais –   colonos,

292 extrativistas,ribeirinhos e pecuaristas. In: Zoneamento Ecológico-Econômico: documento final -

293 Primeira   Fase. Rio Branco: Sectma, v. 2, p. 79- 133.

294   5. Araújo, I. V. (2011). A governança global ea atuação das redes internacionais de cidades.

295 Proceedings   of the 3rd ENABRI 2011 3 Encontro Nacional ABRI 2011

296 6. Azevedo, A. A & Saito, C.H. (2013). Deforestations profile in Mato Grosso, after

297 implementation of the environmental licensing in rural properties. Cerne 19.1: 111-   122.

298 7. Brown, I. F.; Brilhante, S. H. C.; Mendoza, E.; Oliveira, I. R. (2002). Estrada de Rio Branco,

299 Acre, Brasil aos Portos do Pacífico: como maximizar os benefícios e minimizar os prejuízos para

300 o desenvolvimento sustentável da Amazônia Sul-Ocidental. In: Encuentro internacional de

301 intergracion regional - Bolívia, Brasil y Peru. Lima. Lima: CEPEI, 8 p.

302 8. Buss, P.M; et al (2012). Governança em saúde e ambiente para o desenvolvimento sustentável.

303 Ciênciasaúde coletiva. Vol17, n.6, pp. 1479-1491. ISSN 1413-8123

304 9. Cardoso, G. D., & de Sousa, A. D. S. C. (2013). Os reflexos da globalização na governança da

305 amazônia: um estudo sobre os programas e estratégias para a defesa de sua soberania. Anais:

306 Encontros Nacionais da ANPUR, *15*.

307 10. Cavalcanti, C. (2004). Economia e ecologia:Problemas da governança ambiental no Brasil.

308 Revista ibero-americana de economia ecológica.v.1, p. 1-10,

309 11. Cavalcante, M. M. D. A., Nunes, D. D., Silva, R. G. D. C., & Lobato, L. C. H. (2011).

310 Políticas Territoriais e Mobilidade Populacional na Amazônia: contribuições sobre a área de

311 influência das Hidrelétricas no Rio Madeira (Rondônia/Brasil). Confins. Revue franco-

312 brésiliennedegéographie/Revista franco-brasilera de geografia, (11).

313 12. Cruz, N. F; Marques, R. C. (2011) Índices de governança municipal: utilidade e

314 exequibilidade. 8° congresso nacional de administração pública.

315 13. Diniz, V. (2010). Como conseguir dados governamentais abertos. In Congresso consad de

316 gestão pública, III, Brasília.

317   14.   DNIT-   Departamento   nacional   de   infraestrutura   e   transportes.

318   http://www.dnit.gov.br/mapasmultimodais/shapefiles. Acess, 17 September 2013.

319   15. Fearnside, P.M. (1993). Deforestation in the Brazilian Amazonia: The Effect of Population

320   and Land Tenure. Ambio. 22(8)537-45.

321   16. Fearnside, P. M. (2005). Desmatamento na Amazônia brasileira: história, índices e

322   consequências. Megadiversidade,v.1.n.1, jul., p. 113-123.

323   17. Fearnside, P. M. (2006). Desmatamento na Amazônia: dinâmica, impactos e controle. Acta

324   Amazônica, *36*(3), 395-400.

325   18. Fearnside, P. M., & de Alencastro Graça, P. M. L. (2009). BR-319: A rodovia Manaus-Porto

326   Velho e o impacto potencial de conectar o arco de desmatamento à Amazônia central. NCN-

327   Novos Cadernos *NAEA*, *12*(1).

328   19. Fearnside, P.M. (2010).Consequências do desmatamento da Amazônia. Scientific American

329   Brasil Especial Biodiversidade, pp. 54-59.

330   20. Fearnside, Philip Martin, et al. (2012) O futuro da Amazônia: Modelos para prever as

331   consequências da infraestrutura futura nos planos plurianuais. NCN-Novos Cadernos NAEA

332   15.1 .

333   21. da Fonseca, I. F., & Bursztyn, M. (2009). A banalização da sustentabilidade: reflexões sobre

334   governança ambiental em escala local. Sociedade e Estado, 24(1), 17-46.

335   22 Franzese, C. (2005). Município, estado e união:Três esferas de governo para o mesmo local.

336   Fundação Getúlio Vargas. Escola de Administração de empresas de São Paulo.

337   23. Fukuyama, F. (2013). What is governance?. Governance, 26(3), 347-368.

338   24. Gomides, J. E., & Silva, A. C. (2010). O surgimento da expressão ''governance'', governança

339   e governança ambiental: um resgate teórico. Revista de Ciências Gerenciais, 13(18), 177-194.

