Geodesign as Co-creation of Ideas to Face Challenges in Indigenous Land in the South of Brazil: Case Study Ibirama La Klano

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Abstract. Strong development pressures affect areas in South American countries, resulting in conflicts of interests in land use and ownership, and problems of environmental protection and anthropization. Geodesign proved to be a robust systematic methodological framework to guide a workshop in which the actors are real people of the place, professionals from public administration and the academy. The paper presents a case study about an indigenous land in Santa Catarina, South of Brazil, called Ibirama La Klano, the territory of Xokleng indigenous group. In 1970 a huge dam was constructed in their land to control flooding downstream in the Itajaí valley, but it ended up causing the flooding of their place. The goal of the Geodesign workshop was to support a meeting in which different actors could co-create ideas to face vulnerabilities and to develop potentialities of the area. To prepare Geodesign workshop the academic group from UFMG and UDESC worked with the Civil Defense of the State of Santa Catarina, constructing maps about the place and evaluations about suitable areas to receive proposals. The indigenous main executive chief and regional chiefs were invited to Geodesign workshop, which resulted in ideas representing values of different sectors of society, arriving to a negotiated design.

Keywords: Geodesign · Geoprocessing · Territorial planning · Co-creation

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1 Introduction

Strong development pressures affect urban and rural areas in South American countries, as the population grows and people migrate from the countryside, resulting in conflicts of interests in land use and land ownership, and problems related to environmental protection and anthropization of the territory. Design to accommodate these conflicts and challenges is often guided solely by economic factors and implemented without consideration of social and environmental factors and, mainly, without considering the opinion of people of the place and the actors involved in the process. This approach risks unsustainable forms of land use and territorial planning.

Investment in new methodologies, procedures, collaborations and technology are needed, and Geodesign proved to be a robust systematic methodological framework to guide a workshop in which the actors are real people of the place, professionals from public administration and the academy.

Geodesign is design "with" the territory and "for" the territory. It aims at the contextualized transformation of the landscape, respecting nature and culture. Geodesign can provide a systematic methodological framework for regional, urban and local planning, aiming at the sustainable integration of human activities with the natural environment, respecting cultural peculiarities and enabling a democratic decision-making process.

It is a method of collective construction of alternative futures for a landscape or territory, which can be applied at any scale, in which citizen listening is fundamental to the construction of opinions and decision-making. It is largely based on geo-visualization applications, even if they are analog. The principle is to inform the participant about the main characteristics of the place, and for this it is necessary to provide a set of thematic information and its syntheses in main systems, which will be the basis for the co-creation of policies and projects.

Important authors such as Dangermond [1], Ervin [2], Flaxman [3], Miller [4] have already written about the theme, presenting their contributions, but the work of Steinitz [5] stands out, who structured the procedures through a methodological framework, a work framework. This methodological framework was expanded and disseminated throughout the world through the use of the web-based platform GeodesignHub that favors the development of the collaborative workshop, developed by Ballal under the supervision of Steinitz [6, 7].

Steinitz [5] presents a work structure in the form of a framework with six steps to be followed, composed of six models. The paths in these six models must be done three times, in what he calls three iterations, for adjustments and adjustments to the requirements of the case study (Fig. 1).

The case study developed was about an indigenous land in Santa Catarina, South of Brazil, called Ibirama La Klano. It's an area of 37018 km^2. The indigenous group called "Xokleng" had the first contact with the white men just 105 years ago, so they keep important values about land use and territory (Fig. 2).

In the 1970's, without any previous consultation on the opinion of the Indians, a huge dam was constructed, with the goal to control flooding downstream in the Itajaí valley. According to Fraga [8, 9], the dam stated to be constructed in 1976 and was

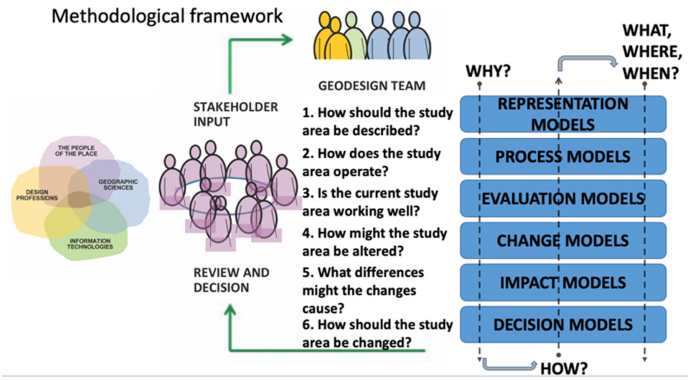


Fig. 1. Geodesign framework proposed by Steinitz [5].

