

## Review report on ms #10.5194/HESS-2020-338

The manuscript titled "Global scenarios of irrigation water use for bioenergy production : a systematic review" summarizes recent literature on global water requirements for irrigation of bioenergy production (BP). Using a systematic review approach, the authors have searched, identified, extracted and analysed recent studies that report estimates of global water demand for irrigation of BP. They found that water use for BP is wide ranging and that this water use is of same order of magnitude as water use for other sectors of the global economy (agriculture, industries, households). They examined the cause of variation in estimates of global water use across studies and highlighted the minimum set of parameters and assumptions that should be included in future studies to allow consistency in estimates and straightforward comparison of estimates of global water use across studies. Overall the manuscript itself is interesting and the topic is timely giving the relatively few studies on global water use of bioenergy with carbon capture and sequestration (BECCS) as well as on global water use of negative emission technologies (NETs). However, they are issues that need to be addressed before the manuscript can become a valuable contribution to the current literature. The manuscript also requires a thorough English grammar check/edit to improve the readability. I have corrected few sentences but there are many more to check and correct.

### General comments

In general I think the methodology section to be improved. It is not clear to this reviewer how grey papers/reports were obtained and what were the inclusion and exclusion criteria used to include/exclude a study in/from the analysis. For example, marine biomass also consumes water (like terrestrial crops), and some of these biomass types may be cultivated in farm ponds. I am puzzled why marine biomass feedstock was excluded from the review? Are they excluded because they consume less water? or because there is not algae/marine biomass based BECCs? Could author state in the methodology their inclusion and exclusion criteria?

Could authors also provide rationale for including review studies in their analysis. Often review studies are excluded from systematic review or meta-analysis studies.

How was the grey literature obtained? In the methods section, authors state that they manually added the study of Hejazi et al. 2014 which could not be obtained using search queries. I therefore wonder how does grey literature was obtained? by contacting authors of these articles/reports?

The section 3.1 (overview) could be improved significantly by for example making a graph showing the global distribution of the studies reviewed (how many studies originate from EU? USA? Japan/China? etc), How many focus on BECCs and how many deal with NETs? How many consider the whole supply chain (from biomass production to conversion to energy with carbon storage) and how many treat only a segment/Stage of the supply chain (e.g. biomass production only, biomass conversion only, carbon capture and storage only etc). How many include green, blue and grey water? green+blue? Blue+grey? green+grey? how many consider only green/only Blue or only grey water? How many studies use numerical simulation models? how many use other types of models?

Authors state in the conclusion section that there is a lack of clear relationship between water requirement and total BP. After reading this manuscript I wonder if this lack of clear relationship between water requirement and total bioenergy production is not due to the fact that the downstream process of biomass conversion are also included in the analysis. Could authors check if there will be a relationship between water requirements and total BP, when downstream processes/stages are excluded (i.e.; limiting the analysis to energy crops production only).

### Specific comments

Line 127 : Some of the studies included in the analysis were out of the scope of this review, but the authors still maintain them in their analysis. Why not simply use these studies to substantiate the discussion section? It would be important to clearly state in the methodology section what were the inclusion and the exclusion criteria.

Line 140 : I think this statement is not complete. Please complete this statement by adding "Berndes (2002) combines bioenergy demand scenario and projection based on measured evapotranspiration fluxes to compute global blue/green water demand for BP"

Line 146 : Please consider rephrasing, it is not clear as it is now. Perhaps "supply driven studies" rather than "potential studies"

I found that some of the sentences/description in section 3.2 actually fit in section 3.1. Please consider moving these sentences/description into section 3.1.

It would be nice if section 3.2 is restricted to the explanation of the cause of variation in the estimates of water use in the reviewed studies (difference in model used, difference in model structure, difference in model parameters, inputs data, difference in assumptions used). Which of the models is actually better suited for analysis of water use of a given stage/process of the BECCs/NETs supply chains? which model is better suited for assessment of water use of carbon capture and sequestration only? Do integrated assessment models (IAM) capture well the water use process than other models? Please discuss also here the strengths and weaknesses of the model used (A table would be better).

