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Reply on RC2

Marthe L. K. Wens et al.

Author comment on "Education, financial aid, and awareness can reduce smallholder farmers' vulnerability to drought under climate change" by Marthe L. K. Wens et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-216-AC3>, 2022

Dear reviewer,

Thank you for acknowledging the complexity of the topic of and your interest in this manuscript. We greatly appreciate your detailed feedback.

To address your first general comment, we would like to clarify the position of this research in the introduction as follows: *"In this study, we apply ADOPT, to test the variation in household drought risk under different drought management policies: (i) a reactive government only providing emergency aid, (ii) a pro-active government, which supports ex-ante cash transfer in the face of droughts and sufficient drought early warnings, and (iii) a prospective government that supports adaptation credit schemes and provides regular drought adaptation extension services to farmers. In addition, ADOPT is used to evaluate drought risk and the robustness of these policies under different climate change scenarios. The design of ADOPT as an agent-based drought risk adaptation model is described in Wens et al., 2020, while Wens et al. 2021 detail the empiric data on pasta adaptive behaviour, used to calibrate the model, as well as empiric data on adaptation intentions that can be used to compare with the model outputs. While ADOPT should be subject to additional validation steps in order to more accurately and precisely predict future drought risk, we elaborate the potential of this proof-of-concept model by showcasing the trends in drought risk under risk reduction and climate change for a case study in semi-arid Kenya"*.

To address your second general comment, regarding section 3, we agree that some more information about the dataset is necessary. The data used to parameterize and partially calibrate ADOPT, are indeed described in detail in Wens et al. 2021. We will add the most important variables from this dataset to the ODD+D and will add the following to the model description in the main manuscript: *"ADOPT was parameterized with information from expert interviews, a farm household survey with 260 households including a semi-structured questionnaire and a discrete choice experiment (a quantitative method to elicit preferences from participants without directly asking them to state their preferred options) executed in the Kitui Region, Kenya (Wens et al. 2021)"*.

To address your third general comment, regarding section 4, we agree that the structure is confusing. We will add subheadings according to your suggestion to improve the clarity. Besides, multiple longer sentences will be identified and improved. We disagree that figure 5,6 and 7 are obsolete. While indeed one message (prospective intervention has the most

promising effect on drought disaster risk reduction) stands out in all three, many other messages (e.g. also climate change does change the adoption rate, average harvest still decreases under proactive intervention; poverty reduction in the proactive scenario is only distinctly different from the reactive one after multiple years) would be lost if we remove these figures. We will improve the figures to align with the journals' specifications and to facilitate reading information about the climate change scenarios.

To address your fourth general comment, regarding section 5, we will add multiple interpretations to the discussion (we intend to significantly rewrite this section) to improve the content. Besides, we will adjust confusing sentences so as to make this section easier to read. With respect to your second remark: similarities with other studies are pointed out repeatedly (e.g. in 5.1: Hartwich et al., 2008a; van Duinen et al., 2016a; Villanueva et al., 2016; Wossen et al., 2013; Enfors & Gordon, 2008; Mango et al., 2009; Mosberg & Eriksen, 2015; Sherwood, 2013 Gebrehiwot & van der Veen, 2015; Holden, 2015; Makoti & Waswa, 2015; Mude et al., 2007; Oluoko-Odingo, 2011; Winsen et al., 2016; Wamari et al., 2007; Aker, 2011; Wossen & Berger, 2015; (Asfaw et al., 2017; Davis et al., 2016; Pople et al., 2021).

To address your fifth general comment, regarding section 6, we will shorten and merge the first two alineas to highlight better the main messages. We will add key results that were missing and avoid long complex sentences to improve clarity of this section.

To address your specific comments, we propose the following:

We will change (non-)governmental into "top down

We agree that inadequate and erratic are human constructs, as are disasters. Because human expectations are not matched, there is a drought disaster. Given this, we think it is best to keep erratic and inadequate.

We will add a map of Africa

We will spell out ODD+D

We will add the following to explain DCE: "*a quantitative method to elicit preferences from participants without directly asking them to state their preferred options*". More details can be found in the cited Wens et al. 2021

We will change L165 to better reflect fig3: "*Under the no change scenario, 25% of the thirty simulated years fall below this threshold. Under the wet scenario, less such droughts occur (15% of the years), but under the dry scenario, the number of drought years more than doubles (54% of the years). Temperature is dominant over precipitation is determining drought conditions, as under the hot-wet scenario, 41% drought years are recorded, and under hot-dry conditions, 78% of the years can be considered drought years.*"

We will rephrase L314 to: "*The diverse climate change scenarios have a distinctly different effect on the evolution of drought risk in the rural communities.*"

We want to note that in AquacropOS, daily biomass growth depends both on temperature and precipitation. Under a hotter and drier climate, the balance between evaporative demand and moisture supply will be different than in scenarios with only hotter or only drier conditions.

L329 discusses the proactive scenario, while L336 discusses the strategic scenario – in the reviewed manuscript this will be called "prospective" to match the terminology of GAR 21 SR on Drought.

Assuming the comment about L178-183 is about L378-383: Wens et al. 2021 shows a data-driven econometric analysis of empiric data, while this manuscript shows a model-implementation based on existing theory. While only the historic behaviour in Wens et al 2021 is used to parameterise the model, the choice model results about potential future adaptation can be used to compare the model outputs (now this is referred to in the

discussion). Besides, while Wens et al 2021 could only make hypotheses about the increase in adoption under policy changes, ADOPT model is able to estimate the effect of this on the drought risk of individual households and communities in terms of poverty, aid needs and food security – and this under different climate scenarios.

We will rewrite the first two paragraphs of the conclusion - merge them into one.

We would like to highlight that the cost of the on-farm individual adaptation measures is taken into account (cost for the farmers themselves, also detailed in Wens et al 2019) – but the cost of the top-down interventions (eg extension services) – thus costs for NGOs or government - is not - and will clarify this in the ODD+D.

In our opinion, ADOPT is a decision support tool that provides insight into the effects of measures on drought risks. The predictive element is not important here, but we did look at the trends in impacts under future conditions which is different than trying to foresee actual impacts in actual future years.

L378 will be rephrased to *"Extension services increase the adoption of low-cost, less popular drought adaptation measures while credit schemes are useful for more expensive but cost-effective drought adaptation measures"*.

We thank you very much for your constructive feedback and are sure that implementing this will greatly improve the manuscript.

Respectfully,
Marthe Wens