

Article

# Fit-For-Purpose Applications in Colombia: Defining Land Boundary Conflicts between Indigenous Sikuani and Neighbouring Settler Farmers

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**Abstract:** One of the most difficult types of land-related conflict is that between Indigenous peoples and third parties, such as settler farmers or companies looking for new opportunities who are encroaching on Indigenous communal lands. Nearly 30% of Colombia's territory is legally owned by Indigenous peoples. This article focuses on boundary conflicts between Indigenous peoples and neighbouring settler farmers in the Cumaribo municipality in Colombia. Boundary conflicts here raise fierce tensions: discrimination of the others and perceived unlawful occupation of land. At the request of Colombia's rural cadastre (Instituto Geográfico Agustín Codazzi (IGAC)), the Dutch cadastre (Kadaster) applied the fit-for-purpose (FFP) land administration approach in three Indigenous Sikuani reserves in Cumaribo to analyse how participatory mapping can provide a trustworthy basis for conflict resolution. The participatory FFP approach was used to map land conflicts between the reserves and the neighbouring settler farmers and to discuss possible solutions of overlapping claims with all parties involved. Both Indigenous leaders and neighbouring settler farmers measured their perceived claims in the field, after a thorough socialisation process and a social cartography session. In a public inspection, field measurements were shown, with the presence of the cadastral authority IGAC. Showing and discussing the results with all stakeholders helped to clarify the conflicts, to reduce the conflict to specific, relatively small, geographical areas, and to define concrete steps towards solutions.

**Keywords:** fit-for-purpose land administration; indigenous land conflict; Cumaribo; Colombia

## 1. Introduction

### 1.1. Indigenous Land Boundary Conflicts

One of the most difficult types of land-related conflict is that between Indigenous peoples and third parties, such as settler farmers or companies looking for new opportunities who are encroaching on Indigenous communal lands [1]. Although the number of people with communal rights is relatively small, the areas covered by communal land rights are vast and are often under pressure from the rising global demand for natural resources, raising conflict, and debate [2,3]. This causes conflicts and land boundary disputes between the Indigenous peoples, settler farmers, miners, companies, and other spatially expanding actors [4,5].

This article describes boundary conflicts between Colombian Indigenous reserves (resguardos indígenas) and their neighbours in the Cumaribo municipality in the Vichada department and analyses possible solutions using fit-for-purpose land administration

methodology of land conflicts. These *resguardos indígenas*, or Indigenous reserves, are territorial divisions that, by means of a property title, guarantee a certain Indigenous community the ownership of a territory that is communally owned and traditionally inhabited by them. Boundary conflicts here raise fierce tensions: discrimination of the others, perceived unlawful occupation of land on both sides, stealing of cattle, and removing of fences.

Land in Peace is a project cooperation between Kadaster, Twente University, the Dutch Embassy, and Colombia's Universidad Distrital to develop and propose an efficient land administration system for securing land rights in rural Colombia. The project works together with Colombian land institutions, such as the Instituto Geográfico Agustín Codazzi (IGAC), Agencia Nacional de Tierras (ANT), and Superintendencia de Notariado y Registro (SNR). The fit-for-purpose method is applied to jointly measure land with the land users, using a Global Network Satellite Systems (GNSS) antenna and a mobile collector app that was developed, and especially for the purpose improved, by Esri. Kadaster's Land in Peace project analysed the situation in three Indigenous reserves of Cumaribo (2019–2020) in cooperation with IGAC, Colombia's National Geographical Cadastral Institute Agustín Codazzi, who started updating the complete cadastre of Cumaribo. The three Indigenous reserves have different land boundary disputes with their neighbours. The first case describes a situation where Indigenous land overlaps with neighbouring settler farmers' lands. In the second case, Indigenous communities are located outside of the official reserve's boundaries. In the third case, the Indigenous community claims additional land based on local traditional knowledge that has never been recognized by the Colombian government.

The fit-for-purpose (FFP) methodology was applied to map and define the overlapping land claims between the Indigenous peoples and the neighbouring settler farmers (*colonos*). The land boundaries were measured by each party themselves, and the resulting concrete contested areas were afterwards discussed with all of the parties involved. In several cases, both parties held official ownership documents describing the boundaries in text or with unclear maps, leaving room for different interpretations. The official map of the reserve, for instance, was drawn on a small scale, which means that this limit cannot be related to a precise location in the field. The FFP methodology aims to define, in a participatory way, a clear and transparent definition of the boundaries together with the community, whereby potential huge conflicts can be downsized to a specific area, providing a solid basis for conflict resolution.

This article starts with a description of the Indigenous land situation in Colombia and describes, more specifically, the situation in the pilot region, the municipality of Cumaribo. This is followed by a description of the participatory FFP methodology that was used to measure land boundaries. Finally, the results of the measurements of the Indigenous reserve boundaries in Cumaribo are discussed to show different Indigenous land-related issues that were found based on the three cases before mentioned.

### *1.2. Indigenous Land in Colombia*

The proportion of Indigenous peoples within the Colombian population is low. According to the last population census of 2018, there were 1,905,617 Indigenous peoples in the country, which corresponds with 4.4% of its total inhabitants [6]. This percentage grew by almost 37% since the previous census of 2005, when it was 3.4%, a difference that could be explained by a growing self-consciousness playing a role, since the census question was formulated as asking to which ethnic groups one considers him or herself to belong to. The census established that there are 64 Indigenous ethnic groups in the country with great differences in demographic size. For example, the Wayuu number is 380,000 and the Sikuani is 52,000, while the Bari number is 208 and the Yukuna is 396 [7].

In rural areas, there are 710 Indigenous reserves with legal land titles, which occupy an area of approximately 34 million hectares, which is 29.8% of the national territory [6]. This great discrepancy between the demographic Indigenous peoples' proportion and the proportion of Indigenous land property is explained by the fact that huge parts of these

reserves are forest or savanna areas. It is also somehow mitigated by the fact that the inhabitants of the Indigenous reserves also include non-Indigenous people, some by invasion, and others by consent of the legal owners. The limited number of people who declare themselves Indigenous in the census may be another explanation for this discrepancy.

The 1991 Colombian Constitution gave Indigenous peoples the right (the Constitution speaks of Indigenous peoples) to define who can live in their reservations: “The Indigenous territories will be governed by councils formed and regulated according to the uses and customs of their communities” [8]. However, in many cases, the Indigenous peoples do not have the territorial control that legally corresponds to them. For example, in the Indigenous reserve assigned to the Nukak Makú in Guaviare of one million hectares, the Indigenous peoples do not have access. The guerrillas and coca producers in that reserve do not let them enter their own land property.

The institution of Indigenous reserves, a legacy from colonial times, reflects, for the Indigenous, the painful process of the slow occupation of their territories by invading immigrants and marks the historical result of this occupation. However, while the nineteenth century saw a slow degradation of Indigenous communal land property, later constitutional reforms re-established the idea of legal recognition of communal Indigenous lands [8].

Today, there are still occupations, sometimes peaceful, sometimes conflictive, by settlers in search of land in Indigenous reserves. Many Indigenous groups are trying to increase the lands of their reserves, arguing that they should also have control and ownership over the lands surrounding the Indigenous reserves that they consider ancestral lands. From the Indigenous perspective, their position on these vacant, state-owned lands (tierras baldías) is understandable: for them, this category does not exist, since they are the original inhabitants. This problem—the distribution, control, and allocation of territorial property—remains at the heart of the country’s history and was one of the principal issues of the recent Peace Accords with the guerrillas [9].

