Between concepts and experiences: people's understandings of climate change in southern Ecuador

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Abstract

For decades, researchers have worried about people's understanding of climate change. Although this understanding varies by cultural context, most studies so far have taken place in industrialized countries. Few studies have explored people's understandings of climate change in the global South. Through standardized questionnaires and semi-structured interviews conducted in southern Ecuador, this paper explores differences between urban and rural dwellers and compares these with farmers' understandings of the causes, consequences and risks. We found urban and rural dwellers hold a similar understanding to that found in other nations, but articulated in ways that reflect their particular realities. Despite reporting first-hand experience of the agricultural effects of climate change, when prompted, farmers do not link climate change to their own experience. It is thus important to go beyond judging knowledge as correct or incorrect, and instead, incorporate local realities in the climate narrative.

1. Introduction

A number of studies have reported people's understandings[1] of climate as being assembled from partial and inaccurate knowledge, and to exhibit fundamental

[1] In this paper, understanding is not about holding 'accurate or inaccurate knowledge' but simply what people understand by climate change or global warming.

misconceptions. For example, the general public often fails to differentiate ‘climate’ and ‘weather’ (Bostrom et al., 1994; Bord, Fisher and O'Conor, 1998; Reynolds et al., 2010), or to define the causes and consequences of global warming (Lorenzoni and Pidgeon, 2006; Huxster, Uribe-Zarain and Kempton, 2015).

Whilst it is claimed that the media and political actors play a key role in shaping knowledge and understanding of climate change (Carvalho 2007; Boykoff 2009; Antilla 2010), other studies suggest these understandings are driven more by the dynamic of the human-environment relationship guiding comprehension and interpretation of changing climatic conditions (Vedwan and Rhoades 2001,Vedwan 2006). Climate change indeed elicits multiple viewpoints shaped in the cultural context in which individuals grow and develop (Esbjörn-Hargens, 2010; Hulme, 2013; Hoffman, 2015), whereby personal experiences help give meaning to the concept of climate change (Myers et al., 2012; Weber, 2016). This suggests that urban or rural residence may have an effect on the formation of climate change understandings. Yet, type of residence, although reported to have some influence (Ming Lee et al., 2015), is not well studied. Also, little is known about farmers’ understandings, despite their livelihoods being fundamentally reliant on weather (Mertz et al., 2009; Turner and Clifton, 2009). Moreover, few studies consider such understandings outside of non-Western societies; the great majority of studies of public perceptions having been conducted in Europe, the USA and Australia (Capstick et al., 2015; Ming Lee et al., 2015).

In moving beyond the commonly studied Western context, this paper aims to explore people’s understanding of climate change in a developing country, Ecuador. The objectives of this paper are: a) to describe common understandings of the main causes, consequences and risks of climate change in southern Ecuador; and b) to compare these between urban/rural dwellers and farmers.

2. Methodology

Study area

This study focuses on Ecuador, a Latin-American country that has attracted considerable attention in debates around climate change, mainly in relation to the ambitious, though unsuccessful, Yasuní ITT project. The Yasuní ITT sought to keep over a million barrels of oil in the ground under the Yasuní National Park, a Biosphere Reserve in the Ecuadorian Amazon, in exchange for an international monetary payment. This, along with similar 'payment for ecosystem services' projects (such as the *Socio Bosque* initiative), has received broad media attention and generated extensive debate within Ecuador. But in-country climate-related social research is scarce, and mainly confined to the northern Andes, in order to study historical, climatological and local dimensions of glacier retreat (Rhoades et al., 2006), adaptive management (Perez et al., 2010; Rebaudo and Dangles, 2015) or the influence of climate variability on climate change beliefs in central Amazonia (Eisenstadt and West, 2017). Geographically expanding this research area, Southern Ecuador was selected as the region for the data collection (Figure 1).

