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Analysis of the Vegetal Cover in the Floodplain of Paranapanema River, County of Rosana, São Paulo State, Brazil: A Study for the Creation of An Ecological Corridor

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Abstract: This article has as its aim the analysis of the vegetal cover in the area known as Varjão (large area of floodplain) of Paranapanema River, in the county of Rosana, São Paulo. The mapping of the vegetal cover stems from an interpretation key of a WorldView 2 satellite image from 2012, which is panchromatic, with spatial resolution of 0.50 m and radiometric resolution of 11 bits. The data validation was performed through phytosociological survey done in loco, in order to analyze the vertical structure of the vegetation, aiming at elucidating the importance of creating an ecological corridor at the site, under the sight of GTP system (Geosystem-Territory-Landscape) in accordance to other projects that contemplate this area.

Key words: floodplains of paranapanema river, phytosociological survey, ecological corridor

1. Introduction

The study of the vegetation is one of the main issues in the study of landscape, in view of its importance to the quality of the environment and the balance of the natural system. According to Lacoste and Salanon (1973) [1], vegetation works as a sensor that adverts us of the changes in certain ecosystem. This way, we can identify, from its physiognomy, the floristic composition as well as recognizing the areas whose characters of settlement and ecological conditions are practically homogenous.

In this context, vegetation becomes a key factor to understand the landscape from the point of view of human scale. From it, we can assess which steps were taken by humankind along history, since all productive activities generate by men started from a direct attack to the vegetation.

To sum up, the landscape in its dynamic must not be understood without the evolution of vegetal formation, once both must be analyzed and studied together, so that we can, during the process of space organization, obtain the most productivity with the least exploitation of the current landscape and vegetation [2].

Thus, we intend to discuss the landscape of the floodplain of Paranapanema River in the county of Rosana-SP, from the study of the vegetation in two steps: the first is regarding the preliminary mapping with identification key of the current veg etation in the floodplain of Paranapanema River, whereas the second is a study directed to phytosociology, from field work and phytosociological survey, systematized in vegetation pyramids. From these results, we intend to draft a proposal for the creation of an Ecological Corridor at the site, taking into consideration the regional context.

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2. Material and Methods

2.1 Mapping of the Vegetation in the Floodplain of Paranapanema River

In order to perform the mapping of the vegetation in the floodplain of Paranapanema River, we used the WorldView 2 satellite image, with spatial resolution of 0.50 m (panchromatic), with radiometric resolution of 11 bits, being compatible with the mapping in the scale 1:25.000.

The interpretation of the satellite image was obtained through the technique of visual interpretation, as proposed by Panizza & Fonseca (2001) [3]. According to these authors, this technique requires previous knowledge of the study area to be mapped, that is why the user must transpose each step, familiarizing with the observation criteria, this way decreasing the subjective aspect of its visual interpretation. Six specific criteria have been used: shape, size and shade, location of the object in the landscape, texture and structure.

Therefore, the features and geometries to be mapped were defined, being: forest fragments, floodplain fields and waterlogged floodplain, besides the fluvial channels and springs that are present in the area of the floodplain. From these definitions, an interpretation key was elaborated, prioritizing examples that could elucidate determining traces of each feature, as we can observe in the interpretation key below (Fig. 1).

