RISK MITIGATION AREAS FOR VILLA RICA SCHOOL USING GIS AND CROWDSOURCING

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ABSTRACT

The environmental problems in Bogotá, in the School Villa Rica, affecting the quality of life of people. The risk areas concerning security and environmental matters were defined by the academic community, using crowdsourcing, showing good results allowed the definition of points of surveillance. As a result, GIS models, scenarios for mitigation areas, and safe alternatives to go from home to school were created. Also the project let the school community to be interested in use ArcGIS online.

Keywords: academic community, crowdsourcing, environmental problems, student security,

INTRODUCTION

In Bogotá the capital of Colombia, there are different ways to go to school, even in extreme conditions, which students must go to attend the school far or closest where they live. The public school Villa Rica like most of the schools of Bogota, Sometimes, many students come from nearest municipalities such of Soacha, which imply risk on the roads, long walks, lack of resources to take transportation, despite the fact there is not enough the subsidies for the students of the community.

Therefore, taking into account the importance to solve problems by the incorporation of Information and Communication Technologies (ICT) was used as a means of registration, consolidation and representation of the subject to be addressed: Risk and vulnerability areas in both security aspects and environmental that occurs in the educational community that makes up the District School Villa Rica from the place of residence of students, who are mostly located in the UPZ 48, Timiza.

This work challenged the implementation of three elements within the institution: Technology, Geographic Information and crowdsourcing. Tools that provide great help in the collection of information, by the educational community of the Villa Rica school, the

generation, evaluation, analysis and comparison of risk areas, based on information from both the school and external sources, with the end to determine patterns of coincidence; that allow to define possible points of surveillance.

1. STUDY AREA VILLA RICA PUBLIC SCHOOL

The selection of the study area, was important to highlight the characteristics that stood out among the others. In this sense the UPZ Timiza is located on the south western side of the town of Kennedy, one of the twenty towns that make up the city of Bogotá D.C. The UPZ has forty-nine (49) neighborhoods, eight (8) schools and three (3) Immediate Care Centers (CAI); A factor to consider within this zone are the multiple narrow roads, evidence of the lack of planning in front of the great affluence of automobiles along with the constant urban and population growth. Causing problems of mobility and insecurity to its inhabitants the moment they leave their homes. On the other side reviewing official sources at the time of selecting the study area and the institution as a sample, there was contact with the school's educational community, who additionally highlighted the following problems to what they must face, both security and environmental.

Security**:**
- Consumption of narcotics.
- Aggressive encounters between brave bars, fans of the Colombian Football teams: Independiente Santa Fe, Millonarios FC and Atlético Nacional.
- Robbery
- Risks near to the river Tunjuelito.

Environmental:
- Frequently there are complaints about the mishandling of garbage, since in some sectors of the UPZ an organization has not been established as to the place to locate the waste to be picked up by the service operator in charge.
- There are industries that do not have a good management of their waste and in general, the contamination that can origin, for example, the machinery they use.
- Due to high vehicular flow, there is air pollution.

2. SAFE ROADS FROM AND TO HOME TO SCHOOL - SCHOOL TO HOME

The base of this approach was a project carried out by the Department of Education of the capital called *"Safe roads, solidarity roads from home to school, from school to home: pedagogies, narratives, cartographies and re significations constructed from schools for the protection and care of children"* (Secretaría de Educación de Bogotá, 2007). Carried out in 2007 and materialized in a booklet, shows a detailed description of the existing situation in the public schools of the city, in aspects such as safety and environment. Additional, it exposes all the activities carried out in each locality.

According to the above, alternative solutions are offered, such as the following:
- Development of protection Works
- Vulnerability intervention
- Incorporation of preventive aspects in investment Budget
- Preparations for emergency care.

A tool that can contribute to the prevention and control of disaster conditions is social cartography, establishing in the project *"Social cartography as a methodological instrument in the processes of territorial construction based on citizen participation in territorial planning and construction of public space "*(Cubides, 2009) through a review of participatory practices in territorial planning and citizen participation, applying a methodology that will contribute to broadening the process of citizen participation.

Highlighting the value of social memories within the realization of maps and other representations of the territory, since local knowledge arises from there leading to a construction of better realities, sociocultural, environmental, political, economic and, in general, management territorial in different scales (neighborhood, local, regional, sectoral, social, etc.). Citizen participation is essential for administrations and their efficient management; This facilitates the exercise of citizenship, strengthens the sense of belonging, generates processes of empowerment and, consequently, increases the presence and active management of the citizen on public issues.

