EUCALC

Explore sustainable European futures

Expert consultation workshop on the biodiversity and water impacts of biomass provision for food, feed, energy and materials in the EUCalc

D 4.3

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Main authors	Warren, Rachel, Price, Jeff, Baudry, Gino, Mwabonje, Onesmus, Rankovic, Ana,Kelly, Garret Patrick, and Bouchet, Alexandre
Partner in charge	University of East Anglia, Imperial College London
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Short Description

This report summarises the discussions and conclusions from the expert consultation workshop on the biodiversity and water impacts of biomass provision for food, feed, energy and materials within the framework of the EUCalc project. It covers the presentations given at the event by the organisers as well as feedback and recommendations provided by participants on the modelling approach, key assumptions and features of the water and biodiversity impacts modelled in the EUCalc tool. The workshop was held in London on 19th and 20th September 2018. For biodiversity, the final consensus was to maintain the lever levels as proposed but to look at adding sub-levers separating preservation from restoration. Furthermore, there was a recognition that there will be largely unquantifiable benefits to biodiversity from lever settings in other work packages. We have proposed a way forward to potentially capture this issue. For water, there was a strong recommendation to enable the model to flag users when water related constraints are exceeded, and that ideally water should have its own lever. We were encouraged to consider if possible levers for sustainable water abstraction, water quality and water use efficiency.

Aspects of the workshop related to land, land use and carbon stock dynamics (LULUCF), biomass provision (food, energy, materials) & minerals are covered in a separate report, the interlinked Deliverable 4.2.This report, Deliverable 4.3, should therefore be read with a view of the Deliverable 4.2.

Quality check	
Name of reviewer	**Date**
Luis Costa, PIK	05.12.2018
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Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

EUCalc policy of personal data protection in regard to the workshop

EUCalc defined the procedures in order to reply to ethical requirements in Deliverable 12.1 (Ethics requirements – procedures and criteria to identify research participants in EUCalc – H – Requirements No. 1). All procedures in relation to the co-design process, in particular the stakeholder mapping, the implementation of the workshops and the follow-up of the workshops, follow these procedures. The informed consent procedure in relation to the workshops is based on D9.2 "Stakeholder mapping" and D9.4 "Method for implementation of EUCalc co-design process". The originals of the signed consent forms are stored at the coordinators' premises without possibility of access of externals. Scans of the informed consent forms are stored on the internal EUCalc file storing system

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Glossary

Blue Carbon – carbon sequestration through marine and near-shore land use management (mangroves, sea grasses and saltwater meadows/estuaries)

CORDEX - Coordinated Regional Climate Downscaling Experiment

GHG – Greenhouse gas emissions

Green Carbon – carbon sequestration through terrestrial land use management (e.g., afforestation, reforestation, soil management)

LULUCF - land, land use change and forestry

RoW – Rest of the World

WFD – Water Framework Directive

1 Executive Summary

The representation of water and biodiversity within EUCalc was discussed at an expert engagement workshop held at Imperial College, London in September 2018. It was attended by delegates from a range of institutions representing the interests of both governmental and non-governmental organisations, business and academia. They provided input on the design and inclusion of levers relating to water and biodiversity.

Key pieces of advice received were (1) not to be able to position the biodiversity lever so as to allow the level of biodiversity to 'backslide' below current levels of protection; (2) general support for the proposed biodiversity lever based on the Convention of Biological Diversity stated 2020 (Aichi) targets; (3) to account for the important interactions between water use, land use change and climate change by allowing appropriate combinations of lever positions which result in breach of a water resource constraint to, at a minimum, be flagged to the user.

It is recognized that both water and biodiversity will need tabs within the EUCalc framework to provide warnings/additional information to users that lever settings may lead to negative (or potentially positive) additional impacts. A proposed dashboard mechanism has been developed to deal with this potentiality.

2 Introduction

The EUCalc project will create a state-of-the-art public policy climate change model for analysing trade-offs and pathways towards a sustainable and low-carbon European future in the timeframe of 2030-2050 and beyond. Its mission is to provide decision makers with an accessible modelling solution to quantify the sectorial energy demand, greenhouse gas (GHG) emissions trajectories and social implications of lifestyles and energy technology choices in Europe. EUCalc also aims to enable users with the means to explore a very broad range of multiple possible low-carbon transformation pathways for Europe by 2050 and beyond.[1]

The EUCalc addresses multi-dimensional and inter-disciplinary issues, which require a wide range of expertise to develop the tool. Decision-support tools are increasingly being shaped by highly disciplinary and technically deep scientific debates combined with inputs from a representative cross-section of experts, especially transdisciplinary ones. In that spirit, the EUCalc embeds a co-design process with stakeholders who are leading experts in their field, organised through a series of workshops, one for each main module (see Figure 1). Through this process, experts are involved in a co-design process, in order to shape and calibrate the EUCalc tool by helping co-design the determinants and the scope of the scenarios.

[1] For more information, please see http://www.european-calculator.eu/.

