

Amazonia, Organized Crime and Illegal Deforestation: Best Practices for the Protection of the Brazilian Amazon

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Abstract This chapter examines the vigorous and focused enforcement the Federal Police of Brazil against the wide range of mass environmental crime in the country's Amazon region, which covers 60% of the entire rainforest Basin (the other 40% is divided among eight other countries). It concentrates on organized crime, of which environmental violations are a rapidly growing proportion, with a focus on criminal networks of deforestation and mining in Amazonas State, the world's ninth largest jurisdiction whose protection of the rain forest is almost singlehandedly responsible for Brazil's GHG reduction and a bulwark against the region's "arc of deforestation."

Keywords Amazon · Brazil · Crime · Environment · Satellite monitoring

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INTRODUCTION

The Brazilian Amazon is a region of continental proportions. With 4.2 million square kilometers, it covers approximately 49% of Brazilian territory (8.5 million square kilometers). It is larger than nearly all of Europe, as represented in Fig. 2.1.

This huge size has long made Brazil's Amazon a focus of the international community and nearly every debate on global conservation. The centrality of the region is due not just to the magnitude of natural resources it holds, but unfortunately also to the extensive environmental impacts afflicted by illegal timber cutting, particularly in the protected areas such as Indigenous Lands and Conservation Units. Deforestation of the Brazilian Amazon has been tracked closely since 1998 by the National Institute of Spatial Research (INPE: *Instituto Nacional de Pesquisas Espaciais*). Between August 2007 and July 2008, the institute found a total of 12,911 square kilometers of deforestation in the region. But after adoption of a series of coordinated actions among the Ministries of the Environment, Justice, Defense and the Staff of the Presidency of the Republic,¹ rates of observed deforestation since 2010 have been the lowest registered by INPE since the systems of monitoring began operating in 1988 (Fig. 2.2).

Despite this progress, the Brazilian Amazon has lost around 25% of its total original cover—a scenario even bleaker in light of the fact that the original cover was around 95% in the early 1980s. The rates of 2014



Fig. 2.1 Amazonia legal and Europe comparison. Source INPE (2016)

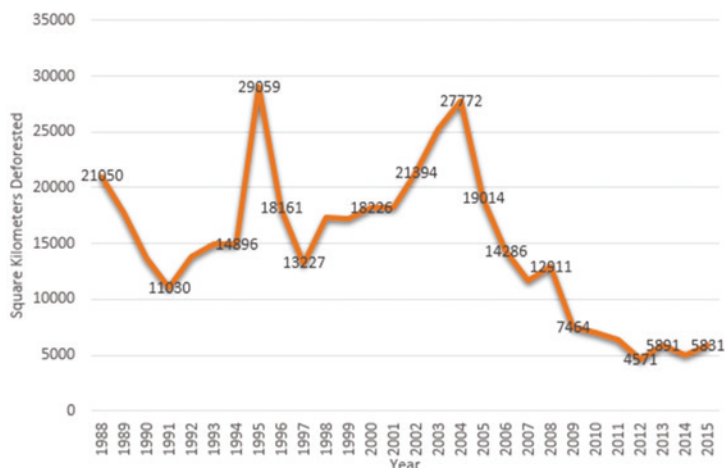


Fig. 2.2 Annual deforestation rates, Brazilian Amazon. *Source* INPE (2016)

and 2015, even after considerable reduction, still meant approximately 6000 square kilometers of deforestation—the equivalent of 600,000 soccer fields (90 m × 120 m). Among the resulting impacts are a loss of soil productivity; change in the hydrologic system²; the loss of biodiversity; global warming; acculturation of indigenous and traditional communities; tax evasion³; and rural violence.⁴ Such data are alarming, particularly because of its implications for the world’s climate and life. The situation appears even more intractable because illegal deforestation, the primary engine of the Amazon’s destruction, is fomented in large part by powerful organized criminal groups, the focus of this chapter.

ILLEGAL DEFORESTATION AS A BRANCH OF ORGANIZED CRIME

In 2010, after two years of investigations, the Brazilian Federal Police arrested some of the most important politicians and authorities for illegal logging in the Amazon. Operation Jurupari uncovered a massive illegal logging scheme that resulted in the arrests of over 90 people and caused an estimated \$500 million in damage to the Amazon rain forest. Over 496 square kilometers (192 square miles), an area the size of California or

Spain, was affected, and an estimated 1.5 million cubic meters (642 million board feet) of timber was illegally extracted. While the investigation focused on activities in the state of Mato Grosso, which is located in the southern Amazon and is one of the most deforested states in Brazil because of clearing land for expanding soya farms, it also involved many others, including São Paulo, Paraná, Rio Grande do Sul, Espírito Santo, Minas Gerais, and the Federal District (Brasília). The list of those arrested was a “who’s who” of the forestry industry and included high-level government officials, business owners, and private landowners. Top officials in both the current and former Mato Grosso administrations were implicated, as well as those “throughout the State Environment Agency (SEMA), which oversees the logging industry” (Mongabay 2010).

When we speak of “organized crime” in Brazil, the first image that comes to mind is drug trafficking in cities like Rio de Janeiro. But Jurupari clearly demonstrates that organized crime has definitively extended into the terrain of environmental crime. In fact, operations carried out by a range of state security forces, especially the Federal Police, have exposed a growing network of organized groups carrying out an expanding range of criminal activities against nature.⁵ Empowered by their infiltration of state agencies, these groups focus on the extraction and illegal trade of forest products, minerals, and precious stones from the Brazilian Amazon. Brazil is the source of 75–80% of all timber exported from the region. Of that exported Brazilian timber, up to 70% is illegal. Such vast criminality is fueled by stratospheric prices of such goods and facilitated by the increasingly sophisticated strategies to avoid state control,⁶ such as (a) contracting with people at different levels of the government; (b) the tight control, secrecy, and discipline in the communications and conduct of criminal operations; and (c) use of “persuasion” and recruitment, from corruption of public officials to threats against anyone who gets in their way—with acquiescence by public authorities, technocratic specialists, and professionals. In the area of illegal logging, common strategies are fraud in the authorizations of forestry concessions, forest management plans, and the document authorizing transport and commercialization of forestry products (DOF—*Documento de Origem Florestal*); the availability of fraudulent forestry credits that permit deforestation and illegal cutting in non-authorized zones, particularly in public lands and officially protected areas; and the transport, transformation, and

commercialization of illegally source forestry products by sawmills and lumber businesses, which receive “legalized” products with fake documentation. These multiple forms of fraud are the fuel of a now vast criminal enterprise.

