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Degree of importance of demographic and socio-cultural factors in environmental perception: bases for the design of public policies in Argentina and Spain

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Abstract
Environmental problems on a global scale (such as climate change) are of increasing concern in the scholar. However, it is unclear to what extent society is aware of the severity of these problems. The aim of this study is to advance our knowledge about the environmental perceptions of citizens, with the understanding that citizen participation and action are key to mitigating environmental problems. Specifically, we aim to determine the degree of importance of demographic and sociocultural factors in this perception. To this end, data from 506 questionnaires carried out in Spain and Argentina were analysed. Quantitative data were treated using multivariate analysis based on multiple logistic regression. The results showed that demographic variables, such as location and age, have a greater influence than sociocultural variables, such as profession and sources of environmental information, in the perception of environmental problems. Our findings show that the analysis of environmental perception is a useful tool both for incorporating the point of view of local actors in public policies and for defining effective strategies for action in participatory management. They also show that the different age, occupation and profession of the population must be taken into account and that, to address specific environmental problems, it is necessary to carry out diagnoses focussed on demographic factors, mainly to find out which aspects should be strengthened through programmes and projects aimed at solving environmental problems. It is important to bear in mind that the behaviour of local actors is related to their environmental perception.

Keywords Citizen participation · Environmental problems · Environmental sensitivity of citizens · Public policies · Stakeholders

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1 Introduction

In the current context of global change, changes in the climate system, desertification and drought are recognised as environmental problems caused or greatly accentuated by human activities. The Sustainable Development Goals (SDGs) are institutional call to action to end poverty, protect the planet and improve people's quality of life in the coming years (McCright & Dunlap, 2011; UN, 2015). The development of measures to achieve these goals is progressing at uneven speeds in different countries, closely linked to their level of development, and with the involvement of the population still considered to be low (UN, 2015; Fukuda-Parr, 2016). One key challenge to improve this situation is the incorporation of citizen participation and collectively constructed knowledge in the formulation of public (environmental) policies to achieve the SDGs (Dunlap et al., 2000; Rubio et al., 2020). As part of the long road towards achieving the SDGs, the environmental awareness and commitment of civil society is necessary for the achievement of these goals. In this context, determining the degree of importance of demographic and socio-cultural factors in the awareness and perception of environmental problems in citizens of urban settings (over 50% of the world's population) with different socio-economic and environmental characteristics is essential.

The conceptual framework for the approach of our study is based on ecology, environmental psychology, territorial planning and socio-ecological urbanism. In this context, the environment can be defined as the space that surrounds and sustains people, composed of interacting natural and sociocultural elements, both tangible and intangible (Allen, 2000; Bergquist, 2020; Burger, 2000). The interactions are directly proportional, so that as human-generated impacts on the environment increase, the environment gradually loses its capacity to support living beings (Myers et al., 2013). Thus, an environmental issue is considered a problem as soon as it is perceived by society; therefore, environmental problems require knowledge about the functioning of ecosystems to improve the ability to diagnose their current state and to understand their short- and long-term response to human presence and activity (Dunlap, 2008; Dunlap et al., 2000; Hudson, 2001).

In recent years, there has been increasing interest and, consequently, concern for environmental issues on the part of both companies and citizens, especially as consumers. On the one hand, as evidenced by Lotfi et al. (2018), green entrepreneurship is also very important in the commitment to achieve sustainable development and the communication (marketing) that they make of their involvement with environmental care (Awan, 2011) despite often being considered as "green washing" and not a real commitment of companies (Supran, 2021). On the other hand, the incipient but growing concern for the environment and the awareness of consumers to buy more environmentally friendly products has a positive impact on the emergence of the green market, especially in Europe and the USA due to their greater purchasing power (Awan & Raza, 2012; Dangelico & Vocalelli, 2017; Lotfi et al., 2018).

Environmental psychology has advanced in its understanding of the relationship between human behaviour and environment, considering the effect of the environment on human behaviour or, alternatively, considering the effects of people's behaviour on the environment (Burger, 2006). In fact, authors such as Moser and Uzzell (2003) have emphasised that the person–environment relationship is based on interaction, i.e. people affect the environment, while the environment is simultaneously affecting them. Along the same lines, ecology has developed to assume a unity between the ecological (biophysical) subsystem and the social (and economic) subsystem, forming socio-ecological systems

(Berkes et al., 1998; Rescia et al., 2012; Herrero Jáuregui et al., 2018; Andersson et al., 2021). Considering that the actions of human beings are directly linked to environmental problems, the importance of investigating environmental perceptions associated with actions in response to any change or difference in the environment should be highlighted (Lozano et al., 2016).

