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Protected areas versus areas occupied by productive activities and infrastructure in Brazil – is there room for everybody?

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Protected areas versus areas occupied by productive activities and infrastructure in Brazil – is there room for everybody?

José Augusto Drummond

Abstract

The text argues that there has existed and will continue to exist for much time enough geographical space and related natural resources in the Brazilian national territory to accommodate the expansion of five sets of uses and activities: (i) rural productive activities, (ii) infra-structure installations, (iii) protected areas, and (iv) indigenous homelands and (v) maroon homelands. This point has become highly relevant because recently a pro-agriculture social coalition / lobby and an associated congressional caucus have argued that the expansion of Brazilian agricultural activities has been confined by protected areas and indigenous homelands. These actors call explicitly for the unfettered expansion of agricultural activities and consider it to be strategic for the future of Brazil as a major producer of food and agricultural commodities. This coalition gives little attention to the fact that rural activities compete for territory with other activities and land uses that are common components of modern societies and economies. The present text criticizes an influential research report that defends the unlimited expansion of agricultural activities. It also pulls together data that show the contrary – agricultural areas have expanded strongly over the last decades, the same having happened with areas dedicated to environmental protection, indigenous homelands and infrastructure installations. The major inference is that although agriculture may call for freedom to expand to "new frontiers", it can also expand by improving the productivity in currently occupied lands and by using lands officially classified as underused, unused or abandoned by farmers. Additionally, it is argued that this pro-agriculture stance should not be rejected outright, but incorporated into a wider debate about a socially legitimate distribution of different land uses in the large, tropical, humid, biologically rich territory of Brazil.

Keywords

Land uses; natural resources; agriculture; protected areas; indigenous homelands; infrastructure; economic-ecological zoning

Contents

1. Introduction: background and context

This text discusses current allegations that publicly protected areas for the purpose of nature conservation and indigenous homelands in Brazil are excessive in number, in combined area, and in the restrictions that they place on rural productive activities. These widespread allegations have been recently synthesized into a single influential text that will be used here as a major reference. A research group that works under Brazil's premier agricultural research organization, Embrapa, wrote this text. It has been widely publicized and debated among scientists, congressmen, political parties, state and local office holders, media and farmers' associations.[1]

Those who study Brazilian protected areas[2] or work in their management are familiar with the numerous arguments used by those who oppose them outright or wish to limit their numbers, areas and goals. These arguments are not original or more uncompromising than those used in other countries, in the past and in the present. Controversies between the defenders of biodiversity, endangered species, protected areas, and exceptional or wild landscapes, on the one hand, and those who defend the unlimited expansion of agriculture, cattle raising, mining, logging, water management, and urban-industrial landscapes, on the other, were and continue to be common in many countries.[3] In many countries the continuity and the expansion of protected areas and even the adoption of less "geo-referenced" environmental policies (rational use of water, good soil practices, pollution control, energy efficiency etc.) continue to face opposition. Typically, such opposition comes from considerably large constituencies (specially on local scales) who believe that social wellbeing and economic growth are necessarily jeopardized by restrictions on resource use for the purpose of environmental protection.

Over the last few years, opposition to protected areas and related policies in Brazil achieved a national and well-organized scale. There has been a "trickling up" of this opposition from local farmers all over settled and frontier sections of the national territory, through regional farmers' organizations, reaching national agribusiness associations, besides state and federal lawmakers and politicians at several levels. This large coalition has been amplified in the media by a durable, proactive and strong "*bancada ruralista*" (a pro-farming caucus), active in the National Congress and some state assemblies. This led to the aforementioned law that reformed the 1965 Forest Code. This

[1] Miranda, E. E.; Carvalho, C. A.; Spadotto, C. A.; Hott, M. C.; Oshiro, O. T.; Holler, W. A. *Alcance Territorial da Legislação Ambiental e Indigenista***.** Campinas, Embrapa Monitoramento por Satélite, 2008. Available at http://www.alcance.cnpm.embrapa.br/ (accessed on May 9 2012). Embrapa Monitoramento por Satélite is an Embrapa research sub-unit, based in Jaguariúna, state of São Paulo. Embrapa, a federally owned company, is Brazil's major agricultural research agency.

[2] Brazil seems to be unique in the world for officially calling its public protected areas "conservation units". In this text I used the more common expression protected areas, except when it creates ambiguities.

[3] Almost all current arguments raised worldwide against conservation units or protected areas and other government-controlled lands and resources emerged about 120 years ago in the US, particularly in the US West. Local politicians, representatives and senators, large companies (logging, mining, oil drilling), farmers and cattle ranchers fought against national forests and national parks, defending *laissez faire* as the best mode of natural resource appropriation. See Alfred Runte, *National Parks - The American Experience*. Lincoln and London, University of Nebraska Press, 1984; Roderick Nash, *Wilderness and the American Mind*. 3 ed. Cambridge, Yale University Press, 1982; Char Millar, *Gifford Pinchot and the making of modern environmentalism*. Washington, Island Press, 2001; Donald Worster, *A Passion for Nature – the life of John Muir.* New York, Oxford University Press, 2008; Richard White, *"It's your misfortune and none of my own" – a new history of the American West*. Norman, University of Oklahoma Press, 1991; Richard White, *Railroaded – The Transcontinentals and the Making of Modern America.* New York, Norton, 2011

new law substantially reduced restrictions on land use in private properties.[4] Miranda and co-authors, in their 2008 report, had criticized specifically some of these restrictions.

Their arguments are basically "productivist". Not surprisingly, they sustain that protected areas (in their different types – to be explained below) grew excessively, to the detriment of rural productive activities. The excessive growth of protected areas and related environmental policies, in this view, restricts:

(i) established agriculture (agribusiness and family faming, cattle raising), commercial tree planting, together with mining and logging of native vegetation) and the expected expansion of these activities;

(ii) the deployment of land reform settlements;

(iii) roads, railroads, hydroelectric lakes and plants, transmission lines, oil and gas ducts, ports and related installations etc.[5]

Although these arguments are debatable, they cannot be summarily dismissed, because they have strong social (and electoral) support. In October of 2011, the pro-agriculture congressional coalition included 202 of 514 federal representatives and 13 of 81 federal senators, supported by a considerable number of state legislators and governors from strong agricultural states, besides local and national farmers' organizations and cooperatives, agricultural scientists and economists, land reform planners and beneficiaries etc.[6] "*Ruralista*" federal representatives, plus numerous congressional allies, approved the aforementioned law instituting the new Forest Code in late April 2012, changing basic regulations (that date back to the 1930s) and giving full "amnesty" to all farmers who over the last decades illegally deforested portions of their properties.

This is not surprising, because by definition there must be some degree of incompatibility between areas protected for their natural endowments and all sorts of productive activities and infrastructure installations conceived in a *laissez faire* mode. The limitations placed on the productive use of portions of public and private lands for the sake of conservation and preservation, in the form of different types of protected areas, are, in my view, a small part of the price that modern societies must pay if they are to use their resources in "prudent", "rational" or "sustainable" manners.

Hardly any substantial public policy is cost-free or universally supported. Nature conservation or preservation could not be an exception. Restrictions on productive activities or production relations

[4] Law 12.651, May 25, 2012. This law was a major victory of the aforementioned pro-agrarian coalition and of the rural caucus in the Brazilian Congress. The most important changes were drastic reductions of the restrictions to agricultural uses in sections of private properties. APPs and RLs (see definitions below) were reduced in area and opened for productive activities. Native vegetation can now be thoroughly eliminated on riverbanks, around watersheds and lakes, on mountaintops and slopes, in wetlands and even in indigenous homelands. Certain cultivations on illegally deforested slopes (grapevines, fruit trees and coffee, for example) were sanctioned as "consolidated agricultural areas" and landowners were exempted from any administrative or judicial proceedings and from any obligation to restore native vegetation. A detailed examination of the changes introduced by this law is found in Márcia Dieguez Leuzinger and Sandra Cureau, *Direito Ambiental* (Rio de Janeiro: Elsevier, 2013), pp. 164-190.

[5] It should be added that in Brazil conservation units regularly come under fire also by movements of indigenous peoples, "traditional" peoples and "maroon" communities (all to be examined below). However, most types of conservation units and most of their protected acreage allow the presence and the productive activities, by both local populations and companies.

[6] Source: http://www.fpagropecuaria.com.br/composicao, accessed on May 10, 2011. This site belongs to the "Frente Parlamentar Agropecuária" ("Parliamentary Agricultural Front"), the formal civil organization of legislators, politicians and supporters who belong to the "rural" caucus.

are never suggested or put in place without conflict or, at least, serious differences of opinion.

Brazil created over the last 30 years a legal context favorable to substantial environmental policies. The 1988 Brazilian Federal Constitution (articles 5, XXII, 170, III, and 186, II), for example, instituted the "social role" of private property. This role is fulfilled when, among other requirements, private property uses natural resources adequately, preserves the natural environment, and obeys labor laws. In respect to the preservation of the natural environment, this precept is tightly linked to article 225 of the same Constitution, which states that all Brazilians have the right to an "ecologically balanced" natural environment. New environmental laws and regulations were issued since then – some examples are the laws on water resources (1997), environmental crimes (1998), conservation units (2000), and solid waste (2010). Additionally, there have been many national and regional programs and plans focused on sustainability. Thus, conservation and preservation policies have not come from the whims of radical environmentalists or enemies of agriculture, as the uninformed reader of Miranda and co-authors would be led to assume.

2. Objectives

This text has three major goals: (i) argue the legitimacy of restrictions imposed on agricultural activities in the name of wider social interests; (ii) show that Brazilian protected areas and indigenous homelands have not "smothered" agricultural activities; and (iii) present and discuss comparatively data pertaining to three different sets of land uses (agriculture, protected areas and infrastructure). The discussion of these matters leads to the conclusion that there is "enough" space for these land uses. Additionally, the text argues (i) that protected areas are not closed to all forms of agriculture, (ii) that restrictions to agricultural activities in portions of private properties seek to conserve resources and allow for longer lasting cultivation, and (iii) that enormous areas officially deemed to be underused, non-used and abandoned prove that Brazilian farmers historically have not adopted techniques that conserve resources, practicing more soil mining than cultivation.

3. Protected areas and restrictions to the expansion of productive rural activities

Conceptually, this text argues that restrictions posed by protected areas to agricultural activities are legitimate. These restrictions are justified by several considerations of the public interest including (albeit not exclusively) the aspects of environmental quality and the conservation of natural resources. The principle that many types of industrial activities, processes, inputs and outputs must be regulated, closed down or even banned is widely accepted today in industrial countries (including Brazil), on account of any number of negative environmental externalities and in the name of a wider public interest. Even 30 years ago, this was still a highly controversial matter. Industries, lobbyists and workers commonly fought against such regulations and many politicians similarly opposed to these regulations were easily elected. However, many restrictions – on the use of certain raw materials and inputs, on risks posed to consumers and workers, on emissions, on energy inefficiency, on wasteful packaging, and even on the physical location of industrial installations - are

now accepted and even routine in different countries and industrial sectors.[7]

Getting closer to the matter of this text, there is no reason why agricultural activities should be exempt from equivalent environmental restrictions. Some have become accepted, like public health rules that control the use of chemical/synthetic inputs in agriculture and animal husbandry. After all, agricultural activities (i) use natural resources that only controversially can be argued to be full private property (soils, native vegetation, water bodies, wildlife, biodiversity, genetic materials, atmosphere, coastlines, oceans etc.) and (ii) they are fully capable of generating serious negative externalities on the natural environmental itself and/or on society at large. These are more than enough legal and technical grounds, therefore, to justify social and environmental limitations on agricultural production, in the name of the wider public interest.

