

Climate change in Colombia

A study to evaluate trends and perspectives for achieving sustainable development from society

Clara Inés Pardo Martínez
*Universidad del Rosario, Bogotá, Colombia and
Colombian Observatory of Science and Technology, Bogotá, Colombia, and*

William H. Alfonso P.
Universidad del Rosario, Bogotá, Colombia

Abstract

Purpose – This research analyses and evaluates the trends and perspectives of climate change in Colombia. This study aims to understand the main ideas and concepts of climate change in five regions of the country by analysing attitudes and values, information habits, institutionalism and the social appropriation of science and technology.

Design/methodology/approach – The research study involved a focus group technique. Ten focus groups in five regions of the country, including rural regions, were administered. The selection of cities and municipalities in this study took into account vulnerability scenarios based on the two criteria of temperature and precipitation for the 2011-2040 period.

Findings – The participants of the focus groups believe that climate change began 10 years ago and that human activities have caused climate change. The main effects of climate change are believed to be droughts and floods that have appeared in the past several years and have negatively impacted agricultural activities and the quality of life of the population. Moreover, the participants believe that it is important to design and apply adequate measures to adapt to and mitigate climate change.

Originality/value – This study makes an important contribution to the extant climate change literature by identifying and categorising the main ideas and knowledge on this issue from the perspective of the population in Colombia. In developing countries with high climate change vulnerability, it is especially important to analyse this issue to determine relevant official policy instruments that could promote adequate actions and instruments to prevent, adapt to and mitigate climate change.

Keywords Vulnerability, Climate change, Sustainable development, Colombia

Paper type Case study

1. Introduction

Global warming is generated mainly by the accumulation of greenhouse gas (GHG) emissions in the atmosphere, which triggers an alteration of the climate in most



regions of the world and causes social, economic and environmental changes (IPCC (Intergovernmental Panel on Climate Change), 2007a, 2007b). Climate change is defined as a variation in the state of the climate that can be attributed directly or indirectly to human activity. It is identified through statistical techniques by changes in the mean and/or the variability of its properties that persist for an extended period, typically decades or longer, altering the composition of the global atmosphere (IPCC (Intergovernmental Panel on Climate Change), 2007a, 2007b; UNFCCC (United Nations Framework Convention on Climate Change), 2011).

It is important to take into account the definition of climate variability according to the IPCC TAR (Intergovernmental Panel on Climate Change Third Assessment Report) (2001), which refers to variations in the mean state and other statistics of the climate on all temporal and spatial scales beyond individual weather events. Variability may be because of natural internal processes within the climate system (internal variability) or to variations in natural or anthropogenic external forces (external variability).

Another important concept related to climate change is vulnerability, defined as “the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt” (IPCC (Intergovernmental Panel on Climate Change), 2014a, 2014b, p. 1775). This concept suggests that vulnerability increases when people’s capacities and opportunities to adapt to climate change and adjust to climate change responses are weakened (IPCC (Intergovernmental Panel on Climate Change), 2014a, 2014b). This situation has generated worldwide concern, especially in countries with greater vulnerability, such as Colombia. In this country, the majority of the population live in the high Andes (where water scarcities and damage to the soil already pose a risk) and the coastal and insular areas (where the expected rise in sea level and flooding will disturb human settlements and economic activities). Furthermore, the country shows a high incidence of extreme weather and disasters associated with climate conditions and variability (IDB (Interamerican Development Bank), 2011; UNDP (United Nations Development Program), 2010).

Addressing this point, the UKCIP (2004) and UNDP (United Nations Development Program) (2005) described the importance of adaptation to climate change as a process that involves practical steps to safeguard countries and societies from the disruption and harm that will likely result from the consequences of climate change. These steps include the enhancement, development and implementation of strategies to moderate, cope with and take advantage of the consequences of climatic events. In this context, another important concept is climate change mitigation, defined as efforts to decrease or prevent GHG emissions through new technologies and renewable energies, making older equipment more energy efficient or changing management practices or consumer behaviour (UN Environment, 2014; Pardo, 2015).

With regard to climate change, it is important to analyse the synergistic effects between the climate and other anthropogenic variables that will likely exacerbate climate-induced changes. These are non-independent effects that should be studied with regard to changes in human behaviour (Harley *et al.*, 2009). Perception studies are key to determining adequate energy policies for society.

Studies on perceptions and ideas of climate change play an important role in establishing adequate strategies, channels and messages based on the objectives and the target population, especially in vulnerable areas, where it is crucial to provide adequate knowledge related to climate change.

Research on climate change and its relationship with anthropogenic activities, its related risk analyses and the prediction of potential consequences has been of scientific interest for more than two centuries (Leiserowitz, 2007). However, it was not until approximately

20 years ago (the 1980s and 1990s) that the scientific community began to produce evidence of the reality of climate change. In 2007, the Intergovernmental Panel on Climate Change confirmed that anthropogenic global warming in the past three decades has affected or influenced the majority of the world's physical and biological systems (IPCC (Intergovernmental Panel on Climate Change), 2007a, 2007b).