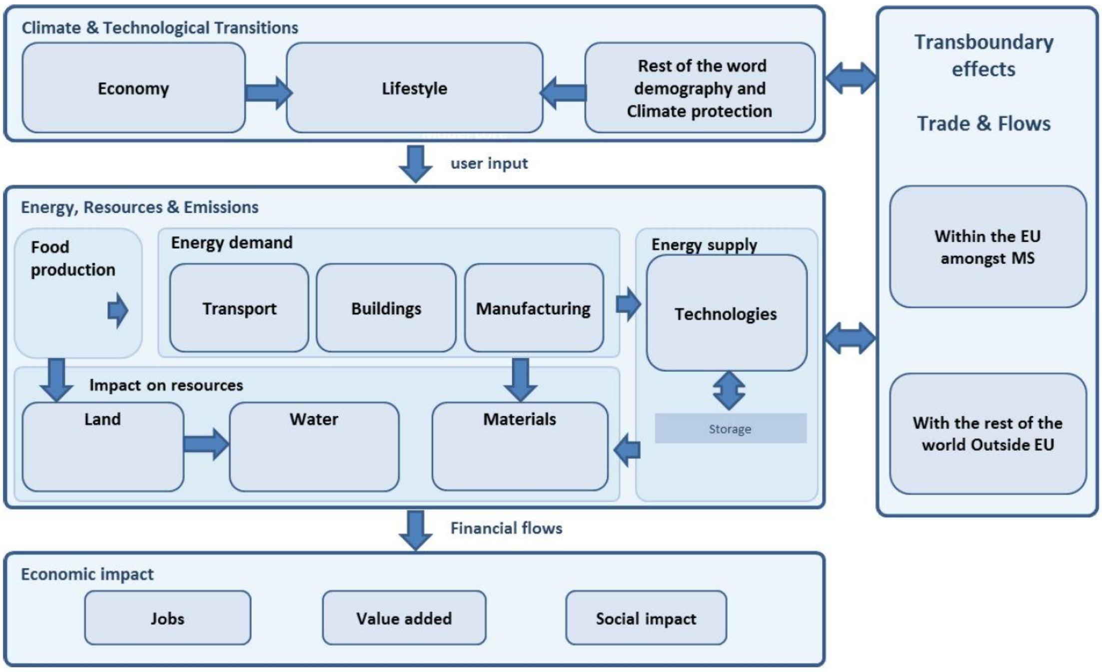

Figure 1 – Overview of the EUCalc structure and modules integration

Imperial College London, is leading the Land use, Water and Biodiversity aspects of the EUCalc project in collaboration with University of East Anglia (UEA), PIK-Potsdam, Climact, T6ECO, TU Delft, SEE Change Net and Climate Media Factory.

Within the EUCalc, land use, water and biodiversity impacts are computed based on the lifestyle patterns and potential policy frameworks from now to 2050. These lifestyle patterns affect the demand for specified food types (e.g., bovine meat, cereals, wine), for transportation by mode (e.g., demand for cars, public transport), for buildings (e.g., area per capita, heating demand, and for manufactured products (i.e., those products resulting in a demand for steel, wood, and so on). Figure 1 shows the integration among the main sectors modelled in the Calculator. Biodiversity functions as a constraint on land uses for other purposes, especially food and timber.

The EUCalc expert engagement workshop was held on 19th and 20th September 2018 at the Imperial College London. The workshop was devoted to discussing the land, water & biodiversity module of the EUCalc in order to gain input from the leading experts from these sectors. The workshop results - related to water and biodiversity aspects - are presented in this report as Deliverable 4.3. Aspects related to land, land use change and forestry (LULUCF) and their relationship with carbon flux, biomass provision (food, energy, materials) & minerals are covers in a separate report, the Deliverable 4.2. The two deliverables are highly interlinked.

2.1 Objectives of the expert consultation workshop

The objective of this facilitated workshop was to introduce the philosophy of the EUCalc tool and to present preliminary results and assumptions, based on a literature review ,of the modeling work to a cross-section of experts. The workshop provided a venue for experts to validate and/or to critically examine the underlying methodology, the levers/ambition levels within the land-use, water and biodiversity modules. The results of the workshop presented in this document, Deliverable 4.3, relate to water and biodiversity aspects of the EUCalc.

The questions that the workshop aimed to address were:

- To what extent should consideration of global biodiversity be taken into account in the calculator - either through supply chain, land competition or from climate change perspective? Are there other ways of capturing impacts on natural capital and ecosystem services in the Rest of the World (RoW)?
- Should water be included as a lever in the model? What parameters that could be used to develop this lever, alongside the levels of ambition that could be used?
- The discussion was then taken forward further to consider, where applicable, if the proposed selection of levers is appropriate and are the levels defined adequate?

2.2 Identification and selection of expert stakeholders

The expert selection process for key stakeholders to participate in the co-design process - was structured in such a way as to ensure a balanced range of respected expertise and scientific input concerning the critical aspects of the water and biodiversity modules (see Section 3.3).

The workshop organizing team mapped and sent invitations to a total of 184 experts, from civil society, academia, public and private sector with relevant expert background and experience to critic whilst providing evidence based quantitative input regarding the future of land use, water and biodiversity in Europe. Invited experts come from all over Europe and represent expertise from various land-use and biodiversity settings. Participant list is annexed to this report (Section 6.1).

The experts were invited specifically to attend the workshop, but also - in case not available - to take part in subsequent exchange planned under the EUCalc's Call for Evidence online consultation process.

2.3 Facilitation and structure of workshop

The workshop was professionally designed and facilitated with three distinct components, namely:

- Introduction of the EUCalc project in a plenary scene setting, supported by a keynote speaker;
- Presentation of the EUCalc model and the specific components of the land use, water and biodiversity modules;
- Break-out group discussions in which experts reviewed and reported back on key questions and topics.

The logical flow of the workshop meant that the process proceeded from the general big picture scene setting elements, through a demonstration of the EUCalc tool - using the

Global Calculator as a proxy - and a detailed description of the particular elements of the water and biodiversity components of the module and their specific issues. This was then followed by structured and facilitated breakout sessions, which allowed for detailed discussion and review of both pre key questions and any new questions emerging during the groups discussions (see the workshop program in Section 6.2).

The workshop followed a "top down" process, covering three levels of depth and complexity. Day 1 focused on the definition and identification of levers (depth 1) and practices (depth 2). Day 2 focused on the definition of the ambition levels (depth 3). Table 1 illustrates the definition of the three levels that were investigated, using biodiversity as an example.

Table 1 – Overview of the workshop process

Day 1		**Day 2**
Levers *Depth 1*	**Practices** *Depth 2*	**Ambition levels** *Depth 3*
Identify the relevant determinants to mitigate GHG emissions	Identify the practices or actions (if relevant)	Define the potential by 2050 through 4 ambition levels for each practice
E.g. Biodiversity	E.g. Preservation of land important for biodiversity.	E.g. 50% of the land is set aside for biodiversity by 2050 as a level 4

To support small-group discussions, the workshop engaged the assistance of designated rapporteurs made up of members of the consortium, as well as researchers and students from ICL. Small-group discussions used a world café style approach[2], facilitated by the rapporteurs. Participants self-organized into groups and rotated through six stations, of which two related to water and biodiversity in particular. Discussions at each station aimed to cross-examine reasoning and to provide evidence and quantitative input subsequent plenary sessions created a space for aggregation of provided estimates and judgments.