### *1.3. Cumaribo: Overlap of Indigenous Lands with Neighbouring Settler Lands*

The immense forests and savannah lands of Cumaribo are subdivided into one half with 34 Indigenous reserves, while the other half is vacant territory that is property of the Colombian State, with only a few formal assignments of land to private settlers. Cumaribo is situated on the borderline between two large Colombian ecosystems: its northern part belongs to the Orinoco Savannah plains (los llanos) and its southern half is part of the Amazon rainforest basin. With its area of 6.6 million hectares, Cumaribo is the biggest municipality of the country.

Until the middle of the twentieth century, the savannahs of Vichada were mainly populated by semi-nomad Sikuani Indigenous tribes and other minor ethnicities, such as the Piapoco, Cuiba, Saliva, and other Indian tribes. From the 1950s and 1960s onwards, a slow immigration by people from other departments started and Colombia’s Land Reform Institute INCORA (Colombian Institute of Agrarian Reform), in charge of titling state land, granted formal ownership of big parcels of land to these settler farmers. This initiated an increasingly problematic process of land claims between the original Indigenous peoples and the colonists.

According to the anthropologists Metzger and Morey, among the Sikuani there was no notion of private property or communal land tenancy or collective possession [10]. A Sikuani leader expressed that the Sikuani consider land as a collective heritage and not as a tradable good susceptible to being private property. An Indigenous leader of the reserve, Santa Teresita del Tuparro, explained to the IGAC–Kadaster mission the Indigenous position on the so-called vacant lands (not privately owned and thus, consequently, state-owned land) as follows: “State land does not exist” and “that the state land is owned by nobody is not true,” meaning that the land was always theirs, and that they were there before anybody else.

During the last half of the twentieth century, many traumatic changes occurred in the Sikuani society. Apart from the settlers who started huge cattle farms and introduced

more and more barbed wire fences, towards the end of the century, wide-scale coca leaf production was introduced, and the south of the municipality became an important route for the trafficking of cocaine to neighbouring Brazil and Venezuela. Both guerrilla and paramilitaries made their entrance after the drug mafias, with whom the guerrillas became more and more mixed up [11].

Additionally, the tropical plains soils, until recently regarded as practically useless apart from extensive cattle ranching, came in the purview of national and international agricultural investors. The savannah region of Colombia has recently and increasingly been compared to the Cerrado region of Brazil, where, under the same soil and climate conditions, an impressive agricultural production came into being and which catapulted Brazil into one of the principal food exportation nations of the globe [12]. The Colombian savannah region has been named the last agricultural frontier of Colombia, while the country has been included, by the Food and Agriculture Organization of the United Nations (FAO), among the world's five global potential food producers. During the last decade, maize, soya, and oil palm plantations have been established in Cumaribo. Moreover, Colombian development economists argue for the need to construct a road connecting Bogotá with the Orinoco river a thousand kilometres further afield. Nevertheless, the current situation in Vichada and Cumaribo is still one of economic stagnation and poverty, with a lack of basic services and infrastructure. On the contrary, an agricultural boom in the near future, such as in Brazil, is a real possibility and an opportunity for an increasing number of agricultural investors in the area [13].

#### *1.4. Fit-for-Purpose Participatory Land Administration*

Different studies have addressed participatory mapping with Indigenous peoples [14–18]. These studies indicate that to understand the situation and tradition of the Indigenous peoples, their communal knowledge should be used to map land boundaries and important places by mapping together with the Indigenous peoples. They must be present in the process to extract and map local knowledge. Álvarez and McCall [14], for example, stated that this approach helps local Indigenous groups to be incorporated as active subjects in the registration of their cultural heritage, as well in the defence and management of it.

Additionally, Sletto [19] mentioned how the development of participatory mapping increases the possibilities for Indigenous peoples to use cartography to better represent their conceptions of space and place. Nowadays, Indigenous land rights are included more, after years where state maps often did not include Indigenous toponyms, where Indigenous lands were labelled as “empty”, and where contiguous Indigenous land use zones had been fractured in isolated reserves or donated to other land users, such as settler farmers, as described by Bryan [20]. From Bracerás' [21] study, where different participatory mapping methods to capture land perceptions of Indigenous peoples were compared, it can be concluded that a social cartography session is a useful tool for conflict resolution and for increasing Indigenous empowerment. However, this will only be reached with involvement of all stakeholders, such as neighbours and the State. The State's reality in official registries often differs from the Indigenous people's reality, and makes decisions based on their information; therefore, involvement of the State is essential to establish and guarantee Indigenous land rights. Other researchers [22] stress that the government has to protect Indigenous land rights to prevent market forces, such as settler farmers and companies, from grabbing more Indigenous lands and thereby undermining communal land rights.

An approach with this participative, community-based focus is the FFP land administration approach. It is used to reach agreements between neighbours on their mutual boundaries and easements [23–25]. Following Enemark et al.'s guidelines [25], FFP focuses on flexible, efficient, affordable, and transparent land recording methods, including all types of land occupation, to be able to improve land tenure security. This FFP methodology contributes to some of the Sustainable Development Goals' (SDGs) objectives, as Enemark highlighted. According to Enemark [25], land administration systems should

be designed for the needs of the people when identifying the occupation and use of land, whether these land rights are legal or locally legitimate. To meet the actual needs in society today, the systems need to be flexible in terms of the legal regulations, as well as the institutional arrangements. Enemark [25] stated that good land administration is essential to be able to reach the accorded Sustainable Development Goals, because it provides a country with an infrastructure for implementing land management strategies in support of sustainable development.

The FFP approach was also applied in the Cumaribo project. Since conventional Colombian land data collection methods are expensive and time-consuming, an efficient and user-friendly data collection scheme was developed for the current Colombian situation, using advanced but easy-to-use technological tools [26,27]. Parcels are always measured together with the land users and community members, who are trained to carry out the work with professional supervision. After the data collection, a public inspection is held to show the results to the community and to collect signatures of approval on the measured limits.

The literature on the FFP concept for Indigenous boundary disputes is scarce and does not go far beyond the remark that Indigenous or customary land rights should be included in the land administration [24]. An FFP approach might be beneficial to safeguard the rights of customary groups, since data are collected of all claims in a certain area, with the stakeholders participating. This can be used as a basis for conflict resolution. Contrary to more traditional approaches, the collaborative FFP methodology is very much in line with the intent of the UN's Free, Prior and Informed Consent guidelines (FPIC) [28]. The FPIC guidelines provide a framework that ensures that the rights of Indigenous peoples are guaranteed in any decision that may affect their territories. The framework comprises four components: (a) free, without coercion or bribery; (b) prior consultation with the community-found place before starting; (c) informed information to the community is provided in an understandable way; and (d) consent—the community has the right to give or withhold their consent to any decision [28]. The FFP approach operationalises these guidelines, because the Indigenous peoples themselves are the prime actors in the process, including their responsibility for the field data collection, and the community is always informed of the whole process before starting. Moreover, the FAO's Voluntary Guidelines on the Responsible Governance of Tenure (VGGT) emphasize the importance of Indigenous land tenure [29]. Section 9, and more specifically 9.4, of the VGGT focuses on the customary land rights of Indigenous peoples and points out the responsibility of the State to protect the land used by the Indigenous peoples.

