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GeoSelva, a tool for Amazonian environmental governance

GeoSelva, una herramienta para la gobernanza ambiental amazónica

GeoSelva, uma ferramenta para a governança ambiental amazónica

GeoSelva, un outil pour la gouvernance environnementale amazonienne

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Abstract

One of the persistent gaps in the Colombian Amazon is access to environmental information. The causes of this gap are varied and include low institutional presence of the State, the absence of public policies focused on this direction, and the persistence of centralist and hierarchical visions around the territory. In many cases, this gap translates into socio-environmental conflicts, becoming a barrier to the conservation and sustainability of the region. In this article we present GeoSelva, a map viewer that seeks to contribute to close this gap. We describe the construction process of the tool, its design, functionality, and potential for strengthening environmental governance processes in the region. Furthermore, we offer some reflections on its limitations and possibilities in both the Colombian and pan-Amazonian contexts.

Keywords: access to information, geographic information systems (GIS), environmental governance, Amazonia

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Resumen

Una de las brechas persistentes en la Amazonia colombiana es el acceso a la información ambiental. Las causas de esta brecha son variadas e incluyen la poca presencia institucional del Estado, la ausencia de políticas públicas enfocadas en esta dirección, y la persistencia de visiones centralistas y jerárquicas alrededor del territorio. En muchos casos, esta brecha se traduce en conflictos socioambientales, convirtiéndose en una barrera a la conservación y sostenibilidad de la región. En este artículo presentamos GeoSelva, un visor geográfico que busca contribuir a subsanar dicha brecha. El artículo describe el proceso de construcción de esta herramienta, su diseño, funcionalidad y potencial en el fortalecimiento de procesos de gobernanza ambiental en la región. Asimismo, planteamos algunas reflexiones sobre sus limitaciones y posibilidades tanto en el contexto colombiano como el de la pan-Amazonia.

Palabras clave: acceso a la información, sistemas de información geográfica (SIG), gobernanza ambiental, Amazonia

Resumo

Uma das lacunas persistentes na Amazônia colombiana é o acesso à informação ambiental. As causas dessa lacuna são variadas e incluem a baixa presença institucional do Estado, a ausência de políticas públicas voltadas para essa direção e a persistência de visões centralistas e hierárquicas sobre o território. Em muitos casos, essa lacuna se traduz em conflitos socioambientais, tornando-se uma barreira para a conservação e a sustentabilidade da região. Neste artigo, apresentamos o GeoSelva, um visualizador de mapas que busca contribuir para preencher essa lacuna. Descrevemos o processo de construção da ferramenta, seu design, funcionalidade e potencial para fortalecer os processos de governança ambiental na região. Além disso, oferecemos algumas reflexões sobre suas limitações e possibilidades nos contextos colombiano e pan-amazônico.

Palavras-chave: acesso à informação, sistemas de informação geográfica (SIG), governança ambiental, Amazônia

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GeoSelva, a tool for Amazonian environmental governance

Résumé

L'une des lacunes persistantes en Amazonie colombienne est l'accès à l'information environnementale. Les causes de cette lacune sont variées et comprennent la faible présence institutionnelle de l'État, l'absence de politiques publiques orientées dans ce sens et la persistance de visions centralisatrices et hiérarchiques sur le territoire. Dans de nombreux cas, cette lacune se traduit par des conflits socio-environnementaux, devenant ainsi un obstacle à la conservation et à la durabilité de la région. Dans cet article, nous présentons GeoSelva, une visionneuse de cartes qui cherche à contribuer à combler ce fossé. Nous décrivons le processus de construction de l'outil, sa conception, sa fonctionnalité et son potentiel de renforcement des processus de gouvernance environnementale dans la région. En outre, nous proposons quelques réflexions sur ses limites et ses possibilités dans les contextes colombien et panamazonien.

Mots-clés : accès à l'information, systèmes d'information géographique (SIG), gouvernance environnementale, Amazonie, conflits socio-environnementaux, développement territorial.

Introduction

This article discusses the development of GeoSelva, a environmental information[2] geographic viewer[3] for the Colombian Amazon. GeoSelva was developed as part of a research project on socio-environmental conflicts associated with deforestation in this region[4]. The creation of this tool was based on two central principles or interests that guided this research project. First, as a research group, we were interested in exploring possibilities for the production and dissemination of knowledge beyond exclusively academic realms. To a large extent, our experience as researchers has been linked to forms of knowledge production where the prevailing logic is the collection, analysis, and publication of information on a specific topic or problem. Although this logic is grounded in the importance of making little-studied phenomena visible, confronting views on them, or contributing new elements to conceptual and historiographical debates, it does not prevent, for those of us engaged in this work through interaction with "research subjects," facing the uncomfortable question of why or for what purpose we conduct research.

