

An investigation and evaluation of risk management for urban drinking water crises: A case study of Wuxi City, China

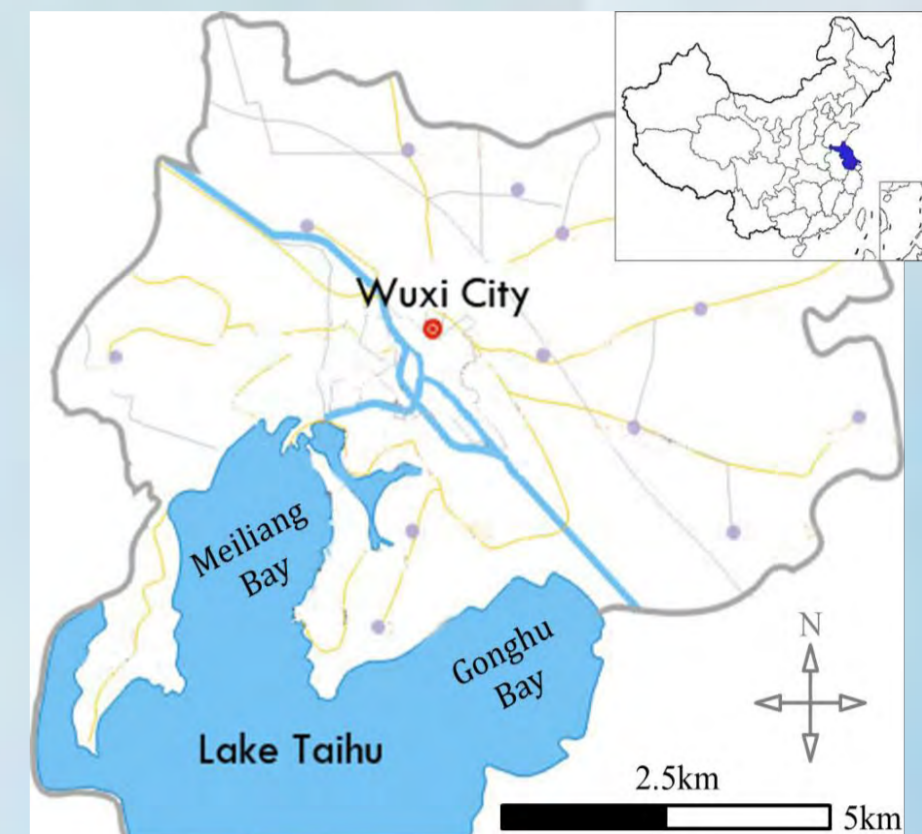
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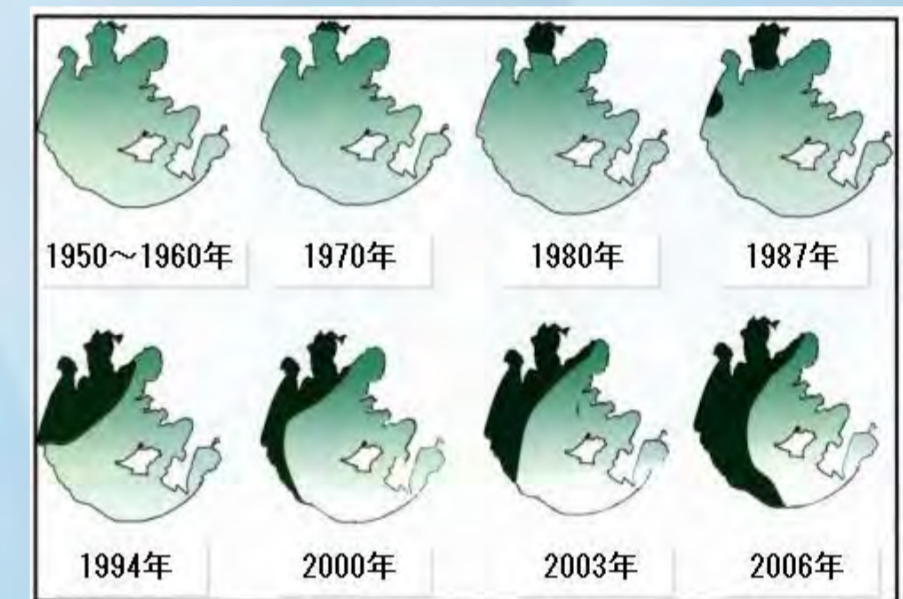
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INTRODUCTION