Southern Ecuador is also interesting because it is characterised by a complex climatic regime determined by its location in the Andean depression. The southeast study areas are dominated by mild temperatures (14^{o}C), and rainfall distributed quite uniformly across the year (500-1000mm.), with slightly more precipitation between January and April. The southwest areas are dominated by lower-altitudes between 100-1600m. strictly marked by rainy and dry seasons, with a lesser annual rainfall <500mm., and warmer average temperatures (23^{o}C).

For planning purposes, Ecuador is divided into 9 zones. Zone 7 covers three southern provinces (Loja, Zamora, El Oro), of which Loja, the city that hosts the Regional Ministry of Environment offices responsible for regionally implementing the 2012-2025 national climate change strategy (MAE, 2012), was selected as the urban study area. Loja has a population of ~225.000 inhabitants, whose working population is mainly active in commerce (21%), agriculture (13%), construction (11%), education (11%), and industrial activities (9%).

The distinction between urban and rural areas in Ecuador is defined according to the presence of basic services, such that ‘urban’ areas have electricity, drinking water, street cleaning, etc.; and 'rural' areas do not. Using a map of the Zone 7, the rural study sites San Pedro (1491 inhabitants), Celica (7947 inhabitants), Tablón (992 inhabitants), and Pindal (6411 inhabitants), were chosen randomly. These sites are active in agriculture (47%), commerce and services (32%) and construction (7%). The canton of Oña (2636 inhabitants), where subsistence agriculture represents 67% of the workforce, was selected for the study of farmers.

<<< Here Figure 1 >>>

Methodological and analytical framework

Semi-structured interviews with farmers were used to gather data on how their farming experiences, which rely profoundly on weather conditions, inform their understandings of climate change. Urban and rural dwellers were more reluctant to participate in semi-structured interviews, mainly due to time constraints. Therefore, a face-to-face questionnaire was administered to describe and compare understandings of climate change between urban and rural dwellers. Comparisons between farmers and urban/rural dwellers on their climate change understandings were based only on those parts of the questionnaire and sections of the interviews that were very similar in nature (e.g. open-ended questions from the questionnaire that resembled discussions on understandings of climate change from the interviews)

Face-to-face questionnaires

Applying the statistical formula for infinite populations at 95% confidence level and confidence interval of 5, a sample size of 384 people was obtained. For comparative purposes this sample size was rounded to 400, split into 200 each from urban and rural sites, with 50 respondents for each rural site (after Newing, 2011). Using a random sampling strategy, ‘urban’ individuals over 18 years old were surveyed during their leisure time in public places such as parks, pubs, churches, bus stations, etc., and ‘rural’

persons, in parks, after church, in markets at weekends, and at their homes at different times on weekdays.

Following piloting and revision, the questionnaire was administered between 04/2014-01/2015. It included demographic questions, and open-ended questions exploring understandings of the causes and consequences of climate change, and perceived risks. The data were content-analysed, coded, and aggregated into nineteen categories for causes, seventeen categories for consequences, and eleven categories for risks. Chi-square tests were carried out to examine differences between urban and rural respondents and across demographic parameters.

Participants' socio-demographic information is depicted in Table 1.

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Semi-structured interviews

Thirty-two farmers who had lived in the area for 30+ years[2] were selected for the study using the snowball sampling technique. The final sample size was determined upon reaching saturation. Interviews were conducted between 07/2014-07/2015, each lasting approximately two hours.

The interview schedule was designed to gather detailed data on how farming daily experiences inform understandings. However, the terms 'climate change' and 'global warming' were mentioned only at the end of the interview, so as to avoid influencing the narrative with any bias associated with these terms. Instead, the focus was on farm production, management, and change. The interview data were transcribed, content-analysed, coded through causation coding and categorised according to the established procedure (Saldaña, 2016), first manually, and then using NVivo 10 software. Causation coding identifies the mental models participants use to uncover what people believe about events and their causes; its use is appropriate for discerning peoples' reasons, beliefs, or

[2] This period of time would be sufficient to experience changes, taking into consideration the IPCC claims which indicate that changes in climate occur typically every 30 years.

worldviews regarding the complexity of causes and effects of human actions and phenomena (Saldaña, 2016).