Other research has analysed the concept of vulnerability in relation to climate change from three approaches (Wolf *et al.*, 2013):

- (1) *Assessing harm for projected future evolutions*: Cuevas (2011) designed a model to establish adaptive actions that can be successfully applied in a system affected by climate change after determining that vulnerability represents a vital link between climate change and risk. Jacobs *et al.* (2014) used an integrated assessment of vulnerability to climate change that allows the consideration of multiple interacting stresses. This study examined differential adaptive capacities and was prospective as well as historical in the understanding of climate impacts.
- (2) *Assessing the present capacity to decrease harm*: Acevedo *et al.* (2016) analysed the capacity to respond to climate change in the Chinchina River of Colombia and found that there is a low response to severe events related to climate change because local communities are tasked with response without adequate resources or support from national or regional institutions. Metternicht *et al.* (2014) evaluated the vulnerability and impact of climate change in Latin America and indicated the need for climate change adaptation in this region. This study provided a crucial equilibrium between evaluation and action.
- (3) *Combining the two*: Soares *et al.* (2012) identified three general conceptual perspectives on vulnerability, biophysical, social and integrated, which are fundamental in the evaluation of climate change vulnerability. Harley *et al.* (2009) analysed the impacts of climate change in coastal marine systems and found that over the long term, a reduction in GHG emissions will be necessary if we are to slow and eventually reverse global warming. Furthermore, strategies must be adopted to reduce the potentially harmful effects of climate change in coastal marine systems.

These studies demonstrated the importance of analysing perceptions of climate change, which depends on factors such as social, economic and cultural features as well as multidimensional inequities generated by an unequal development process. These factors may cause differential risks related to climate change, and the poorest populations face major threats and negative consequences.

In general, the research on climate change has been concerned with scientific topics, whereas studies on ideas or public perception of this issue are limited, especially in developing countries such as Colombia. This is true although Colombia is recognised as a country that is at high risk and is vulnerable to climate change impacts. This study is important because people's lack of understanding of global warming may obstruct actions taken to mitigate the problems caused by climate change (Kreibich, 2011; Greiving *et al.*, 2015). These actions may include support for or opposition to climate policies, such as international agreements, taxes and regulations.

Moreover, the penetration of new low-carbon technologies or the use of cleaner production methods will depend mainly on public opinion, changes in cultural patterns and the conscious and responsible selection of goods and products based on the knowledge of the population regarding climate change. For this reason, it is important to understand the

public perspective and opinion on climate change to determine the impacts and effects of ideas about and different relationships to the situation generated by climate change.

Another point to consider is that success in mitigation and adaptation measures for climate change will depend on changes in the habits and behaviour of the population. These involve cultural change and collective thinking because the accumulation of individual actions can increase the impacts and consequences on the environment and can accelerate climate change (Capstick *et al.*, 2015; Leiserowitz, 2007).

This study involves a qualitative analysis using a focus group to determine the views of the Colombian population on the topic of climate change. The study takes into account the elements mentioned above and the importance of understanding public views on climate change in a country with high vulnerability to climate change because of its geographic features and biodiversity. The aim of the study is to provide information to policy makers on the effective design of instruments that allow better adaptation and mitigation by society based on people's perceptions of and ideas about climate change.

The following section outlines the trends in studies of the public perception of climate change around the world. Section 3 presents the features of climate change in Colombia. Section 4 specifies the methods used to develop the focus group. Section 5 describes the main results and a discussion of this study, and Section 6 provides the conclusions.

2. Trends in studies of the public perception of global climate change around the world

Various studies on the public perception of climate change have been conducted around the world. Based on the research of Capstick *et al.* (2015), these analyses can be divided into four representative time periods in the past few decades (see Figure 1), as shown below.

2.1 The 1980s and early 1990s

This period is characterised by a gradual increase in the knowledge and awareness of climate change. In the late 1980s, interest in climate policy began, especially in Western countries. The public perception of climate change increased, specifically in regard to topics related to the consequences and environmental problems observed around the world. Studies in this period were conducted in developed countries, such as research on how US

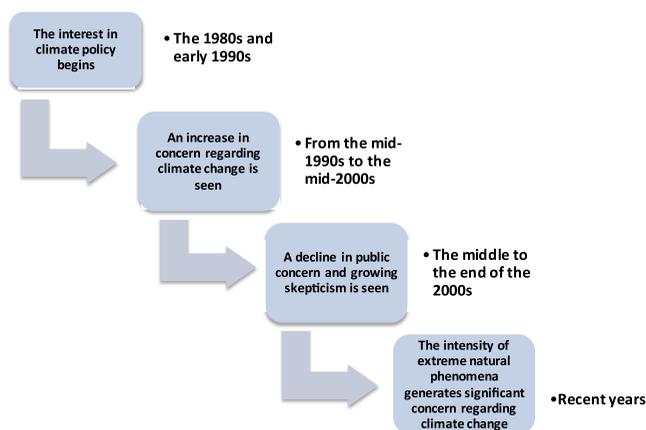


Figure 1. Trends in studies of public perception in the past few decades

residents conceptualise global climate change and make value judgements about it (Kempton, 1997) and research on the possible causes and effects of global warming and the efficacy of possible interventions in the USA (Read *et al.*, 1994).

