

Evaluation of the Social Impact of the Construction of the Fourth Generation Highway Ibagué-Cajamarca in the Urban Area of the Municipality of Cajamarca, Tolima Department, Colombia

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Abstract

The purpose of the present article is to evaluate the social impact of the construction of the fourth generation highway Ibagué-Cajamarca in the urban zone of the Municipality of Cajamarca, Department of Tolima. This is studied from the field of Civil Engineering and from a complex approach that understands how multiple social and technical situations are intertwined in the territory, making it necessary to carry out field work, surveys and review of technical documents. A compilation of bibliographic information on the subject, an acquisition and analysis of data were made to present clear and orderly conclusions in order to fulfill the objective of the project. The research and reflections extracted from this project are supported by variables of a social, economic, environmental, demographic and historical nature, some from bibliographical sources and others with direct contact with its population. Faced with a possible scenario of confrontation between the community and the project, alternative solutions are presented regarding its development and the well-being of the community, avoiding all conflicts.

Key words: Territorial conflicts, territorial dynamics, fourth generation highways, social impact, social perception.

INTRODUCTION

In construction works and, in this case, major road works such as the fourth generation highways in Colombia, it is greatly satisfying for the professionals who make these projects possible to be able to contribute with this significant progress. This also makes them harmonious with people and their environment, thus offering a better quality of life. Highways have become very common places for protests led by our country's communities, as a way for groups of people who are dissatisfied or who feel their rights are violated by decisions made by the State to react upon these situations [1] [2]. The field of construction has not been unaware to this social problem [3] [4] [5], thus becoming one of these unforeseen situations that must be dealt with. In order to cope with this situation and for it to no longer be unforeseen, it is imperative that the community be actively involved [6] [7], opening spaces for concertation, reliable information disclosure channels and a deeper, consistent and thorough investigation of these communities. As civil engineers, and therefore as progress managers, it is important to execute fair projects with the communities [8] [9] without violating their rights, such as

participation [10], thus giving way to development, having people and their welfare as a priority, while continuing to aim towards the common good. Other authors [11] [12] argue that the satisfaction of citizens is one of the main objectives of each public institution, which requires listening to the "voice" of citizens, understanding their needs, and verifying compliance with the real services provided to comply with expectations.

For the case study, the inhabitants of the urban area have been exposed for decades to high levels of noise pollution and contamination. In 2018, the Corporación Autónoma Regional del Tolima reported that the population of Cajamarca is exposed to noise levels greater than 80 decibels, generated by more than 4,500 vehicles that transit through this town. The necessary works to conceive this route imply the relocation of 8.1% of the urban population. This evidences that the Esquema de Ordenamiento Territorial (EOT) [13] of the municipality does not conceive the passage of the fourth generation highway by the urban area of the municipality, because the topographic conditions make the expansion of the urban center difficult. On the other hand, the relevant authorities that give free rein to this type of road projects, the Autoridad Nacional de Licencias Ambientales (ANLA) [14] and the Asociación Nacional de Infraestructura (ANI) [15], have already granted the relevant licenses to start work [16]. The contractor company argues that this option is the least harmful to the community and the environment. In this way, the social impact of large-scale projects that have taken place in Cajamarca has been a little studied or not at all. These projects have generated environmental studies and have been deficient in the social aspect, such is the case of The Line tunnel and the mining projects, that can be seen in studies of [17] [18] [19] [20]. It is also important to mention that recent studies at the national level, in [21] [22], have addressed issues such as the obedience of users to signage and traffic rules, as well as the safety of pedestrians, important issues addressed in this research. It is for this reason that it has been decided to evaluate the social situation surrounding the start-up and execution of the works, thus showing the magnitude of the social impact, making an objective analysis from a neutral perspective. Accordingly, reducing the level of uncertainty expressed by the inhabitants is important due to the political interests and institutions that are perceived, making the current level of confusion more critical and elevated. This will also leave a precedent for other populations where this problem could be presented with the passage of road projects

which are having a rapid growth in the road network of the country [23] [24].