Additionally, as a support of social cartography, Crowdsourcing was implemented in the article. Jeff Howe in his book *"Crowdsourcing: Why the power of the Crowd is Driving the Future of Business."* (Howe, 2008) Defines the crowdsourcing model as a tool for gathering information characterized by being based on a multitude of observers, considering it closest to the truth that the information obtained by a single observer.

3. MATERIALS AND METHODS

Once the study area was selected, information was obtained related to the safety and environmental time risk zones of the school's educational community through a web application, for the respective analysis.

To carry out the study, we used a spatial database created from the information provided by the educational community in some surveys and later using an application supported with the crowdsourcing tool and created for the development of the project.
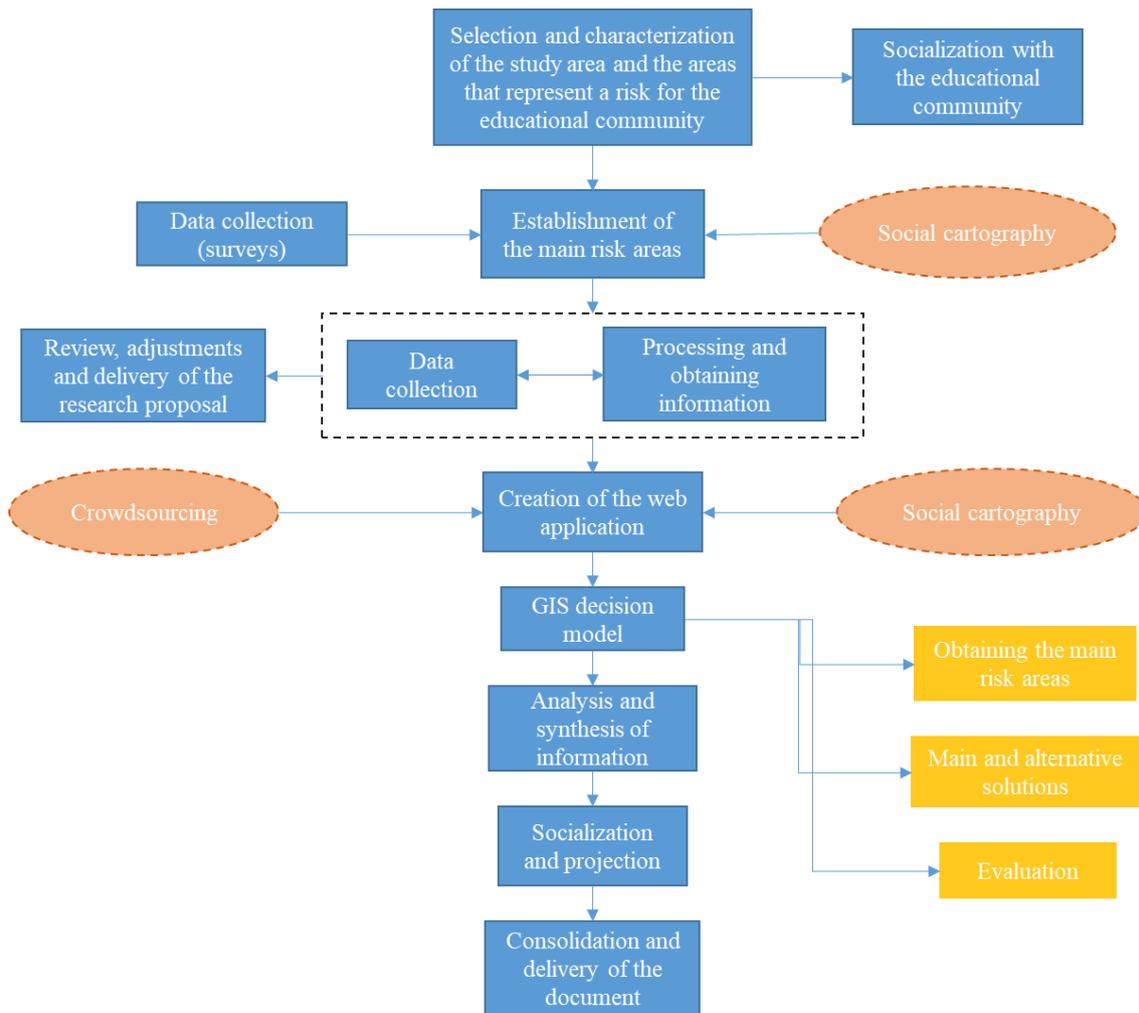
Illustration 1: Activity diagram. Source: Author

