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# DRAFT PROJECT DOCUMENT ON GRAND WATER ATLAS OF ASIAN WATER TOWERS

SUMMARY

This document contains background information on the following sub-item:

8.2. The Grand Water atlas of the Asian Water Towers (and the related Draft Resolution)

# Grand Water Atlas of Asian Water Towers

## 1. Summary

The Asian Water Towers are the most important and most vulnerable water towers among the 78 water towers in the world. The Grand Water Atlas of the Asian Water Towers will address the glacier melt and its impact on rivers and lakes in the Third Pole region, and consequent disasters such as glacial lake outburst (GLOF) and ice collapse. Particularly focus will be the interactions among glaciers, water cycle and climate warming and the water availability and water security for billions of people in the region. It will also propose recommendations for water security and adaptation strategy contributing to the sustainability of the downstream countries. Four working groups, i.e. glacier melt, river and lake, climate change, synthesis, will be formed to efficiently carry out the project. The project will take 2-3 years to complete with specific four workshops as key activities. TPE related programs such as the Pan-Third Pole Environment (PAN-TPE) and the Second Tibetan Plateau Scientific Expedition and Research (STEP) will be scientifically and financially supporting the project.

## 2. Project Description

### 2.1 Overall purpose and relevance

The Third Pole, encompassing the Tibetan Plateau (TP), the Himalayas, the Karakorum, the Hindu Kush, the Pamirs and the Tien Shan Mountains, is characterized with the Asian Water Towers which are the most important and most vulnerable water towers among the 78 water towers in the world. The Asian Water Towers is the planet's largest reservoir of ice and snow after Arctic and Antarctic regions. The Asian Water Towers hosts the world's 14 highest mountain peaks and about 100,000 $km^2$ of glaciers. Melt-water feeds large lakes such as the Qinghai Lake, Nam Co and Selin Co, as well as over ten great Asian rivers, including the Indus, Brahmaputra, Ganges, Yellow and Yangtze etc. The water cycle associated with the Asian Water Towers ensures permanent flows of the Asia's major river systems, thus significantly influencing the social and economic development of more than 10 countries around the Asian Water Towers, including China, Nepal, Tajikistan, Pakistan, India, Afghanistan, Bhutan, Myanmar, Thailand, Vietnam etc., where more than 2 billion people live.

The Asian Water Towers have been exposed to significant environmental changes during the last five decades. Global warming-induced glacier retreat, ice collapse, glacial lake expansion and frequent Glacier Lake Outburst Floods (GLOFs) affect the stability of the Asian Water Towers, impacting on the lives of people living in the region. Research efforts have addressed the rapid changes in glaciers, lakes, rivers and

their downstream effects. It is now time to highlight the challenges of the Asian Water Towers to help develop mitigation and adaptation policies and water security strategies for the society in the region. The challenges can only be solved through international cooperation with involvement of scientific communities, international organizations and policy makers in related countries.

Third Pole Environment (TPE) is an international program of multi-sphere interaction of earth system across the Third Pole region. Over the past 10 years, TPE has developed into a well-known earth system science research program with a particular focus on the changes of the Asian Water Towers and their downstream impact. TPE is currently capable and ready to promote and to facilitate multinational collaborations across the Third Pole region. TPE has established a global network which consists of 5 international centres, including Chinese Academy of Sciences, Beijing, China; Tribhuvan University, Kathmandu, Nepal; Ohio State University, Columbus, USA; Gothenburg University, Gothenburg, Sweden; and Senckenberg Society for Nature Research, Frankfurt, Germany. Two more potential ones are cooperatively establishing with Pakistan Space & Upper Atmosphere Research Commission, Islamabad, Pakistan and Academy of Sciences of the Republic of Tajikistan, Dushanbe, Tajikistan. Within TPE, cryosphere melt and its associated regional hydrology and water resources are important research topics that receive more attention in recent years. Based on the research progress in TPE, it enables to synthesize advanced research results to produce knowledge regarding water regimes in the Third Pole region and to develop the Grand Water Atlas of Asian Water Towers, and to bridge the scientific knowledge with the society policy.