Given the above, this article aims to evaluate the social impact of the construction of the fourth generation highway Ibagué-Cajamarca in the urban area of the municipality of Cajamarca, Department of Tolima. To achieve this goal, the project was divided into four clearly defined phases. The first consisted in contextualizing the social problems that were developed due to the implementation of the road project. This phase was done in a descriptive way. The second phase consisted in analyzing the Plan de Gestión Social Contractual (PGSC) in force at the time the project was carried out and according to the characteristics of the population. The third phase evidenced the perception that the inhabitants of the municipality had regarding the development of the road project. A fourth and last phase was carried out to present the solution alternatives to the problem that had been generated by the execution of this work in the population of the Municipality of Cajamarca.

MATERIALS AND METHODS

The present investigation was descriptive. The compilation of all the information was made in the study area, the urban area of the Municipality of Cajamarca. This research is also considered non-experimental because no experiment was conducted to obtain the data.

The first phase is clearly shown in the introduction to the article. In the second phase, to obtain and later analyze the current PGSC of the project, the request was sent to the ANI, by filing N°20174090858762. The document was scanned and sent satisfactorily by said entity in magnetic storage. At the beginning of this investigation, the current PGSC was available, on which the analysis was based, according to the current situation of the municipality and which was expected to bring the construction of the new road. On the other hand, it is also compared with what the ANI establishes for social management plans in the Asociación Público Privada (APP) contracting modality and its definition. The plan that is initially presented, in general, adheres to the programs and requirements established by the ANI, and incorporates the programs stipulated in the basic plan and in the PGSC indicated in articles 6 and 7 of resolution INCO 545 of 2008.

The third phase was carried out through the application of a survey, which was applied to the community to find out what was the perception of the inhabitants of the center of the municipality of Cajamarca about the project. The survey seeks to establish the level of agreement and disagreement with the road work, therefore, a multiple-choice questionnaire with a single response was established, based mainly on questions posed with a five-point Likert type element. The questionnaire is made up of 10 questions: two are "yes" or "no" questions: ¿Do you live within the area of influence of the project?, and ¿Do you know the social management plan that the contractor company will develop?; one is a multiple choice question with a single answer: If the previous answer is positive, ¿how did you find out about these works?; two open questions: ¿How long have you lived in the municipality? and ¿Do you have

anything to add to this survey related to the topic?; and five on the aforementioned scale: "Is aware of the work that will be carried out within the municipality, as part of the Ibagué-Cajamarca fourth generation highway", "Agrees that the divided highway crosses the center of the municipality parallel to the existing Pan-American highway", "Agrees that this project will be beneficial and/or positive for the municipality", "Believes that it is easy to have access to accurate information regarding the project", and "Believes that in this type of projects the opinion and the needs of the people are taken into account".

For the calculation of the size of the population sample to execute the survey [25], the following equation is used:

$$n = \frac{P*Z^2*q*N}{E^2(N+1)+Z^2*P*q} \quad (1)$$

Where n = Number of elements in the sample; N = Total population (in this case 9,968 inhabitants of the urban area); P = Approximate proportion of the phenomenon under study in the reference population (50% is taken in this case); q = 1 - P; E = Accuracy (5%); Z = Confidence level (1,96). Replacing this data within the presented equation, the result shown is that the sample n = 370 units to be surveyed. For economic and technical reasons based on the fact that in the development of this study there is only one person, the survey was carried out to the representatives of the family units that will be transferred because they are located within the study area. There was a total of 269 family units [16], the survey was applied to 100, that is to say, 37,17% of the population to be displaced was surveyed.

The fourth phase of the project can be seen in the conclusion number. A priority analysis was made to the programs that are directly linked to the social problem, making emphasis on analyzing the concept and study reflected in the PGSC of the current social and environmental problem of the municipality and how the community perceives the execution of the project.