340   25. Gonçalves, A. (2005). O conceito de governança. XIV Encontro do Conpedi.

341   26.IBGE-Instituto   Brasileiro   de   Geografia   e   estatística.   Cidades@.

342   http://www.ibge.gov.br/cidadesat/topwindow.htm?1. Acess, 28 August 2012

343   27. IBGE- Instituto Brasileiro de Geografia e estatística. Perfil dos municípios brasileiros.

344   http://www.ibge.gov.br/home/estatistica/economia/perfilmunic/2001/default.shtm . Acess, 28

345   August 2012

346   28. Kampel, S. A; Câmara, G; & Quintanilha, J. A. (2000). Análise Exploratória das relações

347   espaciais do desflorestamento na Amazônia Legal Brasileira. Anais Gisbrasil,   Salvador,

348   Brasil.

349   29. Kampel. S. A; Câmara, G; Quintanilha. J.A. (2005) Análise exploratória das relações

350   espaciais do desflorestamento na Amazônia legal brasileira.São Paulo.

351   30. Kern, A.P. (2012). Evidências de relação entre governança municipal e qualidade da

352   educação.

353   31. Kjær, A.M.(2011). Rhodes' Contribution to Governance Theory: Praise, Criticism and the

354   Future Governance Debate, Forthcoming in Public Administration.

355   32. Legendre, P. (1993). Spatial autocorrelation: trouble or new paradigm?. Ecology, 74(6), 1659-

356   1673.

357   33. Lima, J. A. D. S. (2014). Banco Mundial e as estratégias de desenvolvimento nacional: a

358   aplicação da boa governança para o Brasil e para a China (1990-2010).

359   34. Machado, J. S., et al. (2013). Diminuição do efeito de borda pela unificação de reservas

360   ambientais em Uruçuí-PI.. Scientia Plena 8.4 (b).

361   35. Medina, G. (2012). Governança local para manejo florestal na Amazônia. Revista Brasileira

362   de Ciências Sociais, 27(78).

363   36.MMA-   Ministéio   do   meio   ambiente.   Dados   georreferenciados.

364   http://mapas.mma.gov.br/i3geo/datadownload.htm. Acess, 17 September 2013

365   37. Nolte, C. et al. (2013). "Governance regime and location influence avoided deforestation

366   success of protected areas in the Brazilian Amazon." Proceedings of the National Academy of

367   Sciences 110.13 .. 4956-4961.

368   38. de Oliveira, S. M. M., Barcellos, F. C., & Green, A. P. L. (2013). Urbanizaçâo, impactos

369   ambientais e governança no complexo regional Centro-Sul. Revista Iberoamericana de Economía

370   Ecológica.

371   39. Piotrowski, S; Bertelli, A. (2010). Measuring Municipal Transparency, in 14th IRSPM

372   conference Bern, Switzerland.

373   40.   Prodes-   Monitoramento   da   floresta   amazônica   brasileira   por   satélite.

374   http://www.obt.inpe.br/prodes/index.php Acess, 28 August 2012.

375   41. Rothberg, D; & Liberato, F.P. (2013). Opinião pública e cidadania: a qualidade da informação

376   nos portais eletrônicos de governo das regiões administrativas do Estado de São Paulo.

377   42. Santos, R. I. (2013).. Atores Sociais e Gestão Participativa em um Território em Movimento:

378   o caso de Vitória do Xingu (PA). Amazônia, Organizações e Sustentabilidade, 2(1), 23-43.

379   43. Sayer, J.A; & Collins.M. (2012). Forest governance in a changing world: reconciling local

380   and global values. The Round Table 101.2 137-146.

381   44. Serrano, A. L. M., Gonçalves, R. D. S., & Gonçalves, A. D. O. (2013). Avaliação do impacto

382   de políticas públicas federais no processo de desmatamento na Amazônia.

383   45. Silva, L. D. J. D. S., Miranda, T. N., & Monteiro, R. (2013). Resistências e mobilizações das

384   comunidades no Pará: entre novos e velhos discursos sobre modelos de desenvolvimento na

Amazônia. Somanlu: Revista de Estudos Amazônicos, 12(2), p-128.

46. Soares-Filho, Britaldo S., Renato M. Assuncao, and Alexandre E. Pantuzzo.(2001). Modeling the spatial transition probabilities of landscape dynamics in an Amazonian colonization frontier. BioScience 51.12: 1059-1067.

47. Soares- Filho, Britaldo, et al. (2004) Simulating the response of land- cover changes to road paving and governance along a major Amazon highway: the Santarém–Cuiabá corridor. Global change Biology 10.5: 745-764.

