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Applying structurational divergence theory to climate change adaptation in a localized context: understanding adaptive potential of coffee producers in Risaralda, Colombia

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ABSTRACT

Climate change impacts threaten farmers' livelihoods and global food security. Adaptation to climate change can protect both farmers and our food supply. Structurational divergence theory (SD theory) provides a holistic framework to understand the unique contexts of groups impacted by climate change and to reveal constraints and opportunities for adaptation efforts. We apply SD theory to climate change adaptation, focusing on a population of Colombian coffee farmers in Risaralda who are impacted by climate change. Our findings reveal a SD cycle blocking successful adaptation. Climate change impacts exacerbate farmers' pre-existing financial strain and threaten their livelihoods, yet they lack the information and political and structural support needed to take action. This impedes development and creates a downward spiral of immobilization; the farmers will continue to be unprepared for climate change and practice inconsistent adaptation efforts until structures shift to provide them with the information and resources needed for successful adaptation.

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Without climate-informed development, climate change could force more than 100 million people into extreme poverty by 2030 (Hallegatte et al., 2015). To reduce this impending crisis, natural and human systems need to adapt to climate change impacts (IPCC, 2007). In Colombia, climate change impacts threaten agricultural production and risk the livelihoods of millions of people, as well as political and economic stability (Ramirez-Villegas et al., 2012). Climate change induced weather fluctuations (Hodson de Jaramillo et al., 2017) and the subsequent increase in pests and plagues wrought by unusual weather events (Constantino et al., 2011) are threatening Colombia's coffee crops. By value, coffee is Colombia's most important agricultural export and an essential crop for the livelihoods of approximately 500,000 farmers, providing jobs for over 2 million people. Without climate change adaptation, the future for Colombia's coffee farmers looks bleak.

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In this article, we demonstrate how structurational divergence (SD) theory can support climate change adaptation through modeling factors that constrain and enable adaptation within a particular group in a localized environment. We use the term 'adaptation' to refer to the human response to climate change impacts, ranging from an individual (micro) to group scale (macro) and including economic, political and cultural responses, amongst others. We define adaptation as actions taken collectively or individually to adjust to climate change for personal and community well-being both now and in the future. 'Climate change impacts' at their climatological core refer to changes such as disrupted seasons, increased extreme weather events such as droughts, changing currents and rising sea levels. However, the effects of climate change extend well beyond these climatologically 'felt' physical phenomena into lower crop yields, food scarcity, increased potential for violence and psychological distress, cultural strain, etc.

We use data collected from a population of coffee farmers in Risaralda, Colombia, who are experiencing uncertainty in the face of climate change (Lambert & Eise, 2020). We argue that SD provides a system for organizing and categorizing data that incorporates the social context of structure and agency from both micro and macro levels, making it possible to generate useful climate change adaptation recommendations that are specific to the complex social realities of a local environment. This study is built on two assumptions: first, that structures emerge from and are built upon communication processes between people and groups, and second, that structures and agency are best understood by an examination of how the individual or group communicates their understanding of their structures and agency.

Communication and climate change adaptation in the Colombian coffee sector

The implementation of climate change adaptation is not keeping pace with the ever-increasing need and the 'adaptation deficit' (Burton, 2004) is getting wider, making it critically important to identify and analyze adaptation barriers in order to identify opportunities to overcome them (Eisenack et al., 2014). More broadly, a shift has begun towards actor-centered approaches to adaptation research in climate change (Dow et al., 2013; Eisenack & Stecker, 2012; Ekstrom & Moser, 2014; Klein & Juhola, 2014). This marks an important turn of attention to the social factors and human agency influencing local adaptation, and heralds a critical moment for communication to contribute insights into processes shaping these outcomes.

In the last decades, climatic shifts related to El Niño and La Niña have caused serious challenges for Colombian agriculture, demonstrating that many agricultural producers do not have the capacity to effectively manage risk and adapt to climatic fluctuations and catastrophes (Lau et al., 2011). Scholars have noted the urgent need for innovative action based on existing knowledge and technology to anticipate the effects of climate change in Colombia alongside the development of specific knowledge and technology (Costa Posada, 2007). Despite this call for action, a decade later Muñoz et al. (2017) report that there have been low levels of planning and implementation of adaptation measures to reduce agro-climatic risk, and few have made attempts to incorporate local-level knowledge.

A one-size-fits-all approach to climate change communication more broadly will almost certainly fail, as each community or audience differs in their values, aspirations, knowledge and other traits (Moser & Dilling, 2011). To this end, communication scholars have argued for participatory and culture-centered approaches (Dutta, 2011; Melkote & Steeves, 2001) to effect social change and avoid the diffusion model of communication that may be inappropriate in countries with different political structures and cultural beliefs (Dagron & Tufte, 2006).