RESULTS AND DISCUSSION

The results obtained are listed according to the objectives proposed in the study:

According to Figure 1, it can be seen that the entire population surveyed is directly related to the execution of the project, and as a second intention their awareness of this fact can be verified.

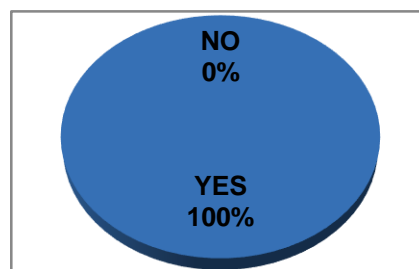


Figure 1. ¿Do you live within the area of influence of the project?. Source: authors.

According to Figure 2, regarding the knowledge that the respondents have about the work to be executed, 8 of them are in total agreement, 22 agree, 2 are indifferent, 33 disagree and 35 totally disagree. It is noteworthy that the two people who showed indifference on this issue are 4 and 6 years respectively, living in the municipality, and both have settled with their families to work in the The Line tunnel project.

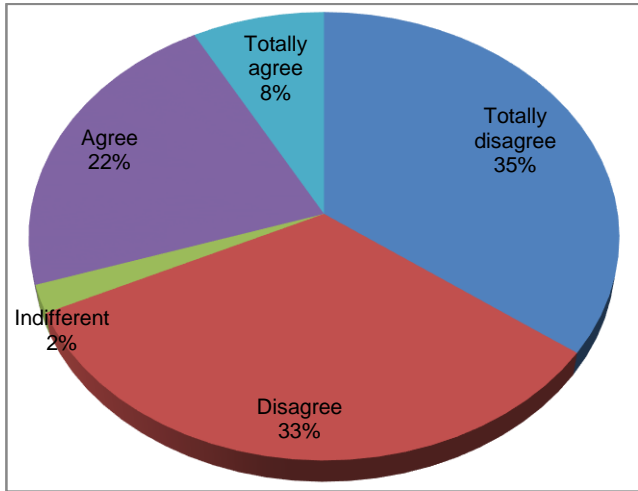


Figure 2. ¿Do you know the social management plan that the contractor company will develop for the fourth generation highway Ibagué-Cajamarca?. Source: authors.

From the results shown in Figure 3, it can be seen that the project, on the one hand, has become more known. In this way, at this point of the survey, television was the medium through which the project was most widely disseminated, with 12 people among the respondents having found out about it from the television. Then, 8 people reported finding out through comments from neighbors or friends, better known as "word-of-mouth". The newspapers, magazines or printed media were chosen by 7 people, and other means by 3 people. Within those other means chosen by the respondents, the most relevant were the internet, radio and meetings arranged by the same community for purposes opposed to the project.

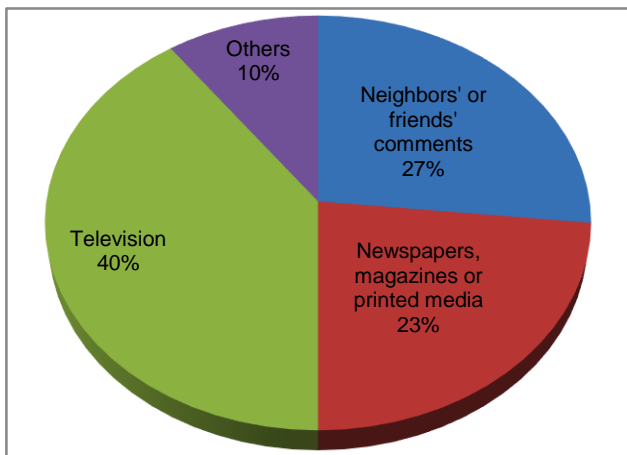


Figure 3. ¿If the previous answer is positive, how did you find out about these works?. Source: authors.

