Localization of water resources management technology to adapt to climate change in Hong-Thai Binh River basin

Activity 2.2 Review of challenges and climate change risk to transboundary water resource management

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Prepared for UNFCCC Climate Technology Centre and Network, CTCN, as part of the Adaptation Fund Climate Innovation Accelerator Programme

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Represented by	Ms Clara Landeiro, Regional Manager, Asia-Pacific

Quality Supervisor:	Bertrand Richaud
Author:	Nguyen Ngoc Bach, Roar Jessen and Sílvia Leirião
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DHI A/S • Agern Allé 5 • • DK-2970 Hørsholm • Denmark
Telephone: +45 4516 9200 • sls@dhigroup.com • www.dhigroup.com

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Acronyms

CHIRPS	Climate Hazards Group InfraRed Precipitation with Station data
CTCN	Climate Technology Centre Network
DCC	Department of Climate Change
DWRM	Department of Water Resources Management
IMHEN	Vietnam Institute of Meteorology, Hydrology and Climate Change
KLORCE	Key Laboratory of River and Coastal Engineering – Vietnam Academy for Water Resources
MONRE	Ministry of Natural Resources and Environment
NAWAPI	National Center for Water Resources Planning and Investigation
NCHMF	National Center Hydrometeorological Forecasting
NDC	Nationally Determined Contribution
NVWATER	North Division for Water Resources Planning and Investigation
TA	Technical Assistance (TA)
WRI	Institute for Water Resources Science

Executive Summary

This report is the written deliverable of Activities 2.2 of the Climate Technology Centre Network (CTCN) technical assistance (TA) to Viet Nam entitled 'Localization of water resources management technology to adapt to climate change in Hong-Thai Binh River basin' (reference number AF-2021000099). The beneficiaries of the TA are the National Center for Water Resources Planning and Investigation (NAWAPI) and its North Division (NVWATER).

This report is the second and final deliverable of Output 2 which is the identification of climate change risk and challenges to transboundary water resources management in the Hong-Thai Binh River basin. Additionally, this report elaborates on the findings of the stakeholder consultation documented in 'Activity 2.1 Stakeholder Consultation Report', namely, the data needs and existing conditions for data and information sharing amongst institutions.

Key findings are the following:

- A modelling system to cover the Chinese area of the Hong-Thai Binh basin is needed to support national water resources management and planning since inflow from the upstream subcatchments (Chinese part) to Vietnam is unknown.
- There is no observed data in this part of the basin available to NAWAPI. Therefore, available data sources are mostly global, satellite based and free.
- Data needed as input to the model include precipitation, evaporation, land use, water use amongst others. Furthermore, observations of rainfall, evaporation and flow discharge by the border will be crucial to conduct model calibration.

A brief background to the TA is given in section 1 and while section 2 contains a preliminary analysis of the study area. Sections 3 contains the key findings with regards to identified climate change risks as investigated during consultation meetings with NAWAPI/NVWATER and the broader range of key stakeholder institutions.

1 Background

The United Nations has awarded funding to a technical assistance (TA) request to the Climate Technology Centre Network (CTCN) to select and customize technologies that can provide science-based information on transboundary water resources in the Hong-Thai Binh River basin in Viet Nam, to ensure more accurate and integrated planning. The main anchor institutions for the technical assistance are the National Center for Water Resources Planning and Investigation (NAWAPI) and its North Division (NVWATER). The organization delivering the technical assistance is DHI.

The duration of the TA is from April 2022 to October 2023 and the main objectives and outcomes are:

- Identification of climate change risk and challenges to transboundary water resource management in the Hong-Thai Binh River basin
- Identification of the most appropriate technology to provide science-based information on transboundary water resources
- Customization of the selected technology
- Capacity building in relation to the selected technology

This report is the second deliverable of **Output 2: Identification of climate change risk and challenges to transboundary water resources management in the Hong-Thai Binh River basin**, representing the first objective of the technical assistance.

Supported by the findings of the stakeholder consultation mission to Hanoi, meetings and technical meetings documented in “Activity 2.1 Stakeholder Consultation Report”, the chapters that follow present a summary of identified climate change risks and challenges.

2 Analysis of the Study Area

The Hong River rises in mountains south of Dali in China's Yunnan Province, and then descends 1,149 km through Vietnam where it passes Vietnam's capital Hanoi to finally exit into the Gulf of Tonkin. Flooding is a significant issue on the Red River as the average altitude in the Delta is 3-5 meters lower than maximum flood levels. Consequently, much hydraulic infrastructure in the basin is devoted, in whole or in part, to flood control. (WLE, 2022).

