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Challenges for sustainable development in Brazilian Amazonia

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ABSTRACT

Most economic initiatives and infrastructure projects in Brazilian Amazonia have social benefits that are small and ephemeral, while their socio-environmental impacts are severe. More sustainable forms of development are inhibited by barriers such as a decision-making system with heavy influence (including corruption) from actors with interests in non-sustainable activities. These interests have driven a recent surge of legislative threats to environmental licensing. Better alternatives exist for many destructive forms of “development” projects. Examples include transport using rivers (rather than building highways) and electricity generation from Brazil’s vast solar and wind resources (rather than hydroelectric dams). Traditional rural population could receive support from programs that tap the value of the Amazon forest’s environmental services, but institutional mechanisms are in their infancy, among challenges that include differing political interests of countries providing environmental services and those that might pay for them, lack of data, and a “theoretical battlefield” regarding accounting for benefits.

KEYWORDS: Deforestation, Environmental licensing, Environmental services, Global warming, Environmental impact assessment, Amazon

1
2 The challenges to sustainable development in Brazilian Amazonia can be
3 divided into two broad categories: counteracting the forces that lead to unsustainable
4 development and offering alternatives to the current economy that is almost entirely
5 based on destruction of natural ecosystems. “Sustainable development” can be
6 interpreted in various ways. At a minimum, in order to be “development” the actions
7 undertaken must lead to an improvement in human wellbeing, presumably of the
8 population at the location in question, and to be “sustainable” these benefits must last
9 indefinitely (or at least for a very long time).

10
11 The present paper examines challenges to sustainable development in Brazilian
12 Amazonia, but many of the challenges in this region are similar to those in other parts of
13 the world, including Peru (Doleac, 2015; Erickson-Davis, 2016), Bolivia (Bottazzi and
14 Dao, 2013; Muller et al., 2012a,b; Redo et al., 2011; Tejada et al., 2016), Ecuador
15 (Mosandl et al., 2008; Tapia-Armijos et al., 2015), Indonesia (Busch et al., 2012;
16 Fearnside, 1997a; Purnomo et al., 2017), Malaysia (Bryan et al., 2013; Miettinen et al.,
17 2011) the Democratic Republic of Congo (Ickowitz et al., 2015; Wilkie et al., 2000) and
18 Papua New Guinea (Filer et al., 2009; Shearman et al., 2009).

19 20 FORCES IMPEDING SUSTAINABLE DEVELOPMENT

21
22 Counteracting unsustainable development, including land-use changes such as
23 deforestation for extensive cattle pasture that can hardly be called “development”
24 (Fearnside, 1997b), must begin with the reforming the decision-making process.
25 Decision making currently leads to government priority on building highways, dams
26 and other large infrastructure projects that destroy ecosystems both directly and by the
27 economic transformations and population migrations they promote. These government
28 decisions do not, in practice, consider alternatives. Examples include the BR-319
29 (Manaus-Porto Velho) Highway and the many proposed dams in Amazonia (Figure).

30
31 [Figure here]

32
33 It is relevant to note the revelation by Brazil’s Supreme Electoral Court (TSE) in
34 2013 that the four largest donors to political campaigns in Brazil in the preceding
35 decade were construction firms that build dams and other infrastructure in Amazonia
36 (Gama, 2013). The effect of political campaign contributions, both legal and illegal,
37 became public knowledge in 2015 and 2016 with a series of confessions concerning
38 bribes paid for contracts for building the Belo Monte Dam, both from the companies
39 paying the bribes (*Amazonas em Tempo*, 2015a) and from the politicians on the
40 receiving end (e.g., do Amaral, 2016). The construction firms paid 1% of the contract
41 value as bribes, and these payments were critical to funding the 2010 and 2014
42 presidential campaigns of the victorious political party, according to the confession
43 (released by federal courts) of the party leader in the Federal Senate (do Amaral, 2016).
44 This provides a rationale for the extraordinary personal involvement of two Brazilian
45 presidents (Luiz Inácio Lula da Silva and Dilma Vana Rousseff) in promoting the dam
46 and pushing for approval of its licensing despite high socio-environmental and financial
47 costs (see: Fearnside, 2017a,b).

