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Article

Perceptions of Climate Adaptation and Mitigation: An Approach from Societies in Southern Ecuadorian Andes

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Abstract: Climate research has steadily identified that public responses to the impacts associated with climate change are locally adjusted. These responses are mostly shaped by the prevailing socio-cultural knowledge systems underpinned by resilience thinking in the face of change and adversity. Despite the increasing scientific and policy attention to peoples' perceptions of climatic changes and adaptive responses, there is still a lag in the more detailed probing and exploration of the local level demographic profiles related to the perceptions of and attitudes and responses to mitigation and adaptation strategies. This is of particular importance as the research, planning, and action concerning climate change mitigation and adaptation needs to be informed by and implemented within specific place contexts. Based largely on semi-structured interviews and complementary face-to-face questionnaires, this study focuses on southern Ecuador to identify people's stances on climate change mitigation and adaptation and to investigate further the perceptions of farmers on adaptation. The results indicate a tendency among urban residents towards a pro-mitigation stance. Those with a pro-adaptation stance are mainly the residents of rural areas and farmers. Farmers appeared to be highly adaptive to climatic changes and are led by a self-assessed ability to adapt. Their adaptive responses vary according to the geographical place of residence, type of farmer, and age. The findings offer local level empirical evidence for designing effective adaptation strategies.

Keywords: climate change; resilience thinking; Ecuador; survey; qualitative data

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1. Introduction

Addressing the impacts associated with climate change requires both adaptation and mitigation strategies. The implementation of such strategies is differentiated among nations, with some agendas more oriented towards mitigation measures and the transition to green and blue infrastructure, and others inclined towards strengthening adaptive capacities. In both cases, the actions that people may implement are determined by their perceptions of [1,2], exposure to, and experience with risk [3], which differentially affect social groups such as women or low-income sectors. Social differentiation within geographical regions and communities is an important vector of climate vulnerability [4–6] (ref. [5] pp. 6–7, 73–74, 191–192), in that that real vulnerabilities are rooted in social inequalities and power structures [7–11]). Yet, local realities and perceptions are poorly represented in the international climate framework [12]. According to Araos et al. [13], roughly 60% of the peer-review climate literature worldwide reports which social groups were involved in the planning or implementation of the adaptation measures. In European cities, adaptation policies have been designed paying little attention to vulnerable groups such as children and immigrants [14]. In Latin American countries, data are scarcer, with one research study dedicated to studying the perceptions of change and their association with climate and weather variables [15], and a single study reporting the usefulness of incorporating the cultural heterogeneity of traditional knowledge into climate adaptation actions [16].

In contrast, for the African continent, there is a growing body of climate adaptation research that has provided valuable insights into the demographic factors associated with the implementation of adaptation measures, particularly in agrarian environments. To mention a few examples, in Kenya and South Africa, formal education, group membership, credit access, gender, marital status, land tenure, and farm size were associated with implementing either mitigation or adaptation strategies [17,18]. In Ghana, socio-cultural beliefs tend to inform the responses of farmers in addressing negative climate impacts [6]. In Ethiopia, age, family size, and income were among the factors found to significantly influence a farmer's choice of adaptation strategies [19].

In brief, each nation has its own demographic and territorial particularities that need to be explored to assist governments in the design of mitigation and adaptation measures. This is relevant in that research, planning, and responses must assess the implications of climate change within specific place contexts [20,21] and in regard to climate justice [11]. Defining a local level demographic profile associated with mitigation and adaptation stances, perceptions, and attitudes may help nations develop climate agendas that are more tailored to their territories. In spite of this, no previous studies have been concerned with exploring this association in the Latin American countries.

The main aim of this study was to explore the demographic variables involved in shaping public perceptions of climate mitigation and adaptation in southern Ecuador. Drawing on quantitative and qualitative data, the public stance on mitigation and adaptation was specifically determined, and then the adaptive responses of farmers were explored in depth. The data presented shed light on the importance of local context in implementing mitigation and adaptation strategies.

2. Methodology

2.1. Study Area

Southern Ecuador is characterised by a complex climatic regime that varies according to the latitude, longitude, solar radiation, atmospheric currents, land cover, and, perhaps most importantly, the Andes relief effect [22] (pp. 7–15). Here, the Andes are characterised by lower altitudes (3798 m. max) in relation to the Ecuadorian northern Andes, which enables the penetration and distribution of humid and dry air coming from the Pacific Ocean, as well as the circulation of humid air coming from the Amazon basin, thus forming many micro-climates and strong thermal contrasts. Our study area (Figure 1) includes the canton of Palanda, located in the eastern flank next to the Andes, where the landscape is dominated by an altitude of 1140 m., precipitation levels range from 2500–3000 mm, and the average temperature is 22 °C. Right in the Andes, the study area includes the cantons of Oña and Loja, where the landscape is dominated by altitudes of a maximum of 3800 m., template temperatures (14 °C), and a rainfall regime distributed uniformly throughout the year (500–1000 mm.), with more precipitation between January and April. In the western flank of the Andes, the study area includes several cantons from the Loja province, where the landscape is dominated by lower altitudes between 100–1600 m., strictly marked rainy and dry seasons, a less intense rainfall regime of <500 mm., and a warmer average temperature of 23 °C. This climatic variation makes this region appealing for contrasting the perceptions of people living in diverse places within the same region.