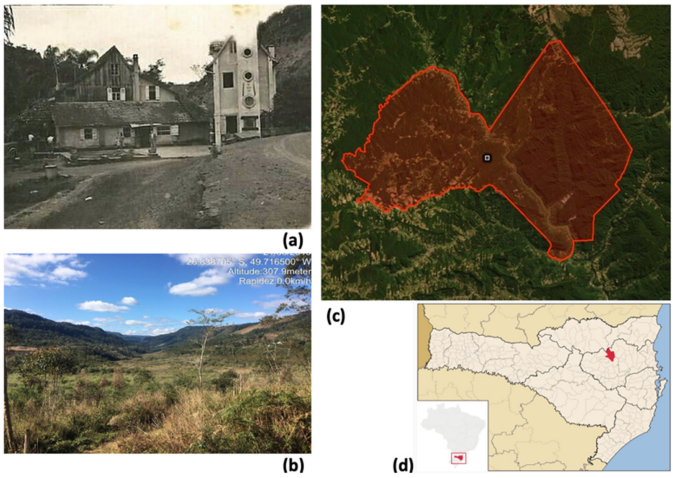


Fig. 2. Images of the place: (a) the colonizer house; (b) the point where the Indians met the first white man; (c) Indigenous Land Ibirama La Klano; (d) Municipality of José Boiteux, in the State of Santa Catarina, where the area is located. Source: Organized by the authors from CDSC Report and Wikipedia.

finished in 1992. The intention was to protect the medium and low part of the valley, but it ended up causing the flooding of the high valley, in 900 hectares of Ibirama land, especially the most productive land, which influenced their livelihood. There are movies that tell about the issue, presenting their challenges and difficulties: https://youtu.be/VCM5yu56Gzk and https://youtu.be/_awC-Ri1aa0.

The goal of the Geodesign workshop was to support a meeting in which different actors could co-create ideas to face vulnerabilities and to develop potentialities of the area.

2 Methodology

To prepare the Geodesign workshop the academic group, composed by the Federal University of Minas Gerais and the State University of Santa Catarina, worked with the Civil Defense of the State of Santa Catarina. They constructed Thematic Maps about the main characteristics of the place and Evaluation Maps about the suitable areas to receive proposals. The indigenous executive chief (sagamore, the main "cacique") and regional chiefs were invited and took part in the Geodesign workshop, together with technicians from the Civil Defense and the academic group. The meeting resulted in designs representing the values of different sectors of society and portions of the territory, as each part of the land, downstream or upstream of the dam has its expectations, but also arrived in a negotiated design.

Just after defining the main challenges to be faced, discussing vulnerabilities and potentialities, the conductor group prepares data about the case study, which are Representation Models, to answer how the area should be described. In this step happened many important meetings with the academic group and the Civil Defense of Santa Catarina State, mainly with the technicians that work with indigenous case studies and could tell us about their culture, their land, their way of living. Expressive efforts were done to get data and to construct georeferenced information.

The data organized was transformed in the spatial distribution of occurrences and phenomena's, resulting in Process Models to answer about how does the study area operates. Geoprocessing models were applied, as slope models, satellite classification to map land cover, calculation of NDVI (Normalized Difference Vegetation Index) to map vegetation and their characteristics, buffers of hot-spot elements, buffers of roads, concentration of houses, areas of influence of elements like the dam, and so one. The academic group using geoprocessing knowledge conducted the works.

The third step was based in the definition of main systems, which are the main research themes on which they want to listen to citizens and promote the co-creation of policy and project ideas for the area. The systems legend must be divided into the classes: very indicated (feasible), adequate (suitable), possible (capable), inappropriate (inappropriate) and resource that already exists or already solved (existing). These systems, as the name implies, are compositions of sets of variables of interest to the theme, which can be integrated by Combinatorial Analysis or by Weights of Evidence, presenting to users, a previous judgment or an opinion of the workshop conductors about the most suitable places to propose ideas. The combination of variables analyzing if the area is working well results in Evaluation Models. These models are uploaded in the platform to be used in the Geodesign workshop, as bases to guide the users about the suitability for change of each part of the territory.

The organizers also have to suggest targets, investigate costs and define a matrix of conflicts of interests. This information will be used in Impact Models, which tells about what differences might the changes proposed by the participants in the workshop can cause.

With Representation, Process, Evaluation and data to Impact Models already constructed, it was time to conduct the presential workshop. The workshop was held in UDESC, during "Geodesign South America 2019", as part of the conference activities.

The workshop received numerous participants, and it was necessary to distribute them to two computers' laboratories, placed side-by-side. Carl Steinitz conducted the workshop, with the support of Ana Clara Moura.

The participants were composed by professors of public and private universities, technicians from public administration, Civil Defense group, undergraduate and post-graduate students, indigenous representatives. It's important to highlight that the main hierarchy of the Indians came to the workshop.