As can be seen in Figure 4, among the surveyed population, it was evidenced that 42 people strongly disagree that the fourth generation highway crosses the center of Cajamarca, 32 disagree, 18 fully agree and 8 agree. That is, of the 100 people surveyed, 74 disagree, arguing that this work will be harmful to the community because the flow of vehicles will increase, and consequently there will be greater air pollution due to greater emission of gases. They also consider that, for people who own vehicles, the cost of moving from one side of the municipality to the other will be increased because they do not have the certainty that they will have to make a long journey looking for a return or they will have to travel on a long vehicular bridge. The remaining 26 people do support the project going through the center of the municipality, adding that this work will be beneficial to the population in general.

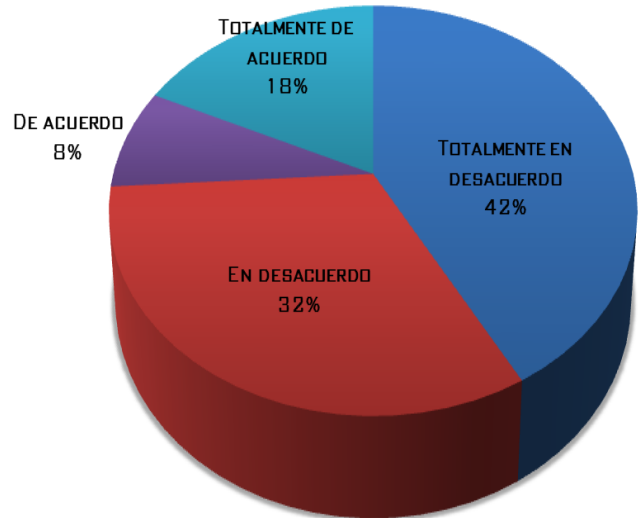


Figure 4. ¿Agrees that the fourth generation highway crosses the center of the municipality parallel to the existing Pan-American highway?. Source: authors.

According to Figure 5, regarding the perception that the respondents have on whether the project will benefit the municipality, the results were that 42 people disagree completely, 32 disagree, 18 totally agree and 8 agree. In summary, 74 people do not believe that the project is beneficial for the people and the other 26 people think that it will be. In this way, we can say that most people believe that this work will not bring any benefit to the municipality, while the counterpart believes that the fact that this route passes through the center of Cajamarca will boost the economy of the municipality, comparing it with the case of the municipality of Gualanday, also in the Departamento del Tolima, where the second highway was a variant and where the economy of this population reduced drastically by decreasing the number of people that circulated there.

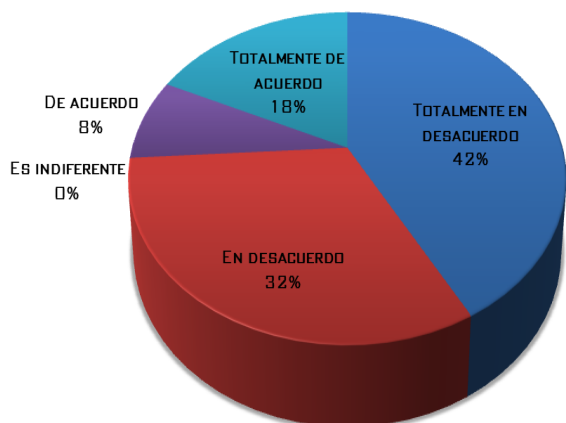


Figure 5. ¿Agrees that this project will be beneficial and/or positive for the municipality?. Source: authors.



Figure 7. ¿Believes that it is easy to have access to accurate information regarding the project?. Source: authors.

As can be seen in Figure 6, 98 of the 100 people do not know the mitigation plans for social impact on the part of the contractor and only 2 people are aware of it. Of these 2 people, one owns the two most recognized bakeries in the municipality and they are within the properties to acquire to make way for the project, makes their interest in knowing the destination of their business understandable. The other person is a councilor of the municipality of the current administration, who has learned about implicit actions of his office.

