	Theme 3. Fresh water availability and access
SC 3.2	**Fresh water availability and access: guidelines and methodologies**
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Water sector adaptations for hydraulic fracturing in Texas
Syeda Mariya Absar, University of Tennessee Knoxville, USA
In Texas, ground water use is large, which has worsened with the increasing droughts. Also, the mining sector is growing, with Shale Gas causing an increase in ground water usage. The focus of the research lays on the Barnett shale area, which is the largest shale area in Texas. 95% of the water used for fracking is injected in the ground without any treatment. In addition, climate change will increase droughts and threat water resources in the future. All of these factors contribute to a stressed water situation.
This study aims to understand the water and energy needed for the shale gas process by applying various methods, such as a life cycle assessment of Barnett shale gas, both a carbon and water footprint, and combining them with socioeconomic storylines. This helps determine what the options for the future are. Accordingly, the water footprint seems especially high after injecting. This could be decreased by treating the water first. A sustainable option would be to use carbon neutral desalination; here, energy for transportation and desalination is derived from wind farms in Texas - this would decrease the water and carbon footprint. Complete carbon neutral desalination would be the most sustainable option: 79% less water footprint, 5% less carbon footprint (only the desalination and transportation is carbon neutral; other inputs remain the same). Conventional desalination would decrease water content by 79% but increase global warming potential by 25%.

Guidelines to assess sustainable production limits for agriculture: Letaba basin/Scenarios for irrigated agriculture: case – study Letaba sub-basin (South Africa)
Jeroen Veraart, Wageningen UR, the Netherlands
The aim of this study was to evaluate opportunities and constraints of combining deterministic impact models with participatory scenario building to explore possibilities for sustainable expansion of food production. The conditions of the area included a limited access to geographical information, food production in a water scarce environment, and aiming for poverty alleviation. The Letaba basin relies on water resources including rainfall, dams and ground water. An option would be a public-private partnership, receiving support of a local supermarket by investing in farming equipment and allocating water rights. Challenges include local economic development, increasing resilience to increasing weather extremes, and improving food security. The deterministic scenarios looked at three scenarios; increase water supply, improve nutritional application, or both. These deterministic models are useful to see what has the most impact; e.g. climate change
Participatory approaches were also evaluated such as the quick scan and touchscene. Here, one needs to prepare for the meeting; prepare the land use map. Afterwards, they identify areas suitable for irrigation. For irrigation, there are some guidelines where to provide this; for instance there needs to be market access. This you can also use for the land use map, marking the area that is interesting for irrigation. In considering adaptation options, this touchscene is more applicable – showing where adaptation is more suitable.

Critical periods for adaptation in Asia; irrigation demand by crop linked to water supply by source
Qurat-ul-Ain Ahmad, Global Change Impacts Study Center, Pakistan / VU University, Amsterdam
Critical periods can be defined as the times when climate risks are highest and adaptation interventions are most effective; for water this means that supply is less than demand, this is mostly applicable at times when in the past rainfall water was sufficient for agriculture, whereas this is changing now because of climate change. The research addresses the following question: What are the impacts of high risk seasons on crop production? An LPJmL model is used, which links water and climate cycles.

In South Asia, Monsoon enters in June, reaches Pakistan end of July, which affects the crops. India requires very high irrigation quantities in the Rabi season; in Pakistan this irrigation demand is almost similar for the dry and wet seasons. One can observe that the seasonal water demand depends a lot on the season and region. In the Rabi season, water is especially demanded for wheat production; in the Kharif season a smaller peak is required by rice production. Most food is produced during the Rabi season, but a very large part of the food production is dependent on irrigation (90%). Most importantly, critical moments will especially take place during Kharif, as here a large part is rain fed; so this is more vulnerable to dry seasons – not irrigation dependent.

BeWater: Making society an active participant in water adaptation to global change
Anabel Sanchez, CREAF, Spain
The research focus lays on the Mediterranean, an area very vulnerable to climate change. A collaborative approach was taken, with scientists and the society of these basins. 4 case studies were completed in river basins: Slovenia, Spain, Cyprus, and Tunisia. An adaptive water management approach was chosen for, moving away from a technocratic approach to more circular system; stakeholders/local society present during different steps of the process, an iterative process.
Firstly, one should diagnose; what are the challenges of the basin, what is the desired future state, and what are the solutions. Secondly, one should decide what option fits best. Aims are to gather data, evaluate water management, and consult stakeholders. The solutions come from the stakeholders who were consulted; options coming from supply and demand management, health of water ecosystems, and protection of water quality. Conclusions: droughts and flood will increase in the Mediterranean; these answers cannot only come from scientists or politicians. Need to work together as a society to face these challenges of water management together.

Discussion
Presentation Syeda Mariya Absar:
Q: (Anabel Sanchez): What would be most suitable for the neighbourhood?
A: There are very mixed feelings about fracking and water usage.
Q (Eddy Moors): Did you involve stakeholder participation?
A: No regulations in Texas now for waste water management; need to spread the knowledge about this issue.
Q (Eddy Moors): Still there is significant contamination of water involved in fracking, did you consider that?
A: Not included in research.
Q (Tong Jiang): Do you have more information on the SSP?
A: Storylines only look at four of the SSPs, relevant to developing countries.
Presentation Jeroen Veraart:
Q (Anabel Sanchez): Were people ready to use the touchscene?
A: Yes, it does work. Very effective method, but more experience in Europe. In SA this is still new, also challenges related to energy.
Addition (Ainun Nishat): it is sometimes very hard to consult people's opinions in such an approach, not everyone is willing to open up.
Presentation Qurat-ul-Ain Ahmad:
Q (Syeda Mariya): Why does India use a lot more irrigation water than Pakistan?
A: The water coming from Monsoon is more in India, which is why during the rain season no irrigation is needed. Surface and ground water also considered in study.
Q (Anabel Sanchez): Do you have plans to consult the farmers?
A: Yes this is planned, to ask for a validation from the farmers.
Addition (Ainun Nishat): Government policy also important. Mostly focused on food security – rice mostly – now more focus on nutritional security. During the Monsoon you do not need anything else than rainfall, but in the winter months you do. Also now need this irrigation for supplementary water. Now the rainfall is very unreliable, some places too much and some places not enough – climate variability.
Presentation Anabel Sanchez:
Q (Annemarie de Groot): You presented a process for planning water adaptation issues. But for the implementation phase, what processes are important for the monitoring and evaluation stage?
A: We are now looking if the plans can be integrated in the planning. Will try to link to the ongoing processes and water authorities.