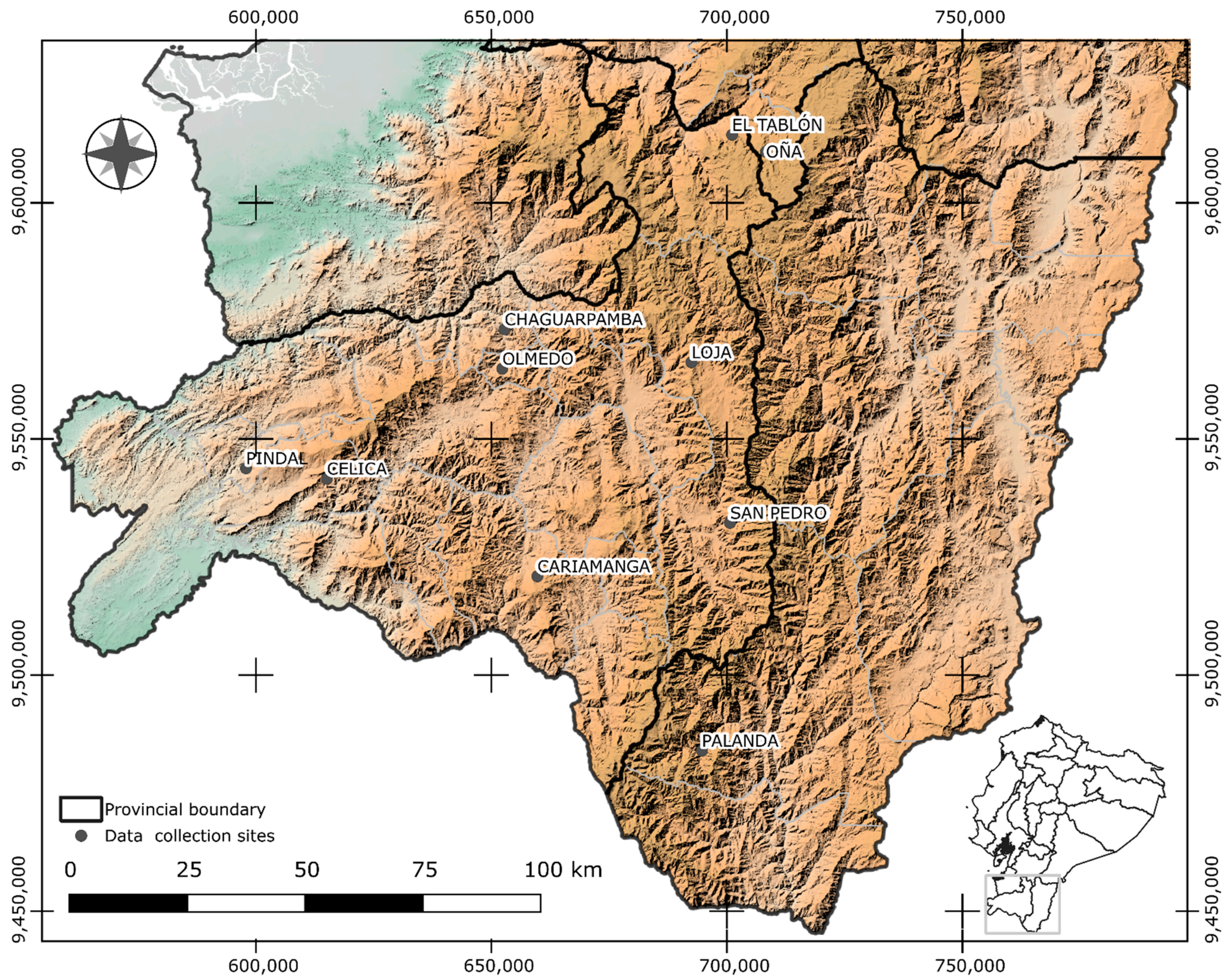

Figure 1. Digital elevation model of the study area. The figure includes the provincial boundaries (black line), and the villages and the city of Loja where data were collected. The files used to create the map are licensed under CC BY-NC-SA 3.0 available at: https://www.geoportaligm.gob.ec/portal/index.php/descarga-de-servicios-wms-del-igm/ (accessed on 14 January 2022) DTM Service. (https://www.geoportaligm.gob.ec/dtm/wms?service=wms&version=1.1.1&request=GetCapabilities (accessed on 14 January 2022). Ecuador provincial administrative boundary layer freely obtained from http://qa-ide.ambiente.gob.ec:8080/geonetwork/srv/api/records/64f61941-168c-4f4f-837b-5a3172c26d8e062 (accessed on 14 January 2022) under interoperability parameters by Open Geospatial Consortium—OGC.

The city of Loja was picked for approaching people in urban areas. Loja is the second most populated city in the southern region (~225.000 inhabitants), and it hosts the governmental offices under the Ministry of Environment—Coordinación Zonal 7—responsible for implementing the national climate change strategy in southern Ecuador [23,24]. The population is mainly active in commerce (21%), agriculture (13%), construction (11%), education (11%), and industrial activities (9%). The villages of San Pedro, Celica, Tablón, and Pindal were chosen randomly for gathering data from rural areas. The villages differ in altitude, temperature, and precipitation, with their population mainly being active in agriculture (47%), commerce and services (32%), and construction (7%). At total of 79% of the agricultural production units in these villages are rainfed, and are thus highly reliant on climatic conditions. The village of Oña, where subsistence agriculture represents 67% of the jobs, was selected for collecting data from subsistence farmers, whereas Cariamanga, Chaguarpamba, Olmedo, and Palanda were selected for collecting data from commercial farmers (mainly coffee producers). Subsistence farmers include those who cultivate for self-consumption and sell the surplus crops in nearby markets, whereas commercial farmers include those who cultivate to sell their production in the national and international coffee markets. Commercial farmers cultivate coffee along with other types of crops in on integrated farms [*fincas integrales*]; therefore, coffee sales are not the only income source for these sorts of farmers.

2.2. Methods and Data Analysis

In order to explore people's stances on climate adaptation and mitigation, we used face-to-face questionnaires to gather quantitative data from urban and rural dwellers. The perceptions of farmers (both subsistence and commercial) on adaptation to climate change and the factors associated with their adaptive responses were explored in-depth using semi-structured interviews. Data obtained from the face-to-face questionnaires guided the design of the interview questions and the selection of informants.