Line 167-169. Why mentioning this model here (ESM models) if they were not used in the reviewed studies?

Line 155, please insert 'by' between 'demand' and 'comparing' in this line, so as to read "...water demand by comparing rainfed and irrigated BPs...."

Line 177, please consider rewriting this statement, it does not read well as is now

Line 211. Rephrase to state that 'Among the reviewed studies, only two consider 1G bioenergy plants as feedstocks' or 'Only two of the reviewed studies consider 1G bioenergy crops'

Line 214 Please rephrase to state that 'some studies assume change in biomass productivity over the 21<sup>st</sup> century'

Line 215 Please rephrase to state that 'This increase in productivity might, however be difficult to reach in the case of 2G crops because the whole aboveground biomass is used for bioenergy'. I also think that the argument here that productivity is difficult to increase in the case of 2G energy crops because the whole plant is use dis weak. There are several studies showing increase in productivity (via genetic improvment) of 2G energy crops

Line 218 : Here and in many other place in this manuscript. It is not clear to me what the authors mean by "demand studies". Do you actually mean "demand driven" studies or "demand driven case studies", please consider rewriting because it is not clear.

Line 228 : I think these are not losses, but the efficiency of the CCS technology adopted. Losses are only 10-15% (say this efficiency range represent that of the CSS solely, and not the supply chain carbon efficiency which can be much lower)

Line 240 This statement in this line does not read well. Do you actually mean "The projections of future freshwater requirements (125-11350 km<sup>3</sup>/year) for irrigation of BPs vary substantially across the reviewed studies due to the differences in model structures, the scenarios, as well as the methodologies adopted". I also think that variation in projection of future water requirements for BPs might be also due to data input and study goal; please add this in the line 240.

Line 244, please replace "by" with "in" to state that scenario in Hejazi et al. (2014) and food first (FF) in Jans et al. 2018

Line 248. Please repharse to state that "Assuming water use efficiencies of 585 m<sup>3</sup>/ton for miscanthus Hu et al. Project water requirements of the RCP2.6 to be up to 11350 km<sup>3</sup>/yr consisten with estimate of Hajazi et al. 2014

Line 250-254. This sentence is too long and does not read well. Please consider shortening and rephrasing it. Line 254 and also Line 281, not clear to me what authors mean by primary bioenergy. Do you actually mean energy crops ?

Line 258 : Please replace 'large span' by 'large range'

Line 263 Rephrase to state that " all exisiting croplands in 2005 is assumed to be replaced/converted by/to irrigated plantation for BPs"

Line 273 change in tense from present to past tense, this lead to mix tense within the manuscript. Please consider choosing one tense and stick to it throughout the manuscript. Having the paper edited by a professional native english speaker will significantly improve the readability of this manuscript.

Line 320 : Does the reported range here correspond to the total water use for the other sector or it just represent the range of each of the sector (agriculture, industrie, households) gathered from different literature source ? Please clarify.

Line 325 : Authors suggest/recommend that all the scenario parameters be reported in the plucation to enable straightforward interpretation and comparison of results. I wonder if such could be possible given that studies are designed to serve different purposes (e.g . some studies may only focus on a specific stage/segment of the whole BP supply chain such as CCS process). This said, I think i twill be good that authors track the parameters and assumptions that contribute most to the global water requirement of BPs, then make recommendation for future studies to include most if not all of these parameters/assumptions to allow consistency and comparison among studies.

Line 326 : Here the authors suggest a set of parameter that should be included in future studies to allow consistency and comparison of estimates of different studies. However, this recommendation is not convincing (at least to me), not based on solid evidence from the reviewed studies. Indeed the manuscript lacks a breakdown of contribution of the different paramter/process or stage contributing most to global water use of BPs. What is for example the contribution of plantation locations and crops species to the total water use of BPs ? Such breakean will show process/stage having significant influence on estimates of global water use.

Line 338. This (i.e ; biodiversity) has not be discussed in the manuscript. I suggest to remove this in the conclusion of this manuscript

Line 345. Please rephrase to state that "integrated assessments that consider all water use sector are highly desirable and are crucial to get a better understanding of the limits and options of the future water use consumption.