As discussed throughout this book, quickly catching up to logging as a source of destruction in the Amazon is legal and illegal mining. Like logging, illegal mining also involves a range of crimes⁷: (a) Fraud in the concession and acquisition of large-scale mining permits, or the extraction of minerals or gems with no authorized title at all; (b) Utilization of authorizations for a certain area with the sole intention to “legalize” illegally extracted minerals in other areas, especially public or indigenous lands and protected areas; (c) Falsification or alteration of documents, particularly adulteration of numbers on a permit to indicate a high permitted quantity, and so legalize extraction in regions where miners do have authorization by the National Department of Mineral Production (DNPM: *Departamento Nacional de Produção Mineral*)⁸; (d) Corruption of DNPM personnel to grant authorization, such as of Kimberley Process certificates (required for the transport and international trade of diamonds); and (e) Transport, commercialization, and export of those minerals, again accompanied by fraudulent documentation. Such conduct constitutes crimes already specified in Brazilian penal law, ranging from illegal tree removal, whose penalties range from one to three years of prison (article 38 of Law 9605-98), to more serious crimes such as corruption, falsification of public documents, money laundering and conspiracy, whose penalties together may exceed 30 years of incarceration.⁹ Significant sectors from at least five major professions have lent their expertise and power to support, legitimize, and benefit from this criminality:

1. Engineers, topographers, and other technical consultants who apply their knowledge to approve state-funded activities and the completion of authorizations for timber forestry and mining operations.
2. Corrupt public officials, who are responsible for the approval of environmental projects, licenses, and authorizations.
3. Prospectors, power saw operators, and motor vehicle operators, who comprise the criminal pyramid’s base. These individuals are generally recruited from local communities, receive the lowest

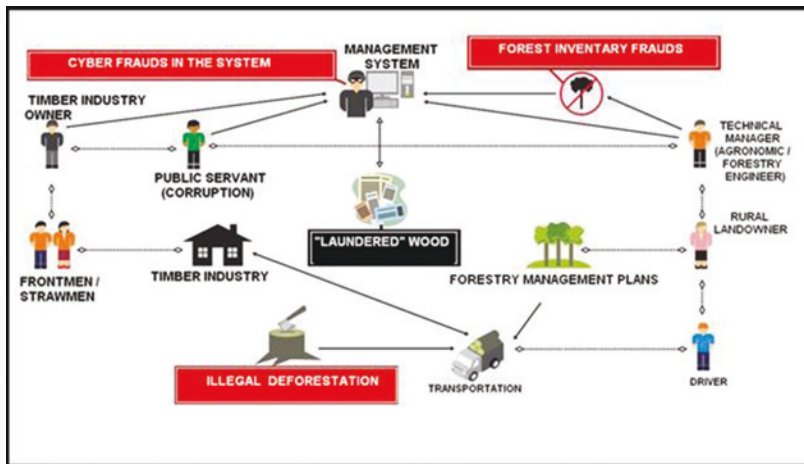


Fig. 2.3 Visual outline of illegal forestry in Brazil. *Source* Perazzoni (2012)

compensation, and, as the most visible face of illegal organizations, face the highest risk of detention.

4. Rural landowners, who are presumably responsible for any legal extraction of timber or minerals from within their property. Throughout the region, though, these landowners employ a very wide range of fraudulent arrangements to permit the legalization of minerals and forestry products extracted in illegal ways, not only from their own land, but also from within protected areas such as indigenous lands and national parks.
5. Wood and mineral companies, which have become the main economic pillar of this wide criminal enterprise. From protected areas throughout the country, illegally extracted timber and minerals are transported to these companies' facilities, from where they are later resold, duly legalized (Figs. 2.3, 2.4).

The first two of these groups, technical professionals and public officials, promote and provide key services to criminal enterprises. By issuing fake permits that legalize illegal activities, above all, they pave the way for criminals to expand the underground trade of forestry products and minerals. It is, therefore, no surprise that the World Bank (Pereira et al. 2011) urges Basin governments to better target the illegal extraction and

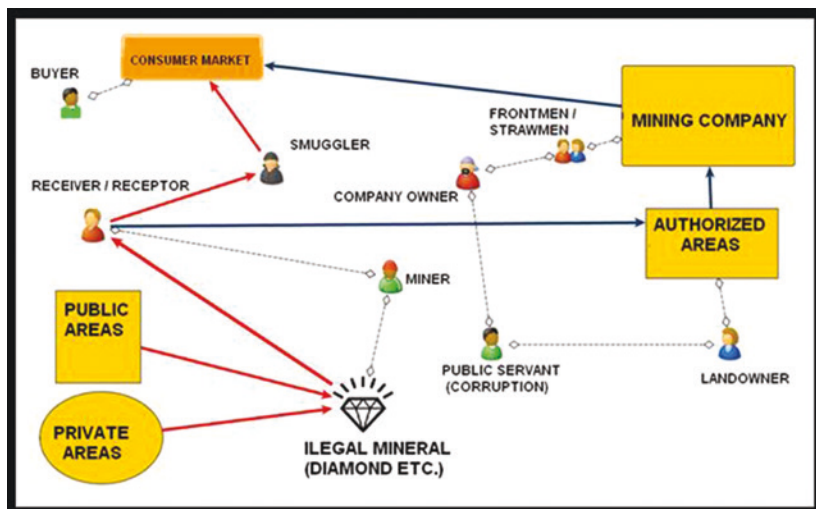


Fig. 2.4 Visualization of illegal mineral extraction in Brazil. *Source* Perazzoni (2013, p. 57)

trade of forestry products through better understanding of these spreading forms of white-collar collaboration. In particular, the World Bank pointed out that penal sanctions for deforestation in the Amazon are applied only to the weakest links—such as chainsaw operators, pickaxe workers, truckers, and miners—in the long illegal chain of criminality, leaving untouched the higher level and more lethal criminals and officials to whom most of the profit flows. It is, therefore, critical that state authorities start to adjust their strategies to focus on the nodes of these criminal networks. In this regard, Brazilian officials have made significant headway in the past several years, and that much of their approach can and should be applied to other countries facing similar situations. With a focus on this approach, the next section describes innovations and best practices—along with the lessons and ideas they generate—that are increasingly helping to fight illegal deforestation in the Brazilian Amazon.

BEST PRACTICES IN BRAZIL IN THE FIGHT AGAINST ILLEGAL DEFORESTATION

Sustainable Forest Management in the Brazilian Amazon

In 1965, Brazil adopted a Forest Code (Law 4771) that explicitly prohibits “the predatory exploration of the primitive forests of the Amazon basin” (article 15). As the code clearly states, the “exploration of forestry resources in that region can only be done in compliance with technical plans of conduction and forestry management, following the rules e content to be established by act of Government, within one year.” Article 15 also requires logging activities to be “in accordance with technical plans and sustainable forest management, accomplishing with the regulations to be issued by the public authorities within one year.” This law, in short, mandated a sustainable forest management for the country. But it was not until 2009 when the National Environmental Council (CONAMA: *Conselho Nacional do Meio Ambiente*) actually issued the first regulation (resolution n. 406-2009 CONAMA). That is, it took 44 years—not the one year required—for just an initial rule to be so established.

Prior to this regulation, Sustainable Forest Management Plans (PMFS is the Portuguese acronym) were prepared and carried out without following rules on the form and content of their forestry inventory—a document that identifies, locates, and quantifies all commercial species in the regulated zone, as well as establishment of the quantity of wood that can be extracted sustainably (since specified by CONAMA as 30 m³/ha). In other words, any harvesting of native forests requires a PMFS, which stipulates the techniques of removal, forest replacement and management that are compatible with the area’s ecosystems. A PMFS must comply with the following standards: (1) document the physical and biological environments; (2) determine the existing inventory of trees; (3) ensure that harvesting intensity is compatible with the capacity of the forest environment; (4) ensure that the cutting cycle is compatible with the time for reestablishing the volume of timber harvested from the forest; (5) promote natural regeneration of the forest; (6) adopt appropriate silviculture systems; (7) adopt appropriate forest harvesting systems; (8) monitor development of the remaining forest; (9) adopt mitigating measures for environmental and social impacts. An approved PMFS gives the holder authorization to practice sustainable forest management, but with submission of an annual report with information covering the

management area and a description of activities conducted. This approach was created to enable continuous activity in a sustainable manner by dividing each area into smaller annual production units (UPAs—Unidades de Produção Anual). The number of UPAs in a Management Plan correspond to the cutting cycle, which is the number of years the harvested area needs for complete regeneration and be ready for harvesting again. When the last UPA is harvested, harvesting can return to the first one the following year.