GeoSelva fits within these alternative or complementary forms of knowledge production-diffusion and, specifically, within an interest in addressing some of the demands from the people and communities with whom we conduct research in the region. In this sense, we believe it is one of many efforts to rethink our place as academics in the places and contexts where we conduct research.

The answer to this question is often, at best, insufficient. Aware that academic language is inherently exclusive for audiences unfamiliar with specialized jargon and disciplinary codes, the alternative often becomes the socialization of research results. Beyond good intentions and a genuine interest in involving these "subjects" in the learnings and findings of research, this ritual of return rarely answers the question of why, especially when tangible solutions to those findings are, in most cases, out of our reach.

In places like the Amazon, whose history has been marked by a multitude of violence related to extractive economies, this question is evident even when not explicitly raised. The absence of a satisfactory answer, in addition to being a source of mutual frustration between researchers and "subjects," ends up paradoxically linking our work as academics to those same economies, even though they are the very subject of our critique. With this, we do not wish to undermine the need and relevance of academic research in the region, nor do we mean to suggest that it is guided by the same logic. On the one hand, the classic and hierarchical relationship between researchers and "subjects" has been deeply (self) questioned and has given way to reciprocal and collaborative ties that transcend academic goals. On the other hand, there are increasingly more examples of research that aims to go beyond the aforementioned production logics. GeoSelva fits within these alternative or complementary forms of knowledge production-diffusion and, specifically, within an interest in addressing some of the demands from the people and communities with whom we conduct research in the region. In this sense, we believe it is one of many efforts to rethink our place as academics in the places and contexts where we conduct research.

[2] For the purposes of this work, environmental information refers to territorial data relevant to environmental governance processes.

[3] A geographic viewer or geovisor is a geographic information system (GIS) optimized for non-specialized users. Unlike a static image or map, a geographic viewer is interactive; that is, it responds to queries or inputs.

[4] For more information about this project and other products derived from it, see Selva y Conflicto on the University of Rosario website.

Secondly, in this same line, this tool was born out of an interest in responding to a demand for access to environmental information that we identified during the research project. Although this information is theoretically public, we found that it is not easily accessible or is presented in a decontextualized manner due to factors such as the complexity of existing geographic viewers, the dispersion of this information across multiple entities, or its display at very general or inadequate scales for many organizations and communities. For these groups, this information is vital for environmental governance in their territories, understood here as their effective participation in collective management processes of environmental goods and resources (Montoya-Domínguez and Rojas-Robles, 2016). During the process of building GeoSelva, we worked with potential users to identify what type of information should be included in the viewer, at what scales it should be displayed, and for what specific uses or purposes it could be employed. Despite its limitations, which we will return to later, we believe that the result meets this demand, is replicable in other contexts, and is easily accessible to researchers, social organizations, communities, and other territorial actors.

The article is structured in four sections. In the first, we thoroughly review some official and non-governmental geographic viewers, both nationally and regionally, and how their quantity and diversity fail to meet the demand for environmental information. In the second section, we use concrete examples to highlight the importance of ensuring access to this information, how GeoSelva contributes in that direction, and, through this, to territorial environmental governance processes. In the third section, we describe the process of building the tool, emphasizing both its technical development and its participatory design with potential users. Finally, in the fourth section, we offer reflections on the potential and limits of tools like GeoSelva in Colombia and Pan-Amazonia.

Relevance and Issues in the Diffusion of Environmental Information in Colombia

Article 79 of the Colombian Constitution recognizes the right to a healthy environment as a collective right and establishes the need to guarantee participation in environmental matters (Constitution of Colombia, 1991). This served as the starting point for an extensive network of laws, international commitments, and rulings that have expanded the scope of the right to the environment. Among these is the Rio Declaration on Environment and Development, which adds an additional element: public information (Rio Declaration, 1992, principle 10). The Escazú Agreement (2018) further connects the issues: it elevates participation in environmental matters and access to environmental information to the category of rights (Escazú Agreement, 2018, Art. 1, 6, and 7) and establishes a series of concrete duties for signatory states. For example, it urges the production and dissemination of environmental information in an accessible and understandable manner and to disaggregate information at local and subnational levels. The agreement was signed by most of the Pan-Amazonian states, although not all have ratified it (ECLAC, n.d.). In Colombia, it was signed, later ratified by the Congress, and is currently under review by the Constitutional Court.