The participants, representing actors of the society, were divided in two rooms and were asked to propose and defend ideas of teams established according to territorial divisions and social divisions: Public Administration, Civil Defense, Non-Adopters (people that was not willing to propose changes), Down (people from low part of the valley), Low (people from the medium valley) and Up (the high part of the stream).

They were asked to draw diagrams about policies and projects to the 10 systems, that are the main thematic discussion considering vulnerabilities and potentialities of the area: displacement, risk, new houses, area of operation (also corresponding to the hydro), accessibility, agriculture, vegetation, tourism and culture, entrepreneurship, others. Each team proposed at least one idea of a project or policy for each system.

After drawing the diagrams, they were asked to select, from all the systems, the ideas they approved, among all of those proposed by them and by the other teams, and to save the first design, that is a Master Plan to the territory. They defended orally their ideas and had the opportunity to construct a second design because Steinitz [5] explains that the first design is not the best one, so it's a way to make them prepare a better proposal.

They were asked to analyze the proposals of the all the teams, and were asked to compose one proposal per room, based on negotiation: in room 1, conducted by Steinitz, the group was composed by the teams Down, Low and Up; in room 2, conducted by Ana Clara Moura, the group was composed by the teams Civil Defense, Public Administration, and Non-Adopters.

Two designs resulted from the previous step, one per room, and all the participants went to the auditorium, where the last and final design was composed based on negotiation. The steps of the process can be summarized in the framework (Fig. 3):

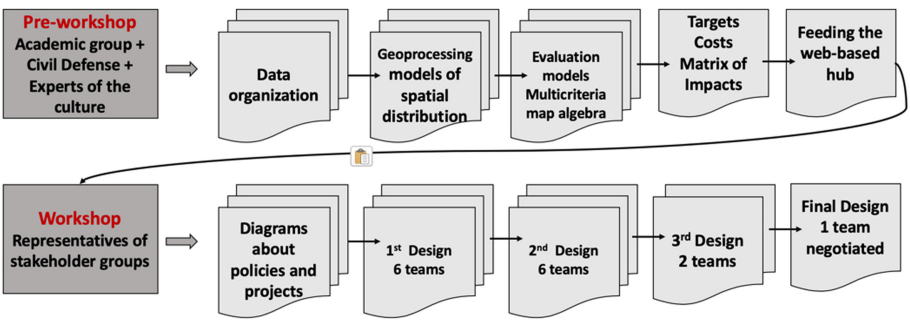


Fig. 3. Main steps in methodological framework. Source: The authors.

3 Development and Analysis

The development of any spatial analysis as a basis for proposing territorial planning actions requires clear knowledge about the object under study and the research objectives. This stage consists of the definition of the systems' analysis, which is chosen according to the main themes for the demands or needs of discussions.

In the case study of the Indigenous Land, based on the videos watched and interviews with experts on the topic and on the region, the main problems were the conflicts resulting from the construction of the dam and the flooding of the lands upstream resulted from that intervention. Added to these problems there is also the responsibility of the Civil Defense to serve the people of the place and, therefore, to negotiate emergency access and risk protection areas.

On the other hand, in order to guarantee indigenous peoples' survival resources on the lands, it would also be necessary to discuss potentialities related to cultural tourism, sustainable agriculture, improvements in infrastructure conditions related to accessibility, possible diversification in land use considering protection and requalification of vegetation cover, choices of strategic locations for new housing or for the eventual displacement of units at risk of flood impacts.

From the problematization, the production of data was started, transformed into information by geoprocessing models, and prepared for use during the workshop. The investment time in this stage was about 40 h spread over 2 months, in weekly meetings by videoconference and development in a geoprocessing laboratory.

3.1 Representation Models

Once the main characteristics of the place were identified, it resulted in the definition of the 10 systems: tourism/culture; displacement/relocation related to hydro system; geological risks; places for new houses; operation area to be protected against use; accessibility; sustainable agriculture; vegetation protection or requalification; possible entrepreneurship; other ideas. The system "other ideas" was proposed to receive ideas that were not considered in the previous systems. The goals of the systems were:

a) GEOLOGICAL RISK - Where to propose actions to correct or contain the risk. Remembering that there is, above all, flooding and flooding, in addition to areas with high declivity.
b) DISPLACEMENT/RELOCATION OF USE – CORRESPONDING ALSO TO HYDRO SYSTEM - Where to propose actions to remove housing or activities and relocate to other places. Remembering the risk related to the dam.
c) NEW HOUSES - Where to propose new houses resulting from reallocation or expansion of occupation. Recalling the risk related to the presence of the dam and the potential for growth.
d) OPERATION AREA - Where to propose new areas for operational safety. Recalling the risk related to the presence of the dam and the need for Civil Defense action.
e) VEGETATION - Where to propose new areas for protection or requalification of vegetation. Remembering the expressive vegetation to be protected, since the fact of

being an indigenous reserve does not eliminate the possibility of suppression of vegetation cover.