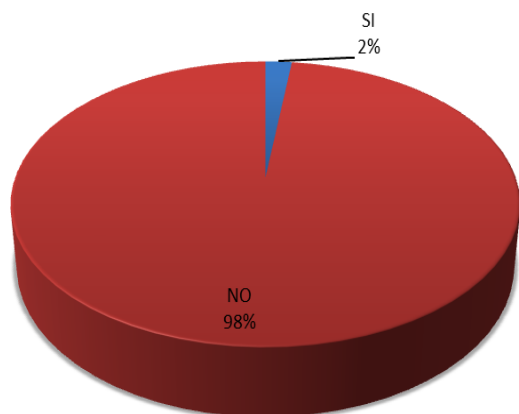


Figure 6. ¿Do you know the social management plan that the contractor company will develop?. Source: authors.

According to Figure 7, related to how easy it is to have access to accurate information of the project, it was found that 41 people totally disagree, 16 disagree, 31 agree and 12 totally disagree. The surveyed residents are skeptical of the veracity of the information disclosed, given that they have doubts and contradictory opinions regarding compensation and land payments, among others. People who disagree with this question say that within the town there are divided opinions and speculation, facts that the contractor must clarify to have an objective appreciation of the project and affirm the actions that are going to be taken.

According to Figure 8, 51 of the people surveyed disagree with the fact that in this type of projects the opinion of the community is available, 42 disagree, 3 agree, 2 agree and 2 are indifferent to this question. 2 of the 5 people who agree are the owner of the bakeries and the council mentioned above. In total, 93 people believe that these projects do not involve the population, allegedly because there may have been corruption in the awarding of these contracts and the desire to execute them. The 2 people who are indifferent, agree that taking into account the citizenship or not, these projects are carried out regardless of the opinion of the population.

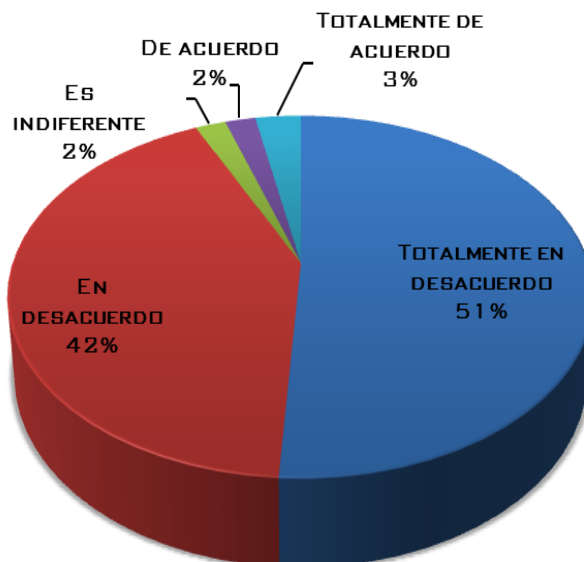


Figure 8. ¿Believes that in this type of projects the opinion and the needs of the people are taken into account?. Source: authors.

Among the main aspects with which there is greater uncertainty or concern, are: vehicular emissions, affectation by land resettlement and local mobility.

3	PR DE LA ESTACION	SECTOR	CODIGO VÍA	LONGITUD (KM)	SERIE HISTORICA Y COMPOSICION DEL TRANSITO PROMEDIO DIARIO SEMAL TPDS TERRITORIAL TOLIMA													DESVIA. ESTAND.	
					1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2010		2011
243	CAJAMARCA-IBAGUE			29	3.803	3.877	3.449	3.579	4.027	3.597	4.019	4.567	4.961	5.206	5.475	5.326	4.672	6.143	840

Figure 9: TPD highway Ibagué – Armenia. Route 4003. Source: www.invias.gov.co

The noise and environmental pollution by emission of noise and CO₂, respectively, emitted by the vehicles, is a relevant issue within the community under study, given that the levels, which already exist, will increase considerably with the crossing of the new road. When analyzing this point, it is observed that the vehicular traffic along this route is relatively high, as can be seen in the figure that shows the TPD (average daily traffic) made by the Instituto Nacional de Vías (INVIAS).

