Quantifying Geotourism: A Demoscopic Study for the “Litoral del Biobío” Geopark project (Chile)

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Abstract

Geotourism as a tool for local and social development requires evaluating how geology is perceived by society and how the geology can contribute to solve society's needs and perspectives. This research is the result of a survey undertaken in the “Litoral del Biobío” geopark project (Chile) from April to September 2019. This survey consists of over 400 people and is a direct geoturistic demoscopic study on local communities. It covers a large diversity of social setting (ranging from urban to rural indigenous) and also a diverse level of education.

Salient points of the results includes more than 80% of the community are aware of the sites of tourist interest in their community, while less than 20% recognize the geology and/or geosites of the territory. The need for economic development (21%) and tourism in natural areas (82.5%) stand out as the main tourism focus and tool for generating sustainable economic resources for the territory. Geodiversity and geotourism play an important role (48.1%), but are subordinate to biodiversity (76.7%) in the territory. Furthermore, geotourism is far from the perceptions of crime (23%), given that it is still a minority tourism sector. Finally, there is a certain level of resignation in the community regarding the medium-term development of its territory (52%), with education on geological and environmental risks (77%) being one of the main priorities.

This study shows that, although there are basic needs to be covered in the territory, such as security and public infrastructure, there is also a great interest in developing tourism in natural areas. In this scenario, geotourism becomes relevant as a tool that can contribute to local sustainable economic development, education on geological risks, awareness of the geological value of the territory, as well as the revaluation of the cultural heritage in the study area.

Keywords UNESCO Global Geoparks · Geotourism · Demoscopic study · “Litoral del Biobío” Mining Geopark project · Sustainable development

Introduction

On November 17, 2015, UNESCO Global Geoparks (UGGp) were recognized by UNESCO as a new brand, becoming part of UNESCO International Geoscience and Geoparks Programme (IGGP), although work done by the Global Geoparks Network (GGN) had already been underway since 2004 (UNESCO 2020).

The UGGp as stated in part of its definition “are unique and unified geographical areas, where sites and landscapes of international geological importance are managed, with a holistic concept of conservation, education and sustainable development. UGGp stimulates the creation of innovative local businesses, new jobs and high-quality training courses, as new sources of income are generated through geotourism” (UNESCO 2015). It follows from this definition, that

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they should also contribute to the development of the local economy of the territories through geotourism as a main engine of development (Mc Keever & Zouros 2005; Martini & Zouros 2009; Mc Keever et al. 2010; UNESCO 2015, 2016; Silva et al. 2015; Brilha 2018; Rosado-González et al. 2020). Today, sustainable development goes hand in hand with improving the quality of life of people in the territories, not only from an economic but also from a cultural and social point of view. It is therefore important to take into account the different perspectives that the community has concerning its own territory in terms of geotourism (Ólafsdóttir and y Tverijonaite 2018; Duarte et al. 2020; Herrera-Franco et al. 2020).

The contribution to the development of the territory comes from the enhancement of the different sites of geological interest (called geosites), which can have different orders of relevance from international, national, regional, or local (Cendrero 1996; Wimbledon 1996; Coratza and Giusti 2005; Bruschi & Cendrero 2009; Vujičić et al. 2011; Fassoulas et al. 2012; Kubalíková 2013; Tomić & Božić 2014; Brilha 2016 and references therein). These geosites, linked to the biotic, cultural, historical, tangible, and intangible heritage of a territory, and from a sustainable territorial development point of view, are key for the development of an UGGp.

It also has to be considered that the creation of an UGGp involves the inhabitants of the territory in a “bottom-up approach” (UNESCO 2015). This means that geopark projects result from the coworking between all the involved stakeholders including, social organizations, governmental institutions and educational systems, local associations, and even individual citizens. In this way, all the needs and ambitions of the territory are required to be taken into account (Ferraro et al. 2020). Any geopark proposal should know how local people feel and consider the geology of the territory as a first step in designing the project. At the same time, it is important to make them understand that tourism related to geosites can improve their lives. Geological education and raising awareness for the preservation of natural areas is therefore a basic tool for developing sustainable tourism.

A previous review of 256 scientific publications on geotourism (Ólafsdóttir and y Tverijonaite 2018) demonstrated that they are mainly addressed to geological heritage and the potential development of geotourism (46.1%). Other fields such as social awareness by tourists (6.1%), sustainable development (3.9%), and local communities (0.78%, only two studies) are largely unexplored, in this context, the work presented here is a complete demoscopic study that sheds light on two important fields: sustainable development and local communities.

After framing our research in the context of geotourism, UGGp, and the sociology of the territory, we design a demoscopic study for the “*Litoral del Biobío*” geopark project (LBG) based on a multidisciplinary approach. The results

obtained from an extensive survey program using questionnaires allowed us to obtain a robust overview on (a) social awareness of the geological heritage and (b) the potential of geotourism for local development.

Geotourism Concept and the UNESCO Global Geoparks

Geotourism is a concept that arose from the enhancement of sites of geological interest (also known as geosites¹). The geosite concept emerged in 1996 through the Global Geosites programme, promoted by the International Union of Geological Science (IUGS). The objectives of this program are twofold: on the one hand, the generation of a database that can provide a solid basis for the conservation of geological heritage as a resource for research and education; on the other hand, to correct the existing decline in the conservation of this heritage (Wimbledon 1996, 2000). Thus, an international working group was created, as well as regional working groups to develop and promote this program on the identification and conservation of geological heritage. Wimbledon (1997) defines a geosite as “*Geological or geomorphological features, terrains or landscapes that provide indispensable information by contributing to the understanding of the geological history of a country, region or continent or global processes.*”