Through the collaboration with the UNESCO IHP, the Grand Water Atlas of the Asian Water Towers will **address evidence-based challenges related to water vulnerability and its impact on people and society under environment changes in the Third Pole region**, and to **propose recommendations for water security and adaptation strategy in the downstream countries**. This includes improving the understanding of glacier change in the Asian Water Towers under climate warming, and its impact on rivers and lakes as well as hazardous consequences, which are now regionally significant in term of water availability and water security, in order to strengthen local capacities for adaptation planning. The Grand Water Atlas of Asian Water Towers will share knowledge and understanding of the TPE research and, propose policy advice for the people in and around the Third Pole region.

The Grand Water Atlas of the Asian Water Towers will build on two TPE related research projects: The Pan-Third Pole Environment (PAN-TPE), an international research project initiated in 2018, and The Second Tibetan Plateau Scientific Expedition and Research (STEP), an initiative recently launched focusing on environment changes and their impact and adaptation on the Tibetan Plateau. This

guarantees the successful implementation of the Grand Water Atlas of the Asian Water Towers in terms of science support and coordination. This also guarantees the implementation of "The Grand Water Atlas of the Asian Water Towers" to address the problem of Asian Water Towers change and its local to regional impacts, as well as to provide scientific advice to policy makers to ensure green and sustainable development in the region.

The project will collaborate with UNESCO IHP by bringing innovative, multidisciplinary and environmentally sound methods and tools to society. UNESCO provides an intergovernmental collaboration platform and acts at the science-policy nexus to help meet today's global water challenges. The collaboration with UNESCO IHP, as part of its current, eighth phase (IHP-VIII 2014–2021) "Water Security - Responses to Local, Regional, and Global Challenges", as well as for ninth phase (IHP IX 2022-2029), particularly on achieving sustainable water management, and bridging the data and knowledge gaps in high elevation cold regions, is the most important platform for the Grand Water Atlas of the Asian Water Towers.

The project could be a companion of The Andean Glacier and Water Atlas that launched by UNESCO and the Norwegian GRID-Arendal Foundation in 2018. UNESCO has experience on executing such an outcome.

2.2 Impact

The Grand Water Atlas of Asian Water Towers will share knowledge and understanding of TPE research and produce policy advice for the people and nations not only in the Third Pole region but also beyond. It will have long-term positive effects on scientific community, policy-makers and local residents. Based on key messages and policy recommendations of the Grand Water Atlas of the Asian Water Towers, policy-makers in different nations in and around the Asian Water Towers can develop long-term science-based policies on water availability and water security, consequently governments would be able to strengthen local capacities for adaptation; and residents can be aware of environmental changes and their induced impacts in Asian Water Towers for improving their living condition. All these can contribute to global ecological environment protection and to the economic development in the region. Scientific community will benefit from the Grand Water Atlas of Asian Water Towers to improve observation and understanding of glacier change in and beyond the Third Pole region under climate warming, and to develop earth system science with integration studies of cryosphere, atmosphere, hydrosphere and their impact on rivers and lakes as well as hazardous consequences in and beyond the Third Pole region. An important long vision in the future is to develop the Grand Water Atlas of the Eurasian Water Towers with the cooperation of more scientists worldwide.

2.3 Contribution to Sustainable Development Goals

This project will directly support the implementation of the Sustainable Development Goals (SDGs) GOAL 6: CLEAN WATER AND SANITATION and GOAL 13: CLIMATE ACTION, by providing science-based policy recommendations on integrated water resources management including transboundary cooperation, and water-related hazards early warning. It will also directly support the implementation of Paris Agreement and the Sendai Framework for Disaster Risk Reduction.

2.4 Outcomes and outputs

**(1) The status of glacier melt**

Based on ongoing research carried out by TPE, the Grand Water Atlas of the Asian Water Towers will provide a latest glacier inventory of Third Pole. Based on previous glacier inventories and data collected from literatures, the temporal and spatial changes of glacier area and volume under climate warming will be evaluated.