The keynote speakers served three distinct purposes: a) to set the overall context through description of future-oriented, inspirational, best practices; b) to attract potential invitees due to the reputation and profile of the speaker; and c) given their high profile, to help with the social media profile of the EUCalc by linking the speaker to the EUCalc tweeter account (#EUCalc). However, these keynote speakers were not necessarily expected to give critical scientific input to the workshop and the development of the specific modules.

[2] A World Café or Knowledge Café is a structured conversational process for knowledge sharing in which groups of people discuss a topic at several tables, with individuals switching tables periodically and getting introduced to the previous discussion at their new table by a "table host".

3 Workshop description

3.1 Setting the scene

The expert consultation workshop was opened with a welcome address by Jeremy Woods of the Imperial College London, which he followed by giving an overview presentation on the EUCalc project. In his presentation, he outlined the logic of the Calculator approach and how it allows future users to interactively navigate and visualize the results of each selected scenario in real-time. Garret Patrick Kelly of the SEE Change addressed the experts highlighting the role and importance of the co-design process for the EUCalc development. Their presentations were followed by a motivational speech by Tom Heap, the invited keynote speaker, a BBC rural affairs, environment and science reporter.

In their opening address on Day 2, Onesmus Mwabonje from the Imperial College London and Jeff Price of the University of East Anglia provided a summary of key takeaways from the previous day. This was followed by presentations of prof. Ad de Roo from Joint Research Center of the European Commission and Keith Kline from ORNIL (Oak Ridge National Laboratory, US).

3.1.1 Contributions from invited speakers

The workshop benefited from plenary speakers from a wide range of backgrounds. Table 2 lists them together with their contributions.

Table 2 – Speaker contributions

Speaker name	Organisation	Content
Tom Heap	**Journalist, UK**	The agricultural bill in the UK, and how it identified a number of issues such as the need for higher biodiversity and better water use. For further details, see D 4.2
Professor Ad de Roo	**Joint Research Centre (JRC, Italy)**	Provided an update of the latest work at JRC on water resources modelling in Europe, the development of which started in nineties. It began as a flood simulation and flood prediction model and has been modified, extended and made better over the years. For further details, see Annex 5.3.
Keith Klein	**Oak Ridge National Laboratory (ORNL, USA)**	Highlighted the need to challenge some of the conventionally held assumptions about land use and biodiversity and instead deploy science-based approaches and causal analysis to better understand relationships among drivers of land use change. For further details, see D 4.2

3.2 Description of the land use, water and biodiversity module of the EUCalc

Gino Baudry introduced the land use, water and biodiversity modules of the EUCalc from the Imperial College, London, providing an overview of the modeling approach and illustrating levers, practices and ambition levels[3]considered in the Calculator through a number of examples. Key elements presented to experts are summarized hereafter. He also emphasized that nothing has been written in stone and welcomed experts to critically review and challenge the proposed levers, practices and levels, by taking into account time and spatial dimensions (Europe, Member states and RoW).

3.2.1 Modelling approach

The land-use, water & biodiversity module is dedicated to compute the impacts and inter-linkages associated with the production and supply of food, bioenergy, biomaterials and minerals in order to reduce or mitigate GHG emissions in the period to 2050.The extent of these impacts will depend on the choices users make when designing their own decarbonisation pathways.

The land-use, water and biodiversity module consists of a dozen sub-sectors that enables the computing of the impacts associated with the supply of food, bioenergy, biomaterials, and minerals (illustrated in Figure 2):

[3]Levers represent the first level of reflection, defining the scope of action that we can take towards sustainable land use management, biodiversity and water. Deeper analysis includes the sphere of practices for each lever, providing future users a choice to understand the impact and implications of different practices and ways to move towards more sustainable society. Levels of ambition represent the third level of complexity and seek to define how fast we can move towards the sustainable society.