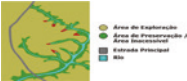




Since the circulation of wood in Brazil is controlled by the government through computerized systems (SisDOF, discussed below), the approval of a PMFS immediately generates forest credits that correspond to the species and volumes of timber authorized for harvesting. These credits are placed in the account of the respective holder and, as the timber is harvested and sold, a DOF¹⁰ is issued. Accompanying the timber all the way to the buyer (usually a lumber mill), the forest credits corresponding to the timber shipped will be transferred from the seller's account to the buyer's account. Although Brazil's forest management structure remains rife with the irregularities and the types of fraud mentioned above, significant and durable advances have been made under a new model. Among the main reasons for improvement is that data from all these businesses is centralized in state agency databases, allowing officials to conduct audits and analysis, even remotely, on the activities carried out under any PMFS, particularly regarding preventative measures and appropriate restrictions. Table 2.1 below spells out the different stages of development and approval of a PMFS.

We now turn to a focus on controls of timber and mining.

Systems to Control of Timber and Mining Activities: SisDOF, Cadastro Mineiro, and SIGMINE

Up until 2006, an Authorization for Transport of Forest Products (ATPF: *Autorização para o Transporte de Produtos Florestais*) a document printed on specialized paper by the Brazilian Environmental and Natural Resource Institute (IBAMA: *Instituto Brasileiro del Medio Ambiente and Recursos Naturales Renovables*), the country's top federal environmental agency, was required for any business carrying out extraction, storage, commercialization and transport of wood and other forestry products. This system was practically entirely manual, which not surprisingly opened a very wide door to fraud. A small cottage industry even sprung

Table 2.1 Phases of development of a PMFS in the Brazilian Amazon

<i>Stages</i>	<i>Activities</i>
<p>Zonification</p> 	<p>During zonification, the rivers, lakes, and roads in the property are identified. During this stage, the zonification divides the forest property in explorable zones; permanent preservation areas (APPs); and non-exploitable zones (riverside areas and other courses of water and vegetation as steep slopes or hills)</p>
<p>Forestry inventory</p> 	<p>Documentation of vegetation and general conditions of the forest through a forest inventory. Species that are commercialized are inventoried, as are the types of trees that, by legal imposition, may not be felled (particularly protected species and seedlings, which are used for natural regeneration. Since seedlings serve as the gene source for the new crop, they must be phenotypically superior, prolific in flowering, sturdy, and disease-free)</p>
<p>Road planning</p> 	<p>Main roads are planned, as well as secondary roads that will connect the exploration area with principal roads</p>
<p>UPA división</p> 	<p>The assigned areas are divided into smaller UPA units, each of which corresponds to an annual cutting cycle that must be followed. The number of UPAs in a Management Plan should correspond to the cutting cycle, which is the number of years the harvested area needs to completely recompose itself, and be ready to be harvested again, in such a way that, when the last UPA is harvested, it is possible to return to the first one the following year. The most common cutting cycles are 10, 20, or 30 years</p>
<p>Authorization</p> 	<p>With permission of the environmental agency, the PMFS account is created in the Electronic Forest Management System (SisDOF). This account is analogous to a bank account: forestry credits are equivalent to the volumetric and species of the forestry inventory, that will be deducted with each sale, through the registry of the operation in question in the system and the emission of a transport authorization that must accompany the product to its destination (DOF)</p>

(continued)

Table 2.1 (continued)

<i>Stages</i>	<i>Activities</i>
Tree harvesting	Once the PMFS is authorized by the environmental agency, designed trees may now be felled and sold, but in clear accordance with the established demarcation of annual units (UPAs) and the forestry inventory data. Harm to protected species is strictly prohibited to harvest seed trees and those with a diameter inferior to the environmental regulations in force



Source Perazzoni (2013)

up of groups formed exclusively for the sale and transport of forestry products utilizing “ideologically” false ATPFs (a valid document with false information ATPFs stolen from IBAMA offices, or counterfeit documents made from scratch.

Because of these weaknesses, ATPFs were replaced in 2006 by the Electronic Forest Management System (SisDOF), a non-paper control of sales, purchases, transport, and storage of forestry products and sub-products. A document authorizing such activity (DOF) is done through IBAMA’s website by prior registration of the forestry specialist or company, which must itself be registered and legally authorized, ensuring there are no pending questions over their status or activities. Upon approval of its PMF, a “forestry credit” account is put into IBAMA’s SisDOF database. These credits, in turn, are adjusted in the SisDOF account with each transaction of the respective buyer (the company) through a transit letter that must accompany the product and be presented to officials at any inspection. The system thus forces the buyer to demonstrate the legal origin of all products purchased and in their stock. It also documents changes in ownership of a product and any transformation of the product itself (such a cutting timber into boards) as it moves along the supply chain. Through that approach, the DOF tracks every native-origin forestry and sub-forestry product until its destination by any form of transport: road, air, railroad, river, and sea (Fig. 2.5).

In short, the DOF is a required license for movement of all native-origin forestry and sub-forestry products, including native vegetal charcoal. SisDOF electronically documents and controls the balance (credits

ANEXO 1 - MODELO DO DDF			
Identificação da instituição emissora do documento de transporte			
			
1 - Estado		2 - Região C/UF	
3 - Endereço			
4 - Bairro		5 - Município	
6 - Origem		7 - Destino	
8 - Endereço			
9 - Bairro		10 - Município	
11 - Fornecedor de Armas			
12 - Autenticação			
13 - Tipo			
14 - Produto - Espécie		15 - Qtd	16 - Un.
		17 - Valor	
18 - Intermediário		19 - Região C/UF	
20 - Endereço			
21 - Bairro		22 - Município	
23 - Endereço		24 - Coordenadas	
25 - Bairro		27 - Município	
26 - Fornecedor de Armas			
28 - Meio de Transporte		29 - Para Espécie	30 - Para uso de Recolhimento de...
31 - Sr. José. Silva		32 - Validade	repartição finance e outras
33 - Fim do Transporte			
DDF VERDE (PRETO) - LARANJA DE AMARELO			
34 - Código de controle			
Código de Barra			

Fig. 2.5 Examples of an ATPF and DOF documents

and debits of the forestry products in the accounts of each participant in the supply and trade chain operations) in the same way as a bank tracks its customers' accounts. The issuance of a DOF is like a cheque from a bank account: it requires credit for the wood or forestry sub-product in relation to the emitter; these credits are then transferred to buyer's SisDOF account. Such careful tracking has provided much stronger control of the entire chain of ownership of forestry products, from extraction to sales or export. In contrast to the ATPFs, SisDOF makes this possible through its comprehensive database, which has for all commercial transaction the type of product, species, volume, origin, destination, and transit, as well as data on the transporting vehicle, the time in route to the recipient, and the sales receipts, among other documentation. This thorough approach, though, has not made SisDOF completely immune to the well-honed ruses of unscrupulous operators and of groups specializing in environmental crimes that operate in Amazonia's many corners. Because criminality extends beyond SisDOF's scope, its needs to be supported by tele-detection and geo-intelligence data, particularly from satellite imaging in the zones of operations, to carry out analysis and data mining to more fully and accurately detect and identify the wide range of fraudulent schemes or irregularities that previously went unnoticed by the authorities.