In general, the methodology to be followed was as follows:

- Definition of the relevant characteristics for the selection of the area as the study area of the project, identifying areas that represent a potential risk. Associated to this, the project was presented, the theme worked on, definition of the most important aspects and terms, benefits and finally, the educational community was motivated to participate.
- Survey: is applied in two ways: written description and application of maps to indicate areas identified as risk: Safety and environmental risk.
- Relevant data: Once the surveys were applied, it was delimited what general data would be considered in the project. The main risks according to the perspective of the educational community. In addition, an evaluation was made of the documents referring to the environmental and safety risks proposed by official bodies such as the Secretariat of Planning, National Police, Media, among others.
- Methods and technological tools: Taking into account the cognitive skills of the participants (ninth and tenth grade) and starting from a previous preparation where

the topics and subtopics to be worked on are contextualized about the project, the application for collecting and analyzing the information given a representative sample.

The application provides an interactive base map where the users worked, an editable layer to create risk reference points, real-time comments from the participants on the points and a list with the update on the latest data entered.

3.1 Implementation of the application in a sample group of students.

3.1.1 Social cartography: workshops and surveys

For the teachers, through a talk of approximately two hours where the perception of teachers working in the institution was determined was done. The interest was clarified beyond the degree project and the clear intention to provide an alternative solution to the risk areas, in addition to proposing support from the school mobility project. Likewise, he was motivated to continue with the idea so that, instead of avoiding the risks, they are completely eradicated, with the support of the competent official entities.

In the case of students, as they would implement a web application it was necessary to develop a more extensive and theoretical workshop, due to the need to contextualize them with their environment. The workshop lasted approximately three (3) hours.

The exercise was elaborated in four sections:
- ✓ Contextualization of the project that was to be developed and how they would participate in it.
- ✓ Implementation of the surveys, which were applied to teachers and parents.
- ✓ Collective discussion of each of the questions that made up the questionnaire.
- ✓ Work at ArcGIS online titled: *"Where are we?"* And the risk points were identified in groups.

3.1.2 Web application using crowdsourcing

For the creation of the application using crowdsourcing it was important to establish the audience and the use that would be given to the application and resulting map. In this project was implement for the students. The items to be taken into account within this tool were the following:
Purpose:
Audience: Students
Key points to extract from the experience, risk points.
Functionality: Location of risk points, both environmental and safety to subsequently generate risk areas.

The category of this application was "data capture and editing", and the subcategory was "collective contribution or crowdsourcing". (see illustration 2)
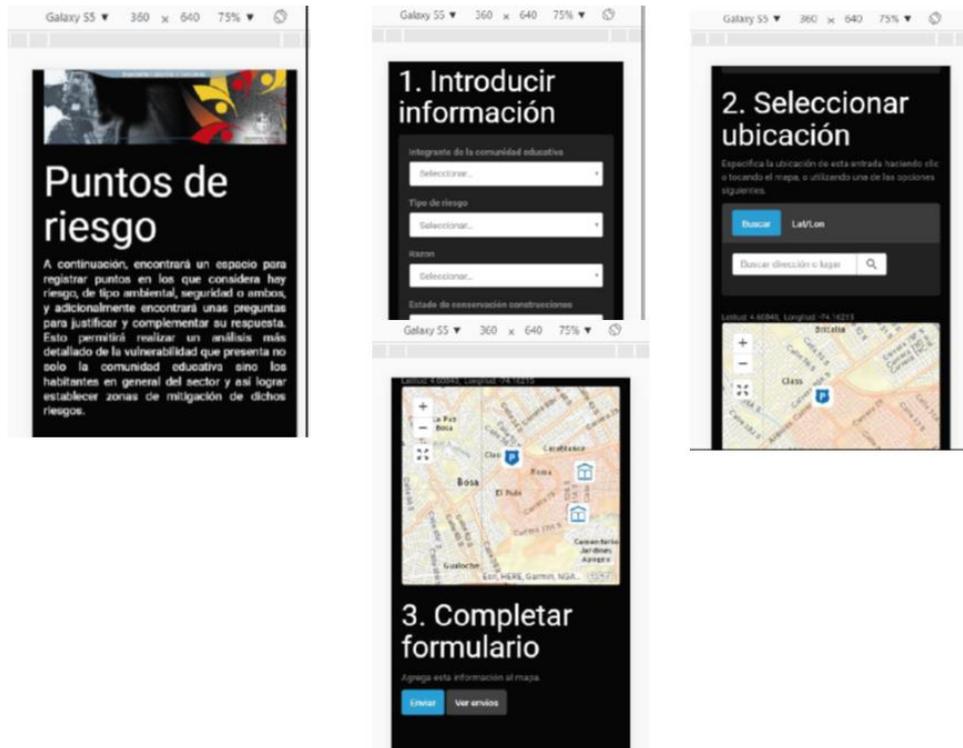