48. Soares-Filho, B. S; et al. (2005) Cenários de desmatamento para a Amazônia. Estud. av. . 2005, vol.19, n.54, pp. 137-152. ISSN 0103-4014.

49. Torres, H. D. G., Ferreira, M. P., & Dini, N. P. (2003). Indicadores sociais: por que construir novos indicadores como o IPRS. São Paulo em Perspectiva, 17(3-4), 80-90.

50. Umemiya, C; Rametsteiner, E; Kraxner, F. (2010) Quantifying the impacts of the quality of governance on deforestation. Environmental Science & Policy 13.8.. 695-701.

51. Valente, E; Feijó, C; Carvalho.P.G.M (2012). Além do PIB: uma visão crítica sobre os avanços metodológicos na mensuração do desenvolvimento sócio econômico eo debate no Brasil contemporâneo. Estatística e Sociedade 2.

52. Viola, E. (2013). Brazilian climate policy since 2005: continuity, change and prospective. CEPS Working Document No. 373 .

53. World Bank. (1992). Governance and development.Washington, D.C; World Bank.
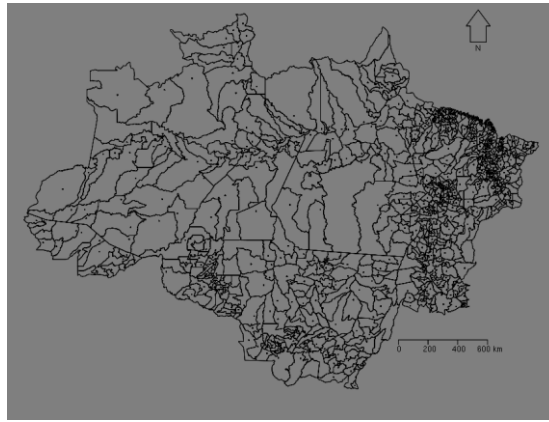
Figura 1: Brazilian Amazon. Boundaries of (lines) and capitals (black dots) of the municipalities of the Brazilian Amazon

Dimensions of governance	Definition	Indicators collected
Voice and accountability	Participation of a country's citizens in selecting their government as well as freedom of expression, association and a free media.	-Municipal newspaper -Contact phone number available for the municipal council -Municipal website -Mechanism to record citizen complaints -Radio station AM -Radio station FM -Television station -Internet service provider
Regulatory quality	Ability of the government to permit and promote private sector development through sound policies and regulations.	-Support to private entities
Government effectiveness	Quality of the public and civil service as well as of the government's policy formulation and implementation.	-Municipal transportation -Committees for the sector of transportation -Committees for the sector of education -Committees for the sector of culture -Committees for the sector of tourism -Committees for the sector of health -Committees for the sector of sports
Rule of law	Credibility with the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	-Committee for consumer protection -Small-Causes Court -Municipal council for the rights of children and adolescents -Municipal police -Child-protection services -Police stations dedicated to women victims -Municipal fund for human rights
Control of corruption	Vulnerability of public power exercised for private gain, as well as "capture" of the state by elites and private interests.	–
Political stability and absence of violence	Risk of the government to be destabilized or overthrown through unconstitutional or violent means.	–

