# Hin Nam No Hydrology and Meteorology – Studies, Historical Data and Measurement Needs

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Date: Spring 2019

For ProFEB, GIZ Project

*Background*

Hin Nam No National Protected Area is a candidate for listing as a UNESCO natural World Heritage Site in the near future. Outstanding Universal Values (OUVs) are the justification of any inscription into the World Heritage list and the Xe Bang Fai (XBF) Cave is perhaps the world's largest river cave passage, and with the world's highest peak water flows from a cave (or karst spring), and therefore an OUV in itself. As Hin Nam No NPA features a collaborative management system that follows an integrated conservation and development-approach, it's essential to warrant the long-term integrity of the OUVs, namely the Xe Bang Fai Cave, and to understand the threats to the local communities living around Hin Nam No NPA through the high variation of the discharge in the Xe Bang Fai River, possibly aggravated through climate change. Key to the protection of Xe Bang Fai Cave and Xe Bang Fai River is the management of the catchment area, especially the area upstream of the cave.

The Nam Ngo is another river system in the northern part of Hin Nam No which is an important resource for Hin Nam No NPA and its wildlife, and for the local communities living in its catchment area. Currently, little is known about the meteorology, hydrology or water quality of Hin Nam No and its water resources. Such information and knowledge is needed to support the World Heritage nomination and the sustainable management of the water resources for both conservation and human welfare and development.

*Objectives*: The proposed meteorological and hydrological studies aim to outline:

1. A general understanding of the characteristics of the meteorology and the hydrological systems of Hin Nam No NPA. A preliminary identification of trends relevant to Hin Nam No NPA with a strong focus on the Xe Bang Fai River system based on both existing data and new field research and measurements.
2. Development of a basic hydrogeological map of Hin Nam No NPA, as an important tool for the management of the karst and caves of Hin Nam No, and management of the upstream or allogenic catchment areas draining into the Hin Nam No NPA.
3. A risk analysis of potential hydrological threats to the OUVs (focus: Xe Bang Fai cave ecosystem and cave formations, also potential threat to tourism in the cave) and preliminary identification of potential risks and threats to buffer zone settlements.
4. Assessing the framework conditions needed to preserve the quality of the watershed, preventing degradation of the OUVs (focus on Xe Bang Fai cave, see above) and potential mitigation of risks and threats to buffer zone communities.
5. Devise a basic hydro-meteorological monitoring system for Hin Nam No NPA.

*Historical Data*

- Meteorology: data on rainfall and other parameters (temperature, humidity, wind, radiation, etc) should be identified and collected from a site(s) as close as possible to

Hin Nam No NPA. Apparently, there is a weather station at Boualapha town maintained by DONRE, and they have weather data for 'many years'. Mr Thongsri is a possible contact person at Boualapha DONRE. These is supposed to be a rainfall station at Ban Sa-Ang. There should be a good record of meteorological data from the hydro-met station at Mahaxay. Khammouane PONRE should have information on the locations of weather stations near Hin Nam No NPA, and possibly the historical data as well.

- Hydrology: data on daily discharge of the Xe Bang Fai River should be available from the hydro-met station at Mahaxay. The historical discharge data for the Mahaxay station should be useful up until 2010. From 2010 onwards, additional water inputs from the Nam Theun 2 hydropower project make the data from Mahaxay no longer useful for extrapolating to Hin Nam No NPA. There is a hydrologic station at Kuanpho, which is upstream of where waters enter the Xe Bang Fai from NT2. This station only measures daily water level (not discharge), but would provide useful information, especially for the period from 2010 onwards. There is also supposed to be a rainfall station at Kuanpho. At Ban Sa-Ang there is supposed to be some measurements of daily water level, kept by the village (according to Boualapha DONRE).

*Measurement Needs*

Hydro-meteorological stations should be set up at 3 locations in and around Hin Nam No:

- *Ban Laboy*, upstream of the Hin Nam No karst. This station would give data on the quantity and quality of water flowing into the Hin Nam No karst from non-karst (allogenic) sources. A hydro-met station at this location could also provide the basis for a flood early warning system for downstream villages.
- *Ban Nongping*, at or downstream of the resurgence from the Xe Bang Fai Cave. A station at this location is needed to determine the flows emerging from the Xe Bang Fai Cave, to determine if they truly are among the greatest in the world, and therefore an OUV. It is also critical to measure and monitor water quality in the Xe Bang Fai Cave.
- *Ban Vangmaner*, upstream from the village, before the confluence with the Huay Hok stream. This station would give data on the quantity and quality of water flowing out of the karst in the northern part of Hin Nam No. A hydro-met station at this location could also provide the basis for a flood early warning system for downstream villages.

Meteorology and hydrology considerations:

- Meteorological stations (rainfall and other parameters), in combination with hydrological stations, will allow for some basic hydrological modelling to be done. Hydrologic modelling is necessary for assessing risks associated with flooding, drought and climate change.
- Water discharge (m3/sec) measurements are desirable, but more difficult to obtain than water level measurements. Discharge measurements are needed at Ban Nongping, at least, to prove and document the Xe Bang Fai Cave as the largest karst spring in the world (an OUV for WH).
- If discharge measurements are also made at Ban Laboy, then the difference in discharge between Ban Laboy and Ban Nongping will provide a good estimate of subsurface inflow from the karst plateau.

Water quality considerations:

- Baseline water quality information is required, so that in future years there is a reference point for assessing the effectiveness of river basin management. Both chemical/physical and biological indicators of water quality should be measured. At Ban Nongping, water quality measurements (water samples) should be taken (located) in a totally dark section of the river in the downstream end of the Xe Bang Fai Cave.
- Fish and macroinvertebrates may be useful as biological indicators of water quality. Also, analytical measures such as biological oxygen demand (BOD) should be used to assess and monitor water quality. Biological indicators of water quality should be monitored on a regular basis.
- Chemical and physical indicators of water quality include: pH, temperature, dissolved oxygen, total dissolved solids, nutrients (N and P), metals, and water clarity. A baseline assessment of chemical and physical indicators should be made, with monitoring on an occasional basis, or when biological indicators detect a decline in water quality.

Catchment Condition:

- Use remote sensing techniques, such as NDVI, to assess and monitor catchment condition and change (in terms of vegetation cover, land use, etc) in the protected areas (Hin Nam No, Khoun Xe Nongma), and catchment areas outside of the protected areas.

*Outputs*, from collecting and analyzing this hydro-met and water quality data could include:

1. A review of existing hydrological and meteorological data and preliminary analyses
2. A preliminary comparison with hydrological characteristics of Phong Nha Ke Bang
3. A basic hydrogeological map of Hin Nam No NPA
4. An assessment of risk and threats to the XBF cave and buffer zone communities, including recommendations for threat prevention
5. A report on the setup and functioning of the monitoring system(s)
6. A summary for framework conditions and recommendations for catchment protection
7. Recommendations for integrating remote sensing data into the monitoring, and assess the potential for remote sensing to provide information for developing a hydrogeological map