Some environmental communication research has oriented toward understanding and privileging local contexts, including localizing climate change (Howarth & Anderson, 2019) and the importance of local framing for climate change messaging (Scannell & Gifford, 2013). But more research into the localized nature of adaptation strategies is needed to develop theoretical approaches that illuminate local communication processes in the climate change adaptation process.

Adaptation to climate change has grown in importance only recently, as the irreversibility of climate change impacts becomes clearer. As we confront a future defined by climate change, now is the time to focus on adaptation to help communities build resiliency and maximize scarce resources with tailored adaptation programs. Applying SD theory to climate change adaptation supports this need for adaptation strategies that are contextually appropriate.

Structurational divergence

SD draws from structuration theory (Giddens, 1990; 1991). Nicotera and Clinkscales (2003) first conceptualized the theory while studying the interpenetration of contradictory structures in African American human services organizations. They noted that when faced with opposing and equally constrained structures, individuals experienced organizational divergence. They underscored the idea that divergence is a process, where communication of opposing beliefs escalates into a divergence cycle, and hence requires a navigating structure to evolve into its own structure. It was subsequently developed into SD theory by the authors in a study identifying the multiple opposing structural sets that enabled and constrained nurses in a healthcare setting, (Nicotera & Clinkscales, 2010), building on Giddens' concept of structural interpenetration.

SD has two key components known as the SD-nexus and the SD-cycle. An SD-nexus is a unique form of divergence, wherein the social/institutional position in which multiple structures exist compel simultaneous obligations. Within this nexus, interpenetrating structures are incompatible and create simultaneous, equally compelling and contradictory obligations. There is no way to make sense of interaction within this nexus, to know what things mean and therefore to make an adequate choice about what to do. (Nicotera & Mahon, 2013) An SD-cycle is the resulting downward spiral of communication that self-perpetuates and creates immobilization through lack of progress (rather than inactivity) and a sense of feeling stuck in the face of a recurrent problem with no foreseeable end. Agency is efficacy or the ability to act meaningfully and break the cycle or arrest its escalation. (Nicotera & Mahon, 2013) Breaking away from the cycle may result in convergence, which Nicotera et al. (2010) propose occurs when differences are negotiated, goals are attained and development is accomplished, creating positive cycles of communication (Nicotera et al., 2010). For convergence to occur, actors exercise agency to

take action, such as negotiating differences and formulating strategies to reach convergence.

Organizational communication scholars have applied SD theory in various settings. In the context of athletic injury, Zanin (2018) found that the SD-nexus did not spiral into an SD-cycle because athletes perceived they could exercise their own actor agency or pseudo agency. In another study on adoption of emergency medical records or EMR systems, Overton (2020) noted that health providers experienced an SD-nexus as they struggled with the cost and time delays of the system, but also acknowledged how it helped hospital administrators to meet federal guidelines. In Overton's study, this resulted in a downward spiral of communication (SD-cycle) between several health care units, creating ethical dilemmas amongst providers about patient care.

In this study, we extend the application of SD to climate change and coffee farming in Colombia. Climate change represents a recurrent conflict that is common, distressing and complex, which impedes the ability to accomplish organizational and personal goals. Recurrent conflict is a multilayered phenomenon requiring complex explanation (Nicotera & Mahon, 2013), and SD offers a framework to understand it. To the best of our knowledge, climate change has not been explored in organizational communication literature in this context. However, in their examination of the undesirable disagreement between members of American Meteorological Society on the human causation of global warming, Stenhouse et al. (2016) reference to conflict is very similar to an SD-nexus. In this disagreement, the conversation around global warming appeared to be stuck in an SD-cycle, interrupting intervention and effective policy changes to address the issue.

Here, we examine how SD theory might aid the development of climate change adaptation strategies by identifying any deeply entrenched structural contradictions that create negative outcomes for agricultural producers and their communities. We use the findings to extend SD theory for practical application in the climate change adaptation context. We are guided by the following research questions:

RQ1: How do structures constrain and enable climate change adaptation for Colombian coffee farmers?

RQ2: What are the identifiable points of, if they exist, SD-nexus, SD-cycle and convergence that Colombian coffee farmers experience with climate change adaptation?

Method

Data collection

Data for this study were collected in Risaralda, Colombia, by the first author as part of a larger study to understand how coffee farmers adapt to and communicate about climate change. Risaralda is located in the western central region of Colombia. It is a mountainous territory that is part of the United Nations World Heritage site the Coffee Cultural Landscape of Colombia. Colombia has 32 departments, of which Risaralda is one. Departments are broken down into municipalities. Risaralda has 14 municipalities. Participants in the study were coffee farmers in Risaralda and we interviewed two to four coffee farmers in each of the 14 municipalities, reaching a total of 45 interviews. Interviews were conducted one-on-one and in Spanish. Inclusion criteria consisted of being

a coffee farmer in Risaralda. To recruit participants we asked local coffee associations to circulate study information to their members who could then contact a researcher. Local coffee associations are self-organized groups of coffee farmers in a particular region within Risaralda and are extremely common. While there are no statistics as to the number of associated coffee farmers in the region, estimates run very high. Our sample also included two independent coffee farmers who had heard of the study and reached out to the researcher.

