

## **MapBiomias: How Open Data Can Unlock New Solutions to Address Climate Change**

**By:** Linda Peia\*, Hanae Baruchel\*, Konstanze Frischen\*

\*Senior. Director, Ashoka

\*Member, Leadership Team, Ashoka Next Now

\*Leader, Tech & Humanity, Ashoka

**Keywords:** open data, big data, open source, climate change, deforestation, land use, data platform, technology, forests, tipping point, Amazon, Brazil

### **Abstract**

The lack of reliable, timely, and accessible information makes some of our most intractable social issues difficult to solve. MapBiomias, a collaborative network incubated by the Climate Observatory in Brazil, is demonstrating that open data can unlock new solutions to address climate change at scale. Its historical land use and change in platform is enabling leaders across all sectors to better understand land use in Brazil and design effective actions. With 70% of Brazil's greenhouse emissions being generated by land use, the potential impact is huge. MapBiomias is the most complete, up-to-date, and detailed spatial database of land use in the world and has been rolled out in several countries in Latin America and in Indonesia.

### **Introduction**

The lack of reliable, timely and accessible information makes some of our most intractable social issues difficult to solve. The rapid growth of deforestation and its influence on climate change is a case in point. Open data platforms can unlock and inform new solutions, as demonstrated by [MapBiomias](#), a collaborative network incubated by the Climate Observatory in Brazil under Tasso Azevedo's leadership. MapBiomias was created in 2015 in response to the lack of accurate, historical land use data in Brazil. Thanks to MapBiomias's multi-disciplinary network, Brazil has now the most complete, up-to-date, and detailed spatial database of land use in the world. Access to and easy navigation of the land use data has, in turn, enabled actors across all sectors to address climate change in novel ways. This has huge implications because [Brazil could address 70% of its greenhouse emissions through better land management.](#)<sup>i</sup>

### **The Challenge**

In 2015, when MapBiomias was founded, there was no timely way to analyze historical trends in land use. New land use maps were produced only every seven years. For historical data, producing one map alone would take an additional year. Data quality was further weakened by a lack of coordination between the analytical efforts of multiple subject matter experts, including land use experts, geospatial data experts, conservation specialists, etc. To understand long-term trends, the founders of MapBiomias needed high-quality historical data going back till 1985, when satellite imagery first became available. With the then available technology and resources,

they would have needed decades to produce these maps, and decades more to analyze the urgent problems they sought to address, such as deforestation.

Speeding up the production of high-quality maps was a technically difficult challenge that no organization could solve alone. Tasso Azevedo, an [Ashoka Senior Fellow](#) and also leader of a [greenhouse gas emissions data platform](#) at the Climate Observatory realized that to speed up the production of land use maps, he would need to facilitate collective action across multiple organizations, drawing on diverse talents.

### **The Solution**

Tasso Azevedo, in partnership with Carlos Souza (a remote sensing scientist from Imazon), convened technology providers, universities, non-profits and research institutions to understand how to produce high-quality land use data faster and cheaper. They facilitated an exchange of ideas to bridge across each expert's domain and account for local context and map variations. MapBiomias was born due to this cross-domain dialogue. The founding team then engaged Google to use its Earth Engine. Google's cloud infrastructure enabled MapBiomias to easily manage large volumes of image data while also working in a distributed way – geographically spread across Brazil. Within six months, the team was able to:

- Launch the first data collection initiative;
- Prove that it was feasible to generate a historical series of annual maps of land cover and land use at high accuracy (30x30m pixel);
- Leverage existing resources and investments to efficiently build their data platform;

The resulting maps classify land use to a high degree of accuracy and consistently identify when data is missing or unclassifiable. To produce them, the platform aggregates distributed and automated data processing. Since 2016, MapBiomias has evolved into a collaborative, open platform that comprises 20 institutions across multiple sectors. Land use is sorted into 25 classes (e.g., agriculture, forest, pasture, etc.). Maps have a 90% global accuracy rate and are re-deployable for different use cases. Instead of taking a year to produce, historical maps can be generated in a day. As a result, Brazil has the most complete, up-to-date, and detailed spatial database of land use in the world.