The concept of geotourism was first defined by Hose (1995; 1996) under the context of providing information to the tourists about the different geological and geomorphological features of the territory that allows them to understand its formation. During the following years, different researchers have continued to provide different definitions, which can be grouped into two different approaches. The first is based on understanding the prefix “*Geo*” from a purely geological tourism perspective, where the heritage to be explored is the geology of the territory (Dowling and Newsome 2006, 2011, 2013; Hose 2008, 2012; Newsome and Dowling 2010; Ehsan et al 2013). The second approach focuses on understanding this prefix beyond the geological concept of territory and giving it a broader sense by understanding geotourism as tourism of the Earth or of a territory. This second approach encompasses not only geological heritage but also cultural, biotic, tangible, and intangible heritages, and provides a more holistic concept of geotourism (Stokes et al. 2003; Arouca Declaration 2011). Subsequently, Dowling (2013), Pásková and Zelenka (2018) indicated that geotourism should have an

¹ An area that forms part of the geological heritage of a natural region by showing, continuously in space, one or more characteristics considered important in the geological history of the region. (García-Cortés et al. 2013).

Table 1 Geospatial people data in communities of LBG. (Source: Census 2017)

	Community	Area (km ²)	PEOPLE				
			Total population	Population Density (hab./km ²)	Woman (%)	Rural (%)	Indigenous communities (%)
Concepcion province	Tomé	494.5	54,946	917.6	52.8%	9.8%	7%
	Penco	107.6	47,367		52.2%	1.0%	9%
	Talcahuano	92.3	151,749		51.9%	0.9%	8%
	San Pedro de la Paz	112.5	131,808		52.2%	0.1%	10%
	Hualpén	53.5	91,773		52.6%	0.9%	9%
	Coronel	279.0	116,262		52.0%	2.7%	12%
	Lota	136.0	45,535		51.8%	0.2%	12%
Arauco province	Arauco	956.0	36,257	38.4	50.7%	24.6%	17%
	Curanilahue	994.0	32,288		50.9%	6.5%	15%
	Lebu	56.9	25,522		51.2%	8.0%	29%
	Los Álamos	599.1	21,035		51.5%	11.0%	28%
	Cañete	760.4	34,537		51.8%	43.6%	36%
Total/average		4641.8	789,079	550.4	51.8%	9.1%	16%

“ABC” approach, that is based on the “Abiotic, Biotic and Cultural” values of the territory.

These two approaches are complementary. While the approach of a sustainable development of the territory is more representative of the guidelines proposed by UNESCO on the UGGp in terms of the holistic vision of the territory, the more geological approach helps to improve processes or management in the area of geoconservation and the understanding of geological elements by tourists (Newsome and Dowling 2010; Dowling 2013; Dowling and Newsome 2018).

Similarly, the Declaration of Arouca (2011) encourages territories to embrace geotourism as a general approach, considering both the geological, biodiversity, and cultural values and involving the local community and tourists in an active role in order to generate the necessary synergies to promote the identity of the territory.

In recent years, there has been a debate between the previous ways of conceiving geotourism, ignoring to some extent the epistemology of tourism, since today the only way to understand tourism is from a current and modern perspective as an alternative to “mass tourism” (Coutinho et al. 2019).

The study presented here focuses on the value of the geological heritage of LBG and how this is perceived by the community in line with other tourist aspects of the territory. Our intention is to find out the degree of knowledge, needs and perspectives in relation to sites of geological interest (sensu Frey et al. 2006). This allows us to visualize the perception of the community about important geosites and geoconservation issues, and at the same time to

approach the community about the potential of the territory for geotourism.

Socio-economic Context of “Litoral del Biobío” Geopark Project

The touristic use of abandoned mining districts has been the target of several studies (Baczyńska et al. 2018a, b; Kazmierczak et al. 2019). In our case, this heritage is framed in a geopark proposal and is studied under the scope of social perception. The LBG in the Biobío region of Chile, is a geopark project born in 2016 through the joint work between a university (*Universidad Católica de la Santísima Concepción*), a public body (*Servicio Nacional de Turismo—SERNATUR*) and 12 municipalities of the abandoned coal mining district that makes up the geopark territory (Ferraro et al. 2018, 2020).

Through different instances of public events with the community during 2015 and 2016, it the need was apparent to provide the territory with a tourism offer, based on the territorial identity as an alternative for sustainable development. In these dissemination activities, it was possible to explain the meaning of the UGGp, as well as the objectives of preserving the geological, cultural, and natural heritage values of the territory, and the commitment and participation of the community of the territory in their construction.

The LBG territory essentially comprises the Concepción-Arauco coalfield, which lies between latitudes 36° 30' and 37° 45' S and longitudes 73° 45' and 73° 00' W. It consists of 12 municipalities along the coast of the Biobío region,

Table 2 Unemployment percent at a national, regional, and in some of the municipalities of the geopark territory, between 2006 and 2019. (source: Instituto Nacional de Estadística y Encuesta Nacional de Empleo)

Year	Unemployment							
	Chile	Biobio region	Province		Community			
			Concepción	Arauco	Concepción*	Talcahuano**	Lota	Coronel
2006	7.8	10.1	11.0	9.5	10.5	11.4	14.7	11.1
2007	7.1	8.5	9.8	11.0	8.3	11.4	12.6	12.9
2008	7.8	8.7	10.5	11.0	9.3	12.1	12.8	13.1
2009	8.5	11.3	12.9	12.3	10.9	14.0	16.3	16.9
2010	8.1	9.3	9.4	10.0	8.5	11.4	12.0	10.4
2011	7.1	8.1	8.4	7.9	7.9	8.6	9.3	10.3
2012	6.4	8.2	8.5	7.2	7.9	9.3	11.4	11.4
2013	5.9	7.8	7.7	7.3	7.2	8.0	10.6	10.9
2014	6.4	8.3	8.1	5.7	7.6	8.2	11.0	10.2
2015	6.2	7.6	7.6	6.0	7.1	8.3	12.5	10.4
2016	6.5	7.1	7.4	6.4	6.5	8.5	11.5	9.0
2017	6.7	7.2	7.5	6.6	7.3	8.4	10.1	7.9
2018	7.0	7.0	6.9	5.7	7.1	6.8	9.5	8.7
2019	7.0	6.9	6.8	5.5	6.6	6.4	8.7	8.8

*Includes San Pedro de la Paz and Chiguayante.