The two government systems established to provide that support are *Cadastro Mineiro* and SIGMINE, which are accessible through the Internet and maintained by the National Department of Mineral Production (DNPM: *Departamento Nacional de Produção Mineral* at www.dnpm.gov.br). *Cadastro Mineiro* is a conventional database that permits access to registry data and authorization to any business or person authorized to carry out mining activities anywhere in Brazil. The specific data includes the location of the authorized mining area, minerals allowed to be extracted, the technician overseeing the operation, the specific types of activity, the valid dates of each mining and environmental permits. Within this system, searches can be conducted by a wide range of criteria, including the number of the DNPM case, the name of the company or its owner, the municipality, or the substance being extracted. Such searches then verify the accuracy of the licenses and if the specific person or business is in fact authorized by state agencies to carry out mining activities. The complementary SIGMINE is a Geographic Information System¹¹ (GIS), also accessible through the Internet that allows, based on case number or the coordinates of a

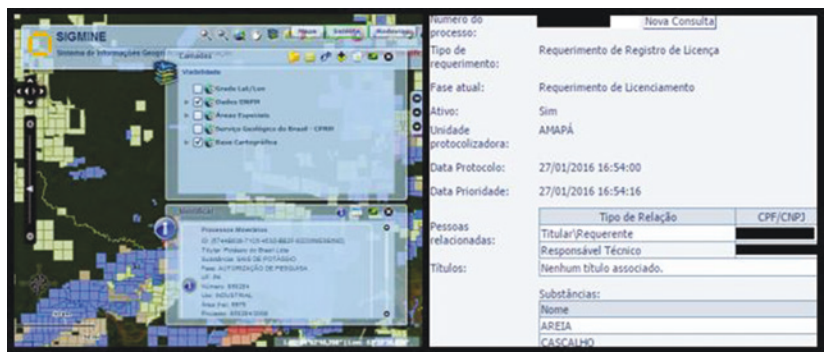


Fig. 2.6 Screenshots of a SIGMINE and Cadastro Mineiro search. *Source* DNP (2016)

specific geographic location, to rapidly and securely identify the location and dimensions of the pertinent estate in the authorized zone.

The joint use of *Cadastro Mineiro* and SIGMINE has been extremely useful to officials by allowing them to not only verify if a particular person or company has the permits for mining activities, but also to determine, based on SIGMINE data (which can be downloaded onto any device or cell phone with GPS), if the physical limits of the authorized area are being respected by the owner of the extraction permits (Fig. 2.6).

Systems of Official Monitoring of Burning and Deforestation

Brazil uses three powerful systems to monitor deforestation in real time: DETER (Real-Time Detection of Deforestation), PRODES, and PROARCO. DETER is an alert system developed by the National Institute of Spatial Research (INPE: *Instituto Nacional de Pesquisas Espaciais*) to support both domestic and international organizations. Its data is geared toward the formation and prioritization of both preventive and policing actions against illegal deforestation, such as with financial penalties, administrative fines, and criminal investigations. Data is gathered and reported on a monthly basis for deforested estates of over 25 square hectares. Through its real-time gathering of this information, accessible at www.obt.inpe.br/deter/, DETER facilitates a wide range of research and analysis: searches for deforested areas, for example,

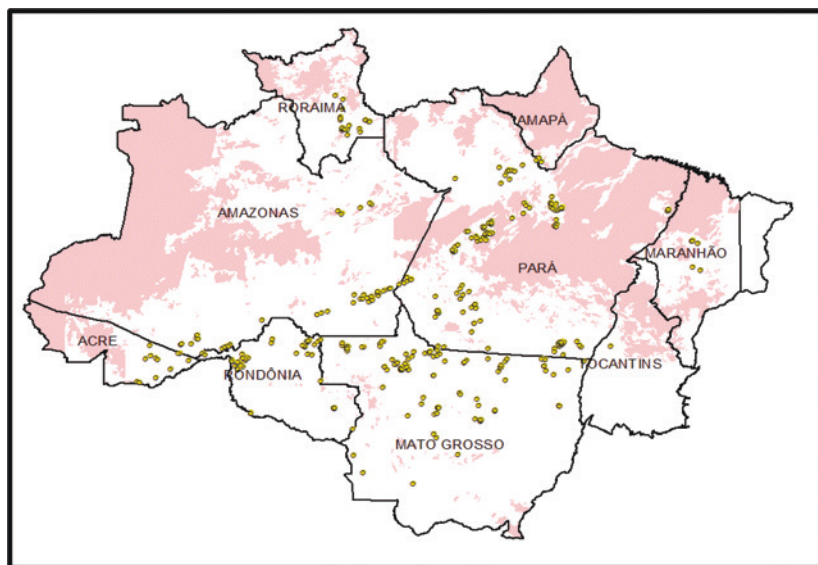


Fig. 2.7 Map produced thorough data of DETER in January 2016. The *yellow dots* indicate the location of deforested areas; the *red areas* represent cloud cover. *Source* INPE (2016)

can be conducted specifically within the interior of either federal and state-designated conservation areas; within protected indigenous lands; or by state, city, or more generally, for the entire Brazilian Amazon (Fig. 2.7).

Since 1988, Brazil has used a system called PRODES to measure annual rates of deforestation (a PRODES year begins in August and ends the following July) to detect deforestation of areas over a 6.25 hectares in the entire Amazon region (If someone deforests one ha or less, it will not appear on PRODES—a problem afflicting deforestation enforcement throughout the Basin). The initial presentation of data is given in December each year, as estimates, while consolidated data is presented in the first semester of the following year. Access to and format of the data are similar those of DETER and are done though the Internet page at <http://www.dpi.inpe.br/prodesdigital/prodes.php> (Fig. 2.8).

For over 20 years, INPE has also maintained an operative satellite system of forest fires, known by its acronym, PROARCO: www.dpi.inpe.br.

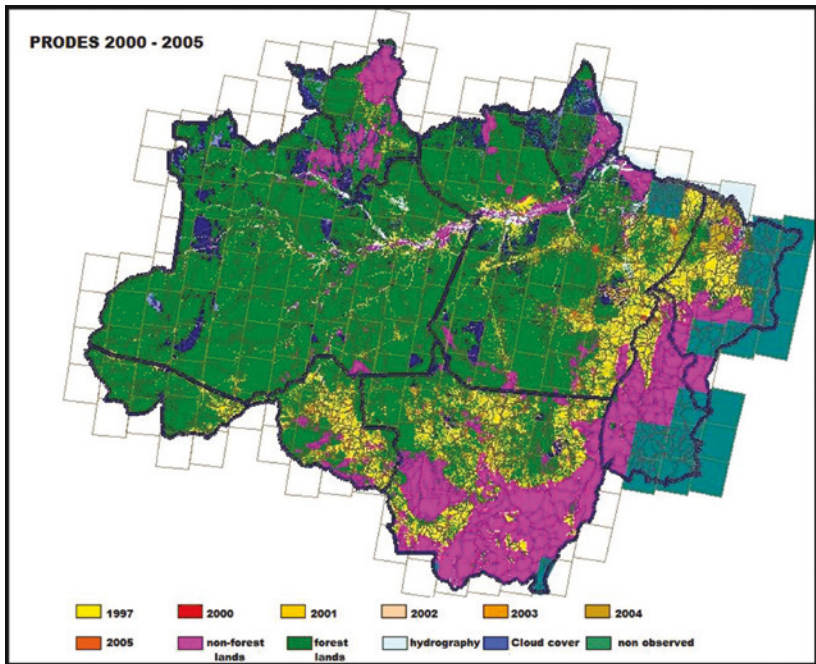


Fig. 2.8 Cumulative map, PRODES 2000–2005. *Source* INPE (2016)

br/proarco/bdqueimadas. The data that PROARCO produces and publicizes is not limited to Brazil or even South America—it also provides up-to-date information on forest fires on different continents, including Africa and North America. Such data can be obtained through a search by region or by direct navigation on the map on the project site (Fig. 2.9).