48
49 The revelations regarding political campaign financing provide an explanation
50 for the mystery of why the Brazilian government would so heavily subsidize a project

51 with little chance of viability in strictly financial terms, even disregarding its social and
52 environmental impacts. The over US\$10 billion cost is 80% financed by Brazil's
53 National Bank of Economic and Social Development (BNDES) at 4% annual interest,
54 while the federal government finances itself by selling bonds at 10% annual interest
55 (e.g., Leitão, 2010). Because of the extended period of the year with low seasonal water
56 flow in the Xingu River, the dam's chance of financial viability is minuscule even
57 assuming no future impacts of climate change (de Sousa Júnior and Reid, 2010; de
58 Sousa Júnior et al., 2006; Fearnside, 2017b,c). Projected decrease in the Xingu River's
59 flow due to precipitation changes predicted to result from global warming (Ângelo and
60 Feitosa, 2015; Sorribas et al., 2016) and altered seasonal distribution of flow due to
61 deforestation (Stickler et al., 2013) make the outlook even more untenable as an
62 investment.

63

64 The influence of money on environmentally destructive decisions was
65 dramatically demonstrated by the votes in the National Congress in 2011 and 2012 on
66 reforming (gutting) the country's Forest Code (Law 12.651/2012: Brazil, PR, 2012).
67 The initial vote in the Chamber of Deputies, which has representation proportional to
68 population, was in a ratio of 7:1 against the environment, allowing more deforestation
69 on steep hillsides and in gallery forests along rivers, and forgiving 43 years of violations
70 of the previous Forest Code. Brazil's scientific community had provided ample warning
71 of the environmental consequences of the proposed revision, including a joint report by
72 the Brazilian Society for the Progress of Science (SBPC) and the Brazilian Academy of
73 Sciences (ABC) (da Silva et al., 2011), but this advice was ignored by the National
74 Congress. Brazil's population is 85% urban, and the fraction of the total with a financial
75 stake in being allowed to deforest in these areas is minuscule. Opinion polls at the time
76 showed 85% of Brazil's population opposing any change in the Forest Code
77 (Barrionuevo, 2012). The logical explanation for a 7:1 vote against the interests of the
78 electorate lies in the financial power of agribusiness interests such as soy plantations
79 and cattle ranches. The "ruralist block" that represents large landowners in the National
80 Congress has continued to gain strength; Blairo Maggi, who became Brazil's minister of
81 agriculture on 12 May 2016, is the country's largest soybean producer and was awarded
82 the Greenpeace "golden chainsaw" when he was governor of the state of Mato Grosso
83 (Greenpeace, 2005).

84

85 Weakening of environmental licensing in Brazil is a major barrier to
86 counteracting forces for unsustainable development. In 2016 the National Congress
87 produced an explosion of new legislative proposals (and of sudden accelerations of
88 longstanding ones) to weaken or even effectively abolish the licensing system
89 (Fearnside, 2016a). Proposed laws moving forward under "urgent" status (PLS-
90 654/2015 in the Senate and PL-3.729/2004 in the Chamber of Deputies) would allow
91 "strategic" projects (such as dams) to be licensed in a streamlined one-step process
92 (Brazil, Câmara dos Deputados, 2004; Brazil, Senado Federal, 2016a). Approval by the
93 Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) is
94 demanded within deadlines that make adequate analysis impossible, after which the
95 proposed projects are automatically approved. The proposed law in the Senate is led by
96 Senator Romero Jucá, whose fortune stems from Amazonian gold mining and who has a
97 long record of actions to diminish the rights of Amazonian indigenous peoples (Rocha,
98 2012). He is currently the leader of the largest political party in the Brazilian Senate.
99 The proposed law in the Chamber of Deputies is led by Deputy Mauro Pereira of the
100 Parliamentary Front for Agriculture and Ranching (FPA, 2016).

101

102 A proposed constitutional amendment (PEC-65/2012), also progressing under
103 “urgent” status, would make the mere submission of an EIA sufficient to allow major
104 infrastructure projects such as dams and highways to go unstopably forward to
105 completion (Brazil, Senado Federal, 2016b). This proposal is particularly incongruous
106 given the environmental-licensing failure behind the still ongoing disaster of a mine
107 tailings dam breaking on 5 November 2015, destroying a town near Mariana, Minas
108 Gerais and virtually all aquatic life on one of Brazil’s major rivers (Oliveira, 2016).
109 Many senators and federal deputies have given ample indications of their tendency to
110 respond to influences promoting non-sustainable options in debates like this (Fearnside,
111 2015a). This proposed constitutional amendment was authored by Senator Acir
112 Gurgacz, who, as the founder of a mining company in Rondônia and owner of the
113 largest bus company plying Amazonian highways, is the second wealthiest member of
114 the Senate (*Infomoney*, 2014). Constitutional amendments are very much more common
115 in Brazil than, for example, in the United States. Amendments in Brazil require a 60%
116 majority in two votes in both houses of the National Congress, after which they
117 automatically take effect with no need for presidential sanction. Since coming into force
118 in October 1988, Brazil’s current constitution had been amended 90 times by December
119 2015 (Lima, 2016).