Figura 2: Dimensions of governance and indicators collected. Dimensions of governance established by the World Bank, their definitions and indicators collected from official stats.
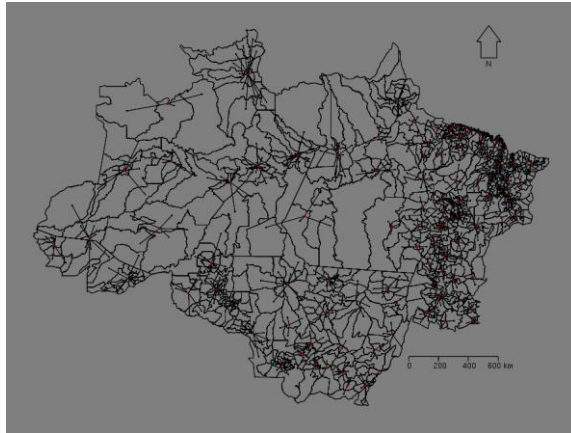
Figure 3: Supermunicipalities of Brazilian Amazon. Sites for municipalities (black dots), and supermunicipalities (red dots) formed after grouping.
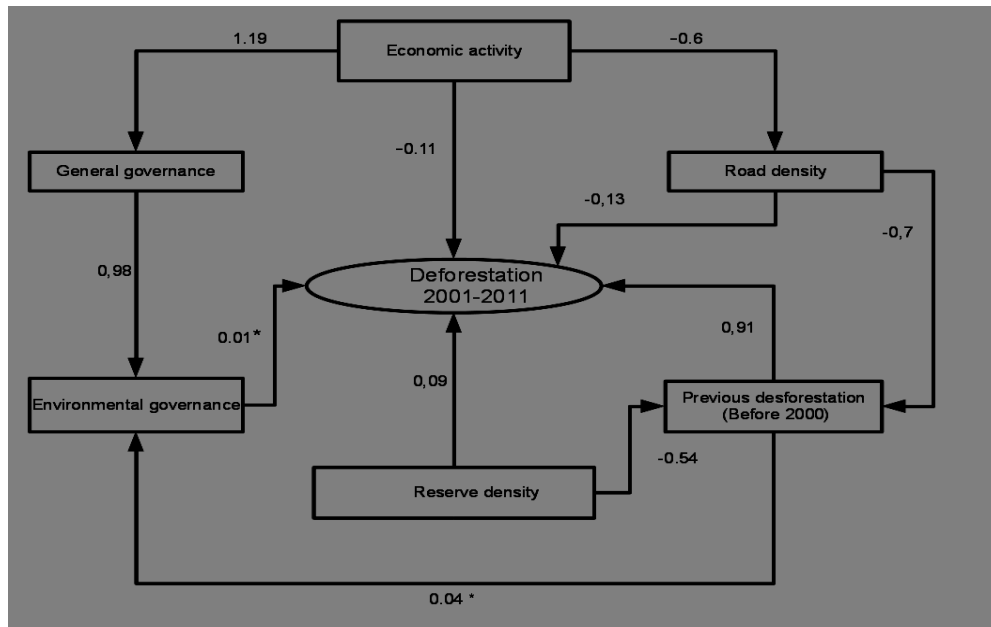
Figure 4: Flowchart of the analysis results. Each arrow represents a path and its associated path coefficient. Asterisks represent statistically significant relationships in simple or multiple regression tests (P < 0.05).

CONCLUSÃO

Os resultados do presente trabalho demonstram que, embora a governança local tenha influenciado a governança ambiental (também mensurada em escala local), a governança ambiental não influenciou o desmatamento. Os dados coletados foram satisfatórios para medir governança, mas falharam em captar as atividades ilegais realizadas na Amazônia Legal. Sugerimos que estudos futuros incluam uma análise mais detalhada da influência das atividades informais sobre o desmatamento, e na relação entre os problemas ambientais e as respectivas propostas de governança.

APÊNDICE A – Teste estatístico para ponderação dos dados.

Iterations = 10005:60000

Thinning interval = 5

Number of chains = 3

Sample size per chain = 10000

1. Empirical mean and standard deviation for each variable,
   plus standard error of the mean:

	Mean	SD	Naive SE	Time-series SE
a	269.301	92.147	0.53201	0.54628
b.estradas_relative	6.818	2.695	0.01556	0.01577
b.relative_area_uc	5.081	96.656	0.55804	0.54268

2. Quantiles for each variable:

	2.5%	25%	50%	75%	97.5%
a	87.120	207.161	269.834	331.229	448.40
b.estradas_relative	1.625	4.997	6.787	8.616	12.21
b.relative_area_uc	-183.514	-60.148	5.561	69.607	196.05

Trace of a

Density of a

N = 10000   Bandwidth = 12.43
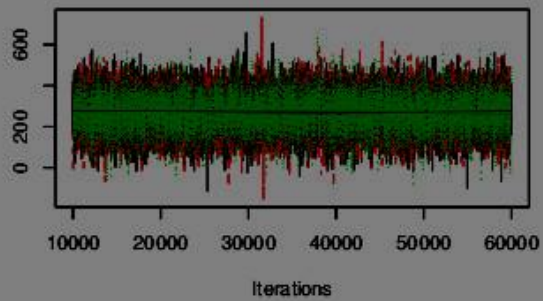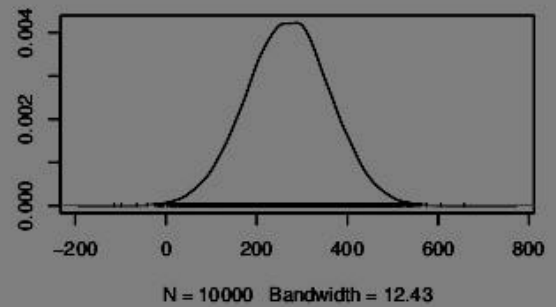
Trace of b.estradas_relative
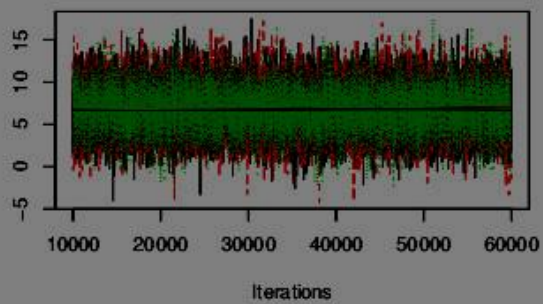
**Density of b.estradas_relative**