USE OF GEO-INTELLIGENCE AND THE GAGEO PROJECT OF THE FEDERAL POLICE

In addition to well-known means of criminal investigation such as communications tapping (e.g., telephone and e-mail) and banking or financial transactions (e.g., checking accounts and credit cards), the growing skill and efficient use of geo-intelligence (GEOINT) techniques have

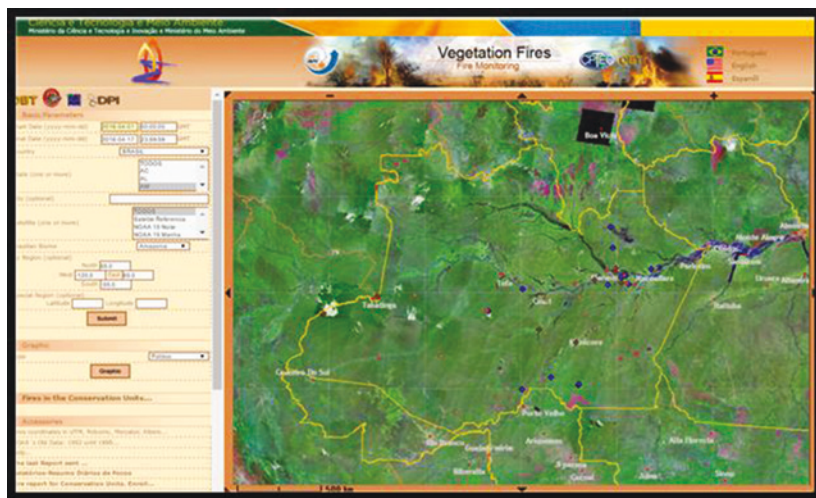


Fig. 2.9 A PROARCO search and map (*Fuente INPE 2016*)

become indispensable to Brazilian penal authorities, who struggle with the huge physical dimensions and complex characteristics of the Brazilian Amazon. The use of images obtained by satellites and airborne sensors (from a plane, helicopter, or, increasingly, a drone), along with the evolving capacities to analyze spatial and non-spatial information, has led to breakthroughs in the detection of fraud by criminals who would otherwise be impossible to detect, even with extensive human and material resources. To deepen this work, the Federal Police's Environmental Crimes Division (*Divisão de Repressão a Crimes Contra o Meio Ambiente*) established its Analysis and Geointelligence Group (GAGeo: *Grupo de Análise e Geointeligência*) in 2010. Since then, GAGeo has launched a range of operations and police investigations in the Amazon, many of them utilizing publicly available software and data. Its success with such instruments has led to global recognition, such as by the Association of Police Forces of the Americas (AMERIPOL 2014).

To best appreciate GEOINT's impact, it is first necessary to understand how it works. The most common definition of GEOINT is the one developed by the National Geospatial-Intelligence Agency (NGA) and used in US legislation: "[...] the exploitation and analysis

Table 2.2 Components of GEOINT

Imaging	Visual registry of objects (both naturals and artificial), produced by satellites, aerial platforms, unmanned aerial vehicles (UAVs), or through related means
Intelligence of images	Technology to extract useful information through interpretation or analysis of imagery and collateral data ^a
Geo-spatial information	Information on the surface of the Earth that identifies the location, geometry and attributes of the surrounding, buildings, objects, resources, or phenomena that occupies physical space (which may be base on maps, statistical data, graphs, archives, and digital data)

(NGA 2006)

^aCollateral data is all non-spatial data of different types that may contribute to the understanding and interpretation of images, including the information of data and intelligence from other sources

of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth [...] GEOINT consists of imagery, imagery intelligence, and geospatial information.” (Title 10 U.S. Code §467). More specifically, GEOINT comprises the following components (Table 2.2):

Such categorization is of course conceptual, since practice necessitates the combination of them that more precisely captures GEOINT’s principal function: consolidating all activities involved in the planning, acquisition, processing, analysis, and diffusion of spatial data to allow for the fullest possible comprehension and contextualization of information from all intelligence sources (Fig. 2.10).

GEOINT was initially conducted primarily through aerial photographic recognition and interpretation of the resulting data was completely manual. But it developed rapidly. Currently available is a wide range of resources and systems of targeted information, most commonly and broadly called Geographic Information Systems (GIS), which enable us to work with large quantities of digital data from many sources, including satellite images. This chapter now turns to the ways in which GEOINT can help identify and prosecute illegal deforestation crime in Amazonia. It will center on a case that illustrates GEOINT’s foundation and potential by showing how it used satellite images to confirm extensive of activities of mining between 2010 and 2011 in a specified area (Fig. 2.11).

Although these dual photographs clearly show intensive mining activity in the areas in 2010 and 2011, they do not show if the extraction

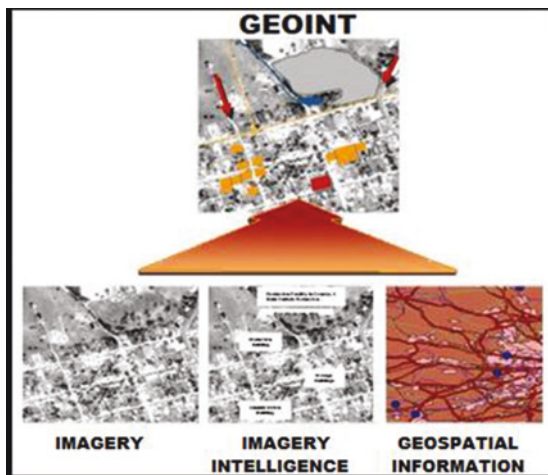


Fig. 2.10 GEOINT components NGA (2006)

was legal or identify those conducting it. Such photographs must therefore be analyzed with additional information from other sources, such as environmental agencies, DNPM and the Federal Police of Brazil. In this case, using the geographic coordinates of this mining operation, a search was conducted with the above-mentioned SIGMINE and Catastro Minero systems. Examining the region, the search identified the existence of a process in the DNPM and obtained the digital archive of a specific polygonal of territory. With that material, it was able to discern that there was a business located within it, but that the business did not have a valid permit for the exploration of minerals emitted by DNPM, since August 2007 (Fig. 2.12).¹²

In short, analysis of all this data (satellite images, the geology of the polygon, and the information recorded in its DNPM case) enables verification not only that the mining being conducted in the zone was clearly illegal, since it took place outside the prescribed limits, and at a time much later than August 2007, after when no document had authorized mining under any pretext or legal title (Fig. 2.13).