### **MapBiomias Alert: A Use Case of MapBiomias**

MapBiomias data is now being deployed to respond to such pressing and complex issues as deforestation, particularly in the Amazon. Since 1975, [20% of the Amazon has been deforested<sup>ii</sup>](#) and another 20% has been degraded. [Ashoka Senior Fellow](#) and renowned climate scientist Carlos Nobre argued in 2007 that if deforestation reaches 40%, it may put the Amazon on an irreversible path toward grassification or desertification. The rainforest would become a savanna. With rising global temperatures, Nobre recently revisited that threshold, arguing that the tipping point is now closer to 20 and 25%.<sup>iii</sup>

This extremely urgent problem led the MapBiomas team to better understand where deforestation happens and engage actors to take actions against it. In 2018, when the MapBiomas team started to analyze deforestation, it realized that Brazil had eleven independent initiatives tracking deforestation. Each had a different way of collecting data, monitoring data quality, and issuing alerts. Differences in data included images with different resolution, different data enhancements for cloud coverage, time series, and different ways of classifying deforestation, degradation or exploitation. In 2018, these initiatives produced more than 150,000 deforestation alerts, but only 1% resulted in reports ready for effective action.

To determine how they could make the alerts more actionable, the MapBiomas team brought together providers of alert systems with their users (e.g., environmental agencies). They agreed that alerts would need to cover all the Brazilian biomes, they would need to be validated with high-resolution data, and they would be published in a public, open, and customizable platform. To improve the usability and effectiveness of alerts, the MapBiomas team created the [MapBiomas Alert](#), a system that validates and refines deforestation alerts with high-resolution land images. The platform currently analyses every single deforestation alert detected through six alert systems in Brazil. Using artificial intelligence and high-resolution images, it validates and refines deforestation alerts and produces reports on every alert detected. Users can now zoom in on a particular geographic area and go all the way back to 1985 to see how the land has changed over time. One can also see every single deforestation detected and confirmed since January 2019. This includes information about the extent of the deforestation event, as well as when and where it happened. MapBiomas also cross-references the data with land tenure, territorial boundaries and administrative information. This allows users to see whether the alert is in a protected, public, or private area, or if the proper timber permits are in place.

Users can create customized reports according to their own needs and can come back and report on what they did. To support data exploration and new use cases, MapBiomas has a team that responds to inquiries from users within 24 hours. Data exploration and case development is further supported by the ability to navigate high-level trends, aggregated geographically or temporally, to specific local impacts.

## **Impact**

Today, MapBiomas Alert produces around 1500 reports on deforestation ever week, 50% more than what was generated in 2018. There are currently 158 organizations and over 1500 people that use MapBiomas Alert. These include banks, meat packers, grass roots organizations, environmental agencies, justice departments, and NGOs. Thanks to MapBiomas' analysis, it is now known that [more than 99% of deforestation in the Amazon has evidence of illegality.<sup>iv</sup>](#) By cross referencing confirmed alerts with the Rural Environmental Registry (CAR), the vegetation suppression authorization database, and all information relating to protected areas, MapBiomas has shown that 70% of deforestation in the Amazon occurs on private land. Given that private land is registered to an individual or organization, public agencies can use the MapBiomas platform to identify the responsible party and provide supporting documentation to enact

penalties or prosecution. Landowners can now be fined remotely or by mail, since the CAR collects proprietors' addresses.

MapBiomass Alert is enabling institutions to take more timely actions. For example, banks can use the system as part of their due diligence in the lending process. Policymakers could also use the data to suspend land registration to those who are involved in illegal deforestation. It now provides a previously absent feedback loop that has the potential to prevent future deforestation from taking place. To expand the use of the platform and increase the number of actions taken against illegal deforestation, MapBiomass is actively engaging institutions such as public, private, and cooperative banks and the national council of public prosecutors.

## Principles

Looking from a bird's eye perspective at the MapBiomass experience and that of nearly 400 other Ashoka Fellows working with open data and technology, we discern a set of overlapping design principles that underpin the work of these innovators for the public good.

