Responses to hessd-10-C6682-2013

1. Page 4 line 12-15, please check the sentence. It is kind of reduplicate; You have already said this in the Abstract.

The sentences in **Page 4 line 12-15** has been revised as: “The approach for environmental flow decision making was comprised by three steps (Fig.1): analyze the water use conflicts between agriculture and ecosystem, and also the water volume maybe lost in agricultural sector due to the maintenance of environmental flows; evaluate the trade-offs between different water use options using the BNs, the outcomes of which were the probability of economic losses under different water allocations scenarios; calculate the environmental flows based on risk assessment using the inflection point analysis method.”

2. How did the ecosystem water requirements be calculated, in this case the requirements of freshwater inflows into the Yellow River Estuary, should be detailed. The citation of a previous work by one of the co-authors (Sun et al. 2008) is not enough as the initial e-flows are the key component of the agricultural water shortage analysis.

In this study, initial environmental flows are defined as water requirements for desired ecological objectives, which can be considered as an initial step towards providing a boundary of the recommended environmental flows in practice. The recommended environmental flows may not be ideal for ecosystem health, they are suitable for preserving balancing of water usages between human being and ecosystems, which can be accepted by different stakeholders. We added the following sentences in the revised manuscript after **page 6 line 18** to describe the approach of initial environmental flow assessment:

“The initial environmental flow W_e^i can be determined based on different ecological objectives for ecosystem protections. Sun et al. (2008) develop a method for quantifying the environmental flows integrating multiple ecological objectives in estuaries.

$$W_e = \sum_{i=1}^{n} W_i + \mathrm{MAX}(\mathrm{W_{j1}}, \mathrm{W_{j2}}, ..., \mathrm{W_{jm}}) \qquad (6)$$

where W_e are environmental flows in the estuary (m^3), $\mathrm{MAX}(a, b)$ denotes the maximum of variables a, b, W_i is the consumptive water volumes (m^3), W_j is the non-consumptive water volumes (m^3), n and m indicate the number of the objectives of consumptive and non-consumptive water volumes, respectively. The rule of summation is generally used for calculating consumptive water requirements, while

the rule of compatibility (i.e., maximum principle) is adopted for estimating non-consumptive ones. In the environmental flows assessments of the Yellow River Estuary, the water needed to ensure replacement of evaporative loss and maintenance of appropriate surface area and depth for wetland habitat stability is considered consumptive. Water needed to maintain the salinity balance and provided adequate transport of sediment and nutrients is identified as non-consumptive, constituting runoff to the ocean. ”
The following equations number was already modified.

3. Page 4 line 20, please check “70% of natural water resources are diverted” Check this, because “natural water resource” is different from the concept of “freshwater withdrawals from rivers and groundwater” and “global storage capacity”.

In the original manuscript, "Natural water resources" was misused. Natural water resource is different from the concept of “freshwater withdrawals from rivers and groundwater” and “global storage capacity”. Molden (2007) concluded that the production of food and other agricultural products takes 70% of the freshwater withdrawals from rivers and groundwater. According to Lehner et al. (2011), the Global Reservoir and Dam database captures more than 75% of the total global storage capacity.

In the revised manuscript, we have changed the sentences in **Page 4 line 20**, “Approximately 70% of natural water resources are annually diverted from global river systems to supply agricultural irrigation (Molden, 2007)” to “Approximately 70% of freshwater, withdrawals from rivers and groundwater, is annually diverted from global river systems to supply agricultural irrigation (Molden, 2007)”.

4. Page 6 line 1: What is water-saving coefficient”? Is it different from “water use efficient”?

There are has different definitions for “Water use efficient” depending on the time and space scales of the processes and system aggregation it refers to (Steduto and Albrizio, 2005). At the leaf scale, water use efficient can be defined as the ratio of photosynthesis to transpiration. At the canopy scale, it can be defined as the ratio of crop productivity to evapotranspiration. More conveniently and for agronomic assessment, water use efficient has been expressed as the ratio of biomass production to evapotranspiration (Zhao et al., 2007). Actually, the water-saving coefficient is different from water use efficient. It’s an indicator to represent the implementation effect of water-saving measures.