In Colombia, as in other Pan-Amazonian countries, the generation and dissemination of environmental information is the responsibility of various state agencies. The institutes Sinchi, John von Neumann, Alexander von Humboldt, and Invemar, which are linked to the Ministry of Environment and Sustainable Development (MADS), are entities specifically tasked with generating scientific environmental information. On the other hand, the Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM) collects, stores, processes, and disseminates environmental data and information and is in charge of implementing the Environmental Information System for Colombia (SIAC).

The SIAC collects and disseminates information from various entities in the environmental sector. Currently, it has 17 subsystems, although not all are accessible. Much of the information generated by the SIAC has a strong geographical or territorial component. In fact, several of its subsystems have their own geographical viewers. For example, there is the geovisor of the Colombian Amazon Territorial Environmental Information System, which allows users to view land cover in the Amazon region and other layers. Additionally, there is the viewer for the National Registry of Protected Areas (RUNAP), which shows the protected areas of the country, and a general viewer for the SIAC, managed by MADS, that visualizes layers such as ecosystems, RUNAP areas, and zoning from Law 2 of 1959. Furthermore, since environmental information in a broad sense can encompass any relevant information for the environment and risk prevention (Escazú Agreement, 2018, Art. 2), other entities such as the National Mining Agency (ANM), the National Hydrocarbons Agency, and the National Roads Institute, among many others, also generate such information.

The geovisors containing relevant environmental information for the Colombian Amazon can be classified into three categories. The first category includes state-specific viewers for a particular theme or entity. These include both simple viewers that show a single variable with little additional information, as well as more complex viewers.

A good example of the former is the one from the National Land Agency (ANT), which has a different viewer for each of the three types of collective territories it manages. A good example of the latter is the viewer from the ANM, which has complex tools and allows users to work with data uploaded by them. However, all these viewers have in common the lack of interoperability. Even the most sophisticated ones, like the aforementioned ANM viewer, make it difficult to conduct queries or analyses involving multiple sources, as they require certain skills with Geographic Information Systems (GIS) and familiarity with the platforms of various entities. This often necessitates downloading information and working with specialized programs on a computer, which is not accessible to most of the population.

The second category consists of viewers that collect information from multiple topics and entities within the state. "Colombia in Maps" from the Agustin Codazzi Geographic Institute is probably the most significant effort in this direction. This viewer collects data on diverse topics such as agrology, tourism, geology, and the environment, and makes it available for download. Another noteworthy platform is "Datos Abiertos Colombia" from the Ministry of Information Technologies and Communications. Although not strictly a geovisor, this is an important effort in consolidating public information, which includes geographic and territorial data. Both "Colombia in Maps" and "Datos Abiertos Colombia" function as data base search engines, making them powerful tools for researchers or decision-makers who can be sure of finding state-held information in one place. However, the way they present information is not adapted to Amazonian or rural contexts in general. This aligns with the conclusions of Sanabria et al. (2014), who found that Latin American governments often do not adapt these tools to their own contexts. An indigenous, Afro-Colombian, or campesino community usually has very specific information access needs, often related to the space they inhabit. This transcends traditional categories under which state tools group information: departments or municipalities, which in the Amazon are very large entities that are often distant from people's daily lives.

In this regard, a significant weakness of Colombian state viewers is that they follow a "top-down" logic, wherein the state does not take into account the specific information demands of local populations. This contradicts the growing emphasis in digital governance on participatory design, user-centered design, and user innovation (Simonofski et al., 2017). We found that, in general, state viewers do not meet territorial demands. On one hand, viewers focused on a single entity or theme are insufficient for environmental governance, as their functionality is limited and requires consulting multiple sources to obtain relevant information in different contexts. On the other hand, although broader viewers collect data from various sectors, they do not present the information in a way that is accessible to many Amazonian inhabitants, which, in fact, seems not to be their objective.