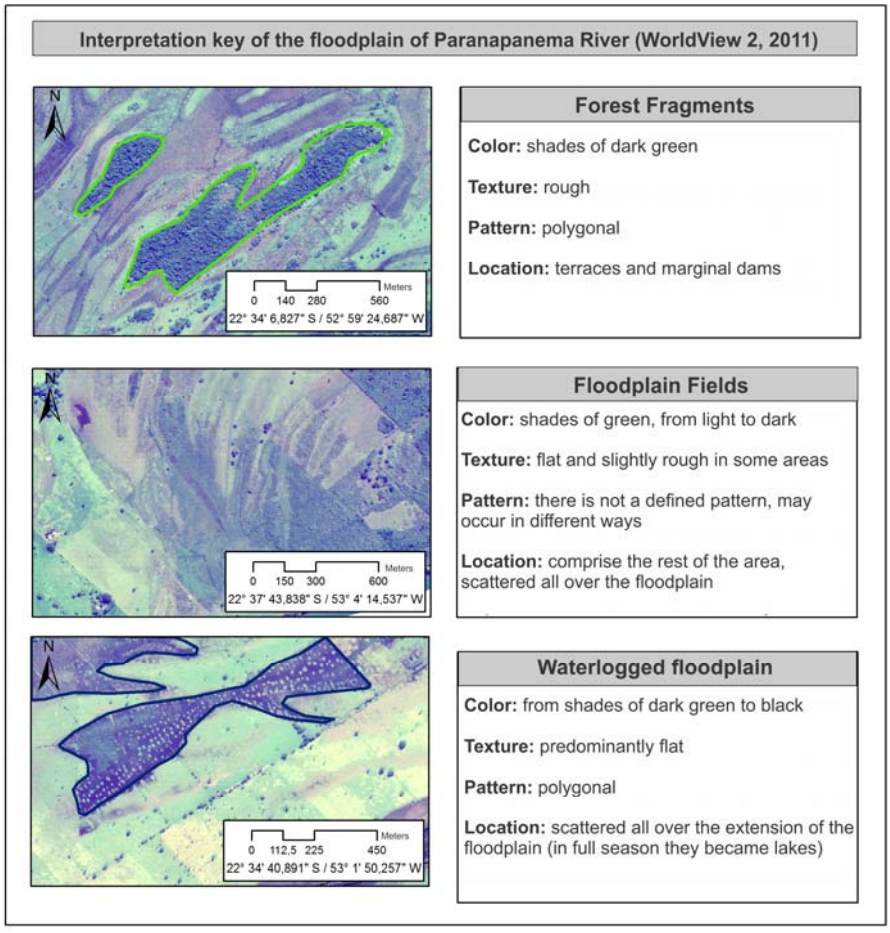

Fig. 1 Interpretation key of the floodplain of Paranapanema River (WorldView 2, 2011) [4].

In general, on the floodplain of Parapanapanema River, the vegetal formation of floodplain is predominant. It is a rural and hydrophytes vegetation, with herbaceous-shrubby species reaching varied size

that are typical of hydromorphic soils. There are also some small-sized tree species of soft wood such as *Sangra-d'água*.

In some areas of the floodplain, the vegetation has been substituted by gramine commonly used for cattle raising. This is due to the presence of cattle, specially in ebb seasons. In the areas next to the urban perimeter of the district of Porto Primavera and the county of Rosana, we can find some pasture areas.

In the waterlogged floodplain, there are water mirrors and marches with hydrophyl vegetation. They are herbaceous-shrubby species, not taller than 1.5 m. They present small foliage, and may have small flowers as natural indicators of the presence of water mirror in hrydromorphic soils (gleisols). The figure below (Fig. 2) shows the distribution of vegetal formation in the floodplain of Paranapanema River in the county of Rosana.

2.2 Phytosociological Surveys

In order to perform the field phytosociological survey, the indications proposed by Bertrand were used, choosing an area that represents the average state of plant formation being study, limiting the area in a radius of 10 meters. After this step, the support of a biologist or a bushman with popular and scientific knowledge about the species of the study area is used to help with the identification of the species in the lot.

Table 1 Phytosociological parameters according to Braun-Blanquet (1979) [5].

Cover-abundance Percentage		Sociability Percentage	
	Covering between 75% and 100%.	5	Continuous population, dense stains.
4	Covering between 50% and 75%.	4	Growing in small colonies, not so extensive dense stains.
3	Covering between 25% and 50%.	3	Group growing.
2	Covering between 10% and 25%.	2	Grouped in 2 or 3.
1	Abundant plant, however, with cover value no higher than 10%.	1	Isolated individual.
+	Some rare specimen.	+	Rare or isolated plant.

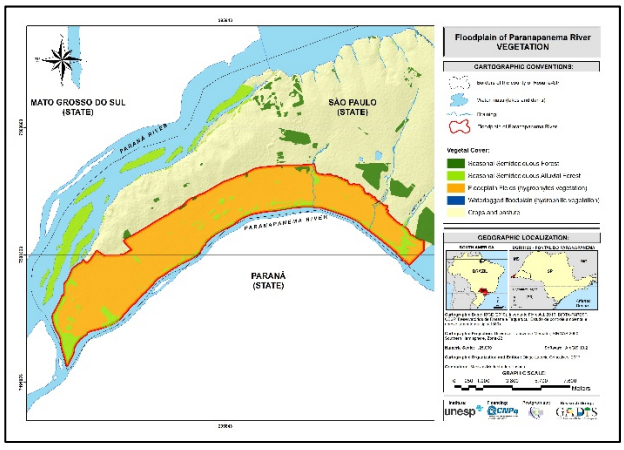

Fig. 2 Vegetal Cover of the floodplain of Paranapanema River, county of Rosana –SP [4].