2.2.1. Face-to-Face Questionnaires

A face-to-face questionnaire was completed by a statistically reliable minimum sample of 400 individuals of a survey population of ~1.2 million inhabitants of southern Ecuador. The sample included 200 people from urban and 200 people from rural sites, for comparison purposes. Each rural site included 50 cases [25] (pp. 46–79). 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" participants in parks, after church, and in markets on weekends, and at their homes at different times of the day on weekdays.

Following piloting and revision, the questionnaire was applied between April 2014–January 2015. The questionnaire involved demographic queries as well as two Likert-scale questions designed to examine participants' views on climate adaptation and mitigation actions. Specifically, participants were asked to agree or disagree with the following statements: "Humanity should stop CO_2 industrial emissions" and "Humanity should adapt to climate change and move on". These two statements served to identify people's general stances on the mitigation versus adaptation debate. Importantly, these sentences were formulated on the basis of the official IPCC [26] definitions of mitigation and adaptation. Mitigation refers to human actions taken to reduce the sources and emissions of greenhouse gases, whereas adaptation refers to actions taken to reduce the vulnerability of social and biological systems to the effects of climate change. The data were analysed in IBM SPSS 22. Demographic data such as age, gender, place of residence, and occupation were analysed using descriptive statistics to calculate frequencies. Responses to Likert-scale questions were analysed through CHAID (Chi-square automatic interaction detector) classification tree tests to examine differences between rural and urban respondents. The CHAID classification tree allowed the automatic detection of interactions using Chi-square to define the demographic profile that best fit the selected response. The analysis provided a risk value and an overall percentage error for the tree that allowed us to identify the predictive capacity of the tree. The larger the difference in the percentage values between nodes, the better the predictive capability of the tree, and vice versa.

2.2.2. Semi-Structured Interviews

Semi-structured interviews were carried out with 31 subsistence and 9 commercial farmers. The total number of interviews was determined upon reaching saturation. Participants were selected by considering demographic characteristics such as the type of farmer (subsistence, commercial), and the location in relation to the Andes, including the altitude, temperature, and precipitation. The subsistence farmers were located in Oña, whereas the commercial farmers (coffee growers) were located in the Andean western lower sites (Loja province) and in the eastern Andean flank (Palanda) (Figure 1). All of the subsistence farmers hold small parcels between 0.5 to 2 hectares dominated by short-cycle crops such as peas or beans, which are grown alongside maize. Other common crops grown by the subsistence farmers include potatoes and Andean fruits such as zambos or tree tomatoes. They also raise guinea pigs, chickens, pigs, and some cows. All participants in this group are characterised by a subsistence family farming system that sells surplus produce. All of the commercial farmers selected are coffee growers. Although coffee is the main livelihood crop for the family, it is not the only one. In the study area, coffee is grown on *fincas integrales* where it is cultivated together with fruit trees such as bananas, oranges, mandarins, limes, guava, etc. In addition, the coffee growers dedicate part of the parcel to other crops such as cassava, maize, or peanuts.

All participants have lived in the area for at least 30 years. The sampling unit was the household, and a referral sampling strategy was used to select informants with the help of a community contact. Farmers were approached at their farms at a time chosen by them. Each interview lasted approximately two hours, and the interviews were conducted between July 2014–July 2015.

It was deemed important to avoid using the terms "climate change" or "global warming" in the conversations, with the aim of allowing participants to bring the topic up themselves [27]. The interview was designed to collect data that would help us to understand their perceptions of adaptation to and resilience thinking about changes. It also included questions inquiring about demographic characteristics, perceptions of weather changes, the impacts of such changes on agricultural practices, adaptation techniques incorporated to cope with the observed changes, and the drivers allowing adaptive responses. For clarification purposes, climate change is a long-term variation (at least 30 years), while weather changes are short-term changes that are observed locally through variations in the weather such as rainfall, humidity, or temperature. Data were transcribed, codified, and grouped into categories according to the procedure suggested by Saldanã [28], first manually and then using an attribute and causation coding process available in the NVivo 10 software. Attribute coding refers to descriptive variable information such age, gender, occupation, etc. Causation coding locates, extracts, and infers causal explanations, at its most basic responding to the question "Why?" [28]. The results were eventually compared with the survey results, aiming at robust conclusions regarding the perceptions of climate adaptation and the role of demographics in such perceptions.

3. Results

3.1. Public Stance on Climate Adaptation and Mitigation

Respondents (n = 400) as distributed by gender were 57% male and 43% female, and most were between 18–30 years old (41%) or 31–40 years old (23%). The most common occupation categories in the rural areas were "professional worker" (22%), "farmer" (21%), and "unskilled worker" (17%), and those in urban areas were "professional worker" (34%) and "student" (27%).

The analysis conducted with rural (n = 200) and urban dwellers (n = 200) regarding their general stance on climate mitigation and adaptation actions found that most participants disagreed (48%) with the adaptation statement "Humanity should adapt to climate change and move on". The second largest group agreed with the same statement (20%) (Figure 2). The CHAID classification tree analysis defined occupation as the main factor involved in the response selection. Thus, most participants who disagreed with the adaptation sentence were students, semi-skilled workers, skilled workers, and the unemployed, whereas those who agreed with the same statement were unskilled workers, professionals, retired people, and farmers. Within this latter group, the CHAID analysis defined place of residence as a predictor for agreeing or disagreeing with the adaptation sentence. Thus, while most participants who disagreed with that statement came from the urban sector, those who agreed came from the rural sector. At the same time, the risk value (0.523) and the overall percentage error (47.7%) reduce the predictive capacity of the tree and hinder the definition of a clear demographic profile. This is because of the small percentage differences between the two groups of occupations and sectors. In any case, it is worth noting that the professions that were declared by participants from the rural sector coincide with those of the participants who agreed with the adaptation statement.