**Includes Hualpén.

seven municipalities in the province of Concepción: Tomé, Penco, Talcahuano, Hualpén, San Pedro de la Paz, Coronel, Lota, and five in the province of Arauco: Curanilahue, Lebu, Los Álamos, and Cañete, whose population characteristics are displayed in Table 1.

Coal has been mined in the Concepción-Arauco coal district for more than 150 years since the middle of the nineteenth century. The development and growth of Chile and the Biobío region has long been linked to this regional coal mining industry (Santa-Cruz 2018). The sudden closure of the mines between 1992 and 1997 was a socio-economic reversal for more than 6828 families whose main source of income was linked to the exploitation of the territory's coal beds (Barahona 2014). Since then, a series of reconversion plans and programs have been carried out for the Concepción-Arauco coal district for example the “*Plan de Desarrollo Integral de Lota*” (1998). One of the lines of action diagnosed in the first phase of the Pro Rural Plan (1998 and 1999) was tourism (Araya 2019).

This plan would later evolve into the *Programa Emprende Chile* (2001–2004) and *Chile Emprende* (2004–2010), which through different public–private strategies and state incentives and subsidies, sought to reconvert the territory of the province of Arauco. To date, the implementation of the different investment projects portfolios has not had the desired impact on the territory according to the perception of the own communities (Santa-Cruz 2018). In this same context, in 2014, a law was enacted for Productive Gap Areas, with the generation of the Gap Territories Program sponsored by the Under-Secretary of Regional Development (SUBDERE).

This scenario favored the continuity of public investment in the territory of the province of Arauco through different instruments such as the “*Programa Transforma Arauco*” of the *Corporación de Fomento Productivo* (CORFO) in 2016, and the *Fondo Nacional de Desarrollo Regional* (FNDR) of the Regional Government of Biobío in 2015. These programs focused in a certain way on the development of the tourism area of the territory (Araya 2019). However, it was not until 2019 that the document on the regulation that establishes the National Policy on Lagging Areas in social matters appeared and in which the management of resources for these areas will be governed, among which is the province of Arauco.

To date, these programs, initiatives, projects, and public policies have not managed to reconvert the economic development of the territory (Table 2).

Methodology

The procedure used for the field data collection was a structured survey (Arias 2012), responding to open, closed, and/or optional questions (Kerlinger 1997). Open-ended responses allow the respondent to express themselves freely. This can provide important information that may not otherwise be considered in the questionnaire but at the same time, the analysis of responses is more complex, given the variability of responses on the same question. Closed responses are essential to collect the respondents' perception of a narrow range of options. This permits a specific, quick, and easy

Fig. 1 Main fields considered in the design of the survey

RESPONDENT PROFILE	TERRITORIAL KNOWLEDGE	TERRITORIAL NEEDS	TERRITORIAL PERSPECTIVES
<ul style="list-style-type: none"> •Rural/Urban •Age •Gender •Education level 	<ul style="list-style-type: none"> •Tourist sites in the community •Natural hazards affecting the community and emergency plans •Community Development Plan •"Litoral del Biobío" Mining Geopark Project •Geosites 	<ul style="list-style-type: none"> •Needs of the community •Priority of tourism for the territory •Tourism development areas •Biodiversity and Geodiversity conservation •Education needs 	<ul style="list-style-type: none"> •Community and staff perspective in five years •Preparing the community for a natural disaster •Prioritization of development areas for the community •Importance of a geopark in the territory

analysis of the respondents' perception, given that the possibilities of responses are limited. Finally, multiple choice or closed-ended multi-choice responses, on the one hand, allow a better analysis of the responses since a certain value can be assigned to each option to make statistical interpretation easier, and also allows a more specific question to be asked, since the questions have a specific meaning (Kerlinger 1997). The survey served as the main data collection instrument for this research.

Design of the Questionnaire

The design of the questionnaire had the main objective of interrelating different fields such as geology, political science, sociology, and anthropology in the structure of the questions. This allowed the results to be analyzed in an holistic way through a single tool, but from different points of view. This interdisciplinarity was reflected in the design of four dimensions: (i) the profile of the respondent, (ii) the degree of knowledge that people have of their territory, (iii) the needs that people perceive of their territory, and (iv) the perspectives that people have of their territory (Fig. 1).

To define the first field (respondent profile), information was collected on the range of age, education level, gender, and living environment (rural or urban²).

For these four fields, a total of 14 questions were generated, six of which refer to the dimension of the respondent's degree of knowledge about his/her territory, six refer to the dimension of the territory's needs as perceived by the respondent, and finally two refer to the respondent's perspectives on his/her community (Table 3).

The questions in the first field aim to find out (a) which are the main tourist sites that the respondent knows about his or her territory, (b) the degree of knowledge of geology and geosites that the respondent has, and (c) how much importance the respondent attaches to the geopark project.

Regarding the second field, the questions seek to know the perception of the respondent on how necessary she or he believes tourism is for the community, together with evaluating the situation of geotourism around different tourist and non-tourist themes. To achieve this, a strategy was followed of not directly asking about geotourism, but instead of integrating geotourism as one more variable of the answers in which were evaluated according to a Likert scale of 1 to 5 (Likert 1932), (where "1" is not necessary or a priority and "5" is very necessary or a priority). Finally, in this same dimension, the prioritization between biodiversity and geodiversity was compared, and was also assessed on a Likert scale of 1 to 5.