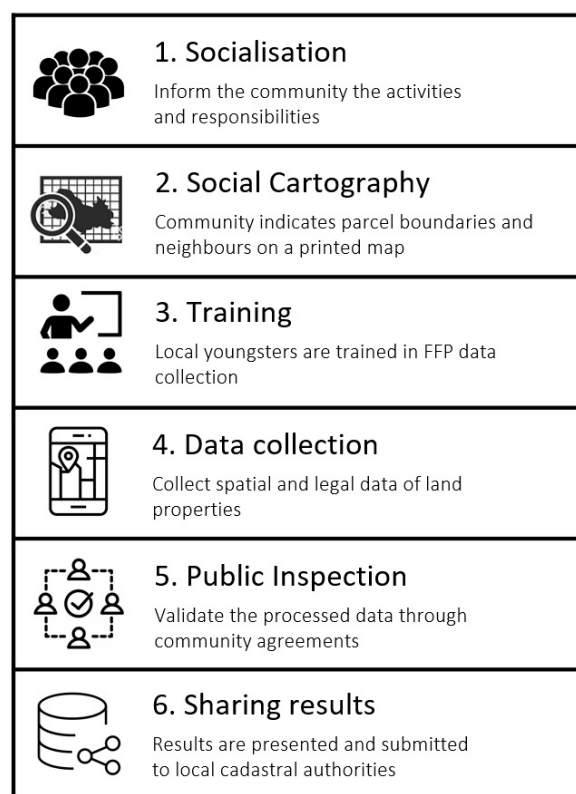
The work in Cumaribo is based on experiences of FFP applications in rural areas in Colombia and elsewhere [27,30–33]. These have been adapted to map traditional land of Indigenous reserves. The next section (Section 2) describes the steps of the FFP approach applied in the Colombian project with Indigenous peoples.

## 2. Materials and Methods

Being a participative land administration approach, the community is always involved in each step of the FFP application in Colombia, as can be seen in Figure 1. The point of departure in the application of FFP in Colombia is a socialisation process with all the stakeholders present, followed by a social cartography session. Here, the land users first indicate their parcel boundaries on a large, printed map on which the official parcel information on top of a satellite image is visible.

Most parcel boundaries are defined by natural boundaries, such as rivers or streams, but depending on the available imagery of the specific region, these boundaries cannot always be identified in the satellite image. In case there is not much vegetation in the area and high-resolution imagery is available, land boundaries can be identified more precisely during the social cartography session.





**Figure 1.** The fit-for-purpose (FFP) methodology steps as applied in the Colombian Land in Peace Project. Elaborated by the authors. Source: Land in Peace Project, Kadaster.

When more precise boundary definitions are necessary, the community is invited to measure the boundaries in the field. During the field measurements, the vertices of the parcel boundaries are indicated by the land user and the coordinates of each vertex are recorded with a Global Network Satellite Systems (GNSS) antenna. These points are recorded with the mobile application Esri Collector on a standard smartphone (Android or iOS). This application is connected by Bluetooth to the GNSS antenna to capture the coordinates (latitude and longitude), as well as the horizontal and vertical accuracy and the number of found satellites, among other things. The antenna is always handled by the land user themselves—in this case, the Indigenous leader or settler farmer—with the objective that they can measure the boundaries of their property according to their local knowledge and perceptions. The Indigenous leader decides what information is collected and communicates this with his community. This generates confidence in the processes since the perception of the Indigenous peoples is deciding. The Esri Collector app is operated by a grassroots surveyor, a local youngster who has received a short FFP data collection training session. The grassroots surveyor is supervised by a professional surveyor for quality control, technical assistance, and coordination.

Both spatial and legal information are gathered in one run per land user in the Esri Collector app, which assures integrated data collection. The measurements of the parcel are visualised in the app as polygons, which makes it possible to directly show the shape and size of the property to the land user. The legal collected data are names, ID number, and date of birth of the right holder(s) with a photograph of the person(s) and their ID card(s); a picture of the parcel; a description of the right holder(s) relationship with the parcel; and photographs of the documents that provide proof of some kind of land right or long-term land use. After data collection, all data are uploaded to a PostgreSQL database. To protect Indigenous Data Sovereignty, the CARE principles (Collective benefit, Authority to control, Responsibility and Ethics) are taken into account [34]. The Indigenous peoples decide what is captured in the field. This includes the boundaries of their reserve, based on

local and historical knowledge, but also traditional and sacred places for the Indigenous peoples. Collected data are afterwards checked with the Indigenous leaders, maps of all measured places are shown, and they have the opportunity to modify and add information that is important to their community. Colombian governmental institutions can only use data that are officially approved by the Indigenous peoples.

The technology that is used in the FFP application in Colombia was developed to meet the purpose, to develop a participative approach of capturing relationships between land and its users, for the Colombian situation. The hybrid technological basis between adjusted proprietary (Esri) and open source (PostgreSQL) software has been found to be most effective [35] and has made it possible to create different applications around it for data collection, processing, and validation, and for their integration into the data systems of State agencies. The developed applications for the FFP approach in Colombia are visually oriented. The applications show maps of the parcel boundaries and include the names and pictures of the neighbouring settler farms, pictures that were taken in the field and a satellite image that shows the natural elements that can be recognized by the Indigenous peoples, such as rivers and vegetational corridors. This makes it easier to communicate field results with the Indigenous peoples.

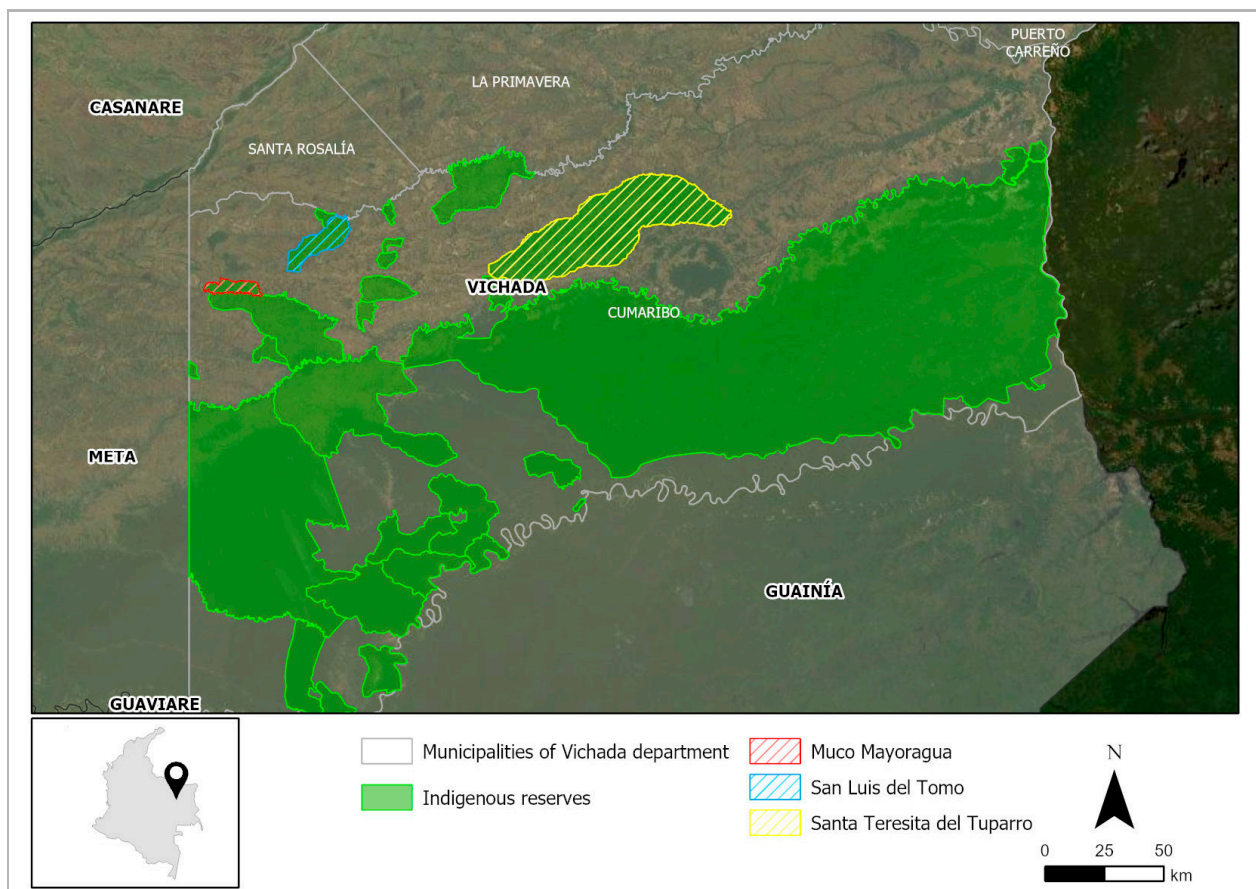
Using these innovative technologies and adjusting the mobile application to this purpose has led to several advantages, which can be summarized as follows: (i) it makes it possible to capture physical and legal administrative data in an integrated way; (ii) it is user-friendly; (iii) it is robust enough to guarantee the capture of the spatial, semantic, and topological relationships of the data without the need for direct intervention of the data collector; (iv) it can work in a disconnected way in areas without internet; (v) it makes it possible to centralize information from a database in the cloud, without intermediate files; and (vi) the collected data comply with the profile of the Land Administration Domain Model (LADM) standards for Colombia.