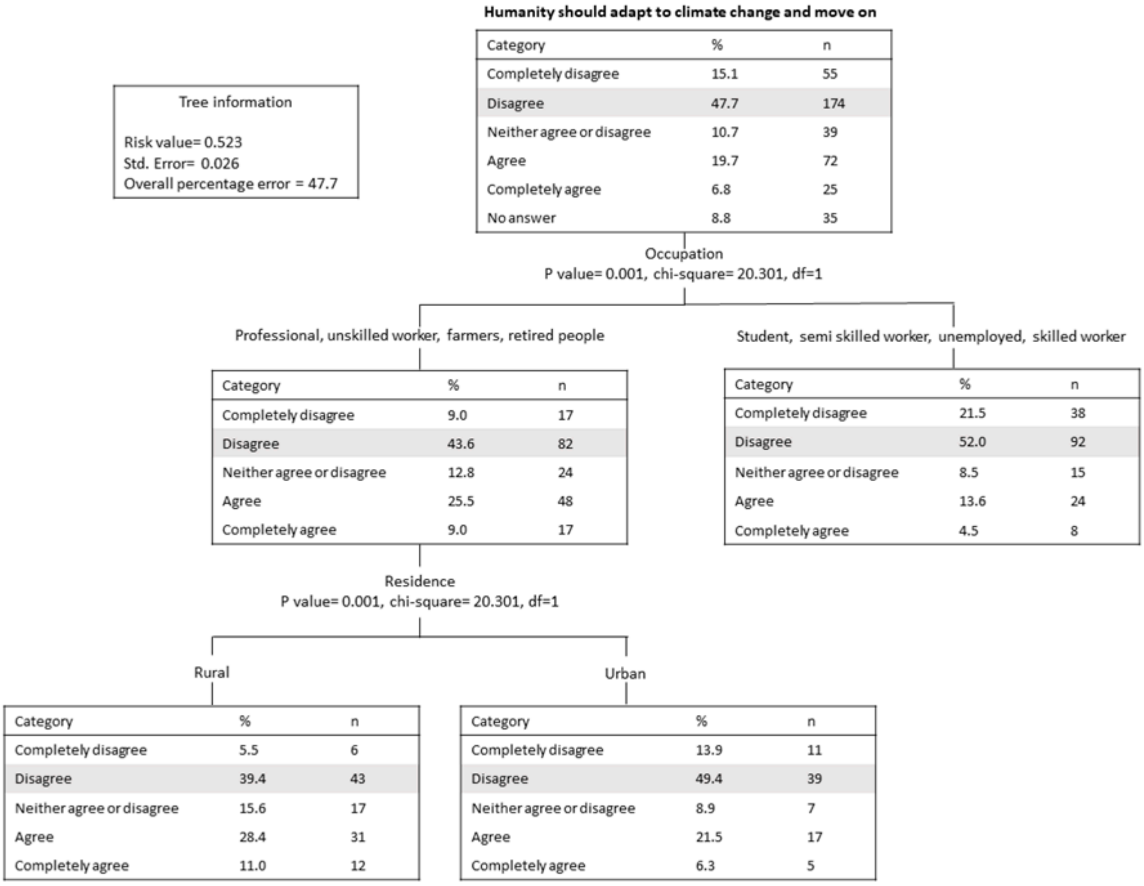

Figure 2. CHAID classification tree model showing the demographic profile of rural (n = 200) and urban (n = 200) participants who responded to the climate adaptation statement.

As for the mitigation statement "Humanity should stop CO_2 industrial emissions" the majority agreed (44%) or completely agreed (38%) with the statement (Figure 3). The results of the CHAID classification tree analysis identified place of residence as the main factor predicting the response selection. Thus, the participants who agreed with the mitigation statement were mainly urban dwellers. Similar to the adaptation statement, the predictive capacity of the tree is reduced by the risk value (0.559), and the overall percentage error (44%), again hindering the definition of a clear demographic profile.

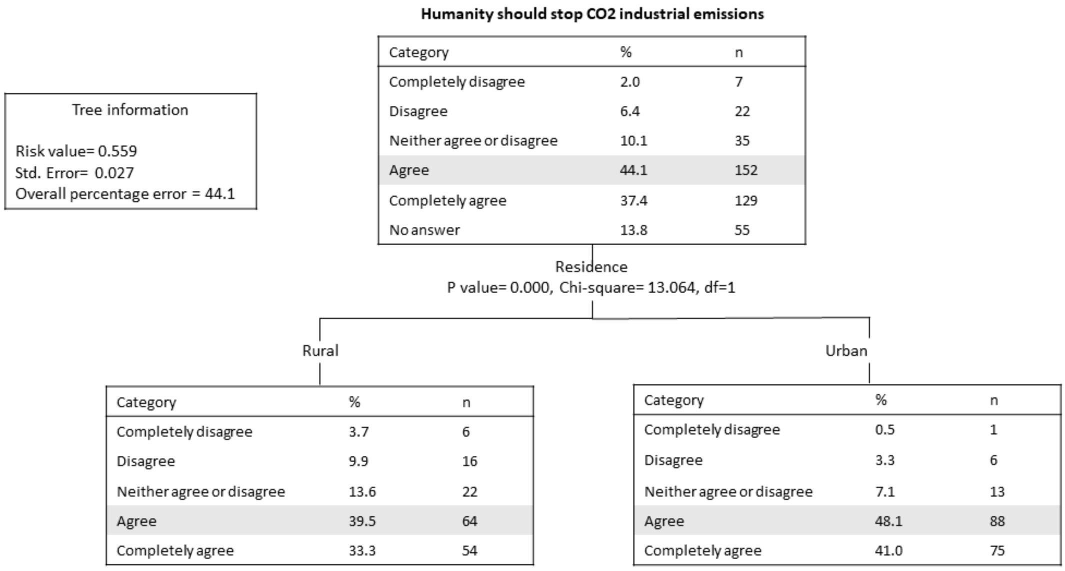

Figure 3. CHAID classification tree model showing the demographic profile of rural (n = 200) and urban (n = 200) participants who responded to the climate mitigation statement.