Illustration 2: Crowdsourcing application for capture data aboutrisk areas near to Villa Rica Public school. Source: Author

Due to the requirements of the application, mainly the use of forms to enter data, for this flexibility was chosen "Geoforms"
- **Supported devices:** The application is designed for browsers of desktop computers, smartphones and tablets.
- **Requirements:** As the application includes the possibility of editing a service hosted on the network or a service located in a service. The creation of these services requires an organizational or a developer subscription. For this exercise, a developer account was used.

3.1.3   Processing, obtainment and construction of the decision model

For the visualization of the collected data, a geoprocessing model was created in a Geographic Information System (GIS) to generate and analyze the risk zones, and to establishing the risk mitigation zones. The main sources considered to create the Geodatabase were the following:
- Reference map: Spatial Data Infrastructure of the Capital District (IDECA)
- Information provided by the academic community. Sample: 100 people.

- Web application: member of the educational community, type of risk, reason, state of conservation of buildings, state of conservation of public space, have you been harmed?

Geoprocessing Model:

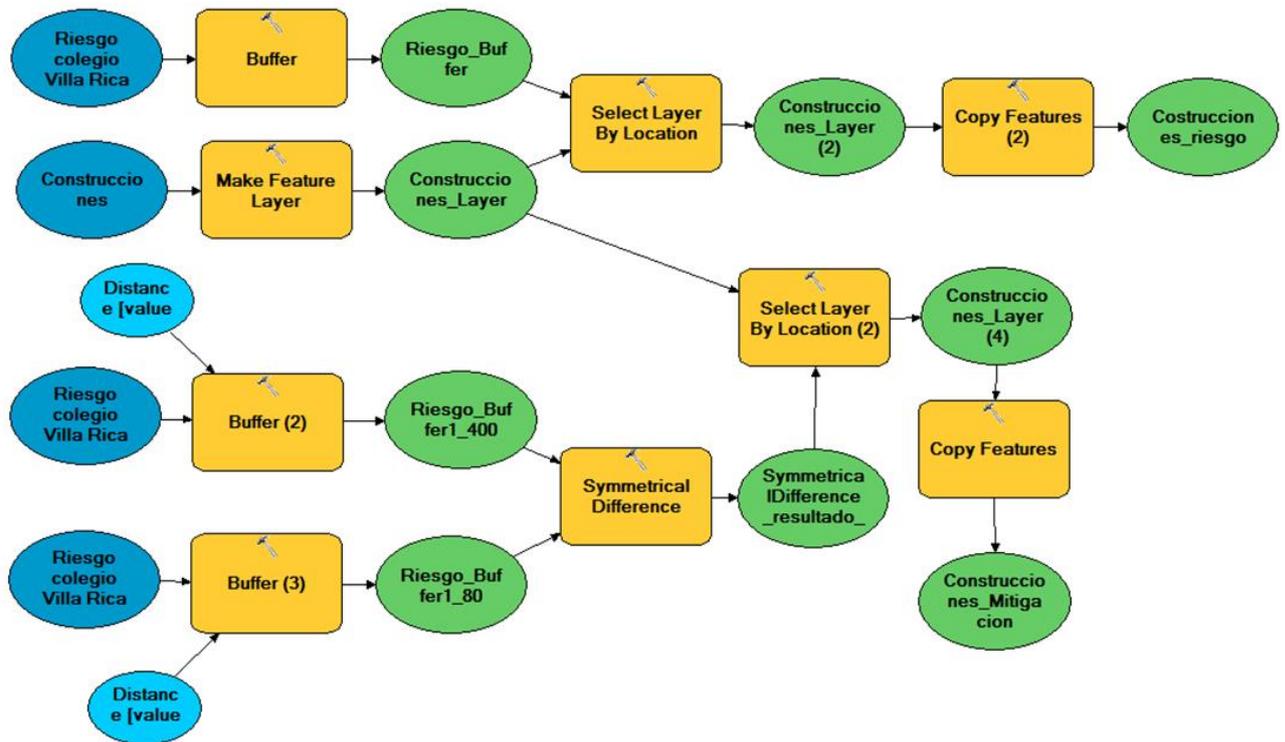The geoprocessing Model was created in the application Model Buider