Obviously, a complete clarification of this case would require more detailed analysis, as well as the realization, in situ, of investigation activities such as technical examinations lead by forensic experts to identify and evaluate the environmental damage. But this example still provides

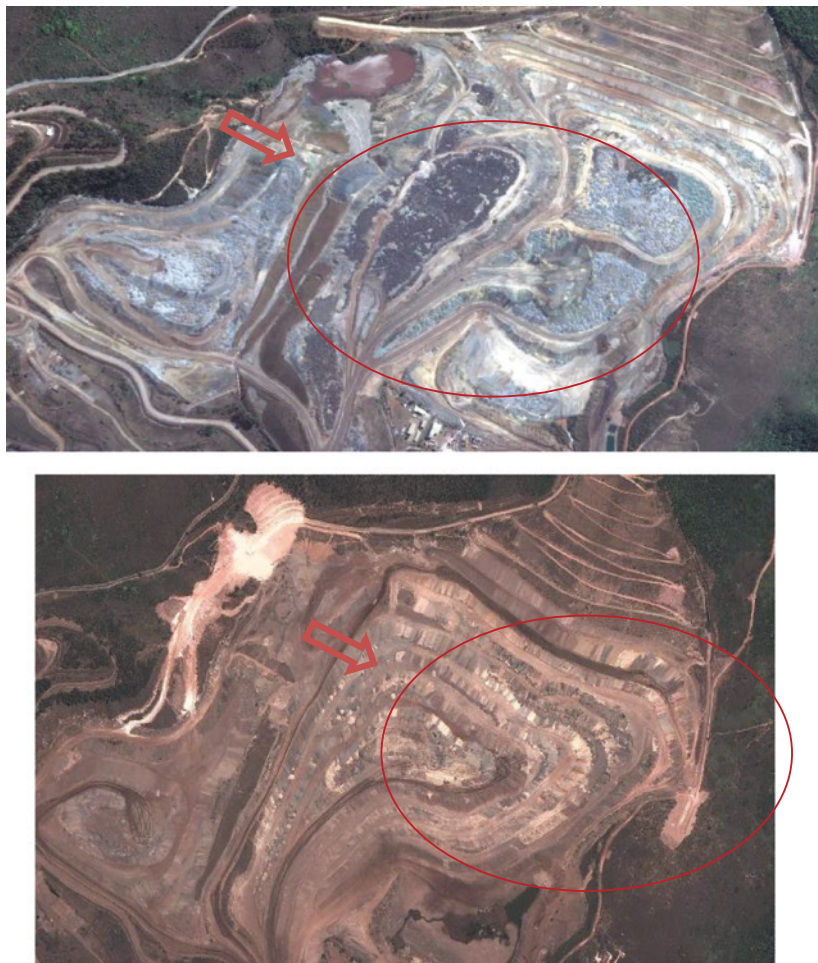


Fig. 2.11 *Above* Orbital image in 2010 of a mining zone. *Below* Image of the same zone in 2011 (GAGeo [2016](#))

a general vision of the many opportunities of GEOINT for the investigation of crimes committed against the environment. After all, without the joint analysis of the spacial and non-spacial data that we used in this system, any verification of the infraction would have been difficult,

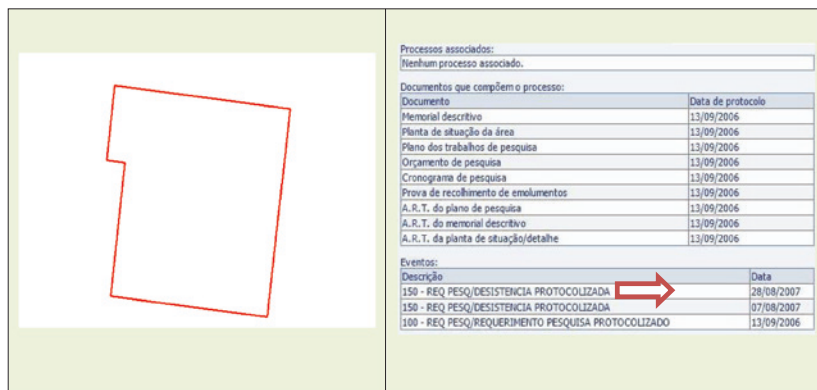


Fig. 2.12 Mining area polygon file and information available in the *Mineiro Cadastre* (GAGeo 2016)



Fig. 2.13 Joint analysis of vectoral data, the image, and the DNPM mining case (GAGeo 2016)

in particular in operations carried out illegally after 2007. Without evidence or *in flagrante delicto* seizures, perpetrators can always argue that the mining was done years earlier, prior to the expiration of the DNPM license. In other words, the joint processing and analysis of all this data allow us to confirm the practice of crime in this specific area and time (Imagery + Imagery Intelligence + Geospatial Information = GEOINT).

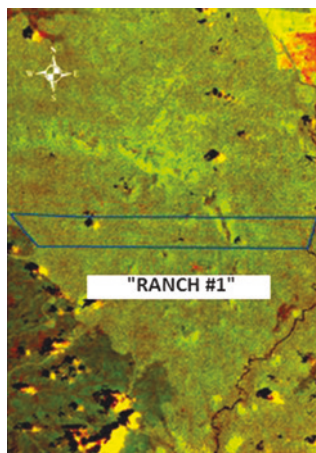
As mentioned above, in 2010, the Federal Police's Division of Crimes Against the Environment launched a project called GAGeo (Portuguese

acronym for Analysis and Geointelligence Group), which brings together specialized agents to carry out analysis and GEOINT on behalf of the Federal Police for investigation of groups conducting illegal deforestation, especially in the Amazon. In recent years, the activities of GAGeo provided the data, information, and analysis that enabled a range of police operations, many of them undercover.

Among the operations that have been made public, particularly illustrative was Operation Salmo 96:12, carried out on May 23, 2012. It began with an investigation by the Federal Police in Roraima State, which had gathered evidence of serious fraud against the federal land agency, the National Institute for Colonization and Agrarian Reform (INCRA: *Instituto Nacional de Colonização e Reforma Agrária*), in the unlawful acquisition of property in the State. Investigative activities, such as telephonic interception supported by judicial warrants, also exposed corrupt public officers involved. In the course of the investigation, suspicion arose not just of illegal acquisitions through fraudulent documents, but the spread of environmental crimes like unauthorized deforestation within both the zones under investigation as well as nearby protected areas. Initially, GAGeo agents thus carried out exhaustive analysis of the all trade of forestry products within and from these illegally acquired properties. We found that nearly all these properties' owners had licenses to carry out cutting in the forests and had sold large volumes of wood to several sawmills in the area in a short amount of time. But also found through SisDOF analysis were various inconsistencies indicative of fraud in the movement of forestry credits for the legalization of wood extracted in other areas. Around 40 authorizations given by the state environmental agency were identified, and all of them involved some kind of fraud of SisDOF during the process. In all these cases, the data analysis, along with satellite images of the region and vectoral data defining property boundaries, allowed not just confirmation of fraud on forestry credits, but other environmental crimes as well, such as unlawful extraction within areas of permanent preservation, and deforestation within properties of areas much larger than those authorized by the environmental agency.

To show how such crimes are conducted, the next section turns to another emblematic case: the Property Known as "Ranch 1." Covering 1237,108 hectares, this property was located in the municipality of Rorainópolis, approximately 12.2 kilometers from the Anauá National Forest and 50.8 kilometers from the PA Ecuador (PA is a

Fig. 2.14 Landsat-5/TM Image October 15, 2010 shows no deforestation within the property perimeters (*blue polygon*)



Projeto de Assentamento, or Settlement Project, which is a federal public area in the Amazon destined to land reform). Both of those areas are under federal jurisdiction. The preliminary analysis of this property's SisDOF account revealed several incompatibilities, especially regarding vehicles supposedly used for the transport of forestry products (such as passenger vehicles, utility vehicles, and motorcycles).¹³ Interpretation of satellite images of the region along with SisDOF data, however, brought in new and valuable elements to the investigation:

The Landsat-5 / TM 15/10/2010 image below shows that, on October 15, 2010, there were no signs of deforestation within the perimeters of the property, or that could be confirmed by environmental agents of IBAMA who inspected that area on March 29, 2011 (Fig. 2.14).

However, SisDOF registered the sale of 4486.567 m³ of wood from different forest species from January 20, 2011 to March 24, 2011—that is, in the period prior to this image and IBAMA's inspection. This showed that all of those DOFs were issued to cover up forestry products originating in other non-authorized zones. Following the issuance of the DOFs, as well as the IBAMA agents' inspection and of the respective administrative fine by federal environmental authorities, the Landsat-5 Imagen/TM of August 31, 2011 revealed approximately 489 ha of logging, which exceeds the 212 approved. It also verified that the exploration disregarded the limits established in the project as well as by

environmental norms. In total, approximately 276.7734 hectares were illegally deforested (Fig. 2.15).