3.2. Farmers' Perceptions of Adaptation

Most subsistence farmers were female (67.5%) and between 51–60 years old (32.5%), and the remaining ages were equally distributed between 30–40 years old (22.5%), 41–50 years old (22.5%) and over 60 years old (22.5%). Most commercial farmers were between 41–50 years old (45%), followed by 30–40 years old (33%), and were almost equally distributed by gender (55% male, 45% female).

Both subsistence (n = 31) and commercial farmers (n = 9) consider adaptation as "*part of life*", emphasising that the key to adaptation is "*good willing*" and joint work between scientist and farmers as it is illustrated below:

> "*You, who work for the universities, must get to know what we do in the countryside, so you will learn how to lead. Without resources but with much good willing and a bit of leadership, we have grown more. You need to create leaders with experience [in the countryside]. We don't need office workers. Here is my finca [farm], you are welcome to do experiments with soil, just as I do . . .* " [Commercial Farmer 1].

These perceptions were accompanied by a rooted cultural resilience thinking and practice that has been encouraged by their parents or by their own experiences with the farm, as expressed in the following quotations:

> "*One must adapt otherwise you will be screwed up . . . so it is . . . the whole world must adapt . . . When you work hard, there's not such a thing as bad years . . . we must diversify the production, have an orchard to ensure our food. My father taught me to work hard and have the passion of everything I do*" [Subsistence Farmer 7].

> "*Before it used to rain between October and November. Now it is November, and we just have the rain that soothes the land dryness. You must adapt to the temporal [weather]. If it starts raining in December, then you should start planting . . . If I wait until January, then I will be lost . . .* " [Subsistence Farmer 23].

The farmers interviewed embrace adaptation as critical for their survival. To confirm this, and as explained in the methods, it was necessary to gain in-depth descriptions of farmers' adaptation capacity by avoiding the terms climate change or global warming, and by following four main thematic areas: (1) observations of weather changes, (2) impacts of such changes in agricultural practices, (3) farmer's adaptive responses to changes, and (4) determinants for adaptive responses (Figure 4), as described in the subsections to follow.

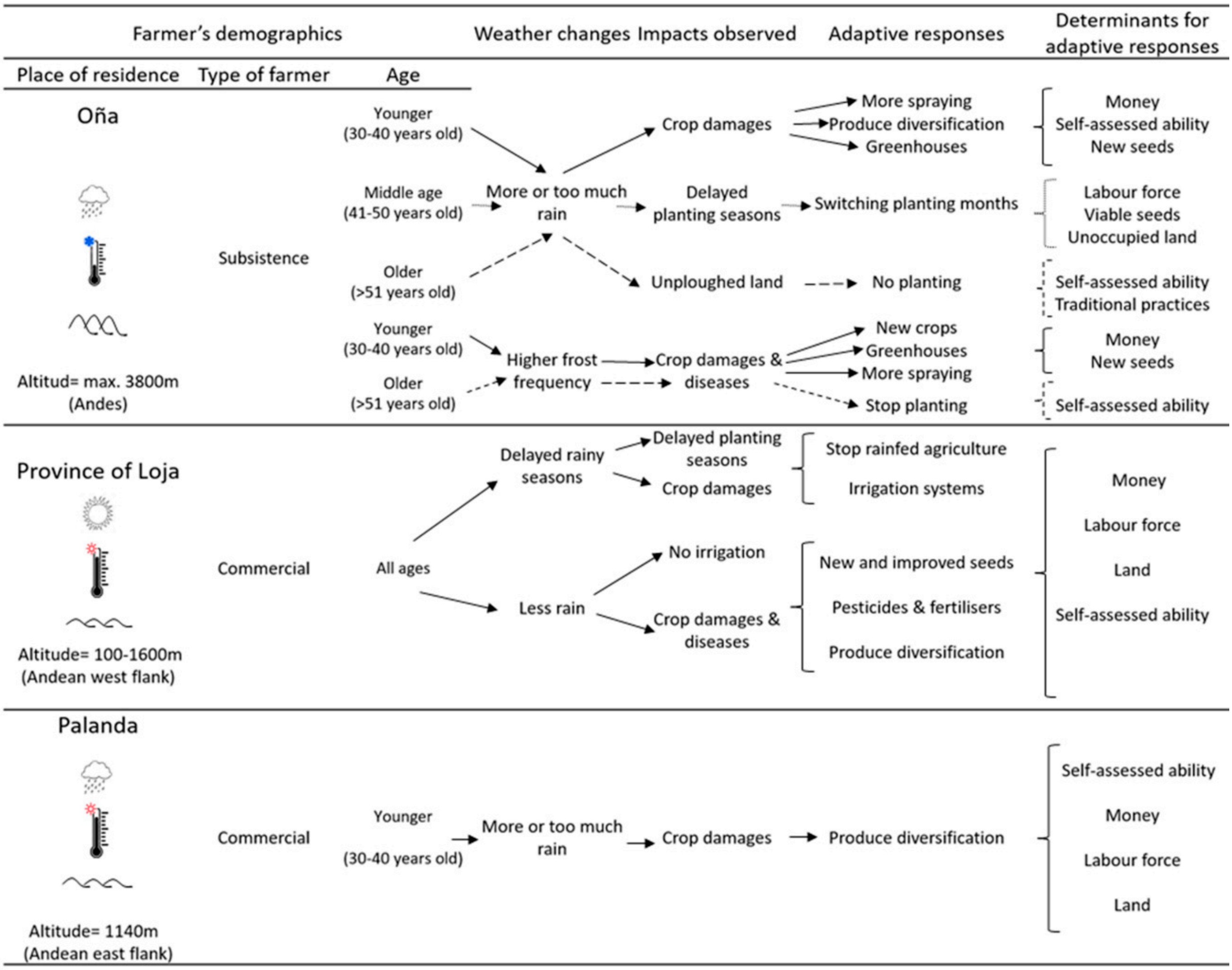

Figure 4. Responses obtained from qualitative interviews applied to 31 subsistence and 9 commercial farmers regarding weather changes observed, impacts caused by these changes, adaptation strategies implemented, and determinants for adaptive responses according to farmer's demographics.