For the third field, the two questions were focused on knowing the economic perspective of the community where the respondent belongs, and the understanding that the improvement or decline in this aspect would directly affect the development of tourism and therefore geotourism. The last question of the questionnaire is focused on knowing the priority that the surveyed person gives to the development of geotourism for his/her community. As is previous questions, this was done not by means of a direct question, but with the selection of alternatives based on a Likert scale of 1 to 5.

This is an English translation of the questionnaire that was originally written and applied in Spanish.

Definition of the Sample to be Analyzed

Based on the population registered in the last census of Chile (2017) and taking into account the geographical area covered by the LBG project (12 communities in the territory), this adds up to a total population of 789.079 inhabitants. No restrictions or biases were applied to this number according

² According to census Chile (2017), the means of residence is defined as the number of registered inhabitants in the population center. If this number is greater than 2000 inhabitants, it is considered an urban center or medium, and if it is below this figure, it is considered a rural center.

Table 3 Questions and answer type of the three fields of investigation

Knowledge of the territory

- 1) From your own knowledge, could you list the three main tourist sites in your community?
- 2) From your knowledge or point of view, how much do you think tourism contributes to the economic development of your community? a) Nothing; b) Little; c) Quite a lot; d) A lot; or e) Do not know
- 3) Geology is the science that deals with the study of the Earth, the different types of rocks and minerals, as well as the processes and natural disasters that occur, such as earthquakes, volcanic eruptions, tsunamis, etc. What level of information do you consider you have about the geology of the territory? a) Nothing; b) Little; c) Quite a lot; d) A lot
- 4) To your knowledge, do you know of any sites of geological interest in your community? Answer: a) Yes; b) No
- 5) Have you heard about the "Litoral del Biobío" Mining Geopark project? a) Yes; b) No. c) Something
- 6) If you answer YES to question 5. Based on your knowledge, do you think the Geopark project is important for your community? a) Nothing; b) Little; c) Indifferent; d) Very important; and e) Do not know

Needs of the territory

- 7) From your point of view, what are the three main needs affecting the population of your community? Open answer
- 8) From your knowledge or point of view, how do you evaluate on a scale of 1 to 5 the need for tourism development in your community? (1) Not necessary; (2) Somewhat necessary; (3) Indifferent; (4) Necessary; or (5) Highly necessary
- 9) Of the following topics listed, could you indicate how necessary you consider them for the development of the community? Evaluate from '1' Not necessary to '5' Highly necessary. Topics: a) Conservation of natural areas, b) Tourism services, c) Public infrastructure, d) Credits for SMEs, e) Curricular education, f) Employment and economic development, g) Local and indigenous community, h) Technical education, i) Heritage conservation
- 10) Of the following tourist areas listed, could you indicate the level of priority? Evaluate from '1' Not necessary to '5' highly necessary. Areas: a) Business tourism, b) Rural tourism, c) Nautical tourism, d) Events tourism, e) Tourism in natural areas, f) Adventure tourism, g) Gastronomic tourism, h) Sun and beach tourism, i) Cultural tourism
- 11) Evaluate from '1' not necessary to '5' highly necessary according to your perception, the importance of the different services/topics for tourists: a) Development of Ethnic Mapuche tourism, b) Scientific knowledge, c) Transport services, d) Digital information, e) Information on geodiversity, f) Crafts and traditional festivals, g) Typical gastronomy, h) Accessibility, i) Guided service, j) Tourist information stands
- 12) If you were in charge of the management of economic resources allocated to the conservation of the natural environment, evaluate from 1 to 5 what would be your priorities for the different options. With '1' not necessary and '5' highly necessary. Options: a) Geodiversity (special types of rocks, fossils, minerals, etc.), b) Endemic flora (forests, natural grasslands, wetlands, etc....), c) Endemic fauna (endangered animals, others, etc.)

Expectations of the territory

- 13) In the next five years, how do you think the general situation of the community will be, Answer: a) Better, b) Worse, c) Indifferent, d) Do not know
- 14) Of the following topics listed, indicate the level of priority that you assign to each, being '1' Not a priority and '5' high priority. Themes: a) Participation of higher education institutions in the territory, b) Strengthening the territory's identity, c) Mediation of the Mapuche problem, d) Gender equality and reduction of inequality, e) Water and sanitation, f) Support for organic production and clean energy, g) Support for SMEs and employment for young people and women, h) Alliances between the public and private sectors, i) Biodiversity conservation plans, j) Geological heritage conservation plans, k) Promotion of tourism in natural areas, l) Education on natural risks

to the profile of the subject to be interviewed. Thus, it is possible to classify the survey as extensive since the entire population is susceptible to being surveyed. Knowing the value of N , it is possible to calculate the sample to be surveyed, using the following formula:

$$n = \frac{k^2 \times p \times q \times N}{(e^2 \times (N - 1)) + k^2 \times p \times q} \quad (1)$$

where N is the total population of the territory; $k = 1.96$ is a constant that depends on the selected confidence level, which for our case study was 95%; $e = 0.05$ the value of the sample error accepted in our study, which in our case is 5%; $p = 0.5$ is the proportion of elements that present a certain characteristic to be investigated (if this is not known, the standard value selected is 0.5); $q = 0.5$ is the proportion of

elements that do not present the characteristic being investigated, which as in the previous, if this is not known, the standard value selected is 0.5, given that in both cases the value of 50% of the sample selection are the most unfavorable values.

Considering a population of 789,079, the size of the sample to be surveyed is 384.