The age range of the sample was 23–81 years of age, with a mean age of 51 years old. The sample included 7 women and 38 men. Education levels ranged from 2nd grade to a post-graduate degree, however for the majority, their highest grade of schooling did not exceed high school. For this demographic, absent a centralized database of all farmers along with the geographic realities of accessing remote coffee farmers, it was impossible to obtain a randomly selected representative sample. We therefore attempted to maximize geographic representativeness by interviewing 2–4 coffee farmers in each of the 14 municipalities of the department of Risaralda.

The interviews were conducted by four CITI-certified interviewers; the first author, two local professors and a local research assistant. Interviews lasted approximately 45–90 min. Three Colombian undergraduate research assistants at a partnered university who were trained in transcription protocol transcribed the interviews. A bilingual member of the team translated the transcriptions into English and a second bilingual member checked them for accuracy. For this study, we selected a total of 32 questions for analysis: 21 primary questions and 11 sub-questions (Appendix). These questions sought to capture how the coffee farmers viewed the structures regulating their existence, their role in this environment and their personal agency. Several questions may appear 'leading,' however within this cultural context (as advised by local collaborators), participants may hesitate to speak of challenges unless they are explicitly given permission to do so through a question that indicates it is acceptable to discuss challenging/sensitive topics. In these cases, such as question 8 (Does the community appreciate the challenges you face as a farmer?) and question 10 (Do you feel valued and heard by your local policymakers around agriculture?) we attempted to remain as neutral as possible by using the positive form (appreciated vs. unappreciated) and (valued and heard vs. not valued and heard) in order to minimize a guided response. Additionally, for questions that appear close-ended (yes/no), interviewers were instructed to probe by asking for elaboration. Saturation was reached at two-thirds of the interviews (approximately 30), yet data were collected from a total of 45 interviewees.

Data analysis

To analyze the data we used thematic analysis, which is a method for identifying, analyzing and interpreting patterns of meaning, or themes, within qualitative data that is guided by the research questions (Clarke & Braun, 2014). Joffe (2011) argues for the value of understanding naturalistically occurring themes in qualitative data through a dual deductive/inductive process to draw themes from the data. Our study followed this dual pattern, wherein we sought themes guided by SD theory but also let the raw data inform us as to how coffee farmers understood their agency and environmental structures.

For this study, three members of the research team, including the authors of this paper, independently coded and developed themes for the entire data set. The authors then met to compare their themes to determine where themes aligned and diverged. Where themes diverged, the authors discussed and re-coded the themes with each theme supported by direct quotes from the coffee farmers. The SD analytic strategy we used was to review the data looking for divergence/convergence through coffee farmers' reports of their own experiences.

Findings

The data reveals that coffee farmers face not only climate change but various challenges, such as financial pressures and lack of institutional support. In this study, we examined the data through the lens of climate change adaptation specifically and found evidence of competing structural sets that led to an SD-nexus preventing effective adaptive practices. It became clear through our coding that, due to the complexity of climate change adaptation contexts, structures needed to be divided into delineated dominant areas for parsimony and clarity. These structural sets capture the challenges faced by the coffee farmers, and were dominant in five areas: cultural, economic, environmental, informational and political. This SD-nexus produced an SD-cycle. The farmers, while stymied by an SD-cycle from successful adaptation, expressed a willingness to adapt if structural shifts allowed for it.

Figure 1 visually represents the coffee farmers' experience with climate change adaptation, and we provide subsequent elaboration of each category with condition