One way to create limitations to non-urban productive activities in the name of the wider public interest is the creation of publicly protected areas that exclude or limit, in different degrees, productive activities that use or affect natural resources. This may be done in combination with restrictions valid for private properties (in Brazil this happens in the form of APPs and RLs – see below). This is the case of 20th century legal standards in Brazil, in which private landowners do not fully own the (i) subsoil (including ores, oil, coal and natural gas deposits), (ii) surface waters, (iii) native vegetation or even (iv) native fauna occurring on their properties. These resources are considered "public goods" (state property or national patrimony, according to each case). Their use is subject to limitations associated with different permit systems, some of them more strictly applied than others. The legal use of the Brazilian fauna, for example, is more severely restricted than the use of the flora. On the other hand, soil fertility, for all practical and legal purposes, can be used (even wastefully) without any effective legal restriction or sanctions.[8]

It must be admitted, however, that the currently dominant opinion about protected areas in Brazil's Ministry of the environment and in other federal and state environmental agencies unfortunately converges with the views under criticism here. Many office holders and technicians in these agencies "defend" protected areas in general, and conservation units, in particular, by emphasizing their purported role in production and development, in lieu of their role in the protection of biodiversity and the integrity of ecosystems and landscapes.

The most telling – and quasi-official – statement of this position lies in an article signed by six technicians of the Ministry of the Environment (and two other authors).[9] They strive to provide details about the productive potential of each of the 12 kinds of conservation units defined by Brazilian law. Their text contains several tables filled with figures recording the estimated monetary values of the potential productive outputs of all Brazilian federal conservations units. In other words, the authors treat these protected areas as if they were farms or factories that would activate the developmental potential of the places in which they are set. The pro-agrarian coalition, quite

[7] The extent of these and other more severe restrictions and of their acceptance is broadly mapped and analyzed in Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism* (New York, Little and Brown, 1999). See also Marcel Bursztyn and Maria Augusta Bursztyn, *Fundamentos de Política e Gestão Ambiental - Caminhos para a Sustentabilidade* (Rio de Janeiro, Garamond, 2013).

[8] José Augusto Drummond and Ana Flávia Platiau, Brazilian Environmental Laws and Policies, 1934–2002: A Critical Overview, *Law & Policy*, Vol. 28, No. 1, p. 83-108, January 2006; José Augusto Drummond, Conceitos Básicos para a Análise de Situações de Conflito em Torno de Recursos Naturais. In Marcel Bursztyn, ed. *A Difícil Sustentabilidade – política energética e conflitos ambientais*. Rio de Janeiro, Garamond, 2011, p. 123-147.

[9] Helen C. Gurgel et al. Unidades de Conservação e o falso dilema entre conservação e desenvolvimento. *Regional, Urbano e Ambiental*, N. 3, 2009, p. 109-119.

comfortable with the soaring monetary figures of the agricultural output of commercial farms, is most probably gratified by the use of this type of argument (so close to their own) and amused by the meager figures of the estimated output to be generated by conservation units. Indeed, the authors of the article transform protected areas into productive areas, instead of defending them on the basis of their legitimate and legally defined role of protecting biodiversity, ecosystems and natural resources

To test the solidity of current allegations in Brazil against the "excess" of protected areas demands the gathering of a fairly extensive amount of data and its proper analysis, in the context of conceptual controversies over the very nature of these protected areas, the proper role and size of agricultural activities, and the expansion of infrastructure. This is what I attempted in the following sections of the text, in order to measure the alleged excess and to reflect on how much it may have hindered agricultural production and infrastructure.

Production and infrastructure are, of course, legitimate land uses, but they should not be argued as absolute, particularly in the context of a belated and much-needed discussion about the macro-zoning of an enormous territory such as the one held by the Brazilian nation. Miranda et al's text, the major reference in this text, is rich in data, original in scope, innovative in methodology, and bold in its inferences. It is a welcome addition to the discussion about the macro zoning of the Brazilian territory. However, the text loses much of its impact by coming very close to a statement in favor of an absolute priority given to a continuously expanding agricultural frontier and production, depicted as the single most important and strategic pursuit of the Brazilian society and economy. Sober analysis must take into due consideration all land uses and the roles and relative weights of all sectors of the Brazilian economy.

The present text shows that the numbers and the combined area of protected areas and indigenous homelands in Brazil indeed expanded rapidly over the last 30 years. However, **there is no sign that this expansion contained the growth of agriculture and infrastructure**. On a national scale and even on regional scales, Brazilian agriculture and infrastructure have expanded prodigiously and have **not** been limited by protected areas. There are, of course, numerous local collisions between protected areas and agricultural or potential agricultural areas, just as there are local collisions between different types of agricultural activities, or between agricultural activities and infrastructure.

Admittedly, there are a few states (such as the Amazonian states of Roraima, Acre and Amapá) in which there are exceptionally extensive conservation units, in combination with large indigenous homelands. In those states, agriculture and cattle ranching will probably not grow as expansively as they did and still do in most of the country, particularly the Midwest and Northeast regions and the southern fringes of the Amazon region. It is in itself remarkable that this combination of large acreages of conservation units and indigenous homelands occurs exactly in three states belonging to the Amazon region, in which live the largest numbers of indigenous groups and in which there is a rich and highly valued biodiversity.[10]

The text under critique herein is rich in data, original in its scope, methodologically innovative and

[10] Concerning the state of Amapá, see a more detailed analysis of this matter in José Drummond, Teresa Cristina Albuquerque de Castro Dias e Daguinete Maria Chaves Brito, *Atlas das Unidades de Conservação do Estado do Amapá* (Brasília, Ministério do Meio Ambiente; Macapá, Ministério Público do Estado do Amapá e Secretaria de Estado de Meio Ambiente do Amapá, 2008). Available at http://academia.edu/3390507/Atlas_das_Unidades_de_Conservacao_do_Estado_do_Amapa

bold in its inferences. Although data and analysis about the growth and current dimensions of Brazil's major agricultural cultivations and about degraded, abandoned or underused areas are missing, it is a remarkable contribution to the macro zoning of the uses of the Brazilian national territory. However, as stated above, the text loses a good part of its thrust because it chooses to be an absolute statement in favor of a permanently expanding agricultural frontier. Such a frontier is construed as the most strategic component not only of Brazilian agriculture, but also of the Brazilian society and nation as a whole. This is a gross exaggeration. Rural productive activities are important and legitimate, but there is no reason to emphasize them to the detriment of all other dimensions.

It is admitted, therefore, that Brazilian agriculture faces legal and legitimate restrictions, of several kinds. Nonetheless, there has been a considerable expansion of agricultural areas. Let us examine the restrictions that Miranda and collaborators consider most detrimental to agriculture – conservation units, indigenous homelands, maroon homelands, APPs and RLs. The available data (not thoroughly used by the Embrapa researchers) show that over the last 30 years there has been indeed and accelerated expansion of conservation units and indigenous homelands, following a global trend.[11] APPs and RLs are fixed in area. Maroon homelands did not even exist 30 years ago and; although their numbers grew swiftly since the mid-1990s, their combined area is small. However, the data that record the growth of the conservation units and indigenous homelands do not prove or even suggest that they confined or blocked agricultural expansion. Infrastructure installations also grew swiftly over the last 30 years.

It should be added that many agricultural activities attained remarkable gains in productivity over the last 20 years. Miranda and co-authors, however, ignore this and explicitly call for the unfettered physical expansion of agriculture as the only way to increase its output and guarantee the greatness of the Brazilian nation. This may seem like a "modern" idea, but it descends directly from a colonial and post-colonial vision that defended the continuous growth of the production of agricultural commodities by means of the horizontal expansion of cultivated areas.

Of course, there are many local collisions between agricultural activities and protected areas. Agriculture is also limited within each individual property, by APPs and RLs. But both also collide with infrastructure or with any number of productive activities, such as mining. This scenario of multiple activities striving for space is absent from the text under examination.

A relevant inference of my findings is that Brazilian society can live well with the admittedly large percentage of protected areas and even with a moderate additional amount of them. This statement is supported not only by the data to be examined below but also by generic considerations such as (i) the large size of Brazil's territory, (ii) its mostly tropical condition (Brazil is the largest tropical country in the world), (iii) its generally low altitudes, (iv) its generally smooth or gently waving relief, (v) its amenable soils, (vi) its reliable climate, (vii) its abundant water and – not the least – (viii) its rich biodiversity. I also consider the variables of population growth, population distribution, and predictable advances in agricultural technology.

However, the most telling variable that indicates the need for continued regulations on agriculture are the 200 million hectares (a staggering 23 percent of the Brazilian national territory) of lands that lay unused, abandoned or underused (usually occupied only by low productivity grazing operations).

[11] Ver A. Zimmerer, Cultural ecology: at the interface with political ecology - the new geographies of environmental conservation and globalization. *Progress in Human Geography*, 30(1), p. 63-78, 2009.

This figure, officially publicized by a high-echelon federal agency, amounts to three times the currently cropped areas in Brazil.[12] Surprisingly, it is not mentioned in the Embrapa report. Agriculture, as a collective enterprise, simply abandoned them or refused to invest in their reclamation. Miranda and colleagues implicitly support the "easy way out" – the advance on new lands on the frontiers and the capture of extra rent provided by "virgin" soils and associated resources. Degraded lands are not legally "fenced off" to agriculture by protected areas, as Miranda et al argue about. Brazilian farmers themselves have been made them technically improper for agriculture.

If "only 22.98 percent" of the Brazilian territory are currently available for agricultural activities, as Miranda and collaborators argue (I will show that this figure is vastly underestimated), it still is a considerable percentage of one of the largest countries in the world. First of all, this percentage is equal to that of the aforementioned unused, underused or abandoned areas. Other traits favorable to agriculture abound. This territory has mostly arable lands. It has no deserts. It is mostly humid and super-humid. No permafrost soils or tundra-like biomes exist, no rigorous winters and ice sheets occur, no volcanoes are active. There are no regular hurricanes or other regular types of devastating storms. Earthquakes are rare and moderate. Granted, Brazil has a fairly extensive semi-arid region. However, millions of family farmers live there and try to adapt to the irregular rainfall. Besides, in parts of this drier region, mechanized irrigation is viable and allows the operation of modernized farms belonging to the agribusiness sector.