The analysis takes into consideration the situation of forest fragments from present species, variety, successional stage, animal access, surrounding anthropogenic pressure and the presence or not of erosive process focus, as well as other aspects that may influence the changes of the vegetal stratum. Overall, three lots have been analyzed up to the present moment, being two of them in the area of Seasonal Semideciduous Alluvial Forest and the other in the area of floodplain.

The phytosociological parameters used for the survey in the area of study were defined from the methodology proposed by Braun-Blanquet (1979) [5], being: cover-abundance and sociability. The two first are equivalente to the degree of surface covered by the plants, while the last indicates the degree of grouping among them [6].

The first lot is located in the area known as Pontalzinho, next to the encounter of the rivers Paraná and Paranapanema. It is an area of plain terrain with an approximate altitude of 247 meters, relativey higher in comparison to the rest of the floodplain because it is comprehended in a marginal dam and a little higher than the quota of Paraná river, which is approximately 239 meters in this stretch.

It is an area of landfill for the construction of a road towards the encounter of the rivers, where there was once an office of the company Camargo Corrêa S/A. This company was responsible for the allotment of the land in the county of Rosana in the 1950s. After the end of their activities, the office was abandoned and the road was mostly covered by vegetation.

According to the information by the geographer Celso Machado, from CESP, there were also some

areas where native seedlings were planted by CESP, as a compensation for the construction of the hydroelectric power plant Engenheiro Sérgio Motta. There are also some ranches and summer houses, constituted by a small riverside population who lives on fishing, in special from the banks of Paraná River.

In reference to the composition of the vegetal strata, they are mostly in balance, except for the subshrubby stratum that is in progression. The lot, in general, presents the formation of Seasonal Semideciduous Alluvial Forest, having great variety in the arboreous stratum with species between 20 and 35 meters, presenting a wide canopy.

The litter layer, on the other hand, is expressive with approximately 10 cm of decomposing leaves, remarkable characteristic of this kind of vegetal formation. All around the area of the lot, three types of exotic species were found, being: Drimys winteri (Casca-D'anta), Ricinus communi (Carrapateiro or Mamona) e Syagrus coronata (Palmeira Licuri). The expressive presence of a non-identified species also occurred in the subshrubby stratum.

In relation to the anthropic action, the lot itself presents few characteristics, except for the surrounding with ranches and summer houses, besides the old road that is, mostly, unaccessible because of the vegetation advance. The information about the strata were systematized in the vegetation pyramid in Fig. 3.

