Reply to Referee 1

We would like to thank you for your constructive comments and feedback on this manuscript. We think that the suggested revisions based on the Referee's comments will certainly improve the article. Please find our responses (in blue) to the main points raised (shown in black) below.

The manuscript deals with the estimation of drought vulnerability for agricultural activities in pre-Alpine climates. The authors propose a so-called "mixed method" approach which consists in taking several vulnerability factors, normalizing them and making a weighted sum of them to derive an empirical vulnerability index. The approach is "mixed" because the choice of the factors and their weighting (in the "expert weighting" method) take into account expert advice (interviews, questionnaires, …). Indeed data availability limits significantly the applicability of the approach, as the experts can recommend factors without taking into account the real availability of datasets for the factors.

→ The identification of factors through experts' interviews contributed to represent the region-specific vulnerability conditions that might not have been possible to identify using a purely top-down approach. We agree that the lack of data to represent some of the identified factors hampered a full description of the potential vulnerability. For this reason, we decided to explicitly refer to the partial availability of data representing both the initially identified and the finally selected factors in Figure 3. By doing so, we were able to answer one of the research questions in our study. This way the study reveals an estimate of potential improvement and therefore pointing to data that should be collected in order to improve other vulnerability studies in the case study.

Overall, the manuscript is well written and methodologically sound. The main issue I see is that the structure of the manuscript needs improvements (in particular the discussion section), as it is not sufficiently concise. An improvement in this sense will increase the potential impact of the manuscript, if published.

→ We appreciate the suggestion and we will revise the discussion section in a more concise way. In particular, we will shorten and restructure the discussion section inverting 5.2 with 5.1. in order to follow the order of the research questions reported at the end of the introduction in the following way:

5.1 Strengths and weaknesses of the mixed method approach (answering RQ1)

5.2 Sensitivity of region-specific vulnerability (answering RQ2)

5.3 Towards adaptation strategies to decrease vulnerability (providing an outlook)

Specific comments

L23-25 - I agree that climate change is an issue. However, I believe that one should always mention uncertainties of the climate projections which are at the basis the IPCC reports and conclusions (see e.g., https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017JD027463, https://nhess.copernicus.org/articles/20/3057/2020/)

→ Thanks for mentioning this point. We will refer to the climate change uncertainty providing peer reviewed articles with reference to the greater alpine and pre-alpine areas.

L204 - Perhaps explain a bit what "political conservative vote" is.

→ We will add an explanation of what the experts meant with this factor.

L224 - the factor "distance to large water bodies" may not take into account the presence of water transfers between the bodies. Is this a relevant issue for the area? Perhaps a comment on this could be added, in that case

→ We acknowledge that other factors can affect agriculture's vulnerability to drought, such as 'water transfers'. However, we only considered factors that were identified, reported and discussed by the involved experts in order to account for their knowledge on factors relevant for the regions. Nevertheless, we will better highlight this assumption in the methodology and the discussion to improve its clarity and transparency within the manuscript.

Sect. 4.1 - The vulnerability factors may be somehow statistically dependent (collinearity). I am thinking, e.g., at soil texture and water holding capacity. A comment on this is desirable. Also, how this can be prevented when involving the experts for suggesting vulnerability factors?

→ In this study, we applied the mixed-method approach letting the experts identify those factors considered as relevant according to their knowledge. By doing so, we considered all the identified factors without introducing any external assumption, e.g. on statistical correlation. This way, we addressed the first research question on the systematic identification of vulnerability factors with the support of the regional experts. Nevertheless, we see the need of mentioning the alternative approach to use statistical tests on correlation in case of quantitative data modeling and analysis and we will specify it in section 5.1 on Strengths and weaknesses of the mixed-method approach.

Sect. 5 - Discussion repeats many concepts already presented in methodology and results sections, and thus must be shortened. An important point that could be more discussed is how the approach/results can be somehow extended to other regions with different climate and socio-economic conditions.

→ Thanks for this point. We will shorten the discussion according to your suggestion. Additionally, we will elaborate a bit further on transferability and application potential to other regions.

Minor points

Equations are in unusual notation: the definition intervals of the variables are mixed with operators. Perhaps separate the two things as commonly done

→ Thank you for pointing this out and we will improve the equation according to your suggestion.