**(2) The status of lakes and rivers under the impact of glacier melt**

Based on the data collected from literatures and research carried out by TPE, the latest distribution of lakes and rivers on the Third Pole will be mapped, and the temporal and spatial changes of lake and river water storage as well as river runoff under the impact of glacier melt will be presented.

**(3) The climate change impact on glacier melt and water cycle**

Based on historical gridded climate products (bias-corrected) using the available observation data and remote sensing data, and downscale high-resolution climate model, the hydrological-component distribution of the Grand Water Atlas of the Asian Water Towers will be evaluated in space and time.

**(4) The impact of Asian Water Towers and policy recommendations**

Based on statistical data and model simulation, the impacts of Asian Water Towers change on streamflow, water-related disasters, such as ice collapse and GLOFs, as well as the status of societies and economies can be assessed. By synthesising the above outputs, challenges will be addressed and recommendations will be made in terms of adaptation strategy for the Third Pole region.

2.5 Implementation strategy

The overall strategic approaches to ensure the achievement of project outcomes are described as follow:

(1) Setting up four working groups (WG) closely related with the major topics of the research activities to focus on four outcomes mentioned above. Each working group

members consist of TPE researchers, nominees by their UNESCO IHP National Committee and other key scientists and stakeholders from various organizations within and outside of the TP region.

(2) Linking and connecting to TPE and other ongoing program(s) through international collaboration. The activities and connections with other program(s) include sharing of data, knowledge, human resources, research tools, facilities, and models for climate, rivers, lakes and glacier.

(3) Supporting by TPE related research projects. The project will build on two TPE related research projects: PAN-TPE, an international research project initiated in 2018, and STEP, an initiative recently launched focusing on environment changes and their impact and adaptation on the Tibetan Plateau. This guarantees the successful implementation in terms of science and finance support, as well as coordination.

2.6 Project timeline

The duration of the project is 24-30 months.

Key activities will be carried out through four workshops outlined below:

- First workshop, summer 2022, to discuss objectives, form the Working Groups and develop the detail work plans and outline of the report.
- Second workshop, winter 2022, to discuss the Working Group themes and report draft.
- Third workshop, summer 2023, to review the final reports of the Working Groups and related outcomes and to discuss the major synthesis issues.
- Fourth workshop, winter 2023, to finalize the Grand Water Atlas report and distribute/publish the data/products by TPE/UNESCO IHP.
- There might be a fifth workshop in the spring 2024 if necessary.

2.7 Stakeholders: Beneficiaries and partners

The countries in and surrounding the Asian Water Towers, such as China, Nepal, Nepal, Pakistan, India, Myanmar, Thailand, Vietnam in the region will be the direct beneficiaries, as the Grand Water Atlas of the Asian Water Towers can improve the understanding of glacier melt under climate warming, and its impact on rivers and lakes as well as hazardous consequences in the region, which are now significant in term of water availability and water security.

International organizations, scientists, policy makers and local residents are the key partners. They will be involved in the Grand Water Atlas of the Asian Water Towers design and delivery activities. The project will invite IHP National Committee

members, individuals and groups from hydropower sector, agriculture sector, etc. During the project design and delivery, they will review the products of the project.

The above-mentioned specific workshops will also invite representatives of the direct beneficiary groups and key partners to ensure the project to protect their rights and opportunities, address their concerns and meet their needs.

2.8 Sustainability and exit strategy

The Grand Water Atlas of the Asian Water Towers will be produced with the help of the existing TPE and its related projects such as PAN-TPE and STEP, the benefits of the project will be sustained through TPE after its termination. TPE program itself or its related projects have funds available for the next five years which ensures the continuation of activities, and outcomes.