The used GNSS antenna, Trimble R2, is equipped with a FieldPoint real-time extended (RXT) correction service. It communicates with an operations centre through a satellite link or through the internet and provides the antenna the real-time position with a submeter accuracy [35]. The accuracy of the vertices that are measured in the field meet the official standards in Colombia, which have been adjusted recently to comply with the realities in the field. No geodetic network needs to be established before starting the field measurement, which facilitates the work in remote, Colombian rural areas. Moreover, the fact that the antenna is easily operable by land users themselves enhances the participative process. This increases trust of the community in the collected field data.

After data collection, the results of the field surveys per community are shown and publicly discussed in a so-called public inspection: all land users can judge the results concerning their own parcels and other parcels. Conflicts or disputes can be settled during the public inspection, where Colombian cadastral authorities are also present. The status of the moment is captured, both agreements and disagreements. This information is then handed over to the local Colombian land institutions, who are responsible for resolving the land conflicts.

### 3. Results

Three Indigenous reserves in Cumaribo were visited in cooperation with IGAC: Santa Teresita del Tuparro, Muco Mayoragua, and San Luis del Tomo (see Figure 2). There was an unclear boundary situation in each reserve that was analysed, whereafter the FFP approach was applied to clarify the boundary situation and to find a possible solution. The following paragraphs describe the situation and applied methodology in each reserve.



**Figure 2.** The three Indigenous reserves that were visited in Cumaribo: Muco Mayoragua, San Luis del Tomo, and Santa Teresita del Tuparro in the municipality of Cumaribo, 2020. Source: Land in Peace Project, Kadaster.

### 3.1. Santa Teresita del Tuparro

The Indigenous Santa Teresita del Tuparro reserve consists of approximately 200,000 ha with 86 small communities. Most of the reserve's borders are defined by rivers and creeks; on the remaining part, a land stretch of approximately 20 km, conflicts with settler farmers have arisen. Although this only represents 9% of the total border of the Indigenous reserve, this stretch of unclear boundaries fuels serious land conflicts.

Santa Teresita was established as an Indigenous reserve in 1978, and in 1983, it was given legality. The official documents of the Indigenous reserve state that the road, south of the reserve, represents the boundary. However, in the savanna reality of Cumaribo, a road is a moving boundary, without exact limits (Figure 3). This leaves room for different interpretations. It is impossible to know the location of the road in the year 1978 to which the land title refers.

Additionally, there are inaccuracies in the existing official State information that lead to confusion between the land users: the Santa Teresita del Tuparro reserve of 1978, for instance, had an official size of 180,000 ha, while the later document of 1983 reveals 220,000 ha for the same reserve.

The case of Santa Teresita del Tuparro illustrates the further encroachment of settler farmers into the reserve, which is a result of unclear boundaries and the need for the government to align and update the existing official government data (see Video S1).





**Figure 3.** Network of roads that form the southwest limit of the Indigenous Santa Teresita del Tuparro reserve, Cumaribo, 2020. There is not one road that can be indicated as the main road. Source: Land in Peace Project, Kadaster.

The FFP approach was used to clarify the land situation by defining the boundaries according to the perception of each party in the field itself. First, a socialisation with the Indigenous peoples was organized, with the presence of the traditional leaders (caciques) and authorities of Indigenous communities close to the borders with the settler farms. The next day, a similar meeting was organized with the settler farmers. During these socialisation sessions, the Indigenous leaders expressed that the settler farmers are invading their territory around the southern border of the reserve. The settler farmers claimed that they have rights to this land too: four have official property titles and others have been settled there for many years. To clarify the situation, the FFP approach was proposed and explained to both the Indigenous peoples in the local Sikuani language and to the settler farmers. They agreed to measure the limits of the reserve and farms, based on their perceptions, in the field. The Indigenous peoples also gave permission to the neighbouring settler farmers to enter the reserve to be able to measure the farms. Subsequently, several measurement crews went out to measure the limit of the Indigenous reserve and to measure the limits of the eight neighbouring parcels.

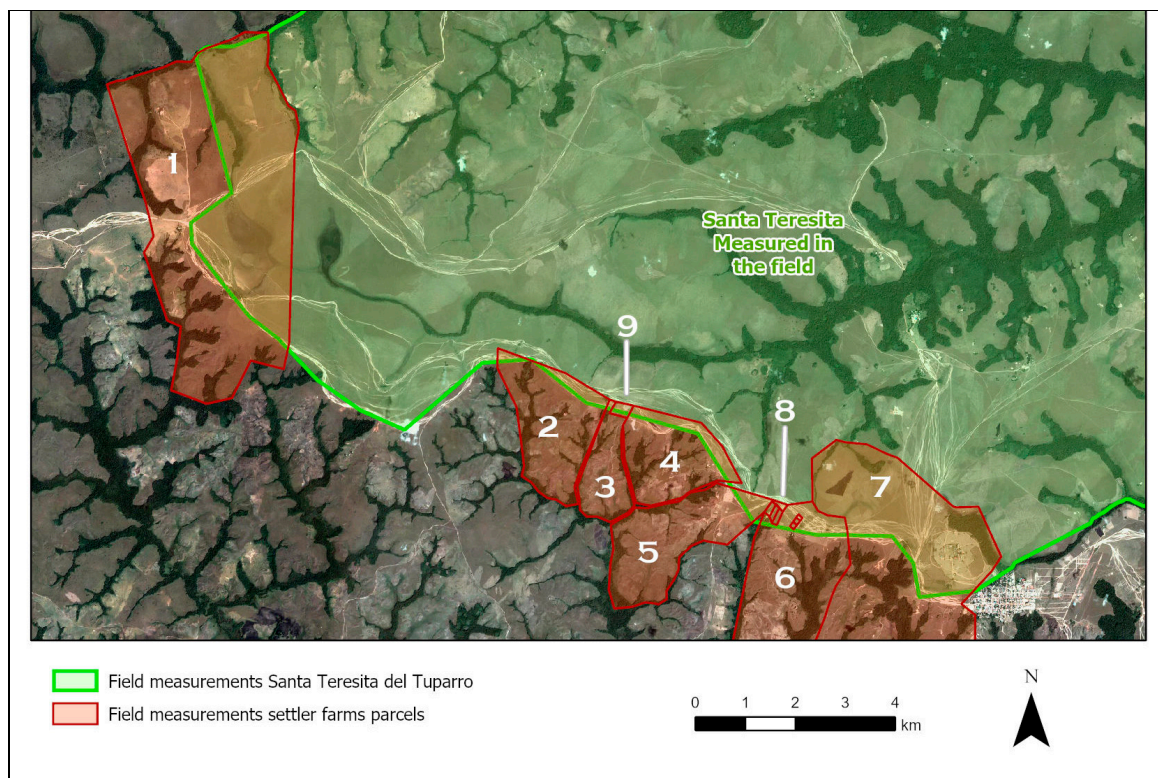
Traditional leader Horacio Bonilla, who was present at the establishment of the reserve in 1963, led the Indigenous representatives along the borders and indicated each point with its local Sikuani name. With the captured coordinates, the perceived boundary according to the Indigenous peoples was constructed. The fieldwork was also an opportunity for Indigenous youngsters to learn about the history of their land and about the FFP data collection, which was carried out with Trimble R2 antenna and the Esri Collector app (see Figure 4). Likewise, the neighbouring settler farmers measured the limits of their parcels using the antenna and Esri Collector app. Due to the complexity of the terrain, these measurements were made by car or, in some cases, by motorcycle.