Also, according to (WLE, 2022) rainfall is unevenly distributed across the basin and ranges from 700 to 4,200 mm a year, about 80% of which falls between May and October. Average annual discharge from the river is about 136 km³. 61% of this water is derived from Vietnam meaning that 39% of the runoff originate from the upper Chinese parts.

During the inception meetings with the Vietnamese institutions even higher boundary flow fractions (50%-70% of the river flow) were mentioned. The difference to the WLE numbers may be due to reference observation points used in the analyses and how many transboundary tributaries are accounted for.

A rapid independent assessment based on satellite rainfall from source CHIRPS[1], made as part of this TA, indicate that the 39% of the total basin rainfall falls in China. Under an assumption that the runoff coefficients and water abstraction pattern are similar in the upper and the lower basin this seems to confirm the (WLE, 2022) flow estimate. However, the assumption probably leads to sub estimation of the transboundary flow fraction, since the population density and water use intensity in the delta is higher than those in the upper parts of the basin and the assessment by the Vietnamese institutions may therefore very well be realistic.

The uncertainty in the transboundary flow assessment does not change the fact that a very substantial part of the available surface water in the Vietnamese Hong-Thai Binh Basin enter from the upstream Chinese parts of the basin, see Figure 2.1 for an illustration.

Hence, the transboundary inflow from China is an important natural contribution to the water resources available in the (lower) Vietnamese parts of the basin where the water resources situation is under considerable stress both due to high rates of industrial and urban developments, the large population density and the requirements for river transportation, power generation, irrigation, domestic supply and flood control that follows.

With the water resources of the Vietnamese parts of the basin being under considerable stress, the forecasts of the transboundary flows from China are important elements both for long-term (investment) planning, for seasonal (operational) planning and for short-term planning (flood management and navigation purposes). It goes without saying that possible changes in these transboundary flows as a consequence of climate change and possible regulation are essential parts of such forecasts.

Furthermore, the projected sea level rise will, in combination with possible future decreases in low flows from the basin into the densely populated delta areas, increase the tidally induced salinity intrusion through the estuary and further constrain the access to fresh river water for irrigation and domestic fresh water supply in the delta areas.

[1] Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 40+ year quasi-global rainfall data set. Spanning 50°S-50°N (and all longitudes) and ranging from 1981 to near-present. CHIRPS was created in collaboration with scientists at the USGS Earth Resources Observation and Science (EROS) Center in order to deliver complete, reliable, up-to-date data sets for a number of early warning objectives, like trend analysis and seasonal drought monitoring.

