





Comparative Analysis of Spatial and Environmental Data in Informal Settlements, from Point Clouds and RPAS Images

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Abstract. Although there is access to QGIS, ArcGIS, MappingGIS platforms, with extensive historical and current information, environmental and spatial data, paradoxically, there is little analysis of the data from these platforms on urban structures that contribute to decision making, and even less on informal settlements; Paradoxically, there is little analysis of the data from these platforms on urban structures that contribute to decision making, and even less on informal settlements, we start from this problem question: the lack of knowledge coupled with little use or implementation of geoinformatics in municipal planning offices, have allowed the uncontrolled and uncontrolled growth of informal settlements, therefore, their problems are becoming more complex every day? In addition to this hypothesis, could we infer from geoinformatics possible solutions to informal settlements, guiding the steps of government authorities, seeking to support decision making, promoting welfare and protection of vulnerable communities there? In this exercise, which will be presented with the support of geoinformatics, we intend to present the results of a comparative analysis on issues related to critical environmental aspects in informal settlements -such as water courses and flood plains-. Seven informal settlements are analyzed: three in La Plata (Argentina), two in Mocoa and two in Villavicencio (Colombia). The method seeks the interrelation of geometric information from point clouds, and radiometric information from orthomosaic images of Piloted Aerial Systems (RPAS), to then classify the variables, with the objective of generating new information derived from the analysis, which. The images resulting from the crossing of information generating new spatialities will be made available to communities, public and private entities.

Keywords: Geoinformatics · environmental spatialization · informal settlements · point clouds · RPAS images

The original version of the chapter has been revised. An error in the author's name has been corrected. A correction to this chapter can be found at https://doi.org/10.1007/978-3-031-46813-1_31

1 Introducción

Geoinformatics today is presented as an unavoidable tool for the analysis of the territories from different areas, although it is costly for municipal administrations, because of this, it seeks to consolidate through some of the platforms that allow access to information of maps of Colombia, such as GEOPORTAL in <https://www.igac.gov.co>, Colombia in maps in <https://www.Colombiaenmapas.gov.co> maps - Datos Abiertos Colombia in <https://www.datos.gov.co> Portal Servicio Geológico Colombiano in <https://www.sgc.gov.co> among others, with Qgis software, due to its versatility, will allow to compare in a direct, clear and concrete way. The parallel or comparison will be made of seven informal settlements: the cases of El Rincón, Abasto Nuevo and La Aceitera, in La Plata, Argentina, in El Brillante, Playa Rica in Villavicencio, and the Yanacona indigenous cabildo, and Nueva Betania in Mocoa - Colombia, informal settlements in Argentina, in the city of La Plata, The study was carried out from three environmental and spatial data scopes, critical environmental aspects in informal settlements such as watercourses and flood plains, recognizing and classifying the variables: vulnerability, threats, risks and mitigation, in order to provide new information that offers new possibilities for solutions in decision making. These platforms are still little used, given the need to understand the problems that go beyond physical deficiencies, such as social, cultural and psychological ones, which affect the quality of life of the inhabitants of the area. This study has as objectives, to publicize the possible solutions of this geoinformatics tool, the speed in time, and versatility in reaching possible solutions and therefore results in informal settlements.

2 Methodology



Fig. 1. methodological design. Own elaboration 2023

As Del Rco, J. y Beltrán [1] point out, “to know and analyze space requires data, the raw material; to interpret and manage it requires technological tools

and, to make it known and transform it, communication (...); three interrelated and indissoluble aspects that make up an open system: the tool of networked geography is technology, which consumes data (inputs) and produces communication (outputs)". In this framework, Geographic Information Systems are the tool par excellence for analyzing territories that are blurred in the digital world as mentioned by [1]. For his part, [6] points out that "the development experienced by GIS is related to that which has given rise to the constitution of a new scientific and technical discipline, called geomatics (or geospatial technology) that integrates all the sciences and technologies used for the knowledge of the territory and the management of spatial databases, including geographic information systems, remote sensing or remotely and global satellite navigation systems". All of which enable the acquisition, storage, retrieval, management and interpretation of spatially referenced information. Data today come from multiple sources, from traditional sources (statistics, maps, archival documents) to new ones (artificial satellites, remote sensing, photo-interpretation), comment [6] all of which are processed by modern computer techniques.