120

121 A law passed in September 2016 (Law 13.334/2016, enacting proposal MPV
122 727) can achieve the same weakening of Brazil’s licensing system by another
123 mechanism. This law, which established the Program for Partnerships for Investment
124 (PPI), states (Article 17): “The agencies, entities and government authorities on
125 which the viability of a PPI enterprise depends have the duty to act so that
126 completion will [occur] on a time-schedule compatible with the national-priority
127 character of the project [of] all processes and administrative acts necessary for [the
128 project’s] structuring, release and execution. Release means obtaining any
129 environmental, indigenous, and any other [type of] license necessary for the
130 deployment and operation of the enterprise” (Brazil, PR, 2016). This means that the PPI
131 Executive Board will have power over IBAMA, the National Foundation for the Indian
132 (FUNAI), and all relevant state and municipal agencies, and that the Board is
133 empowered to set deadlines and demand approval of any project regardless of impacts.

134

135 There is also a proposed constitutional amendment (PEC-215) that would
136 transfer authority from the executive branch to the legislature for creating indigenous
137 areas and conservation units (Brazil, Câmara dos Deputados, 2014). In practice, this
138 would be the end of creating more of these areas, and this amendment is a top priority
139 of the “ruralist block” (*OEco*, 2015). Indigenous lands would be opened to mining by
140 PEC-210 and PL-1619/1996, which have long been dormant and now have emerged as
141 legislative priorities (Fearnside, 2016a).

142

143 Licensing is also weakened by the increasing tendency to override the technical
144 opinions of the licensing staff in IBAMA. Pending approval of the one-step system
145 being considered in the National Congress, licensing is done in three steps: a
146 preliminary license allowing preparations to begin, an installation license allowing the
147 physical structure (such as a dam) to be built, and an operational license, allowing, for
148 example, the reservoir behind a dam to be filled. In the case of the Madeira River dams,
149 a 121-page formal opinion (*parecer*) by the technical staff recommending against
150 approval of the preliminary license (Deberdt et al., 2007) was overruled by changing the

151 head of the licensing department; the replacement was then promoted to head IBAMA
152 as a whole, in which capacity he overruled a 146-page technical opinion (Brazil,
153 IBAMA, 2008) and approved the installation license (see Fearnside, 2014). In the case
154 of the Belo Monte Dam, two technical opinions totaling 366 pages opposing the
155 preliminary license (Brazil, IBAMA, 2009, 2010) were overruled by changing the head
156 of the licensing department and the head (“president”) of IBAMA (Agência Brasil,
157 2011; Hurwitz, 2011). The installation license was approved overruling a 252-page
158 technical opinion (Brazil, IBAMA, 2011) by changing the head of IBAMA again
159 (Fearnside, 2012a). These precedents demoralize the technical staff and can be expected
160 to increase the tendency to allow politically favored projects to pass without meeting
161 requirements. An additional weakening is the practice of approving licensing steps with
162 a list of “preconditions” (*condicionantes*) that are supposed to be satisfied before the
163 next license in the sequence is granted. Preconditions have only been used since 2003
164 and are an increasingly common feature of the licensing process, allowing projects to
165 move forward that would previously have been required to meet these demands before
166 receiving the license. An even more drastic precedent has been set by Belo Monte in
167 2015, when the operating license was granted, overruling a 242-page opinion (Brazil,
168 IBAMA, 2015), even though most of the 40 preconditions established by IBAMA had
169 not been met (Villas-Bôas et al., 2015). This opens the door to any project being
170 completed without satisfying IBAMA licensing demands.