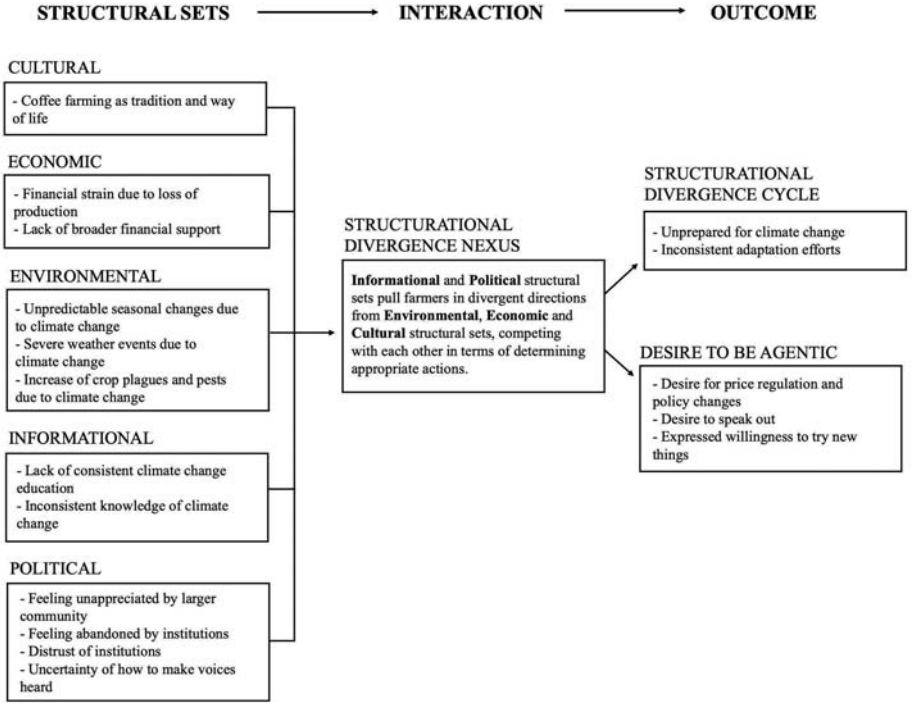

Figure 1. Visual representation of Risaralda Coffee Farmers' experience with climate change.

statements. Below, we make explicit how each category was derived from the data through the condition statements and provide supporting quotes.

Cultural structural set

The first condition statement, *Coffee farming as tradition, culture and way of life*,[1] was informed by three interview questions: (1) 'How did you learn to be a farmer?' (2) 'Are any of your family members farmers?' and (3) 'Why did you become a coffee farmer?' Responses revealed a way of life that is passed on from generation to generation at a young age and considered tradition. Interview participants reported learning how to cultivate coffee 'through our land, where I was born, with my father and grandfather' and 'from my family, I owe it to my grandfather and my parents.' Almost every participant had family working in coffee farming and for the majority, their entire families, including extended families, were involved. They reported taking up the profession due to family roots, love of the land, culture and, at times, a lack of other options, with one representative quote from a farmer: 'It's not that I wanted to, but that I was born a farmer. The earth attracts me and gives me energy. It's like a magnet.'

Economic structural set

The coffee farmers in this study reported struggling to manage the imbalance of production costs and fluctuating coffee prices alongside decreased production due to climate challenges, which at times made it difficult for them to make ends meet. The loss of production due to adverse climatological conditions gave rise to the economic condition statement *Financial strain due to loss of production.* This emerged from responses to the question 'What is your greatest barrier to solving a problem when it arises on your farm? What is the factor that consistently gets in the way of fixing problems with your coffee?' as well as frequent allusions across the rest of the data. Low production stems partially from unpredictable seasons and climate change, which leads to lower profitability in the long run. One participant stated that

> in the period of flowering there was summer, and during harvest there was winter, but from 2008 onward this changed and now we don't know when it will be summer and when the coffee will blossom and production varies up to 40%.

In addition to this, economic constraints also resulted in *Lack of broader financial support* in managing the stresses of climate change. When asked 'Are there resources that exist for farmers like yourself who are experiencing climate change issues?' the majority reported no, that there was only bureaucracy and little governmental support. A labor deficit compounded the situation as farmers struggled to find enough labor to work the fields in the face of new child protection laws and youth wanting to move to the cities and not work the fields. Within the recurring theme of fluctuating prices, farmers spoke of economic pressures, in which they struggled to come up with enough money to purchase supplies, pay employees, keep the farm in good condition and make a profit.

Environmental structural set

The environmental structural set condition statements allude to the primary disruptions coffee farmers experienced due to climate change, which are *Unpredictable seasonal changes due to climate change, Severe weather events due to climate change* and *Increase of crop plagues and pests due to climate change.* These themes emerged through responses to the interview question 'What are the greatest challenges you face as a coffee farmer?' as well as appearing frequently across other question responses as illustrative examples or as connections they organically drew. Responses such as 'agricultural products depend on the climate … it's not feasible to make production decisions based on how you did it ten years ago when we used to know we would have a large harvest twice a year' and 'the [current] climate also makes us susceptible to pests' reflect commonly articulated views.

Informational structural set

Lack of consistent climate change education is the first condition statement under this set, emerging in response to the questions 'Where and when did you first hear about it [climate change]?' 'Who would you actually trust to deliver it [climate change adaptation techniques]?' and 'What could they [scientists, educators, etc.] do to best help you implement those techniques?' In all three response sets, the answers were inconsistent. There was no consistent original source for having first heard about climate change, no consistent sense of trust around any one stakeholder group for delivering education and no one consistent preferred assistance in implementing any adaptation strategies. Together, these reveal an overall lack of consistency in climate change education. Answers frequently tied into the second condition statement, *Inconsistent knowledge of climate change*. While most participants reported being aware of climate change and talking with others about it, most of their information on climate change impacts was from mass media, such as television and radio. However, in response to 'What did you learn, if anything, about climate change from these information sources?' the participants reported only gaining superficial knowledge that was not particularly relevant, with an illustrative quote being that 'it is not very accurate, and it ultimately makes a person doubt.' Additionally, participants reported largely distrusting the accuracy of weather predictions, using more traditional methods instead, such as analyzing the clouds. 'I believe my mom more, and the analysis she gives when looking at the clouds,' stated one representative participant. Another said, 'I hear the news, but I do not pay much attention, because I do not believe much in that.' Not having consistent or trusted meteorological reports prevented farmers from making strategic choices based on short-term climatological information. One interviewee stated: 'The media only shows the tragedies and environmental events that happen in certain areas, but there are many things one can prepare for and that can be mitigated, but we can only do that if we are informed.'