Human perception has been the subject of study in philosophy, understood as a cognitive process of consciousness that consists of the recognition, interpretation and relevance for the elaboration of judgments about sensations obtained from the physical and social environment (Vargas, 1994). From this approach, the relationship between the individual, society and its environment through sensory studies was based on the theory of environmental psychology (Fernández Moreno, 2008). In this regard, two main lines of thought can be identified: one based on the idea that perceptions are socially constructed in a collective way and another that maintains that the meaning of what is perceived is individual. The latter holds that the perception process is influenced by personal experience and experiences (Sánchez Álvarez, 2008) or even by demographic, cultural and socioeconomic factors (Brody et al., 2004).

Assuming that cities form an integrated socio-ecological system in which tensions are generated between the biophysical component and the socio-economic structure that threaten the sustainability of the system, they must be managed according to socio-ecological principles. In this line, nature-based solutions articulated through public policies developed with citizen participation are an increasingly valid alternative to solve the problems of this type of management. To this end, an essential first step is the analysis of citizens' environmental perception in order to address the link between society and the environment. To our knowledge, there are few studies with a considerable amount of qualitative and quantitative data in different urban settings on citizens' perception of environmental problems. From the results of our study, recommendations could be deduced for decision-makers (politicians), managers (technical and sector-specific administrations), civil society organisations. At the same time, they would contribute to the improvement of the knowledge of the degree of perception of environmental problems by society and, based on this improvement, to assume a public commitment to solve these problems with the maximum participation of those affected (citizens).

Several studies which deal with the perception of environmental problems that can verify links to demographic and sociocultural variables are of great interest when it comes to incorporating the different actors in the co-participatory process of elaborating measures or policies and actions aimed at sustainable development (Aragonés et al., 2006; Reames & Bravo, 2019). Despite the relevance of this, there is little research focussed on identifying the variables that influence the perception of environmental problems. Identifying the socio-cultural or demographic variables that have the greatest degree of influence on the perception of environmental problems is a useful tool to design specific action strategies to address these problems. For example, if age is identified as a variable that significantly influences the perception of environmental problems, specific actions in environmental education and citizen participation, segmented by age, could be implemented. In this sense, there are numerous studies that refer to the importance of citizen participation in the design of public policies (Ju et al., 2019; Wagle, 2000). Despite this, there is still a challenge in terms of implementing effective and specific forms of citizen participation that can be reflected in a change of behaviour in the face of environmental problems.

Two countries, Argentina and Spain, were chosen as study areas. Based on the hypothesis, economic level, the degree of development of sustainable policies and regional climatic conditions may condition the social perception of different ecological problems (Gifford,

2014; Rocha et al., 2012). Under this framework, the aim of this paper was to determine the degree of influence of demographic and socio-cultural factors on the perception of different environmental problems by citizens of Argentina and Spain. To this end, the specific objectives were a) to analyse the profile of the respondents and the frequency of the most mentioned environmental problems, b) to analyse the possible correlation/covariance between the dependent variables and c) to analyse the statistical influence of demographic and socio-cultural factors on the perception of the most mentioned problems. The results of this research make it possible to establish guidelines focussed on the variables that have the greatest influence on environmental perception, with the aim of designing more effective environmental public policies. In this way, specific actions can be established to encourage citizen participation in the search for knowledge and solutions to environmental problems.

2 Materials and methods

2.1 Study areas

The present research was carried out in Argentina and Spain, countries with a markedly different Gross Domestic Product (GDP). Spain has a GDP of €25,000 and Argentina about €8500 (World Bank, 2019). Specifically, the study was developed in the capital cities of both countries (i.e. Madrid in Spain, and Buenos Aires in Argentina), as well as in non-capital cities (i.e. Almeria and Mendoza, respectively) (Fig. 1).

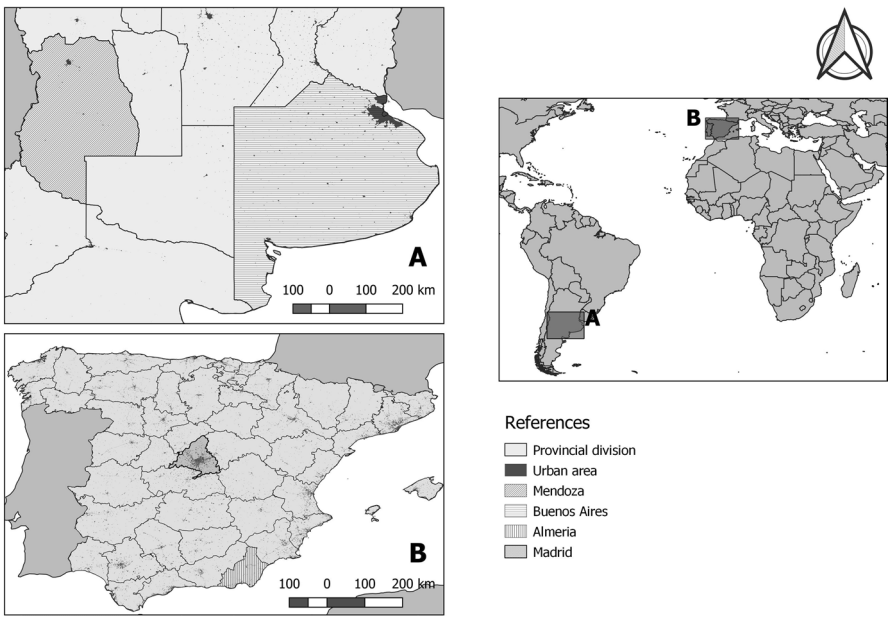

Fig. 1 Geographical location of the study areas. In the darker colour, the provinces where the cities in which the questionnaires were carried out are located (A; Argentina, with Buenos Aires and Mendoza; B: Spain, with Madrid and Almería)