3. Results

Urban/Rural dwellers' understandings of the causes and consequences of climate change and the risks perceived

The results of the analysis of the questionnaire-based face-to-face interviews are presented in Figure 2. Urban and rural participants responded to the open-ended questions: what do you believe is causing climate change? What do you think would be the consequences of climate change? and, do you believe climate change threatens you personally? If so, would you please explain why?

<<< Here Figure 2 >>>

Causes: pollution, deforestation, unfriendly environmental attitudes[3], industry and transportation, and greenhouse gases were categorised as the leading five causes of climate change (Figure 2A). Chi-square analysis found urban respondents named pollution more often than rural respondents [$X^2(1,400) = 4.040$, $p < .028$.]: urban participants tended to say that "*pollution is caused by industries and motor vehicles growth*" (Respondent 25). Rural respondents, although recognising industries and vehicles as contributors, described "*environmental pollution is caused by the usage of fungicides, herbicides, etc.*" (Respondent 34).

Consequences: impacts on health, natural disasters, and impacts on agriculture were those most categorised as consequences of climate change (Figure 2B). Chi-square analysis

[3] Includes attitudes and behaviours such as consumerism and misuse of energy, water, soil, lack of environmental awareness, etc. Activities regarding development, pollution, policy and technology were excluded.

found that rural respondents tended to name agricultural effects [$X^2(1,400) = 21.981$, $p < .000$.] and lack of water availability [$X^2(1,400) = 11.481$, $p < .001$.] more frequently than urban respondents. Furthermore, urban respondents tended to name "*disruptions in ecosystems",* "*biodiversity loss",* or "*species extinction"* more frequently [$X^2(1,400) = 3.250$, $p < .047$.], whereas answers such as "*forest destruction"* or "*orchard plants die"*, were more commonly mentioned by rural respondents. Chi-square tests further indicated rural respondents named pollution significantly more often than urban respondents [$X^2(1,400) = 5.582$, $p < .014$.].

Percieved risks: the majority of participants (74%) agreed that climate change constitutes a threat, and their reasons were grouped into 11 categories, of which the five most frequently mentioned are presented in Figure 2C. Threats to health, agriculture, place of living, wellbeing, and economy were perceived as a personal risk. Other types of responses, express concern about extreme weather events, effects for future generations, or denoted empathy for species and biodiversity loss. Some positive effects were also mentioned as voiced by Respondent 63: "*I like temperature changes, right now Loja is warm*". The Chi-square analysis produced one significant association by place of residence. Rural respondents named the effects on agriculture more frequently than urban respondents [$X^2(1,400) = 10.256$, $p < .001$.]. Indeed, the perceived risks frequently apply to people's daily activities as the following quotes illustrate:

> "It affects us all, because it will be too hot and we agriculturalists won't be able to cultivate our lands causing food shortage." *Rural respondent 121*

> "We don't longer know when it's winter or summer, so I don't know when I should sell summer or winter clothes." *Urban respondent 89.*

In short, survey participants understand climate change as a general environmental issue mostly caused by pollution and deforestation. However, the reasons molding this understanding varied between urban/rural dwellers, whose answers were associated with their place of residence. For example, pollution caused by cars and industries was perceived mainly in urban areas, whereas that caused by agricultural activity, was observed primarly in the rural sector.

Farmers' understandings of climate change

The results of the analysis of the semi-structured interviews are summarised in Figure 3. Answers were provided by subsistence farmers (N=32) to explain processes relating to their farm production, management, and changes. They were then asked about climate change, and their answers regarding causes and consequences were similar to those provided by rural respondents.

