Development of future water use scenarios: Water Futures and Solutions (WFaS) initiative’s approaches

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Long-term and efficient strategies for water security have become increasingly important to achieve sustainable development. In order to explore practical development goals and pathways, a scenario-base approach provides valuable insights, since it can identify our challenges. However, still only few water resource assessments have considered “Shared Socioeconomic Pathways (SSPs)”. It is expected that water demand will increase in conjunction with population and economic growth. On the other hand, economic and technological progress have potential to improve water use efficiency leading to a reduction in water use. Water Future and Solutions (WFaS) aims to establish a comprehensive water assessment framework which covers agricultural-industrial-domestic sectors. The purpose of this study is to develop and analyze a set of consistent global water scenarios, especially about agricultural sector.
As a fast track, WFaS chose three sets of SSPs and Representative Concentration Pathway (RCPs), then developed global water narratives.
For agriculture sector, future trajectories of two key drivers were assumed; crop and irrigation area, and irrigation efficiency (*IE*) (Yearly, 2010-2099). It is expected that crop area and the area equipped for irrigation will expand over time. Irrigation area change reflects structural socioeconomic change such as food demand and land use. The Global Agro-ecological Zones (GAEZ) system provided a series of projection of spatial distribution of crop and irrigation area. GAEZ encompasses climate scenarios, demographic and socio-economic drivers, and production, consumption and world food trade dynamics.
WFaS provides dynamical scenarios of *IE* with a hypothesis that *IE* improves along with socio-economic growth, considering possible combinations of five crop types and three irrigation systems; gravity, sprinkler and drip irrigation. Each system has specific range of *IE*. The projection of *IE* was aggregated at country level to meet specification of existing global hydrological models. The country level *IE* will improves when an existing irrigation system is replaced with an innovated same irrigation system or another higher efficiency system, or an irrigation area expands with a higher efficiency system. Thus this study formulates the improvement of *IE* as a function of country/scenario-specific or system-specific parameters of replacement speed and a function of irrigation area. To define country/scenario-specific parameters, a country classification which is based on its socioeconomic condition and hydrological condition was applied. For instance, a country who has less water resource and higher financial power shows more rapid improvement of *IE*.
Forced the three scenarios, three global water models (H08, PCR-GLOBWB, WaterGAP) projected and estimated future water supply and demand. As results of the projection, two water resource assessments which covers agricultural, industrial and domestic sectors will be presented. The first assessment is about imbalances between supply and demand, then hot spots of water scarcity is highlighted. For example in Asia, potential population under severe water scarcity will increase throughout all scenarios considered, in the range of 1.7 to 2.1 billion, which represents

approximately 40% of Asia’s total population in the 2050s. The second assessment is a country classification from the view point of their cooping capacity and hydrological challenge. Our result suggests that Pakistan, Afghanistan, and Azerbaijan will remain the most vulnerable countries in Asia because they will be highly water stressed with low adaptive capacity under all scenarios. The number of people living in these three countries will total between 323 and 450 million people in the 2050s.

Keywords: Global water scenarios, Water demand, Shared Socioeconomic Pathways (SSPs), Global water model