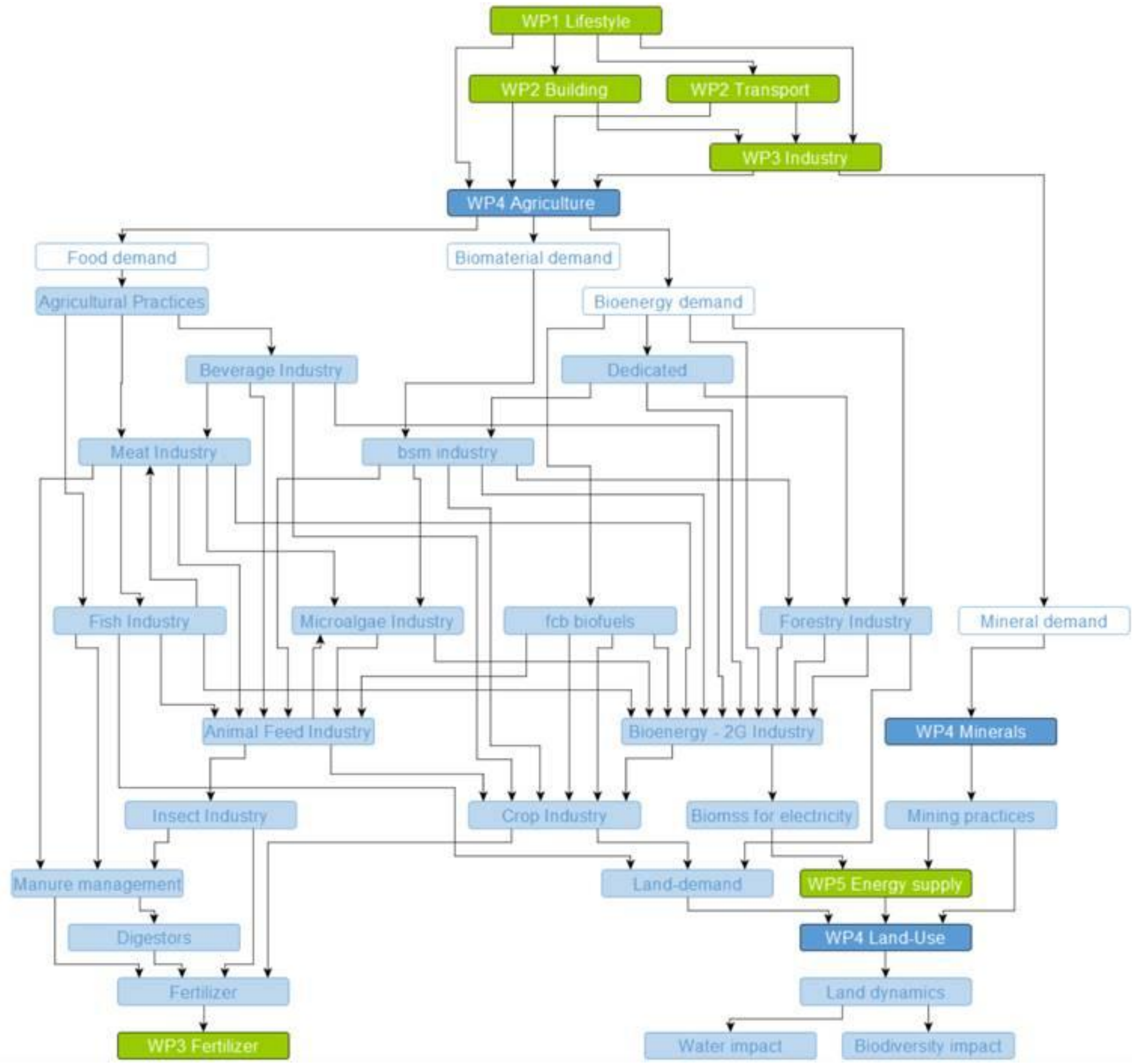

Figure 2 – Overview of the module structure

Figure 2 illustrates the three main demand streams, namely, the demand for food, bioenergy and biomaterials, and the interlinkages that are driven by these demand streams. Dark blue and green represent the modules associated with WP4 (e.g. agriculture) and the other work packages (WPs) respectively (e.g. transport). The light blue represents the set of modules that are composing the land-use, water & biodiversity WP (e.g. insect industry), and the white boxes only illustrate the main flows (e.g. food, bioenergy). Arrows depict the connections between the modules and flows.

In the EUCalc, the demand for agricultural commodities drives the demand for agricultural inputs at farm level, such as energy, water, fertilisers and land-use. Consequently, this generates environmental impacts, particularly, in terms of GHG emissions, water and biodiversity.

3.2.2 Module scope & granularity: biodiversity and water

Table 3 presents the main sectors, inputs and outputs of the model. In this report only water and biodiversity aspects of the module are presented. For full description please consult Deliverable 4.2

Table 3 – Scope of the land-use, water & biodiversity module

Sectors	Inputs	Outputs
Biodiversity	Ambition based on Aichi Objectives	Degraded lands; protected lands & inland water; fish stocks;

3.2.3 Levers for water and biodiversity

Abatement of CO_2 equivalent emissions in the module can be obtained by following a number of emission mitigation strategies. Hereafter identified are the most relevant actions that need to be taken in order to significantly reduce emissions by 2050. Each of these actions constitutes a lever in the land use, water and biodiversity module that when shifted can help to reduce CO_2 equivalent emissions, as presented in Table 4. The magnitude of this reduction is expressed in the four increasing levels of ambition that range from a minimal to an extraordinarily ambitious effort to tackle climate change, offering a broad variation of mitigation choices, including intermediate levels (see Section 3.2.4).

Table 4 – Scope of the co-creation process

Levers	Units	Short description
Biodiversity protection practices	%	The lever sets practices to protect and prevent biodiversity erosion, for example, with an emphasis on the Strategic Plan for Biodiversity (the Aichi Target[4]). It requires land savings for protecting areas, also affecting the water availability.

3.2.4 Levels of ambition for water and biodiversity

Similar to the existing calculators, for each lever, four levels of ambitions can be set to express the extent of the emission reduction effort that could be achieved from 2015 until 2050. Table 5 presents how the lever setting should reflect the four levels of ambition. The proposed ambition levels of each lever had been defined beforehand based on literature review, and provided to the experts for critical review and discussion (see Section 3.3). In the example below ambition levels for biodiversity are provided.

Table 5 – Levels of ambition in the EUCalc framework

Level	Business as usual
1	This level contains projections that are aligned and coherent with the observed trends.

[4] For more information, see: https://www.cbd.int/sp/targets/

Level 2	**Ambitious but achievable**	This level is an intermediate scenario, more ambitious than business as usual but not reaching the full potential of available solutions.
Level 3	**Very ambitious but achievable**	This level is considered very ambitious but realistic, given the current technology evolutions and the best practices observed in some geographical areas.
Level 4	**Transformational breakthrough**	This level is considered as transformational and requires additional breakthrough and efforts such as a very fast market uptake of deep measures, an extended deployment of infrastructures, major technological advances, or strong societal changes, etc.

3.3 Discussion & recommendations

The third and largest segment of the workshop was dedicated to eliciting input from experts. Participants, working in small groups, were invited to collect their thoughts individually and collectively, to discuss the scope of levers, practices involved, ambition levels, the relevance and reasoning in terms of complexity of the real world versus simplicity for the future users who will use the EUCalc tool. In addition to the EUCalc presentations (see Section 3.2) during the workshop, handouts and guiding questions were provided to help in initiating the discussions, as presented below. Small groups worked using a World Café process, in which each group rotated through a set of discussion topics that aligned with practices represented in the tool. The discussion topics relevant to this deliverable were as follows:

Discussion topics:

- Topic1: Forestry management (covered in Del 4.2) and Biodiversity (Section 3.3.1)
- Topic3: Animal feeding practices & Fishery practices (both covered in Del 4.2)
- Topic4: Mineral /mining practices & Land management (both covered in Del 4.2)
- Topic6: Water management (Section 3.3.2)

Day 1 - How can we move towards a more sustainable society?

Levers (Depth 1)

- Do you agree with the selection of proposed levers? Do you think our choice of levers is coherent and comprehensive enough?
- Are there any other important levers missing on the list? Are there irrelevant levers you think we should remove from the list?

Practices & their associated impacts (Depth 2)

- Do you agree with the selection of practices?
- Are there any other important practices missing on the list? Are there irrelevant practices you think we should remove from the list?
- Are the scope and range of the practice impacts well covered?
- Is there an innovative practice/solution that you think would make a positive change or a major disruption?