f) ACCESSIBILITY - Where to propose new accesses or qualify existing ones. Recalling the need to integrate areas to favor services, assistance and entrepreneurship.
g) AGRICULTURE - Where to propose new areas of activity or increase existing ones. Recalling the need for production for subsistence, but also the possibilities of entrepreneurship.
h) TOURISM AND CULTURE - Where to propose areas for exploration or increased visitation activities. Recalling the possibility of receiving interested in knowing the activities of the local culture and way of life, in ecological and adventure tours, among others.
i) ENTREPRENEURSHIP - Where to propose new areas of activity or increase existing ones. Recalling the possibility of making culture and way of life sources of entrepreneurship, related to products and interest in visits.
j) OTHERS - Free system to receive proposals that do not fit in the previous systems. It only blocks the Integral Protection Conservation Unit and authorizes proposals in any part of the territory, since they can be of any nature.

Some images of the main representation models, that tells about "how should the area be described" are presented. To construct them we used satellite images (Sentinel 2A, from Copernicus Program) that was classified according to land use and NDVI (Normalized Difference Vegetation Index); collection of data by field camp made by the Civil Defense (touristic attractions, roads, dam limits, and existing houses); DEM data (Alos Palsar from Alaska Satellite Facility, about Digital Elevation Data) to calculate slopes; and official data from the public administration (administrative limits and Conservation Units of sustainable use and of permanent protection) (Fig. 4).

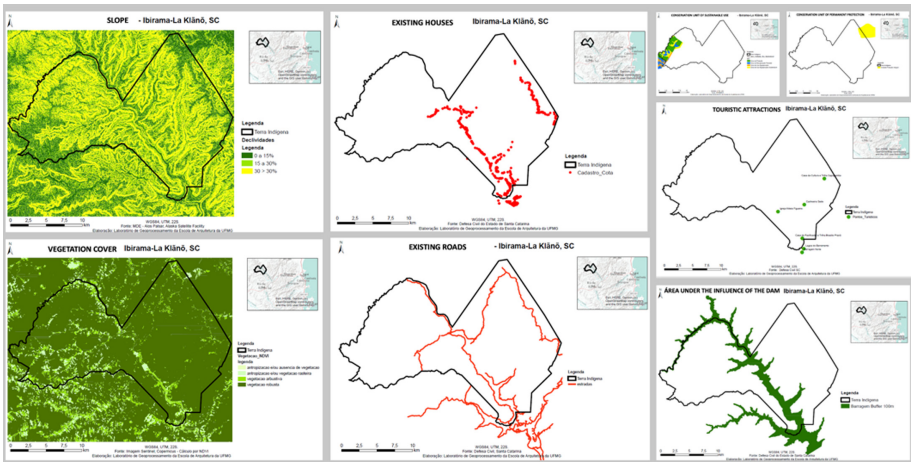


Fig. 4. Some thematic cartographic data produced: slope, vegetation cover, existing houses, existing roads, conservation units, tourist attractions, area of influence of the dam. Source: The authors.

3.2 Processes Models

With the goal to understand how the area operates, the data produced was classified according to the interest of each system, and received colors according to Geodesign semiotics proposed by Steinitz [10]:

- Dark green – "Feasible" for the best condition to receive ideas of projects and policies,
- Medium green – "Suitable" for not the best but a very good place to receive ideas of projects and policies,
- Light green – "Capable" for not a very good but an acceptable area to receive ideas of projects and policies,
- Yellow – "Not appropriate" for areas not indicated for projects or policies of that thematic,
- Red – "Existing" for areas in which the problem as already solved and it was worthless for projects or policies.

To each system was defined a set of maps and they were processed according to the specific needs of the thematic. For example: a Slope Map in the system Risks could be organized in the legends defining the most fragile areas to be protected and the areas to which it was not necessary to do an intervention (more than 47% - most fragile in terms of risks, 30–47% - medium risks, 0–30% not in risks of slope); but the same map, when used in the system Agriculture presented the legends defining areas that were most suitable for agriculture and specifying those that were not good due to topographic difficulties (0 to 5 – excellent, 5 – 15 – acceptable, more than 15% not suitable). In this sense, what is dark green (feasible) is the opposite in each case (Fig. 5).