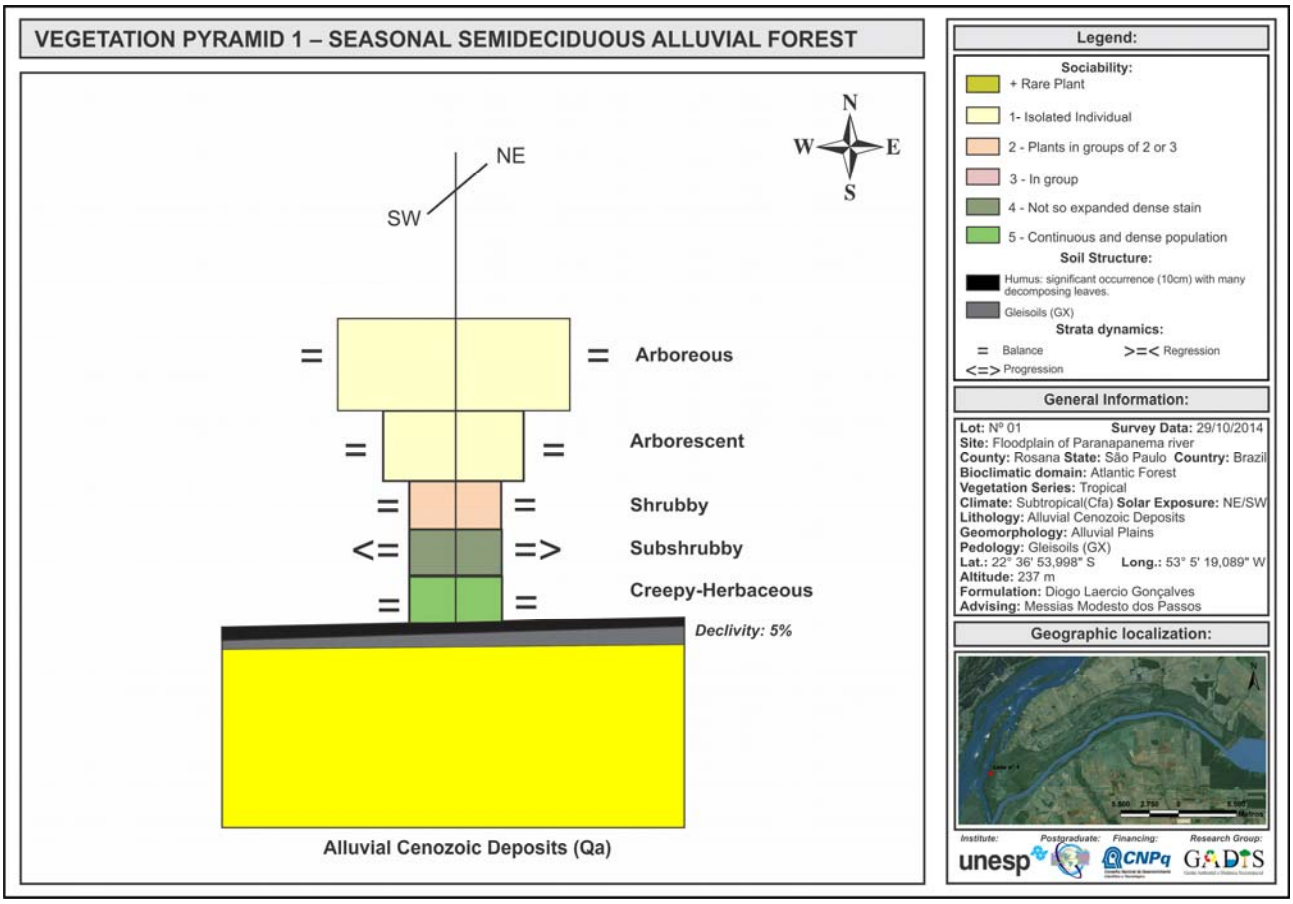

Fig. 3 Vegetation Pyramid of lot nº01 [4].

Lot number 2 is located in an area to the South of the region of Pontalzinho, next to the encounter of Paraná and Paranapanema Rivers. According to the geographer from CESP, it is the final point of the road where the old office of the company Camargo Corrêa was located. The structure of the old building, as well

as the light post and water well still exist in the area.

The area was not reforested by CESP. However, after the death of the old owner, it is now without any farming activities. Therefore, the vegetation developed in a natural way, according to the information provided by CESP.

As a result of this process, the vegetation presented similar characteristics to those of lot nº01, yet presenting little diversity of tree species and smaller canopy than what was found in the previous lot. The occurrence of 3 types of tree species with individuals between 12 and 18 meters still in development were noticed.

Among the species found in the area, the expressive presence of Triplaris brasiliana (Pau-Formiga or Novateiro) stands out, with several species in this lot in three different strata (arboreous, shrubby, herbaceous-shrubby). In relation to the composition of the strata, we can notice the absence of the arborescent, whereas, in all found strata the abundance and dominance are in progression, highlighting the arboreous and creepy-herbaceous strata. The presence of litter is also smaller than the previous lot (3 cm), observing a strong dynamics between the found strata with plant species of typical woods of initial secondary vegetation.

The surrounding is constituted mainly by the presence of ranches, summer houses, and a small riverside population. In periods of high discharge in the floodplain, many residents face difficulties to keep themselves in the region, having even the structure of their houses compromised by the increase in the water level, mainly in Paranapanema River. There are also some structures for the restraint of marginal erosion on the banks of the river, done with used tires. Check the information of the lot, systematized in the vegetation pyramid of Fig. 4.