From images obtained from a remotely piloted aerial system (RPAS) it is possible to generate detailed topography. The advantage of this methodology is the speed in obtaining high precision digital surface models (DSM) and terrain models (DTM) and their corresponding orthophotography, at a very low cost, as well as the possibility of obtaining information at large scales or "in detail", due to the capacity of RPAS to fly at "low altitudes" and obtain high resolution images. The use of RPAS images contributes not only to the generation of orthophotos, he mentions it from his experience [4] but also of reliable topographic products for medium-sized projects that require detailed information at affordable costs. The main advantages of RPAS are: obtaining and processing spatial data in short periods of time. Converting a LIDAR point cloud to a Digital Elevation Model (DEM) with the LAsTools add-on in QGIS 3 Digital Elevation Models (DEM) are a digital representation of the visible surface of the earth that allow numerical determination of heights or elevations with respect to a reference surface. Unlike digital terrain models (DTM), DEMs describe the features and elements present on the earth's surface, both anthropogenic and natural. DEMs are used in various applications and disciplines such as cartography, photogrammetry, civil engineering, geodesy and geophysics, and are therefore a product in demand by a wide range of users. The applications of DEMs or DTMs are varied, for example: Generation of contour lines, Generation of slope maps, Creation of relief maps, Flight planning in three dimensions, Geometric rectification of aerial photographs or satellite images, Reduction of gravity measurements, also called terrain or topographic correction, Projects of large engineering works, Tracing of topographic profiles, Volume calculations, Environmental risk analysis (IGN).

2.1 Study Areas

The three study areas are characterised as follows: La Plata (Buenos Aires, Argentina), Mocoa (Colombia) and Villavicencio (Colombia).

2.1.1 La Plata, Buenos Aires, Argentina. La Plata (capital of the Province of Buenos Aires, Argentina) is the fourth most populated city in the country with 772,618 inhabitants [5]. It is located 56 km from the Autonomous City of Buenos Aires and southwest of the Río de La Plata. [2] Its main characteristic is that it was designed under hygienist standards and planned from its foundation based on a scheme in which the urban area was demarcated, as opposed to the areas destined for intensive and/or extensive agricultural activities from a ring road. Over the years, the city grew beyond these limits and formed the urban peripheries.



Fig. 2. Location of the La Plata district. Source: Own elaboration 2023

With regard to environmental aspects see Fig. 2, the La Plata district is located on an alluvial plain, where two different topographical zones can be distinguished, called the coastal plain and the high plain. The first occupies small sectors on the border with the districts of Ensenada, Berisso and Magdalena, where the lowest elevations are found. The second zone comprises almost the entirety of the District, with a main interfluvium of flat relief, which acts as a watershed between the two main watersheds, the Río de la Plata to the north, and the Samborombón River to the south [3]. The district of La Plata is partially located on the basins of the Pereyra and San Juan streams and entirely on the basins of the Carnaval, Martín, Rodríguez, Don Carlos, del Gato, Pérez, Regimiento, Jardín Zoológico, Circunvalación, Maldonado, Garibaldi and El Pescado streams. Two main basins can be highlighted according to the amount of population that settles on them: the basin of the arroyo del Gato, and the basin of the arroyo Maldonado. Flooding is the result of heavy or continuous rainfall that exceeds the absorption capacity of the soil and the carrying capacity of rivers, streams and coastal areas. This causes a given watercourse to overflow its channel and flood adjacent lands. Flood plains are the orographic part of a watercourse (river, stream, lake) that can be inundated by rising water. They are

therefore “flood prone” and a danger to development activities if their vulnerability exceeds an acceptable level, is clarified by [14]. In 2013, the Partido de La Plata experienced the worst flooding in its history, and it is therefore important to pay special attention to this problem.

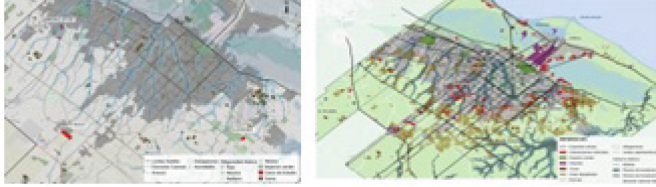


Fig. 3. Left. Environmental aspects, Partido de La Plata, Buenos Aires, Argentina. Source: Own elaboration 2023. Right. Informal settlements, La Plata, Buenos Aires, Argentina. Source: Own elaboration 2023.

