Better understanding and preparedness for drought risk: use of the “chrono-systemic timeline” tool for a transversal analysis (case study in Belgium)

Technical topic : Drought Preparedness

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INTRODUCTION AND OBJECTIVES

With its slow dynamics, broad scope and numerous cumulative and multidisciplinary impacts (Wilhite & Glantz, 1985; Sthal et al., 2016), drought is a complex and extreme climatic event that can cause both a simple environmental disturbance and a major socio-economic crisis. Moreover, global warming will increase the frequency and intensity of droughts (IPCC, 2021). The consecutive droughts of 2018 and 2019 in Europe are already considered to be unprecedented in the last 250 years (Hari et al., 2020).

In Wallonia (southern part of Belgium), water deficits have multiplied in an almost structural way over the last twenty years. Autorities must therefore prepare for this new climatic challenge in order to limit costly and destructive impacts. A way to prepare for this risk and to improve crisis management is to analyse feedbacks from field actors who have experienced droughts. This process of increasing the knowledge is optimal if a multidisciplinary logic is used.

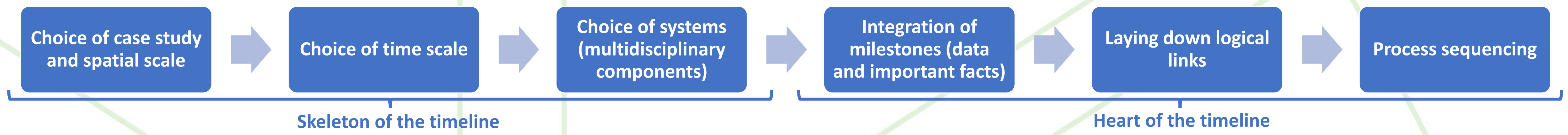
In this context, this study build and develop an original and innovative tool - the chrono-systemic timeline - in order to better understand the interdisciplinary process of droughts and to promote a sustainable and transversal management of this risk.

METHODOLOGY

A chrono-systemic timeline is an interdisciplinary instrument for analysing change processes in a territory (Bergeret et al., 2015). This tool contributes, through a socio-ecosystemic analysis of an experience, to improve the management of similar future situations.

In the context of a drought during which the consequences are extremely varied, whether sectorally, spatially or temporally, the timeline allows us to combine the key events of the crisis and the logical links between them in a single and synthetic diagram.

The timeline is constructed in six stages :



Choice of case study and spatial scale → Choice of time scale → Choice of systems (multidisciplinary components) → Integration of milestones (data and important facts) → Laying down logical links → Process sequencing

Skeleton of the timeline — Heart of the timeline

The case study selected is the successive droughts of 2018, 2019 and 2020 in Wallonia. These events have exceptional weather conditions marked by much higher than normal sunshine and temperatures, as well as exceptionally low precipitation in frequency and quantity. These droughts are also recent and in phase with the current climatic reality. In terms of temporality, the chrono-systemic timeline is constructed on a linear time scale of three years.

The contexts considered are climatic and hydrological conditions, economic and social context (water production, agriculture, natural environments, energy, navigation, tourism, public health) and political decisions. The data used for each of these contexts comes from the Regional Crisis Centre of Wallonia (CRC-W), the Royal Meteorological Institute of Belgium (RMI) and the National Institute of Public Health in Belgium (Sciensano).