On the other hand, among other data, the vehicle projection can be seen, which indicates that by 2020 the number of vehicles that transit through the Pan-American Highway in Cajamarca will be around 7.180 vehicles, of which 70% are heavy vehicles or trucks and 30% buses and cars. Distribution by direction: 50% Armenia-Ibagué, 50% Ibagué-Armenia. The vehicle projection was: year 2016 (6.500 vh.), year 2020 (7.180 vh.), year 2030 (8.800 vh.), year 2040 (10.400 vh.). Vehicle composition: 70% trucks and 30% buses and cars.

With the acquisition of the properties necessary for the execution of the project, the owners are forced to acquire their new property outside the area of influence of the project. The problem here is the difficult task of relocating the houses, due to the geographical situation and the topography that the municipality presents. Regarding this, the EOT [13] stipulates: "The topographic and geological conditions that impede the growth of the urban area and that also restrict the possibility of proposing an urban level road plan mean that the road infrastructure proposal for the municipality is limited to the conservation and maintenance of the existing road network (p.24)". On the other hand, after the population census of 2005, it shows in its projection that by 2017 the total population of Cajamarca was of 18.500 inhabitants, desegregating it into 9.968 inhabitants in the municipal seat and 8.532 inhabitants in the rural sector [26]. The average

used by this entity to have made this projection can present a variation of increase in the population in the last decade. This is due to the macro projects that are developed within the municipality, as is the case of the Line Tunnel and the mining exploration, which have generated migration and have increased its inhabitants. Taking into account the above and what is contemplated by APP GICA [16], where it is indicated that "The execution of the project involves the transfer of two hundred and sixty-nine (269) families, with a total of eight hundred and twelve (812) people" (p. 493), it can be demonstrated that a mobilization of 8,1% will be carried out of the urban population either voluntarily through negotiation or through legal channels or expropriation.

With the crossing of this new road, the municipality will be fragmented into two sectors, the northern sector and the southern sector. The necessary displacement to make the crossing of the two future roads is an unclear subject. Having characteristics and customs typical of a municipality in this region of the country, the issue of local mobility, linked to its social and economic dynamics, Cajamarca is analyzed from three different types of approach, such as: pedestrian mobility, vehicular mobility and animal mobility.

Pedestrian mobility: The current Pan-American highway does not have pedestrian bridges to cross it. To reduce the speed of vehicles and to generate pedestrian traffic from one side to the other, the road has ridges. Being a two-lane road only, one in each direction, it does not represent a high level of difficulty for the pedestrian to pass through, which does not indicate that it is not dangerous. In this section of the road, people can be involved in automobile accidents, either as pedestrians or as inhabitants of the surrounding buildings near the road. In relation to the pedestrian bridges, an analysis is shown as to the routes that the inhabitants would have to make to move from one side to the other.

No.	Tipo de Puente	Abscisa de diseño		Coordenadas	
		Norte	Sur	Este	Norte
1	Peatonal	K32+450	K32+450	850.168	983.047
2	Peatonal	K32+945	K32+928	849.726	982.804
3	Peatonal	K33+470	K33+475	849.274	982.640
4	Peatonal	K34+135	K34+180	848.658	982.421

Figure 10. Proposed location points for pedestrian bridges. Source: authors.



Figure 11. Location of the proposed pedestrian bridges. Source: authors.