Day 2 – How fast can we move towards a more sustainable society?

Ambition levels & future scenarios (Depth 3)

- Do you agree with the levels of ambition in each of the levers?
- What are the main trends for the different practices by 2050? Does the model allow enough flexibility to take them into account?
- What is the pace of technological, behavioural and practices change?

At the end of each workshop day, the comments of the experts from each discussion tables were summarized and presented to the plenary and are listed below together with the comments concerning the module approach and scope.

3.3.1 Biodiversity

Topic discussion

Reported by: Jeff Price (University of East Anglia) and Alexandre Bouchet (EPFL)

Lever rationales:

In 2010, the Convention on Biological Diversity Parties engaged themselves to reach biodiversity conservation and restoration targets by 2020, namely the Aichi objectives[5]. The later are essential for sustainable development and highly interlinked to the 2030 Agenda through all the SDGs, for instance, through SDG13: climate change action, SDG14-15: life on land and bellow water, or else SDG6 focusing on water issues[6]. Biodiversity consideration in EUCalc will be tracked across the WPs (e.g. agricultural practices impacts) and also as a dedicated lever to set ambition for biodiversity conservation and restoration. Given the interlinkages between biodiversity and life under water, it has been decided to develop a fishery and aquaculture module (see Deliverable 4.2). The rationale behind the levers and levels of ambition stems from the multiple inter-relationships between land use, biodiversity conservation and, ultimately, mitigation as either sinks or potential sources. For example, land preservation both benefits biodiversity and potentially maintain carbon stocks. Furthermore, land restoration to benefit biodiversity would also act to create or improve carbon sinks. However, these changes may concomitantly constrain other uses (e.g., food production). Other levers and levels of ambition in other work packages may also benefit biodiversity but in ways that may be less quantifiable. These can potentially be captured within ambition level 3, which is based more on meeting more of the Sustainable Development Goals (SDGSs).

Lever rationale & practices (Day 1)

Several participants identified the need to split the current lever into two sub-levers, one sub-lever for protection and one for restoration. This would offer more flexibility to the user regarding the ambition settings. Otherwise, how we reach different ambition levels for different practices without consideration of other levers needs to be explicitly mentioned (n other words, one sub-lever would include reforestation, while the other would include afforestation, etc.). Moreover, it is considered important to facilitate differentiation between the relative scale of impacts on biodiversity arising from different land use management options, such as agroforestry, forestry, etc. The question of the options efficiency to implement the biodiversity measures was also raised. For instance, how much biodiversity benefit can come from urban/green cities? How much carbon do green roofs provide? While this can be measured to a small extent, this led to the development of the ecosystem services (natural capital) dashboard concept to best capture these largely unquantifiable benefits. For example, a properly designed green roof can lead to increases in natural capital for pollination, clean air, carbon capture,

[5] https://www.cbd.int/sp/targets/

[6] Biodiversity 2030 Agenda Technical Note, Convention on Biological Diversity: http://www.undp.org/content/dam/undp/library/SDGs/English/Biodiversity_2030_Agenda_Technical_Note.pdf

clean water and biodiversity (plus aesthetics and, potentially, education). Finally, there was a discussion about using the lever for biodiversity as a 'stand-alone' lever or whether it should be linked to other policies (like the CBD). The experts ultimately opted to go for the CBD option. While Level 1 seems to not match well with other Levers in EUCalc this was a compromise among experts between those who want Level 1 to allow for countries to 'backslide' or remove protection from areas (as has occurred recently in Brazil and the United States). To keep a simple goal more aligned with other EUCalc levers we have added in a management component.

The potential for International "leakage" or exportation of emissions was identified as a critical issue to consider, owing to direct implication for trade-off between practices and transboundary effects (WP7). In particular, if the highest ambition level for biodiversity was selected it might require greater importation of wood products or food from elsewhere in the World. While this would be good for biodiversity in the EU, it could have negative implications for both biodiversity and emissions elsewhere in the World (see above). Experts recommended that warning of some sort should be raised to inform users when this might occur for a given lever setting.

Ambition levels (Day 2)

Table 6 – Levels of ambition for biodiversity

Biodiversity	Brief description
Level 1	Maintain existing refuges and policies around nature conservation. Maintain existing refuges and protected areas in good status and well-managed. This is the do-nothing scenario. This lever will hold percentage of protected areas (as defined by the World Database on Protected Areas, but we need to make sure Natura 2000 sites and SSSIs are included) static at a defined level (specified year).
Level 2	Each country meets their Aichi 2020 target 11 by 2020, with the definition of protected being restricted to those areas primarily focused on biodiversity conservation. For example, some National Parks contain settlements, and allow uses not entirely consistent with biodiversity conservation. This level will focus first on IUCN Protected Areas categories I – V, and then consider which other categories, per country meet the threshold of preservation for biodiversity. This means that 17% of terrestrial land is protected, 17% of freshwater (so a link to the water lever) and 10% of the coastal and marine areas. This means that for 2020, and continuing to 2050/2100, we set the **biodiversity** protection threshold at 17%, leaving a % for all other users. This amount is not strictly 15%, 83% as many areas are defined as protected in the database for cultural and geological features. Defined from the World Database on Protected Areas data, IUCN categories I-V (with some VI) and coupled with areas defined as non-agricultural, non-bare ground or ice, and non-urban in the European Space Agency Climate Change Initiative Land Cover Database for 2015 for land cover definition.
Level 3	Each country meets ALL of their Aichi targets considering climate refugia for biodiversity at a set threshold (1.5/2°C). Some countries will require

	substantially more protected areas than 17% but it will differ by country. Values for climate refugia based on data from Warren et al. 2018 a,b.
Level 4	Highest biodiversity protection ambition. 50% of each country is set aside for nature, drawing from primary habitats, then look at full restoration of secondary habitats (helps meet target 15). Draws from the European Space Agency Climate Change Initiative Land Cover Database for 2015 for land cover definition and Warren et al., 2018 a,b for biodiversity.