Because this property was fraudulently acquired through the state agency in charge of agrarian reform and that, therefore, all of the deforestation within it was illegal, the perpetrators were subject to penalties for document fraud and illegal deforestation. They were also required to provide economic compensation for the environmental damages. The forensic expert assigned to the case estimated that the cost to repair these areas combined with the total value of the illegally produced forestry products was R\$ 9.546.714,46 (US\$4 million at the time).

In the Salmo 92:12 case, criminal evidence was acquired through GEOINT techniques, which exposed a network of fraud and corruption that covered up deforestation in Roraima with an appearance of legality. Such fraud was carried out in two phases: (1) through submission of false data and documents to INCRA, acquisition of property titles for public areas designated for land reform in the state; and (2) acquisition of permits to cut down trees in these areas, along with fraud and the corruption of public officials in both state and federal environmental agencies.¹⁴ Analyses conducted through GAGeo demonstrated that, in addition to carrying out illegal deforestation within areas where permission for activity was fraudulently acquired, the criminals also conducted false transactions with the corresponding forestry credits, with the aim of legalizing forestry products extracted in other zones.

GEOINT data and information, together with other penal mechanisms to obtain proof (such as monitoring, stakeouts, telephonic surveillance and information obtained through bankruptcy and financial records), laid the path for Operation Salmo 96:12, in which arrest warrants were carried out against 44 suspects, including eight officials in IBAMA, three in INCRA, and six of FEMARH, Roraima State's environmental agency. Data information and penal proof produced by GAGeo also allowed the police to attain, through the courts: (I) dismissal of 18 public officials; (II) confiscation and destruction of all the good (moveable and stationary) of 28 individuals and 20 businesses, in addition to suspension of all forestry permits that were fraudulently issued to them. In total, 115 persons were charged for crimes of land invasion and illegal deforestation. In addition to its scope, what was notable about this case is Roraima state historically has not been one of the major areas of Amazon deforestation. But just between 2011 and 2012, it experienced a 368% increase in deforestation, much of which

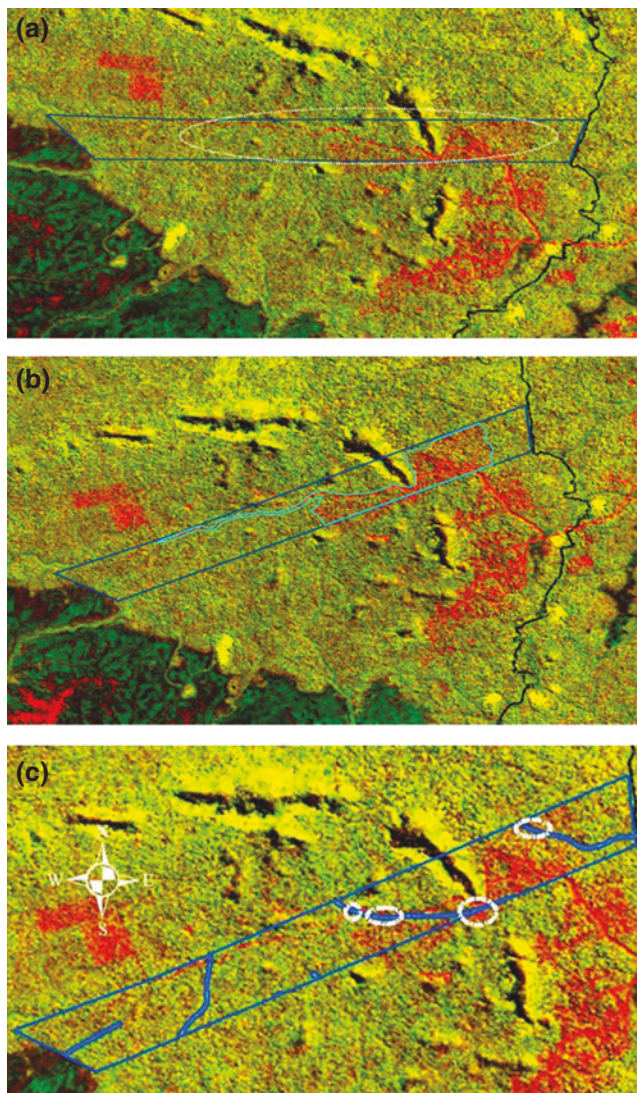


Fig. 2.15 **a** Landsat-5 Imagen August 31, 2011 shows the cutting in a significant part of the rural property (*reddish areas* within the *white ellipse*) and its outskirts in the date after issues of the DOFs. **b** The same image revealed that deforestation within the property was approximately 489 hectares. **c** The image also showed that deforestation within the property neared 15.53 hectares of Areas of Permanent Preservation (*APP* Áreas de Preservação Permanente)

was certainly connected to the group investigated by this operation. That realization only reinforced GEOINT’s importance of as an instrument of protection in the Amazonia.

SPECIAL OPERATIONS AGAINST ILLEGAL DEFORESTATION IN THE
AMAZONAS

In the past 5 years, the Police Federal of Brazil has conducted a range of special operations against illegal deforestation in the Amazon.¹⁵ The legal mechanisms that they use include Quebra de segredo, literally translated as “breach of secrecy,” which is judicial authorization to access data or information that is otherwise confidential, like bank and financial accounts, as well as to intercept communications like phone and e-mail exchanges. Another primary mechanism is Entrega controlada, or “controlled delivery,” used when a consignment of illicit products (drugs, timber, minerals) is detected and allowed to go forward under the surveillance of law enforcement officers in order to identify all those involved. Some of the main operations, as well as their results, are as follows (Table 2.3):

Table 2.3 Principal special operations against illegal forestry and mining in Amazonía, 2010–2015

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Jurupari	May 21, 2010	To investigate fraud in forestry management plans and corruption of public officials related to the extraction, transport and illegal sales of forestry products from federal protected areas in Mato Grosso state, such as indigenous lands and national parks	94	91

(continued)

Table 2.3 (continued)

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Ouro Preto	June 16, 2011	To dismantle a criminal organization whose illegal mineral extraction operations were devastating Amazonia's tropical forests. Investigation began in 2008 of illegal extraction of cassiterite (tin oxide) within the Indigenous Land Tenharim-Igarapé-Preto, located in a remote area with difficult access, straddling Rondonia, Amazonas, and Mato Grosso states	18	8
Salmo 96:12	May 23, 2012	To dismantle a sophisticated criminal apparatus responsible for the 363% increase in deforestation in Roraima state in 2011 and 2012. It identified participation of 24 businessmen, eight IBAMA officials (including Roraima's inspections chief); three in INCRA, six in FEMARH; several in the Roraima state Land agency (ITERAIMA), one municipal official, and over 100 front men	06	44

(continued)

Table 2.3 (continued)

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Xawará	July 13, 2012	Against environmental crimes and illegal exploitation of gold in the indigenous land of the Yanomami. Confiscated were eight (08) kilograms of gold, six aircraft, and US\$150,000	44	33
El Dorado	Nov 6, 2012	To dismantle a criminal network of illegal gold extraction in the interior of the indigenous land of the Kayabi and illegal mining in the Teles Pires river region of Mato Grosso state	64	28
COOPI	Dec 20, 2012	Operation to halt irregular tree cutting in indigenous lands in the municipalities of Maranhãozinho and Centro do Guilherme in the state of Maranhão	7	0
CONTRA GARIMPO	March 3, 2013	To combat the activity of illegal mining in Pontes e Lacerda, MT, Results: Confiscation of three trucks; two chargers; one tractor; two motorcycles; one backhoe; one scale to weigh gold; 246 grams of gold, and 458 grams of mercury	01	05