Once the initial locations of the bridges are shown, as can be seen in Figures 10 and 11, it should be noted that depending on certain characteristics, such as the site and the flow of people, the pedestrian bridge can help pedestrians or become an obstacle in itself. For the case of pedestrian bridges 3 and 4, the urban dynamics and the transversal mobility on the road is not so strong, so in this case the construction of the pedestrian bridge would be justifiable because it is imperative that no interruption be made in the vehicular flow of the national road due to the small number of pedestrians residing in this sector of the municipality. The contrary happens in the pedestrian bridges 1 and 2 in the center of Cajamarca, since in these points the urban dynamics and pedestrian transversal mobility is totally different from the previous case. Pedestrians always depend on crossing the main Pan-American road because it divides the municipality and presents high commercial and economic activity. Considering that for this route, as mentioned above, 70% of the vehicles are heavy, there is an ascending and descending ramp route calculated at 72 m each one, and if the pedestrian is right in the middle of the two bridges, which are separated every 400 m, the pedestrian will have traveled 272 m in the middle of its ascent route and then in descent this same length, which would give a total of 544 m in pedestrian travel if they need to go from one side to the other of the municipality, crossing the proposed fourth generation highway. It is important to note that the path that belongs to the length of the bridge is not counted, since it is the same distance either using the bridge or not. At the end there will be a route of 1.088 m making the round trips (544 m in each direction).

Vehicular mobility: Regarding vehicular mobility, the main question posed by the inhabitants who do not know the design of the projected road, especially vehicle owners, is how will the two future highways be crossed by vehicle? And, on the other hand, those who are somehow aware of the design of the

construction show concern about the new route that must be made. When inquiring about what solution GICA APP gives [16] to this problem, it is found that within the environmental license no vehicular bridges are contemplated. In solution to the local vehicular mobility, two returns were presented, in this way the route that local vehicles would have to take, from where the commercial and social dynamics of municipality, K32+450, up to the returns, K34+ 290, will be of 1.840 m, which would generate a significant increase in operating expenses.

Animal mobility: Finally, it is worth mentioning another of the possible forms of social affectation perceived by the inhabitants, which is about the cargo transport through the use of animals. In the municipality of Cajamarca, due to its geographical position of proximity to the coffee area, the need for transportation, mostly livestock products and the rugged rural topography, there is a need to carry out the activity known as *arriería*, which is the animal transportation of cargo. This is how farmers, for the most part, transport their agricultural products to the center of Cajamarca, either for marketing them within the municipality or for storage for later transport to other locations.

When carrying out the analysis of problems that will be caused by the execution of the project, named and analyzed previously, the case of the local mobility of public and private transport is presented. For this problem, the current PGSC does not show a plan or program that mitigates it or another similar one as an action in favor of giving a response that generates credibility within the population. In order to generate and establish relationships of credibility and trust with the community, it is strictly necessary to ensure that the plans and programs are socialized, and that they reach all the inhabitants of the municipality, emphasizing those who inhabit the area of influence of the project. In order to evaluate how inclusive the PGSC of the project is with the

community, the question was included in the interview, the result of which is shown in Figure 6. With it, it was possible to obtain a part of how well-informed the inhabitants are with regard to this plan, with the result that two people have knowledge and the remaining 98 do not. This PGSC applies equally for the entire layout of the project, that is to say it is for all the sections where the second highway will be completed. This includes the section five that will pass through Cajamarca.

CONCLUSIONS

Within the characterization that is made of the area of influence of the project, for Cajamarca, it is exposed that the main affection to the community is the poor management of waste produced by the animal slaughter plant and the inadequate management of water, waste and other pollutants resulting from car washings along the current national Pan-American highway [13]. In this way, this plan shows that the contractor does not have data on other types of conditions that the municipality is going through. In order to inform the population and in accordance with the type of project being carried out, it is relevant to show data related to emissions, both of CO₂ and noise, of the vehicles currently traveling and the future traffic attracted, and so on, to be able to make plans to mitigate this problem.