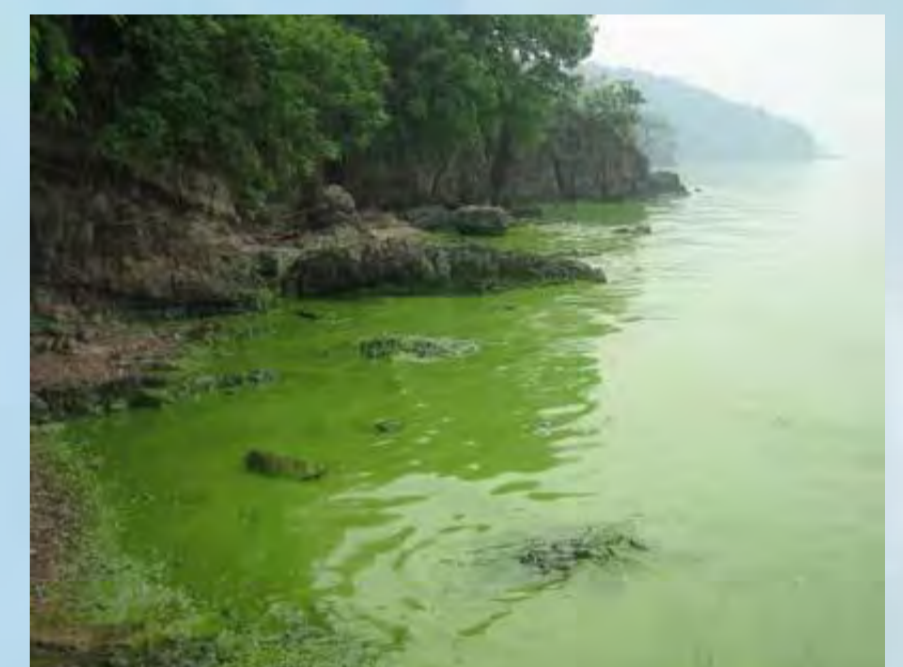
Internationally, the last a few decades have witnessed a large number of drinking water crises. In China, one of the most large-scale outbreaks was the 2007 Wuxi water crisis caused by an algal bloom in Lake Taihu, the third largest freshwater lake in China, which has affected over 2.5 million residents in the city. The expansion of algae bloom due to Taihu eutrophication status over the past decades has increased the risk of drinking water crises. As a response to drinking water crises all around the world, it is considered that comprehensive risk management is the most effective mean of consistently ensuring the safety of a drinking water supply. However, risk management is quite a new concept for water supply authorities in China. Therefore, this research has taken Wuxi City as a case study and applies a risk analysis approach to semi-quantitatively evaluate the current water supply system in Wuxi City, and from this analysis, proposals have been developed for effective risk management in the future.