Implementation Criteria for the Survey

Once the number of subjects to be sampled (n) was known, the main geospatial criteria through which the questionnaire would be distributed were defined.

For the first, the total sample ($n = 384$) was divided according to the number of communities in each province, where the province of Concepción with seven of the 12

Table 4 Distribution of the number of surveys per community according to the criteria of representativeness applied

Community		criterion 1	criterion 2	criterion 3		criterion 4			
				Men	Women	Men Rural	Women Rural	Men Urban	Women Urban
Concepcion province	Tomé	224 + 12*	19 + 2*	9 + 1*	10 + 1*	1 + 1*	1 + 1*	8	9
	Penco		17	8	9	0	0	8	9
	Talcahuano		53 + 2*	25 + 1*	28 + 1*	1*	1*	25	28
	San Pedro de la Paz		46	22	24	0	0	22	24
	Hualpén		32 + 4*	15 + 2*	17 + 2*	2*	2*	15	17
	Coronel		41	20	21	1	1	19	20
	Lota		16 + 4*	8 + 2*	8 + 2*	2*	2*	8	8
Arauco province	Arauco	160	39	19	20	9	10	10	10
	Curanilahue		35	17	18	8	9	9	9
	Lebu		27	13	14	6	7	7	7
	Los Álamos		22	11	11	5	5	6	6
	Cañete		37	18	19	9	9	9	10
	396	396	191	195	45	48	146	157	
	396	93	303						
	396								

*N of surveys added to obtain a geographical coverage of the rural areas to better represent the province of Concepción.

This way, a better representation of the territory could be obtained. To this end, four consecutive distribution criteria were applied (Fig. 2).

communities represents 58.3% (224 surveys), while of the province of Arauco with five communities represents 41.6% (160 surveys).

This criterion is more representative than opting for a distribution based on the population data by communities provided by the 2017 census, where the population of the province of Arauco represents only 20.9% of the total sample and would be underrepresented with only 80 surveys.

The second criterion refers to the distribution of the surveys in each community. For this purpose, a distribution was applied based on the percentage of the population of each community with respect to the total of the province to which it belongs, according to the data provided by the 2017 census (Table 1).

Regarding the third criterion related to gender, the data analyzed by community in the 2017 census indicates a similar percentage in the distribution between men and women, which is why an average was chosen for the twelve communities. This resulted in a percentage of 51.8% for women and 48.2% for men, which was transferred to the distribution of surveys according to the previous criterion.

Finally, a fourth distribution criterion was applied to the survey, taking into account the environment in which the respondent lives, differentiating between urban and rural. In this criterion, a differentiation was made by province (Arauco and Concepción) in order to more realistically represent each (Table 1). In the case of the province of Arauco, a 50% distribution was made between the two environments (urban and rural), while for the province of Concepción, the data provided by the 2017 census was used for the

percentages of each community with respect to the rural or urban setting (Table 1).

The exact geographical location of where to apply the different surveys within each of the communities was established after discussion with officials from the territorial planning department of the different municipalities. Thus, it was possible to find the sectors with the highest concentration of population, given that the data from the 2017 census does not reach the required level of detail needed in this work.

Since it was observed that some sectors of the communities of Hualpén, Lota, Talcahuano, and Tomé were not represented due to a lack of surveys, and considering that they are important population centers, it was decided to increase the number of the sample (n) by 12 and thus reach a total 396 surveys (see * in the Table 4).

Geographical Situation of Application and Criteria

Prior to the application of the questionnaire, six trial surveys were carried out in the communities of Talcahuano and Hualpén, in order to adjust the format of the questions and answers of the questionnaire. The final questionnaire was applied during the period between April and September 2019 to a total of 402³ respondents within the territory of the LBG.

³ The surveys carried out for the adjustment of the form were considered valid, given that the form did not undergo any changes in this respect to the content of the questionnaire, neither in the number of questions nor in their content.

Fig. 2 Geographical location of data collection

Fig. 3 **a** Age ranges of respondents (Ruiz 2005; Defensor del Pueblo 2016), and **b** school levels of respondents

This research was carried out as field work, as the surveys were applied as personal interviews in the field and the information was collected in written form through the questionnaires.

The selection of the persons surveyed was random (random probability sampling). In this sense, it was only taken into account that the residence of the person interviewed coincided with the community of data collection. Once the candidate was selected and before answering the questionnaire, the interviewer made an introduction explaining the academic purpose of the questionnaire, as well as the need to answer in an objective and sincere way, in order to achieve the maximum objectivity of the results.

The active role of the interviewer was fundamental for several reasons. Firstly, it allowed that the person being interviewed felt comfortable and that the survey takes place in a cordial atmosphere and in a pleasant conversation. Secondly, so that the person answering the questionnaire understands, at all times, the concepts dealt with in the questions, taking special care in the impartiality of the information given so as not to influence the answer.

This study did not require the approval of an ethics committee even if it is a human study, as it only involved the opinion (perception) of the activities disclosed. The information in the form of answers was provided voluntarily and with the consent of the interviewee, who was informed beforehand about the academic and non-profit purpose of this research.

Data analysis Techniques

The data was processed in a quantitative and qualitative way, using an empirical and deductive approach (Arias 2012). Depending on the type of questions asked, different types of responses were obtained. For this reason, the analysis of the results was also carried out in a differentiated manner depending on the types of response. This analysis of the answers was implemented using simple descriptive statistical techniques through bar or pie charts and the percentages of their variables analyzed.

In the case of open responses, where the results are multiple and varied, those that could make up a similar subject

were grouped together using deductive and inductive logic. This allowed the percentages of these subjects to be quantified and compared between them. An example of this could be for answers such as medicines, hospitals, and illnesses were grouped within the area of “health,” or for answers about theft, crime, drugs, etc. were grouped in the area of “public security.”