Table 6 indicates the ambition levels for biodiversity which were discussed in the breakouts. It was emphasized that ambition levels 3 and 4 would have impacts on other levers, and some combinations with other settings of other levers in the Calculator might be infeasible. The following potential interactions were noted (i) removal of subsidies harmful to biodiversity (which might impact other levers), (ii) production and consumption sustainable at levels keeping natural resource use at safe ecological limits (clearly limits other levers), (iii) rate of natural habitat loss halved, fragmentation reduced (impacts other levers on land use), (iv) areas under agriculture and forestry managed sustainably (could only be implemented as warnings),(v)reduction in acidification to non-detrimental levels in ecosystems, (vi) maintenance of genetic diversity of agriculture, (vii) ecosystem services are protected or restored (viii) enhancement of carbon sinks through restoration of at least 15% of degraded ecosystems (UK has proposed 40% forests).

Much of the early discussions centred on the lowest level of ambition. A number of experts wanted a 'backsliding' scenario for level 1. In other words, they suggested considering an increase of the biodiversity loss as the level 1, given conflicts between some current EU policies, and the realization that some prioritization of land uses will likely be necessary in the future. However, the majority of the experts suggested that adding a backsliding biodiversity option might send a message that this is acceptable. While there are other ways, other than lever settings, in which backsliding could be included in EUCalc (to be discussed internally), having a backsliding level was removed and the existing suggestion for Level 1 (business as usual, no change in current protection levels) was accepted as a compromise. Beyond the Aichi objectives for 2020, which form the basis for the levels of ambition used, then the possibility of tracking biodiversity through some of the Sustainable Development Goal (SDG) indicators was mentioned. Experts also wanted to see a consideration of ambition levels that might focus on prioritizing preservation/restoration of high carbon storage ecosystems. As this is a biodiversity lever, then this level of mitigation ambition would need to be considered as a co-benefit rather than a driving goal.

Lever proposal

Aichi objectives constitute a suitable framework for setting the biodiversity lever and ambition levels. Nevertheless, the 20 Aichi objectives cannot all be implemented in the EUCalc framework. As suggested in Table 6, we will focus on land and water issues. The lever will specifically look at lands protected specifically in natural habitats and for biodiversity conservation (including potential for restoration). There were suggestions that there might be separate sub-levers for preservation versus restoration. However, this is really only feasible at higher ambition levels. This Lever is trying to deal with multiple policy goals and as such a simple approach, such as increase land protected by x%, restore y% (the easier approach) does not meet the goal of making a tool that recognizes that EUCalc sits within other key International policies (e.g., Convention on Biological Diversity). If a simple approach is taken (e.g., increase protected areas by 10%) then some countries would have so much land protected there would be little left for other purposes, and other countries still would not meet their CBD targets. Mechanically, two sub-levers cannot be formally liked within the model and would only be advisory. The idea of two sub-levers came out of discussions when some experts realized that for higher ambition levels then restoration would be required to meet the target. Therefore, there is conflicting ideas from experts that the biodiversity team are still in the process of meshing into a coherent whole. Finally, biodiversity impacts will also be tracked across the WPs, for instance, though agriculture, fisheries, and aquaculture practices. The later may increase or decrease the amount of land required to conserve and restore biodiversity.

Additional comments

There were no discussions in the biodiversity groups about aquatic biodiversity as this was thought to be captured in discussions around the water lever. How can we reach different levels without consideration of other levers? See above for discussion about the possibility of an ecosystem services dashboard. However, this is an issue when it comes to differentiation of lands uses between biodiversity, forestry and agriculture.

One expert wanted a greater consideration of a fully implemented REDD++ (reducing emissions from deforestation and degradation) with the ++ referring to inclusion of mitigation options from agricultural and non-tropical forests.

There was appreciation that one of the levels of ambition included the fact that biodiversity will be changing with warming, and that this moving target needs to be considered in maintenance of biodiversity. For example, at warming levels above 2°C, many parts of the EU could see significant reductions in species richness of flowering plants, including many of the trees making up temperate forests (deciduous). This will feedback on emissions (see forestry).

Some participants wanted a more continuous set of ambitions for each lever, but the overall design of EUCalc does not allow this, so the ambitions were set relevant to policy and, in the case of Level 4, aspirations.

3.3.2 Water management

Topic discussion

Reported by: Alexandra Collins (Imperial College London) and Rachel Warren (University of East Anglia)

The approach for this group discussion was different as the relevance of having this lever was questioned in the EUCalc consortium. During these interactive and facilitated conversations, experts discussed regarding whether water should be included as a lever in the Calculator and suggestions for the parameters that could be used for this, along with the levels of ambition that could be used as levels for the levers.

Lever rationales

The European Commission [7] estimated that in 2007, more than 16% of EU total population had been affected by water scarcity and droughts. Although spatial and temporal distribution of water resources were considered as an outstanding reason to this situation, Europe wastes more than 20% of its water due to inefficiency. Moreover, the EEA [8] evaluated that respectively 40% of reported water bodies were under hydromorphological pressure and 18% were under point source pollution pressure. These figures reveal a tremendous potential for water saving and ecological status improvement of water bodies. Consequently, a water management lever would enable the user to act upon several parameters such as water efficiency, sustainable water abstraction or ecological status improvement of water bodies. The main objective of such a lever would be to reduce pressure caused by water demand on water bodies, especially for areas sensitive to droughts.

Lever relevance

Many experts felt strongly that water should be considered both as a lever and through the impacts that will be communicated to users of the Calculator given its related closely with GHG emissions and climate change. It was also felt that as Europe has strong policies and objectives for water such as the water framework directive (WFD), Directorates and Ministries need to understand how water is related to the model and climate change.

Others were less sure that water should be a lever and that aspects related to water management could perhaps be covered adequately through communication about the impacts of climate change from other levers. However, it was considered necessary that water be included as a lever if the issues relate either directly to GHG emissions or climate change mitigation, for example the GHG emissions related to water use and energy intensive water treatment.

[7] http://ec.europa.eu/environment/water/quantity/pdf/comm_droughts/ia_summary_en.pdf
[8] https://www.eea.europa.eu/themes/water/european-waters/water-quality-and-water-assessment/water-assessments/pressures-and-impacts-of-water-bodies

An idea to use constraints was proposed in order to highlight where trade-offs may exist. For example, this was proposed where a lack of water availability may limit some of the mitigation strategies. Here the model would prevent certain levers being increased past a certain point or if other objectives were selected. Another idea was to use a flag/warning to highlight where there will be impacts or contradictions with other EU targets e.g. WFD status

Possible lever(s) & levels

A number of suggestions for what could be modelled as a lever for water management were made.