Finally, the last category includes non-governmental viewers. Notable among these are two viewers managed by the Amazon Network of Georeferenced Environmental Information (RAISG) and the global deforestation monitoring tool, Global Forest Watch (GFW). These viewers fill some of the gaps left by state viewers. For example, the "RAISG Online Map" seems to follow an approach that understands certain needs of Amazonian environmental governance, as it combines information from different sources and, by making the correct clicks, allows users to access disaggregated deforestation data for protected areas and indigenous territories. GFW is even more powerful in technological terms. It allows users to access deforestation data at national, departmental, and municipal levels and upload their own polygons to calculate deforestation statistics. Although both tools are important contributions to environmental governance, their global (in the case of GFW) or regional (in the case of RAISG) reach limits their ability to address specific variables of Colombia or provide subnational information that is relevant to each context. Furthermore, they appear to be targeted at a global audience interested in understanding phenomena such as deforestation from a broad perspective or conducting comparative analyses between different regions or countries. This is evident in GFW, which provides very detailed information on forest change, land cover and use, climate, and biodiversity at the global level but does not easily allow access to something as essential as the user's location. In reality, the demands for access to information are generally much simpler. People and communities want and need access to information that directly involves them. They need to know if their plot is located within a Protected Area, if they are within a petroleum block, and access information at scales that are relevant to their daily lives and the governance of the territory they live in.

Access to environmental information is a right supported by the Colombian Constitution and international agreements. In Colombia, there are several state geovisors that display geographic information relevant to Amazonian environmental governance; however, few attempt to gather information from different themes or entities in one viewer. Some of the most recurrent issues we identified were: lack of interoperability, difficulty of access for non-specialized users, and the persistence of "top-down" logic that overlooks territorial needs. There are also non-governmental viewers that address some needs and provide complex information, but they do not

satisfy the demand for information related to the user's environment. As we describe below, GeoSelva is an initiative that seeks to overcome these limitations by adopting a participatory approach and focusing on the specific information demands of Amazonian communities.

GeoSelva: A Tool to Read the Territory from the Territory

Am I standing on a conservation area or a collective territory? What are its boundaries? Are there mining or oil exploitation licenses near my land? Who holds the rights? These are questions that, despite their simplicity and the information dissemination initiatives described earlier, we frequently hear from indigenous and rural communities during the development of GeoSelva. Many of these questions concern territorial information essential to environmental governance processes. However, finding answers to these questions is often very difficult. Even for researchers and public officials—who are typically the ones addressing them—it is challenging to extract information in the field using traditional cartography or by consulting the multiple existing platforms. This difficulty stems from technological and design barriers, as well as the presence of multiple territorial figures. For instance, a piece of land may simultaneously fall within an Indigenous Reserve, a National Natural Park, and the Forest Reserve of Law 2, or within a Campesino Reserve and an oil block. Naturally, each of these figures has legal and environmental effects on the space they encompass, and consequently, on its governance.

The relationship between various territorial figures and the people living within or around them is often uncertain, as people are not always aware of their presence, boundaries, impacts, or restrictions. This creates a gap between the law and practice, where ignorance or ambiguity of the former leads to disputes over land use or resources. For example, in infrastructure projects, the lack of territorial clarity from the State and the unavailability of information for populations affected by these projects becomes a source of conflict (Uribe, 2018). In general, it can be said that these access issues are widespread and affect very relevant figures for environmental governance, such as protected areas, collective territories, and mining extraction polygons, among others. While communities have an in-depth knowledge of their territories, it is often very difficult for them to consult the official information, which ultimately determines how they are perceived by the State and forms the basis for public policy design.

In the Amazon context, one of the phenomena where barriers to environmental information are most evident is deforestation. In Colombia, the official source of deforestation data is the Forest and Carbon Monitoring System (SMBYC), part of the already mentioned SIAC. This system played a key role in the green militarization policy that characterized the years following the signing of the Peace Agreements with the FARC[5] and is essential for conservation projects through market mechanisms. Although early warning reports have been published, and reductions in deforestation have been reported for 2023 (MADS, 2023; MADS, 2024), access to data remains difficult both for the general public and for those working with GIS. The SMBYC geoportal has been offline for years, and its data is not available in other State platforms, including IDEAM's[6], which has been reluctant to publish information in formats other than PDF or press releases. In fact, in September 2023, the Attorney General's Office of the Nation warned that deforestation data might be violating the Transparency Law and the Escazú Agreement (2023a; 2023b), and only in April 2024 did IDEAM announce that it had enabled a public repository for downloading data (Visión Amazonía, 2024)[7].