Results

Respondent Profiles

Our study achieved a balanced population spectrum in terms of age and education profile. Figure 3 shows the results of the profiles of the respondents, according to the unspecified variables of age and schooling. In the case of education, the maximum level of education that the person has completed (if they had completed the education cycle) or are currently completing was taken into account.

Knowledge of “Litoral del Biobío” Geopark Project

Regarding their territory, most of the respondents identified few touristic, they do not consider it has a touristic potential, they are unaware of its geology, or they hardly know anything of the geopark project and its potential. Figure 4 shows the results of the answers about the field of knowledge of the territory (questions 1 to 6).

Needs and Expectations of the “Litoral del Biobío” Geopark Project

In general, the respondents consider security, public infrastructure, and economic development their major needs, but they also consider it necessary to enhance tourism. Conservation of natural areas and heritage are considered very necessary and is also considered very important to support all kind of tourism projects, together with tourism stands. Finally, geological heritage has a slightly lower

Fig. 4 Pie charts for answers to questions 1, 2, 3, 4, 5, and 6 of the survey on the level of knowledge of your territory

consideration than the biotic heritage. Apart from basic needs, there is a large concern on environmental and natural hazards.

Figures 5 and 6 show the percentages of the fields on the needs of the territory (questions 7 to 12) and the expectations of the territory (questions 13 and 14).

Discussion

In general, this demoscopic study can be considered robust, given that normal values have been achieved (in the sense of Lastra 2015), with an estimated error of 5% and a confidence level of 95%. Thus, the sample studied (386 inhabitants) is representative of the whole population (787,079

inhabitants). Several issues are discussed in order to clarify the strong points of our study and also the weak ones.

We are also confident that the answers of the persons that responded were relatively objective if compared to a political demoscopia. We noticed that the persons felt free to provide their true answers since they understood that the questionnaire had a scientific purpose rather than a political one.

Another important point is the timing of data collection, since the answers are provided in a context that may not be extrapolated in time and space. In our case, this is particularly relevant, since the questionnaires were answered between April and September of 2019. They were not affected by the corona virus pandemic or the explosion of social demonstrations and unrest that took place in Chile

Fig. 5 Pie and bars charts of the responses to questions 7, 8, 9, and 10 regarding the community's perceived needs in the territory

in October 2019 lead to the October 2020 plebiscite referendum to modify the Constitution of Chile, inherited from the transition from the previous dictatorship (Heiss 2020).

Another point to be considered is the attitude of the pollsters towards the respondents. In this sense, special care was taken to (1) not to coerce the answer of the pollster and (2) to spend the necessary time to ensure the respondent understood what was being asked. This is particularly important when we are dealing with geology, a term most people generally ignore.

Another strong point regarding timing has to do with census of 2017. A peculiarity from Chilean demoscopia is the usual controversies about “census,” since there is a large, dispersed, and inaccessible rural population hampering rigorous datasets (Neupert 2017). For our study, we benefited from the “2017 census.” This was further improved from the

previous 2012 census. Additionally, in the LBG territory, the 2017 census had no major inaccuracies detected.

On the Respondent Profile

The educational and social spectra of the studied population correlates with the Census data, i.e., we happen to get a very significative proportion distribution despite our random sampling. For example, 39% of respondents (157 people) are in the age range of 36–65, which also coincides with the population pyramid curve for the LBG project territory. Similarly, the majority of those surveyed (69.1% or 249 people) have completed basic and secondary education, which is also close to the population data from the 2017 census, where an average of 77.3% of the population has completed secondary education. This difference

Fig. 6 Graphs for responses to questions 11 and 12, for needs and 13 and 14 on respondents' perceived expectations of their territory

of 8.2% could not be controlled since the selection of the respondents was random and schooling was not a requirement. These data allow us to say that the sample surveyed is in agreement with the characteristics of the people in the LBG territory, in terms of age, schooling, gender, residence and population.

On the Community's Knowledge of Tourism and Geotourism in Relation to Their Community

We state that there is a relatively wide knowledge regarding tourism. In question 1, 90% of the respondents can list 2 or

3 touristic sites from their community. Based on the whole dataset, 1006 touristic sites were identified. In a later filtering of the answers, it was possible to decipher that 21% of these tourist sites correspond to sites of geological interest, inventoried by the LBG (Ferraro et al. 2018).

Despite that touristic points were identified, question 2 shows that the respondents hardly identified tourism as an economic sector. Only 57% consider that tourism has some economic significance (9% consider that it has a lot of significance, and 48% consider that it has few significance). We also observe that this 9% are dominantly urban (64% of respondents) and aged between 35 and 65 (52% of

respondents). In contrast, rural areas do not consider tourism as an economic resource. On the other hand, the 14% of respondents that say that tourism has no contribution do not show any particular trait. Finally, the 48% saying that tourism has few contributions are basically urban respondents.

The comparison of questions 3 and 4 is also relevant. Although 95% of respondents say that they know nothing or very little about geology (question 3); in fact, 23% of them, can identify sites of geological interest (question 4). We can conclude that people do know something about geology, but they consider themselves as not knowing anything regarding geology. The educational level of the 23% subsample is higher education (57.3%), high school education (24%), technical (1.3%), and primary/basic (17.3%). The 23% is easily correlated with the lack of experience of teachers in basic and high school education with regard to the geological content of educational programs (see Ferraro et al. 2020).

A total of 89% of the respondents indicate that they have not heard about the geopark proposal or that they have heard a little. The 11% that know about the geopark consider it to be a very important project (75% of the subsample). This means that it is worth disseminating the geopark project, since people who are aware of it take it more into serious consideration. This 11% is basically people with a university formation (80.6% of the subsample). Understanding that the geopark as a very important project is basically viewed by people with a higher education, most of the people with a higher education (which represents 37.5% of our general sample) do not have this vision. Higher education respondents (of the subsample) basically consider the geopark as a very important project.