N = 10000   Bandwidth = 0.3634
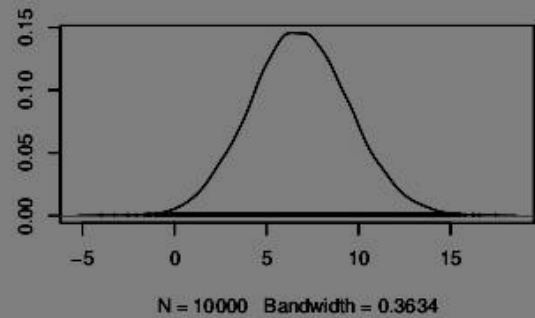
Trace of b.relative_area_uc
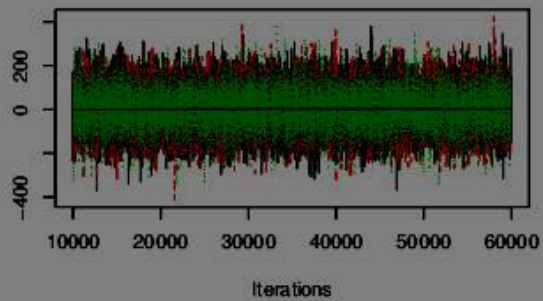
Density of b.relative_area_uc

N = 10000   Bandwidth = 13.03
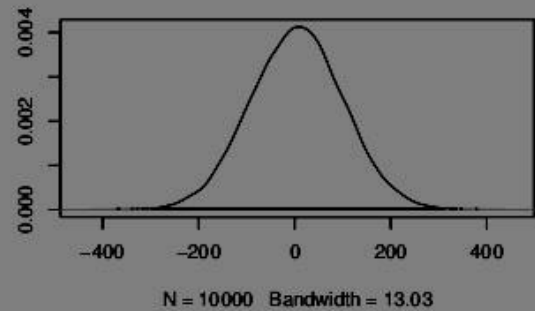
Iterations = 100005:150000

Thinning interval = 5

Number of chains = 3

Sample size per chain = 10000

1. Empirical mean and standard deviation for each variable,
   plus standard error of the mean:

	Mean	SD	Naive SE	Time-series SE
a	7.631e+01	7.824e+01	4.517e-01	5.995e-01
b.area	1.075e+02	8.663e+01	5.002e-01	5.001e-01
b.desmatamento2000	1.235e+00	5.844e-02	3.374e-04	4.115e-04
b.estradas	-3.681e+00	1.445e+00	8.344e-03	1.019e-02
b.govamb	-1.939e-01	8.299e-01	4.791e-03	1.501e-01
b.pib	-1.983e-05	1.098e-05	6.338e-08	6.354e-08
w.coleta_seletiva	-1.220e+01	6.290e+01	3.631e-01	7.960e+00
w.comite_bacia	1.197e+01	8.606e+01	4.969e-01	6.484e+00
w.conselho_meio_ambiente	-2.177e+01	1.083e+02	6.255e-01	1.214e+01
w.conselho_saneamento	1.218e+01	8.302e+01	4.793e-01	6.328e+00
w.fundo_meio_ambiente	-3.902e+01	1.641e+02	9.473e-01	3.226e+01
w.licenciamento_impacto_ambiental	4.853e+00	4.737e+01	2.735e-01	1.958e+00
w.manejo_aguas_urbanas	2.226e+01	1.095e+02	6.320e-01	1.743e+01
w.manejo_residuos_solidos	-1.565e+01	7.109e+01	4.105e-01	1.142e+01
w.secretaria_meio_ambiente	1.259e-01	3.309e+01	1.911e-01	2.600e-01

2. Quantiles for each variable:

	2.5%	25%	50%	75%	97.5%
a	-7.933e+01	2.391e+01	7.612e+01	1.287e+02	2.295e+02
b.area	-6.336e+01	4.954e+01	1.080e+02	1.654e+02	2.776e+02