## 3. Project Management

3.1 Project management and implementation

The Grand Water Atlas of Asian Water Towers will be composed of two major parts:

Part 1 Outline:

1. Preface

2. Key messages

3. Policy recommendations

Part 2 Main contents:

1. Introduction

2. The Third Pole and Asian Water Towers

3. The amplifying warming

4. The accelerating glacier melt

5. The rapid changes of lakes and rivers

6. The hydrological, social and economic impacts of the Asian Water Tower changes

7. Challenges and recommendations

Working groups (WGs) of the Grand Water Atlas of Asian Water Towers will be formed which are closely related with the major topics of the research activities, and they will be based on the strong collaboration from all the nations within and outside of the

Tibet Plateau region. Four working groups are necessary to efficiently carry out the proposed work.

**WG 1 Glacier melt** – Tobias Bolch (University of St Andrews, UK), Ninglian Wang (Northwest University, China), Francesca Pellicciotti (Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland), Wei Yang (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China)

**WG 2 River and lake** – Walter Immerzeel (University of Utrecht, Netherlands), Zhongbo Yu (Hohai University, China; UNESCO IHP), Fan Zhang (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China), Yongwei Sheng (University of California, Los Angeles, USA)

**WG 3 Climate change** – Deliang Chen (University of Gothenburg, Sweden), Nicholas Pepin (University of Portsmouth, UK), Yongkang Xue (University of California, Los Angeles, USA)

**WG 4 Synthesis** – Tandong Yao (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China), Lonnie Thompson (The Ohio State University, USA), Deliang Chen (University of Gothenburg, Sweden), Walter Immerzeel (University of Utrecht, Netherlands), Tobias Bolch (University of St Andrews, UK), Xiaoming Wang (The Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, China), Lonnie Thompson (The Ohio State University, USA), etc.

The proposed leading authors are as following:

- Tandong Yao (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China)
- Lonnie Thompson (The Ohio State University, USA)
- Deliang Chen (University of Gothenburg, Sweden)
- Walter Immerzeel (University of Utrecht, Netherland)
- Tobias Bolch (University of St Andrews, UK)
- Zhongbo Yu (State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, China)

The proposed contributing authors are as following (listed in alphabetical order):

- Deepak Aryal (Tribhuvan University, Nepal)
- Suhaib Bin Farhan (Space and Upper Atmosphere Research Commission, Pakistan)
- Koji Fujita (Nagoya University, Japan)
- Andreas Kääb (University of Oslo, Norway)

- Arthur Lutz (FutureWater, Netherland)
- Fabien Maussion (University of Innsbruck, Austria)
- Francesca Pellicciotti (Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland)
- Nicholas Pepin (University of Portsmouth, UK)
- Chem Phalla (Cambodia Development Resource Institute, Cambodia)
- Yongwei Sheng (University of California, Los Angeles, USA)
- Ignasius Sutapa (Indonesian Institute of Sciences, Indonesia)
- Yasuto Tachikawa (Kaoto University, Japan)
- Ninglian Wang (Northwest University, China)
- Xiaoming Wang (The Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, China)
- Weicai Wang (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China)
- Chong-Yu Xu (University of Oslo, Norway)
- Yongkang Xue (University of California, Los Angeles, USA)
- Wei Yang (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China)
- Fan Zhang (Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China)
- UNESCO representative

The additional contributing authors will be included before and during the first workshop. Potential participants to be invited to the first workshop are showing in the table below. They are either the TPE participants or IHP members (or both) in different countries in the Third Pole region and other parts of the world.

It is important to emphasize that the implementation of The Grand Water Atlas of the Asian Water Towers needs international cooperation beyond the Third Pole region. The contribution from the scientists in the countries outside the Third Pole region, such as USA, Germany, UK, Sweden, Norway, are critical to a successful achievement.