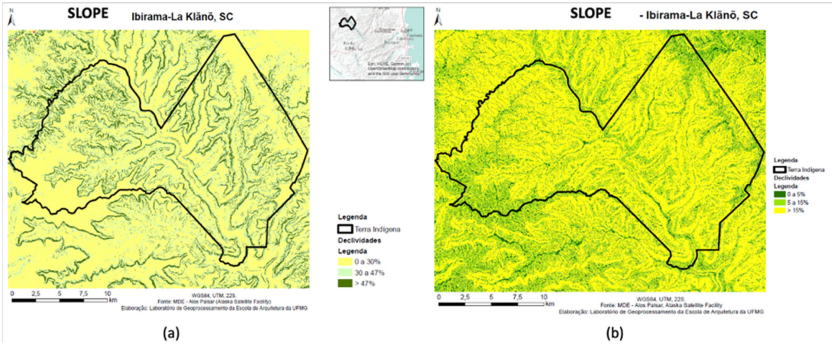


Fig. 5. Slope Map presenting different legends and semiotics, according to the system it's going to be used: (a) Slope Map in Risks System; (b) Slope Map is Agriculture System. Source: The authors.

3.3 Evaluation Models

The evaluation models have the goal to indicate if the area is working well, presenting those that are most suitable for proposals of projects or policies. It is constructed as support to participants of the Geodesign workshop, presented as a background map, to guide them where to put their contribution.

It is a result of a map algebra in which the organizers select the main variables to be combined and classify them according to their opinion of suitability to the thematic. Even when the organization group listen to people's opinion and apply methods to do a more democratic decision about the evaluation, it is still a qualitative map based on opinions. Therefore, they will never consider all possible variables (because anytime someone can arrive with a new suggestion of map to be included), and they will never feet all the possible opinions about what is more important.

Evaluation Maps have a great level of uncertainty that it is more representative if the thematic goes from technical subjects to cultural subjects. Risks Map can have less uncertainty than New Housing Map because the first one is based on quantitative parameters while the second one is based on qualitative parameters that change with local culture and even change among individuals. The problems related to the use of Evaluation Maps were observed in many workshops conducted by UFMG group because in Brazilian culture people don't accept very well the pre-defined map telling where is the best place for something, or they don't feel comfortable until its explained how the map was created, or them just don't care about the Evaluation maps during the workshop and prefer to use a general base map to draw their ideas [11–13].

Evaluation Maps results from the combination of selected variables, which can be characterized as an overlay of levels in Multicriteria Analysis (MCA). There are two methods of combining variables in MCA: based on Weighted Sum and based on Combinatorial Analysis [14]. When the relationship among the variables can result in an index, classified in a ranking and resulted from different weights applied to define the hierarchical importance of each variable, the method is the Weighted Sum [14, 15]. However, when the relationship among the variables must be decided defining which is the most important and must be on top of decisions, and then continue this definition changing levels positions of variables, the method is the Combinatorial Analysis [14].

The majority of Evaluation Maps used in Geodesign workshops are more robust if constructed according to Combinatorial Analysis. It is necessary to previously classify each layer of variables according to the Geodesign semiotics (dark green, medium green, light green, yellow and red), and it's not sad that all colors will be used, because they are definitions of conditions that may not exist. The user takes first the green elements from all variables and combines them, and if he uses transparency, the greener he can see the more expressive is the spatial combinations of suitability conditions. Then the user takes the yellow elements, but all of them must be together overlaying the previous combination because even if it considered "not appropriate" in just one layer, the area is undoubtedly not appropriate. Finally, he uses the red elements overall, defining areas in which the resources already exist and is useless to receive more projects or policies. The combinations are tested in geovisualization, but must be constructed in map algebra of addition and subtraction (Fig. 6). The conductor can share decisions with a group.

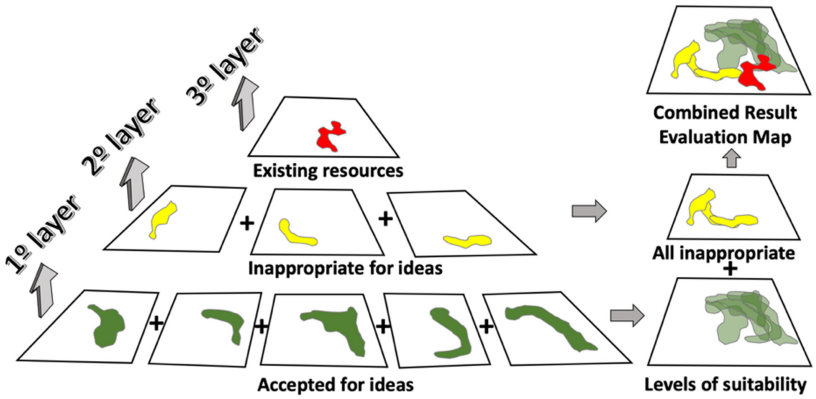


Fig. 6. Combinatorial Analysis classifying the territory according to levels of suitability: from accepted areas for ideas, to inappropriate areas for ideas, to areas already with existing resources. Source: The authors.