The field data collected by the Indigenous representatives of Santa Teresita del Tuparro and the neighbouring settler farmers themselves clearly show the overlapping areas (see Figure 5). There are large parts of land of the Indigenous reserve that are claimed as well by the neighbouring settler farmers. For example, the owners of an informal parcel sold out small plots of their land to others, despite the fact that these lots are partly located on the land that is also claimed by the Indigenous peoples and, above all, are located on top of

a moving road (see Figure 6). In total, 1621 ha of the neighbouring parcels overlap with the Indigenous reserve.

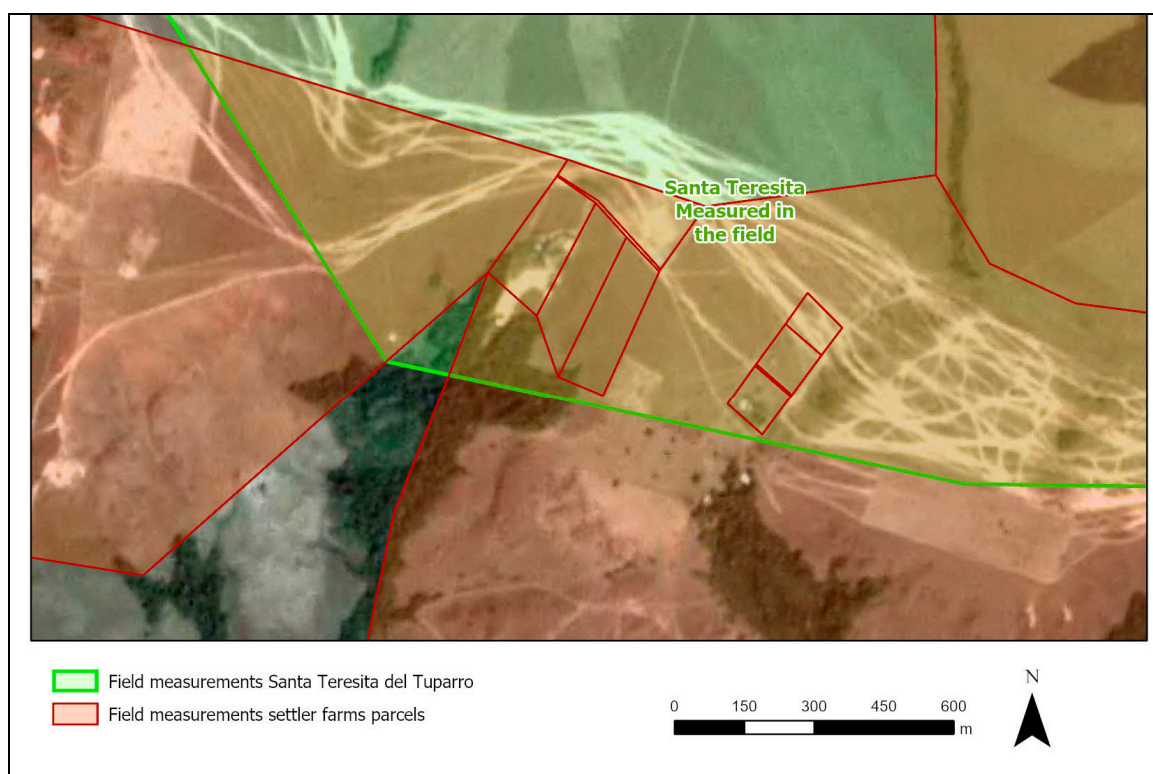


**Figure 4.** Measuring the boundary of the Santa Teresita del Tuparro reserve with Indigenous leader Horacio Bonilla using a Global Network Satellite Systems (GNSS) antenna. Cumaribo, 2019. Source: Land in Peace Project, Kadaster.



**Figure 5.** The Indigenous Santa Teresita del Tuparro reserve, as measured in the field by the Indigenous leaders compared to the parcels of the neighbouring settler farmers, as measured in the field: 1, La Guajira; 2, Buenavista; 3, Cuatro Vientos; 4, La Estancia; 5, Los Moriches; 6, Patio Bonito; 7, military base; 8, sold lots; 9, El Basurero (the municipal garbage belt). Cumaribo, 2020. Source: Land in Peace Project, Kadaster.





**Figure 6.** Sold lots on the land that overlaps with the Indigenous Santa Teresita del Tuparro reserve. The lots overlap with the network of roads that is officially the limit of the reserve. Cumaribo, 2019. Source: Land in Peace Project, Kadaster.

Table 1 shows the areas of each parcel according to the cadastral institutions in Colombia compared to the areas that resulted from the field measurements of 2019. It also shows the area of the overlaps between the corresponding parcel and the Indigenous reserve. What can be seen is a significant difference in the areas known by the different governmental land institutions, such as IGAC and, for example, INCORA, the former National Land Agency. Furthermore, there are many differences between the areas in the official State registries and the areas indicated by the land users themselves in the field. For example, according to the documents of the parcel La Guajira, the parcel measures 1324 ha. However, the FFP field measurements show that the parcel has an area of 1900 ha.

**Table 1.** The size of the measured parcels in hectares and the number of hectares overlapping with the Indigenous Santa Teresita del Tuparro reserve.

	La Guajira Farm		Military Base		Municipal Garbage Dump		Patio Bonito Farm		Los Moriches Farm	
Source	Year	# Hectares	Year	# Hectares	Year	# Hectares	Year	# Hectares	Year	# Hectares
IGAC	2012	200 (182 + 18)	2012	1214	2012	0	-	-	-	-
INCORA	1998	1324	1964	1596	2007	10	1988	1300 <sup>1</sup>	2012	311 <sup>1</sup>
Parcel measured by owner	2019	1900	2019	1392	2019	9.6	2019	1955	2019	412
Overlap title parcel with title Indigenous reserve	1998	1008	1964	430	2007	0	-	-	-	-
Overlap parcel measured by owner with title reserve	2019	850	2019	614	2019	6.5	2019	66	2019	23

<sup>1</sup> The deed is not registered; the area is extracted from informal transaction documents. IGAC, Instituto Geográfico Agustín Codazzi. INCORA, Instituto Colombiano de Reforma Agraria.

At the following public inspection, three mapping realities were shown: the borders as defined by the government, the borders as defined by the Indigenous peoples, and those as defined by the settler farmers. Seeing the overlaps, discussions between the Indigenous peoples and settler farmers started in a harmonious way, based on the different mapping realities.

Showing maps of the measured limits made the dispute focus on the real area of conflict. Overlaps with informal neighbouring farms could be solved by the government when these farmers enter the formalisation process. The government can, by law, not adjudicate land to farmers that overlap with the reserve. For the formal landowners, the problem is more complicated. It became clear that the land dispute is part of a bigger problem: the inconsistent data of different governmental institutions at different times. The people of the Indigenous reserve have valid claims, as do the formal owners, as both parties have official documents in which the land claims overlap. The state—in this case, INCORA—gave out the same piece of land to the Indigenous peoples, to the military base, and to the settler farmers.