2.2 From the mid-1990s to the mid-2000s

In this period, the population became increasingly concerned with climate change. Contradictions in opinions on this topic increased in relation to its greater coverage in the mass media, greater scientific proof and growing political attention. Carvalho and Burgess (2005) analysed reports on climate change from three UK broadsheet papers and indicated that social learning begins with the experiences of actors related to climate change science and policy development. Brechin (2003) used a selection of public opinion polls on cross-national public concern regarding global warming increases in the 1990s and determined that the majority of the public in many countries expressed personal concern about global warming as well as the significance of the problem. In all but a few countries, global warming seemed to rank near or at the bottom of the list of environmental concerns.

2.3 The middle to the end of the 2000s

This period showed a decrease in public concern and an increase in scepticism regarding climate change characterised by polarised viewpoints within and among countries. The public showed a higher consensus on the contribution of human activity to climate change. In this period, Pietsch and Mcallister (2010) conducted a national survey in 2008 of Australian public opinion on climate change and public policies that indicated widespread public concern about climate change, in which a majority of respondents supported the introduction of an emission-trading scheme. Lorenzoni and Pidgeon (2006) studied the way in which climate change was conceptualised by the public in Europe and in the USA and determined that most respondents related to climate change through personal experience, knowledge, the balance of benefits and costs and trust in other societal actors.

2.4 Recent years

Public perceptions of climate change have stabilised. However, in some countries and regions, public perception has intensified because of the occurrence of natural hazards related to climate change that represent risks to the population or studies of specific regions or populations. For example, studies in Peru and Siberia analysed how cultural and ritual patterns affected climate change (Paerregaard, 2013; Lavrillier, 2013, respectively). In Africa, Pauw (2013) analysed perceptions of how climate-related hazards lead to adaptation and generated suggestions for the finance community to maintain adaptation by farmers to climate change. Morgado *et al.* (2017) studied perceptions on climate change among students in the higher education system in three countries (Portugal, México and Mozambique). They determined that students' knowledge of climate change did not necessarily transform into concrete mitigation practices and behaviours. In an Indian context, Rao and Thamizhvanan (2014) analysed the impacts of climate change based on the perceptions of junior corporate executives. This analysis identified significant awareness in support of adaptation strategies and an understanding that it is important to encourage participation in adaptation strategies through organisations.

The trends in perceptions of climate change in these regions show the following results (Ratter *et al.*, 2012). During the past few years, there has been a similar pattern in Europe, where respondents consider climate change is a grave problem. In Australia, concern about climate change has decreased, and in the USA, the pattern indicates a decrease in the number of American people who feel climate change has already begun or will start within a

few years. These trends show a decline in public attention to climate change in countries that have produced studies in the past decades of perception that depends on events and the mass media.

In Colombia, studies on perceptions of climate change have been limited and different with respect to global trends, according to [Capstick *et al.* \(2015\)](#). The perception of climate change in this country has been studied through surveys related to citizens' perceptions in cities (Bogotá, Cali and Medellín). These studies addressed the issue "which way are we going?" in 2011-2013 and included three questions on climate change (knowledge, how climate change affects quality of life and government actions to decrease the impacts of climate change). The studies demonstrated that in these cities, the respondents had knowledge of climate change and were affected by its impacts ([Red Colombiana de Ciudades Cómo Vamos \(RCCCV\), \(2014\)](#)). Governmental offices such as the [General Controllorship of the Republic \(2013\)](#) have developed specific surveys to determine values and behaviours related to the adaptation and mitigation of climate change. These studies determined that responsibility and engagement are more common values than protection and creativity. [IDEAM \(Institute of Hydrology, Meteorology and Environmental Studies\) \(2014\)](#) developed a survey to assess citizens' perceptions related to the services of Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) in which information and data on climate change were identified. At the local level, [Pinilla *et al.* \(2012\)](#) designed a study to determine the perceptions of communities of potential micro-climate changes in the reservoirs exploited for hydroelectric power of the ISAGEN Company. These studies have contributed to the analysis of climate change in Colombia. However, it is important to analyse and compare different perceptions of climate change in the Colombian regions to establish differences and similarities to determine different programmes according to the requirements of specific territories.

Other studies ([Zaval *et al.*, 2014](#); [Pidgeon, 2010](#); [Capstick *et al.*, 2015](#)) have indicated that the public has an interest in this topic and have sought new alternatives to face climate change. For this reason, it is important to analyse public opinion on climate change to determine more adequate and appropriate policy instruments to achieve sustainable development and to decrease the consequences of climate change.

3. Climate change in Colombia – trends and actions

Certain Colombian regions are particularly vulnerable to climate change, especially populations that have been established in zones that are prone to flooding and in unstable lands in the high sierras. Moreover, Colombia shows a high recurrence and magnitude of disasters related to changing climatic conditions or environmental problems. This situation generates impacts that affect the quality of life of the citizens, especially in rural areas, and marginal and excluded populations, which may increase internal displacement and migration ([UNDP \(United Nations Development Program\), 2010](#)).

In Colombia, GHG emissions have increased in the past two decades ([Table I](#)). Agriculture, silviculture and other related land uses are the highest contributors to GHG emissions, which are caused mainly by an increase of livestock and the use of fertilisers. However, Colombia has achieved decelerating deforestation (from an annual average of 315,000 ha/year between 2000 and 2005 to an annual average of 166,000 ha/year). Another important contributor is the energy sector, especially the transportation sector and energy generation. Industrial processing and product use also contribute to GHG emissions, especially the chemical, metal and mineral industries ([IDEAM \(Institute of Hydrology, Meteorology and Environmental Studies\), UNDP \(United Nations Development Program\),](#)

MADS (Ministry of Environment and Sustainable Development), DNP (National Development Planning) and Chancellery, 2015a, 2015b; Pardo and Alfonso, 2016).