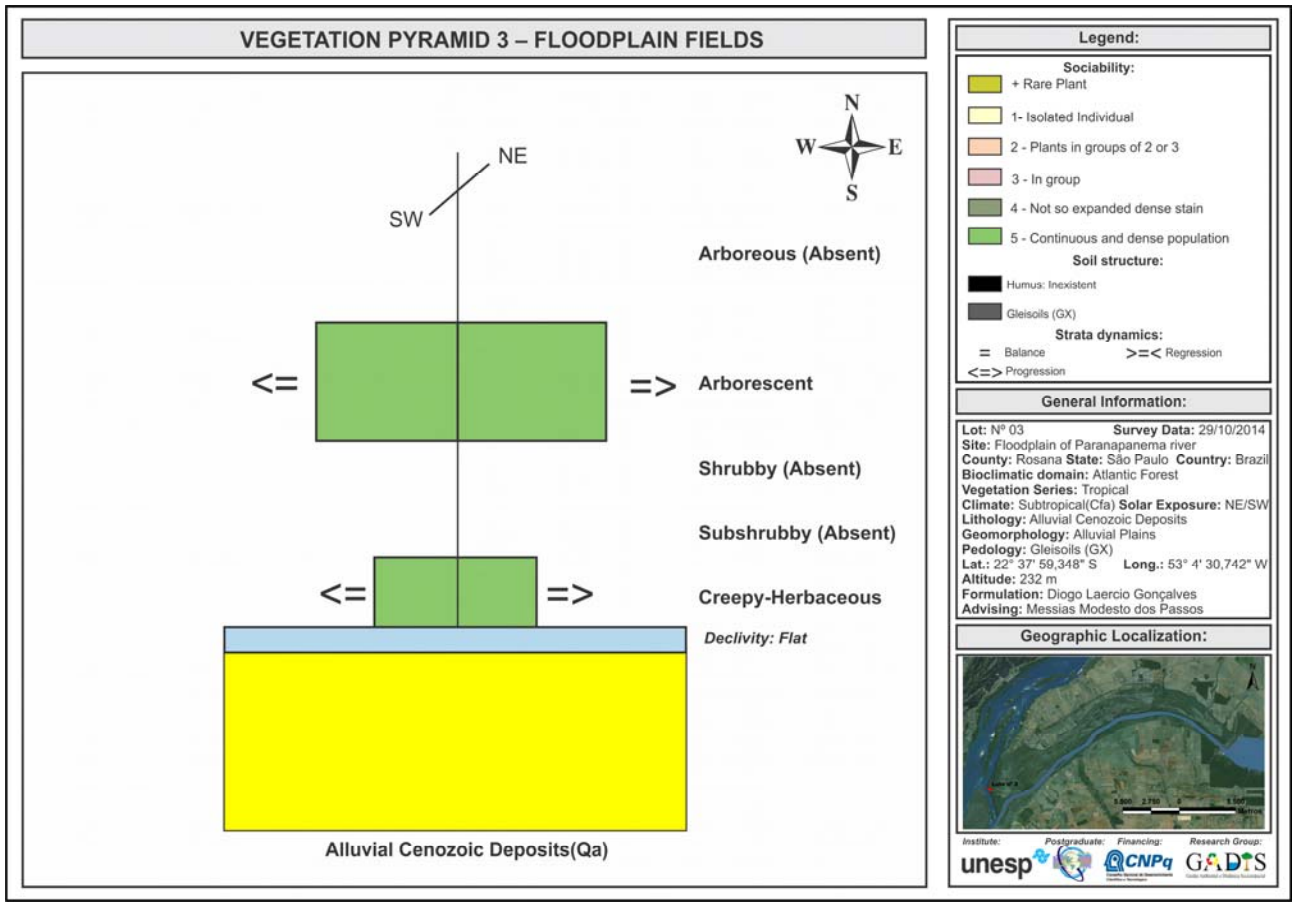

Fig. 4 Vegetation Pyramid of lot nº02 [4].

The last analyzed lot is a typical area of alluvial plain, constituting in vegetation of floodplain fields. It presents low altitude, with hydromorphic soils of low drainage. In most part, the original vegetation was succumbed by the advance of extensive farming, with the massive presence of Paspalum notatum (mato-grosso grass).

In the decades of 1970 and 1980, the area was used for rice culture due to the moisture present in the soil. In some points of the surrounding, it was possible to observe some drains made in order to improve the terrain for farming production directly impacting the changes of this landscape. With the decline of rice culture, a great part of the areas around practice now beef cattle raising.