The study area cities were selected based on their urban character where a large population is concentrated: 16.66 million inhabitants in Buenos Aires, 1.88 million in Mendoza, 6.75 million in Madrid and 0.7 million in Almería (EUROSTAT, 2015). In this regard, it is worth noting that several studies (Reames & Bravo, 2019; Rocha et al., 2012) highlight how population density conditions environmental perception. Thus, people who live in densely populated environments, usually have a greater awareness of urban problems (e.g. pollution or discharges), due to their relationship with the increased incidence of different health problems and detriments to the state of population well-being (Brody et al., 2004). At the national level, there are mainly two factors that may condition the environmental awareness of the citizenship: (a) the difference between environmental policies, which are more widespread in Spain, for example, at the level of waste recycling, with a greater awareness of society towards the problem of plastic waste being to be expected at this country (Compa et al., 2019); and (b) the climatic conditions of each country where, as Spain has a predominantly Mediterranean climate (i.e. average temperature between 15 and 18 ºC and annual rainfall of 650 mm, with periods of summer drought) compared to Argentina's temperate climate (i.e. average temperature of 14–16 ºC and annual rainfall of 400 mm, but really with remarkable contrasts due to the large territorial extension), there is a greater risk of droughts that condition, for example, the effectiveness of agricultural activity (Rodríguez Sousa et al., 2020a). However, in both countries there is a broad agricultural culture, whose management models have been intensified in recent years, causing several environmental problems that affect the human welfare, being considered a matter of social concern (Lence, 2010; Rodríguez Sousa et al., 2020b; Torres-Miralles et al., 2017).

2.2 Data collection: sample design and questionnaire implementation

Data collection was carried out through structured questionnaires. To optimize the sampling effort, a "snowball" sampling design was carried out, consisting of the selection of an initial number of potential subjects as respondents, who in turn distribute the questionnaires to secondary subjects, thus increasing the sample size through non-probabilistic sampling (Pattison et al., 2013). The questionnaires were tested and adapted after a first series of implementations on primary subjects (i.e. $n = 50$ people) in each country. The primary subjects were selected using target groups, that is, subjects of variable age (i.e. from 18 to over 46 years) whose studies or profession may or may not be linked to environmental aspects. Thus, an attempt was made to distribute the initial sample size of 50 respondents in each country into two equitable subgroups of 25 individuals according to whether or not they were linked to environmental aspects. Subsequently, these primary subjects generated secondary subjects (Hopmann, 2012), increasing the sample size to obtain 536 questionnaires, of which 506 were applicable (final sample size of $n = 506$, see Annex I for complete questionnaires text). The questionnaires were executed in two modalities: face-to-face and virtual. These questionnaires, executed in a time frame of six months, were based on a combination of personal characteristics of respondents (independent factors), and closed (i.e. dichotomous or multiple choice) and open questions, where respondents could express and assess the environmental problems they considered most relevant.

As independent variables, demographic and socio-cultural aspects of the respondents were evaluated, constituting classification tools for data analysis (Fig. 2). On the other hand, from the questionnaires conducted, we selected those environmental problems that showed the greatest population sensitivity. Specifically, this information was extracted from an open-ended question, where the respondent had to mention six environmental problems

Independent factors		
Classification	**Factor**	**Treatments/Levels**
Demographic	Age	18-30 years 31-45 years > 46 years
	Location	Argentina Spain
	Gender	Male Female Other
	Occupation	Student Teacher/Researcher Employed Unemployed
	Educational level	Obligatory education Professional/Tertiary education University education
Sociocultural	Profession (linked to environmental aspects)	Yes No
	Opinion about which level of government is most involved in the environmental policies	No level Municipal Provincial/National All levels
	Sources of environmental information	Scientific Community Both
	Financial contribution to environmental or conservacionist institutions	Yes No
	Interest in the result of the study	Yes No

Dependent variables (environmental problems)
Air pollution
Water pollution
Other types of pollution
Deforestation
Global change
Plastic waste
Agricultural pollution
Droughts
Discharges
Biodiversity loss

Fig. 2 Independent factors, including their levels, and dependent variables (environmental problems) of the questionnaires implemented

and rate their importance on a semi-qualitative Likert scale from 1 (very unimportant) to 5 (extremely important). From this sample design, a total of 107 environmental problems were mentioned. However, in order to find out how demographic and socio-cultural variables influence the degree of environmental perception of citizens, the 10 most frequently mentioned problems by all respondents were chosen (i.e. the selection of the dependent variables took into account the percentage of mentions obtained including all study areas (i.e. only environmental problems with a mention rate of more than 11.98% were selected for analysis) (Fig. 2).