- 1) **Tech must amplify agency.** To encourage early adoption, it is important to lead by example when developing new use cases. For example, MapBiomass Alert demonstrates that timely data visualization that cross references data across multiple data platforms can lead to powerful actions that address illegal deforestation. Everyone can play a role.
- 2) For this to happen, **tech (and data) must be open**, and users must have sovereignty over it. MapBiomass does not limit itself to making its data open, its source code is also open. Their role is to provide high-quality data and to ensure it is explorable. Users of MapBiomass Alert can customize the data and create their own sets of reports according to their own needs. They can also get help from the MapBiomass team when they have questions accessing and navigating the platform. However, users are responsible for their own reporting and subsequent actions against deforestation. Data privacy is also essential. MapBiomass does not have access or knowledge about how users use the data or what types of reports they create. Instead, they invite institutions and users to share how they are using the data.
- 3) **No single data system is perfect.** As a result, new, interdisciplinary teams are needed to shape and govern technology itself. Open data collaborations create more responsive systems because they leverage the data sets and domain expertise of diverse teams.
- 4) **Tech must be embedded in social fabric.** Context matters. MapBiomass identifies and trains local organizations or consortia in other countries so that they can make their own maps, ensuring that the result is relevant to their contexts.
- 5) **Tech interventions must become community, or rather: humanity centric (not user centric).** The MapBiomass consortium got 20 organizations to see the bigger picture. The previous organizing model focused on each individual organization as the key user,

whereas the network approach helps them focus more effectively on the broader communities they serve or common purposes they seek to address.

- 6) We must **demystify the data and bring back civilian oversight**. Creating stories (e.g., infographics) or new interfaces, such as MapBiomias Alert, can make the difference between cool data and data that mobilizes. Countless social entrepreneurs find creative, enjoyable ways to explain complex topics through videos, comics, illustrations, bridging the divide between experts and the public. For example, in partnership with Natura, InfoAmazonia, hacklab, and Natura & Co, MapBiomias also launched [Plenamata](#), an online campaign to engage citizens, businesses, government, and civil society in ending deforestation in the Amazon. One key product that it uses for powerful storytelling is a [forestry dashboard](#) that tracks in real time the number of trees being cut in the Amazon.
- 7) **Tech must change the economic architecture and drive sustainability**. MapBiomias Alert system ensures that timely information can flow to a number of actors, including land registry offices and banks, which in turn have a critical role to play in ensuring sustainable (and even regenerative) land use. These players have the ability to tweak our existing incentive structures so that our economic architecture brings people and planet back into balance.

The authors would like to thank MapBiomias co-founder Tasso Azevedo for his valuable time and input.

---

<sup>i</sup> McKinsey & Company. Pathways to a Low-Carbon Economy For Brazil. 2021.

[https://www.mckinsey.com/~media/mckinsey/dotcom/client\\_service/infrastructure/pdfs/pathways\\_low\\_carbon\\_economy\\_brazil.ashx](https://www.mckinsey.com/~media/mckinsey/dotcom/client_service/infrastructure/pdfs/pathways_low_carbon_economy_brazil.ashx) (Accessed on November 5, 2021)

<sup>ii</sup> MapBiomias Amazon. Unprecedented Mapbiomas Study in The Amazon Reveals a Loss of Vegetation Cover in 36 Years Equivalent to One Chile". 2021.

<https://amazonia.mapbiomas.org/en/unprecedented-mapbiomas-study-in-the-amazon-reveals-a-loss-of-vegetation-cover-in-36-years-equivalent-to-one-chile> (Accessed on November 5, 2021)

<sup>iii</sup> Lovejoy, E. Thomas, and Carlos Nobre. Amazon Tipping Point. Science Advances. 2021.

<https://www.science.org/doi/10.1126/sciadv.aat2340> (Accessed on November 5, 2021)

<sup>iv</sup> MapBiomias Alert. News. 2021. <http://alerta.mapbiomas.org/en/news> (Accessed on November 5, 2021)