

**Response to reviewer number 2 – NHESS SPECIAL ISSUE Drought, society, and ecosystems
(NHESS/BG/GC/HESS inter-journal SI)**

Dear Dr. Kelly Smith,

Thank you for your thoughtful and constructive comments on our manuscript, as well as for the time and promptness of your review. Your feedback has greatly contributed to improving the clarity of our work, and several of your comments aligned with those from the other reviewer. I apologize for the delay in my response, as I needed some time away from my research before my PhD defense. As the first author, I am now able to fully address your comments below.

Kind Regards,

Louise on behalf of all co-authors.

Comment	Response
<p>Given the interconnected, cascading nature of different types of drought and drought impacts, it is perhaps inevitable that questions arise about how many distinctions is too many and how many is enough.</p> <p>I recommend that the authors add ecological drought to the paragraph on types of drought – lines 53-65 – with a citation to work by Crausbay et al.:</p> <p>Crausbay, S. D., Ramirez, A. R., Carter, S. L., Cross, M. S., Hall, K. R., Bathke, D. J., ... & Sanford, T. (2017). Defining ecological drought for the twenty-first century. <i>Bulletin of the American Meteorological Society</i>, 98(12), 2543-2550. https://doi.org/10.1175/BAMS-D-16-0292.1</p> <p>Also, the statement on lines 53-54 isn't quite right. The different categories of drought relate more to context and discipline, not to characteristics such as duration, extent and intensity. Tsakiris is saying that drought indices that help measure those characteristics can work with each type of drought, not that indices are used to categorize drought.</p> <p>As first mentioned on line 180, grouping "socio-environmental-economic" impacts of drought is quite a large catch-all category.</p> <p>Also, here you are acknowledging environmental (ecological?) drought but it is grouped with socio-economic drought. That group has quite a span. It is possible that the main uniting feature of socio-economic and environmental impacts is that people</p>	<p>As you suggested, we have incorporated the concept of ecological drought into our manuscript. Specifically, we added a discussion of ecological drought in the paragraph on types of drought, citing the work of Crausbay et al. (2017) as you recommended. This addition helps to further emphasize the multidisciplinary nature of drought research and highlights the importance of understanding drought impacts on ecosystems.</p> <p>Now it read as:</p> <p>"Another category, often considered by ecologists, is environmental or ecosystem drought, which refers to a temporary shortfall in water availability that pushes ecosystems beyond their vulnerability limits, disrupts ecosystem services, and triggers feedback loops within both natural and human systems (Crausbay et al., 2017)."</p> <p>We also integrated ecological drought into the discussion section, where we explore the broader implications of our findings.</p> <p>"The focus on environmental drought was to highlight the interconnectedness of natural and human systems (Srivastava and Maity, 2023). The experiences of those directly affected by drought in Northeast Brazil offered powerful insights into the real-world impacts of this phenomenon, revealing that drought extends far beyond water scarcity. While the more visible effects, like reduced crop yields, are often easier to notice and report, the less tangible or indirect impacts on ecosystems frequently go unaddressed. Future studies should aim to bridge this gap by specifically examining ecological drought impacts, and how it affects</p>

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<p>are less likely to recognize and describe them. Please consider splitting environmental impacts from socio-economic, or at least providing a good explanation for why they are grouped that way. I'd consider socio-economic vulnerability to be quite distinct from environmental vulnerability.</p> <p>A group this large and diverse increases the risk that you will miss or oversimplify causal pathways.</p>	<p>biodiversity, allowing for a better understanding of how these impacts are distributed on ecosystems” .</p> <p>Regarding your suggestion to reconsider the grouping of environmental drought impacts with socio-economic drought, we have given this careful thought. While we understand the distinct nature of environmental (or ecological) impacts, we have chosen to maintain the categorization of environmental drought within the broader socio-economic context in this paper. The rationale for this decision lies in the specific impacts we are examining, particularly those related to wildfires. Wildfires are a significant concern that links environmental and human dimensions. Therefore, in the context of our study, these impacts are closely intertwined with human activities, justifying their inclusion in the socio-economic category.</p>
<p>Counting mentions</p> <p>Lines 308-310: You can't conclude that successful policies are responsible for reducing the cascade of impacts based on frequency of mentions. To draw that conclusion you would need quantitative measurements of individual impacts, such as migration or reduced income, not the number of times that those impacts were mentioned in reports. ... Or you would need evidence that the low number of mentions of socio-economic impacts isn't due to the way the data is collected or to what people pay attention to. Typically, tangible impacts such as reduced crop yield are much easier to notice and report than less tangible or less direct impacts.</p>	<p>In response to your feedback, we have revised the relevant section to clarify that while the frequency of mentions provides some insight into the perceived success of policies, it is not sufficient to draw definitive conclusions about their effectiveness.</p> <p>Now read as: The data analysis indicates that socio-environmental-economic impacts have the lowest frequency of reporting, suggesting that public policies may have been effective in alleviating some of the cascade of impacts. However, this should not be generalized to environmental impacts, as farmers and observers might not have reported on the state of ecosystems, including forests, freshwater systems, and water quality in lakes and rivers. Additionally, no specific policies targeting the alleviation of environmental impacts were identified. It's important to acknowledge that the low frequency of reported socio-economic impacts may not necessarily indicate a reduction in these impacts. Instead, it could reflect the way the data was collected or what people chose to focus on. Tangible impacts, such as</p>

