

## Cover letter

April 21st, 2025

**Number:** hess-2024-399

**Manuscript Title:** Impacts of Inter-basin Water Diversion Projects on the Feedback Loops of Water Supply-Hydropower Generation-Environment Conservation Nexus

Dear Prof. Pieter van der Zaag,

We sincerely appreciate the time and effort you have dedicated to evaluating our manuscript titled "Impacts of Inter-basin Water Diversion Projects on the Feedback Loops of Water Supply-Hydropower Generation-Environment Conservation Nexus". We much appreciate your professional and insightful comments. All the concerns raised have been carefully treated and an itemized reply to your comments is presented in the revision files. Our changes are marked in **Red** in the revised manuscript.

Thank you very much again for your time and kind help. Looking forward to hearing from you.

Sincerely yours,

Dedi Liu

Email: dediliu@whu.edu.cn

## RESPONSES TO EDITOR'S COMMENTS

**COMMENT:** Thanks to the improvements made, the manuscript now reads much better, although it is still hard work to read the paper, and there remain many minor grammar weaknesses, which I do not have time to address. (But if the authors would share the word manuscript, I could make an attempt to edit it.)

**RESPONSE:** We sincerely appreciate your constructive feedback and the time you have dedicated to improving our manuscript. We are glad to hear that the revisions have enhanced readability and are grateful for your continued support. We fully understand the challenges posed by remaining grammatical inconsistencies and deeply value your offer to assist with further edits. As requested, we can provide a Word version of the manuscript. Your expertise in refining these details would be invaluable, and we are eager to incorporate your suggestions to elevate the manuscript's clarity and precision.

Please let us know if there are additional adjustments or sections you believe warrant priority attention. We remain committed to addressing all concerns thoroughly and are truly thankful for your guidance throughout this process.

### **Point #1**

**COMMENT:** *At several instances the paper refers to “reservoirs group” (e.g. lines 15, 47, 84, 205, 207, 215, 217 etc.), which nowhere is defined. This definition is needed because “reservoirs group” is not an established concept.*

**RESPONSE:** We sincerely appreciate the editor's careful reading and constructive feedback. We agree that the term "reservoirs group" requires clearer definition given its non-standardized usage in existing literature. In this study, “reservoirs group” refers to multiple reservoirs operated in series and parallel configurations to collaboratively manage water resource development and utilization across the basin. In the revised manuscript, we will add the following definition in the Introduction section (Section 1) where the concept is first introduced (Line 47):

“From the perspective of reservoir nodes under scrutiny, current research primarily focuses on single reservoirs (Wu et al., 2021), virtual reservoirs (Chen et al., 2020), and cases of two connected reservoirs (Khalkhali et al., 2018). To optimize the allocation of basin-scale water resources, the deployment of cascade reservoir systems has increased significantly (Liu et al., 2022), wherein multiple reservoirs with different priority functions are strategically interconnected through series-parallel hydraulic linkages. These reservoirs establish a reservoirs group to collaboratively manage the basin's water resource development and utilization. However, few of them focus on the reservoirs group with different priority functions.”

### **Point #2**

**COMMENT:** *At several instances the paper uses the term “collaborative states” (lines 14, 85, 101, 597, 615). Is this the same as “synergies”? I am not sure whether “collaborative state” is a felicitous term, as it may suggest that there is a “volition” of working together, but that’s not what this is about. In practice there is either a synergy or a trade-off or an absence of interaction. It is in my view noteworthy that in a nexus paper the word “synergy” is nowhere mentioned. Similarly, equally surprising is that the concept of trade-off is nowhere mentioned in the text.*

**RESPONSE:** We sincerely appreciate the editor's constructive feedback regarding the readability of the manuscript. The points raised are indeed crucial for enhancing the clarity and academic rigor of our nexus analysis. We fully agree with the reviewer that the term “collaborative states” could inadvertently imply a volitional or intentional dimension of interaction, which does not align with the objective nature of nexus. After careful consideration, we have replaced all instances of “collaborative states” with “synergies” throughout the manuscript (e.g., Lines 14, 87, 104, 601, 619) to better reflect the systemic interdependencies inherent in SHE systems.