This is, therefore, a large stretch of land free from serious obstacles to stable human occupation, including agriculture. Therefore, the value of those "mere" 22.98 percent for Brazilian agricultural production should not be downplayed, as do Miranda and collaborators, just because the rest of the land is used or scheduled to be used for other purposes.

4. Productive activities and infrastructural installations to be considered

Box 1 contains a fairly encompassing (but admittedly incomplete) list of 15 productive activities and infrastructure installations that, according to Miranda and collaborators, are suffering losses or restrictions caused by the excessive expanse of protected areas and related environmental policies.[13]

[12] Source: Recuperação de áreas degradadas. Secretaria de Assuntos Estratégicos - SAE. Available at http://www.sae.gov.br/site/?p=495. Accessed on June 27 2013. The SAE is a presidential level office in charge of strategic studies and planning. Several requests made by the author about data and criteria used to compute this figure were not responded.

[13] Actually, Miranda and collaborators pay scant attention to infrastructure, industrial installations and urban areas. This adds to the inconsistency of their article, as will be argued later in the text.

Box 1 - Productive activities and infrastructure installations to be considered

1 – total area under agriculture (including cattle raising)
2 – areas dedicated to selected large-scale monocultural crops (coffee, orange, sugar cane, soybean, corn, cotton, sorghum, sunflower etc.)
3 - area used for other forms of animal husbandry
4 – area of planted commercial forests
5 – area of native vegetation subjected to recent logging
6 – area of land reform settlements
7 – roads
8 – railroads
9 – areas of lakes created by hydroelectric dams
10 – areas covered by electric energy transmission lines
11 – oil ducts
12 – gas ducts
13 – areas granted for mineral prospection and production (non-oil and non-gas)
14 – areas granted for oil prospection and production
15 – areas granted for natural gas prospection and production

The present text will deal mostly with comparisons between the areas of protected areas and those of some of the items listed in Box 1. When reliable historical data series are available, we use them to compare the expansion of protected areas and of productive activities and infrastructure. When they are not available, comparisons are made based on the data closest to the ones used by Miranda and coauthors.

However, a few analytical points must be clarified about these items before comparisons can be made. First, relevant data concerning some of them are missing or were excluded from the analysis on account of the difficulty of making comparisons. Second, several productive and infrastructural dimensions are missing from Box 1. They were excluded from our analysis. However, a few words about some of these missing dimensions are relevant to our critique of Miranda and collaborators' arguments, findings and inferences. These dimensions are apparently irrelevant, or lack visibility, while others are more obviously relevant to a discussion about the different land uses. Among the apparently irrelevant are port[14] and airport[15] areas or districts, warehouses and silos, water reservoirs and ducts. Landfills and sewage treatment units are more obvious missing components.[16]

[14] Brazil has 84 officially defined water port areas/districts. Many of them combine large docking facilities, warehouses, storage and parking areas, industrial and office buildings, and yards, all of which monopolize considerable extensions of lands, shorelines and waters. No consolidated data were found about the total or average sizes of these ports. Miranda et al's study hardly mentions them. See *Boletim Estatístico da Confederação Nacional dos Transportes*. Brasília, março de 2009.

[15] There are 2,564 officially recorded airports (33 international, 33 domestic and 2,498 "small airfields") in Brazil. Airports typically comprise huge areas with landing fields, access lanes, hangars, office areas, passenger terminals, warehouses, and storage and parking areas. Many "small airfields" are mere unpaved landing strips. All of them also immobilize significant sections of the Brazilian territory. No consolidated data exist for them. They were also left out of Miranda's study. See *Boletim Estatístico da Confederação Nacional dos Transportes*. Brasília, março de 2009.

[16] In the cases of landfills and sewage treatment plants, the immobilization of areas lands, soils and waters is a consequence of the "sink" function of the natural environment, i. e., its ability to "absorb" residues of human society. This function is as relevant to the limitation of productive activities (and human welfare) as "source" functions, such as the

Waterways (*hidrovias*), of which Brazil has officially 13,000 km, can also be rightly included in the list.[17]

The point is that these non-agricultural features and installations immobilize portions of lands and resources for their own purposes, to the same degree as some of the protected areas, even though many of them may be smaller than some of the larger protected areas. However, they serve the productive structure of which agriculture is a part. They provide energy, transportation, accessibility, communication, waste disposal etc. Maybe Miranda and collaborators spare them on account of their productive functionality. Protected areas, obviously, do not serve productive activities and infrastructure equally, although in some instances they may benefit them – for example, with clean water for industries and urban supply, flood control, crop pollination etc.

Third, a sound examination of the subject matter demands an outlook that takes into account the fact that all activities/installations **compete among themselves** for space and resources, as much as with protected areas. There are many examples of this. Mining and agriculture cannot use the same parcels of land at the same time.[18] A sewage treatment plant is not the ideal neighbor of a resort hotel. Cattle cannot forage on roads and landing strips. The point is that protected areas are not alone in restricting the expansion of agricultural activities. These activities are many times incompatible with each other at the same time and location. Miranda and collaborators' text does not recognize this highly relevant fact, nor explores it analytically.

5. Types of protected areas that restrict to agriculture, according to Miranda and collaborators

As stated, the text by Miranda and collaborators has had a strong impact on recent discussions about the future of both agriculture and protected areas in Brazil, and deservedly so. It results from an on-going, ambitious, technologically innovative, long-term research and monitoring project, conducted under the institutional umbrella of Embrapa, Brazil's major agricultural research institution. The text seeks to identify what it calls the "territorial reach" of environmental policies and regulations in Brazil and their effects on the expansion of agriculture.[19]

Miranda and co-authors measured this "reach" basically by the amount of territory that is

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supply of "useful" resources – soil fertility, provision of food and building materials, ores, fuels etc. On the concepts of "sink" function and "sink" areas and their growing importance in environmental limitations to human activities, see Donella Meadows, Jorgen Randers; Dennis Meadows. *Limits to Growth – the 30-year update* (White River Junction, Vermont: Chelsea Green Company, 2004, Chapter 3). These areas are also important receptacles of agricultural and animal husbandry wastes. They represent legitimate, current and expanding land uses that help define/occupy the territory. However, Miranda et al's text pays no attention to any parts of the natural environment used as sinks. I found no consolidated data on the areas of Brazilian landfills or sewage treatment plants.

[17] Waterways in several Brazilian states are increasingly used to carry large quantities of agricultural commodities. This particular use of rivers obviously competes with other productive uses (fishing, irrigation, energy generation, urban and industrial supply) and with conservationist and preservationist uses. Miranda and collaborators' text also ignores waterways. See *Boletim Estatístico da Confederação Nacional dos Transportes*, março de 2009.

[18] Actually, under Brazilian law the mere issuance of a prospecting or mining permit to a mining company excludes any other land uses in the conceded perimeter. Many times this exclusion lasts for years, even if there is no prospection or if mining ceases.

[19] So much controversy resulted from this text that in late 2009 the president of Embrapa, which employs Miranda and his co-authors, issued a specific statement clarifying that the text did not reflect the agency's position concerning protected areas. This disclaimer would seem superfluous in a research institution that has dozens of independent research groups. The disclaimer was issued because the text was widely adopted and cited by agricultural and anti-environmental interests, generating controversy, prompting Embrapa as an institution to distance itself explicitly from the study.

supposedly "fenced off" to agricultural activities (including cattle ranching) by protected areas. At this point, therefore, a detailed explanation of the types of lands considered by Miranda and collaborators as "fenced off" to agriculture is required. As will be shown, Miranda and his team made serious – and misleading – mistakes in this matter. The general heading of "protected areas" hides important distinctions among them. By not dealing properly with these distinctions, the authors jeopardized/distorted their research and results.

Protected areas, as officially defined in Brazil, are divided into five types – conservation units, indigenous homelands, *quilombola* ("maroon") homelands, APPs (permanently protected areas) and RLs (legal reserves). This was defined in an official document drafted by the Ministry of the Environment, published in 2006, entitled "National Strategic Plan for Protected Areas". This was a formal statement of Brazil's continuing allegiance to the Convention on Biodiversity Protection - CBD.[20] Decree 5,758, April 13 2006, sanctioned the text of this plan. Brazil thus officially committed itself to the protection of these areas.

In the rest of this section, I discuss the concepts used in this complex definition of protected areas. Then I present my critiques to this definition and argue that the five types of areas have substantially different effects in terms of limiting the expansion of agriculture and of protecting biodiversity. This allows us to depart strongly from Miranda and collaborators' findings and inferences.

Let us consider, one by one, Brazil's five types of protected areas.

(i) Conservation units

These are publicly created and managed areas, created for the purpose of protecting the natural features of portions of the Brazilian territory. The 12 types of conservation units defined by Law 9,985, July 18 2000, are divided into two groups. The first is composed by five types of **fully protected** units (of which the most relevant to our discussion are national/state parks, national/state biological preserves and national/state ecological stations). The second group comprises seven types of **sustainable development** units (of which the most relevant are national/state forests, national/state extractive reserves and national/state environmental protection areas).

One of the major problems of Miranda and collaborators' text is not taking into account the highly relevant differences between the first group (in which people and productive activities are excluded) and the second one (in which people and productive activities are admitted, even if with stipulated limitations). We sustain that Miranda and co-authors' allegations that conservation units limit the expansion of agriculture should be aimed solely at the fully protected units, which comprise a little over one third of the total area affected by federal, state and municipal conservation units. The total area of sustainable use units is much larger: 974.624 km^2, 65.37 percent of the joint area of all federal, state and municipal conservation units, leaving only 519,154 km^2 (34.63 percent) for lands actually "fenced off" (See Annex, Table 1). [21] Thus, conservation units closed to agriculture amount to only one third of the area alleged by Miranda and coauthors.

[20] Source: Ministério do Meio Ambiente. *Plano Nacional de Áreas Protegidas*. http://www.mma.gov.br/estruturas/ascom_boletins/_arquivos/plano_completo.pdf. 2006. Accessed on June 27 2013.

[21] Data taken from "Cadastro Nacional de Unidades de Conservação do Ministério do Meio Ambiente (CNUC-MMA)", available at http://www.mma.gov.br/sitio/index.php?ido=conteudo.monta&idEstrutura=119. This is the official registry of all Brazilian conservation units.

This distinction is all-important to the subject matter, because the seven types of sustainable use units allow a broad range of productive activities and infrastructure installations. For example, national forests alone comprise the second most expansive type of federal conservation unit in Brazil – 65 units (out of 304), covering 24.99 percent of the combined area of federal units (the respective for figures for national parks are 64 and 34.09 percent). Sustainable use units have management plans that create some limitations to their productive uses, although some of these limitations are valid also for private properties. However, all sustainable use units allow the permanent residence of humans and a long string of productive activities.

In national/state forests and forested extractive reserves, for example, inhabitants may migrate, collect plants, hunt and fish, besides grow crops and animals (including cattle), manage fauna and cut trees selectively. In national/state forests, commercial-scale logging, extraction of non-wood products and mining are target activities, to be engaged in by both resident and non-resident populations. In marine extractive reserves, resident artisanal fishermen may have exclusive rights to fish certain species or all species in designated areas (supposedly in a quasi-subsistence scale and employing only simple technologies). They may engage also in fish farming. Waterworks, roads, ports, hydroelectric plants, electricity transmission lines, communication towers and antennas and other installations may be located in all sustainable use units.