In relation to the informal habitat, there are 163 informal settlements in the interior of the Party where 20,491 families live in extremely precarious and vulnerable situations see Fig. 3. 60 % of the informal urbanisations are crossed by streams, or are located on flood plains. In relation to the distribution of informal urbanisations, the basins of the district with the highest concentration are: Pereyra, Carnaval, Martin Rodr'iguez, El Gato, Maldonado, Garibaldi, Pescado y Abascay, Circunvalaci'on and Diagonal 74. Of these, Pereyra, Garibaldi and Abascay are the ones that cover the largest areas in the territory, however, they have very little population in comparison with the others. The basins of the Gato and Maldonado streams are the ones with the highest number of informal urbanisations, with 60 in the Gato stream basin (40 %) and 20 in the Maldonado stream [3] basin (20 %).

2.1.1.1 El Rincón The informal settlement is located on the northern axis of the Partido, and is divided into three neighbourhoods: Rincón I, II and III, where 190 families live. Are located on the Carnaval-Martin basin, on the banks of the Carnaval stream. See Figs. 5 y 6, (Fig. 4).



Fig. 4. Left. Case 1, El Rincón. Source: Own elaboration based on Google Earth, 2023. Center. Case 2, Abasto Nuevo and Right. Case 3, La Aceitera.

NEIGHBOURHOOD	AMOUNT OF FAMILIES	SURFACE HECTARES	YEAR OF ORIGIN	ACCESS TO ELECTRICITY	ACCESS TO SEWERS	ACCESS TO SAFE WATER
EL RINCON I	56	3	Decade of 2000	Formal connection with domestic meter	Drainage of septic chamber and cesspool	Domestic Well Water Pump
EL RINCON II	122	4.82	Decade of 2000	Formal connection with domestic metering system	Drainage only to cesspit or hole	Domestic well water pump
EL RINCON III	10	10.42	Decade of 2000	Irregular Connection Grid	Drainage only to cesspit or hole	Irregular connection to the water network

Fig. 5. Comparative graph of the population characteristics of the informal settlements, El Rincón I, II, y III.

2.1.1.2 **Abasto Nuevo Neighbourhood** is located in Abasto, on the southern axis of the city. see Figs. 7 y 8.

NEIGHBOURHOOD	AMOUNT OF FAMILIES	SURFACE HECTARES	YEAR OF ORIGIN	ACCESS TO ELECTRICITY	ACCESS TO SEWERS	ACCESS TO SAFE WATER
ABA STO NUEVO	160	42	2015	Irregular grid connection	Drainage only to cesspit or hole	Irregular connection to the water network

Fig. 6. Comparative graph of the population characteristics of the informal settlement Abasto nuevo.

2.1.1.3 **La Aceitera Neighbourhood** is located in the catchment area of the Pescado stream. see Figs. 9 y 10.

NEIGHBOURHOOD	AMOUNT OF FAMILIES	SURFACE HECTARES	YEAR OF ORIGIN	ACCESS TO ELECTRICITY	ACCESS TO SEWERS	ACCESS TO SAFE WATER
LA ACEITERA	180	10.21	Decade of 1990	Irregular grid connection	Drainage only to cesspit or hole	Domestic well water pump

Fig. 7. Comparative graph of the population characteristics of the informal settlement La Aceitera.

2.1.2 **Mocoa, Putumayo, Colombia** was founded on September 29, 1563. This municipality is located on the Amazonian foothills, to the north of the department of Putumayo see Fig. 1. Physiographically, it comprises a varied range of geofomas that range from high mountain slopes to slightly undulating plains. It includes mountainous areas, corresponding to Laderas Altas de Cordillera, whose geomorphological characteristics are slopes greater than 75 %. The territory contains great water wealth, and many of its water currents cross the urban area of the municipality, generating in some areas a potential to be susceptible to torrential floods that influence the growth and development of the municipality.



Fig. 8. NLevels of territorial location in Colombia, the department of Putumayo and the municipality of Mocoa. Source: Elaboration with information from the DANE Geoport, Consulted on July 6, 2023.

2.1.3 Villavicencio, Meta, Colombia. Villavicencio (capital of Meta, Colombia) is the 22nd most populated city in the country with 558,299 inhabitants, that’s how he mentions it [13]. It is located 86 km from the capital of Colombia and south of the Guatiquia River. Its main characteristic was of spontaneous conformation and built since its foundation with cadastral lot was delimited the urban area. After 119 years, the city grew beyond these limits and formed the 4 radial road rings, see Fig. 12.