Colombia has developed three voluntary commitments to mitigation action within the framework of the Cancun agreement (COP 16) (IDEAM (Institute of Hydrology, Meteorology and Environmental Studies), UNDP (United Nations Development Program), MADS (Ministry of Environment and Sustainable Development), DNP (National Development Planning) and Chancellery, 2015a, 2015b): (i) to guarantee a 77 per cent minimum contribution of renewable electricity generation based on the total installed capacity in 2020 within the energy matrix (this is a unilateral voluntary action); (ii) to stimulate the growth of biofuels such as ethanol and biodiesel without threatening natural forests or food security and to strengthen the usage of these fuels in the national market to achieve a mandatory blending in at least 20 per cent of the total volume of fuel used by 2020; (iii) to reduce deforestation in the Colombian Amazon region to zero by 2020 (numbers ii and iii correspond to voluntary actions that are required to receive international financial support).

Moreover, Colombia has formulated 12 Nationally Appropriate Mitigation Actions, of which five projects are in the initial stages of implementation (energy efficiency in street lighting, domestic refrigeration, integral improvements in freight transport, transit-oriented development and integral waste management) and seven are being formulated (IDEAM (Institute of Hydrology, Meteorology and Environmental Studies), UNDP (United Nations Development Program), MADS (Ministry of Environment and Sustainable Development), DNP (National Development Planning) and Chancellery, 2015a, 2015b) in the agricultural sector (three projects for starch production, coffee and cattle farming), in energy, mining and hydrocarbons (one project for renewable energy in non-interconnected zones), in the transport sector (two projects to control GHGs and non-motorised transport) and in industry (one project for energy efficiency in small and medium enterprises).

These facts demonstrate that Colombians have applied different strategies to mitigate climate change. However, it is critical to understand the public perception of climate change to ascertain the possibilities of designing adequate instruments according to the sector, vulnerability level or zone to decrease the potential effects of climate change in this country.

4. Methods

To develop this study and understand the views of the Colombian population on the climate, ten focus groups in five regions of the country (two groups per region), including rural regions (see Table II), were formed. The focus group method was selected to allow an analysis of interrelations within the group regarding the respondents' opinions on specific topics using a set of guiding questions that are often applied in decision-making policy related to climate change (Peterson, 2004). These questions are appropriate for the

Categories	1990	1994	2000	2004	2010	2012
Energy	50,331	57,094	63,640	62,660	71,210	77,784
Industrial processing and product use	4,656	5,877	5,156	6,541	8,692	9,865
Agriculture, silviculture and other land uses	102,737	104,139	103,669	118,354	130,341	76,312
Waste	7,317	8,907	10,578	11,654	13,706	14,297
National total	165,041	176,017	183,044	199,209	223,949	178,258

Source: IDEAM (Institute of Hydrology, Meteorology and Environmental Studies), UNDP (United Nations Development Program), MADS (Ministry of Environment and Sustainable Development), DNP (National Development Planning) and Chancellery (2015a, 2015b)

Table I.
Trends of GHG
emissions in
Colombia
(Gg of CO₂ eq)

Region	Municipality	Features of population	Vulnerability	Attendants
Caribe	Municipality 1	Representatives of the Community Action Council, researchers and population of the municipality	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	15
	Municipality 2	Residents of the municipality and community tradespersons	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	10
Oriental	Municipality 3	Residents of the municipality and scholars/professors	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	11
	Municipality 4	Public employees, students from the general population	Temperature: $\uparrow > 0.51 - 0.80^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	13
Pacific	Municipality 5	Public employees of the environmental office	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	14
	Municipality 6	Researchers, professors and students of Nariño University	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	23
Central	Municipality 7	Students and professors of Antioquia University, the general population and the Corha NGO	Temperature: $\uparrow > 0.51 - 0.80^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	10
	Municipality 8	Employees of the Red Cross, civil defence, government offices and the general population	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	10
Orinoquía - Amazonia	Municipality 9	Employees of government offices, the indigenous community and environmental officials (Corpoamazonia)	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or $\downarrow > 30\%$	10
	Municipality 10	Employees of government offices, the indigenous community, professors and community leaders	Temperature: $\uparrow > 0.81^{\circ}\text{C}$ Precipitation: \uparrow or \downarrow 10-20%	20

Table II.
Description of the focus groups developed to understand the opinions and perceptions of climate change

geographical conditions of Colombia, which generate different effects of climate change that require specific interventions. However, a limitation of this study is that the results are not representative of the total population in Colombia. However, these results should help to understand trends in climate change in different Colombian regions.

The advantages of focus groups are as follows: the participants can express their opinions in their own language to give a multidimensional perspective of the knowledge, attitudes and behaviours of the participants and to emphasise specific opinions (Bonnett and Williams, 1998); focus groups provide an excellent opportunity to hear the opinions of Colombian citizens, to explore issues in depth and to obtain insights that may not be heard outside the discussions that the focus groups provide (Palomba and Banta, 1999, p. 196); information can be collected that offers the possibility for a deeper, more specific and more contextualised understanding of value-based human dynamics (Stewart *et al.*, 2007, Frazier *et al.*, 2010) and this technique encourages participants to share and express interpretations, opinions, knowledge and ideas generated by the social and interactive process, which is key in the analysis of climate change from different approaches and stakeholders (Glaas *et al.*, 2017).