b.desmatamento2000	1.122e+00	1.195e+00	1.234e+00	1.274e+00	1.352e+00
b.estradas	-6.525e+00	-4.650e+00	-3.679e+00	-2.715e+00	-8.469e-01
b.govamb	-1.461e+00	-8.079e-01	-5.167e-01	6.123e-01	1.334e+00
b.pib	-4.133e-05	-2.716e-05	-1.986e-05	-1.242e-05	1.708e-06
w.coleta_seletiva	-1.308e+02	-5.434e+01	-1.761e+01	3.156e+01	1.150e+02
w.comite_bacia	-1.583e+02	-4.729e+01	1.481e+01	7.263e+01	1.738e+02
w.conselho_meio_ambiente	-2.191e+02	-9.883e+01	-3.067e+01	5.448e+01	1.962e+02
w.conselho_saneamento	-1.557e+02	-4.314e+01	1.489e+01	6.855e+01	1.706e+02
w.fundo_meio_ambiente	-2.840e+02	-1.696e+02	-9.131e+01	1.185e+02	2.615e+02
w.licenciamento_impacto_ambiental	-9.026e+01	-2.361e+01	4.324e+00	3.287e+01	1.011e+02
w.manejo_aguas_urbanas	-1.879e+02	-6.815e+01	4.133e+01	1.058e+02	2.064e+02
w.manejo_residuos_solidos	-1.370e+02	-6.626e+01	-3.238e+01	4.423e+01	1.219e+02
w.secretaria_meio_ambiente	-6.952e+01	-1.829e+01	1.117e+00	1.952e+01	6.438e+01
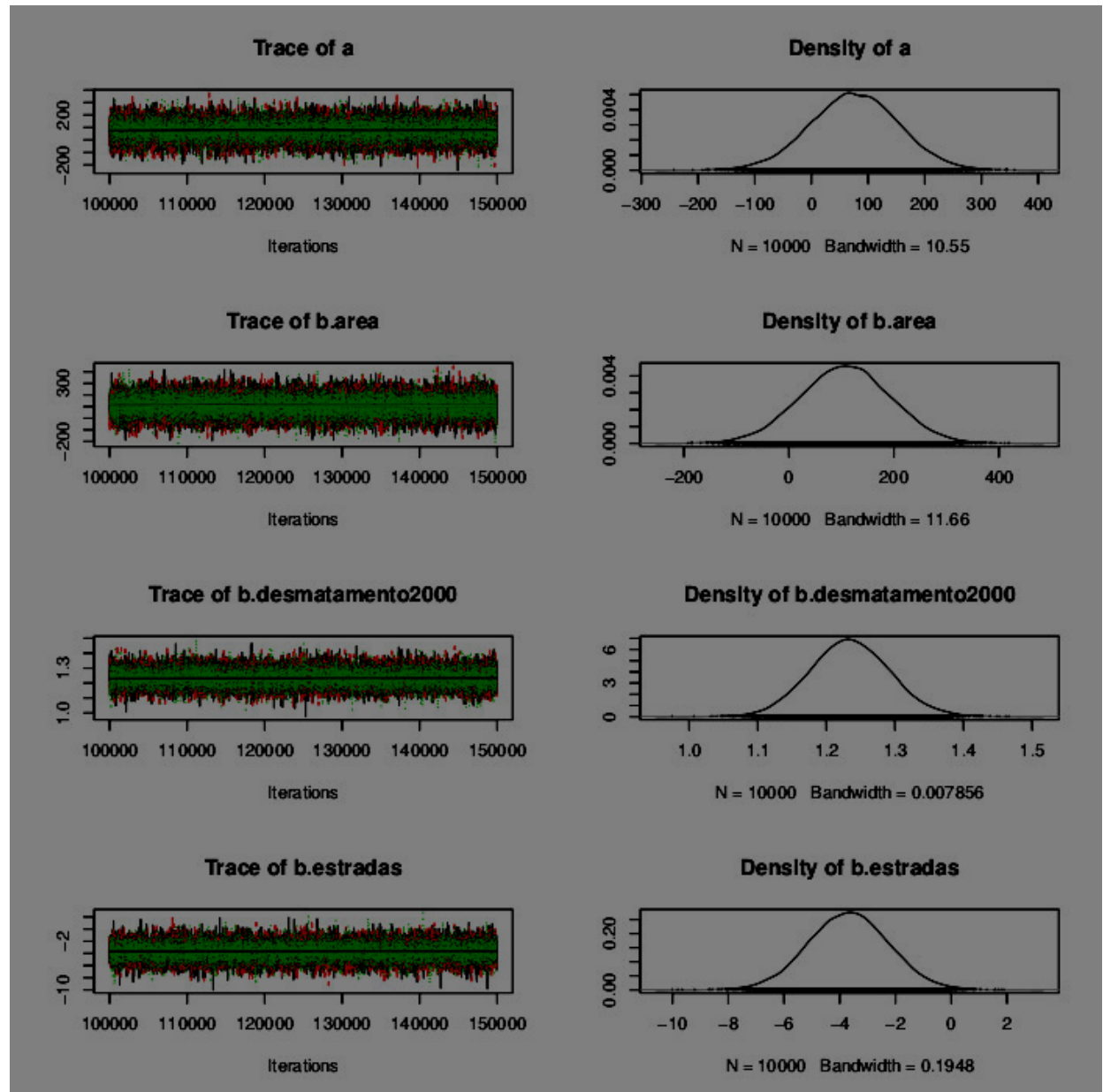
Iterations = 10005:60000