As an example is presented the construction of Evaluation Map to the system "Tourism and Culture", to which it was decided to work with the variables area of influence of the dam, area of influence of existing roads, indigenous houses, trails, touristic attractions, and conservation unit of permanent protection. From this 6 variables, 5 of them are potentialities and 1 is vulnerability (conservation unit of permanent protection), what means that the 5 potentialities are colored in green and combined, while the vulnerability defines an area that is not appropriate for tourism (Fig. 7, Fig. 8).

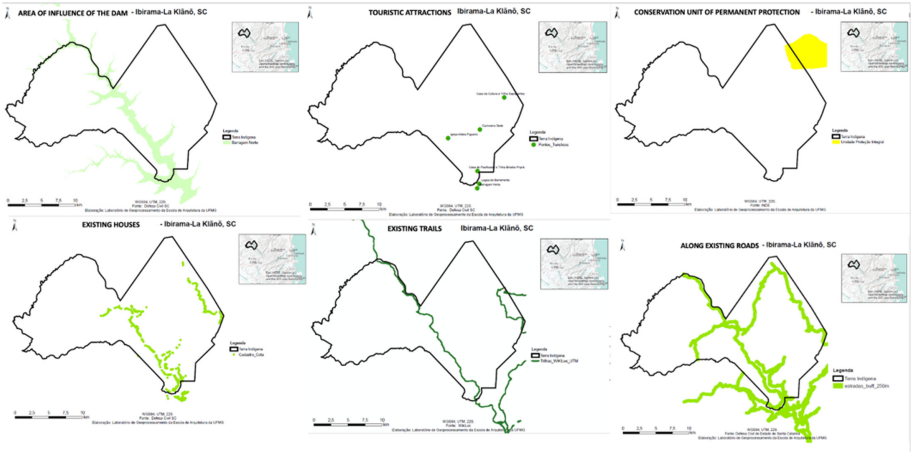


Fig. 7. Combinatorial Analysis classifying the territory according to levels of suitability, example of "Tourism and Culture": the variables classified. Source: The authors.

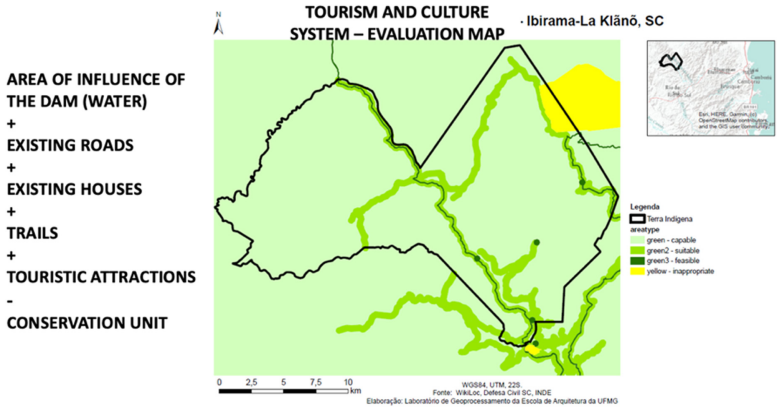


Fig. 8. Combinatorial Analysis classifying the territory according to levels of suitability, example of "Tourism and Culture": the Evaluation Map produced. Source: The authors.

All the Evaluation Maps were created the same way to be used as systems during the workshop (Fig. 9). It was also necessary to prepare external layers, that are data to be visualized as a spatial reference to recognize places and territorial characteristics (Fig. 10).

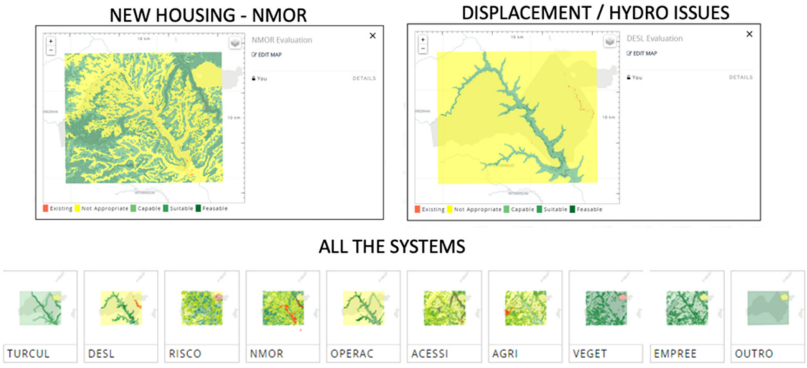


Fig. 9. All the Evaluation Maps used as systems and examples of two of them: New Housing (with the goal to discuss where to build new houses) and Displacement/Hydro Issues (with the goal to discuss what to do in areas under risk of flood). Source: The authors, using GeodesignHub.