3.2.1. Observations of Weather Changes

Weather observations are the way farmers explain their experiences with climatic changes locally (Iniguez-Gallardo et al., 2020). Both subsistence (n = 31) and commercial farmers (n = 9) have experienced weather changes according to their location. Thus, farmers living in Oña and Palanda, where an intense rainfall regime is distributed uniformly along the year, have observed changes mainly in precipitation (Figure 4), claiming that there is "more or too much rain", as expressed in the following quotation: *"There's no longer raining season, it rains when it wants to. It rains that much that I wasn't able to plant . . . "* [Farmer 25]. On the contrary, commercial farmers living in the Andean western flank, dominated by an eight-months dry season, lower altitudes, and warmer temperatures, identified changes in precipitation but in the form of 'less rain' and 'delayed rainy seasons' (Figure 4), as illustrated in the following quotations: *"The rainy season has changed a little bit. Before it started raining in December . . . Now it rains less, the weather has changed, and rains in other months than usual"* [Farmer 17].

Furthermore, subsistence farmers living at higher altitude areas in Oña claimed that *"frosty days"* are more frequent than in the past, as explained by these informants: *"There is more frost or lancha* [Phytophthora infestans] *this is how we call it. It damages potatoes, and it burns them . . . "* [Farmer 13]. *"There are more frost and colder days that damage plants, sometimes* *is more and sometimes is less*" [Farmer 21]. The relationship between frost and *Phytophthora infestans* is due to low night-time temperatures that characterised the higher Andean areas, which are followed by high humidity in the mornings and intense sunlight at midday that favours the fungus growth (Iñiguez 2015, personal communication).

3.2.2. Impacts of Climatic Changes in Agricultural Practices

Farmers were also prompted to discuss the effects of climate changes on agricultural activities. The answers provided were grouped in four main categories, namely, crop damages and diseases, delaying planting seasons, interrupted ploughing, and interrupted irrigation (Figure 4).

Those farmers who identified "more rainfall" indicated that excessive rain harms crop, interrupts ploughing, and delays planting seasons: "*When it rains a lot, it is not possible to plough and weed . . . this is why we haven't planted yet*" [Farmer 11]. Conversely, for yet another group of subsistence farmers, 'more rain' is perceived as positive given that irrigation is no longer needed: "*There is lots of water right now, so we don't longer need irrigation*" [Farmer 9].

Commercial farmers who observed 'less rainfall' indicated that less rain or delayed rainy seasons interrupts irrigation and therefore planting: "*In these latter years, it rains less. There is little water to irrigate and plant . . .* " [Farmer 6]. "*Before it used to rain between October and November, so we had water to plant, right now we are already in November, and we still have no rain, it has rained but not enough to plant*" [Farmer 2].

Subsistence farmers who identified 'more frequent frosty days' tended to agree that frost damages crop as following illustrated: "*In summertime there is frost, and it destroys the crops,* lanchas *destroys a lot*" [Farmer 11].

3.2.3. Farmer's Adaptive Responses to Climatic Changes

At the end of the interview and once farmers spoke by themselves about their experiences with weather changes, it was deemed opportune to inquire about their adaptive responses. Interestingly, such responses varied according to farmer's age (Figure 4).

For younger subsistence farmers (30–40 years old), the damages caused by 'too much rain' and 'frost' prompted them to build greenhouses, spray the crops more frequently, try new crop, and diversify their production (Figure 5B), as expressed by these informants: "*Nowadays, it rains too much, we have to spray the little plants to save them, before we did not spray them this much*" [Farmer 7]. "*Frost damages potatoes, there wasn't as much as we have now, so now we have to spray crops*" [Farmer 10]. Middle age subsistence farmers (41–50 years old) addressed this issue by switching planting months, as this informant explains: "*The planting season for wheat and lima beans used to be in January and February, but now we plant when we can. I plant a month after or a month before*" [Farmer 5]. Finally, only older participants have decided to stop planting and buy their food in markets instead as declared by these informants: "*Winter* [rain] *damages crops, it is too much work for nothing, I rather buy in the market the food that I can't grow*" [Farmer 13].

Regardless of age, commercial farmers who face crop damages caused by delayed rainy seasons and 'less rain', have chosen to give up rainfed agriculture, often called *temporal*, and use irrigation systems instead: "*There is no longer rainy seasons, this's why we stopped planting 'temporal'. Now we plant with irrigation . . .* " [Farmer 5]. Furthermore, commercial farmers decided to try new seeds, improve their own seeds (Figure 5D), or use pesticides and fertilisers as explained by these informants: "*We live with* la Roya [Hemileia vastatrix]*, but atmospheric and climatic conditions have made it stronger, therefore we looked for new varieties resistant to* la Roya *and drought*" [Farmer 3]. "*If we control* la Roya*, we will harvest and therefore sell coffee. It's no longer organic, but without pesticides, we don't have production*" [Farmer 9]. Although produce diversification was frequently named as an adaptive response, it is important to mention that such diversification is not specific to climate-related issues, as it helps farmers to deal with any unexpected events, and to obtain an alternative income source. (Figure 5G): "*A farmer must work with coffee, chickens, manioc* [yuca]*, pigs, plantain, etc.*" [Farmer 4.]

