

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

**Anonymous Referee #2**

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The paper addresses a very interesting topic that many are struggling with: the impact of future demands on biodiversity and wilderness areas. Excellent work on the extent of human influence has been published by Ellis and colleagues and many others before. However, given the large uncertainties, especially in future projections new studies are more than welcome.

However, I have some major problems with the current study. land use - population relationships have been a long topic of discussion in land science, including the famous work of Malthus, Boserup, Turner II on the role of population on agricultural intensification. More recently lots of economic modelling, esp general equilibrium models have been used to endogenously or exogenously make decisions on the expansion vs intensification of agricultural land use under growing demands for agricultural pro-

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duction by a growing population. The paper ignores all this history and literature and neither makes explicit mentioning of changes in land use management intensity upon declining land resources. Rather, it extrapolates directly population - land area relationships by linear relations from historic data. This is largely insufficient and much literature has been published on the role of technological change as well as induced intensification upon economic and demographic change. This is completely ignored. Therefore the paper appears to have been written largely in isolation, not taking stock of the progress made in this field as is usual in scientific practice. In the abstract and conclusion sector large claims on future wilderness and species extinction are made which are not justified by the rough assumptions of the study. Moreover, only the uncertainty/sensitivity towards birth rates is mentioned ignoring all the other sources of uncertainty (technological change / intensification of management / feedbacks on food demand / biofuels / diet change etc) that are at least as large. Also, a comparison with other research addressing similar topics (e.g. the GLOBIO assessment of PBL <http://www.globio.info/assessments-with-globio/global-regional-assessments>) is lacking. To me it seems that these assessments are, although also suffering from limitations, a lot more sophisticated and the current paper has little to add.

page 435: 'wilderness not essential for human population': this ignores the whole discussion about ecosystem services and the wide body of literature on this 436: no distinction of world regions is a big problem, the whole impact of spatial spill-overs, tele-coupling, indirect land use change/ forest transitions is thus ignored while it has large influences on the population-wilderness relationships and the distribution of impact. The provided rationale of uncertainty is insufficient as this even more applies at the global level. 436:the method introduces 4 types of wilderness. These are not clearly defined and from the title they seem to be overlapping section 2.3: how does this estimate relate to earlier wilderness estimates based on RS data or the global wilderness map? what definition of wilderness is used? it seems inconsistent as only agricultural land is excluded (so all kinds of disturbed, logged, secondary re-growth is included) while later on it is assumed that wilderness cannot be restored and thus ignores the

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whole forest transition issue that contributes to more continuous wilderness areas etc. 439: although earlier projections as mentioned in Smith 2010 are re-called they are further ignored and replaced with a much more crude method than earlier work with the argument of new data. I am sure that ignoring everything that is taken into account in the earlier work is much worse than the newer data used. Moreover, 'new' only means probably one more year in the faostat data series which is not so impressive... 439/440: faostat reports harvested areas with largely deviate from remote sensing based land cover areas due to data issues (see Fritz et al ERL paper); fallow land issues (Siebert paper) and other factors (see Verburg GCB paper). So wilderness cannot simply be based on FAO data ignoring the full land cover site, think about pastoral systems etc. 440: statement in first lines unclear: how does calorie intake relate to biofuels

the whole procedure of extrapolation is strange. the area-population relationship ignores important trend shifts due to dietary change, economic change, biofuel revolution etc. Although biofuels are mentioned they are not incorporated while so much literature is available. If land is getting less abundant intensification is likely to happen faster as is common with resource constraint production. this notion is completely ignored

442: it is not proper to use a us 1967 estimate of non-ag land use per person while the world has changes since then and certainly the us 1960 patterns are still not representative for world average as is claimed and not substantiated. A more thorough analysis is possible and needed. 441: nice to see that irrigation sensitivity is assessed, however, the author ignores that there is large potential to extent irrigation compensating for nonrenewable irrigation areas.

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