At the extreme, the type of sustainable use unit called "environmental protection areas" – APA, the most "flexible", may comprise commercial farms and even entire cities or parts of urban areas and their productive activities and infrastructure. According to the Ministry of the Environment, federal and state APAs alone cover 426.273 km^2, a non-negligible 5 percent of the Brazilian territory. 45.6 percent of the area of all state conservation units is made up of APAs.[22]

Although the legally defined goal of sustainable use units is the "sustainable use of biodiversity", the major point is that **they do not exclude productive activities**, as alleged by Miranda and collaborators. Only fully protected conservation units (adding to 519,154 km^2, about 6 percent of the national territory) are incompatible with the expansion of agriculture. This reduces by two thirds Miranda and collaborators' calculations of areas "fenced off" to agriculture by conservation units.

Therefore, sustainable use conservation units belong more to the field of productive activities and infrastructure installations than to the field of obstacles to agricultural production and infrastructure installations. Of course, they are not supposed to be subjected to untrammelled resource exploitation. Legally, they cannot be used in this manner, because their management plans must include the preservation of remnant native flora and associated resources.[23]

Also left out of the analysis of Miranda and collaborators are the private reserves of the natural patrimony (RPPNs), a private type of sustainable use conservation unit created by the initiative of landowners and accredited by environmental agencies. Interested landowners seek environmental agencies (federal, state or municipal) and apply for their lands (or portions of them) to be awarded the status of RPPNs. They enter into these arrangements voluntarily and commit to refrain

[22] Idem.

[23] Not incidentally, Miranda and collaborators consider conservation units (plus indigenous and *quilombola* lands) as lands reserved for "minority" populations. Although the term is dubious in mathematical terms, it correctly denotes these groups as external to the commercially oriented segments of the Brazilian rural population. On the other hand, no hard data is presented by the authors to support their suggestion that agribusiness operations comprise any type of "majority" of Brazilians, or even of a majority of Brazilian rural dwellers.

permanently from agricultural activities the designated areas. RPPNs may be used to support/promote scientific research, visitation, leisure and hospitality. These landowners are not unilaterally affected by decrees over which they have little or no control, as in the case of other types of conservation units. Although the mean and total areas of RPPNs are minuscule in relation to the figures for other types of conservation units, they are Brazil's most numerous type of conservation unit.[24] Landowner initiative in creating RPPNs shows that at least a few hundred landowners consider that the sustainable use of natural resources does not conflict with their productive activities.

As of May 2011, Brazil had 310 federal conservation units, 508 state units and 81 municipal units (plus 1,081 RPPNs), covering a total area of 1.411.834 km^2 (approximately 16.58 percent of Brazilian territory). This percentage is above the world average of 12.8 percent. Only the USA (2.607.132 km^2), Russia (1.543.466 km^2) and China (1.452.693 km^2) have more cumulative protected areas than Brazil.[25] Although these massive figures seem to support Miranda and collaborators' vision of Brazilian conservation units as enormous areas "fenced off" to agriculture, in 88.3% of these conservation units, according to the Ministry of the Environment, there may be "several economic uses that may generate immediate positive effects to the regional economy. The remaining areas do create restrictions to immediate economic use, but on the other hand it may favor local development".[26]

(ii) Indigenous homelands

Brazil's indigenous peoples, as happened in many other countries, were subject to many acts of physical, cultural and religious violence and victimized by lethal introduced epidemic diseases. In the presence of European colonizers, dozens of groups disappeared, and surviving groups suffered serious population crashes and/or geographical dislocations. In 2010, the Brazilian Census Agency counted 817,963 indigenous people in the Brazilian territory, a mere 0.4 percent of the total Brazilian population.[27] Not all of them live in indigenous lands and/or in tribal communities. Some of them live in nearby cities, at least for part of the year.

Nonetheless, over the last 20 years, approximately, surviving native peoples have fared remarkably well in population growth, in the recovery of their homelands, and in the exclusive use of associated resources. Currently, about 13.1 percent of the Brazilian national territory is designated as

[24] According to the Confederação Nacional de RPPNs (a national association of RPPN owners), in 2011 there were 1,081 RPPNs in Brazil, with a combined area of 7.037,24 km^2, less than 0.1 percent of the national territory. Despite their comparatively large number, their average size (6,5 km^2) is relatively small. See Confederação Nacional de RPPNs. Sumarização Nacional das RPPN, por bioma. Available at http://www.reservasparticulares.org.br/relatorios/sumarizacao/bioma/. Accessed on June 23 2013.

[25] Ministério de Meio Ambiente, *O Sistema Nacional de Unidades de Conservação da Natureza* (Brasilia, MMA, 2011), p. 4, 5. For the purposes of this article, we ignored the areas of the 81 officially registered municipal units, given their small dimensions – they have a total area of 5,526 km^2.

[26] MMA, *O Sistema*..., p. 12. In this publication, the Brazilian Ministry of the Environment displays a regrettable willingness to defend conservation units in terms of their productive potentials and uses, as distinct from their intrinsic and legally supported role of biodiversity protection. Such an attitude only weakens conservation units and stimulates pro-development interests to attack them more aggressively. See note 10.

[27] IBGE (Instituto Brasileiro de Geografia e Estatística). Resultados Preliminares do Universo do Censo Demográfico 2010. Available at http://www.ibge.gov.br/home/estatistica/populacao/censo2010/resultados_preliminares/preliminar_tab_uf_zip.shtm. Accessed on June 27 2013.

indigenous homelands. Further designations are under study and could increase this figure, maybe to 15 percent.[28] (See data on the expansion of indigenous homelands in Table 2, Annex)

This recent turnaround resulted from a federal policy that confronts strong opposition by state and local politicians and by associated private interests, particularly in Brazil's Amazon and Midwest regions, in which about 90 percent of all indigenous homelands are located. Nonetheless, from a land use planning point of view, indigenous lands have become a major factor to be reckoned with in terms of land use planning, national geopolitics and economic-ecological zoning.

Although this is not the place to discuss at length my disagreement with the current Brazilian classification of protected areas, I need to address briefly this matter in respect to indigenous homelands. Simply stated, in my view these homelands have only a weak relationship with environmental policies seeking the protection of biodiversity (such as conservation units). Their relationship with biodiversity protection is incidental at best. This is not a critique of native peoples' rights, of their homelands, of their inhabitants, or of their modes of land and resource use. Much to the contrary, it means that indigenous homelands have a thoroughly distinct legitimacy when compared to areas protected for purposes of nature conservation. More than that, they have a much deeper social meaning. Indigenous homelands seek to make a small repayment to the few remnants of the mostly obliterated/assimilated original inhabitants of Brazilian territory, so that they may live according to their customary ways. They are designed to supply them with the means necessary to live in these customary manners, in contrast with a national society that adopts radically different manners.

The decision by the Ministry of the Environment (by means of the aforementioned Decree 5,758, April 13, 2006) to include indigenous homelands in the list of protected areas actually jeopardizes the much stronger (and constitutionally sanctioned) argument for the establishment of these homelands – their "ancestral rights" to their lands, to the detriment of all other groupings of Brazilians. This concept simply preempts all other land uses or users. The "politically correct" or romanticized allegation that indigenous peoples are "friendly" to or live "in harmony" with the natural environment is a flimsy argument that pales in the face of the fact of their constitutional standing. Indigenous rights to their lands are thus much more strongly supported by the argument of their ancestrality – a socio-cultural fact – than by their supposed "harmony" with nature. This is a mere supposition that buries indigenous cultures under a possibly fleeting imperative of the "modern" demands of conservationists/preservationists. The legitimacy of their claims is overrun by an arbitrary obligation of "friendliness" to nature. Moreover, indigenous land claims and this rationale of "friendliness" are not strongly supported by many Brazilians, maybe a majority. Besides, there is little sense in awarding homelands to indigenous peoples with the condition that they adopt a certain standard of behavior towards the natural environment, when this standard is only scantily adopted in the Brazilian national society as a whole.

There are indeed legal limitations for the use of natural resources by the indigenous peoples themselves (or by non-indigenous partners) and for the location of infrastructure installations in indigenous homelands. Miranda and collaborators are correct to write off these homelands as

[28] See Ministério Público Federal - Procuradoria Geral da República, "Índios e Minorias - listagem de terras indígenas federais." 2011. Available at http://ccr6.pgr.mpf.gov.br/documentos-e-publicacoes/terras-indigenas/tis/ Accessed on September 17 2013. On the possible future expansions of homelands, my sources were Funai staff members, personal communication, Brasília, 2012.

locations for agribusiness or even family farming. However, they are **wrong** to state that indigenous homelands have an environmental protection rationale and basis that restricts agriculture. By allowing collection, hunting, fishing, agriculture and sometimes even logging and mining, these lands support indigenous populations in the same way as regular productive areas support non indigenous people, although there is a world of difference between what commercial and family farmers want and do and what indigenous want and do.

In sum, I do not agree with the Brazilian government's classification of indigenous homelands as protected areas. I maintain this position even though I am aware that forest cover in indigenous homelands suffers less with clear cutting than private lands and even non-managed public lands, including conservation units. More to the point of this text, however, is that Miranda and collaborators are wrong in considering them "fenced off" to agriculture.[29] Therefore, the figure that they present for lands that are closed to agriculture loses an additional 13,1 percent of the Brazilian national territory.

(iii) "Maroon" community lands

Quilombola communities (known in English as "maroon") are formed by descendants of escaped Black slaves. Black slavery was abolished in Brazil in 1888, by which time hundreds of communities of escaped slaves had been formed all over the country.[30] Currently there are in Brazil about 1.800 certified quilombola communities. The 1988 Constitution instituted the possibility of rural communities of escaped slave descendants being awarded title for the lands to which they fled and on which they continued to live. These lands were to be titled collectively to each community by the federal government.

These communities are typically small, located in remote or isolated sections (and many times on marginal agricultural lands) of most Brazilian states, reflecting the distance that each group of escaped slaves sought to put between itself and the slave-holding national society. *Quilombolas* are typically the poorest of all rural dwellers in their respective regions. Starting in the 1990s, hundreds of communities and the lands they occupied and wished to receive title on were formally studied and certified, on a case-by-case basis. The federal government awarded hundreds of titles. Benefitted communities typically continue to live on the basis of their very modest subsistence agriculture and animal husbandry.