2.3 Statistical analysis

Statistical analyses were performed with SPSS software (SPSS, 2012), using a significance level of $a = 0.05$ (White et al., 2022). An exploration of the data was implemented, obtaining a general profile of the respondents. Additionally, a concise descriptive analysis of the data on the frequencies (i.e. sample size) of positive and negative responses for each dependent variable at each level of the independent factors was carried out. We tested the normality and homoscedasticity of the respondent data using the Shapiro–Wilk and Levene tests, respectively (Kelter, 2021), and a partial correlation analysis was carried out, considering all the independent factors and their levels, to determine whether there were significant correlations or covariances between the dependent variables analysed (Fouladi, 2000).

According to the questionnaires in which we started with dependent variables (i.e. environmental problems) with binary qualitative data (i.e. yes/no) and multiple independent variables with qualitative levels, multivariate analyses were carried out in order to assess which factors had a significant influence on each environmental problem (including the assessment of the possible correlation between the independent factors). These multivariate

analyses were based on the implementation of multiple logistic regressions for parametric variables, applying, in the case of nonparametric variables (whose distribution instead of being normal resembles a Bernoulli model), a generalised additive model (GAM) of the logistic type (Austin, 2007). In both cases, the construction of the model was based on its saturated version to obtain the optimal final model for each dependent variable, using Ward's minimum variance method based on the selection of variables according to the ideal value for an objective function (Kurth et al., 2006).

In the case of parametric regressions, taking into account that the response (i.e. dependent) variables are dichotomous, the model fits Eq. 1 (Awan & Bilgili, 2022; Wasserman & Pattison, 1996):

$$\text{Logit}\,[P(Y=1)] = \alpha + \beta \times X_1 + \ldots + \gamma \times X_n, \tag{1}$$

where *Logit [P (Yi=1)*: probability, in a binary logistic distribution, that the dependent variable Y takes a value of 1 (i.e. in our research, a positive response in terms of the influence of a factor on each environmental problem); α: intercept of the model; β and γ: coefficient of the degree of influence of the independent variables on the dependent variable Y; X_1 and X_n: independent variables.

In contrast, by applying nonparametric logistic regressions, the dependence of a response is adapted to a nonlinear function *f(x)*, giving the model the formulation of Eq. 2 (Diriye et al., 2022; Jones & Wrigley, 1995):

$$\text{Logit}[P(Y=1)] = f(X), \tag{2}$$

where *Logit [P (Yi=1)*: probability, in a binary logistic distribution, that the dependent variable Y takes a value of 1; *f (X)*: distribution function of the independent variable X corrected (i.e. smooth function replacing the dependence of the response on a straight line).

Finally, it is worth highlighting that these kind of models where the variables are categorical, are descriptive rather than predictive in nature. Thus, their main advantage regarding other types of regressions, is the procurement of the R^2 of Nagelkerke, a goodness-of-fit parameter of the selected model, not representing the variability of the data explained by the model (Austin, 2007).

3 Results

3.1 Profile of respondents and frequency analysis of environmental problems

Table 1 shows the frequency data (sample size, n) of the questionnaires conducted and their representativeness as a percentage of their total number (506 for each factor), according to the age of the respondents, their location, gender, professional occupation and whether or not their profession was linked to environmental issues (classification tools that subsequently formed independent variables for the study of environmental perceptions). Based on these data, the profile of the respondents was described.

In general, it can be seen how a young profile of respondents predominated, representing more than 50% of the total respondents. Although the number of questionnaires was practically equal between countries, the participation of women was 19.96% higher than that of men, and the participation of one person belonging to a non-binary gender was considered insignificant. Fifty per cent of the participants were students, coinciding with the fact that most of the respondents were aged between 18 and 30 years, although there were

Table 1 Profile of respondents according to the sample size (*n*) and representativeness (%) of the questionnaires conducted

Factors and levels		Sample size (*n*)	Representativeness (%)
Age (years)	18–30	276	54.54
	31–45	99	19.57
	> 46	131	25.89
Location	Argentina	240	47.43
	Spain	266	52.57
Gender	Male	202	39.92
	Female	303	59.88
	Other	1	0.20
Occupation	Student	253	50.00
	Teacher/researcher	79	15.61
	Employed	136	26.88
	Unemployed	38	7.51
Educational level	Obligatory	64	12.65
	Professional/Tertiary	69	13.64
	University	373	73.71
Profession (linked to environmental aspects)	Yes	367	72.53
	No	139	24.47

also participants who were employed, whether they belonged to the research community or not, and unemployed people. Finally, the participation of respondents with a university education stood out, representing more than 70% of the total sample, together with the fact that respondents with links to environmental issues were up to 48.06% higher than respondents not linked to such issues.