The implementation of the Grand Water Atlas of the Asian Water Towers will rely mainly on the TPE program in terms of scientific support and coordination. This includes (not limited) to organize the workshops. In addition, with the endorsement

of the IHP NCs, necessary human resources should also be offered to UNESCO, such as a consultant or temporary staff through the secondment of selected TPE researchers/staff to the UNESCO offices in Paris or Beijing. It is also expected for the continuous liaison with IHP Secretariat, IHP NCs in the concerned countries, including China. There is also cost associated with related meetings, data collection, and productions of maps and reports. The TPE program has funds and resources available for such activities that should ensure a successful implementation of the Grand Water Atlas of the Asian Water Towers.

| N° | Potential Participants | Affiliation | Role |
|---|---|---|---|
| 1 | Nasir Ahmed | Bangladesh Atomic Energy Commission, Bangladesh | Contributing author of WG 3 |
| 2 | Vladimir Aizen | University of Idaho, USA | Contributing author of WG 1 |
| 3 | Deepak Aryal | Tribhuvan University, Nepal | Contributing author of WG 3 |
| 4 | Tobias Bolch | University of St Andrews, UK | Leading author of WG 1 |
| 5 | Fanny Brun | University of Grenoble Alpes, CNRS, France | Contributing author of WG 1 |
| 6 | Deliang Chen | University of Gothenburg, Sweden | Leading author of WG 3 |
| 7 | Sayeed Ahmed Choudhury | Bangladesh Meteorological Department, Bangladesh | Contributing author of WG 3 |
| 8 | Suhaib Bin Farhan | Space and Upper Atmosphere Research Commission, Pakistan | Contributing author of WG 2 |
| 9 | Marc Foggin | Mountain Societies Research Institute, University of Central Asia, Kyrgyzstan | Contributing author of WG 4 |
| 10 | Koji Fujita | Nagoya University, Japan | Contributing author of WG 1 |
| 11 | Walter Immerzeel | University of Utrecht, Netherland | Leading author of WG 2 |
| 12 | Tarekul Islam | Bangladesh University of Engineering and Technology, Bangladesh | Contributing author of WG 2 |
| 13 | Andreas Kääb | University of Oslo, Norway | Contributing author of WG 1 |
| 14 | Z. V. Kobuliev | Academy of sciences of the Republic of Tajikistan, Tajikistan | Contributing author of WG 2 |
| 15 | Toshio Koike | The International Centre for Water Hazard, Japan | Contributing author of WG 3 |
| 16 | Anil Kulkarni | Indian Institute of Science, India | Contributing author of WG 1 |
| 17 | Arthur Lutz | FutureWater, Netherland | Contributing author of WG 2 |
| 18 | Fabien Maussion | University of Innsbruck, Austria | Contributing author of WG 1 |

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| 19 | Bolot Moldobekov | Central-Asian Institute for Applied Geosciences, Kyrgyzstan | Contributing author of WG 4 |
| 20 | Volker Mosbrugger | Senckenberg Gesellschaft für Naturforschung, Germany | Contributing author of WG 4 |
| 21 | Santosh Nepal | International Centre for Integrated Mountain Development, Nepal | Contributing author of WG 2 |
| 22 | Sarath P. Nissanka | University of Peradeniya, Sri Lanka | Contributing author of WG 2 |
| 23 | Thaung Naing Oo | Forest Research Institute, Myanmar | Contributing author of WG 4 |
| 24 | Francesca Pellicciotti | Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland | Contributing author of WG 1 |
| 25 | Nicholas Pepin | University of Portsmouth, UK | Contributing author of WG 3 |
| 26 | Chem Phalla | Cambodia Development Resource Institute, Cambodia | Contributing author |
| 27 | Binita Phartiyal | Birbal Shani Institute of Palaeosciences, India | Contributing author of WG 3 |
| 28 | Tilak Priyadarshana | University of Ruhuna, Sri Lanka | Contributing author of WG 4 |
| 29 | Alim Pulatov | Central Asia and South Caucasus Consortium of Agricultural Universities for Development, Uzbekistan | Contributing author of WG 4 |
| 30 | Yongwei Sheng | University of California, Los Angeles, USA | Contributing author of WG 2 |
| 31 | Madan Lall Shrestha | Nepal Academy of Science and Technology, Nepal | Contributing author of WG 4 |
| 32 | Arin Bhakta | International Centre for Integrated Mountain Development, Nepal | Contributing author of WG 1 |
| 33 | Hans Christian Steen-Larsen | University of Bergen, Norway | Contributing author of WG 3 |
| 34 | Bob Su | University of Twente, Netherland | Contributing author of WG 3 |
| 35 | Ignasius Sutapa | Indonesian Institute of Sciences, Indonesia | Contributing author |
| 36 | Yasuto Tachikawa | Kaoto University, Japan | Contributing author |
| 37 | Shresth Tayal | The Energy and Resources Institute, India | Contributing author of WG 1 |
| 38 | Lonnie Thompson | The Ohio State University, USA | PI of the project and leading author of WG 4 |
| 39 | Kenichi Ueno | University of Tsukuba, Japan | Contributing author of WG 3 |