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Changes to farms: all farmers interviewed reported climatic changes in weather patterns affecting their farm production (Figure 3A), particularly mentioning altered planting and harvesting months and more frequent frosty days disturbing their plants and animals:

> "In May… we plant potatoes, but lately the weather's been bad and it hasn't been possible to plant. We are already in June and we still haven't been able to plant because it keeps raining, it's muddy, and it's not possible to plough" *Farmer #28*

> "There are more frosty days, so we have to spray the crops to produce. Guinea pigs don't like frosty days, they could die... Frost damages corn, pumpkins, everything…" *Farmer 11*.

Once farmers had described the climatic changes affecting their agricultural activities, they were asked: Have you ever heard about climate change? if so, what have you heard? Does it affect you somehow? All farmers started moving from their agricultural experiences to name causes similar to the responses from the questionnaire survey, with pollution, ozone layer depletion, deforestation, burning, and the Earth's warming among the categories (Figure 3 B,C). Some farmers offered:

> "Hmmm…, It's been said that we don't have to burn the forests and don't pollute the water. For instance, if you burn nearby the water sources, it [water] will scarce. This's how it affects…" *Farmer 19*

> "Hmmm… I mean, that happens because of pollution. I've heard that there is a climate alteration because of pollution " *Farmer 29*.

These detailed data suggested similar understandings to rural dwellers, whereby farmers understood pollution as agrochemicals in the atmosphere: "*What we sprayed in the air, screws us all… there is so much spraying polluting the air*"(Farmer 7). In other cases, the farmers' own agricultural activities were specifically identified: "*The ozone layer is destroyed by the chemicals we use…people sometimes burn as well, and that smoke and*

pollution… I think it's because of that" (Farmer 4). Agricutural activities were also reported to name global warming and deforestation as causal agents of climate change. For example:

> "Global warming is caused by the misuse of agricultural land. It's been said that we contribute to this because we cut down the forest that keeps the humidity and generates rain." *Farmer 6.*

Moreover, some farmers started replacing the word 'weather' by 'climate' and placed greater emphasis on the ozone layer depletion, which, according to their answers, has caused more intense sunlight:

> "…It's been said that climate has changed a lot because of the ozone layer depletion… sometimes you can notice that the sun burns and you have to dodge the sun because it burns." *Farmer 1.*

Altogether, farmers identified health impacts on human, animals and plants, more intense sunlight, changes in weather patterns, and crop diseases as the main climate change consequences and personal risks percieved (Figure 3B). As with the questionnaire results, expressed concern was focussed on human health impacts such as *allergies* and *skin cancer*. Interestingly, these health issues were associated with pollution and ozone layer depletion, suggesting a general environmental understanding of the topic:

> "I heard that this…layer… it's broken because of pollution. The ozone layer is broken, and this is why the sun is burning and damages our skin." *Farmer 3.*

> "Climate change…!sure! Because that would affect my body. For example, too much sunlight affects me… from time to time I have headaches from too much sunlight." *Farmer 5.*

In brief, analysis of the interview data indicates farmers' own activities play a key role in their understanding the climate change concept. It is also noteworthy that a second type of discourse appeared when farmers are asked specifically about climate change, in that they stopped appealing to their life experiences and either built their explanations using technical words they do not clearly understand, or used more or less accurate descriptions of causes or effects of climate change, although not knowing the 'proper' terms.

4. Discussion

Survey and interview respondents tended to express an understanding of climate change related to pollution, deforestation or the ozone layer depletion – an issue whose consequences threaten the health of the public, livestock or crops. These were interpreted

differently according to the place of residence: more urban respondents related climate change to air pollution caused by cars, while rural respondents and farmers linked it to pollution caused by agrochemicals. The latter two groups also linked the consequences and climatic risks to agricultural effects. Comparing these understandings with the prevailing scientific consensus—that climate change is caused primarily by the combustion of fossil fuels from energy production, industry and transportation, which triggers increased temperatures, water cycle modifications, ocean ice melting and acidification, ice sheet retreat, snowpack reduction, sea level rise, and alteration in species' genetics, growth, phenology and distributions (IPCC 2018)—finds automobile pollution to be the participants' response that best fits the official definitions.