As the respondents' answers are dichotomous, the mean values and standard errors will always range from 0 (no mention of the environmental problem) to 1 (mention of the environmental problem), being more relevant to evaluate the frequencies of these mentions in a descriptive way.

Regarding the frequency distribution about the positive or negative perception of the respondents to each dependent variable (numeric results attached in Annex 2), the most frequently problems mentioned were those related to global change (i.e. 297 mentions), deforestation (i.e. 236 mentions) and water pollution (i.e. 204 mentions), with the least perceived/valued problems being agrarian pollution (i.e. 83 mentions) and non-specific types of pollution (i.e. 61 mentions). Coinciding with this trend, those individuals who showed the highest environmental awareness were young people aged 18–30 years, followed by those aged 46 years and over, with those aged 31–45 years showing the least concern towards the issues raised.

In terms of location, no clear trend was observed, with the most perceived problems in Argentina, being water pollution (i.e. 133 mentions) and in Spain global change (i.e. 167 mentions). In general, the citizens of both countries coincided in the frequency of mentions or non-mentions of problems, except for water pollution, which was detected as a problem mentioned by more than 50% of the Argentine respondents and by less than 30% of the Spanish respondents. Similarly, the gender of the respondents did not influence environmental perception or awareness (men and women coincided in the

frequencies of mentions or non-mentions of the problems), with the most frequently mentioned problems being global change, deforestation and water pollution. It should be noted that there was greater concern among women, with higher values of up to 34.08% for global change. Finally, in terms of demographic variables, within the occupation factor, students were the most aware group, reaching values of 162 mentions for global change, which was the variable of greatest general concern, while those individuals with university studies were those who perceived environmental problems and their consequences for society to a greater extent, with maximum values of up to 82.10% and 88.30% higher than individuals with professional/tertiary and compulsory education, respectively.

In terms of sociocultural variables, professional ties to environmental issues led to higher frequencies of mention of the proposed problems, with global change once again standing out as the main problem, with a 54.42% higher percentage of mentions compared to individuals with professions not linked to the environment. One result worth highlighting was the predominance, for all the environmental problems, of the fact that respondents felt that governments were involved at all levels (i.e. municipal nor provincial/national) in the establishment and dissemination of policies aimed at raising environmental awareness among citizens and mitigating the effects of the concerns raised. On the other hand, while the majority of respondents stated that they were not informed about the environment through scientific or community-based channels, those respondents who did report being informed were predominantly informed through non-scientific sources in all cases, with only a minority consulting scientific articles. Finally, although there was a predominant unwillingness to contribute financially to environmental or conservation institutions, those individuals who were willing to contribute financially were more concerned about the issue of global change (i.e. 297 mentions), being the same individuals who showed interest in learning about the results of the present research (these variables were binary; thus, the descriptive results obtained are dichotomous (i.e. Yes/No)).

3.2 Parametricity of dependent variables and correlation analysis

According to the results of the Shapiro–Wilk and Levene tests, all dependent variables showed a non-normal distribution and a heteroscedastic character, with highly significant p-values $< 0{,}001$*** in all cases, being considered as nonparametric data. On the other hand, a partial correlation analysis was performed, where, taking into account as control variables the independent factors (i.e. demographic and socio-cultural) and their levels, the possible existence of correlation/covariance between the dependent variables was analysed (Table 2).

In general, independence (correlation values of less than 10% or −10%; nonsignificant p-values) was observed between the dependent variables (i.e. environmental problems), with occasional exceptions. In this sense, the significant correlation between the air and water pollution variables stands out, with a positive covariance of 10%. On the other hand, very significant influences were found between water pollution and droughts, and deforestation and biodiversity loss (i.e. correlation values of -15% and 11%, respectively). Finally, all variables except water and agrarian pollution showed covariances with varying degrees of significance towards the global change issue, with a positive correlation of up to 19% for this variable with biodiversity loss and a negative correlation of up to -17% for air pollution.

Table 2 Correlation (*C*) and significance values given ($p > 0.05$ –ns-: not significant; $p < 0.05$*: significant; $p < 0.01$**: very significant; $p < 0.001$***: highly significant) for the dependent variables, taking into account the independent factors as control variables