As it is currently presented, section 5, passing through Cajamarca, of the fourth generation highway project Ibaguë - Cajamarca, in social terms, is not viable or fair with the municipality and its inhabitants, because it is not consistent with the current needs of the population and no alternatives or mitigation programs are proposed for unfavorable situations that this project will generate, such is the case, and of great relevance, of the relocation of the homes required by the concession for the subsequent demolition. The owners, when accepting a negotiation of their property, would not have where to relocate within the municipality, due to the topographic position and the absence of expansion zones as shown by the EOT [13] of Cajamarca, and in the opposite case of refusing to sell their property, people would enter the process of expropriation. In any of the scenarios, people will be forced to move to another location.

After analyzing the results of the survey to know the perception that the inhabitants have of the project, it was possible to confirm that, according to the sample that was taken from the population, the inhabitants of Cajamarca do not agree with the crossing of the fourth generation highway in the center of the municipality, that is to say, the perception that they have is not favorable or of non-approval. Among the situations that support this perception, there is the increase in the costs of local vehicular operation, due to the routes that would now have to be taken to go from one side of the municipality to the other, transferring these increases to the cost of urban passages, of people and cargo.

As it could be evidenced through this investigation, in the international scenarios mentioned, for the cases of Chile and Peru, a previous general public consultation was made, which is within the legislation. These observations must be

consigned in the socio-environmental studies, while in Colombia the prior consultation is directed and is legislated only for special communities (ethnic groups and afro descendants). To anticipate the actions that a Colombian community can take against a project, the law of consultation with communities including the entire population that is located within the margins where the project will be developed could be implemented.

Through this investigation, once the information gaps that exist were detected, it was evident that there has not been a total inclusion of the community in terms of the actions that must be taken to carry out this road work. That is why there should be inclusive actions in the community, offer opportunities for consultation, given that there is a perception of the imposition of this project infringing their right to participate. It is therefore recommended that in this type of project the implementation of social licensing be initiated, where the welfare of the communities could be guaranteed with an adequate social management and in accordance with their situation of the affected inhabitants.

The PGSC of the project analyzed has the same applicability for the entire stretch of the future Ibaguë - Cajamarca road. It offers the same action plans for the study municipality and for the others, for which the implementation of an independent PGSC is recommended for section 5, pass through Cajamarca, because this is not only a road project but an urban project, with an emphasis on pedestrian road culture primarily, since as analyzed the pedestrian bridges represent an extensive route and by not having the culture of their use, pedestrians may prefer not to use them.

When analyzing current PGSC, and when compared to the current regulations for these plans in the APPs and based on the results of the survey, it could be concluded that this plan is not completely known by the inhabitants of the area of influence of the project, which goes against the objectives set out in appendix 8 of the contract of this work.

The absence of characteristic information of each community where a 4G project is planned, generates delays in the works, which leads to economic losses for the concessionaires. When a population does not agree with the projects, it could lead these citizens to take actions to paralyze them, whether through popular acts or via de facto. The proceeds of those actions have cost the concessionaires around \$ 99.000 million [27].

It is recommended to present to the community an analysis of alternatives, which reflects a comparison between the current route, i.e., through the center of Cajamarca and a road and/or a variant type outside the municipality, technically supporting the reasons of favorability for which the best option was chosen and why the others are discarded. This is due to the fact that today, in terms of social impact, the most relevant option is a variant bordering the municipality of Cajamarca.

When investigating the community's perception of the project and the social problems presented, it was detected that within the small percentage of the population that approves the current layout of the fourth generation highway, these indicate that the realization of the project will have a positive

economic effect and that if the variant is reached, the economy of the municipality would be affected. Therefore, this work leaves the gap open for further research on this same issue, deepening in the economic area, to determine to what extent the current commercial establishments of the municipality could be affected, located on the sides of the Pan-American Highway, which focus their economic activity on tourism or passage of travelers and/or vehicular dynamics.

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