In general, this lot presented the least diversity, being possible to detect only the presence of arborescent and creepy-herbaceous strata both in progression, highlighting the undetermined presence of Croton urucurana (Sangra-D'água), typical of humid areas, as well as mato-grosso grass in the pasture areas. For the last five years, the use of agricultural machinery, such as tractors and cutters, has been prohibited in these areas due to the fragility of the soil, as determined by Ministério Público do Estado de São Paulo (São Paulo State Prosecutor's Office). Check the vegetation pyramid of lot nº03 below (Fig. 5).

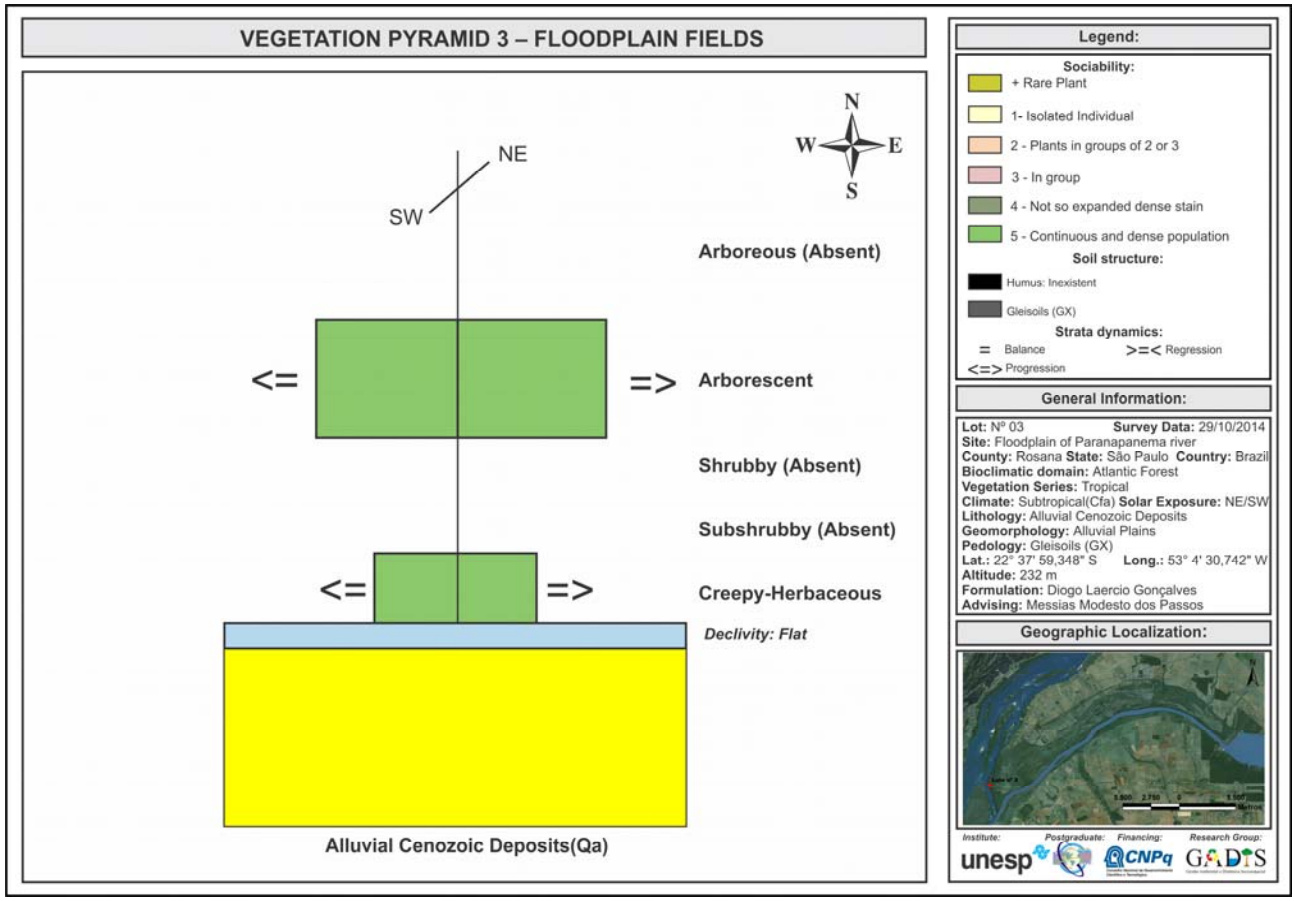

Fig. 5 Vegetation Pyramid of lot nº03 [4]

3. Final Considerations and Indications

The study of the vegetation is essential to the assessment of the socio-environmental impacts in the landscape in the last years. The case of the floodplain of Paranapanema River shows that, in the last decades, the process of land occupation intensely modified its landscape, which causes us to have a different look

from the environmental point of view.