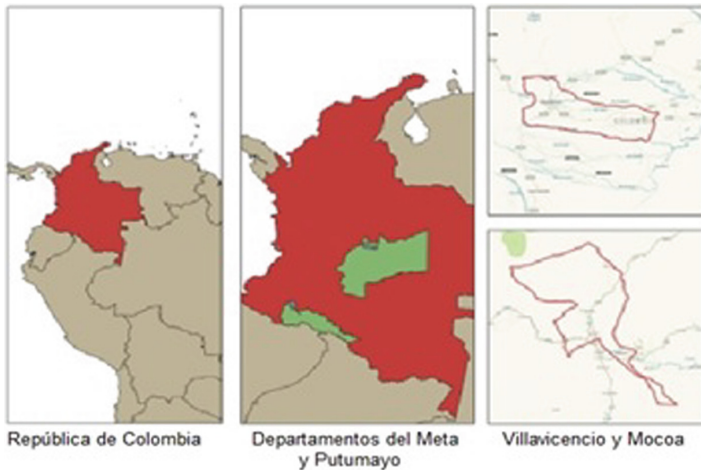


Fig. 9. Location of Villavicencio. SOURCE: Own elaboration based on maps of the world 2023.

Villavicencio is located in the alluvial fan between the Guatiquia and Guayuriba river basins, where the canals originate, and belongs to the Pleistocene-Upper Holocene Price period. These wetland fluvial-lacustrine deposits overlie a basement that locally is represented by Cretaceous-Tertiary

sedimentary rocks, [10] makes known, the whole depositional model is controlled by thrust fault systems that belong to the system. These types of soils are less bearing, besides being in a high Seismicity level, level 1; it makes the construction system used in the study territory take greater relevance, since they have not suffered from collapse of buildings during earthquakes. This shows the great ability, skill, technique and performance of the builders of the XIX and XX centuries, makes known [11]. Threat and risk areas that cannot be mitigated by natural or technological phenomena, so the location of human settlements restricts the possibility of urbanization. The rivers that border the city, to the north the Guatiquia, to the south the Ocoa, and is covered by more than 9 secondary surface tributaries, and more than 45 streams called “can˜os”. Floods are recurrent due to lack of planning and spontaneous generation, according to studies of [15] although today mitigation of hazards and risks is being carried out. In Villavicencio the natural landscape is piedmont, which allows a wide visualization of each of the components: mountain, highlands and plains, generating several incomparable visual foci of landscape, providing them with a unique landscape value in the region; it has visuals on mountain, highlands and plains. These environmental, natural or scenic values must be preserved. The number of informal settlements in Villavicencio amounts to 588. The consolidated number of legal and illegal neighborhoods in Villavicencio (year 2019), Legal are 325, Illegal are 263 and the total is 588, which would correspond in percentages to legal neighborhoods 55.27 %, [12] and illegal neighborhoods 44.73 %.

As will be indicated in the planimetry the greatest are three, the risks and threats of flooding, landslide by mass removal, and technological threat; aggravating or further aggravating the problem to these 30 and 33 settlements are in communes 4 and 8 respectively see Fig. 13, (Fig. 11).

Commune	1	2	3	4	5	6	7	8	0	Total
Neighborhoods	56	51	24	89	114	29	75	71	79	588
Illegal	25	21	15	30	44	11	31	33	53	263

Fig. 10. Illegal neighborhoods 2019 V/cio. Source: urban development office. Municipal archives.

2.1.3.1 Playa Rica He Playa Rica informal settlement is located in the north-west axis of Villavicencio, and is home to 33 families, with 163 inhabitants, located approximately 100 m from the large river. See Figs. 12 y 13.

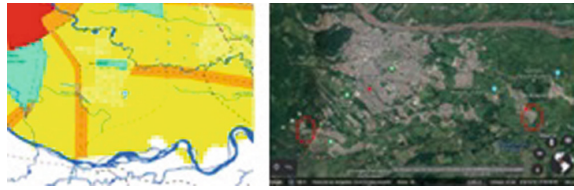


Fig. 11. Left: Map 11C + 12 Urban Land Activity Area Plan - Playa Rica and El Brillante. Right: Location of settlements: Playa Rica and El Brillante.