Another issue is that information is not disaggregated at local or subnational levels, such as protected areas or Indigenous Reserves, which are highly relevant for environmental governance. This is particularly pertinent in the case of REDD+ projects being implemented in the region[8]. The design and execution of these projects are closely tied to deforestation measurements, specifically using the SMBYC, which was the source for calculating the forest emissions reference level to certify reductions in greenhouse gas emissions (MADS and IDEAM, 2019). These reductions are then sold in national and international carbon markets. Since this generates substantial profits for the companies handling the process, there are incentives to make the data as favorable as possible. In fact, several REDD+ projects worldwide have been found to overestimate emission reductions (Rifai et al., 2015; Pelletier et al., 2013), highlighting the need for accessible information to enable citizen oversight.

Certain Indigenous Reserves are particularly attractive for REDD+ projects due to their extensive areas and col-

[5] The centerpiece of the conservation policy of President Iván Duque's government was Operation Artemisa, a military operation that brought together institutional capacities to combat deforestation through the focus on 'environmental crimes' (Corredor-Garcia and López, 2023).

[6] On 08/21/2024, IDEAM finally published a geovisor with deforestation information.

[7] Although we were eventually able to access it, it was not through the link on the IDEAM website (IDEAM, n.d.), which as of 08/29/2024 directs to an offline repository.

[8] REDD+ is a program that, through market mechanisms, aims to reduce greenhouse gas emissions derived from deforestation and forest degradation (MADS, 2022).

lective ownership. Although 53% of Colombia's Amazon is covered by reserves, Indigenous communities and other stakeholders cannot easily access disaggregated data at this level. This means two things: first, communities cannot contrast the information given to them, putting them at a disadvantage or vulnerability and limiting their negotiating power; second, civil society lacks mechanisms to oversee projects, making it difficult to verify whether emission reductions are indeed real. Thus, access barriers prevent local actors from participating in crucial environmental processes, hinder citizen oversight, and concentrate power in those who possess the knowledge, economic capital, or institutional mechanisms needed to overcome them.

The case of REDD+ illustrates how information access issues affect governance processes and ultimately contribute to environmental conflict. With this in mind, we built GeoSelva, a platform designed to improve access to relevant information for territorial environmental governance, including disaggregated deforestation data at subnational levels not present in other tools, such as territories of Black, Indigenous, and Campesino communities. The tool incorporated specific information demands from Amazonian residents and researchers with extensive experience in the region. Compared to similar projects, GeoSelva was developed with limited resources, making it replicable in other pan-Amazonian contexts and adaptable for different environmental governance processes.

The following case describes the utility of GeoSelva. Villa Catalina de Puerto Rosario is an Inga Indigenous Reserve located in the municipality of Puerto Guzmán (Putumayo Department), established in June 2000. It covers 68,176 hectares and overlaps with the Mecaya, Put 36, Put 9, Terecay, and Cag 5 oil blocks. There are no mining titles within the reserve, it does not overlap with protected areas, and it is outside the Forest Reserve of Law 2 boundary. Over the past 20 years, Villa Catalina de Puerto Rosario has lost 7,403 hectares of forest, which represents 10.68% of its total territory. The deforestation is concentrated mainly in the northern part of the reserve and, to a lesser extent, along its southern and western borders (see Figure 1). It has also increased in intensity since 2016. It is the sixth reserve with the highest total deforestation in the Colombian Amazon, after the Vaupés, Nukak-Makú, Predio Putumayo, Selva de Matavén, and Rio Atabajo e Inírida Reserves. All of this information was consulted with GeoSelva through a few clicks. Finding the same information on other geovisors or using traditional cartography would be a complex task for users, whether they are familiar with GIS or not.

In addition to Indigenous Reserves like Villa Catalina de Puerto Rosario, GeoSelva allows users to consult information about Community Councils of Black Communities, Campesino Reserve Zones, protected areas, departments, municipalities, non-municipalized areas, the Forest Reserve of Law 2, oil blocks, mining titles, and their overlaps, along with supplementary information on roads and rivers. It also provides external links that complement the information for each figure. For example, if a user is interested in an oil block, they can click on it to view a general information panel and, if desired, directly access the document containing the concession contract. Regarding deforestation data, GeoSelva incorporates disaggregated information into seven types of subnational figures (see Figure 2), totaling 443 polygons. Additionally, it allows users to view deforestation trends in spatiotemporal terms, download some data, consult official sources directly, and access contextual panels. It also allows users to easily visualize their location and search within territorial figures. In this way, users can perform specific searches based on their needs, either exploring variables in their immediate environment or directly looking up territorial governance figures of interest (Selva y Conflicto, n.d.).