Figure 5. Techniques used by farmers in southern Ecuador to tackle weather changes. (**A**,**H**): home-made fertilisers. (**B**): self-constructed greenhouses. (**C**): potato seeds produced in the farm. (**D**): coffee seeds produced in the farm. (**E**): young family member ploughing. (**F**): artisanal irrigation systems. (**G**): crop diversification in coffee farms.

3.2.4. Determinants for Adaptive Responses

The adaptive responses implemented by subsistence farmers are determined by the money availability to purchase seeds, fertilisers, and new crop, as well as to build greenhouses as expressed by this informant: "*With greenhouses we plant new crops such as "tree tomato"* [*Solanum betaceum*] *and "babaco"* [*Carica pentagona*], *which are delicate to be planted outdoors but, we need to invest to do so*" [Farmer 22]. It was further identified that greenhouses were implemented only by younger farmers who are interested in selling their production in nearby markets. For these farmers, weather adaptation is necessary for survival; consequently, they try new crops and invest in fertilisers and pesticides, as stated by this farmer: "*Elders have planting seasons, but now the weather has changed a lot. Now we must take good care of the crops by spraying them. If we do not do that, then the crops are jeopardised*".

For middle age subsistence farmers, their adaptive response (switching planting months) is subject to labour force availability, viable seeds, and unoccupied land, as the following statement expressed: "*I planted in advance because I had some* papitas bolonas *[potato variety] ready to sow, and because I had vacant land, a ploughman, and a yoke. If I hadn't had them, I would not have done it*" [Farmer 30]. It should be noted that labour, seeds, and land are not accessed through money but through the dynamics of the farm (Figure 5A,C,E,H). Money is needed only when a ploughman needs to be hired, which is usually the case when the family has no young members.

Older subsistence farmers did not have any commercial interests and tended to keep traditional agricultural practices, as the following statement explained: "*In this land, it is a tradition to plant and harvest in the time that it has to, we keep our traditions . . .* " [Farmer 12]. Older farmers perceive themselves too old to start changes at their farms, and many of them, tired of harvesting failures, would rather stop planting and buy their food instead, as indicated by this farmer: "*I am already old, we were born like this, and we will die like this, with* *whatever god wants to provide. If the land does not produce, there is no other option than buying what we can afford*" [Farmer 18]. For them, weather changes are part of life and should not be altered by them; therefore, adaptation measures are hardly applied.

Regardless of age, the adaptive responses implemented by commercial farmers are determined by the available funds, labour, and land, as well as by a self-assessed ability to adapt.

In brief, the demographic differences found in southern Ecuador as determinants for enhancing or limiting farmer's adaptive capacity highlight the importance of understanding the place context when designing and implementing climate adaptation measures. For example, older subsistence farmers were found to be more vulnerable to climate-related changes due to a low self-perceived adaptive capacity, either because of their age or their cultural beliefs. On the contrary, younger subsistence farmers and commercial farmers possess a high self-assessed adaptive capacity, which is reflected in the improvements they implement to their agricultural practices.

4. Discussion

The evidence presented by this study indicates a trend, consisting of slightly above 50% of the predictions, towards a pro-mitigation stance among the public, with place of residence being the only associated demographic variable. Thus, more urban residents were found to share a pro-mitigation stance, although it was not possible to explore the reasons for their selection due to the close-ended format of the questions. Nonetheless, based on previous research conducted in the same study area that found that many urban residents think that climate change is caused by pollution [27], and feel concerned and angry with other people and governments because they neither change their lifestyles nor decrease pollution [29], we hypothesise that participant's pro-mitigation stances may be associated with their climate understandings and emotions. A study using open-ended questions to explore the public expectations for the desired climate actions may shed light on this aspect. This is relevant in that, for a city to be sustainable and climate resilient, the active involvement of multiple stakeholders in the identified climate actions is required [30].

The demographic profile defined for those with a pro-adaptation stance involved the participant's occupation and place of residence. Specifically, mainly unskilled workers, professionals, and farmers living in rural areas share the adaptation stance (slightly above 50% of the predictions). As we collect in-depth data from farmers, from now on we will focus on this population sector and the demographic variables involved in their perceptions of adaptation. According to Mairura et al. [17], farmers more commonly adopt adaptation rather than mitigation measures. Farmers are resilient and would rather try to adapt to the emerging weather conditions and continue innovating to face the changes, as has been found in the Himalayas [31], Iran [1], and Canada [32]. Farmers are indeed acknowledged as employing valuable adaptation strategies. For example, in South American countries, including Ecuador, farmers adapt to climatic changes by switching crops [33]. In Pakistan, farmers also change the crop types as well as the varieties [34], in Ghana they ration grain consumption [6], in Mexico they diversify their productive activities in different landscapes [35], and in Ghana and Ethiopia there is trend of managing the nutrients, soil, and water [17,19]. In our study, the evidence collected through the in-depth interviews indicate similar perceptions of climate variability and adaptive responses, but participants also mentioned other types of measures, such as the use of greenhouses, changes in the harvesting and planting months, more spraying, home-made fertilizers, irrigation systems, and seed experiments. However, these are not implemented equally by all farmers, depending instead on certain demographic variables such as age, type of farmer, and geographical region.

Younger subsistence farmers living in the Andes stand out as having a particularly proactive attitude toward adaptation, and, despite their limited financial means, they have responded to changes by using the available resources. Their needs are strongly linked to the availability of agricultural inputs and the need to improve their farms. Previous studies associated younger farmers in Australia with adaptation [35,36]. Such adaptation measures, however, are linked to financial investments to, e.g., buy more water and land, or expand irrigation areas, which, while desirable, are harder to afford for the young farmers in our study area. In Ghana, Mairura et al. [17] also identified the farmer's age as a determinant for adaptation; however, they did not explain whether it is older or younger farmers who are more willing to adapt, while in Ethiopia younger farmers were found to be less likely to adapt [19]. Development actions and adaptation policies for young people are necessary, and yet they face a devaluation of agricultural activities and an emergence of more profitable occupational alternatives in the city that lure them away from the countryside [36,37]. Making agriculture more attractive for the younger population may strengthen the adaptive capacity of the agricultural sector and thus food security.