MAIN RESULTS

- 12 meteorological seasons with higher than normal average temperatures + 6 heat waves
- 3 years with precipitation < normal (-328 mm over 3 years ≈ -13%/year)
- Critical situation of water resources from August to November in 2018 and 2020
- Strong pressure on the distribution of drinking water Alternative supplies
- ↘ crop yields and severe degradation of grasslands with major financial and health impacts
- ↗ mortality and bark beetle attacks (*Ips typographus*) High risk of forest fires
- Stopping or ↘ production by hydroelectric power plants
- Grouping of boats at locks, impacts on water recreation
- High excess mortality during hot periods
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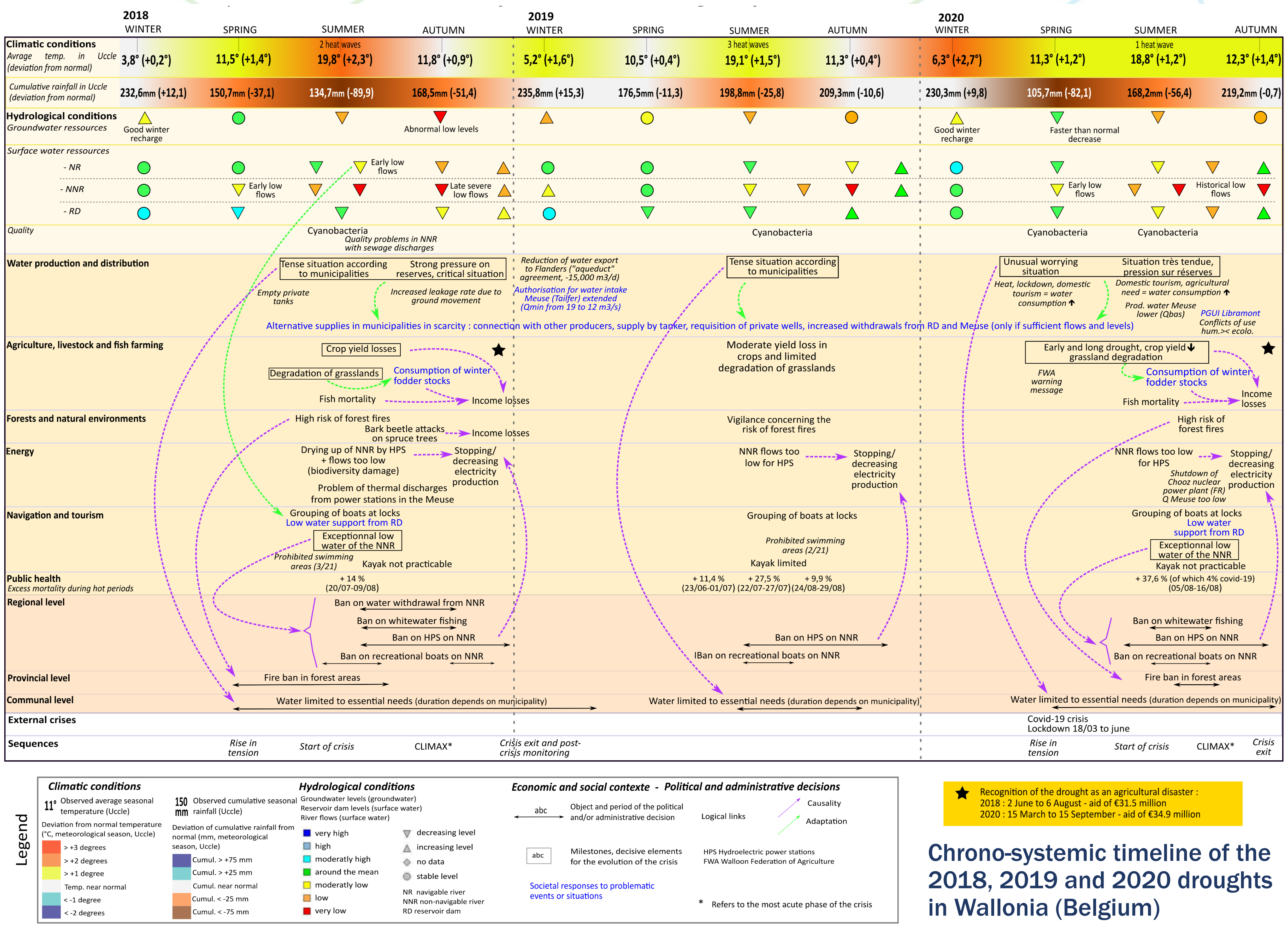
  - regional → bans on water extraction, fishing, hydroelectric micro power plants and tourist navigation; drought recognised as an agricultural disaster allowing compensation
  - provincial → ban on fires in forest areas
  - communal → water use for essential needs only
- Repetition of the cycle : rise in tension→ initiating phenomenon→ crisis management→ climax→ crisis exit



Chrono-systemic timeline of the 2018, 2019 and 2020 droughts in Wallonia (Belgium)

CONCLUSIONS

The chrono-systemic timeline constructed from feedbacks of recent droughts in Wallonia highlights several long periods of major impacts, a slow return to a so-called normal situation and a reactive crisis management (decisions of the authorities taken mainly when the crisis is established). The tool shows the presence of a water stress situation in all the socio-ecosystems of the territory and confirms that the consequences and extent of a drought depend strongly on the environmental and societal context (Thibaut & Ozer, 2021).

With its synthetic, transversal and temporal approach and logical links between socio-ecosystems studied, the chrono-systemic timeline is really an efficient instrument to better understand the dynamic process of drought risk and to improve a holistic management of water scarcity. In conclusion, this tool should be integrated in the crisis management system and the risks related to water deficits should be better considered in public policies in order to implement an anticipative and adaptive management of these risks.

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