The fragmentation of the vegetal cover has become a physical barrier for the development of fauna and flora species, preventing the gene flow. As it can be observed in the vegetation mapping, most of the APPs (areas of permanent protection) around the rivers Paraná River and Paranapanema and their affluents have not been respected and, besides that, some waterlogged areas have been drained for the cultivation of rice. Moreover, in some other areas, the native vegetation has been substituted by grass aiming at the practice of extensive cattle raising.

From phytosociological studies, we are able to guide, in a theoretical-methodological way, our interpretation of the current stage of the vegetal strata, allowing an assessment of evolution, balance or regression of each stratum in the determined area. This kind of study has allowed us to transit in a transdisciplinary way with Biology and Botany in order to understand the vegetation in a more complex manner.

With the vegetation pyramids, we have the final result of this study, from the systematization of the field data, creating a representative model of the composition of the vegetal stratum in each lot. In general, we can see that the anthropic presence was evident, directly or indirectly. However, in some cases such as lots 1 and 2, where the area has not been used for human activities, it is possible to see a natural regeneration of the vegetation, which indicates a good dynamic among the vegetal strata. Nevertheless, we have to point out that one of the areas was reforested with the planting of native species performed by CESP as a compensatory measure for the building of the hydroelectric power plants in the rivers Paraná and Paranapanema.

In this context, the connection of these forest fragments through Ecological Corridors becomes an integrating alternative, with the effective participation of the social actors in accordance to the Brazilian environmental legislation. As an example, we highlight some ecological corridors done by the Institute of Ecological Reasearch (IPE) in Pontal do Paranapanema, linking the fragments of Morro do Diabo State Park and Mico Leão Preto Ecological Stations, preserving the gene flow among the species.

We bring to attention the importance of the area in the regional context, once it is part of the project Paraná River Corridor of Biodiversity, besides being in the context of the priority areas for the connection of biodiversity in the biome of the Atlantic Forest, proposed by the Ministry of Environment, and the project BIOTA-FAPESP [7]. The Civil Inquiry 263/2010 also potentializes the importance of establishing this Ecological Corridor, once the area receives great interest from the government of the state of São Paulo, for environmental preservation.

Therefore, we can point out some steps for the creation of the Ecological Corridor of the Floodplain of Paranapanema River, structured on the methodology proposed by Brito (2012) [8], executed in the projects of ecological corridors of IBAMA and ICMBio, adapted to the reality of the Floodplain of Paranapanema River and to the GTP system (Geosystem-Territory-Landscape), proposed by Bertrand (2009) [9], systematized in Table 2.

From the appointed steps for the creation of the ecological corridors, the proposals must be analyzed and discussed with the target population and neighboring areas that will contribute to the initial draft for these studies. Forming a study group together with the universities, local governments and other official bodies, we can continue the discussions about the creation of the Ecological Corridor aiming not only at

Table 2 Steps for the creation of the ecological corridor of the floodplain of Paranapanema River [4].

Steps for the creation of the Ecological Corridor of the Floodplain of Paranapanema River	
Step 1 – Initial Phase:	*Initial surveying of the area through interviews with the local population; *Mapping of the ecological potential (geology, geomorphology, climate, soil and vegetation) identifying geophysics and geotopes.
Step 2 – Intermediary Phase:	*Creation of Work Groups involving the local population and public services: City Hall, watershed committees, Universities, etc *Discussion forums with the local actors and elaboration of a plan of environmental management, involving the official bodies and all the community.
Step 3 – Advanced Phase:	*Seek for funding sources for the implementation of the Ecological Corridor; *Training of uses to empower the Environmental Education by activities that use the ecological corridor.

the environmental gains but also at the quality of life and valuing of the local and neighboring populations.

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