The cities and municipalities that participated in the focus groups were selected from a database of 1,106 municipalities with continuous information on changes in precipitation and temperature by considering the vulnerability scenarios for climate

change as elaborated by Colombia’s Third National Communication on Climate Change (IDEAM (Institute of Hydrology, Meteorology and Environmental Studies), UNDP (United Nations Development Program), MADS (Ministry of Environment and Sustainable Development), DNP (National Development Planning) and Chancellery, 2015a, 2015b). These scenarios used two criteria, temperature and precipitation, for the 2011-2040 period. The vulnerability of the regions is presented in Table III. Focus groups included municipalities in three categories to assess differences in public opinion of climate change in Colombia.

Participants in the focus groups were selected randomly based on census information and the features of municipalities, taking into account different groups of the population that included citizens, professors, researchers, students, public or non-governmental organisation (NGO) employees and social leaders. Additionally, to guarantee the participation of different stakeholders, an invitation and a message promoting the activity were advertised on the radio to municipalities regarding the scope of this research. This approach allowed the focus groups to include a population of different interests and selection without bias to ensure that the viewpoint of each of the various knowledge bases of stakeholders was captured.

A discussion was initiated concerning climate change and the intensification of natural events such as the El Niño Southern Oscillation phenomenon, among others. The design of the script for the focus groups used four perception dimensions based on the recommendations of the Antigua Manual produced by Rycit (2015). The dimensions included the following: *attitudes and values*: an analysis of the knowledge of climate change, the causes and consequences of climate change and variability and vulnerability; *information habits*: the sources and levels of information about climate change; *institutionalism*: climate policy and public institutions that support climate change and *social appropriation of science and technology*: practices and learning regarding climate change. The duration of the focus groups was 2 h on average and was distributed in the following manner:

- *Presentation* (20 min): The facilitator and the reporter presented the objectives and allowed a brief introduction of each participant.
- *Knowledge, information and values on climate change* (40 min): The discussion began with questions on knowledge regarding climate change; associated concepts; considerations of the presence of climate events and their main sources, causes and consequences; information habits and problems related to climate change. Different images were used to facilitate the discussion.
- *Practices and participation in the policy on climate change* (40 min): In this stage, the definitions of the adaptation and mitigation actions related to climate change were given to clarify these concepts. Moreover, questions on the actions and practices implemented for the adaptation of climate change were asked. New habits, current

Table III.
Description of the types of vulnerability defined for Colombia based on temperature and precipitation

Type of vulnerability	Temperature	Precipitation
Low exposure	↑ < 0.5 °C	↑ or ↓ 10-20%
Moderate exposure	↑ > 0.51-0.80°C	↑ or ↓ 20-30%
High exposure	↑ > 0.80°C	↑ or ↓ > 30%

Source: IDEAM (Institute of Hydrology, Meteorology and Environmental Studies), UNDP (United Nations Development Program), MADS (Ministry of Environment and Sustainable Development), DNP (National Development Planning) and Chancellery (2015a, 2015b)

mechanisms for civil participation and knowledge of regulations for climate change and their effectiveness were discussed.

- *Final observation* (20 min): Based on the topic discussed during the focus groups, the participants analysed the main conclusions from different approaches regarding climate change. Perspectives, closing remarks and appreciation for active and dedicated engagement in the activity were expressed.

5. Results and discussion

In this section, the main results and implications of the focus groups are analysed, taking into account the perceptions, knowledge and understanding of the population on climate change. The results are presented and discussed according to the perception dimensions. In general, the participants of the focus groups believe that climate change is happening and that it is caused by human activities. They believed that it is evident in changes in temperature and precipitation and that it is important to increase government strategies to control and mitigate climate change according to geographical features. Furthermore, they believed that the population should increase actions to prevent and control climate change, such as decreases in energy and water consumption.

5.1 Attitudes and values related to climate change

This dimension seeks to understand the public perception related to climate, its variations and its risks by taking into account the social and cultural constructs of the population. In all focus groups, the participants agreed that climate change is real and is associated with temperature variability and high-intensity rainfall, as shown by the following comments: *precipitation is more intense now; heavy rain periods are very few and very intense, as if the rainfall of one month fell in one day*. In Municipality 6, the participants indicated that *climate change depends on the biochemical and physical processes created by the exposure of these elements to the environment*, which concurs with the comments of Municipality 5, in which *climate change is related to changes in the atmosphere because of emissions from human activities*. In contrast, in Municipality 2, a participant indicated that *climate change is not happening; it is only a natural manifestation or a cycle*.

The main causes of climate change, according to the participants, are deforestation, air pollution caused by industrial processes and poor management of solid waste. For example, in Municipality 3, it was said that *climate change has occurred before, but its consequences are now being caused by damage that we ourselves have caused through actions such as the clearing of trees*. Groups in the Oriental and Orinoquia-Amazonia regions associated climate change with environmental effects such as the dumping of chemical waste into water sources, mining activities, the exploitation of hydrocarbons and the open burning of waste. These causes are associated with environmental degradation, not associated with climate or associated less with climate change and climate variability, indicating that climate change is related to environmental problems.