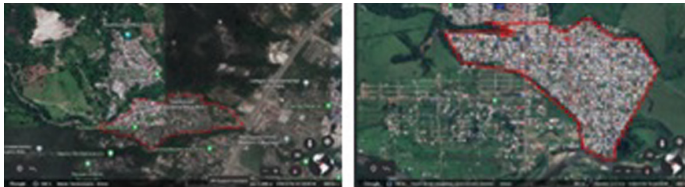


Fig. 12. Left: Case 1, Playa Rica. Source: Own elaboration based on Google Earth, 2023. Right: Case 2, El Brillante. Source: Own elaboration based on Google Earth, 2023.

Settlement	Age	# Dwellings	Location	Risk	Area m2	Access to electricity	Access to sewerage	Access to aqueduct
Playa Rica	1980	185	Comuna 8	flood	153761,26	Formal Connection With Household meter	Drainage	Aqueduct

Fig. 13. Comparative graph of the population characteristics of the informal settlement Playa Rica. **2.1.3.2. El Brillante** The El Brillante informal settlement is located in the northeast axis of Villavicencio, and is home to 30 families, with 128 inhabitants, located approximately 300 meters from the Maizaro river to the north and the Ocoa river to the south. See Fig. 14.

Settlement	Age	# Dwellings	Location	Risk	Area m2	Access to electricity	Access to sewerage	Access to aqueduct
El brillante	2020	965	Comuna 4	flood	802791,01	Formal Connection With Household meter	Drainage	Aqueduct

Fig. 14. Comparative graph of the population characteristics of the informal settlement El Brillante.

2.1.3.2. El Brillante The El Brillante informal settlement is located in the northeast axis of Villavicencio, and is home to 30 families, with 128 inhabitants, located approximately 300 m from the Maizaro river to the north and the Ocoa river to the south. See Fig. 14.



Fig. 15. Informal settlement El Rincón, Nuevo Abasto, La Aceitera in La Plata.



Fig. 16. Urban area of Mocoa and some informal settlements

2.2 Point Cloud Method and UAV Portraits

In geoinformatics it seeks to make spatial information available, in order to guide rural and urban planning; through a process it starts with the capture of information, classifies it, then stores it, processes it, generates the output in an image and then disseminates it. Some of its branches, Cartography, Geodesy, Global Navigation Satellite Systems, Remote Sensing, Spatial Analysis, and Web Mapping; will be the support to combine the point cloud of an unmanned aerial vehicle UAV, or RPAS, with orthomosaic, in order to recognize characteristics in informal settlements, which allow to classify them, and thus collaborate with municipal administrations in the improvement of informal settlements projecting plausible solutions for the quality of life.

2.3 Data Acquisition

In Colombia, the information found on informal settlements; what was expected was a series of analytical cartographies that would provide a synthesis of the



Fig. 17. The Nueva Betania settlement and its transition area with the urban area of Mocoa Note: This photograph was taken by the Self-Sufficient Territorial Planning with Integral Training research group called GOTAFI, 2015. The parceling process is shown with determined environmental limitations and distant from the urban area of Mocoa. Source: Self-sufficient Land Management Group with Comprehensive Training GOTAFI and Adaptation. Own elaboration.

dynamics present in the study territories, and infer possible solutions, be they programs or projects. On the contrary, the information found was a disjointed cartography of national and municipal levels that differ in scales, which does not allow a quick, clear and concrete access to information, analysis, or conclusive deductions. As well as governmental documents, National Unit for Disaster Risk Management (UNGRD), technical reports of INGEOMINAS, municipal planning secretary, P.O.T., PMGRA, Villavicencio, as primary sources; doctoral and master thesis, as secondary sources. The data of water courses, flood plains and natural reserves, were taken from P.O.T., PMGRA, of Villavicencio, documents of 2015, it became necessary to update such information to 2023, with the support of the planning secretary, with the group of neighborhood legalization; as for the regulations of 2017, 2021 and 2023, it will be presented at the end of the results.

2.4 Data Processing

In Argentina, information on informal settlements comes from both secondary sources (National Organisms - National Registry of Popular Neighbourhoods - and Provincial Organisms - Provincial Registry of Slums and Settlements) and primary sources resulting from research projects carried out at the Institute for Research and Policy on the Built Environment -IIPAC- and from academic works - Doctoral and Master's Theses. These sources have guaranteed access to up-to-date information but, as in the Colombian case, the information is disjointed at the national and provincial levels, and there are no records at the municipal level. The aforementioned disarticulation is fundamentally based on the disparity of theoretical and methodological criteria regarding the conception of informal habitat. On the other hand, information on relief, hydrography and flood plains was taken from the National Geographic Institute (IGN). In the case of Argentina, georeferenced information on the physical environment at the national level was taken from the IGN. This information was cross-referenced

with provincial and local data on informal settlements, also geo-referenced. From the analysis of this cross-referenced data, thematic cartography was constructed using GIS. In the case of Colombia, planimetries were taken from the national level, the scale is 1:100000, from the municipal level the scale is 1:5000, this information found was classified and mapped digitally, updating data to 2023 for analytical, diagnostic, conclusive and prospective purposes, in this process it was possible to reach the results.