3.4 The Workshop: Co-creation of Ideas

Once all the information to the workshop was constructed, it was organized to be held in "Geodesign South America 2019", that happened in the end of 2019 in Florianópolis, UDESC. The workshop started in the auditorium, with the Indigenous Chiefs presenting their problems and conditions of life. After watching a video about



Fig. 10. External layers: roads, house, dam, security area, and satellite image. Source: The authors, using GeodesignHub.

the place, people were divided into groups to start working. The participants were divided into teams according to territorial representation (low valley, medium valley, and high valley, called UP, LOW and DOWN) and according to actors of the society (Civil Defense, Public Administration, and Non-Adopters Stakeholders). These teams were defined by Carl Steinitz. The indigenous representatives were invited to take part as consultants from their values and culture, which means two of them were in one room and one was in the other room, and people asked their opinion to construct the proposals. It was a very important opportunity to listen to them, to understand their point of view, and to ask as decoders of their expectations (Fig. 11).

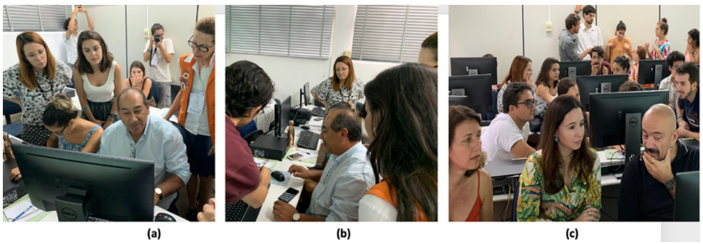


Fig. 11. Teams developing their proposals consulting the Indians' opinion: (a) The main Indigenous Chief explains their problems; (b) People constructing the proposals in co-creation of ideas; (c) Working on teams. Source: The authors.

The teams were asked to design diagrams with proposals of projects and policies to all systems. Once good amounts of diagrams were inserted in the web-based platform, each team (they were 6) was asked to construct the first design, which was presented in

oral defense to everybody. They learned how to calculate impacts of their proposals, to verify if they had reached the targets in ha expected per system, and to analyze possible costs (Fig. 12). This means to use Impact Models that calculate the suitability of proposing each idea in the place they were planned to be and to arrive to that result the organizers of the workshop had to prepare a matrix of possible impacts among systems (Fig. 13).

They understood that the first design is never the best one, and every 6 teams elaborated a new design. After that, they were organized in two teams per room and construct one design per team. The new teams were: Civil Defense + Public Administration + Non-Adopters; Low + Up + Down. The method to construct a common design is to use the tools to compare the proposals, finding agreements and disagreements, discussing possible adaptations to make some ideas acceptable to all the teams, co-creation of new ideas. Finally, two new designs were constructed, one per room, all the participants went to the auditorium to compose together the last design, the negotiated design (Fig. 14).



Fig. 12. Construction of diagrams about projects and policies and the selection of diagrams to compose the first design per team. Analysis of impacts (purple positive, yellow neutral, orange negative impact). Source: The authors, using GeodesignHub. (Color figure online)

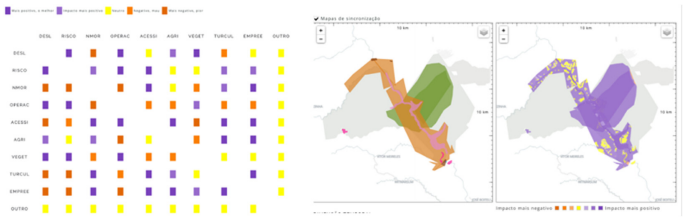


Fig. 13. Impact Matrix proposed by the organizers and example of calculation of impacts in maps representation. Positive impacts are purple, yellow are neutral and orange are negative impacts. Source: The authors, using GeodesignHub. (Color figure online)

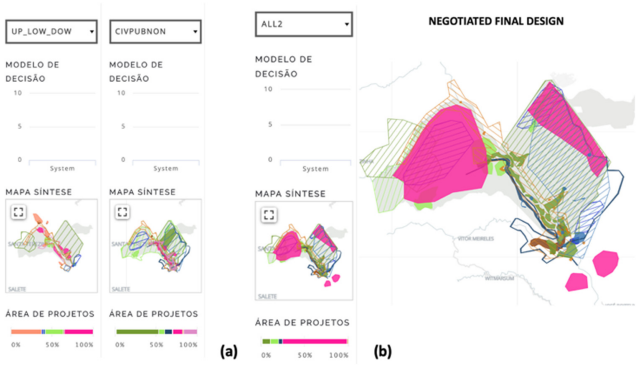


Fig. 14. Negotiated designs: (a) Two designs resulted from negotiation in each room; (b) Final negotiated design. The authors, using GeodesignHub.