It can be concluded that there is an urgency to align official governmental data regarding the same parcel collected by different governmental agencies at different points in time. Therefore, it is necessary for the government to update the existing official State data, not only regarding the location of this moving road, but also for solving the discrepancy between the official documents for the same Indigenous reserve.

### 3.2. *Muco Mayoragua*

Muco Mayoragua is an Indigenous reserve in West Cumaribo of approximately 10,000 ha, located between the Muco river and the Mayoragua stream. The reserve has officially been recognized as an Indigenous reserve since 1997 by INCORA.

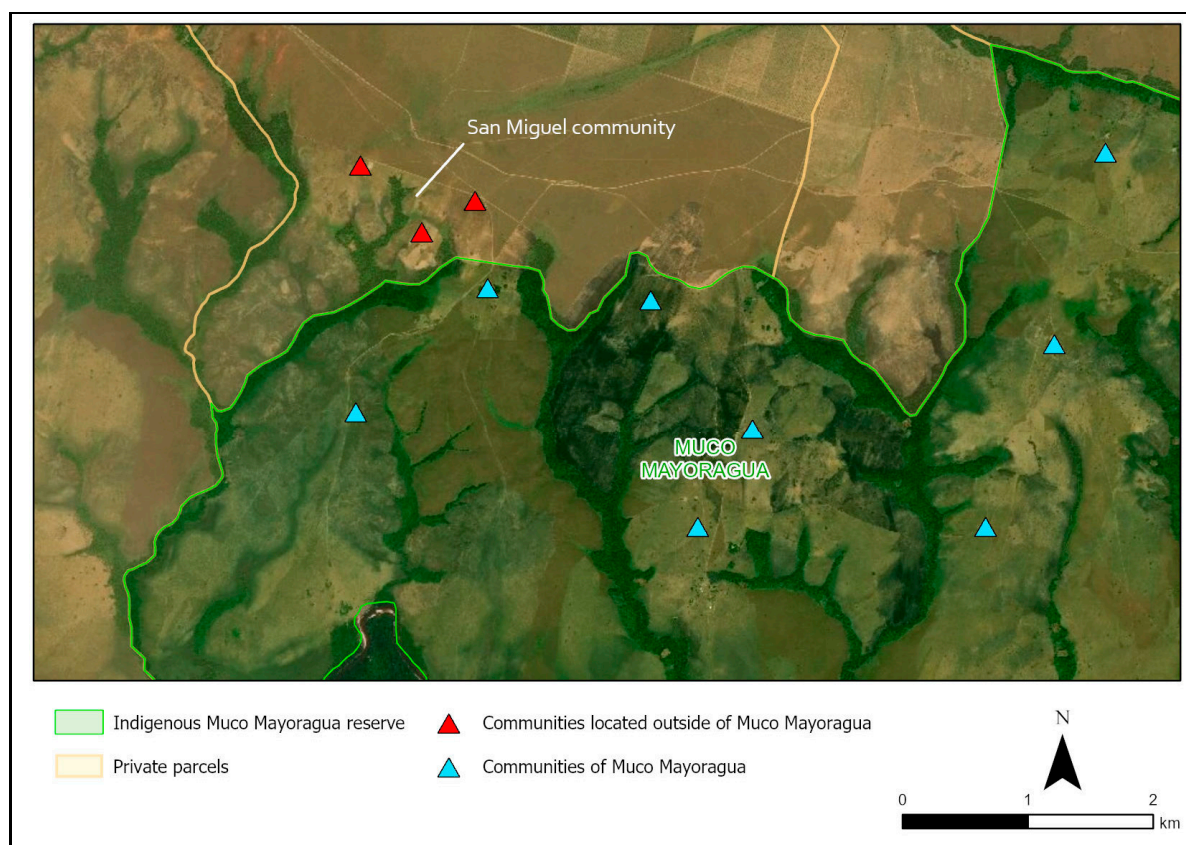
As part of the cadastral updating of the Indigenous reserve with IGAC, a socialisation meeting was planned in the community of San Miguel within the Indigenous reserve. Upon arrival at the location of the community, it turned out that the community is located outside of the official boundaries of the Muco Mayoragua reserve (Figure 7).

In the socialisation with the Indigenous leaders of Muco Mayoragua, they expressed that all communities are within the limits of the reserve, including San Miguel, and that the official limits of the State do not represent the reality. After the social cartography session, an agreement was reached to measure the boundary of the reserve in order to establish the actual limit according to the Indigenous peoples. The three communities that seemed to be located outside the reserve are located on what appears to be a private parcel of a neighbouring settler farmer, on the northwest of the Indigenous reserve. For that reason, the caretaker of the farm, called El Palmarito, was invited to the social cartography session. The caretaker expressed agreement with the Indigenous peoples and indicated that the State map of the reserve is outdated.

According to the FFP methodology, two field surveys of the north western limit were realised, one with the Indigenous leaders and one with the person in charge of the El Palmarito farm. The two measurements were carried out with the Trimble R2 antenna, whereafter legal documents of the reserve and the neighbouring parcel were collected.

While carrying out the field measurements, it was observed that the limit is a fence of concrete poles placed by the neighbour of the El Palmarito farm. Both the Indigenous leaders, as did the farmer, indicated the fence as the real limit of the Muco Mayoragua reserve (see Figure 8).





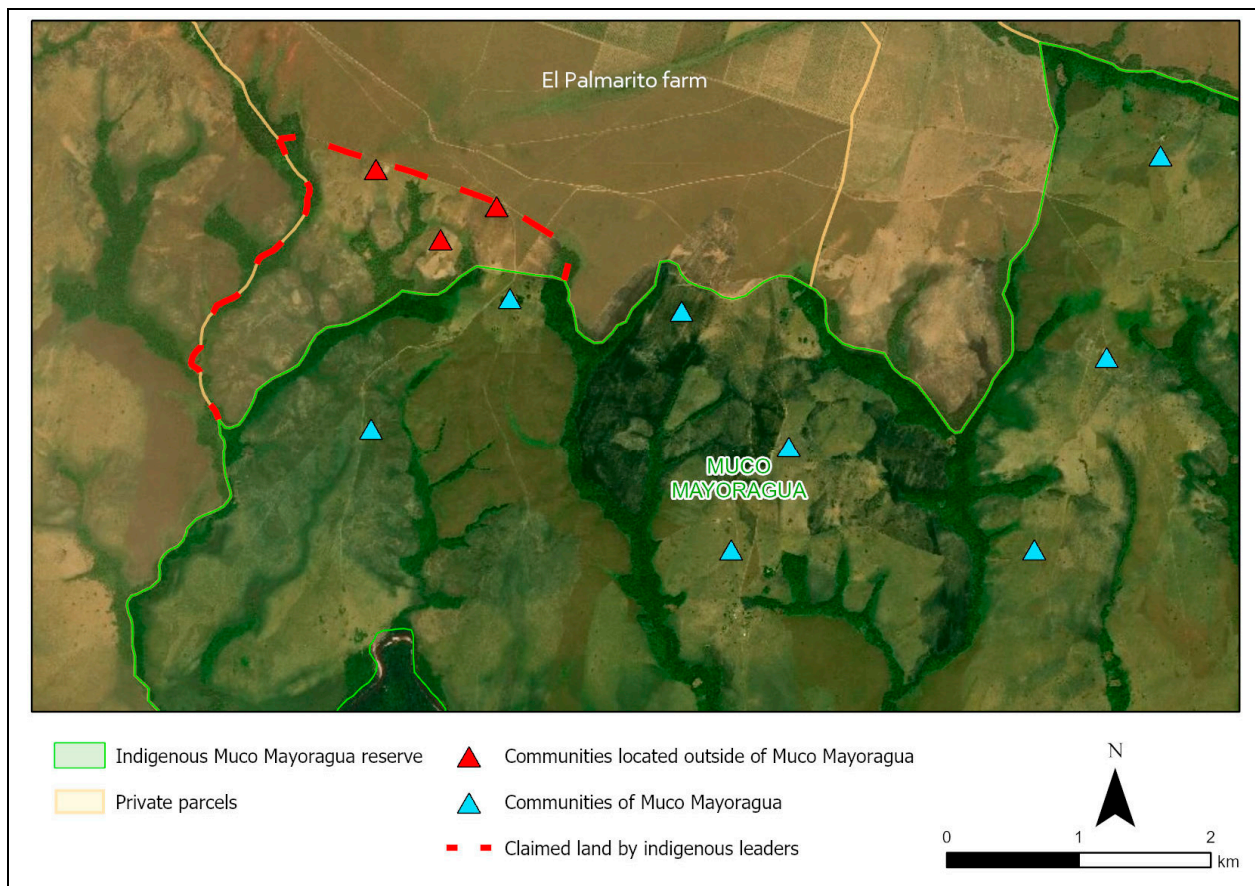
**Figure 7.** The Indigenous Muco Mayoragua reserve. Three communities (in red) are located outside of the official limits of the reserve but claim to be part of the reserve. Cumaribo, 2020. Source: Land in Peace Project, Kadaster.