(continued)

Table 2.3 (continued)

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Curatetinga	March 22, 2013	To combat illegal gold mining in the indigenous land Ynomami, near the Uraricoera river in Roraima. Results: Confiscation of 8000 L of combustible diesel, 3000 L of gasoline and canoes to transport equipment and people; three arms, 10 chainsaws, motors, and other mining equipment	01	42
Dríade	April 3, 2013	Combat illicit business groups conducting illegal deforestation in the Biologic Reserve of Gurupi, in the far north of Maranhao state. Wood extracted illegally from the reserve was taken to zones where the group did have authorization for cutting and production. DOFs and other documents issued by environmental authorities were utilized to “legalize” wood that was then exported	29	0

(continued)

Table 2.3 (continued)

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Ibira	May 21, 2013	To fight illegal extraction of wood in the indigenous land of Alto R�o Guam� (with a surface area of 280.000 hectares, in the municipalities of Paragominas, Piri�, Norte Garraf�o, and Santa Luzia do Par�;) and fraud in the SisDOF	27	0
Termitas II	Nov 6, 2013	To combat criminal organization that carried out fraud in SisDOF and the illegal extraction of wood in the interior of protected areas of Par� state.	21	07
Trair�o	Nov 20, 2013	To combat environmental crimes and fraud in the use of forestry credit (SisDOF), the main objective of Operation Trair�o was to halt illegal timber in the west of Par� state	03	01
Nuvem Negra	Dec 3, 2013	Taking place in the states of Maranh�o, Par�, and Goi�s, it was a part of a full-year investigation spurred by detection of fraud in IBAMA's forestry control system (SisDOF)	07	43

(continued)

Table 2.3 (continued)

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Kalupsis	May 7, 2014	To combat illegal timber in Aripuana and Conselvan, in the northeast of Mato Grosso state	67	9
Castanheira	Aug 27, 2014	To dismantle criminal organizations specializing in land appropriations and environmental crimes	22	4
Mesclado	Dec 10, 2014	To combat illegal felling in indigenous lands in the Southern Cone region of Rondonia	20	7
Xilofogos	Dec 18, 2014	To combat the deforestation in the state of Roraima	49	0
Filão do Abacaxi	Sep 18, 2015	To combat criminal organizations responsible for illegal mining in the Filão do Abacaxis region of Amazonas state	4	3
MAE Do Ouro I E II	Oct 28 and Nov 24, 2015	To dismantle criminal organizations conducting illegal mineral and gold trading in the north of Mato Grosso state	47	11
Corrida Do Ouro	Nov 6, 2015	To dismantle a	32	0
Madeira Limpa	July 24, 2015	criminal network of	41	3
Grand Canyon	Nov 23, 2015	civilian and military police collaborating in mining and the sale of illegal gold in the municipality of Pontes e Lacerda	14	5

(continued)

<i>Operation</i>	<i>Date</i>	<i>Objective(s)</i>	<i>Search orders</i>	<i>Detentions</i>
Cratons	Dec 8, 2015	To combat illegal extraction and sales of diamonds in the land of indigenous peoples of Cinta Larga in Rondônia	41	11
			659	415

Source División of environmental crimes of the police federal—DMAPH (2012)

CONCLUSION

The next two decades will be decisive for the Brazilian Amazon: If properly managed, the forest could be a permanent source of wealth for traditional communities, businesses, and workers; if not, the range of social, economic, and environmental problems resulting from illegal deforestation may drive the region toward a collapse of monumental repercussions. To avoid this fate, we must encourage greater awareness and participation by all branches of government and all sectors of civil society (universities, researchers, NGOs and citizen associations, indigenous inhabitants, professionals, farmers, and laborers). In particular, the state must heavily invest in its preventative and repressive apparatus, especially in the areas of intelligence and infrastructure, taking into account that environmental crimes are conducted by organized networks determined and capable of eluding the law and its enforcers. The best practices presented here illustrate the broad advances that Brazil has made in the past decade. But even with such progress, we must keep in mind that we are still just beginning to lay the path toward durable protection of the Brazilian Amazon. That path is long. Let’s continue on it.

NOTES

1. This office, equivalent to a US Cabinet Secretary, heads the President’s relations with the Cabinet, Congress, and governors. This role makes the position the second most powerful in Brazil.
2. Water vapor produced by Amazonia’s rain forest extends throughout South and Central America. Deforestation thus has a massive impact on water supply and hydroelectric energy (Fearnside 2005).

3. Data from the lumber sectors and production surveys by Imazon showed that state and federal tax deductions, just in 2009, approximated US \$200 million (Adeodato et al. 2011). The amount of such tax evasion is greater than the annual budget of most enforcement agencies, including the Police Federal.
4. Deforestation in Brazil's Amazon is inextricably linked to violence in the region. Comparison of data from the National Institute of Spatial Research (INPE: Instituto Nacional de Pesquisas Espaciais) with the "Map of Violence of Brazilian Municipalities" by the Organization of Ibero-American States showed that, in 2005, of the 100 municipalities with the highest rates of deforestation, 61 also had Brazil's highest homicide rates (Waiselfisz 2016).
5. For information on all Federal Police operations between 2003 and 2016: <http://www.dpf.gov.br/DCS/operacoes/indexop.html>.
6. Data from international organizations show that the global timber industry moves nearly \$100 billion annually, of which close to US \$2.5 billion is connected solely to legal income of this sector in the Amazon.
7. Although the main objective of mining activity is not directly linked to extraction of forest products, such activity does cause serious impacts on the forest, including deforestation of immense areas. In particular, many of the chemical processes and products utilized in mining causes sedimentation of rivers, bringing serious consequences for human and animal health.
8. In Brazil, minerals are State property and extraction requires DNPM authorization, a federal agency of the Ministry of Mines and Energy (MME), as well as authorizations by environmental authorities overseeing forest management and mining in each area.
9. Brazilian Criminal Code article 75 limits incarceration of an offender sentenced in Brazil to 30 years.
10. The DOF (*Documento de Origem Florestal*) is the document authorizing the transport and commercialization of forestry products.
11. SIG is the Portuguese acronym for Geographic Information System (GIS).
12. Consultation in the *Mineiro Cadastre* verified that the applicant requested suspension of the processes of mineral exploitation in August 7, 2007 and that after that date the authorization was never granted to him again, reason why any exploitation after August 2007, in that area, is illegal.
13. This type of fraud in the issue of DOFs is common. To cover wood illegally extracted from public or protected areas, criminal organizations use DOFs of other legalized areas. But this fraud can be detected through incompatible data in DOFs—for example, if the total time the transport spent on the route is incompatible with the distance or the numbers of

- the license plates of vehicles used do not exist, or, if they do, the vehicle is not licensed for the transport of wood (e.g., motorcycles).
14. The criminal organization had been able to “legalize” of an area of 146,000 hectares, and to obtain permits for logging on 21,000 hectares, which gave them about 1.4 million m³ of wood or 56,000 trucks.
 15. A “Special Operation” in the Brazilian Federal Police involves investigations using measures requiring judicial warrants, like telephonic tapping or exceptions to banking secrecy, and the search and seizure of evidence of criminal activity (e.g., cash, vehicles, jewelry).

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