The participants believed that the consequences of climate change began 10 years ago. However, in Municipality 9, some argued that climate change occurred as a result of the Industrial Revolution in the West. In all regions, the main effects of climate change have been observed in health, food and water availability, damage to flora and fauna and the decrease in soil quality.

The main findings by region are as follows: in the Caribe, climate change was linked to low rainfall; in the central region, the participants cited migration because of climate change and increases in diseases such as Zika, dengue and Chikungunya; in Orinoquia-Amazonia,

the participants stated that climate change was observed in severe rainfall or intense storms; and in the Oriental region, regional landslides and flooding were closely linked to climate change, confirming the importance of developing strategies and differentiated policy instruments according to geographical and climatic conditions.

These findings indicate different perceptions of climate change between regions with a strong link between rainfall and diseases. [Wu et al. \(2016\)](#) empirically demonstrated the association between climate and health effects, and [Taylor et al. \(2014\)](#) determined that in England, people perceive heavy rainfall and flooding as being strongly associated with their concerns about climate change, which concurs with the results of this study. In Colombia, it is important to reduce vulnerability through adaptation and mitigation measures by combining technical, social and perceptual knowledge, which are among the most effective approaches to improving the quality of life of human society in the context of climate change.

5.2 Information habits with climate change

To understand the information habits related to climate change in the Colombian population, the objectives are twofold:

- (1) to understand the images, conceptions and representations of climate change through the media; and
- (2) to determine the media and channels that disseminate information on climate change to which the Colombian population has access.

The participants of the focus groups believed that they were relatively well informed on climate change, and the main media used were television and the internet. Magazines, news and radio were rarely used for information on climate change. The television channels used for information about climate change were those shown at the national level (Caracol News, RCN News and RT News), and websites used to obtain this information included the Ministry of the Environment, IDEAM and Corpoamazonia. At the international level, the websites used included the Discovery Channel, YouTube, Geoplanet, National Geographic and Scielo.

In Municipality 7, the participants indicated that *universities make a strong effort to investigate climate change; however, the information is not accessible to the public, the information is not in Spanish and the information presented is complex*. In Municipality 6, the participants indicated that *institutions develop projects on climate change, and they have first-hand information*. Focus groups from Municipality 2, Municipality 8 and Municipality 5 stated that *public outreach campaigns conducted by local governmental institutions do not have an effect on society because the problems associated with climate change are related to the lack of awareness and culture to promote care for the environment*.

These results indicate that the participants have at least heard of climate change from different media sources, which concurs with the studies of [Leiserowitz \(2007\)](#) in the American context. In the communication process of climate change, it is important to take into account the following aspects: purpose and scope, audience framing, messages, messengers, modes and channels of communication and assessing the results and effectiveness of the process, which are related to several contextual factors that may affect the goal and effectiveness of the intended message ([Moser, 2010](#)).

5.3 Institutionalism of climate change

This dimension seeks to analyse the perception of participants of climate policies, public institutions that investigate climate change, public resources used to control climate change and the use and application of mechanisms to ensure citizen participation.

The majority of participants believed that the research on climate change is insufficient in Colombia. The public expenditure is limited to less than 1 per cent of the gross national product, with 3,000 interventions in 1,000 municipalities (Adaptation Fund, 2015), despite its potential consequences and impacts. Consequently, it is important to promote actions to adapt to these facts. In Municipality 6, the participants commented that *universities, NGOs and companies invest in studies or actions for climate change with limited resources, although the public sector should be responsible for generating more investment in this issue.*

In general, the participants believed that government offices are engaged in few activities, programmes or projects related to climate change. In Municipality 2, a participant indicated that typically, the *community is not involved in programmes that are developed by the local government, and based on the lack of knowledge of the population, the residents assume that nothing is done.* The participants confirmed this in Municipality 3, where it was indicated that there is a lack of knowledge on the scope of the projects.

In Municipality 9, the participants indicated that *public entities that are responsible for carrying out educational campaigns on climate change are limited in terms of the control and monitoring activities of companies that generate environmental impacts.* In contrast, in Municipality 8, the participants stated that *local authorities carry out many campaigns to protect the environment, but people are not aware of this topic.*

The use of mechanisms for citizen participation differs among the regions: Orinoquia-Amazonía has high participation; the Pacifico and Central regions have equal proportions between the use and non-use of mechanisms of participation and in the Oriental and Caribe regions, participation is low because of a lack of interest or a lack of information and/or leadership and insecurity in the regions caused by violent situations experienced by community leaders.

The more commonly used mechanisms for citizen participation are the following: Community Action Councils, municipal committees for the environment, participation committees for affairs related to health (territorial, municipal, departmental) and public hearings and public consultation. The Ministry of the Environment, IDEAM and the National Unit for Risk and Disaster Management are public institutions recognised for their work on climate change.

These findings demonstrate that climate change governance is perceived differently, which concurs with Moyano *et al.* (2008), who demonstrated that the same stakeholders may have situationally varying objectives regarding climate change. Governance models must be aware of this “multi-dimensionality”, within which opposing social interests must be consolidated. Therefore, the formulation of adequate and effective climate change governance must recognise the multitude of perceptions that converge in the process of governance that promotes greater participation of non-state stakeholders and other stakeholders (Pohlmann, 2011).