3 Results

The topics addressed in the characterisation of the informal settlements studied in Argentina and Colombia are: watercourses, flood plains and nature reserves. Coincidentally in both cases, after analysing them, they have provided a clear picture of the situation that characterises them: populations with high environmental vulnerability due to their proximity to streams and occupation of flood plains resulting, among other things, from the lack of risk management, weaknesses in the protection of management zones and environmental protection of water bodies by governments at the local-provincial-national level, and insecurity due to environmental and technological threats. In short, these are populations that are “distant” from the interest of governments. Because they are territories that began their development spontaneously, and that in the case of Colombia have been regularised in the last year, but not in the case of Argentina, they form “neighbourhoods” with a future that could be consolidated after two or three more phases, oriented towards quality of life, in the ideal of SDG 1: End poverty, SDG 8: Decent work and sustainable development, SDG 10: Reducing inequalities, SDG 11: Sustainable cities and communities, SDG 13: Climate action.

3.1 Characterization of the Experimental Area

In the case of the city of La Plata, the cases of El Rincón, Abasto Nuevo and La Aceitera present similar problems with regard to the three variables analysed - watercourses, flood plains and nature reserves - which are described below. In relation to the informal residential occupation of the flood plains, it is possible to recognise in the three cases analysed a regular grid pattern organised without respecting the irregularity generated by the towpath, informally invading the natural course of the stream. This situation leads to the following conflicts: i. Overflowing of stream beds flooding the surrounding areas due to heavy and persistent rainfall, insufficient carrying capacity of the beds, overflowing of water from the rainwater network at the point where it meets the beds. In the same way, the deficiency of the piping where it meets the urban layout. ii. The lack of reservoirs - large basins of absorbent land - prepared to receive water when the containment capacity of the conduits and/or streams is exceeded by heavy rainfall. iii. Insufficient pedestrian linkage of both banks; poor maintenance in the watercourses. Likewise, linked to this type of informal residential occupation

is the proliferation of rubbish dumped by neighbours, whether from housing and/or productive activities, which affects the quality of the water in nearby streams and threatens the native flora and fauna, affecting the quality of life of the population.

3.1.1 Results Related to the la Plata, Argentina. In the case of Nuevo Abasto, located in the upper basin of the El Gato stream, the growing greenhouse technology is having negative consequences on the territory, see Fig. 15. The waterproofing of the soil as a result of the plastic cover of intensive fruit and vegetable production and insufficient ditching means that rain cannot infiltrate the soil, and every time it rains, large bodies of water are formed which run off into the natural watercourses and improvise paths for this purpose.



Fig. 18. Yanacona settlement in the process of being formed Note: The Yanacona indigenous community is located in a territory assigned by the Mocoa Municipal Mayor's Office. Its internal organization of the territory is dispersed and in keeping with the existing vegetation. Source: Adaptation. Own elaboration.

In relation to the nature reserves of the district of La Plata, they are not directly affected by the three settlements studied. In this sense, in the case of the La Aceitera settlement, although its location is close to the protected area of the El Pescado stream, it does not affect it. Nuevo Abasto is located in the horticultural belt of La Plata, an area considered protected until the Land Use Ordinance of 2000, but not in the last Ordinance of 2010. Although the informal settlements studied show some weaknesses, little preparation in terms of hazards, risks and disasters or disaster reduction; the informal settlements El Rincón, Abasto Nuevo, La Aceitera, located in La Plata Argentina, El Brillante and Playa Rica in Villavicencio and the Yanacona indigenous cabildo, and Nueva Betania in Mocoa, both in Colombia.