		Air pollution	Water pollution	Other types of pollution	Deforestation	Global change	Plastic waste	Agrarian pollution	Droughts	Discharges	Biodiversity loss
Air pollution	C	1.00	0.10	0.02	0.01	− 0.17	0.01	− 0.01	− 0.03	0.02	− 0.02
	p	–	*	ns	ns	***	ns	ns	ns	ns	ns
Water pollution	C	0.10	1.00	0.03	− 0.02	− 0.07	0.03	− 0.05	− 0.15	0.04	0.04
	p	*	–	ns	ns	ns	ns	ns	**	ns	ns
Other types of pollution	C	0.02	0.03	1.00	− 0.01	− 0.14	− 0.02	0.01	− 0.02	0.03	− 0.01
	p	ns	ns	–	ns	**	ns	ns	ns	ns	ns
Deforestation	C	0.01	− 0.02	− 0.01	1.00	0.18	− 0.01	− 0.01	0.01	− 0.04	0.11
	p	ns	ns	ns	–	***	ns	ns	ns	ns	**
Global change	C	− 0.17	− 0.07	− 0.14	0.18	1.00	− 0.09	− 0.04	0.14	− 0.15	0.19
	p	***	ns	**	***	–	*	ns	**	**	***
Plastic waste	C	0.01	0.03	− 0.02	− 0.01	− 0.09	1.00	0.04	− 0.02	− 0.01	− 0.02
	p	ns	ns	ns	ns	*	–	ns	ns	ns	ns
Agrarian pollution	C	− 0.01	− 0.05	0.01	− 0.01	− 0.04	0.04	1.00	− 0.05	0.01	− 0.03
	p	ns	ns	ns	ns	ns	ns	–	ns	ns	ns
Droughts	C	− 0.03	− 0.15	− 0.02	0.01	0.14	− 0.02	− 0.05	1.00	− 0.02	0.03
	p	ns	**	ns	ns	**	ns	ns	–	ns	ns
Discharges	C	0.02	0.04	0.03	− 0.04	− 0.15	− 0.01	0.01	− 0.02	1.00	-0.06
	p	ns	ns	ns	ns	**	ns	ns	ns	–	ns
Biodiversity loss	C	− 0.02	0.04	− 0.01	0.11	0.19	− 0.02	− 0.03	0.03	− 0.06	1.00
	p	ns	ns	ns	**	***	ns	ns	ns	ns	–

3.3 Statistical influence of demographic and sociocultural factors on the environmental problems

Given the nonparametric nature of the dependent variables, GAM models were carried out, including the possible covariance between the independent factors, to find out what levels of these factors influenced the perception of each environmental problem. Table 3 shows the optimal binomial logistic regression models for each dependent variable.

Although some sociocultural variables influenced the perception of certain environmental problems, demographic variables were more representative. With respect to pollution, there was a negative influence on the perception of air pollution in line with the respondents' professional ties to environmental issues. In contrast, the location of the respondents in Argentina showed a positive tendency towards the perception of problems related to water pollution, other types of pollution and agrarian pollution, with the perception of this last dependent variable also being negatively related to the non-scientific sources of information used by the respondents and positively related to their interest in knowing the results of the study. The perception of deforestation and global change was positively influenced by the age of the respondents, in particular young (18–30 years) and middle-aged (31–45 years) individuals. Perceptions of plastic waste, in addition to being negatively influenced by location in Argentina, also showed a negative tendency towards individuals with professions linked to the environment. Droughts showed a greater awareness among 18–30-year-olds and those with a professional or tertiary level of education, and were negatively influenced by the respondents' lack of interest. The perception of discharges was higher in Argentina, which also showed a greater awareness on the part of those interested in the study. Finally, with respect to biodiversity loss, greater awareness was observed among 18–30-year-olds, with greater government action at the provincial or national level being considered significantly more important, while this variable was considered less important by individuals with a profession linked to the environment.

It is worth noting that the models with the best goodness-of-fit, being highly significant, were those linked to water pollution ($R^2 = 11.20\%$); plastic waste ($R^2 = 16.60\%$); agrarian pollution ($R^2 = 13.80\%$); discharges ($R^2 = 12.50\%$); and biodiversity loss ($R^2 = 12.70\%$), thus consolidating the environmental problems with the greatest descriptive strength in accordance with the research carried out.

4 Discussion

Despite some limitations of the study such as the application of a sample design based on questionnaires conducted in a single time interval, the very diverse profile of the respondents and some existing correlations between the environmental problems analysed, the results obtained showed an approximation of how different demographic and socio-cultural factors can modify the perception of different environmental problems. However, the interpretation of these results should be carried out with caution, in no case making categorical deductions, because although the sample size of the respondents was more or less equal between Argentina and Spain, and location can be assessed as a biasing factor in environmental awareness, a lot of respondents were young people between 18 and 30 years of age (i.e. 54.54%), many of whom had university students

Table 3 Binary regression models for each dependent variable including the model equation (with the intercept and the levels, between brackets, of the independent factors with significant influence for each environmental problem), the value of the Chi-square statistic, the goodness-of-fit (i.e. Nagelkerke's R^2 value) and the significance of the model ($p > 0.05$ –ns-: not significant; $p < 0.05$*: significant; $p < 0.01$**: very significant; $p < 0.001$***: highly significant)