The reference referred in this representation:

Steduto P, AlbrizioR, 2005. Resource use efficiency of field grown sunflower, sorghum, wheat and chickpea. II: Water use efficiency and comparison with radiation use efficiency. Agricultural and Forest Meteorology. 130, 269-281.

Zhao FH, Yu GR, Li SG, Ren CY, Sun XM, Mi N, Li J, Ouyang Z, 2007. Canopy water use efficiency of winter wheat in the North China Plain. Agricultural Water Management, 93,99-108.

Responses to hessd-10-C7359-2014

1. P8 Line 22: Check the statement that "approximately 90% of total water resources are used for agricultural purposes". Is this correct? Is only 10% currently available for industrial, domestic, and environmental uses?

Based on the statistic data in the Yellow River Water Resources Bulletin, approximately 90% of total water resources are used for agricultural purposes in the Yellow River Basin. In the revised manuscript **P8 Line 22**, we added “in the Yellow River Basin” after the sentence “approximately 90% of total water resources have been used for agricultural development”.

2. P5 line14: Explain what is the "reference crop" and how it and the related Coefficients have been adapted to crops and conditions in the Shandong area.

The “reference crop” evapotranspiration was defined in FAO-24 as “the rate of evapotranspiration from an extensive surface of 8-15cm tall, green grass cover of uniform height, activity growing, completely shading the ground and not short of water”. The estimate of reference crop evapotranspiration is important in irrigation and agricultural water researches. According to Khan et al.(2009), the potential evapotranspiration (mm) can be estimated by the reference crop evapotranspiration multiplied by the crop coefficient (**P5 line 14** in the original manuscript). The reference crop evapotranspiration and crop coefficient in the Shandong irrigation district located at North of China has already been estimated by Chen (1995). We added the sources of figures as the note below Fig.5 in the revised manuscript.

3. P13 Line8: Reference to 30% savings clearly contains large uncertainty.

By now, there are no exactly data about how much water can be reduced under the water-saving measures. In China, broad irrigation method has long been used, which can waste 50% irrigation water compared with the high effective water saving technology (Zhang et al., 1999).There is great potential to apply water-saving measures. In our research, we adopted the “reduce 30% of the demand for agricultural water” provided by Food and agriculture organization of the United Nations (2011) to illustrated the influence of water-saving measures to the recommended environmental flow allocation. In the future studies, other levels (like 10%, 50%) of water saving could be adopted to illustrate the influence of water-saving measures to recommend the environmental flows.

The reference referred in this representation:

Zhang H, Wang X, You M, Liu C, 1999. Water-yield relations and water-use efficiency of winter wheat in North China Plain. Irrigation Science, 19:37-45.

4. P10 Line 2 and page 11 line6: Use of the term "maximum environmental flow" is not clear. For the consistent reason, I think the “minimum” in P10 Line 2 and P11 line6 should also be changed too. Here, I recommended “high” and “low”.

The initial “maximum environmental flow” refers to the high level of environmental flow (needed to maintain the particular objective) in Sun et al. (2008). In the revised manuscript, we changed the term of “maximum” and “minimum” to “high” and “low” throughout.

We especially list the revised figures:

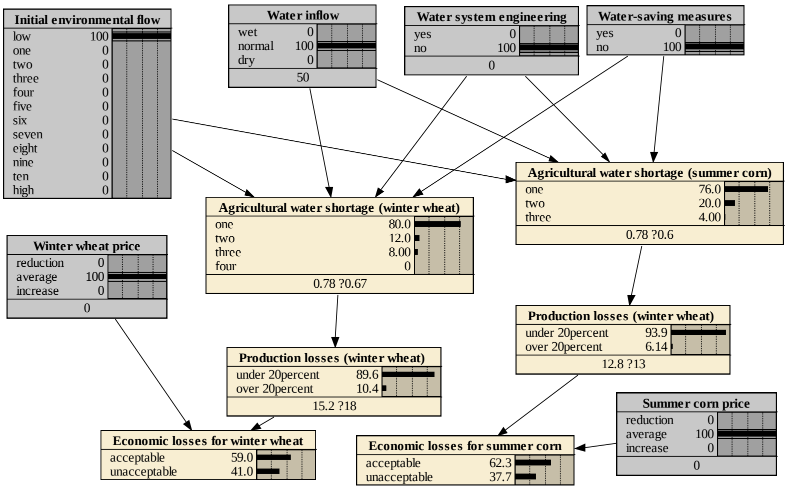

Fig. 6. The structure of trade-off analysis Bayesian networks (TOBNs).

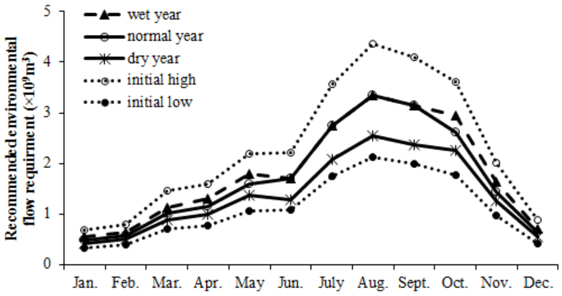

Fig.8. The recommended environmental flow in dry, normal, and wet years.

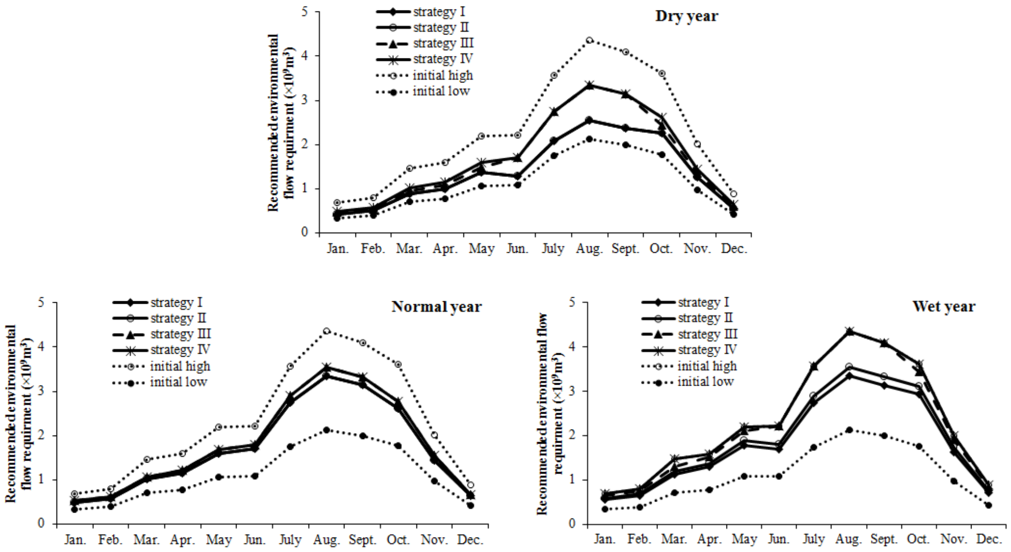

Fig. 10. The recommended environmental flow under different water management strategies.

5. Given that the applications in the paper are all to the past conditions, how about the applicability of the framework to future situations. I think the framework is only valuable if it can be applied in future decision making. How can it now be used?

Actually, the paper have already analyzed the application to the future situation, although in the ‘scenario analysis’ way, such as different scenarios in water utilizations for human activities. Variations was represented by initial environmental flows (twelve levels), river discharges (wet, normal and dry year) and strategies in water resources management (water system engineering and water-saving measures). All this strategies was planned for the future.

In the original manuscript, in the discussion sector **P12 Line 22~26**, the “water management strategy II included **expected** water utilization after the implementation of water diversion projects”; **P13 Line 3~6**, “under water management strategy III, water utilization patterns incorporated the **predicted** impacts of water-saving measures.”