On the Communities Perceived Needs in the “Litoral del Biobío” Geopark Project

Among the three main needs of the territory detected (question 7), the economic development of the territory (21% of the sample) is ranked in second position. This data justifies the implementation of the LBG since the UGGp are projects that seek the sustainable development of local communities (UNESCO 2016).

However, the main need detected in the survey is related to public safety (23% of the sample), which also directly or indirectly affects the productive area of tourism (Fernandes et al. 2016). This need similarly detected at the national level with the data provided by the National Urban Survey of Citizen Security (ENUSC) carried out in 2019 by the Ministry of the Interior and Public Security of the Government of Chile. This survey shows that 82% of the population believes that crime has increased nationwide and 37% believe that they will be victims of crime in the next 12 months. The percentage shown by our survey regarding public safety (23%) is comparable with

the ENUSC data for the Biobío region (20.2% of victimized households). It should be data to take into account, both for public administration and for the LBG, since it may go against the expectations of tourism development (Grosser 2018). To this end, it is important to alert the tourism industry, as well as public security forces to take the necessary measures in the tourist areas of the territory (George 2010).

Finally, we highlight the third need perceived in the territory, which is investment in public infrastructure (21% of the sample), given that the percentages obtained are the same as for the second need (economic development). Tourism and infrastructure are closely related (signposting, accessibility, information stands, human capital, etc.). Positioning geotourism as one of the axes of economic development in the territory (Gaztañaga et al. 2015; Mabvuto Ngwira 2019) can be very attractive, given that it is also a form of tourism which has a much more lower level of crime associated with it than conventional tourism (Pelfrey 1998; Mawby et al. 2016; Tripton et al. 2016).

Regarding question 8, 80% of the population highlights the need for tourism development for the territory (46.6% as “necessary” and 34.4% as “very necessary”). The majority of people (39% of the subsample) are between 35 and 65 years of age and have a medium level of education (50.8% of the subsample), and 64.6% of whom are from the province of Arauco. These data indicate a positive view of tourism development in the province of Arauco, which is precisely an area of “backwardness” and rurality (23%) based on data from the Regional Development Strategy (RDS) 2019–2030 carried out by the Regional Government of Biobío.

A total of 83% of the people surveyed consider the protection and conservation of natural areas and spaces to be “very necessary” (question 9), with 39.4% (subsample) having a secondary education and 45.5% (subsample) between the ages of 36 and 65 years old. This may be due to the knowledge that exists in the territory about the importance of the biodiversity present in the Nahuelbuta Mountain Range, which is considered a Hotspot at an international level (Wolodarsky-Franke & Herrera 2011). At the same time, it also positions geological heritage as a potential resource to be exploited and geoconservation as a potential area to be developed, given that these are also located in natural areas (Ferraro et al. 2018).

It is also worth noting in this same question, the percentages of responses obtained on heritage conservation as very necessary (72%), which are very high values that are on par with economic development (73%) and investment in public infrastructure (71%). This may be due to the large number of national monuments (27 historical monuments, 3 typical areas, 4 archeological monuments, 2 nature sanctuaries, and 2 living treasures) that exist within the LBG and have been recognized by the Council of National Monuments (CMN).

Part of this heritage is formed by the 9 geosites of the Geological Society of Chile in 2020 (<https://geositios.cl>) which are a very important part of the geopark project geosites (Ferraro et al. 2018).

A negative aspect to highlight in the answer to question 9 is the lack of thoughtfulness for the indigenous community. The 38.2% of the sample considered that the development of local communities and indigenous peoples was “not at all necessary” (26.4% responded “not necessary” and 11.8% responded “low necessity”). These percentages are mostly provided by people from the urban area (86.6% of the subsample) and from the province of Concepción (90.2% subsample). If we consider that the largest number of indigenous communities and populations live in the province of Arauco and in rural areas, we can explain this lack of consideration for the prejudices of the urban population (Table 2).

Regarding this issue it is also important to highlight the low percentage of people (37% of the sample) who consider the issue of credits for SMEs to be “very necessary,” given that “economic development” has been one of the main needs detected. The majority of those surveyed (67.5% of the subsample) are over 35 years old, this being the profile of persons according to the 2019 debt report issued by the Financial Market Commission, the age range with the highest financial debt burden (CMF 2020). A possible explanation for the low valuation of SME loans is that the debt of Chilean families (75.4% according to the Central Bank of Chile) no longer allows for more spending.

In question 10, the main tourism theme referred as the most needed in the LBG corresponds to activities related to visits to natural areas (56% “very necessary” and 23% “necessary”). Approximately 68% (subsample) of the answers are from people aged between 19 and 65, of which 32.9% have a higher education, most of these residing in the province of Concepción and in urban areas (88.9% and 85.4% and 88.9% of the subsample respectively). These data identify and locate potential domestic tourists. If we transfer these percentages to values over the number of populations that meet these characteristics in the LBG project, we arrive at figures of 172,009 potential clients, which represent 26.9% of the population of the LBG. Q-Similarly, an unpublished study carried out in 2018 by the Chilean National Tourism Service (SERNATUR) on the profile of Chilean tourists reveals that the average daily expenditure on short trips is 22,643 Chilean pesos (CLP\$) (approx. US\$29.65) and on short trips CLP\$31,049 (approx. US\$40.66). If we transfer these figures to the whole of the potential tourist population of the LBBMG project territory, we obtain a potential income for the territory of between CLP\$3,894,799,787 (approx. US\$5,100,302) and CLP\$5,340,707,441 (approx. US\$7,928,121).