Mimicking what it did with indigenous homelands, however, the Ministry of the Environment

[29] Two further points should be considered about indigenous homelands. First, over the last 30 years, they have been a major factor in the reduction of the areas of established conservation units. There is still a stock of overlaps that tend to be decided in favor of indigenous homelands. This is not recorded by Miranda and co-authors. In other words, conservation units and indigenous lands **compete with each other for land**, a fact unnoticed by Miranda and collaborators. See Fany Ricardo, ed., Terras Indígenas & Unidades de Conservação – o desafio das sobreposições (São Paulo, Instituto Socioambiental, 2004). Second, there are several recorded cases of indigenous groups who, legally or not, have opened their lands to cattle raising, logging and placer mining, either engaging in these activities themselves or through non-indigenous partners who pay them "leases" or "royalties". This has brought both wealth and internal strife to those groups, or between them and their non-indigenous partners. A typical recent journalistic account about this matter is http://www1.folha.uol.com.br/poder/12208155-indios-alugam-terras-para-exploracao-ilegal-de-madeira.shtml

[30] See Charles C. Mann, *1493 – Uncovering The New World Columbus Created* (New York, Knopf, 2011), about the large numbers of Africans forcibly transferred to the American continent as slaves since early colonial times and the consequent formation of "maroon" communities, in Brazil and other colonies. General information about current *quilombola* communities in Brazil can be found at http://www.palmares.gov.br/?lang=en, accessed on June 29 2013.

dubiously transformed this ethically legitimate, although belated act of reparation into a matter of environmental policy. It included these lands in the 2006 list of areas officially protected for the sake of nature conservation, under the unfounded allegation that these communities have a commitment to preserve biodiversity. Such as with indigenous peoples, I believe that it is unfair to demand *quilombolas* to behave harmoniously in relation to nature when the bulk of Brazilian farmers do not. Their territorial rights are based on stronger and more coherent arguments. Other than stating that agriculture, animal raising, fishing, logging and mining are allowed in *quilombola* homelands, I will not debate this matter any further.

However, this conceptual "smuggling" operated by the Ministry of the Environment put *quilombola* communities and their lands on Miranda and collaborators list of enemies of agriculture in Brazil, although these lands are open to agriculture. The authors do not place much emphasis on these lands, however, maybe because their combined area is diminutive (**11.787, 17 km^2**, or **0.13 percent** of the national territory), in comparison with indigenous holdings (See Table 3, Annex).

(iv) Permanently Preserved Areas - APPs

APPs ("*áreas de preservação permanente*") are a quite different type of protected area. First, they pre-exist conservation units, indigenous homelands and *quilombola* homelands. They were created by the 1934 Forest Code (Decree 23,793, January 23 1934) and ratified by the 1965 Forest Code (Law 4,771, September 15 1965). Second, they are located on all privately and publicly owned properties, including areas leased for mining. Third, they correspond to variable portions of each private and public rural property in all of Brazil. Fourth, these portions are defined by biophysical traits, such as hilltops, steep slopes (45 degrees or more), watersheds, river banks and associated floodplains, wetlands, coastal scrub vegetation, dunes, mesa edges, and all lands situated above 1,800 meters asl. Native vegetation of any kind occurring on these portions of each property is to be left untouched.

It is important to emphasize that the rationale behind APPs is **not** the protection of biodiversity, but rather the conservation of resources – prevention of soil erosion, protection of water supply and quality, flood control, protection of "useful" fauna etc. - **for the sake of the continuing use of productive rural areas**. Although not conceived to protect biodiversity, they may help in such protection, mostly as a consequence of the native vegetation being spared.

The aggregate area of APPs had never been computed on a national scale before Miranda and co-authors' innovative effort. APP measurements had been made only on local scales, in isolated properties or small groups of adjoining properties. The database used in their report came from relatively recent orbital images generated by the Topographical Radar Orbital Mission (involving several US Shuttle missions). This was a pioneering use of new, high-tech orbital data, covering the entire Brazilian territory. The authors note that they used a special algorithm and searched only for APPs linked to (i) topography (altitude, hilltops and steep slopes) and (ii) riverbanks (using also data from the Agência Nacional de Águas, Brazil's federal water management agency). All of these APPs were identified, but their distribution among individual properties was not attempted. The Embrapa team simply added all identified areas and worked with the figure for their total.

This time Miranda and collaborators are **correct** in considering APPs "fenced off" to agriculture. However, I must recall that the rationale behind APPs is to **protect agricultural production** and direct it to the more propitious sections of each rural property, a detail that the authors do not

recognize – APPs are addressed exclusively as areas closed to direct productive use. In areas with an aggressive relief and dense creek and river grids, considerable proportions of each property may in fact be made up of APPs and thus be rendered unfit for and off limits to agricultural production.[31] In areas with smoother relief and/or with fewer watersheds, rivers and creeks, the proportions of APPs in each property are consistently lower. Although many rural landowners live far away from conservation units and/or indigenous homelands and/or *quilombola* lands, virtually **all** landowners have the APPs portions of their properties legally "fenced off" to production. Therefore, APPs hit closer to home, because they affect almost all landowners, in contrast with conservation units and indigenous lands, which affect directly only neighboring landowners.

The admittedly preliminary results of the Embrapa research effort found that the hefty figure of **17.01 percent** of the Brazilian territory to be off limits to agriculture, designated as APPs. They make a note that further image interpretation and the consideration of other APP areas may expand considerably this figure. However, as they expand the list of APP areas that may be included in their future computations, they fail to mention that they deal with lands that are increasingly marginal for agriculture – river deltas, estuaries, dunes, coastal scrub forests, fresh water and salt water marshes and wetlands etc.

Nonetheless, 17.01 percent is an admittedly significant figure. It amounts to about as much as all types of conservation units, a bit more than indigenous homelands, and much more than *quilombola* lands. APPs are therefore fat targets for Miranda and co-authors.

(v) Legal Reserves (RLs)

The role of most serious enemy of the expansion of Brazilian agriculture (in the eyes of Miranda and collaborators) is played, however, by the fifth and last type of protected areas, called "legal reserves" ("*reservas legais*" - RLs). RLs were instituted by the 1965 Forest Code. A RL is defined as an area "located inside a property, excluding the area of permanent preservation [APP], required for the sustainable use of natural resources, the conservation and renewal of ecological processes, the conservation of biodiversity, and the safety and protection of native flora and fauna."[32] Although the protection of biodiversity is included in the goals of RLs, their basic rationale, much like that of APPs, is the conservation of resources and processes that aid agricultural activities at the local and regional levels. In a manner similar to APPs, RLs are measured as varying percentages of each individual rural property, according to the biome in which each property is located. An additional similarity between RLs e APPs is that both affect all rural properties, private and public. On the other hand, the exact location of RLs in each property is not defined by natural aspects, as happens with APPs; each landowner decides where the RL will be located on his property.

As they did with APPs, Miranda and colleagues measured RLs on a national scale, also for the first time, achieving original but equally preliminary results. This measurement was inferred from the aggregation of the legally mandated percentages of the lands of each property to be maintained as RLs, per biome. As an illustration, I will mention only the higher and lower extremes of RL percentages. Properties in the Amazonia biome must maintain 80 percent of RLs, while those in the Atlantic Forest biome must keep only 25 percent. Again the computation was not made at the

[31] Miranda and collaborators are especially concerned with APPs in hilly and moist areas that concentrate small family farms, in which hilltops, steep slopes, watersheds and river banks add up to large proportions – sometimes most - of each property.

[32] Article 1, § 2, III, of the 1965 Forest Code.

property level, but for each biome. Results were then added up for Brazil as a whole.

Miranda and collaborators had to deal with uncertainties about the exact percentages valid for properties located in officially recognized transition areas between biomes. Also taken into account were certain legally dubious "flexibilizations" of RLs proposed and/or enacted by some state governments. Further uncertainty was introduced by the controversial decision made by some farmers and state agricultural or environmental agencies to subtract – against the letter of the law - APPs from RLs at the property level, thereby reducing the area of the sum of APPs + RLs. So complex is the situation that Miranda and collaborators were forced to consider three different scenarios concerning the "territorial reach" of RLs. They finally settle on the figure of **2,685,542 km^2** of RLs (equivalent to **31.54 percent** of the Brazilian territory). This figure supersedes by far the ones for conservation units, APPs, indigenous lands and *quilombola* lands.

Miranda and collaborators are not entirely correct when they consider RLs as "fenced off" to agriculture, however. The law allows unspecified agricultural activities to be developed in RLs, under the heading "sustainable". Additionally, government loans, bank credits, and federal and regional development programs have stimulated landowners in several regions to engage in supposedly sustainable activities in their RLs, entailing the usual controversies about their sustainability. Individual landowners are continually reported in the press as unfairly fined by environmental agencies for using or suppressing entirely their RLs, even though they were "officially" stimulated to do so. In some cases they go to court to challenge these fines and even to seek financial support for the recovery of their reduced or degraded RLs.

6. How much area is actually "fenced off" to agriculture?

Let us check now if the figure of 22.98 percent of the Brazilian territory available for agriculture, computed by Miranda and collaborators, holds up in the face of the all the previous considerations.

A - For **conservation units**, we used the data available for July 2011, quite close to the year of the data used by Miranda and colleagues in 2008 (see Annex, Table 1). As explained above, our computation of conservation units' areas "fenced off" to agriculture includes only fully protected units and excludes sustainable use conservation units. The corrected figure is thus obtained by the operation

1,499,158 km^2 – 980,005 km^2 = **519,154 km^2**

= **6.09 percent of the Brazilian territory**

in which

1,499,158 km^2 = aggregate area of all (federal, state and municipal) conservation units (17.60 percent of the Brazilian national territory

980,005 km^2 = aggregate area of all sustainable use conservation units (11.50 percent of the Brazilian national territory)

519,154 km^2 = aggregate area of all fully protected conservation units (6.09 percent of the Brazilian national territory)

B – Concerning **indigenous homelands**, in April of 2011 there were 677 of them, occupying a total

of 1,129,552 km^2, or **13.3 percent of the Brazilian national territory**. 430 of them are fully certified, while 255 others are in advanced stages of certification.[33] Recall, however, that I do not consider indigenous homelands as obstacles to agriculture.

C – In respect to ***quilombola* homelands**, available data are hard to use on account of a certification process that is even more complex than the one adopted for indigenous homelands. The latest consolidated data pertain to December of 2008 (the same year that Miranda and co-authors' text was published) and are summarized in Table 3 (Annex). They are generated by the Fundação Cultural Palmares, the federal agency in charge of *quilombola* homeland certification. For the purposes of this text, I considered the data about the homelands that are in the last and next to last stages of certification, which amount to a little under half of the lands that have been certified or are under study. This amounts a quite diminutive figure:

9.553,33 km^2 (last stage) + 2.233,84 km^2 (next to last stage) = **11.787, 17 km^2**

= **0.13% of the Brazilian national territory**

Recall, however, that, such as with indigenous homelands, I do not consider *quilombola* homelands "fenced off" to agriculture.

D - For **APPs**, I will adopt the figure computed by Miranda and co-authors, considering their high-tech database and methodology and the lack of other dependable estimates. Recall that small rivers and creeks, lakes, reservoirs and dams, besides dunes, mesa escarpments and edges, estuaries and deltas and several types of wetlands were excluded from their computation. The provisional figure for APPs in all Brazilian lands (and not only in private lands) came to **1,448,535 km^2** (or **17.01 percent** of the Brazilian national territory). APPs are effectively closed to agriculture.