Illustration 3: Geoprocessing model. Source: Author

4. RESULTS

The result of the analysis of the information collected through surveys, both in the social and security aspects with the teachers, established nine representative aspects such as:
Environmental:
- inefficient management of garbage in the sector
- Excessive and inadequate management of waste from the community and companies in the sector.
- Risk due to lack of maintenance of electrical networks.
Security:
- Missing signage.
- Important roads in poor condition

- Insufficient presence of the police.
- Limited access of roads to avoid risk areas.
- Little driver education on the part of drivers.
- Parks used for the consumption and sale of drugs.

On the other side, the subject of invasions within the sector was discussed. The teachers were agreeing that the main causes of the problems is the invasion for different negatives agents surround the school. On the other side, the parents, it was found that there is ignorance of the presence of the Immediate Care Centers in the sector, causing them to feel insecure.

Regarding the environmental problems, half of the parents have reconsidered the route they take when moving from home to school and vice versa in order to avoid the various inconveniences that could prevent them from reaching their destination.

The students, meanwhile, identify a point of safety and, compared to teachers and parents, feel less vulnerable within the sector. There are aspects of insecurity that still notice, such as robberies, confrontations between gangs and the consumption of hallucinogenic substances. Like the parents, the students are also tolerant, more than the environmental problems around the school, the Tunjuelito River which borders are considered a main source of pollution.

Most students feel satisfied with the route they follow when they move from home to school; The main consideration in this respect is that since most of the students have lived there for a long time, even several generations of their family have been settled in the sector for a long time; they are people who have adapted to everything that makes UPZ and naturally, for the most of the risks.

Once analyzed the opinion of the entire academic community, through social mapping, the following reasons were established to determine a risk point within the web application:
1. Pollution
2. Zone of invasion
3. Fighting and drug use
4. Fighting, drug use and the presence of roving bars.
5. Theft and sale of drugs.
6. It gives feeling of insecurity.
7. Robberies.
8. Bad smells and insecurity.
9. Expenditure and drug consumption.
10. Mishandling of garbage.
11. Place frequented by the inhabitants of the street.
12. A lot of traffic flow and little traffic signage.

Illustration 4: Map elaborated by social cartography approach. Source: Author

The main results obtained are the risk areas existing within the sector and based on this information, risk mitigation zones were established so that the community living in the sector, especially the academic community should take them into account, when are traveling through the area.

1. CONCLUSIONS

In accordance with the objectives established at the beginning of the project, the following was concluding:

The development of social and participatory mapping workshops with the academic community to consolidate the process of defining risk zones was carried out according to the importance given to it throughout the project. In addition, it is worth highlighting how complex and interesting it turned out to be the information obtained, allowing us to deal with the established problem in an accurate manner.

Illustration 5: Resulting map of the mitigation risk areas. Source: Author

The external entities to the institution, such as the planning secretariat, the police, environment secretariat, among others, also contributed interesting information that helped to enriched and complete approach to the topic. Compare the information collected in field and those from other sources, most of them coincide regarding the complementary data.

The application supported by crowdsourcing tools for the generation of data by different actors of the academic community of the school generated a proposal to approach the problem situation that allows to continue improve it by different members of the academic community. This shows that the tool can be used by different actors since it is easy to use and provides real-time data that are very useful for decision making.

Finally, creating a Geographical Information System, allowed the generation that evidenced both the places that represent risk, and what could mitigate it, being alternatives when moving from home to school, within the study area.

In general, it can be concluded that students and teachers showed a great interest in learning the management of Geographic Information Systems (GIS), when building maps, opening accounts in ArcGIS online, exploring and uploading the necessary information.

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