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## ***Interactive comment on “Estimated impact of global population growth on future wilderness extent” by E. Dumont***

**E. Dumont**

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Dear Referee #1,

Thank you for very much reviewing my paper. Here are my first responses to your comments:

Referee comment 1: My main objection to this study is that there are no feedback mechanisms included. Especially as listed in section 2, line 9 to 15 many possible feedbacks in the agricultural demand and supply system are not taken into account.

Author response 1: The processes (“feedbacks”) listed in lines 9 to 15 in section 2 are not included because this paper does not aim to model the spatial heterogeneity of wilderness (as explained two lines earlier).

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Referee comment 2: No attention has been given towards the possibility of restoration.

Author response 2: The reason is that land degradation is not considered fully (Eq. 2 considers only a portion of the effect of land degradation on wilderness). Probably the unmodelled land degradation is larger than the actual restoration of degraded land (making the model estimate of wilderness loss a conservative one). Further, it may be very difficult or impossible to reliably estimate the possibility of future restoration of degraded land.

Referee comment 3: I would like to see a map of all 4 categories as listed in section in section 2, line5-6.

Author response 3: This paper does not aim to model the spatial heterogeneity of wilderness (see lines 7 to 8 on page 436).

Referee comment 4: Arguing that birth control and education are the only answers for policy makers is far too simple.

Author response 4: I have not argued this in the paper. The paper indicates that improved access to contraception and improved education can be effective measures. However, this does not suggest that other measures are not important.

Referee comment 5: Integrated Assessments Models have been developed to take all possible factors and feedback mechanisms into account to answer these questions.

Author response 5: I do not think that considering more “factors and feedback mechanisms” necessarily improves a model, because it can make the uncertainties in the model more unclear. Further, integrated assessment models are often too large for others to reproduce or fully understand.

Referee comment 6: Section 2.3.1, line23-25. What about the decrease in agricultural areas during the past decades in North America, Japan and Europe ? It's surely not only in Asia, as the text suggests.

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Author response 6: This is not what the text suggests. Lines 23-25 in section 2.3.1 state that the decrease in agricultural area mainly (but not exclusively) occurs in south, east, and central Asia.

Referee comment 7: Section 2.3.1, line 25-27, Expansion is also very much still possible in Africa, not only in Latin America!

Author response 7: The text does not contradict this. Lines 25-27 in section 2.3.1 state that expansion is especially (but not exclusively) possible in the Americas.

Referee comment 8: I do not understand this argument that caloric intake per capita has not increased since 2000.

Author response 8: This is not written in the paper. The paper states that the rate of increase in caloric intake per capita has not increased since 2000 (lines 1-2, page 440).

Referee comment 9: Section 2.3.1., line 7-10. The argument that climate change is not included in the calculation because the impacts of climate change can't be reliably estimated is a weak one. Surely, there are still many uncertainties, but many crop models can fairly accurately predict possible climate effects on crop yields. Many studies exist in this field.

Author response 9: For the aim of this paper mainly the global average agricultural productivity is important. However, crop models do not seem to agree on whether the global average agricultural productivity will increase or decrease. I acknowledge that many crop models can fairly accurately predict possible climate effects on regional crop yields. But they do not seem to agree on the global average picture.

Referee comment 10: Extrapolation of past (agricultural) efficiencies towards the future is dangerous. Very few people can tell what effect new technology can have on future yields, whether it is for food or biofuels. Currently, much of the debate on biofuels is whether this is a good and wise thing to do with the available land (apart from the

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discussion whether it would lead to extra emissions, use of fertilizer, pollution, etc), rather then we are going to do so, no matter what the demand for food is. I'll be very careful with this.

Author response 10: I agree that the effect of new technology and future policy (e.g. regarding biofuels) on future yields is very uncertain. And I agree that this makes any estimate of future agricultural efficiency uncertain (including the estimate made in this paper).

Referee comment 11: Section 2.3.2, first paragraph. "People require" is different than "people are going to get" a certain amount of land for housing, etc.

Author response 11: Yes. This paper does not contradict this.

Referee comment 12: It's a rather poor argument just using one study for Boston, and applying that for the whole world.

Author response 12: No, the paper also describes simulations using a value derived from GAEZ (2000) and compares this to the simulations using the value from the "study for Boston" (simulations 1 and 2 versus simulations 3 and 4).

Referee comment 13: I suggest the author have a look at Potere and Schneider (2007) who complied an overview on global datasets on built-up area.

Author response 13: I was aware of this publication. However I discarded most of the datasets described by Potere and Schneider (2007) because what most of these datasets classify as built-up area does not include all land cover types encompassed by "non-agricultural managed land" in my paper.

Referee comment 14: When you compute the current ratio of built-up area per capita for the year 2000 it indeed yields around 700 m<sup>2</sup>/capita, but this changes really fast over time. In 1950 it was almost 80 m<sup>2</sup>/cap and in 2050 it could be 132 m<sup>2</sup>/cap (based on the RCP scenarios, (van Vuuren et al., 2011)). So keeping that value constant seems to be not correct.

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Author response 14: I agree that the area of non-agricultural managed land per person could increase significantly in the future. Therefore the estimates of wilderness loss in my paper can be considered conservative. Perhaps it would have been better if I would have also simulated the effect of such a possible increase non-agricultural managed land per person. How exactly did the referee derive his/her values of 80 and 132 m<sup>2</sup>/cap from RCP scenarios?

I hope that the referee is satisfied with my responses. If there is still something unclear then I would be happy to provide additional information.

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Interactive comment on *Earth Syst. Dynam. Discuss.*, 3, 433, 2012.

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