E – As with APPs, I accept the figure computed by Miranda and co-authors for **RLs – 2,685,542 km^2** (or **31.54%** of the Brazilian national territory). The computation again affects the entire Brazilian territory, not only those parts that are private property. I will ignore the fact that some productive uses are legally allowed in these areas, even though Miranda and co-authors state that this is not so.

Table 1, below, summarizes and compares the data found by Miranda et al and by me for the areas of the five different types of protected areas.

[33] These figures were taken from http://pib.socioambiental.org/pt/c/0/1/2/demarcacoes-nos-ultimos-governos (accessed on June 27 2013). The same site explains the relatively complex process of certification. FUNAI, the agency in charge of indigenous peoples, has slightly different figures. FUNAI staff members expect the 13.1 percent figure to grow over the next few years to around 15 percent, as additional indigenous territories enter and complete the certification process (personal communications).

Table 1 – Brazil – Comparisons between the Computations of Areas of Five Types of Protected Areas that Preclude – or not - Agriculture (km^2), according to Miranda and collaborators and Drummond

protected areas	area (km^2) / % of national territory (by Miranda and co-authors)	area (km^2) / % of national territory (by Drummond)
conservation units	1,337,649 / 15.71%	519,154 km^2 / 6.09%
indigenous homelands	1,087,213 / 12.77%	Not closed to agriculture
quilombola homelands	---	Not closed to agriculture
APPs	1,448,535 / 17.01%	1,448,535 / 17.01%
RLs	2,685,542 / 31.54%	2,685,542 / 31.54%
total	**6,558,939 / 77.02%**	**4,665,018 / 54.78%**

--- not computed

Sources: * author's research; ** Miranda et al's research.

By considering the obvious fact that sustainable use conservation units and indigenous and *quilombola* homelands are open to agriculture (not to mention other activities), my computations substantially reduce the area of the Brazilian national territory supposedly closed to agriculture from **77.02 percent** to **54.78 percent**. This would leave **45.22 percent** open to agriculture, and not only **22.98 percent** alleged by Miranda and colleagues. This is practically two times the area computed by Embrapa researchers. It amounts to seven times the French national territory.

I included *quilombola* homelands (not measured by Miranda and co-authors) and did not take into account productive activities that may be located on RLs (for which there is no known measurement at the national scale). Another important omission is that of the relatively extensive areas of APPs that the Embrapa researchers are the first to recognize that have been illegally suppressed over the last decades and used for agriculture, for which there also is no known measurement. This omission is one of the reasons for their computations not to make sense. Miranda and co-authors do acknowledge their existence, though, even citing the types of crops and activities that are typically located on steep slopes of certain regions (coffee, oranges, apples, grape vines, flowers, sugar cane, tobacco etc.) or on wetlands (rice, water buffaloes etc.). Of course, as I argued earlier, if "only" 22.98 percent (the finding of Miranda et al) of the Brazilian territory is quite a large expanse for agricultural use, the 45.22 percent that I computed is even more so.[34]

In sum, all data show that Brazilian agriculture is not being constrained, nor is its expansion barred. In many cases, it has illegally used APP and RL areas for important commercial cultivations.

7. The expansion of rural productive activities and infrastructure in Brazil

Arguing the significance of the recorded difference of almost 24 percentage points of actual

[34] At this point, it should be clear that both my figures and those of Miranda and collaborators do not include urban areas and infrastructure installations

agricultural lands is only part of my critique of Miranda et al's study. This section displays and discusses selected data that show a distinct, but related fact: both agricultural activities and infrastructure components have expanded strongly in Brazil over the last decades (together with protected areas), a trend not acknowledged by Miranda and collaborators.

The areas affected by the growth of agricultural activities and by infrastructure components indeed grew remarkably. Farms and ranches advanced strongly on areas covered by native floral formations, converting them into productive areas, typically leaving behind a staggering amount of degraded, "abandoned" or underused lands (estimated officially at 23 percent of the national territory). Several dimensions of infrastructure also went through strong expansion.

Table 2 (below) displays data on a selected set of rural productive activities and of infrastructure installations and on the respective areas that they occupy or affect. The table is followed by short texts containing explanations, sources of the data displayed, and a few comparisons among these different land uses.

Table 2 – Brazil: Areas Occupied or Affected by 12 Productive Rural Activities and Infrastructure Units (2008-2011), in Decreasing Order of Area (km^2)

activity / installation	absolute area / length	% of the national territory
1- cattle grazing (2008)	1,723,330.73	20.23
2 – all crops (2008)	766,973.24	9.00
3 – cumulative area deforested in the Legal Amazon region (2008)	739,418	8.68
4 – total area leased for mineral prospection and production (2009)	518,293.89	6.08
5 – land reform settlements (2009)	470.000	5.51
6 – leased for oil and natural gas prospection and production (2009)	300.112.01	3.52
7 – commercially planted forests (2009)	63,000	0.74
8 – roads (2009)	1,634,071 km / 49,022.13	0.57
9 - lakes created by hydroelectric dams (2009)	36,767.19	0.43
10 – energy transmission lines (2009)	90,654.30 km / 2,719.62	0.032
11 – railroads (2009)	29,817 km / 894.51	0.001
12 – ducts for crude oil, oil derivates, natural gas, alcohol, methanol, petrochemical substances etc. (2009)	16,986 km / 339.72	0.001

Sources: see text (below).

Item 1. **1,723,330.73 km^2** (**20.23 percent** of the national territory) are dedicated to the single activity of cattle farming.[35] This amounts to more than all conservation units (including sustainable use units), more than all indigenous lands, and more than all APPs.

Item 2. 766,973.24 km^2 (**9.00 percent** of the national territory) – this means that cattle ranching (item 1) and all crops occupy close to one third (**29.23 percent**) of the national territory.[36] This is actually more than the 22.98 percent argued by Miranda and co-authors as the maximum available area for agriculture – i. e., official data that they ignore show that their alleged upper limit has been actually surpassed.[37] These figures are not consistent with the alleged scenario of serious restrictions to agriculture.

Item 3. The **739,418 km^2** (**8.68%** of the national territory) of erased Amazonian forests are practically equal to the total area of all current Brazilian crops, although one figure is not directly related to the other.[38] Most of this deforestation happened over the last 25-30 years, accompanying the expansion of crops and pastures, in the region and mostly outside the region. Of course, this figure has an unknown degree of overlap with areas of pastures and crops (items 1 and 2). Consequently, it should be used in association with the two earlier figures, and not added to them. However, it gives an idea of the strong momentum with which logging, cattle farming and agriculture move into frontier areas to convert vast sections of native forests and savannas into agricultural lands and in many cases leaving behind large tracts of degraded or unused lands. All this is not to be expected in the alleged scenario of a "confined" agriculture.

Item 4. 518.293.89 km^2 (**6.08%** of the national territory) are occupied by 35,562 individual perimeters "leased for mineral production and prospecting).[39] As explained earlier, these areas are set aside for variable numbers of years and no other productive activities are allowed in them while leases are valid, even if mineral production and prospecting do not occur. The source stresses that possible overlaps are not recorded in the figures. Even if there is a degree of overlap, the figure of 6.08 percent places mining and mineral prospecting as major land uses that preclude agriculture, practically to the same degree as fully protected conservation units. The uniformed readers of Miranda and co-authors will not grasp the importance of mining, because their bias against protected areas distort their findings.

Item 5. **470,000 km^2** (**5.51 percent** of the Brazilian territory) are dedicated to land reform settlements.[40] This area is included in the figures of items 1 and 2 and should not be added to them. Nonetheless, land reform settlements in Brazil, even if created mostly on public lands (and not in

[35] Source: Instituto Brasileiro de Geografia e Estatística, *Levantamento Sistemático da Produção Agrícola*. (Rio de Janeiro, IBGE, 2009).

[36] Source: Instituto Brasileiro de Geografia e Estatística, *Levantamento Sistemático da Produção Agrícola*. (Rio de Janeiro, IBGE, 2009).

[37] This discrepancy is due probably to the use of APPs and RLs in many properties. Miranda and coauthors ignore this reality or possibility, or take it for granted. The pro-agricultural caucus in Congress, however, came out explicitly in favor of the farmers who did this. It successfully made an effort to transform these illegally deforested APPs and RLs into "consolidated agricultural areas" – this was written into the 2012 Forest Code. Those farmers thus escaped fines and were freed from the obligation to restore their APPs and RLs.

[38] Source: INPE – PRODES – Dados Consolidados 2007-2008. Available at www.inpe.br. Accessed on June 29 2013.

[39] Source: Departamento Nacional de Produção Mineral – DNPM (www.dnpm.gov.br). Accessed on June 25 2013.

[40] See François-Michel Le Tourneau and Marcel Bursztyn, Assentamentos rurais na Amazônia: contradições entre a política agrária e a política ambiental. *Ambiente e Sociedade*, 13(1), junho de 2010, pp. 111-130. They used data pertaining to all reform settlements created since the 1960s, although the overwhelming part of these settlements were created only after 1995. There is no reliable information about overlaps between settlements or about plot abandonment by beneficiaries.

bought-out or confiscated private properties), have become a major independent land use. A relevant point is that the vast majority of these settlements were created only since 1995, when indigenous homelands, conservation units and agricultural areas were also expanding rapidly.

Item 6. 300,112.01 km^2 (**3.52 percent** of the national territory) are leased to oil and natural gas prospecting and production. The figure refers only to "those sections of territory in which exploration currently occurs", meaning that unexplored leases are not included in the figure.[41] These leased areas, such as those leased for mining, remain unavailable to any other activities for years. It should be noted, however, that an undisclosed percentage of this area refers to reserves located on the continental platform (not included in my computations of the Brazilian national territory), as most Brazilian oil and gas and reserves have been found there. This considerably expansive and "unyielding" land use, affecting more than half of the area "fenced off" by fully protected conservation units and more than a quarter of the area affected by indigenous homelands, is ignored by Miranda and colleagues.

Item 7. The total area of commercially planted homogeneous forests (composed almost entirely of varieties of pine and eucalyptus) in late 2009 was **63,000 km^2** (**0.74 percent** of the national territory), spread among tens of thousands of properties (owned by tree-planting companies or leased by them) in more than a dozen Brazilian states.[42] Sources state that commercial tree plantations are recorded apart from areas of crops and pastures when all three occur in the same properties. Commercial forestry is thus partially compatible with other rural productive activities. Also, it is part of the agribusiness sector favored by Miranda and collaborators. Despite the long-term investments required in the sector, they occupy an area that has grown strongly since the inception of commercial forests in Brazil, in the mid-1960s. This area is far from insignificant - one and a half times the size area of the small state of Rio de Janeiro.