These included using the degree of achievement of WFD (Water Framework Directive)[9] good status. This was suggested as this is already a target that Europe has set and is legally binding. However, others thought this should only be included as an impact flag as described above. This lever would set the proportion of water bodies achieving WFD good status. For rivers in England, the Environment Agency uses the 'Environmental Flow Indicator' (EFI) to indicate where abstraction, or flow regulation, may start to have an undesirable impact on river habitats and species. The Environment Agency interprets surface water bodies with flow greater than the EFI as supporting Good Ecological Status under the EU Water Framework Directive (WFD). For groundwater abstraction, the Environment Agency uses 4 quantitative tests that aim to protect surface water flows, groundwater levels, spring discharges and water quality. The Environment Agency interprets groundwater bodies that meet those 4 tests as being at good status for groundwater quantity under the WFD.

Another suggestion for a lever was the degree of sustainable abstraction, i.e. the degree of water use in line with annual recharge in order to reduce water stress and over abstraction. This lever would be modelled as the percentage of water sustainably abstracted. With climate change, we expect less groundwater recharge and larger seasonal variations in river flow as well as changes to when and how extended dry periods occur. Therefore, sustainable water abstraction appears to be essential to ensure that river flows and groundwater levels support ecology and natural resilience to climate change and human activities. In order to achieve the goals of sustainable abstraction, the Environment Agency in UK for instance will focus on abstraction licences having the greatest impact and take action now to reduce future risks. They will review licences by adjusting them as necessary to make sure they do not allow environmental damage now or in the future, or revoke licences that have been shown unused.[10]Some data sets from JRC could be used to model this and it will be followed up directly with JRC scientist on a separate meeting.

Water efficiency through water use reduction, water recycling and technological advances in efficiency was also suggested. This lever would be modelled as the percentage of water loss avoided through water use reduction, water recycling and technological advances in efficiency. According to the latest JRC studies presented during the workshop, water efficiency improvements may not impact much on expected negative

[9] http://www.legco.gov.hk/general/english/library/stay_informed_overseas_policy_updates/water_framework.pdf

[10] https://www.gov.uk/government/publications/water-abstraction-plan-2017/water-abstraction-plan-environment

effects of climate change. Also, some experts advised that water reuse- the use of waste water for irrigation, is politically sensitive issue. However, these points were not considered strong enough reason not to include it, reflecting that changes in practices and new practices may be required to meet climate targets.

The degree of wastewater treatment, through the percentage of wastewater that is treated to certain standards was also suggested. From the EUCalc perspective, this lever would be modelled as the percentage of wastewater treated and reused. Indeed, there is a huge potential in reusing treated wastewater while ensuring a reasonable return flow to the environment. However, reuse of wastewater treatment seems still politically sensitive.

Water desalination was also discussed, which can either be used as a buffer or as a lever that would enable the user to choose among four scenarios (A-D) for water desalination use. For instance, The H2020 project "Revived water" focuses on developing several new low energy electrodialysis systems to support future sea water desalination projects.

Others were concerned with damages from extreme weather such as floods and suggested that reduction in the likelihood of flooding event e.g. one in 100 events could be used.

Additional research will be conducted to define the scope of the water module and lever(s) in EUCalc. Possible synergies with the JRC's model and inputs will particularly be investigated.

Additional comments

Some experts asked how water incorporated in imported products would be considered. Finally, some suggested that health and wellbeing be incorporated and suggested using natural capital, recreation, GDP, energy and food security. A number of people advised against using the terms blue, green and grey water as these terms were considered confusing as they mix between rechargeable and unsustainable sources of groundwater

4 Lessons and conclusions

Some of the important interactions between land, water and biodiversity can be captured by the land use allocation within the WP4. However, water constraints (in particular) will also have important implications for other WPs owing to issues such as the availability of cooling water for power stations. As a next step, it will be important to explore which of these constraints can be included in the model, or failing that flagged to the user by a warning symbol when a water supply constraint is crossed.

Experts provided useful input by:

1) Steering us away from including backsliding in the lowest position of our biodiversity lever. They felt that it was important that the model should take as its reference point the status quo in terms of biodiversity protection
2) Providing support for the proposed lever for biodiversity, but encouraging as also to consider splitting it into protection and restoration sub-levers
3) Encouraging us to include water security issues in the model, at a minimum by including a warning flag, when combinations of mitigation actions in the model would violate a water supply constraint
4) Encouraging us to include a water related lever, providing options of sustainable water abstraction, water quality, or water use efficiency
5) Encouraging us to show the user how water and biodiversity levels are affected by the level of global warming and encouraged us to include these in our representation of the projected impacts climate change.

Therefore the next steps are: 1. Explore how water constraints can be communicated in the model to other WPs or at least to the user; 2. Explore how to represent climate change impacts on water and biodiversity in the model; 3. Explore the use of a dashboard indicator light system to identify when other levers benefit/damage the ability to meet biodiversity and water objectives (possibly via a Natural Capital Risk approach). This would be a tab and not part of the levers themselves. This will be discussed among the consortium.

5 References

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6 Annexes

6.1 Participants list

Participants – Stakeholders:

First Name	Last Name	Organization
Ad	de Roo	Joint Research Centre, European Commission
Tom	Heap	BBC
Keith	Kline	Oak Ridge National Laboratory
Ana	Kojaković	Energy Insitute Hrvoje Požar
Eric	Sievers	Ethanol Europe
Christian	Davies	Shell
Pam	Berry	Environmental Change Institute, University of Oxford
Cary Yungmee	Hendrickson	FAO, University of Rome
Nicole	Kalas	ETH Zürich
Grahame	Buss	LCAworks
Elliot	Buss	Cambridge University
Alex	Mason	WWF European Policy Office
Prajal	Pradhan	Potsdam Institute for Climate Impact Research (PIK)
Kathy	Ryan	Global Green Investments
Sarah	Wynn	ADAS
Steven	Peterson	Thayer School of Engineering at Darthmouth
Richard	Murphy	University of Surrey