Model equation	Chi-square	R^2	*p*-value
Air pollution = − 0.364—0.688 * Profession (linked to environmental aspects) (Yes)	10.617	0.029	***
Water pollution = − 1.010 + 1.228 * Location (Argentina)	43.826	0.112	***
Other types of pollution = − 2.457 + 0.847 * Location (Argentina)	9.239	0.035	**
Deforestation = − 0.924 + 0.876 * Age (18–30 years)	16.471	0.043	***
Global change = − 0.107 + 0.626 * Age (18–30 years) + 0.623 * Age (31–35 years)	9.323	0.025	**
Plastic waste = − 0.286—1.541 * Location (Argentina)—0.725 * Profession (linked to environmental aspects) (Yes)	51.142	0.166	***
Agrarian pollution = − 2.400 + 1.137 * Location (Argentina)—0.738 * Sources of environmental information (Community) + 0.818 * Interest in the result of the study (Yes)	43.032	0.138	***
Droughts = —0.709—0.549 * Age (18–30 years) + 0.619 * Educational level (Professional/Tertiary)—0.536 * Interest in the result of the study (Yes)	20.120	0.059	**
Discharges = —2.059 + 1.142 * Location (Argentina) + 0.633 * Interest in the result of the study (Yes)	44.903	0.125	***
Biodiversity loss = —1.141 + 0.958 * Age (18–30 years)—0.762 * Profession (linked to environmental aspects) (Yes) + 0.920 * Opinion about which level of government is most involved in environmental policies (Provincial/National)	47.746	0.127	***

(i.e. 73.71%) and with a close involvement with environmental issues (72.53%), resulting in a very homogeneous distribution of responses obtained.

Notwithstanding these caveats, in general, respondents recognized a diverse set of environmental problems but none of them, except global change, seem to be of high concern to them. The age and location factors do not influence the mention of problems, although it can be noted that water pollution is of concern to Argentines and that age has an influence on the perception (degree of importance) of certain problems, such as the loss of biodiversity and deforestation. This is interesting as previous research discusses economic well-being as a prerequisite for environmental concern (Assa, 2021; Brechin & Kempton, 1994). However, scholars show that residents of both developed and developing countries show high levels of concern for the environment (Hunter et al., 2010). More in detail, the results of this study show that demographic variables have a greater influence than sociocultural variables on the perception of the environmental problems identified. Among the demographic variables, age and location were the most relevant factors in the perception of environmental problems by citizens, while gender and education do not seem to have an important influence on environmental perception. As for sociocultural variables, profession (linked or not to environmental issues) had the greatest influence on the perception of problems. Although some studies show that cultural and ideological differences influence the perception of the environment and the valuation of environmental problems (Afshar Jahanshahi et al., 2018; Eisler et al., 2003; Schelhas & Pfeffer, 2005), our results indicated that the perception of the population finds common ground in being immersed in a global environmental crisis beyond beliefs, customs, traditions, norms or even attitudes.

4.1 Environmental perception linked to population demographic factors

It is difficult in a highly populated urban environment to generate an identity or sense of place that would provide evidence of residents' perception of environmental problems (Stern, 2000; Gifford et al., 2011; Gifford, 2014). However, respondents to the study, the vast majority of whom lived in very densely populated (i.e. Madrid and Buenos Aires) or densely populated (i.e. Almeria and Mendoza) urban environments, perceived the usual problems of cities (such as different types of pollution, plastic waste and discharges). These perceived environmental problems in large and medium-sized cities, as some studies indicate, are related to a higher prevalence of health problems and lack of well-being and thus exacerbate the lack of identity with the location (place of residence) (Reames & Bravo, 2019; Rocha et al., 2012). Specifically, the impact of location on plastic waste is associated with the strong campaigns promoted by governments, public and private administrations aimed at raising awareness of this problem in Spain. Added to this, the results showed that younger respondents have a higher sensitivity to some specific and more recent impact problems (Leite et al., 2019). Although the younger population did significantly perceive the process of deforestation as an environmental threat, contrary to expectations, the results of our study did not show an age-related influence towards the occurrence of large amounts of plastic (Hudson, 2001). Specifically, the issue of plastic waste is of particular concern in the Mediterranean Sea (Compa et al., 2019), which explains why Spanish respondents are more aware of this problem than Argentinians. It was observed that education level significantly influenced perceptions of droughts, including desertisation (caused by natural processes) and desertification (mainly caused by human activities). Strikingly, the perception of this environmental problem was not significantly influenced by location of the respondent, despite the different climatic-environmental characteristics of the environments where

the questionnaires were conducted. Pioneering articles such as those by Saarinen (1966) and Taylor et al. (1988) (see also, Urquijo & De Stefano, 2016; Adaawen, 2021) have already suggested that people's perceptions, expectations and adaptive responses to recurrent environmental stimuli, such as drought events, are related to their direct experiences. In our case, this perception would be blurred by the fact that respondents' answers to the location question were analysed at the country level and not at the city level, this limitation forming a possible future line of research.