### **Point #3**

**COMMENT:** *Why not call NEXUS I -> NEXUS SH; NEXUS II -> NEXUS SE, and NEXUS III -> Nexus HE (see e.g. Fig 1, line 223, 258, 259, 260, 261, 262, 263, 265). Reads much more easily, as it is more intuitive.*

**RESPONSE:**

We sincerely thank the editor for raising this important point regarding the nomenclature of our

nexus scenarios. We deeply appreciate your effort to enhance the readability of our framework and acknowledge that our original labeling (Nexus I/II/III) may not have been fully explained.

To clarify, the Nexus devices are defined as:

- **Nexus I:** *Nexus with inter-basin water diversion projects.*
- **Nexus II:** *Nexus without inter-basin water diversion projects.*
- **Nexus III:** *Nexus with the different clusters of inter-basin water diversion projects.*

While we agree that acronyms like SH/SE/HE could offer intuitive cues, since the representation of NEXUS is not easy to express in an abbreviated way, it may make the article more complicated. Therefore, we opted for Roman numerals to:

To address your concern, we have:

- Added an explanatory footnote in Fig. 1, explicitly defining the incremental logic of Nexus I-III.
- Added explanations of the Nexus I-III in Section 2.1 to help readers better understand their meanings.
- Added explanations of Nexus I-III in Table S6 in the Supplementary Material.

We sincerely regret any ambiguity caused by our original phrasing and are grateful for your insightful suggestion, which prompted us to significantly improve the transparency of our scenario definitions. Should the editor still consider acronyms preferable, we would be happy to adopt other way of naming.

“To address the impacts of IWDPs across the multiple temporal and spatial scales on the dynamic SHE nexus, multiple temporal and spatial scales runoffs from the water donating basins are provided through a distributed hydrological model. And multi-level ecological flows and their corresponding multi-level ecological flow standards are also determined according to an available method with spatial-temporal variability. To facilitate the identification of the impacts of IWDPs on SHE nexus, scenario experiments are set by “with/without IWDPs”. In order to take the different clusters of IWDPs into account, scenario experiments are classified by the impacts of IWDPs on water donation area, on water receiving area or on an area with both water donation and water receiving if there are IWDPs. To evaluate the feedback loops of the SHE nexus, the priority order of S, H, and E are iteratively set in all reservoir nodes. We set different types of the highest priority in S, H, and E and take the standard scheduling rules as reference scenarios. All scenarios are modeled in a multisource input-output reservoir generalization model, and differences between scenarios are quantified with a response ratio indicator. And the feedback loops with the different impacts of IWDPs are identified through a response ratio indicator. To explore the synergies, positive mutation in a response ratio across time-space is found between pairwise components of SHE. This framework can be applied globally to identify the feedbacks of the SHE nexus in basins with IWDPs.

Thus, our research framework is illustrated as Figure 1. The Nexus I-III in Figure 1 are defined as the nexus with IWDPs, the nexus without IWDPs and the nexus with the different clusters of IWDPs.