In summary, there are unmet demands within current environmental information dissemination mechanisms. The persistence of these demands, due to technological and design barriers, creates a gap between law and practice, potentially leading to land use disputes and conflicts within communities or between communities and the State. Barriers to accessing deforestation information are especially prominent, as the official system, SMBYC, does not meet territorial needs and remains opaque even for those familiar with GIS. We built GeoSelva with the goal of bridging some of these information access

Construction

GeoSelva integrates information from various state sources, including the National Administrative Department of Statistics, the 'Datos Abiertos Colombia' portal, the ANT, ANM, the National Hydrocarbons Agency, RUNAP, SIAC, the National Roads Institute, and the National Planning Department. We have limited the variables to the area of the Colombian Amazon, as GeoSelva is a tool specifically for this region. We defined the Amazon based on the criteria used by RAISG, which, in the case of Colombia, follows a biogeographical approach[9], and we made deforestation calculations according to this boundary. That is, if a polygon has territory both inside and outside the Amazon, GeoSelva quantifies only the deforestation that occurred within it. Given the difficulty

[9] The Amazon can be defined by three main criteria: biogeographic (extent of the Amazon rainforest), hydrographic (Amazon River basin), and political-administrative.

of accessing SMBYC data and with the goal of ensuring the project's long-term continuity, we used Hansen et al. (2013) as a source for deforestation data. Although this choice may lead to discrepancies with official data, as the methodologies are different, it is important to clarify that this is the most widely used and disseminated dataset of this type at the global level. It is also worth noting that many of GeoSelva's processes are automated, providing flexibility to easily incorporate other datasets in the future.

To build GeoSelva, we carried out two parallel processes that mutually enhanced each other: technical development and participatory development. In terms of the technical aspect, we used ArcGIS online[10] for the assembly. We processed most of the variables with ArcGIS Pro and the ArcPy library, which allows for the automation of geoprocessing tasks with Python directly within ArcGIS. We performed deforestation calculations using Google Earth Engine[11], following the documentation provided by Hansen et al. and using JavaScript programming. Using Google Earth Engine, a widely used tool in the field of coverage analysis, allowed us to speed up the calculation of deforestation statistics compared to the alternative, which would have been to process the data locally using only ArcGIS. Additionally, we used ChatGPT as a support tool for programming in Python and JavaScript.

The participatory development took place in various spaces in both Bogotá and Puerto Guzmán, Putumayo, with diverse audiences including students, researchers, social organizations, and members of rural communities, at different stages of the technical development. It began with identifying information access demands and continued with the presentation of pilot versions in various spaces, where we received feedback and incorporated it into the development (see Figure 3). In Puerto Guzmán, we conducted a workshop in which we trained diverse profiles from organizations and communities from different parts of the Colombian Amazon in how to use the tool. The feedback received during this workshop was fundamental in designing the final version. To facilitate accessibility, we created a video tutorial explaining how to use the desktop version of GeoSelva and its various functions (Selva y Conflicto, 2023).

During the development, we identified the need to provide information in a mobile format, as the limitations described in previous sections were compounded by the fact that most of these types of tools are designed for desktop computers, which are not easily accessible for many Amazonian inhabitants. Therefore, in addition to the desktop version, we created a mobile web application for cell phones. Considering the connectivity issues typical of rural Colombia, GeoSelva mobile only visualizes essential information.

One of the simplest yet most powerful features of GeoSelva mobile is the ability to access real-time location and easily view the territorial planning figures surrounding the user. Figure 4 shows what a user in Calamar, Guaviare, would see on their phone, standing on the Forest Reserve of Law 2, less than 15 kilometers from the Indigenous Reserve of La Yuquera. With a single click, the user can check the polygons they are involved in and their respective information. They can also search by location, that is, check which territorial planning figures are within a variable radius. In this way, consultations that would normally require multiple resources and expertise can be carried out simply and more accessible to a wider range of people, contributing to the environmental governance processes of various organizations and Amazonian communities (Selva y Conflicto, n.d.).

In summary, GeoSelva is a tool that collects information from different sources, most of them state-based. The technical development of the tool was focused on meeting demands identified in participatory spaces, where we also presented and tested pilot versions. GeoSelva consists of two components: one for desktop and another for mobile phones.