5.4 Social appropriation of science and technology

This dimension allows for both the identification and evaluation process and actions carried out in everyday life regarding climate change by the participants to understand the integration of scientific knowledge on climate change and the activities and processes performed by the population to control or mitigate climate change. It is important to define the forms and strategies as people become involved, negotiate and participate in this issue.

The participants have applied different mitigation practices, such as changes in the modes of dress and diet, the use of fans or air conditioners and the application of sunscreen. With respect to other practices related to climate change, the participants have decreased energy and water consumption and have made improvements to waste management,

recycling and other practices, although these are intended to improve environmental quality. In Municipality 5, a participant indicated *that more adaptation actions are linked to consumption practices, but this is not a reflection of climate change and how one must adapt to this fact.*

In general, participants are sceptical in terms of campaigns or other educational activities designed for adoption by the population in their daily lives. The majority of the participants have not made complaints, grievances or requests regarding climate change and believe that regions are not ready to address the consequences of climate change. In Municipality 3, a participant commented that *through regulation, companies must integrate environmental plans or socio-environmental compensation in their processes, but these actions are not evident, and governmental entities do not monitor or evaluate the environmental impacts.*

The focus groups show differences in opinions and perceptions of climate change according to region, taking into account the conditions and environment. [Table IV](#) describes the main results according to the four perception dimensions and the location of the focus group.

The results of the focus groups show the following:

- the main interests of the participants in climate change topics are related to effects of human activities on climate change (environmental/climate protection or stewardship);
- the effects on future generations (intergenerational equity);
- the consequences for the poor population, which is more affected by climate change (interregional equity and preventive actions to decrease consequences); and
- strategies to increase awareness about daily activities to prevent climate change (local actions through cultural change to prevent effects of global warming).

These results concur with the research of [Wardekker et al. \(2009\)](#), which analysed ethical dimensions in perceptions in the USA of climate change in relation to public support for climate policies.

The results of this study on perception indicate that policy makers should take into account the following:

- different political instruments based on geographical features, impacts and vulnerability of climate change, and stakeholders;
- increasing public and private investments to prevent and mitigate climate change;
- seeking effective solutions through research and development on this topic based on the typical features of Colombian regions;
- the important gap related to public perception of government and policy responses to climate change; and
- coordinating initiatives at the national and regional levels to guarantee precise implementation measures.

Moreover, adequate governance of climate change must promote equity, participation, pluralism, transparency, accountability and the rule of law ([United Nations, 2009](#)). These elements were noted by different participants of focus groups according to the particular environment and are a fundamental input to strengthening climate change policies in Colombia.

The design of policies and decision-making related to climate change requires progress in the appropriation of science by society. It is important to strengthen communication among scientists, decision makers and stakeholders and to translate knowledge into impacts

Dimension	Main point	Example	Region/stakeholder
Attitudes about and values affected by climate change	Climate change is occurring and it is associated with heavy rains, changes in temperature and prolonged droughts	The climate is increasingly unsettled, which affects the environment, the life in the region and future generations	Oriental/resident
		In the past few years, we have undergone strong waves of heat and severe drought	Caribe/resident
	Climate change is caused by human activity	Human actions cause damage to the environment by deforestation, burning, use of fossil fuels for transportation and emissions of industries altering the climate and environment today and in the future	Central/student
	Consequences of climate change	The main implications of climate change have been for health, food and water availability, alterations in fauna and flora, quality of soils and global survival for future generations, among others	Pacifico/public employee
Information habits with regard to climate change	Participants in focus groups have information about climate change and the main medium of communication is TV and the internet	The information about climate change is restricted to natural disasters, especially in TV	Pacifico/student
		The main information about climate change is from the internet, especially in the web pages of Corpoamazonia and local government	Orinoquía – Amazonía/ community leader
		I find information on climate change on TV (Discovery Channel) and Colombian TV News (Caracol and RCN)	Oriental/scholar/ professor
Institutionalism of climate change	The majority of participants consider that research, actions related to climate change, spaces for public participation and public investments are limited in the country, especially in poor regions of the country	Local governments do not make campaigns related to climate change, and for this reason, the population does not have the tools to control or mitigate the consequences of climate change, especially in poor areas	Central/employees of the Red Cross
		Environmental and biodiversity protection and climate change do not generate public participation mainly because of lack of interest, misinformation and low importance of the topic for local governments, except when the weather conditions cause effects in production activities or natural disaster	Caribe/ representatives of the Community Action Council
		Climate change affects poor regions of the country more because these citizens are localised in areas prone to the effects of climate change, especially floods, extreme droughts and landslides	Central/professor
		Private institutions such as universities, private companies and NGOs made more investments in climate change in contrast to the government	Pacifico/researcher

(continued)

Table IV.
Main results of focus
groups on climate
change in Colombia

Dimension	Main point	Example	Region/stakeholder
Social appropriation of science and technology related to climate change	The municipalities are not prepared to respond to the consequences of climate change, and campaigns related to climate change are not effective	Local governments do not create controls on and verification of companies that generate air emissions that affect the climate	Oriental/students
	The majority of participants have changed habits because of climate change	Campaigns are not effective because the population is not aware to the importance of climate change and the protection of the environment	Orinoquía – Amazonía/ community leaders
		In the various regions, more people have increased the use of fans and sunscreen because of the increase in temperature in the regions	Caribe/resident
		It is important that the population decrease energy and water consumption and increase recycling to control and mitigate consequences of climate change	Central/professor

Table IV.

and guidelines for action. The exploration of innovative institutional forms has become mandatory to achieve better adaptation to and mitigation of climate change (Hidalgo and Natenzon, 2014).