Political structural set

The first condition statement is *Feeling unappreciated by the larger community*, which emerged primarily from the interview question 'Does the community appreciate the

challenges you face as a farmer?' A significant portion of the farmers reported that the broader community does not appreciate nor understand their challenges. This condition is compounded by the second and third conditions, which are *Feeling abandoned by institutions* and *Distrust of institutions*. These two conditions emerged primarily from the interview question 'Do you feel valued and heard by your local policymakers on problems around agriculture?' with participants stating that 'there may be resources, but they are managed poorly and everything is only halfway finished. Resources aren't handled as they should, and everything ends up stolen' and 'there was a promise [from the government] of very good things for rural areas besides solving problems with intermediaries to regulate prices, but we see that the government does not do them.' This general feeling of abandonment and distrust emerged in responses across the entire interview. The farmers' perceived a lack of support, which fostered feelings of abandonment, mistrust and disappointment. The fourth and final condition statement is *Uncertainty of how to make voices heard*. When asked how they would prefer to be heard about their concerns and challenges, participants provided unclear responses with no consistent themes, reflecting uncertainty and a lack of consensus around how to make their voices heard.

As one farmer explained, 'as rural farmers, we would like to be listened to more and taken into account. We have been very marginalized. The government has treated us carelessly and offers almost no help. What would a city be without the countryside?' This desire for recognition was also reflected in responses to 'Do you know anyone who is dedicated to communication around climate change?' – the majority reported no – and 'If not, do you think there should be someone dedicated to communication around climate change, or is it fine how it is?' The majority reported yes, they needed someone

> very much. I do not know a climate change communicator or a group that works and meets to see what campaigns could be done. I do not know one. For example, the [organization name] works a lot, but in the end, I don't see how much overall positive impact they have. I think they are very bureaucratic.

Structurational divergence nexus

Facing environmental or financial challenges in and of themselves is not sufficient for an SD-nexus: farmers are accustomed to challenges and confronting challenges is different from facing a contradictory coexisting set of structures. An SD-nexus creates *irreconcilable* tensions that, no matter how resilient a population is, compel simultaneous obligations that pull people in divergent directions and do not allow for progress. For the coffee farmers, the informational structural set (*Lack of consistent climate change education* and *Inconsistent knowledge of climate change*) and the political structural set (*Feeling unappreciated by larger community*, *Feeling abandoned by institutions*, *Distrust of institutions* and *Uncertainty of how to make voices heard*) create a situation where the farmers do not know what to do and lack support. These two sets diverge from the cultural, economic and environmental structural sets, where farmers face constrained resources, a threatened cultural identity and climate change impacts that damage production. The farmers are confronted with insurmountable, divergent structures; they are unprepared, lack consistent education and possess inconsistent knowledge of

climate change, leading to inconsistent adaptation efforts. This creates an irreconcilable tension that prevents them from dealing with climate change challenges and they are unable to make coherent sense of their interactions even as they create positive communicative constructs around coffee farming as a tradition and cultural construct. This SD-nexus leads to an SD-cycle, as described below.

Structurational divergence cycle

An SD-cycle is a resulting downward spiral of communication that self-perpetuates and creates immobilization. It is not inactivity but a lack of progress, and a sense of feeling stuck in the face of a recurrent problem with no foreseeable end (Nicotera et al., 2010). For coffee producers in Risaralda, the lack of information and political and structural support for change prevents climate change adaptation, which in turn exacerbates the financial strain wrought by climatological changes that impact yield, threatening identity and livelihood and creating a self-perpetuating SD-cycle. This immobilization impedes development and deepens the irreconcilability, as farmers continue to be unprepared for climate change and practice inconsistent adaptation efforts. This downward spiral of increased financial instability, increased threat to livelihoods and increased environmental uncertainty will continue until structures shift to provide farmers with the information and resources they need to successfully adapt.

This SD-cycle emerged through two prominent themes within the data. The first condition statement is *Unprepared for climate change*. This was evidenced through three interview questions, 'Have you heard the term "climate change"?' 'Who has provided you with information on this topic?' and 'Do you feel like anyone has prepared you for it?' Every participant reported having heard the term climate change before but the responses about who had provided them with information were inconsistent. The majority felt no one had prepared them for climate change, saying that 'we have had no help in this at all,' with some stating discomfort with placing formal complaints, as 'you can place a complaint but they won't do anything if you don't sign and give your information, and if you do that, you will gain enemies.'