**Figure 8.** Measuring the boundary of the Muco Mayoragua reserve with one of the Indigenous leaders. Cumaribo, 2020. Source: Land in Peace Project, Kadaster.



The results (see Figure 9) were shown at the public inspection, where both sides agreed that the three communities are indeed located within the reserve. They expressed that the measured area in the field, an area of 245 ha, belongs to the Indigenous reserve. Only in the outdated official State data are the three communities located outside the reserve. In reality, both parties agree on the boundaries, but the State data do not reflect these realities in the field. Including the three communities in the reserve, as they should be, means adjusting the official map of the reserve, as well as adjusting the official map of the private land of the neighbouring farmer.



**Figure 9.** The area that is claimed by the Indigenous Muco Mayoragua reserve (red dotted line). They claim 245 ha of land that is private land (El Palmarito private farm), according to the government. There are three committees of the reserve that are located in these 245 ha. Cumaribo, 2020. Source: Land in Peace Project, Kadaster.

### 3.3. San Luis del Tomo

San Luis del Tomo is an Indigenous reserve in Cumaribo of approximately 25,000 ha, with its limits being the Tomo river, Samarro river, and Urimica stream, which received legal status by INCORA in 1983. The official deed states that the reserve has natural boundaries on all sides, except for a southern boundary with a length of 5 km, whose limit meets three farms.

A socialisation with the Indigenous leaders of the Indigenous reserve was held in the Llano Lindo community within the reserve. When observing the official map of the reserve, the leaders expressed that the map of 1983 is not correct because INCORA defined the boundary following a tributary of the Samarro river and not the main river, as mentioned in the title deed of the reserve.

The social cartography with the community served to understand the situation. Indigenous leaders, through their ancestral knowledge, drew the main course of the Samarro river (see Figure 10). Additionally, using a satellite image of the area, governmental data of

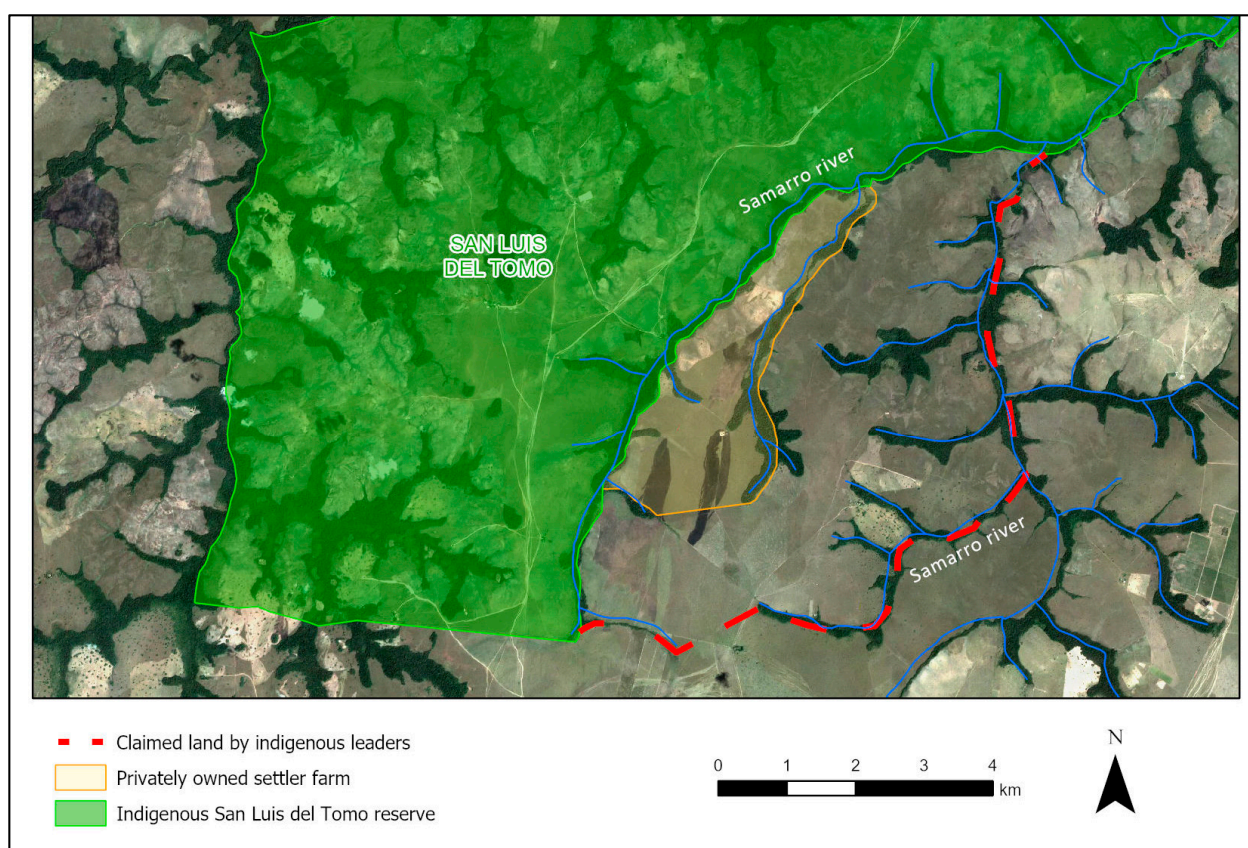
waterbodies, and the indications of the Indigenous leaders, a map was created together with the Indigenous peoples. Figure 11 shows the official limits of the reserve and the limits according to the Indigenous peoples of San Luis. The boundary, as indicated by them, differs from the official limit due to the fact that the community claims that the main cause of the river is not the stream that is currently indicated as the boundary, but is instead located east of the current boundary. The additional area that is claimed with this is approximately 3000 ha. Based on the approximate size of the reserve, the Indigenous peoples claim a 12% expansion of their reserve. Comparing the area with the governmental cadastral data of IGAC shows that there is already one privately owned farm and four other farms without an official property title located on this piece of land.

Based on the produced maps and the resulting discussion, the Indigenous peoples of San Luis del Tomo requested a correction of the title that was granted in 1983 by INCORA, to incorporate the missing 3000 ha into their Indigenous reserve.



**Figure 10.** Drawing of the boundary perception (river) by Indigenous peoples. Cumaribo, 2020. Source: Land in Peace Project, Kadaster.