Although numerous studies found different perceptions based on gender (in general, women were more sensitive to environmental problems, e.g. Eisler et al., 2003; Lee, 2009; Murga Menoyo, 2009), in our study, coinciding with other authors (Aragonés et al., 2006; Ogunbode & Arnold, 2012; Shivakumara et al., 2015), although descriptively such a trend was observed, gender had a very little statistical influence on the perception of the most prominent environmental problems. It can be affirmed that the scale of the study area has an impact on the incidence of gender in the perception of environmental problems. When selecting the household as the unit of analysis, it has been observed in some studies that gender has a greater influence on environmental perception due to the "feminised" tasks that women tend to carry out in this space (Hunter et al., 2010). In particular, Aragonés et al. (2006) obtained results comparable to ours given that, for a population of university students, the variables origin (location) and gender did not offer clearly differentiated responses, despite some significant differences for the perception of some problems (deterioration of the ozone layer, urban waste, environmental deterioration, urban planning and nuclear energy). The difference between our results and the results obtained by other studies indicates that the significance of gender on the effect of environmental problem perception needs further investigation.

4.2 Environmental perception linked to socio-cultural factors of the population

Profession had the greatest impact on the perception of different environmental problems. Among all respondents, while almost 75% of people reported working on environmental issues, the remaining 25% worked on non-environmental issues. At the same time, the results suggest, on the one hand, that people in environmentally related professions have a greater sensitivity and awareness towards environmental issues. In addition, it has been observed that, in emerging economies, companies tend to adopt environmental social responsibility practices mainly with the aim of obtaining certifications that allow them to improve their competitiveness in the market (Awan, 2011). This could be manifested in the perception of environmental problems by workers who are not directly linked to environmentally related professions. Regarding the occupation factor, 40% could be considered as non-professionals (including students and retired people) and, among the professions, almost 10% were related to the environmental sector (biologists, environmentalists, geologists). Considering that, in many cases, profession and educational level are linked (Jalava et al., 2010), a high influence of profession on the perception of environmental problems was to be expected. This factor had a particular impact on the perception of air pollution, biodiversity loss and plastic waste. Consistent with our results (72.53% of respondents with professions related to the environment, 54.54% 18–30 years of age and 87.35% with higher educational attainment), it has been found that biodiversity knowledge, which can be termed "species literacy," and loss of species, was a problem where young people aged 18–30 years showed a high awareness (Burger, 2006; Hooykaas et al., 2019); however,

there was a negative influence of the perception of this problem on respondents dedicated to environmental issues.

To some extent, financial contribution to organisations and interest in the results of this study can be linked to environmental knowledge. To some extent, the economic contribution to organisations and the interest in the results of this study, framed in the analysis of pro-environmental behaviour, can be related to environmental knowledge (Liu et al., 2020). Thus, interest in the outcome of this study had a highly significant influence on the perception of agrarian pollution, droughts and discharges, while the economic factor showed no significant influence. Agrarian pollution was perceived most strongly in Argentina. Argentina is a country with a long agrarian tradition, and its productive system has undergone a high degree of intensification in recent years, generating serious environmental problems (Lence, 2010). The results indicate that society is showing sensitivity and interest in environmental issues, mainly through social movements fighting for comprehensive agrarian reform in the framework of food sovereignty and agroecology (Dominguez, 2019). However, the gap between interest and intervention (e.g. financial assistance) is still quite wide. Despite the interest in knowing the results of research on environmental problems does not necessarily imply a willingness to pay to mitigate those problems, in our study a direct relationship between the two factors was established. Consistent with the findings of Torres Miralles et al. (2017), in whose study was found that while 90% of respondents showed interest in conserving a particular cultural landscape, this percentage dropped to 65% when it came to financially supporting measures for its conservation, our results showed that the majority of the population tends not to contribute financially to the mitigation of environmental problems.

5 Conclusions

Despite the limitations of our study, in which most of the respondents were young people closely linked to studies or professions related to the environment, the results show that the analysis of environmental perception is a useful tool both, for incorporating the point of view of local actors in public policies, and for defining effective action strategies based on participatory management. Specifically, our findings indicate that the different age ranges, occupation and profession of the population must be taken into account and that, in order to address certain specific environmental problems, it is necessary to carry out diagnoses focussed on these demographic factors. It is important to bear in mind that the behaviour of local stakeholders is related to their environmental perception and to programmes and projects aimed at solving environmental problems detected in the diagnoses.

Thus, identifying the degree of influence of socio-cultural or demographic variables on the perception of environmental problems is a first step to design specific action strategies to address these problems. Therefore, it is highly advisable to take into account citizen participation and their perception of different environmental problems, whether global, regional or local, when making decisions on environmental policies. In this sense, there is still a challenge in terms of implementing effective and specific forms of citizen participation that can be reflected in a change of behaviour in the face of environmental problems.

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Data availability All data generated or analysed during this study are included in this published article (and its supplementary information files).

Declarations

Conflict of interest The authors have no financial or proprietary interests in any material discussed in this article, and they have no competing interests to declare that are relevant to the content of this article.

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