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	<p>reduced crop yields, are often easier to notice and report compared to less tangible or indirect impacts like migration or reduced income. Therefore, drawing conclusions about the effectiveness of policies based solely on the frequency of mentions is limited. A more robust analysis would require quantitative measurements of individual impacts or evidence that the low number of mentions is not due to biases in data collection or reporting.</p>
<p>Lines 351-352: Again, be very careful about imputing any meaning to the quantity of hydro-related reports. It may be more relevant to cite the content, something along the lines of “many reports underscored water supply challenges remaining despite the construction of reservoirs.”</p>	<p>Thank you for your comment. We understand the importance of not over-interpreting the quantity of hydro-related reports. Instead, we will emphasize the content of these reports.</p> <p>Now it read as: Many reports emphasize ongoing water supply challenges, indicating that despite the construction of reservoirs, the hydrological drought continues to pose significant challenges in the semiarid region.</p>
<p>Narrative strength</p> <p>But the example from the interview starting on line 310 is good. You could make it stronger by more clearly delineating which experiences were from 1993 and which from 2012-2018. One way would be to add “In contrast” to the start of the sentence that begins on line 316.</p>	<p>Done.</p> <p>In contrast, she mentioned that during the 2012-2018 drought, fish died in the mud, and only one water truck (16 m³) would come per month for 20 families. This scarcity led to conflicts, albeit minor. They received crop insurance, and the impacts were primarily related to water scarcity. Despite the 2012-2018 drought being statistically more severe than the 1993 drought, the support of social programs made the impacts less severe.</p>
<p>Discussion</p> <p>If I am reading this correctly, it suggests that programs such as PAA and PNAE can block the cascade of impacts by giving farmers increased income. This is actually a key point for reducing societal vulnerability to drought – give people enough resources to have options. But it seems as though you may be giving too much weight to counter-arguments on lines 334-343, and/or you</p>	<p>To address your feedback, we have revised the discussion to more clearly articulate the dual role of these programs in both providing immediate relief and contributing to long-term resilience. We’ve also incorporated new citations to support this argument and to reconcile the potentially conflicting views on the effectiveness of these programs.</p>

could do more to reconcile two conflicting views.

I couldn't tell from this article whether the people arguing that assistance doesn't solve the underlying problem believe that is true for all forms of cash transfer programs or for specific programs, or whether they are defining the problem in a way that doesn't separately consider human well-being.

Now it read as follows:

Our research findings indicate that policy responses play a crucial role in alleviating the cascade of drought impacts, leading to variations in the distribution of these impacts depending on the extent of local implementation. The reduction in the frequency and severity of impacts, particularly on livelihoods, reflects the positive effects of development policies in fostering economic dynamism within the region. Programs such as Bolsa Família, Garantia Safra, the Food Acquisition Program (PAA), and the National School Feeding Program (PNAE) have been instrumental in 'breaking' the cascade into socioeconomic impacts by providing crucial financial resources to vulnerable populations, thus giving them the means to cope with drought. Stakeholders, including farmers and observers, noted that recent drought periods (2012–2018) were more manageable compared to the past (80s and 90s) when such governmental programs were absent. Today, droughts no longer result in hunger and mass migration in the rural communities of the Brazilian semi-arid region as they once did. However, it is important to recognize that while these welfare programs have significantly mitigated the immediate impacts of drought, they may have done so more by providing temporary relief rather than by promoting long-term adaptation strategies. This suggests that while the population is better equipped to manage droughts, they are not fully adapted to the phenomenon, highlighting the need for a continued focus on sustainable adaptation measures (Mancal et al., 2016).

However, while these programs have significantly contributed to 'breaking' the cascade of socioeconomic impacts by fostering long-term resilience, their effectiveness is contingent on integration with broader strategies aimed at sustainable development and climate adaptation. This concern is particularly relevant as climate change continues to

	<p>transform the risks faced by individuals and households, potentially exacerbating poverty, inequality, and social instability. Therefore, while the population is better equipped to manage droughts, they are not fully adapted to the phenomenon, highlighting the need for an integrated approach where social protection is aligned with climate policy to strategically contribute to long-term resilience and well-being (Bedran-Martins et al., 2017). Although these programs have succeeded in improving material quality of life and increasing the Human Development Index, they do not fully address the multifaceted nature of vulnerability in the context of climate change. For example, despite the improvements in material conditions, the subjective well-being of households continues to be influenced by factors beyond economic security, such as health status and safety (Costella et al., 2023).</p>
<p>Lines 362-372: This is a good paragraph, pulling out some of the nuance in the data.</p>	<p>Thanks 😊</p>
<p>Lines 373-382: This paragraph acknowledges some of the unresolved complexity, but please consider deleting it. Instead, lean into the excellent narrative accounts that you have collected. As you note beginning on line 395, you don't need artificial intelligence to understand what's happening to people on the ground. You have done a good job of listening to them and giving them a voice.</p>	<p>We have deleted this paragraph and added some comments about the strengthen of the data collected. Thanks for your comments on this.</p> <p>Now it read as: Our study, which leverages data from traditionally low-data environments, highlights the importance of integrating and validating these often-overlooked sources. This approach enriches our understanding of drought dynamics, particularly in vulnerable regions, highlighting how such data can reveal the nuanced impacts of drought on smallholders. These smallholders are among the most vulnerable to climate extremes, and their experiences provide</p>

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	valuable insights into how policy measures can better support long-term resilience.
Line 409: What are natural values?	We recognized that this term could be vague and unclear. To address this, we have revised the sentence to: We also propose implementing policies that enhance ecosystem services, such as soil conservation and water retention through agroforestry practices, to further alleviate residual drought impacts in the semiarid region.
Line 154: On Table 1, the delineation between the period of data collection for drought impacts monitoring data and for field work data is unclear.	Done, the other reviewer also made this comment.
Please review capitalization and punctuation around the use of "e.g."	Done, thanks for noticing it.

FYI: have also included a map, as asked by another reviewer.

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