Item 8. Brazil has **1,634,071 linear kilometers** of federal, state and municipal roads.[43] However, roads are not strictly linear infrastructure features (the same happens with railroads, transmission lines and ducts – see below). They have varying widths and associated rights of way that provide them with a second dimension - width. Average or estimated widths can be used to compute the area of land dedicated exclusively to vehicle traffic on single or multiple lanes, shoulders, overpasses, parking and rest areas etc. Rights of way may also contain signs, telephone and electricity poles and cables, buried cables etc. Estimating 30 meters as an average width that includes all these features, the linear 1,634,071 kilometers of Brazilian roads translate into **49,022.13 km^2** (**0,57 percent** of the national territory). This is larger than the relatively small Brazilian state of Rio de Janeiro. Miranda and collaborators do not record these areas in their study.

Item 9. **36,767.19 km^2** (**0.43 percent** of the national territory) of flooded areas exist behind an extensive network of Brazilian hydroelectric dams.[44] ANEEL informs that the Ministry of Mines and Energy plans to build 89 new hydroelectric dams until 2015, including some "large" ones in the

[41] Source: Letter 80/2009, May 29, 2009, from the General Director of the Agência Nacional do Petróleo (Brazil's top regulatory agency for oil and natural gas production).
[42] Source: Bracelpa - Associação Brasileira de Celulose e Papel (www.bracelpa.org.br). Accessed on June 30 2013). Bracelpa is the business organization of the pulp and paper industry in Brazil. See also the site of the Associação Brasileira de Produtores de Florestas Plantadas (ABRAF) - www.abraflor.org.br (accessed on June 30 2013), an organization that comprises all Brazilian companies dedicated to commercial tree planting.
[43] Source: *Boletim Estatístico da Confederação Nacional dos Transportes* (Brasília, March 2009).
[44] Source: Letter 217/2009, June 22 2009, Superintendência de Relações Institucionais da Agência Nacional de Energia Elétrica – ANEEL (Brazil's top regulatory agency of electric energy).

Amazon region.[45] Of course, flooded lands become unavailable to most agricultural and animal raising activities (an exception may be fish farming), but Miranda and collaborators pay no attention to this type of restriction to agriculture. The figure of 0.43 percent places flooded areas in the same order of magnitude as those affected by roads (item 7).

Item 10. The **90,654.30 linear km** of electric energy transmission lines refer only to those that are part of the National Interconnected System ("Sistema Integrado Nacional").[46] As with roads and railroads, transmission lines also have width and may occupy considerable areas. If we estimate that each line has a right of way of 30 meters (15 meters to each side), the area affected by all transmission lines in Brazil adds up to **2.719,62 km^2** (**0,032 percent** of the national territory). Although this figure is relatively diminutive, it is significant to the major topic of this article, because there are restrictions and even bans to certain productive activities in the swaths of transmission lines. They apply to fire, use of heavy farm machinery, tree plantations, orchards and even buildings. The width of swaths depends on several variables, the most important of which is the power of transmission lines – the general rule is that more powerful lines require larger swaths. However, there are not strict rules concerning this. Swath widths depend also on native vegetation, topography, population density, service roads, bodies of water etc.[47] This land use is not dealt with by Miranda and colleagues.

Item 11. There are **29,817 kilometers** of railroads in Brazil.[48] Estimating an average right of way of 30 meters (15 meters on each side), we find that **894.51 km^2** (**0,001 percent** of the national territory) are dedicated solely to rail transportation and associated installations, equipment and features. Again, the figure is relatively diminutive, but railroad are missing in the text under examination.

Item 12. Brazil has **16,986 linear kilometers** of ducts used to transport raw materials for energy and by-products. They are licensed by the National Petroleum Agency ANP).[49] Estimating an average swath of 20 meters (10 meters on each side) for these ducts generates an area of **339.72 km^2** (**0.001 percent** of the national territory), a diminutive figure in the face of previous ones. This is another land use ignored by Miranda and colleagues.

Thus, agricultural lands compete for space with many more features and activities besides protected areas. Recall that earlier I mentioned some features for which I could not find estimated aggregate areas – airports, ports, sewage treatment facilities, landfills etc. However, both agricultural lands and the areas occupied by these other features show no signs of having been restricted by protected areas in their growth over the last decades.

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[45] Source: Agência Nacional de Energia Elétrica. *Atlas de Energia Elétrica do Brasil*. 3 ed. Brasília, ANEEL, 2008, Part 1. Construction of the huge Monte Belo dam, on the Amazonian Xingu River, for example, started in 2011. Also recently, three conservation units in the Amazon region had their areas reduced to allow for lakes to be formed by new hydroelectric dams.

[46] Sources: Letter 217/2009, June 22 2009, Superintendência de Relações Institucionais da Agência Nacional de Energia Elétrica; Agência Nacional de Energia Elétrica. *Atlas de Energia Elétrica do Brasil*. 3 ed. Brasília, ANEEL, 2008, p. 30. The figure does not include shorter lines, in "isolated systems" located mostly in the Amazon region, not connected to the national grid. The ultimate fate of these isolated systems is to be connected to the national grid, requiring further lines, of course. Priority plans for the 2009-2011 period predicted the construction of 11,500 kilometers of new transmission lines.

[47] See Ministério de Minas e Energia, *Estudos Associados ao Plano Decenal de Expansão da Energia Elétrica. Procedimentos e Critérios para os Estudos Socioambientais* (Brasília, May 2006), p. 21-22.

[48] Source: *Boletim Estatístico da Confederação Nacional dos Transportes* (Brasília, March 2009).

[49] Source: letter 80/2009, May 29 2009, signed by the General Director of the ANP.

The figures for individual agricultural crop areas (Table 3, below) again do not corroborate the scenario of a national agricultural enterprise being confined by protected areas. Significantly, Miranda and colleagues did not use these figures in their report.

Table 3 – Brazil: areas (km^2) dedicated to 21 large-scale agricultural crops (temporary and permanent), by decreasing order of size

crops	harvested area (km^2)	% of Brazilian national territory
soybeans	212,717.62*	2.49
corn	144,433.37*	1.69
sugar cane	81,412.28*	0.95
beans	37,794.49*	0.44
rice	28,616.65*	0.33
wheat	23,735.72*	0.27
coffee	22,160.14*	0.26
manioc	18,608.00*	0.21
herbal cotton	10,570,32*	0.12
oranges	8,334.09*	0.09
sorghum	8,116.62*	0.09
cashew nuts	7,040.00**	0.08
cacao	6,550.09*	0.07
bananas	5,050.00**	0.06
tobacco	5,020.00**	0.06
coconuts	2,810.00**	0.03
castor beans	1,564.12*	0.01
potatoes	1,448.29*	0.01
grapes	740.00**	0.008
apples	360.00**	0.004
guaraná	129.48**	0.002

* 2008; ** 2005

Sources: for 2005: Ministério da Agricultura, Agropecuária e Abastecimento, *Agricultura Brasileira em Números - Anuário 2005*; for 2008: Instituto Brasileiro de Geografia e Estatística, *Levantamento Sistemático da Produção Agrícola*.

The three first listed crops alone occupy a non-negligible more than 5 percent of the national territory. The next three occupy another 1 percent. Several crops (coffee, cocoa, grapes, apples, bananas) that Miranda and collaborators inform to be located mostly on illegally deforested APP and RL areas are large enough to appear in this list of the most expansive agricultural activities.

8. Agricultural productivity – a forgotten dimension

Miranda and collaborators gave virtually no attention to the analytical and empirical dimension of agricultural productivity. They are so biased in favor of the horizontal expansion of agricultural activities that they did not deal with one of the basic parameters used to evaluate the solidity of productive rural activities – productivity, or vertical expansion, expressed by output per cultivated area. Those who read the long and detailed report by Miranda and co-authors may think that Brazilian agriculture does not have a positive record in this respect. However, the truth is different, and the Embrapa researchers should have recognized the relevance of the matter.

The following paragraphs contain data and brief comments about the productivity of a sample of major Brazilian agricultural products. They will show that Miranda and co-authors lost sight of a very important component of the scenario under analysis. Tables 4 through 9 display data on production and productivity of six representative crops; these data are valid for only two years, 1990 and 2005, demarcating a period during which protected areas and indigenous homelands expanded strongly.

The data in these tables record national and state figures; states were selected among the most important producers of each crop. In general, the figures show that in "older" agricultural states cropped areas increased slightly (in a few cases they shrank), but with gains in productivity; in "younger" agricultural states crops expanded their areas in a stronger manner, but they also had gains in productivity. Gains were the general rule. This shows that Brazilian agriculture has displayed an ability to expand vertically – larger crops per cropped area – even when protected areas were expanding strongly in area. By insisting on the topic of "confinement" of agriculture by protected areas, Miranda and co-authors left this obvious and well-documented fact out of their text.

Let us now examine these data, pertaining to rice, potato, bens, oranges, corn and soybeans.

Table 4 – Brazil and selected states: rice production (1,000 tons), cropped area (1,000 hectares), and yield (kg/hectare), 1990 and 2005

	Brazil			Rio Grande do Sul		Mato Grosso		Pará	
year	production (1,000 t)	cropped area (1,000 ha)	yield (kg/ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)
1990	7,241	3,947	1,880	3,194	698	421	355	148	127
2005	13,192	3,916	3,369	6,103	1,006	2,263	854	632	299

Source: Produção Agrícola Municipal, IBGE.

Nationally, both the production and yield of rice grew considerably, while cropped area remained practically stable. In Mato Grosso and Pará, production grew even more strongly, together with productivity gains. Nothing indicates that rice production was "suffocated" by protected areas.

Table 5 – Brazil and selected states: potato production (1,000 tons), cropped area (1,000 hectares), and yield (kg/hectare), 1990 and 2005

	Brazil			Rio Grande do Sul		Minas Gerais		Paraná	
year	production (1,000 t)	cropped area (1,000 ha)	yield (kg/ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)
1990	2,234	158	14,108	339	42	535	28	616	41
2005	3,119	141	22,158	335	24	982	37	568	28

Source: Produção Agrícola Municipal, IBGE.

National production of potatoes increased strongly in a smaller cropped area and with a productivity gain of almost 50 percent. In Rio Grande do Sul and Paraná, cropped areas decreased, but production and yield increased or fell very little. In Minas Gerais, the cropped area grew by one third, but production grew much more. These figures are not consistent with a pattern of cultivation confined by protected areas or by any other identifiable factor.

Table 6 – Brazil and selected states: bean production (1,000 tons), cropped area (1,000 hectares), and yield (kg/hectare), 1990 and 2005

	Brazil			Minas Gerais		Paraná		Bahia	
year	production (1,000 t)	cropped area (1,000 ha)	yield (kg/ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)
1990	2,234	4,680	477	293	523	279	521	227	593
2005	3,021	3,748	806	560	433	557	440	462	690

Source: Produção Agrícola Municipal, IBGE.

National bean production grew by almost a third, while its cropped area fell by one fifth and yield increased strongly. In Minas Gerais and Paraná, production nearly doubled, while cropped areas shrank by 20 percent. In Bahia, production more than doubled, while cropped area grew by only 20 percent. As happened with other crops, bean production was not suffocated by protected areas.