Thinning interval = 5

Number of chains = 3

Sample size per chain = 10000

1. Empirical mean and standard deviation for each variable,
   plus standard error of the mean:

	Mean	SD	Naive SE	Time-series SE
a	3.959e+01	2.891e+00	1.669e-02	1.669e-02
b.pib	-6.415e-07	6.576e-07	3.797e-09	3.817e-09

2. Quantiles for each variable:

	2.5%	25%	50%	75%	97.5%
a	3.390e+01	3.766e+01	3.958e+01	4.153e+01	4.529e+01
b.pib	-1.918e-06	-1.086e-06	-6.383e-07	-1.996e-07	6.447e-07
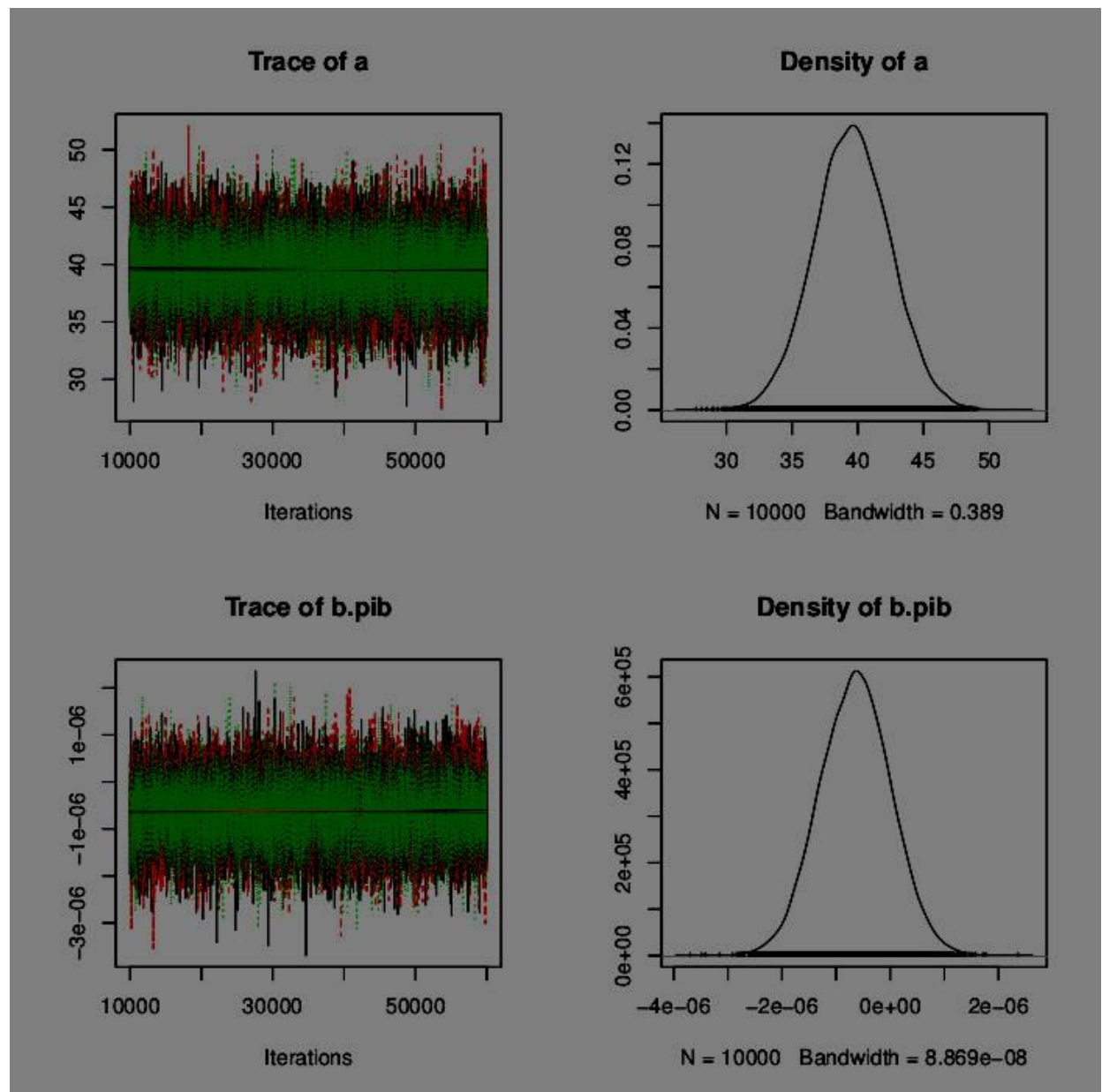
APÊNDICE B – Ata de qualificação e ata de defesa pública.