The findings of this study indicate that participants believe that climate change is occurring and that it is necessary to develop new plans that guarantee adequate adaptation to this situation. The Colombian population faces varying challenges in different regions, and it is important to continue with the design and implementation of effective climate governance that includes:

- exogenous drivers, such as the national political context, lessons from other countries, political support for climate action, the opinion of the population, market dynamics and previous experiences with disasters (Dodman and Mitlin, 2015; Fimmis *et al.*, 2015; Azevedo *et al.*, 2013), and
- endogenous drivers, such as political leadership, collaboration and coordination, political culture, institutionalisation, social and institutional capacity, partnerships with local actors and scientists, regulatory framework, social learning and integration of disaster risk management and adaptation policies (Castan, 2017; Sanchez, 2009; Jones, 2013; Pasquini and Shearing, 2014; Cidell and Cope, 2014).

6. Conclusions

In general, this study shows that the participants of the focus groups believe that climate change is occurring and is associated with changes in temperature, heavy rainfall, contamination and climate variability, among other issues. Perceptions of climate change show some differences between the regions, taking into account environmental conditions and cultural patterns. However, in these regions, the dominant social perception is rainfall and disease.

The participants expressed that they had information on mitigation or adaptation practices from the media and campaigns or other educational strategies that include care for the environment, recycling and reforestation. However, the participants had doubts about

the effectiveness of these campaigns because of the lack of incorporation of adequate measures in everyday life because the public is not aware of or is uninterested in climate change. The main media types used to inform the public about climate change are television and the internet, including national-level news programmes and websites of governmental offices, and at the international level, specialised programmes such as the Discovery Channel and National Geographic.

To strengthen communication on climate change, it is important to create an effective link between different stakeholders (researchers, disseminators, communication media and population) by taking into account the message to be transmitted, the purpose and scope, audience framing, the modes and channels that guarantee the effectiveness of the message and the appropriation of knowledge that creates a higher-level awareness in the population regarding climate change.

Local governments should increase analysis and evaluation of the effects of climate change on the productive sectors, and regions and should empower competence, training, planning and preparedness for enhanced climate change adaptation and mitigation processes to develop adequate policy instruments according to requirements of regions.

It is necessary to develop research to create adequate public policy instruments that allow for awareness and effectiveness in the adaptation to climate change. Likewise:

- climate policy must promote actions that involve all stakeholders to achieve effective climate governance that integrates scientific and social advances in several aspects related to this issue;
- effective climate governance must include effective drivers such as public opinions, data, political leadership, regulatory framework and market dynamics, among others;
- it is important to increase the links among government, the private sector, the community and universities with the aim of generating policies based on facts;
- research must include greater dissemination to the community and stakeholders;
- increased public and private investments to prevent and mitigate climate change; and
- the coordination of initiatives at both the national and regional levels to guarantee precise implementation measures.

The findings of this study demonstrate that perception studies are a key input to develop adequate climate change policy and to ensure inclusive participation and understanding of the requirements of the population with regard to climate change.

Future research on the relationships among risk, vulnerability and perception could generate better strategies to improve political strategies and climate governance in the country by applying different instruments according to the features of each Colombian region because of cultural diversity and different effects based on geographical conditions.

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About the authors

Clara Inés Pardo Martínez is Food, Environmental and Sanitary Engineer, Master in Administration and Master Executive in a Direction and Management and Environmental Systems, PhD in Economics, Auditor with experience in advisory services, consulting, teaching researchers in areas such as the environment, environment quality, health and security management and audit systems, implementation and auditing of management integral systems (HSEQ) in different factories and companies of manufacturers and services. She has experience in research on energy economics, energy efficiency, climate change, empirical analysis, social responsibility and industrial productivity in developed and developing countries. She works in University of El Rosario and Colombian

Observatory of Science and Technology. Clara Inés Pardo Martínez is the corresponding author and can be contacted at: cipmusa@yahoo.com

William H. Alfonso P. is an Architect, graduated from the National University of Colombia, with intensification in Architectural Design and Environmental Issues, Master in Theory of Architecture at the same university, obtained meritorious as the urban research thesis; Urban Environmental Management Specialist, UPC. The professional performance experience has been oriented towards the management and research in land use, environment, public space and heritage as well as in the coordination and development of urban and environmental studies, which includes the implementation of investment projects. These activities have been developed mainly linked to public entities, as an officer and consultant. Participation in the planning, management and development, institutional programmes, allows for additional strengths in the implementation and operation of the project results and investigations conducted. The research and teaching activities in urban planning, environmental aspects, theory and history of architecture and art, have focused on issues related to the processes of development and urban planning, sustainable development, history of the Colombian city, city theory, urban culture, semiotics, research techniques, history of mentalities, architectural and artistic styles, among others.