A slim minority believed they had been prepared for climate change, and largely attributed this to their local, self-organized associations. The second statement, *Inconsistent adaptation efforts*, is likely a direct result of feeling unprepared and lacking resources and education. When asked 'Have you made changes on your farm to adapt to climate change of any kind?' approximately half of the farmers reported yes, with no dominant strategy named, and about half reported no.

Desire to be agentic

The farmers desire to be agentic and to act meaningfully in the face of these challenges, yet are deterred by the SD-cycle. At multiple points in the data, thematic analysis revealed a consistent desire to be agentic even in the midst of experiencing an SD-cycle. Farmers were able to articulate several clear sets of structural changes needed to create convergence. First, they expressed a *Desire for price regulation and policy changes.* When asked, 'What one change, anything at all, would make your life better as a farmer?' the

majority expressed gratitude for what they had and wanted to be able to learn more, but desired better pricing, followed by better governmental policies, primarily in the area of moderating price fluctuation (the price at which they sell their coffee beans). One farmer expressed a desire for

> more appropriate policies for the agricultural sector that allow us as producers to devote ourselves to what we know how to do, which is to produce well and with good quality. Successful policies would make our lives calmer and much more dignified

while another stated that 'we need many things; that the government takes us into account, the price of coffee, motivation to continue in the field and to do things well.' Another said that

> this is a chain. At one end of the chain is the final consumer. Between this chain is the business part, and this business benefits economically. The first part of the chain is us. And we sell our coffee at a different price every day, even though the middle man does not lower the price of coffee to the final consumer.

One participant reported that there are 'many resources the state has, and if I don't go to claim them, they will fall into the hands of the corrupt.' Farmers felt that, without understanding the problems they face on a daily basis, politicians could only do so much for them. Some farmers optimistically avowed the benefits of ties to their self-organizing local coffee associations, describing the 'social cohesion' and tips they provided, and expressed hope for support from possible nontraditional sources.

For condition statement two, *Desire to speak out*, data were found in responses to the question 'Do you think speaking up about problems you face related to climate change makes a difference?' Participants believed that spreading awareness could help and that if more people knew and understood the problem, people could make an impact on a larger scale. They also believed that there was little knowledge about their challenges within government, and that

> we must talk about these issues … but few want to do something and they always delegate things to other people and nothing ends up being done … It is a problem in our department, in the country, the planet and each person who can do something; they do not do it. I find it shameful.

The final condition statement was a *Willingness to try new things*. When asked 'Is it better to try something new and take a risk or keep doing it the old way and have a smaller yield?' the vast majority reported that it was imperative to move out of their comfort zone and progress. They understood that agriculture was constantly evolving and that, despite being scary, they needed to keep up with changing times.

> It is important to be knowledgeable about what we do and to understand when it is time to change. In order to progress, we can't stay in our comfort zones and complain. We have to try new things, but without impacting the environment or human beings,

stated one participant. When asked 'Do you think it's possible to successfully adapt to climate change?', the majority exhibited cautious optimism stating yes, but that it would be difficult and require attention and investment of time, and there were currently barriers.

Discussion

Extending SD theory into climate change adaptation

An SD lens creates space to understand structures, existing barriers and solutions to overcome these barriers, making it applicable for many contexts, including that of climate change adaptation, as discussed here. Scholars have demonstrated its ability to unearth deeply entrenched structural contradictions to study the impact of communicative strategies (Nicotera et al., 2014; Overton, 2020), which builds space to not only identify a challenge but also its potential solution/s. In Table 1, we draw on our findings to demonstrate how SD theory and concepts can be practically extended into climate change adaptation, focusing on agricultural producer populations. We extract key concepts from SD, define each term and extend its application into climate change adaptation. The definitions of key concepts are drawn from Nicotera et al. (2010), Nicotera and Clinkscales (2010) and Nicotera and Mahon (2013).

In our study, while farmers suffered informational and political structural sets restraining their adaptive responses, they also expressed a desire to be agentic with clear ideas and 'desires' to improve their condition if afforded the opportunity. Nicotera

Table 1. Extension of key structurational divergence concepts into climate change adaptation.