AULA DE QUALIFICAÇÃO

PARECER

Aluno(a) LILIAN FERNANDES OLIVEIRA
Curso: ECOLOGIA
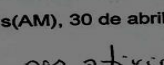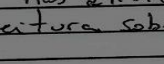Nível: MESTRADO
Orientador(a) WILLIAM ERNEST MAGNUSSON

Título

"Influência da qualidade de governança na taxa de desmatamento na Amazônia Legal"

BANCA JULGADORA:

TITULARES:
Bruce Walker Nelson (INPA)
Karl Didier (WCS)
Rita de Cássia Guimarães Mesquita (INPA)

SUPLENTES:
Charles Roland Clement (INPA)
Eduardo da Silva Pinheiro (UFAM)

	PARECER	ASSINATURA
Bruce Walker Nelson (INPA)	(x) Aprovado ( ) Reprovado	
Karl Didier (WCS)	( ) Aprovado ( ) Reprovado	
Rita de Cássia Guimarães Mesquita (INPA)	( ) Aprovado ( ) Reprovado	
Charles Roland Clement (INPA)	( ) Aprovado ( ) Reprovado	
Eduardo da Silva Pinheiro (UFAM)	( ) Aprovado ( ) Reprovado	

Manaus(AM), 30 de abril de 2013

OBS: A aluna deve buscar qualificar governança nas atividades de campo, e continuar aprofundando a leitura sobre o tema.

INSTITUTO NACIONAL DE PESQUISAS DA AMAZÔNIA INPA
PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA PPG-ECO
Av. Efigênio Sales, 2239 – Bairro: Aleixo – Caixa Postal: 2223 – CEP: 69.060-020, Manaus/AM.
Fone/Fax:(+55) 92 3643-1908/1909
site: http://pg.inpa.gov.br   e-mail: pgecologia@gmail.com

ATA DA DEFESA PÚBLICA DA DISSERTAÇÃO DE MESTRADO DO PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA DO INSTITUTO NACIONAL DE PESQUISAS DA AMAZÔNIA.

Aos 30 dias do mês de maio do ano de 2014, às 14:00 horas, na Sala de Aula do Prédio Novo do PPG Ecologia, Campus III, INPA/V8, reuniu-se a Comissão Examinadora de Defesa Pública, composta pelos seguintes membros: o(a) Prof(a). Dr(a). **Paulo Mauricio de Alencastro Graça** do Instituto Nacional de Pesquisas da Amazônia - INPA, o(a) Prof(a). Dr(a). **Hiroshi Noda** do Instituto Nacional de Pesquisas da Amazônia - INPA e o(a) Prof(a). Dr(a). **Eduardo da Silva Pinheiro** da Universidade Federal do Amazonas - UFAM, tendo como suplentes o(a) Prof(a). Dr(a). João Tito Borges da Fundação Centro de Análise Pesquisa e Inovação Tecnológica - FUCAPI, e o(a) Prof(a). Dr(a). Susan Aragon do Instituto Nacional de Pesquisas da Amazônia - INPA, sob a presidência do(a) primeiro(a), a fim de proceder a argüição pública do trabalho de **DISSERTAÇÃO DE MESTRADO** de **LILIAN FERNANDES OLIVEIRA DIAS**, intitulado **"INFLUÊNCIA DA QUALIDADE DE GOVERNANÇA AMBIENTAL NO DESMATAMENTO NOS MUNICÍPIOS DA AMAZÔNIA LEGAL"** orientado pelo(a) Prof(a). Dr(a). Dra. Willian Ernest Magnusson do Instituto Nacional de Pesquisas da Amazônia – INPA.

Após a exposição, o(a) discente foi arguido(a) oralmente pelos membros da Comissão Examinadora, tendo recebido o conceito final:

☒ APROVADO(A)   ☐ REPROVADO(A)

☒ POR UNANIMIDADE   ☐ POR MAIORIA

Nada mais havendo, foi lavrada a presente ata, que, após lida e aprovada, foi assinada pelos membros da Comissão Examinadora.

Prof(a).Dr(a). **Paulo Mauricio de Alencastro Graça**

Prof(a).Dr(a). **Hiroshi Noda**

Prof(a).Dr(a). **Eduardo da Silva Pinheiro**

_____
Coordenação PPG-ECO/INPA