Middle-aged subsistence farmers are a particular group, as the resources needed to implement adaptive measures do not depend only on financial means, but also on the dynamics of the farm to secure seeds, labour, fertilisers, and land. For this group of farmers, climate adaptation strategies need to improve the labour conditions in the countryside to attract younger people and to ensure the minimum land size needed to maintain agricultural activity, two important issues that are neglected in all developing countries [37–39]. Considering these aspects in addition to age is of relevance for climate adaptation interventions, as small family farmers produce a third of the world's food [39]. In Latin-America, more than 100 million of people depend on subsistence agriculture [40]. In Ecuador, subsistence agriculture produces 64% of the national agricultural production and provide 60% of the food consumed [40].

Older subsistence farmers are the most vulnerable group that we observed. Their vulnerability does not always relate to money or technology, but to cultural beliefs influencing their motivations and therefore their self-estimated ability to adapt, as they see themselves as "*too old to change their traditional practices*" and believe that "*if the land does not want to produce, there is nothing they can do*". Similar results were found in Bangladesh, where farmers perceive themselves as having a low self-capacity to tackle climatic events [41]. This contrasts with the results found in Ethiopia, which mention older farmers as the most likely to implement adaptation measures such as crop rotation, but not fertilisers application [19]. Regarding the design of climate adaptation interventions, only in European nations has the older population been consulted on climate adaptation interventions, albeit for preventing deaths caused by heat waves [14]. This means that age and geographical area act differently between nations in regard to the implementation of climate adaptation measures. In Andean communities, changes are embraced as part of life, as, for the people living in these areas, changes need to occur to keep the balance [42] (p. 251). Moreover, for Andean traditional farmers, subsistence agriculture is important, as it generates employment for members of the population over 50 years old [37,38]. Together, these claims could explain the preference among the older population to maintain the *status quo*. Such a stance undermines resilience thinking and subsequent adaptation.

Regarding the type of farmer and geographical region, the evidence indicates that all-age commercial farmers living in the western flank of the Andes showed highly proactive attitude towards adaptation accompanied by the availability of resources, which make them the group most likely to adapt. Interestingly, despite having access to more resources, they do not rely only on coffee for their income, but also on produce diversification measures such as short-cycle crops and seasonal fruits. In Ethiopia, income diversification is also mentioned as an adaptation measure, but among smallholder farmers [19], while our evidence shows that this measure is also part of the adaptation strategies implemented by commercial farmers. Diversity is key for resilience [43]), and multiple income sources are characteristic of rural settings [44]. In this sense, the design of adaptation strategies must integrate the diversity of the economic-productive activities of the farm in order to make real progress towards reducing climate vulnerabilities.

Throughout this research we have endeavoured to highlight the importance of defining a local level demographic profile that helps to link perceptions with the likelihood of implementing mitigation and adaptation measures among different members of society. In doing so, it became evident that demographic variables such as place of residence, geographical location, type of farmer and age influence perceptions, attitudes, and adapting responses, which have different effects on individuals from the same region and even the same community, thus showing the importance of the place context in the implementation of climate adaptation strategies. Rural areas, far from being homogeneous, are characterised by their economic, social, and cultural heterogeneity [37,38], which must be further addressed in the climate debate. Neglecting these aspects may jeopardise adaptative climate responses and augment climate vulnerabilities, which are exacerbated by social inequalities [7,9–11,45,46], as has been well documented by Salas [47], who describe how intense droughts in southern Ecuador affect peasants more dramatically than landowners, as the latter group has better access to land, irrigation, and a labour force.

Globally, people are acquainted with adaptation processes, as populations adapt to any factors influencing their livelihoods [48,49] and respond to climate change when its threats impact the things they value [50]. Adaptation and resilience thinking are in fact inherent characteristics of social systems [51] (pp. 2–22). Further research exploring the collective capacity and social learning, previously found as predictors of adaptation [52,53], will enrich the adaptation literature in the Latin American context. Additionally, this work did not look at gender differences in the implementation of adaptation strategies, which may influence the effectiveness of such strategies.

We conclude by noting that the implementation of both mitigation and adaptation measures is necessary to achieve climate goals more effectively. Although the global literature considers cities to be key to the implementation of these measures [54], farmers have a very clear memory of years dominated by extreme weather conditions which disturbed their production [55], and they notice physical environmental changes such as increasing temperatures, decreasing rainfall, and altered drought and flood frequencies [56]. Indeed, farmers' weather observations were found to be aligned with local meteorological data [41,57–59]. Farmers employ valuable adaptation strategies that need governmental interventions to strengthen and ensure an effective climate resilience. This should not be seen as an apolitical process that conceives of adaptation as a mere adjustment to danger, but as one that requires the strengthening of local capacities accompanied by the reduction of socio-territorial vulnerability [60]. Understanding the citizens' perceptions according to their place demographics is relevant, as climate change is understood differently by different members of the public [27].

5. Conclusions

Climate interventions requires a local level understanding of the influence of demographics on intentions to implement climate measures. Whilst, in cities, there is a tendency among urban dwellers towards a pro-mitigation stance, in the rural sector, particularly among farmers, there is a strong tendency towards a pro-adaptation stance, which varies within the same social group in the same geographical region. The geographical place of residence, type of farmer, age, and cultural traditions were found to be relevant in this study. Neglecting these factors may undermine an effective adaptation, particularly for old subsistence farmers in Andean communities.

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