Key concept	Definition	Extension to climate change adaptation
Structural Sets	Structures that enable and constrain individuals' actions and interactions.	Individuals experiencing climate change are enabled and constrained to adapt by structural sets.
Divergent Structures	Structures pull an individual in divergent directions, competing with each other in terms of determining appropriate actions.	Individuals experience climate change impacts yet opposing structures fail to support adaptation and mitigation, while long-held traditional practices no longer yield similar results.
Convergence	If structures support each other, convergence creates positive cycles of communication wherein differences are negotiated, goals are attained and development is accomplished by transforming structures or producing a third structure that creates supportiveness between the divergent structures.	Individuals experience climate change impacts and are able to receive support for adaptation and affirmation of their experience or are able to transform existing structures or create new structures to allow them to adapt successfully.
Structurational Divergence Nexus	An SD-nexus is the social/institutional position in which multiple structures compel simultaneous obligations that are incompatible and create simultaneous, equally compelling and contradictory obligations. Individuals cannot make sense of interaction within this nexus, nor determine what things mean and how to adequately choose what to do.	Individuals experience climate change impacts that prevent continuation of previous social or economic obligations, yet structural sets fail to recognize impacts or expectations for the individual remain the same.
Structurational Divergence Cycle	The SD-cycle is a downward spiral of communication that self-perpetuates and creates immobilization that inhibits effective problem-solving and action. This lack of progress builds a sense of feeling stuck in the face of a recurrent problem with no foreseeable end.	Individuals experience failure to adapt and the subsequent detrimental impacts of climate change, both tangible (loss of livelihood, etc) or mental (loss of hope, nihilism), and perceive that there is no path forward in the face of climate change.
Agency	Agency is efficacy or the ability to act meaningfully and break the cycle or prevent it from escalating into the cycle.	Individuals innovate adaptation strategies and take action (i.e. self-organize within the community, invent new farming techniques).

and Mahon (2013) define agency as self-efficacy, or the 'human capacity to exercise control over one's life. Agency is efficacy – ability to act meaningfully' (p. 99). Our data demonstrate that while the coffee farmers experienced the negative effects of an SD-cycle – the inability to act effectively – they nonetheless demonstrated a desire to be agentic in the face of the unease provoked by clashing structural sets. They were able to name several ways to adjust systems such as receiving a stable, fair price for their coffee and receiving governmental support. While they desired to be agentic, structures prevented them from executing agency, which relates to the concept developed by Nicotera and Mahon (2013) known as impotent agency. In their later study on conflict resolution in nurses' work-life, Nicotera et al. (2014) suggest that transformative dialogue within the institution can break the SD-cycle. In the context of climate change adaptation and our study, the conflict is not situated within institutional confines with a shared goal; the farmers fear for their survival and face a broad set of structures that suppress their ability to adapt. Therefore, dialogue or common-ground negotiations are not appropriate. Instead, the alteration of existing oppressive structures or the creation of a third structure to circumvent existing structures is needed to transcend the SD-cycle, mechanisms that Nicotera and Clinkscales (2010) and Nicotera et.al. (2010) also describe. Desire to be agentic reveals interest and willingness in those caught in an SD-cycle to take the initiative to make change if structures shift. Yet ultimately, if structures are what is impeding progress, then they must be attended to first; and this is why, in the following section on practical applications, we dedicate significant attention to identifying and attending to structural barriers.

Practical applications

Practitioners working in areas relating to complex and chronic global stressors such as climate change adaptation confront many challenges. These problems are described as 'wicked' for a reason; because they involve incomplete knowledge and complex systems, whereby one problem is interconnected with other problems. In this case, for instance, the coffee farmers have reported that they face many challenges such as financial instability, not just climate change. Past research in this region has also emphasized the fact that the capacity of local actors to respond to a crisis is dependent on factors that are not solely climatic, such as financial conditions, family structure, community networks and others (Turbay et al., 2014). The findings of this paper stress the importance of understanding local contexts *first*, before performing an intervention or campaign. Here are three primary ways in which practitioners may leverage the findings of this research:

(1) As a practitioner addressing a complex, chronic global stressor, first seek to understand the structures that influence or constrain your target stakeholders' lives. If there is an SD-nexus, whereby structures prohibit the stakeholders from taking meaningful action on a topic, then sending messages directly to them to take action without accounting for these structural constraints *will not work*. In fact, it could do the opposite; it could apply undue pressure and stress by asking a population to do something they are not able to do given their context (even if they want to), causing them to become confused, frustrated or to double down on a previous action.

(2) If there is an SD-cycle, first target efforts toward breaking it. Until an SD-cycle is broken, individuals cannot practice agency – even if they want to. Nicotera et al. (2014) noted that the SD-cycle feeds on itself, which recreates and deepens the cycle. They suggest that individuals can build new structures to channel their impotent agency and transcend the cycle.
(3) Lastly, individuals who are caught amidst structural constraints may also have the desire to exercise their agency and take actions to resolve the conflict. As our findings suggest, a group experiencing an SD-cycle can be aware of the restrictions on their agency and desire to be agentic despite an inability to do so. This is an introduction point for efforts to work with communities or groups to build new structures by leveraging strengths found within the community. We recommend practitioners always engage with these individuals prior to developing strategies to discuss possible solutions to break away from the SD-cycle and to leverage the unique internal strengths found within each community.

This type of approach is time-consuming and requires upfront planning. Communication efforts cannot be an afterthought but must be incorporated into broader project planning from the outset. However, without establishing whether an SD-cycle exists, and if so, understanding its nature, there will be little chance of success if the targeted stakeholders cannot be agentic, no matter their desire.