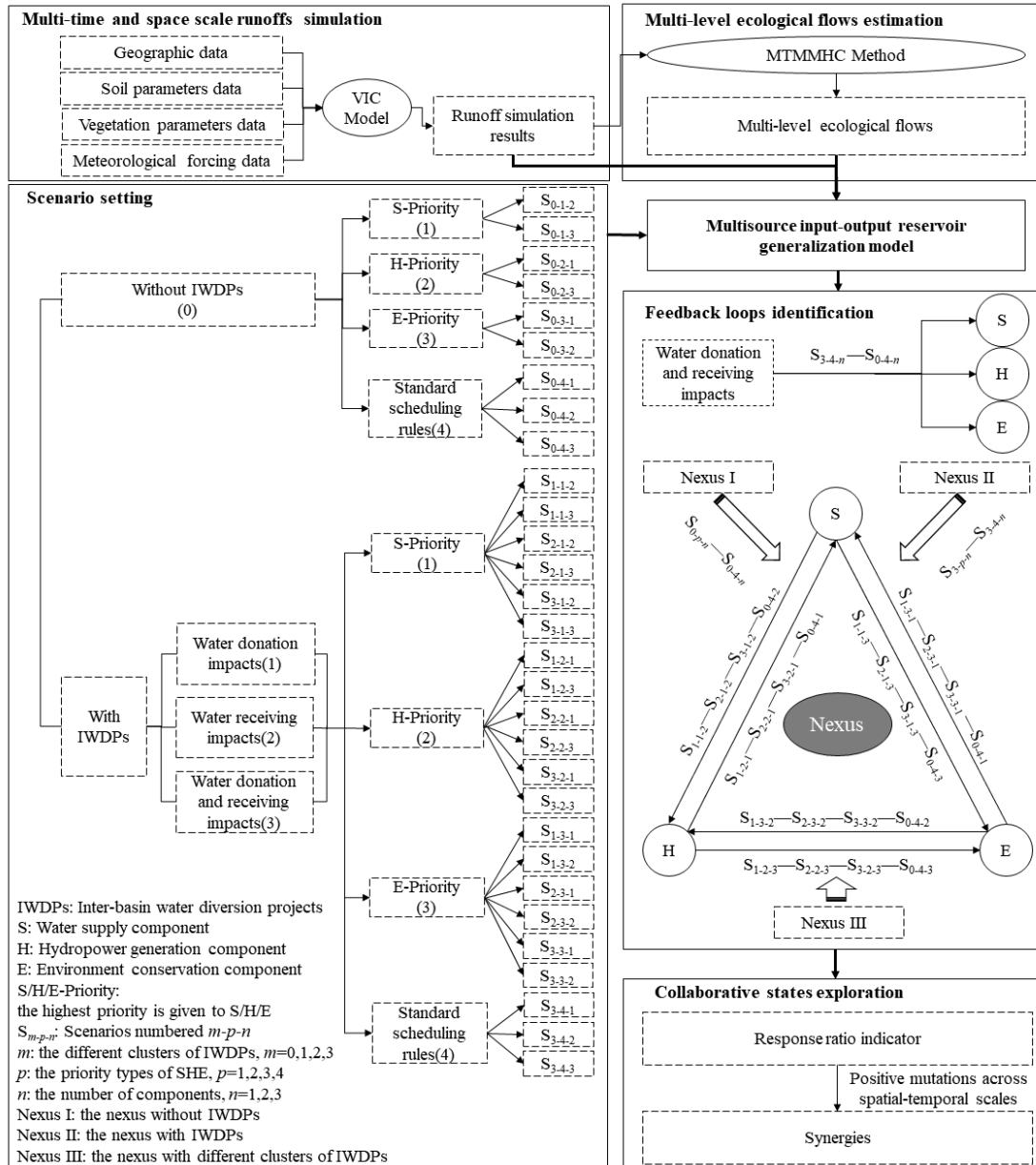


Figure 1. Framework to identify the impacts of different IWDPs on the feedback loops of SHE nexus.”

“Table S6. List of Abbreviations

Abbreviation	Full Term
IWDPs	Inter-basin water diversion projects
S	Water supply
H	Hydropower generation
E	Environment conservation

SHE	Water Supply-Hydropower Generation-Environment Conservation
Nexus I	Nexus with inter-basin water diversion projects.
Nexus II	Nexus without inter-basin water diversion projects.
Nexus III	Nexus with the different clusters of inter-basin water diversion projects.
HRB	Hanjiang River Basin
S-Priority	the highest priority is set to water supply
H-Priority	the highest priority is set to hydropower generation
E-Priority	the highest priority is set to environment conservation
the VIC model	The Variable Infiltration Capacity hydrological model
<i>NSE</i>	the Nash-Sutcliffe efficiency coefficient
$R^2$	Coefficient of determination
<i>PBIAS</i>	Percent bias
the MTMMHC method	The Modified Tennant Method Based on Multilevel Habitat Conditions method
the MIORG model	The Multisource Input-Output Reservoir Generalization model
<i>EFs</i>	ecological flows
<i>LRR</i>	log response ratio
DEM	the Inverse Distance Weighting method. Digital Elevation Model
HWSD	the Harmonized World Soil Database
SWCT	the Soil-Water Characteristics
FAO	Food and Agriculture Organization
IIASA	Institute of Internal Auditors South Africa