171
172 July and August 2017 saw a spectacular series of blows to Brazil’s licensing
173 system and other environmental protections in the days (and even hours) leading up to a
174 vote in the Chamber of Deputies on a motion to authorize impeachment proceedings
175 against president Michel Temer on the basis of corruption revelations (see sources
176 referenced in Fearnside, 2017d). Among the setbacks were the president’s reneging on a
177 promise to the environment minister regarding the administration’s coalition of political
178 parties being obliged to oppose gutting the licensing system under PL-3.729/2004,
179 signing Law 13.465 (formerly MP-759, known as the “land-thieves’ law” or “*lei da*
180 *grilagem*”) that includes allowing “legalization” of illegal land claims of up to 2500 ha,
181 effectively pardoning vast sums in fines and debts owed to the government by the
182 agribusiness and ranching sectors, weakening criteria for definition of indigenous lands,
183 support for a controversial highway demanded by ruralists, and measures to reduce
184 Amazonian protected areas. These are in addition to handing out over R\$ 4 billion (US\$
185 1.3 billion) in pork-barrel appropriations known as “*emendas*” to selected federal
186 deputies, with estimates of future “*emendas*” as high as R\$ 17 billion (US\$ 5.2 billion),
187 in addition to various other expensive concessions. Many of the beneficiaries were
188 among the estimated 231 ruralist representatives in the 454-member Chamber of
189 Deputies. The ruralist block alone is more than sufficient to prevent reaching the two-
190 thirds majority required to begin impeachment proceedings. In the midst of Brazil’s
191 economic “crisis,” the cost of the pork-barrel “*emendas*” translates into a significant
192 addition to the expenditure cutbacks that are already hampering inspection and
193 enforcement by the Environment Ministry. The impeachment motion was defeated on 2
194 August 2017, a result for which ruralist votes were critical.

195
196 A serious barrier to effective licensing is the existence of “security suspension”
197 laws that allow overruling any judicial decision blocking a development project if
198 halting the project would cause “grave damage” to the public economy. Clearly, any
199 hydroelectric dam or major highway is important for the economy and so can be
200 allowed to go forward using these laws regardless of how many laws, constitutional

201 protections or international agreements have been violated. Security suspensions were
202 established during Brazil's 1964-1985 military dictatorship (Law 4348 of 26 June 1964:
203 Brazil, PR, 1964), but continue in force today (Laws 8437 of 30 June 1992 and 12,016
204 of 7 August 2009: Brazil, PR, 1992, 2009). By 2014 these laws had already been used
205 eight times in the case of Belo Monte and 12 times in the case of the Tapajós River
206 dams (Palmquist, 2014). Very few people in Brazil even know of the existence of
207 security suspensions, thereby diminishing any impetus to change these laws (Fearnside,
208 2015b).

209

210 ALTERNATIVES

211

212 It is not enough to fight each environmentally and socially disastrous project that
213 is proposed in Amazonia. Proposals of alternatives are needed in some (but not all)
214 cases. There is no need to provide alternatives for entrepreneurs wishing to make
215 profitable investments in destructive activities in Amazonia, such as deforestation for
216 cattle ranching (Fearnside, 1989). These actors can seek out other options on their own,
217 and the penalties and rewards for different choices need to be adjusted to make
218 sustainable options the most attractive.

219

220 Energy alternatives abound in Brazil, making the government's plans for many
221 more dams in Amazonia unnecessary (e.g., Fearnside, 2016b). The plans themselves are
222 based on flawed projections, as costs and construction times of dams are systematically
223 underestimated (e.g., Ansar et al., 2014) and Brazil's assumed future energy demands
224 are based on wildly unrealistic projections of economic growth (Prado et al., 2016). One
225 obvious step is for Brazil to stop exporting electricity in the form of electro-intensive
226 commodities like aluminum, which generate very little employment in Brazil while
227 wreaking great damage through the dams built to supply these industries (Fearnside,
228 2016c). Brazil has many options for energy conservation, such as eliminating the
229 electric showerheads that consume 5% of the country's electricity (Brazil, CIMC, 2008,
230 p. 58) for a service that can be performed by solar water heaters without using
231 electricity at all (Costa, 2007). Brazil's inefficient electrical transmission system, which
232 wastes 20% of the power transmitted, could be greatly improved without the impact of
233 building more dams (Rey, 2012). Brazil also has enormous undeveloped wind and solar
234 resources, which clearly receive much lower priority than hydropower (Baitelo, 2012;
235 Baitelo et al., 2013). In January 2016 Brazil's president vetoed the inclusion of any
236 funding for "non-hydraulic renewable energy" in the next five-year development plan
237 (PPA) (ISA, 2016).