Accessibility (74.6%) and information stands (71.2%) are the main services that the community believes are

“very necessary” for the touristic development of the territory (question 11), with 70.7% (subsample) being of people residing in urban areas. This data, in the first instance, is related to one of the main needs (question 7) regarding investment in public infrastructure with a focus on tourism. It also indicates that it is mainly the urban population that has the greatest difficulty in accessing the different tourist attractions. This may be due to the remoteness of the tourist attractions, the poor condition of the roads which often require 4×4 vehicles, or the access roads and/or the area in which the tourist attractions are located are on private land.

Interestingly, 39.2% of respondents consider information on geodiversity and geological heritage to be “very necessary” in question 11 and 48% would redirect funds to geodiversity and geological heritage as “very necessary” in question 12. These percentages are obtained mainly from a profile of people with a high school education (42.2% and 36.6% respectively of the subsample in question 11 and 12) and 81.5% of urban setting subsample in question 12, mainly from the province of Arauco. These results indicate that in general, geodiversity and geotourism are perceived as a necessity by urban people in the territory with an average level of education. This may be due to the fact that the urban population is most in need of contact with nature. However, this high valuation of geological heritage is exceeded by 20% compared to the valuation of biological heritage for fauna (67.1%) and flora (76.1%).

On the Communities Perceived Expectations with the “Litoral del Biobío” Geopark Project

Concerning question 13, there is a great resignation about the development of the territory in the next 5 years (52% “Neither better nor worse” and 15% “worse”), mainly by adults between 36 and 65 years old (48% of the subsample) and with a secondary education. Only 31% of the people think that the situation will be better in the territory, where 42.7% of the subsample are people between 19 and 35, and 68.7% are people with a higher education. This informs us of two different profiles: a majority that will be difficult to motivate and a prepared and dynamic minority that can lead in the development of the territory.

Finally, regarding question 14, in the territory, the areas of education on natural hazards and climate change (77.3%) and support for organic production and clean energies (76.6%) are perceived as a “very high priority.” This scenario includes 43.2% of the subsample with an age between 36 and 65 years and with a higher education (45.3% of the subsample). These data indicate that the prospects, although they include the aforementioned needs, also includes an improvement in technology and energy sources, as well as an increase in education in the territory, for which advanced human capital that can take on these challenges is needed.

The plans for the conservation of geological heritage do not stand out as a “very high priority” in this Sect. (52.6%), as does the promotion of tourism in natural areas (55.8%), which is contradictory to the responses obtained previously regarding needs. It should be noted, that 53.5% of the subsample (85 people) are people from the province of Arauco and this, in turn, represents 53.1% of the total population surveyed in that province. The majority age range for the subsample is between 36 and 65 years (40.3%/64 people) of which 51.6% (33 people) have high school studies and 28.1% (18 people) a basic education.

It can be perceived that there is still a lack of interest in the *Mapuche* community, given that only 37.4% (148 people) consider mediation in the “*Conflicto Mapuche*” (Lavanchy 1999; Vergara and Foerster 2002; Rodríguez 2007; Maldonado Rivera et al. 2013) issue to be a “very high priority.” This may be because the *Mapuche* community is 16% (125,932 people approximately) of the sample. The most alarming aspect is that 27.3% (108 people) think that it is “not a priority,” which shows discontent of the local population who do not belong to the indigenous peoples with the *Mapuche*. This gap between these social groups should alert us to potential conflicts that can emerge. There is a great need for a territorial mediator to help bring positions closer together and reach agreements, between the multicultural communities and the state.

Conclusions

Taking into account the population, settings of residence (urban or rural), age, and schooling, we can conclude that the sample surveyed is very consistent with the general characteristics of the total population, in terms of the different variables analyzed.

The obtained results show that the community has a real knowledge of the tourist sites in the territory of which geosites makes up 21% of these sites of interest. It also implies a geotourist potential that must be taken advantage of since the community itself already assigns a certain importance to it. At the same time, there are, however, low percentages of knowledge of the geology (2%), geosites (25%), and the LBG project (11%). While geological knowledge is focused on people with a high school education, knowledge of the project is better known by people with a higher education and without the age factor being a prominent variable.

The main needs of the territory are focused on public security, economic development, and investment in public infrastructure. In the survey, 80% of the people consider tourism to be between very necessary and necessary as an activity to promote production in the territory, and tourism in natural areas is the main tourist activity favored by 78.9% of those surveyed.

Geotourism (39.2%) and geoconservation (48.1%) are perceived as “highly necessary” or “a high priority” by a minority if compared with the importance attached to biodiversity (76.7%). A large part of the cause lies in the lack of knowledge of the Earth Sciences and biodiversity by a large part of the community. Similarly, plans for the conservation of geological heritage (52.6%) and tourism in natural areas (55.8%) do not stand out as “high priorities” for the people of the territory, but those who do strongly agree are mostly people from the province of Arauco, between 36 and 65 years of age and with a high school education.

In general, there is certain pessimism in the development of the territory in the medium term, since almost 70% of the population thinks that the territory will not prosper in the next 5 years, mainly from people between 36 and 65 years of age and with average studies. This implies a warning light, as it can lead to a state of collective apathy that conspires against the possibilities of success of the geopark. The main perceived priorities for the geopark territory lies in education of natural hazards and climate change, as well as support for organic production and clean energy (77%), (mostly by people between 36 and 65 and with a higher education).

A strong prejudice has been detected among the majority of the urban population towards rural indigenous (*Mapuche*) peoples. This apparent controversy of touristic development in an area of insecurity perception is in fact an opportunity. Geotourism is likely to provide a development free from an increase of insecurity, which is not the case of massive tourism. The geopark project is an unbeatable opportunity, and at the same time, a challenge to bring this social group closer to the geotourist.

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Declarations

Competing Interests The authors declare no competing interests.

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