**Figure 11.** The Indigenous San Luis del Tomo reserve. The red line indicates the limit of the reserve according to the Indigenous peoples. Approximately 3000 ha are claimed by the Indigenous peoples. There is already one private parcel in the claimed area. Cumaribo, 2020. Source: Land in Peace Project, Kadaster.

#### 4. Discussion and Conclusions

The three cases that were analysed with the FFP approach show that conflicts concerning Indigenous land boundaries are created due to inconsistencies between the reality and governmental data.

The limits of Indigenous reserves that are known by the State are often outdated and do not match the reality in the field. The resolutions that provide the reserves their legal status contain unclear maps and vague descriptions of boundaries. These resolutions were handed out in the 1970s, when there were not many technologies available for precise field measurements. This resulted in uncertainty about the real limit, which has created overlapping claims between Indigenous peoples and their settler neighbours.

The Santa Teresita del Tuparro case offers an example of how inconsistencies between State data and reality causes conflicts between neighbours. The State gave out land properties to the Indigenous peoples and to the settler farmers on the same land. The vague description of the moving road and the imprecise definition of the boundaries in these titles make it impossible to define the actual limit.

Other cases, such as the situation in Muco Mayoragua, show that not only precision of the boundary plays a role, but that State data do not represent the real extent of the Indigenous reserve. Indigenous peoples are claiming large parts of land to be part of their reserve. The State has never analysed these claims; therefore, communities are located outside of the official limits of the reserve. From the experience in San Luis del Tomo, where the Indigenous peoples state that the limit is another course of the river, it can also be concluded that the State did not include perceptions of the Indigenous peoples when formalising the reserve.



These inconsistencies cause potentially fierce conflicts between Indigenous peoples and neighbouring settler farmers. The Colombian government is the authority that solves these boundary conflicts. Informal parcels of farmers simply cannot overlap with an Indigenous reserve in future formalisation processes, and databases need to reflect the reality. Therefore, the presence of the Colombian state in the process is important for solving discrepancies between boundaries because the State is the only party that can guarantee an official solution or clarification of the situation.

Based on the work in the border regions between the Indigenous reserves and their neighbouring settler farms, it can be concluded that the FFP approach works well in such difficult and deeply-felt situations of land conflicts. The FFP approach, with the cooperation of the Indigenous peoples and social cartography, can be used to map the physical reality and to understand the existing boundary conflicts, overlaps, and errors that were made at the time of awarding the reserves by the government. Additionally, the involvement of the neighbours at the socialisation of the results at the public inspection, and with this establishing local agreements, is crucial for conflict resolution. What can be concluded is that the participatory approach leads to trust in the collected field data.

Several researchers, such as Bracerias [21] and Alvarez and McCall [14], stated that the community has to be involved in the mapping of Indigenous land rights and that participatory mapping is a useful tool for conflict resolution and for increasing Indigenous empowerment at a local scale. Capturing local knowledge is important; however, this is not always sufficient for guaranteeing tenure security for the community for the long term or on a sustainable basis. Bracerias [21] stated that it is important to notice that the State is an important stakeholder, a conclusion that can also be drawn from the experiences in Cumaribo. Looking at real land boundary conflicts in the described cases, many conflicts are caused by inconsistencies in official State data. For that reason, these State data need to be updated to conform to the reality. Participatory mapping studies focus mainly on capturing Indigenous traditional knowledge, while the applied FFP approach provides an example of how information is collected after being shared and discussed with all stakeholders, including the Indigenous peoples, the neighbours, and the State, to solve the conflict on different levels.

FFP distinguishes itself from other, often static, participatory mapping applications by being flexible and adaptable to the circumstances. Flexibility and efficiency are important aspects of Enemark et al.'s FFP guidelines [25]. The FFP approach needs to be adapted to the local situation and to the community. The work in Cumaribo showed the need of adapting the data collection approach to the geographic circumstances in the Indigenous reserves. In San Luis del Tomo, for example, the field measurements were replaced with the use of satellite images, due to the fact that a river, the limit according to the Indigenous peoples, is more easily identifiable on images than by field measurements. By organising a social cartography session and inviting the Indigenous peoples to indicate the actual limit along the Samarro river, the time and costs of fieldwork were spared. In the Santa Teresita del Tuparro case, the boundary was not visible on the map and, thus, participatory field measurements with GPS were necessary.

The applied FFP approach also meets the standards of the UN's FPIC guidelines [28]. The Indigenous peoples were informed of the process before starting any data collection was fully involved in each case, without coercion. Both the Indigenous peoples and neighbours were invited to sign for their agreement or disagreement at the public inspection, to guarantee their consent to any information passed on to the government. Moreover, applying the FFP land administration approach, in cooperation with the State, is in line with Section 9.4 of the FAO's Voluntary Guidelines of Governance Tenure [29]. Mapping boundary conflicts together with the community and proposing solutions for securing land tenure of Indigenous land supports the responsibility of the government to provide appropriate recognition and protection of the Indigenous land rights.

The differences between the Indigenous cultures, and the moving agricultural frontier—in this case, cattle ranchers—remain at the heart of the matter. This funda-

mental clash of values often materialises in boundary conflicts. Although the challenge remains regarding how Indigenous peoples in reserves can develop economically while maintaining their own cultural identity, the experiment with the FFP approach shows that it can greatly help to focus the dispute on specific contested areas, followed by a common discussion on the land dispute at hand and practical handouts for the government to solve the land disputes.

The cadastral actualization project with IGAC in the Indigenous reserves has been finished. All data that are collected are included in IGAC's database. The differences between the official State data and the measurements in the field are included as an informal data layer in their database. This information is also socialized with the Indigenous communities, which means that they understand the situation and are aware of what information is included in the State's registers. The leaders of each Indigenous reserve have received elaborated maps with the information of the situation according to the State's official documents and according to the field measurements that were realized with the community. This means that the collected information is not only in hands of the governmental institute IGAC, but also in hands of the Indigenous community. During the final socializations, it was explained to the Indigenous leaders that the measurements of the real limits in the field are recognized and included by IGAC.

However, the next step is the modification of boundaries and resolution of conflicts at the State level, to guarantee the protection of Indigenous land rights in the long term. When a parcel of a settler farm is sold, the new owner has to be aware of the updated situation and not ignore the agreements that were made. This needs to be done by the Agencia Nacional de Tierras, Colombia's National Land Agency (ANT), which is the only authority that can modify boundaries and grant new parts to existing Indigenous reserves. The collected data by IGAC are shared with ANT, with approval of the Indigenous communities. Therefore, the project continues to work with ANT to analyse how these local agreements are processed at the State level.

Based on the findings of this project, several recommendations for further research arise. First, it is important to continue monitoring the State's participation and its commitment to identify the reality of Indigenous land's borders. This project has been carried out with several Sikuani Indigenous reserves, but Colombia has over 60 different ethnic communities, which have other characteristics than the Sikuani community. Similar studies in other ethnic groups would broaden the knowledge on present land conflicts as a result of ongoing encroachment on historic indigenous land rights in Colombia and other Latin American countries. There are also many Indigenous communities whose land rights have never been officially granted. They live on State-owned lands and their rights on these ancestral lands are not recognized. A follow up program could be the FFP approach applied in a certain region to protect Indigenous lands that are not legalized.

Additionally, a challenge that many Indigenous communities are facing nowadays, is the expansion of the population within the Indigenous reserves. The number of communities within the Indigenous reserves is increasing, and, therefore, land for cultivating crops is becoming scarcer. The lands surrounding these reserves are often already occupied, which makes it difficult to expand the Indigenous territory. To be able to provide for the whole community, further research should be focused on sustainable use of the indigenous lands.

**Supplementary Materials:** The following is available online at <https://www.youtube.com/watch?v=HNTbjPrbLA8>: Video S1: Land conflicts in Cumaribo (Colombia) between Indigenous peoples and cattle ranchers.

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