Reflections on the Limits and Potential of Information

As we mentioned in the introduction of this article, GeoSelva was developed within the framework of a research project on socio-environmental dynamics and conflicts related to deforestation in the Colombian Amazon. The project allowed us to think about and enrich the design of the tool through dialogues with various actors and potential beneficiaries. Both in its conception and construction, we were guided by the premise that GeoSelva should primarily aim to meet information demands that are not covered by other geographical viewers. As we previously pointed out, one of the shortcomings of these viewers is their way of understanding territory 'from above', where the variables or categories used are foreign to the specific contexts of many Amazonian inhabitants. For example, for an indigenous, Afro-Colombian, or rural community in the region, the department or even municipal scale may be as broad as it is abstract, and its information is insufficient or irrelevant for addressing and managing the multiple problems they face in daily life. If we assume that governance—unlike government—implies the exis-

[10] ArcGIS Online is a platform, part of Esri's GIS ecosystem, that allows for the visualization and analysis of data online

[11] Google Earth Engine is a platform that allows for the remote processing of large geospatial datasets.

tence of less vertical and hierarchical power structures, this 'top-down' view undermines its foundations and mechanisms of action. Since information not only allows us to understand or make a territory legible but also to intervene in it (Scott, 1998), it can also perpetuate or deepen dynamics of political and social inequality that, in turn, constitute sources of conflict.

Being conceived from a 'bottom-up' territorial perspective, we believe GeoSelva has the potential to subvert or respond to these power structures. The fact that a community, organization, or inhabitant of the region can consult specific environmental information pertaining to the territorial planning figure they belong to or, if necessary, have that information limited to the area from which the consultation is made, is an important step in that direction. However, GeoSelva has several limitations we would like to point out. First, there are those related to accessibility and access to information. Regarding accessibility, using the tool requires language, digital, and internet connection skills, which are weak or nonexistent in many parts of the Amazon. In terms of access to information, we are aware that this is only one element of environmental governance and, therefore, does not constitute a solution to its challenges and problems on its own. Other variables, such as the strength of organizational processes, the level of socio-environmental conflict, or state support, are key determinants in any governance process. In other words, more than the information itself, it is its interaction with other factors that determines the scope of these processes.

Second, it is important to reiterate that GeoSelva does not produce, but rather compiles information from other sources. This information is disaggregated and can be visualized in different territorial planning figures, so that its users do not have to consult multiple distinct viewers. Furthermore, all data, except for deforestation and Amazon boundary delineation, comes from official sources. Consequently, they are not immune to the inherent problems of these sources, including issues such as outdated or unavailable data, or incomplete or nonexistent information. A case that illustrates this limitation well is the Amazonian roads, many of which have been constructed illegally or by peasant communities with the support of guerrilla groups (Uribe, Otero-Bahamón, and Peñaranda, 2021), and therefore do not appear on official maps or road databases

Finally, in line with the call of this issue to reflect on territorial conflicts and challenges in the Pan-Amazonian context, GeoSelva is not exempt from the epistemological limits imposed by the political boundaries of Amazonian nation-states. While in the Pan-Amazon, national borders constitute artificial lines imposed on the same geographical space where various human, economic, ecosystemic, and knowledge flows converge, reflections on the Amazon tend to be circumscribed to the prevalence of the national or subnational over the regional. Geographic information systems, whose entities are delineated by static lines, points, and polygons that render invisible or fail to consider the flows that shape that space, are particularly susceptible to this state-centric bias. In the case of tools like GeoSelva, overcoming this bias perhaps lies not so much in replicating the tool across other national Amazons but in the importance of conceiving information systems that start with these flows rather than the ruptures or lines of exclusion.

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ACRÓNIMOS

ANM: Agencia Nacional de Minería

ANT: Agencia Nacional de Tierras

GFW: Global Forest Watch

IDEAM: Instituto de Hidrología, Meteorología y Estudios Ambientales

MADS: Ministerio de Ambiente y Desarrollo Sostenible

RAISG: Red Amazónica de Información Ambiental Georreferenciada

RUNAP: Registro Único Nacional de Áreas Protegidas

SIAC: Sistema de Información Ambiental para Colombia

SIG: Sistemas de Información Geográfica

SMBYC: Sistema de Monitoreo de Bosques y Carbono