The method used to arrive at the final design was: the main important system was selected to be the first one, as once it was decided it could define important decisions in the other systems. The most important system selected was "displacement", because it was on this system that issues related to the dam were proposed. They decided not for constructing anything else in indigenous territory, not to remove the dam, but mainly to do works of conservation in the existing dam, facing the problems of silting around it. After this, they discussed where to put new housings, where to construct monitoring points, rescue meeting points, escape routes. They discussed about agriculture and areas to recover the vegetation. They planned entrepreneurship activities and the possibilities of tourism.

4 Conclusions and Discussions

The main lesson learned in the experience was about how to listen to people that come from different territories and cultures and transform their expectations in diagrams of policies and projects, as well as how can the conductor group give support to the co-creation the final design respecting the indigenous knowledge of local reality and the discussion guidelines presented by the Civil Defense.

We learned a lot with the Indians because they stating observing the process to understand the rules and the logic under it, mainly on the first day of the workshop. On the second day, they controlled the final decision with equilibrium, accepting the good ideas and refusing the bad ones presenting their justifications. Since the beginning of the workshop, they patiently explained about their life, their way of being, their relation with the territory. Sometimes, when the proposal of a project or policy was not appropriate to their values and culture, or even to conditions of the geography of the place, they were able to explain the reasons in detail, demonstrating knowledgeable about laws, risks, and potentialities.

They had all the reasons to be reactive, as we were talking about their life and the big impact they suffered from the construction of the dam. But, instead of that, they

were gentle, collaborative, and all the negative presented to bad ideas were followed by an explanation about why they could not be approved. It was a great opportunity for all members from different academic group to learn diplomacy and negotiation with them. And it's important to register that the main issues were all considered, contemplating the needs of Civil Defense to develop their work in operating in risk occurrences or demands.

As feedback to Geodesign method, we observed and controlled the use and the utility of each step in the process, in order to adapt them to local culture. The first observation was about the data prepared for the workshop, organized in Representation, Process and Evaluation Models. They had an importance to the conductor group as it was an opportunity to get together in video-conference meetings to learn more about the place. While we were doing the classification of satellite image and calculating the conditions of vegetation cover we stated to construct an image of the territory. While constructing the 3D representation and calculating slopes we understood the water network and the impacts of the dam. While getting official data about conservation units we identified the conflicts of interests due to the presence of agriculture areas in an area classified as of sustainable use but located in springs of the water basin, responsible for chemical pesticide pollution in the area. Nevertheless, we also understood that conservation unit classified as of permanent protection was an important landmark in the territory, in a high position, but also related to spiritual values to the Indians. While mapping the existing roads and houses we understood the risks, because most of them are in the flood areas. Summarizing, it was important for those that do not live in the territory to identify the vulnerabilities and main values of the place and to arrive in the workshop with minimum knowledge about the case study. But it's important to say that all this information was produced and constructed in Representation and Process Models.

The Evaluation Models are understood as opinions from a group about the suitability of parts of the territory to receive proposals of projects or policies. It's more a personal exercise of combining data, generalizing information and constructing a model that, as models, is a simplification of reality providing reductions in place, time, methodological framework and conceptual definitions [16]. To those that don't know the territory, as the academics that took part in the workshop, the use of Evaluation Models are a question of faith, because they just trust on them as a basis to put their ideas in a suitable place. To people of the place they are useless, because they know their territory better than anyone, and most time they do not agree with the judgment of those who construct the models. Finally, even to the group of conductors that constructed them, as it is an opinion, the judgment can change in time and conceptual evolution.

During the workshop, the Evaluation Models and Impact Models had their importance very reduced. The Impact Models are strongly related to the Evaluation Models, as they inform if the ideas of projects were drawn in suitable places according to cross-combination. As it was not an academic experiment of a theoretical place, but was a real case study, all the questions about suitability were answered by the experts: people from the place and civil defense, using their knowledge and a satellite image as a base map.

The models that worked well during the workshop were Change Models and Decision Models. In that sense, we may say we could work just with some Representation Models, a minimum list, some Process Models and develop Change and Decision Model during the workshop. The facility to draw ideas of projects and policies was much appreciated, what is Change Model. The easygoing negotiation was also much appreciated, what is Decision Model (Fig. 15).

As Geodesign is design with the territory and for the territory, the case study resulted to be very realistic and dealing with the expectations and cultural values of the participants. The final design, constructed from the agreements in a process of democratic decision making, resulted to be a sustainable integration of human activities with the natural environment, respecting cultural peculiarities, both nature and culture.



Fig. 15. Participants from the workshop that was held on Geodesign South America 2019, UDESC, Santa Catarina, Florianópolis, Brazil. The authors.

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