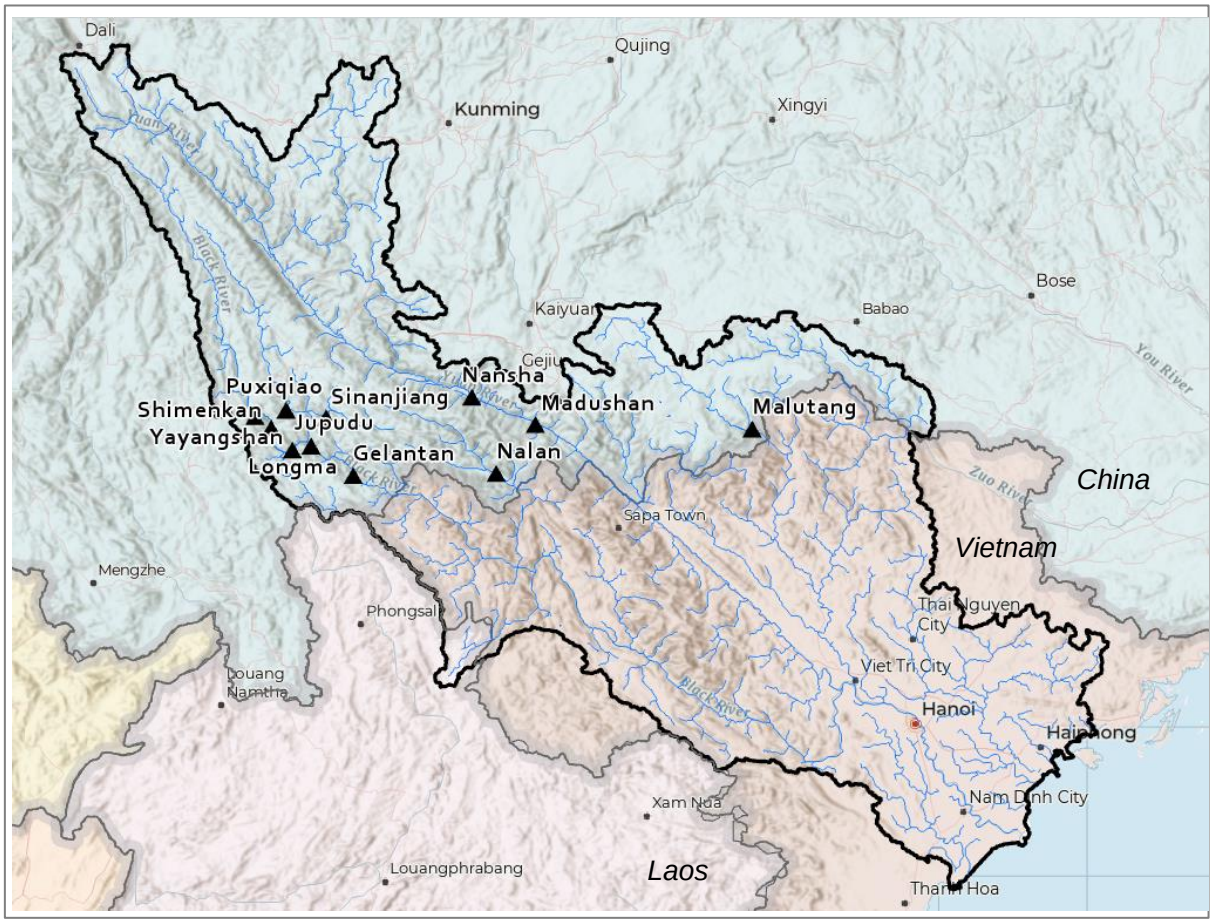

Figure 2.1 **Illustration of the Hong-Thai Binh river basin outline in black, showing the river network in blue, and the reservoirs and dams existing on the upstream Chinese part of the basin in black (baseline map by OpensStreetMap).**

3 Challenges and Climate Change Risks

This section describes the impacts of climate change, mitigation efforts, and adaptation actions. The focus is on the northern part of Viet Nam where the Hong-Thai Binh basin is located, although in many cases only information for the entire country is available. It should also be noted that a large part of the basin is located in China. A map of Viet Nam divided into the regions that are referred to in this chapter can be seen in Figure 3.1. Most noticeably, information was collected for N1 – North West and N2 – North East regions.