Table 7 – Brazil and selected states: orange production (1,000 tons), cropped area (1,000 hectares), and yield (kg/hectare), 1990 and 2005

	Brazil			São Paulo		Bahia		Paraná	
year	production (1,000 t)	cropped area (1,000 ha)	yield (kg/ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)
1990	14,016	913	15,352	11,572	723	339	29	67	4
2005	17,868	803	22,258	14,366	572	780	51	404	17

Source: Produção Agrícola Municipal, IBGE.

Nationally, orange production increased by about 20 percent, while its cropped area fell by about 10 percent. Productivity rose by almost 50 percent. In the state of São Paulo, the largest producer, production also grew considerably, with a more than proportional shrinkage of cropped area. In Bahia, the cropped area grew by almost 60 percent, but production more than doubled. The cropped area in Paraná increased by a factor of four, but production grew by a factor of six. These figures definitely do not indicate into a confined agricultural enterprise.

Table 8 – Brazil and selected states: corn production (1,000 tons), cropped area (1,000 hectares), and yield (kg/hectare), 1990 and 2005

	Brazil			Paraná		Minas Gerais		Mato Grosso	
year	production (1,000 t)	cropped area (1,000 ha)	yield (kg/ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)
1990	21,348	11,934	1,874	5,161	2,080	2,273	1,411	619	270
2005	35,134	11,559	3,040	8,572	2,028	6,244	1,354	3,506	1,053

Source: Produção Agrícola Municipal, IBGE.

Corn production in Brazil also fared well while protected areas expanded. Nationally, production grew by 60 percent, with only a small increase in cropped area. Productivity grew by more than 50 percent. In Paraná and Minas Gerais, a strong increase in production was achieved in slightly reduced cropped areas. In Mato Grosso the picture is even better – a six-fold production increase was achieved with a fourfold increase in cropped area.

Table 9 – Brazil and selected states: soybean production (1,000 tons), cropped area (1,000 hectares), and yield (kg/hectare), 1990 and 2005

	Brazil			Mato Grosso		Goiás		Mato Grosso do Sul	
year	production (1,000 t)	cropped area (1,000 ha)	yield (kg/ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)	production (1,000 t)	cropped area (1,000 ha)
1990	19,898	11,487	1,732	3,065	1,528	1,258	972	2,039	1,256
2005	51,182	22,949	2,230	17,761	6,107	6,984	2,663	3,719	2,025

Source: Produção Agrícola Municipal, IBGE.

Soybeans, the flagship of Brazilian agribusiness, did very well between 1990 and 2005. Nationally, its planted area practically doubled, but production grew two and a half times; productivity also increased considerably. In Mato Grosso, production grew by a factor of six, but cropped areas expanded only four times. In Goiás, the same rate of growth (six) occurred in production, but the cropped area expanded only three times. In Mato Grosso do Sul, production also grew more than proportionally than the cropped area.

The data in these six tables configure a scenario radically different from the one drawn by Miranda and co-authors. Production, cropped areas and productivity increased moderately or sharply in almost all cases and places. The expansion of cropped areas indicates the availability of areas available for these new crops. On the other hand, gains in productivity show that there is another frontier for agricultural expansion, the vertical frontier, the frontier of improved productivity, which depends on technological progress and on investments. At least a considerable part of Brazilian agriculture has moved into this frontier. Miranda and co-authors' obsession with the necessity of new areas for horizontal agricultural growth misguides them from discussing this obviously relevant pattern of vertical growth.

9. Final considerations

The major purpose of this paper was fulfilled. It was shown that the amount of land available to agriculture in Brazil is much more extensive than alleged by Miranda and collaborators – 45.22 percent of the national territory, as opposed to the 22.98 percent computed by them. This finding was based mainly on the rejection of their obviously mistaken claim that sustainable use conservation units, indigenous homelands and *quilombola* homelands are "fenced off" to agriculture. Actually, they are closed, at least temporarily, only to the agribusiness mode of agriculture, which is substantially different from being closed to agriculture in general. I argued also that APPs and RLs – responsible for most of the area supposedly "fenced off" to agriculture - were actually conceived for the purpose of supporting agricultural activities in the long run, by conserving natural resources. They were not designed for protecting natural features, for biodiversity protection, or for the benefit of "minorities". This is relevant because Brazil has enormous areas of non used, underused and abandoned lands, which prove that many Brazilian farmers of the past and present do not adopt the elementary conservation measures embedded in the concepts of APPs and RLs. In other words, these restrictions and others are necessary for Brazilian society to achieve the common good of combining (i) natural resource conservation with (ii) stable agricultural production.

I introduced a distinct line of discussion that brought into the picture the matter of the vigorous growth and areas of infrastructure installations and equipment, either ignored or mentioned only in passing - but not measured nor discussed in detail - by Miranda and collaborators. It was shown that infrastructure in Brazil is robust and has grown strongly, competing for space not only with agriculture, but also with protected areas and indigenous homelands.

Therefore, the simple, non-nuanced answer to the question posed in the title of this paper is "yes" – yes, there is room for everybody. This is so at least for the time being. Miranda and collaborators indeed produced an important text about the macro zoning of agricultural activities throughout the Brazilian territory, although they gave too much weight to protected areas and too little weight to infrastructure and urban areas. This type of discussion, despite its importance, has not advanced enough in Brazil. When it does happen, it lacks the support of enough data and a sufficiently encompassing scope. Miranda and collaborators are to be commended for producing and ordering a large amount of data on a national scale, but their strong pro-agriculture bias unfortunately makes their analysis look like a piece produced by/for a farmers' lobbying group. In their urge to place agriculture above all other economic activities, they fail to acknowledge the existence and even the legitimacy of other land uses and other social groups besides business-oriented farmers. They argue in favor of what would be a uni-dimensional, exclusively agricultural Brazilian society, and do so arbitrarily. This concept of Brazil as a predominantly agricultural society is utterly outdated and unrealistic, given that the Brazilian economy has been for decades a powerful, world-class, urban-industrial-service economy, even if its agricultural sector has been modernized and strengthened over the last decades.

Brasília, 2009; 2010; 2011; 2013; 2014

Annex: Additional tables

Table 1 - Brazil: Numbers and Areas (km^2) of Conservation Units –

situation on 25/07/2011*

group / type	federal number / area	state number / area	municipal number / area	total number / area
fully protected				
ecological stations	31 / 69,230	54 / 46,627	0 / 0	85 / 115,857
natural monuments	3 / 443	14 / 690	4 / 7	21 / 1,141
parks**	67 / 252,053	172 / 94,142	39 / 123	278 / 346,318
wildlife refuge	7 / 2,019	8 / 1,635	1 / 22	16 / 3,676
biological reserve	29 / 38,689	20 / 13,466	1 / 7	50 / 52,162
total for fully protected units	137 / 362,434	268 / 156,560	45 / 159	450 / 519,154
sustainable use				
forest**	65 / 163,453	28 / 133,645	0 / 0	93 / 297,098
extractive reserve	59 / 122,708	24 / 16,521	0/ 0	83 / 139,230
sustainable development reserve	1 / 644	26 / 109,200	0 / 0	27 / 109,844
fauna reserve	0 / 0	0 / 0	0 / 0	0 / 0
environmental protection areas	32 / 100,144	175 / 327,415	33 / 5,354	240 / 432,913
area of relevant ecological interest	16 / 448	24 / 445	5 / 27	45 / 920
total for sustainable use units	173 / 387,398	277 / 587,226	38 / 5,381	480 / 980,005
TOTAL	310 / 749,832	545 / 743,786	83 / 5,541	938 / 1,499,158

* Excluding RPPNs (private reserves).

** Parks and forests may be national, state or municipal.

Source: CNUC/MMA - <www.mma.gov.br/cadastro_uc> Accessed on August 24 2011.

Table 2 – Brazil: Indigenous Homelands Certified between 1905 and 2009 – Numbers, Areas and Percentages of the National Territory

year	numbers of certified homelands	aggregate numbers of certified homelands	areas of certified homelands (km^2)	aggregate areas of certified homelands (km^2)	aggregate percentages of the national territory (%)
1905	1	1	98.58	98.58	<0.01
1955	1	2	55.74	154.32	<0.01
1958	1	3	47.06	201.38	<0.01
1961	1	4	163.75	365.13	<0.01
1965	3	7	43.67	408.81	<0.01
1966	2	9	61.32	470.14	<0.01
1967	1	10	300.60	770.74	<0.01
1980	1	11	30,710.67	31,481.42	0.36
1981	3	14	2,592.47	34,073.89	0.40
1983	8	22	10,307.07	44,380.97	0.52
1984	6	28	7,020.30	51,401.27	0.60
1985	1	29	282.12	51,683.39	0.60
1987	17	46	68,882.19	120,565.59	1.41
1988	6	52	39,101.78	159,667.37	1.87
1989	8	60	41,818.67	201,486.05	2.36
1990	2	62	1,933.91	203,419.97	2.38
1991	4	66	402.91	203,822.88	2.39
1992	2	68	3,046.51	206,869.40	2.42
1993	6	74	96,792.40	303,661.81	3.56
1994	33	107	83,615.87	387,277.68	4.54
1995	25	132	14,408.90	401,686.58	4.71
1996	32	164	21,754.43	423,441.02	4.97
1997	21	185	23,36.86	446,977.88	5.24
1998	20	205	38,657.77	485,635.66	5.70

1999	38	243	63,370.47	549,006.13	6.44
2000	15	258	120,160.92	669,167.06	7.85
2001	15	273	26,724.19	695,891.25	8.17
2002	36	309	129,499.21	825,390.47	9.69
2003	15	324	6,375.52	830,995.25	9.75
2004	25	349	47.102.69	878,868.51	10.32
2005	9	358	2,597.90	881,466.58	10.35
2006	16	374	35,026.01	916,492.60	10.76
2007	11	385	28,746.94	945,239.54	11.10
2008	14	399	34,534.78	979,774.32	11.50
2009*	2	401	4,834.73	984,609.06	11.56
predicted**	2	403	664.65	985,273.72	11.57
total	**403**	**403**	**985,273.72**	**985,273.72**	**11.57**

* Until June 2009.

** Two other homelands were scheduled to be created in 2009.

Source: Adapted from Fundação Nacional do Índio, Diretoria de Assuntos Fundiários, "Áreas de Terras Indígenas Regularizadas no Brasil (1905-2009)." Brasília, June 2009 [unpublished].

Table 3 – Brazil – Summary Data on *Quilombola* Homelands created between 1996 and 2008 – situation as of December 31 2008.

actions	affected communities	affected families	aggregate areas (km^2)	notes
102 titles emitted / 95 homelands created	157	10,974	9,553.33	fourth and last step of the certification process
43 official acts of identification published	47	3,909	2,233.84	third step of the certification process
85 announcements for the drafting of identification reports published	---	11,107	12,198.19	second step of the certification process
831 certification processes initiated	---	---	---	first step of the certification process
1,305 communities recognized	---	---	---	condition for the opening of the certification process

Source: Letter 398/DPA/FCP (Fundação Cultural Palmares)/MinC/2009 (Brasília, May 26 2009).