

Review of MS 1330 (January 7, 2015)

Title of paper: "Integration of biophysical and agro-economic models to assess the economic effects of climate change on agriculture: A review of global and EU regional approaches."

by Francisco Fernández, Technical University of Madrid and Maria Blanco, Technical University of Madrid., which was submitted on October 28, 2014

Summary of main strengths and weaknesses of the paper

Strengths

- A review of this kind, aiming at an examination of integrated assessment (biophysical and agro-economic) and modelling of (economic) impacts of climate change on agriculture at global and EU regional level has not yet been attempted to my knowledge.
- A review with such objectives would be timely and could fill some research gaps e.g. issues and questions raised by Wheeler & van Braun (2013) and, more recently, again in IPCC AR5 by Porter et al. (2014), emphasizing that most CC impact assessments for agriculture are not up to the task or do not address key challenges; in particular, the methodologies applied to assess climate change risk to food production and food security often do not go beyond biophysical impact modelling; they thus mainly deal with the food supply dimension – while other dimensions such as access to food, stability and food utilization are mostly neglected.
- The review in its current form addresses some of these issues and contributes to providing some better understanding on how integrated (biophysical and economic) analysis of climate change impact assessment methodology and modelling at global and regional levels evolved since the early 1990s - whereby surprisingly early developments receive more attention/are more comprehensively described than the more recent developments.

Weaknesses

- Yet, while there are some merits of the review as mentioned above, in its current form it is incomplete and not well balanced (superficial in places; lengthy in others): most importantly, it is not fully up-to-date; comprising 32 pages, the review is quite long and would benefit from substantially cutting parts, e.g. those describing early developments – while some additions on developments during recent 5 years would be needed; a revised structure making it easier for readers to navigate through different methods, stages of development and scales of analysis would also be beneficial (for example, when in section 5, a summary is made, the six categories of methods presented (also illustrated in Fig 1, page 5) do not match with the structure/sections followed in the review text)

- The qualification “not fully up-to-date” especially applies to EU regional assessments (see also other bullet, below); this becomes obvious if one goes through other reviews that look at developments in CC impacts assessments for agriculture during last 20 years – be it for agricultural impacts for certain EU countries or certain crops at EU level (e.g. Wolf et al., 2012; Höhn and Rötter. 2014), or, how crop modelling has served integrated impact assessment of agriculture over time from farm to global levels (Ewert et al., 2014)
- Authors claim that in assessing economic effects of climate change on agriculture, many studies (during last two decades) have relied on the integration of biophysical and agro-economic models; yet, authors fail to explain how they define “model integration”. If one goes through the agricultural impact literature since IPCC WGII, SAR (Second Assessment Report - published in 1996), one finds that in most cases results from biophysical modelling have been integrated with different kinds of economic analysis (not always economic modelling); only in a small fraction of studies have crop models and economic models actually been (physically) integrated. And this situation only is gradually changing in recent years: when looking at agricultural impact studies quoted in the recent IPCC assessment report (AR5) of working group II (see, Porter et al., 2014) most still entirely rely on biophysical modelling – for underlying reasons (i.e. CC effects that can easily be investigated /lack of appropriate methodologies (Wheeler & von Braun, 2013)), see also the recent review by Ewert et al. (2014) on the contribution of crop modelling to integrated assessment and modelling (IAM) of risk to food production from climate change. That review especially examines to what extent crop models comply with IAM demands. This situation also holds true for the farm level (see, van Wijk et al 2014).
- Furthermore, I have my doubts whether in the context of climate change impact modelling, it is useful to speak of a “bio-economic approach” that has gone through different stages (see, also comments by van Wijk et al 2012 on this issue). To my knowledge, “bio-economic modelling” has been a rather *ad hoc* formulation invented by development economists and agro-ecologists from Wageningen when applying the multiple goal linear programming (MGLP) approach at farm and (sub-)regional levels to explore options for sustainable land use, i.e. achievement of different agricultural development goals and their trade-offs (see, e.g. de Wit et al. 1988. *Agricultural Systems* 26, 211-230; Kruseman & Bade, 1998. *Agricultural Systems* 58, 465-481); the meantime the label “bio-economic” has got quite different meanings
- Another claim of the authors is that the review analyses the evolution of the “bio-economic approach”, both at global and EU level; I disagree – unfortunately, the review is quite selective and biased; for example, for the EU level just a few studies are discussed, while a multitude of studies from large European research consortia or networks (e.g. SEAMLESS, SENSOR) (see, van Ittersum et al 2008) have not been mentioned that have developed fully integrated modelling approaches – subsequently applied to CC impact assessment (e.g. Wolf et al 2012).
- Even though the review is restricted to the global and EU regional level, it would have been worthwhile to mention an important recent publication that applies so-called “bio-

economic” modelling approaches with focus on climate change adaptation and mitigation at farm household level (van Wijk et al. 2012; 2014).

- Surprisingly, recent progress in terms of IAM in research networks like AgMIP, MACSUR and CCAFS are not or not explicitly mentioned
- Then, throughout the text there are claims that are not true – e.g., to name a few, that the two EU studies presented (Ciscar 2009; Shresta et al. 2013) (pp. 12-14) are the first integrated assessment studies on EU agriculture, or, that over last two years most impact assessments base their results on new scenarios and are focused on quantification of uncertainty – actually, only few studies already used the “new scenarios (RCPs, SSPs, etc) and while uncertainty finally has received (more) attention, it is not the main focus of recent studies.
- Some of conclusions /common findings (section 5) are trivial or not supported by this review.

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