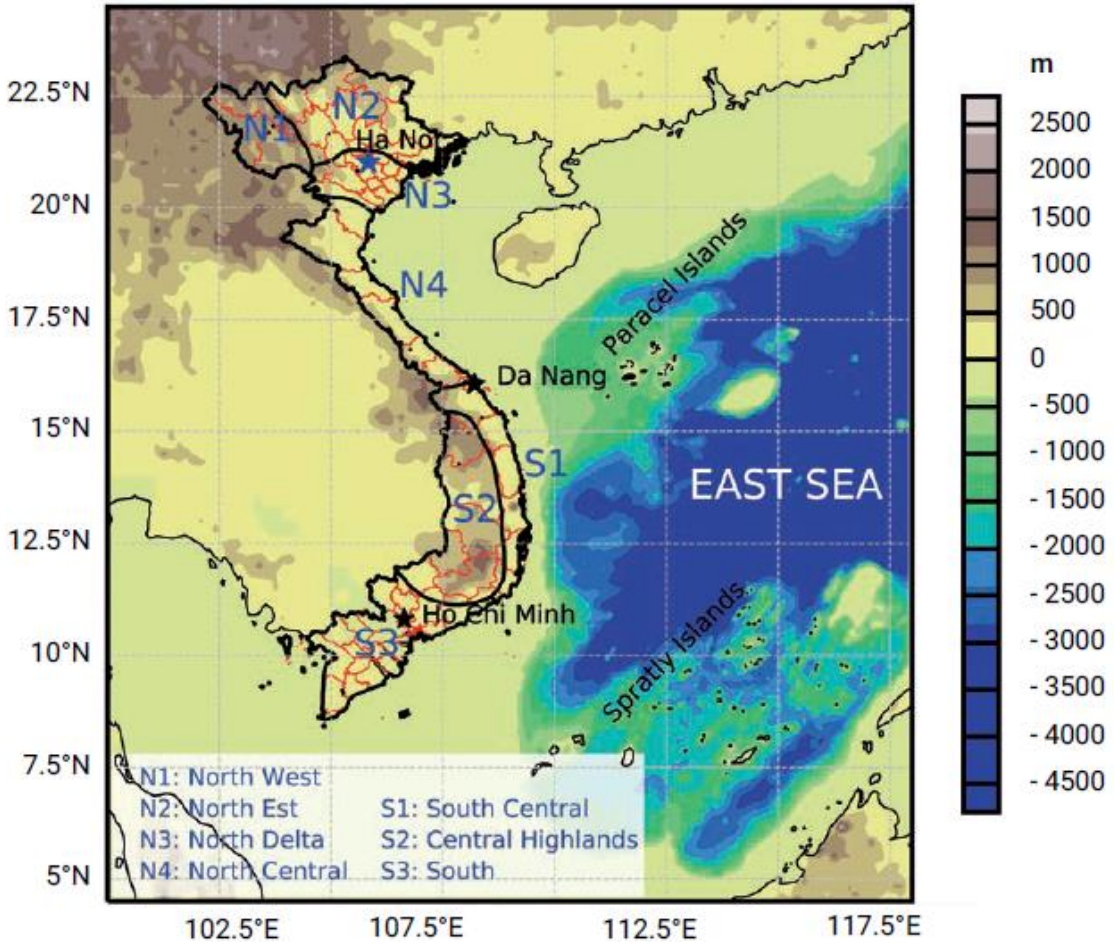

Figure 3.1 Overview of the regions in Viet Nam that are used in this chapter, along with the topography of the basin (Espagne, 2021).

During the consultation period of the TA, it was not possible to obtain data and information from the Department of Climate Change, MONRE, therefore the contents of the sub-chapters that follow are mostly informed by Viet Nam's 2020 Updated Nationally Determined Contribution (NDC).

3.1 Climate impacts

Viet Nam is often presented as one the countries that are most severely impacted by climate change. The impacts described below were sought from Viet Nam's Updated NDC (2020).

For the period 1981-2018, temperature increased across the country. One of the highest increases per decade was in the North Delta in the spring season. However, the smallest decrease per decade was in the North East and North Central regions. Extreme temperatures

increased in nearly all regions. The daily maximum temperature increased across the country, although several monitoring stations in North West and North East regions had a decrease in daily maximum. The daily minimum temperature also increased across the country, overall, with a larger increase than the daily maximum. The second-highest increase in daily minimum temperature in the country occurred in the North West region. The number of hot days (daily maximum temperature ≥ 35^{o} C) and very hot days (daily maximum temperature ≥ 37^{o}C) increased the most in the southern North East and North Delta regions. In some areas of the North West regions, the number of hot and very hot days decreased. The number of cold days (daily average temperature ≤ 15^{o}C) and very cold days (daily average temperature ≤ 13^{o}C) decreased in the north of Viet Nam, especially in the North West and North East regions.

While annual precipitation increased slightly for the whole country, several stations in the North West regions showed a decline while several stations in the North East and North Delta showed an increase. The rainfall extremes increased in many stations in the North East and North West stations (Espagne, 2021).

Additionally, monitoring data over the past 60 years (1958-2018) have shown the following changes:

- A rise in the annual average temperature for the whole country of 0.89^{o}C
- A rainfall decrease in the northern regions of 1-7 %.
- An increase in the number of strong typhoons over the whole country.
- Increases in daily maximum and minimum temperatures over the whole country.
- An increase in the number of hot days in most areas.
- More frequent droughts in the dry season over the whole country.
- A decrease in the number of cold and freezing days over the whole country.
- Increase in extreme rain over the whole country.
- Average sea level rise at coastal and island monitoring stations increased by 2.74 mm/year, particularly 3.0 mm/year during 1993 - 2018.

Water flows at hydrological stations in major main river basins have been below average for several years. In many places, water levels have reached historic lows, causing water shortages for agricultural production and for people's daily use. It is also causing deeper saline intrusion into estuaries (The Socialist Republic of Viet Nam, 2020).

3.2 Mitigation efforts

Similarly, to the impacts of climate change described in the previous section, the mitigation efforts summarized herein were taken from Viet Nam's Updated NDC (2020). It was not possible to ascertain the status of implementation of the measures nor its success rate.

According to the NDC, the country has adopted measures in energy, transport and agricultural sectors.

A policy of energy-saving and energy efficiency to reduce the emissions of greenhouse gasses is adopted. Additionally, the capacity of small-scale hydropower, wind power, biomass, and solar power has been increased, thus increasing the generation of renewable energy.