238

239 Some proposed highway projects, such as reconstruction of the BR-163
240 (Santarém-Cuiabá) Highway, have substantial economic benefits, albeit with serious
241 environmental and social problems (Fearnside, 2007). In other cases, proposed roads are
242 unviable and the best alternative is to simply not build them (Fleck, 2009). Economic
243 viability is determined, in practice, solely from the financial costs and returns of the
244 project, without considering the human and environmental impacts. Since these are
245 high-impact projects, their unviability would very often be clear were these impacts
246 given proper weight.

247

248 The transport case with the greatest potential consequences is the proposed
249 reopening of the abandoned BR-319 Highway (Manaus-Porto Velho). This would open
250 approximately half of what remains of Brazil's Amazon forest to entry of deforesters

251 from the notorious “arc of deforestation” – the strip of land along the southern and
 252 eastern edges of the forest where deforestation activity has been concentrated to date.
 253 The state of Rondônia, long a deforestation hotspot, would be connected to Manaus in
 254 central Amazonia, from which a road network already exists with connections to
 255 Roraima and other locations (e.g., Barni et al., 2015). New roads are proposed
 256 branching off the BR-319, including one that would cross the Purus River at Tapuã and
 257 open the vast block of still-intact forest in the western half of the state of Amazonas.
 258 The environmental impact study (EIA) is limited to considering impacts adjacent to the
 259 highway route, not the impact of migration along existing roads or of building planned
 260 side roads (UFAM, 2009). The EIA endorses the road as “environmentally and socially
 261 desirable” based on the unlikely scenario of “strong environmental governance,” the
 262 example being tourism in Yellowstone National Park in the USA (see Fearnside,
 263 2015c). In a 177-page formal opinion (*parecer*), IBAMA’s technical staff concluded
 264 that “... the EIA lacks the minimal conditions and information that would permit
 265 evaluation of the environmental viability of the undertaking” (Arbocz et al., 2009, p.
 266 175) and that “... even leaving aside the technical quality of the EIA, the preliminary
 267 license cannot be emitted” (Arbocz et al., 2009, p. 176). Nevertheless, in April 2015
 268 IBAMA approved what was euphemistically termed “maintenance” of the highway
 269 (*Amazonas em Tempo*, 2015b) allowing all but laying down the final pavement.
 270 Organized landless farmers have already begun to invade the central section of the
 271 highway area even before the “maintenance” is completed (Assayag, 2016).

272
 273 BR-319 is unnecessary for its supposed purpose of transporting the products of
 274 factories in Manaus to markets in São Paulo. Transport of containers to São Paulo is
 275 19% cheaper by the current system of barges between Manaus and Belém and truck
 276 transport from Belém to São Paulo, and would be 37% cheaper than this current system
 277 if adequate port facilities were installed (for example in Itacoatiara) to carry the freight
 278 by ship to Santos, from which it would be distributed using the existing transport system
 279 in the state of São Paulo (Teixeira, 2007). These represent much better alternatives not
 280 only in terms of cost but also in terms of environmental impact; nevertheless, alternative
 281 routes to São Paulo were not considered in the EIA for the BR-319 (Fearnside and
 282 Graça, 2009). Promotion of the highway by politicians in Manaus has been an effective
 283 means of attracting votes, and this is the most likely explanation for the priority given to
 284 the project. The highway, most of the expense for which would be borne by taxpayers in
 285 other parts of Brazil, is promoted as allowing Manaus residents to travel freely to
 286 population centers in the southeastern part of the country for vacation travel. However,
 287 because Manaus is privileged to be a free-trade zone where factories assemble products
 288 from imported components, the practical effect of the road would instead be population
 289 migration to Manaus from parts of the country with higher unemployment, with
 290 negative consequences for urban residents in Manaus (Fearnside, 2010).