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#### **Point #4**

**COMMENT:** Table 3:

- Usable storage: why not use the more convention unit  $10^6 \text{ m}^3$  rather than  $10^8 \text{ m}^3$ ?
- “Annual generation” -> “Energy generation”
- Correct unit: billion kWh/yr (not billion kWh)

**RESPONSE:** We sincerely appreciate the editor’s constructive feedback on improving the clarity and comparability of our figures.

1) Unit of “Usable storage”: Following your suggestion, we have converted the unit from  $10^8 \text{ m}^3$

to  $10^6 \text{ m}^3$  (e.g., “0.92” → “92”) to adhere to widely recognized hydrological/metric standards.

2) Terminology Adjustment (“Annual generation” → “Energy generation”): The header has been revised to “Energy generation”.

3) Unit Correction for Energy Generation: The unit is now explicitly stated as billion kWh/yr (instead of "billion kWh") to emphasize the annualized nature of the data.

**“Table 3.** List of characteristic parameter values of reservoirs.

Characteristic parameter	Unit	Huang Jinxia	An Kang	Dan Jiangkou	Wang Fuzhou	Xing Long
Operational year	year	2023	1992	2013	2003	2013
Normal water level	m	450	330	170	86.23	36.2
Usable storage	$10^6 \text{ m}^3$	92	1680	16360	149.5	24.6
Dead water level	m	440	305	150	85.48	35.7
Installed capacity	MW	135	800	900	109	40
Energy generation	billion kWh/yr	0.25	2.80	3.83	0.58	0.23
Comprehensive hydropower coefficient	$\text{kg}/(\text{s}^2 \cdot \text{m}^2)$	8.4	8.4	7.7	8.5	8.4
Regulation ability	time	Daily	Yearly	Multi-year	Daily	Daily

”

## **Point #5**

### **COMMENT:**

*Typos / minor grammar issues in the manuscript:*

*a. Line 133: lager -> larger*

*b. Line 245: denoated -> denoted*

*c. Line 263: “can figure out” -> “show”*

*d. Line 279: “15 cascade reservoirs” -> “a cascade of 15 reservoirs”*

*e. Line 588: “in consisted with that in Hutuo River Basin” -> “consistent with those of the Hutuo River Basin” OR “inconsistent with those of the Hutuo River Basin” [I do not know which one of the two is meant. Carefully check!]*

*f. Lines 617-618: “will be figured out” -> “can be elaborated”*

**RESPONSE:** We sincerely apologize for the inadvertent linguistic oversights in our manuscript

and deeply appreciate your meticulous review, which has significantly improved the clarity and professionalism of our work. The corrections have been implemented as follows:

1) Line 137:

“lager” → “larger” (Corrected typographical error).

2) Line 249:

“denoated” → “denoted” (Revised spelling error).

3) Line 264 and 266:

“can figure out” → “show” (Adjusted informal phrasing to align with academic style).

4) Line 283:

“15 cascade reservoirs” → “a cascade of 15 reservoirs” (Revised for grammatical precision).

5) Line 592:

“in consisted with that in Hutuo River Basin” → “consistent with those of the Hutuo River Basin”

(We confirm the intended meaning was "consistent"; this revision clarifies the comparative analysis. We apologize for the ambiguous wording.)

6) Lines 621:

“will be figured out” → “can be elaborated” (Enhanced phrasing for technical rigor).

Thank you once again for your invaluable support and dedication to scholarly rigor. We have checked and verified the word spelling and grammar of the entire article. We hope there will be no more minor mistakes.