In the transport sector, climate change responses have been mainstreamed into the process of updating, adjusting, and developing sectoral strategies and planning. Additionally, the usage of renewable energy in public lighting, including traffic lights, has increased.

In the agricultural sector, long-duration rice types have been replaced with short-duration types. The areas with mid-season water drainage and alternating wet and dry irrigation techniques have been increased. Additionally, areas with integrated crop management and areas with more sustainable and efficient growing techniques have increased. The rate of field burning has been reduced, diets of milk cows have been improved, and organic waste from livestock production

has been collected and treated to make organic fertiliser. Finally, water-saving irrigation techniques have been applied on large areas of coffee.

In the land use, land use change, and forestry (LULUCF) sector, REDD+ programmes have focused on improving institutional frameworks and policies, capacity building, developing technical guidelines, and investing in the implementation of REDD+ activities. National forest coverage is on the rise.

Finally, it is also reported in the NDC that many solid waste treatment plants have been built and implemented with new and advanced technologies (The Socialist Republic of Viet Nam, 2020).

3.3 Adaptation actions

The country is working on implementing adaptation actions. These include according to the NDC (2020):

- Strengthening the capacity for monitoring, warning, risk assessment, etc.
- Working with infrastructure, including clean water supply, assessment of flood prone areas, and adapting infrastructure to the impacts of climate change.
- Developing and implementing the national water resources master plan and river basin integrated master plan to take account of climate change, including ensuring water security under climate change.
- Changing production structures, plant and animal varieties, agricultural production techniques etc. to be more climate-smart, climate resilient and environmentally friendly.
- Implementing sustainable forestry, including conserving and enhancing forest carbon stocks and protecting, restoring, and planting mangrove and coastal protection forests.
- Implementing the master plan for irrigation under the context of climate change and implementing the national action plan to combat desertification.
- Proactively undertaking natural disaster prevention, control and mitigation. This specifically includes implementing flood prevention planning in the Hong-Thai Binh River system and protecting flood drainage spaces in the basins of the Hong-Thai Binh River.
- Implementing programmes to ensure safety and improve the efficiency of reservoir exploitation and building new, small reservoirs and spillway clusters in the Northern mountainous regions as well as repairing and upgrading irrigation systems in the Hong River Delta.
- Promoting measures to prevent and mitigate impacts of high tides, inundation, and saline intrusion due to sea level rise as well as building flood risk maps based on sea level rise and implementing flood prevention schemes for coastal cities.
- Develop and improve urban areas to proactively respond to climate change.
- Conducting research on climate change impacts, climate change responses, climate change adaptation models and applying climate change response technologies to different sectors.
- Enhancing knowledge dissemination and improving adaptive capacity, ensuring livelihoods for people in areas at seriously high risk of climate change impacts as well as in areas frequently affected by natural disasters, and raising awareness of risk management, sustainable management of mangrove forests through education and information dissemination.

4 References

/1/ DHI (2008). *Benefits on Climate Change Adaptation from Small and Medium Scale Hydropower plants. Synergies and Trade-offs with Rural Development.*

/2/ Espagne, E. (2021). *Climate change in Viet Nam. Impacts and adaptation.*

/3/ Kellogg Brown & Root Pty Ltd (2008). *TA4903-VIE WATER SECTOR REVIEW PROJECT*. Prepared for The Office of the National Water Resources Council on behalf of the Government of Viet Nam.

/4/ Ministry of Natural Resources and Environment (2006). NATIONAL WATER RESOURCES STRATEGY TOWARDS THE YEAR 2020.

/5/ Ministry of Natural Resources and Environment, Vietnam institute of Meteorology Hydrology and Envirionment (2010): Impact of Climate Change on Water Resources and Adaptation Measures. Final Report Financed by the Danish International Development Agency (Danida).

/6/ Phuong T.A. et al (2020) *Application of remote sensing techniques for analyzing operation of upstream reservoirs in transboundary river basins of Vietnam*. Viet Nam Journal of Hydrometeorology, 2020, 5, 101–111; doi:10.36335/VNJHM.2020(5).101–111.

/7/ The Socialist Republic of Viet Nam. (2020). *Updated Nationally Determined Contribution (NDC).* Ha Noi.

/8/ WLE Greater Mekong (2022) Cgiar: Webpage on Research Program on Water Lands and Ecosystems, Greater Mekong, https://wle-mekong.cgiar.org/changes/where-we-work/red-river-basin/