3.1.2 Results Related to the Mocoa and Villavicencio, Colombia have similar problems in the first two of the three study variables water courses, flood plains and nature reserves, the third are different; they will be presented below:

3.1.2.1 Results related to the Nueva Betania and Yanacona Yachay Wasi settlements

Regarding the identification of forms of occupation of the territory, in these two informal settlements rural and/or country-type houses with low densities are identified, without access to all public services, with ecological effects, and situations of threats, flood risks and danger of continuing with processes of appropriation of conservation areas, see Fig. 16. The process of urban consolidation and articulation is remote, although inside the town hall there is a better process of construction of the habitat, [7] unlike the case of Nueva Betania, where internal social relations are more difficult to bear. The affectations in terms of flooding and environmental deterioration presented and exposed in the territory of these settlements, increasingly deteriorate the study population, who were affected in their forced displacement from the beginning of their location in said place, see Fig. 16.

Note: The water structure of the urban area of the city of Moco is appreciated with its morphological manifestations and identification of two informal settlements, case studies, Yanacona and Nueva Betania, disjointed from the urban area. Source: Adapted from Google Maps and Google Earth, 2023. Own elaboration.

Today the trends identified in the transformation of urban land, in the dynamics of territorial growth and the uncertainty of water wealth, constitute great challenges associated mainly with losses of natural coverage, biodiversity, conservation of human life and ecological connectivity, presenting in the city a progressive deterioration in the main ecological structure, related to the water course, the floods presented and the existing natural reserves. Notoriously affecting the study sites in this municipality called Nueva Betania and Yanacona Yachay Wasi. Characteristics of the zones, With specific relation to the settlements Nueva Betania and the Yanacona indigenous council, they present the following characteristics: They present deficient communication for the normal functioning of land mobility, [9] reaffirming a delay and lack of support for adequate territorial development, see Fig. 17. The settlements located in Mocoa: Yanacona indigenous cabildo, and Nueva Betania are located in the following areas, the three maps for each settlement water courses, flood plains and natural reserves.

The Yanacona Cabildo is located to the east of the urban area of Mocoa (Fig. 18) and presents an organic territorial organization in accordance with the existing biomes in the place. However, the vision of said community is pessimistic in terms of its territorial and housing development; [9] because the basic needs of health, employment, housing, public services, are deficient and the solution to these problems is not clearly seen in the near future. Additionally, a large part of these problems has had to be solved by the community itself and on other occasions, with the collaboration of the government and non-governmental institutions. They are victims of the Colombian armed conflict and have been brutally dispossessed of their ethnic territories, generating a rupture of the social fabric, deterioration of customs and loss of ancestral spirituality.

3.1.3 Results Related to the Villavicencio, Colombia. As it has been possible to analyze the informal housing occupation of flood plains it is possible to recognize in the two cases analyzed. El Brillante and Playa Rica in Villavicencio a regular plot organized in an orthogonal rectangular shape of half a block respecting the irregularity generated by the layout of the can˜o campo alegre, next to the Ocoa river and can˜o grande, with can˜o Tela, respectively; although if invading in an informal way, draining in some sectors approximately 400 ml of the natural course of can˜o campo alegre, and thus building them. Although the situation is unmanageable, it brings about conflicts: I. Overflowing of the riverbeds, flooding neighboring areas during the rainy season for nine months of the year, influenced by the climatic phenomena of El Ni˜no and La Ni˜na, since their banks are not very high and the surrounding morphology presents a slightly sloping relief, added to the low carrying capacity of the riverbeds. Also, the sewage system is inadequate. II. The absence of reservoirs -large absorbent soil sin charge of collecting the water when the rivers overflow is overcome due to heavy rains. III. The need for pedestrian linkage on both shores; the scarcity of maintenance in the watercourses; IV. Playa Rica extended to the edge of the large canals and Tela, increasing the risk of flooding, which is difficult to mitigate or reduce due to the high cost of intervention works. On the other hand, in this type of informal settlements, there is a proliferation of garbage that is thrown by the neighbors, affecting the quality of the water quality of the watercourses, threatening the ecosystems and consequently the flora and fauna, affecting the quality of life of the inhabitants. The nature reserves near El Charco wetland are not directly affected by Playa Rica.

4 Conclusions

One of the good practices supported by government entities and NGOs is highlighted, it is related to the accompaniment of these informal settlements to generate trust at the beginning of defining actions in the intervened territory; such as planting shrubs and trees to protect the environment on the banks of water currents; In addition, initiate and accompany the communities in organization processes, especially the Yanacona community to develop collective productive processes, who collaboratively develop activities to improve their living conditions. However, poor public services hinder their good intentions.

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