291
 292 Unlike all other major construction projects in Brazil, the reconstruction of
 293 Highway BR-319 has no economic viability study. These massive documents assess the
 294 financial costs and benefits of proposed public works; in the case of a highway, for
 295 example, such a study would estimate the quantity and value of freight to be transported
 296 and would compare the costs with other alternatives. The justification for not requiring
 297 a viability study was that the highway was a matter of “national security.” However,
 298 this role is improbable given that the road is far from any international borders. In 2012
 299 General Eduardo Villas Bôas, then head of the Amazonia Command and now head of
 300 Brazil’s army as a whole, spoke at the National Institute for Research in Amazonia

301 (INPA) for almost two hours on “national security in Amazonia.” The speech was
302 recorded and published (Villas Bôas, 2012). When questioned as to why nothing had
303 been said about reopening Highway BR-319 as one of the priorities, he confirmed that
304 the highway is not a priority for national security (see Fearnside, 2012b). Indeed, the
305 highway does not appear in Brazil’s 2008 “Strategy for National Defense” (Brazil, PR,
306 2008). One might ask, then, why BR-319 is a priority under Brazil’s Program for the
307 Acceleration of Growth, given that the project has neither a military nor an economic
308 rationale. The most evident explanation is that supporting it attracts votes in Manaus –
309 provided that the cost is paid by taxpayers throughout Brazil. Politicians in Manaus are
310 invariably in favor of the road and compete with each other to take credit for its
311 construction (e.g., Farias, 2015).

312

313 The value of environmental services represents the best alternative for
314 supporting the traditional population in the Amazonian interior (Fearnside, 1997c,
315 2008a). The roles of Amazon forest in avoiding global warming (e.g., Fearnside,
316 2000a), in maintaining the hydrological cycle (including supply of water vapor to other
317 parts of Brazil, such as São Paulo; e.g., Arraut et al., 2012), and maintaining
318 biodiversity both for utilitarian and existential reasons (e.g., Fearnside, 1999), represent
319 values that far exceed the monetary returns from most deforestation in Amazonia, for
320 example selling the timber followed by clearing for extensive cattle pasture. Yet the
321 institutional mechanisms for tapping environmental services are only beginning to be
322 developed. A variety of challenges face Reducing Emissions from Deforestation and
323 Degradation (REDD) as an option, but action on this front is essential. Challenges
324 include the differing political interests of countries with forests providing services, such
325 as Brazil, and the countries such as those in Europe that might pay for the services
326 (Fearnside, 2012c, 2013). Another is the need for improved data quantifying the
327 environmental services (Fearnside, 2008b). Finally, there is the “theoretical battlefield,”
328 which involves questions on how carbon and other benefits are accounted (Fearnside,
329 2012d). Issues such as adjustments for uncertainty (Fearnside, 2000b) and the value
330 attributed to time (Fearnside, 2002) can have much greater impact on the value
331 attributed to avoiding Amazonian deforestation than do outstanding uncertainties about
332 forest biomass and carbon stocks (e.g., Fearnside, 1995, 2009; Fearnside et al., 2000). A
333 related question is the relative priority that should be given to creating protected areas
334 near the arc of deforestation, where costs are high and the areas that can be protected are
335 therefore small but where “additionality” is great due to immediate threat, versus
336 creating larger reserves far from the current deforestation frontier.

337

338 The many challenges touched upon in the foregoing review suggest the need for
339 a variety of actions if sustainable development is to be achieved in Brazilian Amazonia.
340 More research is not enough in most cases. More fundamental are changes in decision
341 making, elimination of corruption and other features of the business and political
342 systems that lead to destructive outcomes, and legislative measures to eliminate legal
343 loopholes (such as “security suspensions”) and creation of the institutional mechanisms
344 for an Amazonian economy centered on environmental services rather than destruction
345 of the forest.

346

347 CONCLUSIONS

348

349 Sustainable development is impeded by forces that favor land uses and
350 infrastructure projects that are neither sustainable nor development: they are ephemeral

351 and often worsen rather than improve the wellbeing of the Amazon region's inhabitants.
 352 The current decision-making and licensing processes are influenced to favor projects
 353 with high environmental and social impacts and few benefits to local populations.
 354 Decision-making and licensing procedures must be changed to favor other alternatives,
 355 of which Brazil has many. Rather than building more roads, much of the cargo in
 356 Amazonia can be transported by water. Rather than building more dams, Brazil's
 357 electricity can be obtained by eliminating inefficiency, waste and exports of electro-
 358 intensive commodities and by investment in the country's vast wind and solar resources.
 359 Traditional rural populations in the Amazonian interior can be supported by tapping the
 360 value of the forest's environmental services, a goal that will require progress not only in
 361 environmental and social research but also in developing appropriate institutional
 362 mechanisms.

363

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895 **FIGURE LEGEND**

896

897 Figure. Map of Brazilian Amazonia with locations mentioned in the text.