Similar understandings have been widely encountered by researchers in other geographical contexts (Myers et al. 2012; Moloney et al. 2014), particularly in the USA (Bord, Fisher and O'Connor 1998; Reynolds et al. 2010; Petheram et al. 2010; Huxster, Uribe-Zarain and Kempton 2015), in European countries (Lorenzoni and Pidgeon 2006; Whitmarsh 2009), and Australia (Harriet and Bulkeley 2000; Petheram et al. 2010). These studies find lay people to consistently mention pollution, deforestation, ozone layer depletion, greenhouse gases, carbon dioxide emissions, industries and transportation as climate change causal agents. As for effects, there is a tendency to suggest climate change may trigger extreme weather events, like floods and natural disasters impacting health and agriculture. Our interview results further indicate that farmers' understandings vary depending on whether the terms 'climate change' or 'global warming' are used. If used, responses such as the ozone layer depletion or pollution, accompanied by explanations such as *the ozone layer is broken because of pollution and this is why the sun is damaging our skin*, were more often named. In their absence, responses such as *altered weather seasons* or *more frequent frosty days* were mentioned.

More interestingly, our results highlight another type of understanding: one that drew on daily experiences. For instance, farmers' knowledge regarding the *ozone layer depletion* was combined with sensory-related information, *intense sunlight*, to produce a meaningful input, in this case *global warming produces skin damage* and *cancer*. Likewise, interviewees retrieved existing knowledge '*It's been said that the forest keeps humidity and generates rain*', matched it with their activities/experiences '*we contribute*

because we cut down the forest' and reached an understanding of '*Global warming caused by the misuse of agricultural land*'. Similarly, farmers drew on their knowledge '*It's been said that we should not pollute the water',* to explain their understading of climatic risks '*if you do so, water will scarce*'. Finally, for farmers' outdoors work, *intense sun* and *warmer temperatures* were matched with ideas of global warming and climate change effects.

Similar associations were observed among Tibetans in the Khawa Karpo area, who believe that glaciers are melting because of garbage (Byg and Salick, 2009), where in Australia people linked climate change effects with wider community problems such alcohol drinking (Petheram et al., 2010). Likewise, Huxster et al. (2015) found USA students to confuse climate change with waste production. When people read, discuss or think about climate change, they do so in reference to perceived physical impacts such as temperature increase (Moloney et al., 2014). In England, for instance, people who had experienced air pollution and floods were found to be more convinced of the reality of climate change (Whitmarsh, 2008); in the US peoples' global warming beliefs determined the perception of a warmer summer or a colder winter than normal (Howe and Leiserowitz, 2013).

This paper interprets such confusions as different understandings of a phenomenon whose intangible nature challenges simple explanations. Moving from a narrow conception of public knowledge towards recognition of the complex and contradictory nature of public understanding of global issues is necessary (Harriet and Bulkeley 2000). Despite the intangible nature of climate change, people are increasingly engaged with the issue, thus more qualitative data reflecting the diversity of local understandings are required to explore how people give meaning to climate change, including multi-temporal data that helps identify the influence of climatic seasons on such understandings.

5. Conclusion

The evidence provided by this study indicates that people in Ecuador share common climate change understandings with those in Western societies, seeing deforestation and pollution as the main causes of climate change, and health issues as the main consequence and risk. In addition, more urban respondents are concerned about pollution

caused by cars and more rural respondents concerned with solar radiation and pesticide usage, implying daily life experience informs understandings of this issue. Farmers' understandings of climate change, however, are built on interpretations about the ozone layer depletion or pollution, despite reporting their agricultural activities within climatic changes.

A broad conclusion is that peoples' understandings of climate change are somewhat detached from official definitions and linked to daily experience. Consequently, in order to effectively address and develop interventions that seek to improve public understandings of climate change, these interventions need to be finely tuned to the specific knowledge and experiences of the target populations.

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