James	Millington	King's College London
Ramon	Bicudo	UNICAMP
Luc	Bas	IUCN Europe
Frank	Rosillo-Calle	Imperial College London
Sagar	Sumaria	*Sow Grow* and *Reap*
Lorenzo	DiLucia	Imperial College London
Alexandra	Collins	Imperial College London
Mathilde	Fajardy	Imperial College London

Participants – European Calculator Project:

First Name	**Last Name**	**Organization**
Onesmus	Mwabonje	Imperial College London
Jeremy	Woods	Imperial College London
Gino	Baudry	Imperial College London
Alexandre	Strapasson	Imperial College London
Rachel	Warren	University of East Anglia
Jeff	Price	University of East Anglia
Ana	Ranković	SEE Change Net
Garret	Kelly	SEE Change Net
Alexandre	Bouchet	École Polytechnique Fédérale de Lausanne (EPFL)
John	Posada	TuDElft
Judit	Kockat	Buildings Performance Institute Europe (BPIE)

Facilitator:

First Name	**Last Name**	**Organization**
Jonathan	Buhl	4Sing

6.2 Workshop agenda

Day 1: Wednesday, September 19, 2018 Imperial College London | South Kensington Campus | London | United Kingdom **Royal School of Mines (RSM): Room G01**	
Time	**Activity**
12:00 – 12.30	**Registration and light lunch**
12.30 – 12:50	**Opening & welcome -** *Workshop agenda, objectives, participants introduction* Dr.Jeremy Woods, Imperial College London Jonathan Buhl, 4sing (facilitator)
12:50-13:10	**Presentation of the EUCalc project**- *Short overview presentation followed by clarifying questions and brief discussion* Dr. Jeremy Woods, Imperial College London Garret Kelly, SEE Change Net
13:10 – 13:50	**Reflections on food security, land use and climate change challenge -** *keynote presentation followed by questions and discussion* Tom Heap, BBC Rural Affairs Correspondent
13:50– 14:05	**Coffee/tea break**
14:05 – 14:40	**Background to Land use, water and biodiversity module of the EUCalc**- *Short overview presentation on the methodology, assumptions and levers* Dr. Gino Baudry and Dr. Onesmus Mwabonje, Imperial College London Prof. Rachel Warren and Dr. Jeff Price, University of East Anglia
14.40 – 16.00	**Interactive dialogue and discussion on critical questions**
16:00– 16:15	**Coffee/tea break**
16.15 – 17.10	**Interactive dialogue (continued)**
17:10 - 17:30	**Closing -** *Summary and key takeaways*
19.00 - 21.00	**Dinner** *(optional)*

Day 2:Thursday, September 20, 2018 Imperial College London | South Kensington Campus | London | United Kingdom **Royal School of Mines (RSM): Room G41**	
Time	**Activity**
10:00 – 10.30	**Welcome coffee/Registration**
10.30 – 10:45	**Opening -** *1st day takeaways, objectives of the 2nd day* Dr. Onesmus Mwabonje, Imperial College London Prof. Rachel Warren, University of East Anglia

	Jonathan Buhl, 4sing (facilitator)
10:45-11:30	**European and global perspective on Land use, water and biodiversity impacts**- *keynote presentations followed by questions and discussion* Prof. Dr. Ad De Roo, European Commission, Joint Research Centre, Directorate D – Sustainable Resources, D2 - Water and Marine Resources Unit Dr. Keith Kline, ORNL - Oak Ridge National Laboratory
11:30 – 11:45	**Levels of ambition and scenarios of the Land use, water and biodiversity module of the EUCalc** - *Short overview presentation* Prof. Rachel Warren and Dr. Jeff Price, University of East Anglia Dr. Gino Baudry and Dr. Onesmus Mwabonje, Imperial College London
11:45– 12:00	**Coffee/tea break**
12:00 – 13:50	**Interactive dialogue and discussion on the levels of ambition and scenarios**
13:50 - 14:00	**Closing -** *Summary and conclusion, final reflections* *and outline of next steps by the EUCalc team*
14.00 - 15.00	**Lunch and departure**

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6.3 Further information about hydrological modelling at Joint Research Centre, Italy (JRC)

Professor Ad de Roo from JRC presented the brand new work of Joint Research Center on water resources model, the development of which started in nineties. It began as a flood simulation and flood prediction model and has been modified, extended and made better over the years.

LISFLOOD is a hydrological rainfall-runoff model including the simulation of water abstraction and consumption (irrigation, rainfed agriculture, cooling for energy production, manufacturing industry, livestock, public water usage, environmental flow). It simulates the detailed hydrological cycle, including human water consumption, irrigation, lakes and reservoirs, and riverflow routing. LISFLOOD is used for operational flood (EFAS, GloFAS) and drought (EDO) forecasting, as well as river basin (Meuse, Oder, Elbe, Danube, Toce), European, African and Global water resource studies. It runs with daily timestep, 6 hourly in progress; various spatial resolutions from 250m-50km; Europe at 5km; Global at 10&50km

Since 2003 JRC has been providing information to European Water Authority as an early warning model while globally results go to world food programme and other rescue organizations, as advance warning. Recently, JRC has endeavoured to link irrigation with agriculture to get the crop yield right and the next development step is to include crop yield in the model directly so not only to simulate water cycle but also crop yield.

Various assessments have been done for Europe and climate change, using the CORDEX for historic control scenarios and various CO2 scenarios by the end of the century. A window of 2 degree change will not be equal to 2 degree across Europe. Scandinavia will be hit much more than UK and his conclusions on Europe's water resources up to 2050 under the 2 degree scenario include:

- Climate change causes wetter conditions in north and central Europe, and drier conditions in the Mediterranean
- Mediterranean gets 3 increasing issues: less water for rainfed agriculture; less surface and groundwater for irrigation and other activities
- Water scarcity is exacerbated in areas where it is already an issue. An extreme warming scenario (RCP8.5 end of 21st century) projects increased water scarcity problems in central Europe and England, especially during summer
- Land use change and water demand changes play a role, but the climate change effect is dominating for water resources
- River floods are an increasing problem, even in autumn months in the Mediterranean;
- Urban excess water is a growing issue in central European countries incl. UK

Professor de Roo noted that impact assessment under the 1.5 degrees scenario is being developed by JRC.