Limitations

SD has been developed in a US context and the literature cited here is US-centric. This is the first application of SD theory to climate change adaptation and it is based on one study. We encourage further application within this context in order to continue to test its appropriateness and to refine our theoretical modifications. Additionally, we focus on a farming population. It would be beneficial to see whether it can be extended into other populations experiencing climate change impacts, or if it is best suited for agricultural producers who experience the more immediate and threatening effects of climate change on a daily basis. Secondly, this study was originally conducted in Spanish and has been translated into English for this paper. Intent and meaning are necessarily lost when translating between languages, despite the precautionary efforts taken to minimize them. Lastly, we would encourage future research on this topic to include an agronomist with expertise in this area, who could guide deeper inquiries into the adaptation practices that farmers deploy. For instance, in response to the question, 'Have you made changes on your farm to adapt to climate change of any kind?' some farmers detailed their experimentation with new farming techniques that they hoped might help offset climate change impacts, such as (1) planting trees on their farms to shade coffee plants during hot spells and to prevent soil erosion during big storms, (2) building water tanks to collect rainwater during droughts and (3) diversifying their crops by adding banana and avocados trees to their farms to reduce the risk of single crop failure. Future research would benefit from a more concerted and expert exploration of farmers specific adaptation practices and their reported degrees of success.

Conclusion

Our findings suggest that for Colombian coffee farmers to successfully adapt to climate change, changes must include (1) access to high quality and reliable data/information around climate change to better guide them on adaptive measures and (2) targeted or improved governmental outreach programs providing support (financial and otherwise) *specifically* for long-term climate change challenges that acknowledge the particular realities these farmers face. The ultimate goal for successful climate change adaptation strategy should be a state of convergence, whereby structures support each other and are consistent in their enablement and constraints. The coffee farmers in this study do not currently have convergence; if attained it could create positive cycles of communication whereby differences are negotiated, goals are attained and development accomplished (Nicotera et al., 2010).

Climate change adaptation is a complex, localized phenomenon that must take into consideration both structural sets and human agency. By understanding and accounting for these in a particular population, adaptation strategies can be developed to directly resolve a community's unique challenges by attending to and adjusting structures or agency that community members identify as problematic. Without localized understanding, the potential for successful climate change adaptation for Colombian coffee farmers is uncertain. Adaptation strategies that do not take localized factors into consideration are unlikely to be successful, no matter how firm their scientific grounding.

Note

1. Condition statements (themes that emerged from the data that are represented in Figure 1) are placed in italics for clarity.

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Appendix.

Interviewers were instructed to probe questions that respondents answered with a 'yes' or 'no' by asking, 'Can you explain further?' or 'Why do you feel that way?'

(1) How did you learn to be a farmer?
(2) Are any of your other family members farmers?
(3) Why did you become a coffee farmer?
(4) What are the greatest challenges you face as a coffee farmer?
(5) Does the community appreciate the challenges you face as a farmer?
(6) What is your greatest barrier to solving a problem when it arises on your farm? What factor consistently gets in the way of fixing problems with your coffee?
(7) Do you feel valued and heard by your local policymakers on problems around agriculture?
    (a) If not, what would you like to see change?
    (b) How would you like to be heard?
(8) Is it better to try something new and take a risk, or keep doing it the old way and have a smaller yield?
(9) Have you heard of the term 'climate change?'
    (a) If so, where and when did you first hear about it?
    (b) Who has provided you with information on this topic?
    (c) If so, do you feel like anyone had prepared you for it?
(10) Have you made changes on your farm to adapt to climate change of any kind?
(11) Are there resources that exist for farmers like yourself who are experiencing climate change issues?
(12) Do you think speaking up about problems you face related to climate change makes a difference?
(13) Do you ever talk with others about climate change?
(14) Do you know anyone who is dedicated to communication around climate change?
    (a) If not, do you think there should be someone dedicated to communication around climate change, or is it fine how it is?
(15) Do you ever receive information about climate change through TV, radio, informational pamphlets, etc?
    (a) What did you learn, if anything, about climate change from these information sources?
    (b) Did you apply any of this information to your farming practices?
    (c) Which of these do you use the most frequently to get information and why?
(16) When you want to figure out what the weather will be like tomorrow or later this week, what do you do?
(17) When you have a question about a problem on your farm that you can't figure out, what's your most trusted source of information that you use to resolve it?
(18) Amongst your group of friends who are coffee growers, who is the 'go to' person who generally has all the answers?
(19) Let's imagine a scenario. A group of scientists and experts develop some great adaptation techniques to climate change that would really help you on your farm. How would you like to get the information?
    (a) Who would you actually trust to deliver it?
    (b) What could they do to best help you implement those techniques?
(20) Do you think it's possible to successfully adapt to climate change?
(21) And last, what one change, anything at all, would make your life better as a farmer?