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| 40 | Kalim Ullah | COMSATS University Islamabad, Pakistan | Contributing author of WG 3 |
| 41 | Ninglian Wang | Northwest University, China | Contributing author of WG 1 |
| 42 | Xiaoming Wang | The Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, China | Contributing author of WG 4 |
| 43 | Chong-Yu Xu | University of Oslo, Norway | Contributing author of WG 2 |
| 44 | Yongkang Xue | University of California, Los Angeles, USA | Contributing author of WG 3 |
| 45 | Tandong Yao | Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China | PI of the project and leading author of WG 4 |
| 46 | Zhongbo Yu | Hohai University, China; UNESCO IHP | Leading author of WG 2 |
| 48 | Fan Zhang | Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China | Contributing author of WG 2 |

## 3.2 Monitoring

A 7-9 members of external reviewer panel will be appointed to monitor the performance of the project. External reviewers will consist of scientists and delegates of local government and community who have no conflict of interest with leading and contributing authors.

At least one key quantitative and/or qualitative performance indicators of each outcome will be identified and approved. The authors should report the information on key performance indicators quarterly to external reviewers, so they can track progress towards project implementation, output delivery and achievement of outcomes.

The direct and indirect effects of the project will be measured by its influence in different levels after the project has ended. This can be monitored by the information on citation number by the scientific community, media coverage by the public, policy implementation by the policy makers.

## 3.3 Evaluation

The evaluation will be organized close to the end of the project. Evaluation will start in the summer workshop of 2022 and continue in the winter workshop of 2022, the evaluation members will be UNESCO IHP nominated people.

3.4 Visibility

The Grand Water Atlas of the Asian Water Towers will underline the science communication. Several key measures will be carried out to enhancing the visibility of the project.

A website will be prepared online both at TPE and UNESCO IHP websites at the beginning of the project, showing and updating the latest news and activities of the project.

Social media platform matrix, including Twitter, Wechat, Youtube, will be operated by the assigned person to release information in a timely manner and to communicate with the public.

A joint press release by TPE and UNESCO IHP will be held at the end of the project. During the press release, the Grand Water Atlas of the Asian Water Towers report will be released globally.

TPE office has a team on science communication and will be responsible for above mentioned activities.

The LOGO of UNESCO and the LOGO of TPE will be both shown in publication and other occasions where it is necessary.

**Project Period:** 24-30 months

**Estimated Budget:** 440, 000 US$

TPE will provide financial supported to meet the budget.

**Moving forward**, requests the Secretariat's assistance to:

(1) review the proposed above draft project document with national authorities through IHP National Committees and invite nominations of experts, to establish a Task Force to prepare its Terms of Reference, a detailed project concept and plan by end January 2022, and submit them for approval to the 25th Session of the IHP council;

(2) help prepare a preliminary project budget according to UNESCO's rules and procedures and submit it to the IHP National Committee of China for required funding.

Invites:

IHP National Committees, both in the countries of the high mountain ranges of Asia (Third Pole region) and in all other regions, to support the proposed project and designate participants for its Task Force.