Map of Wuxi City



Expansion of algal bloom in Lake Taihu (Source: Xie Ping, 2008)



2007 Algal bloom in Lake Taihu (Source: Sohu net, 2007)

METHODOLOGY

Investigation on 2007 Wuxi water crisis and current condition of the water supply

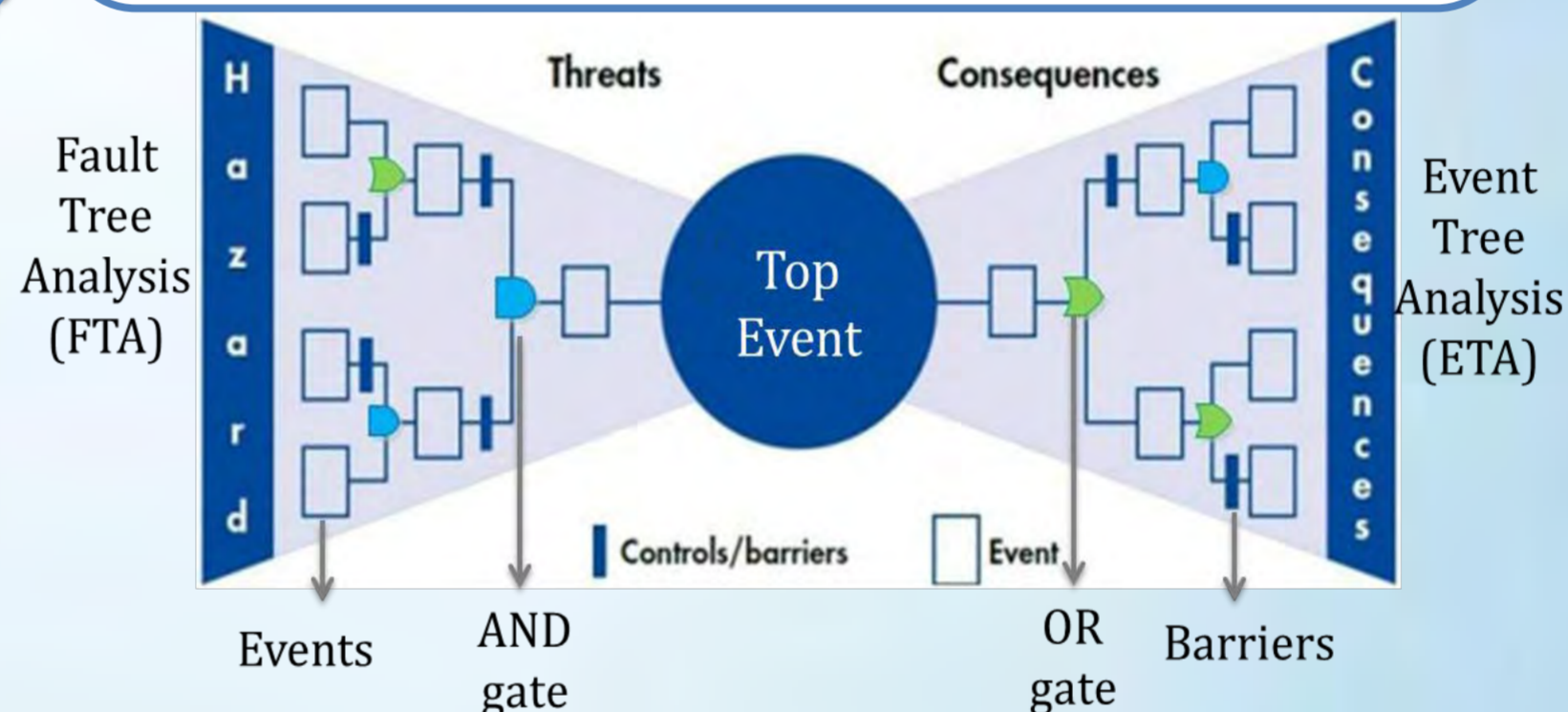
Identification 'Bowtie Analysis' as an appropriate risk analysis method for Wuxi City

Evaluation of the risk of a future water crisis in Wuxi's water supply system

Proposals for effective risk management of Wuxi's water supply

Bowtie Analysis:

- ◆ A graphical analysis based on 'Bowtie Diagram'
- ◆ To undertake thorough analysis of a specific risk
- ◆ To highlight the direct link between the controls and elements of the management system

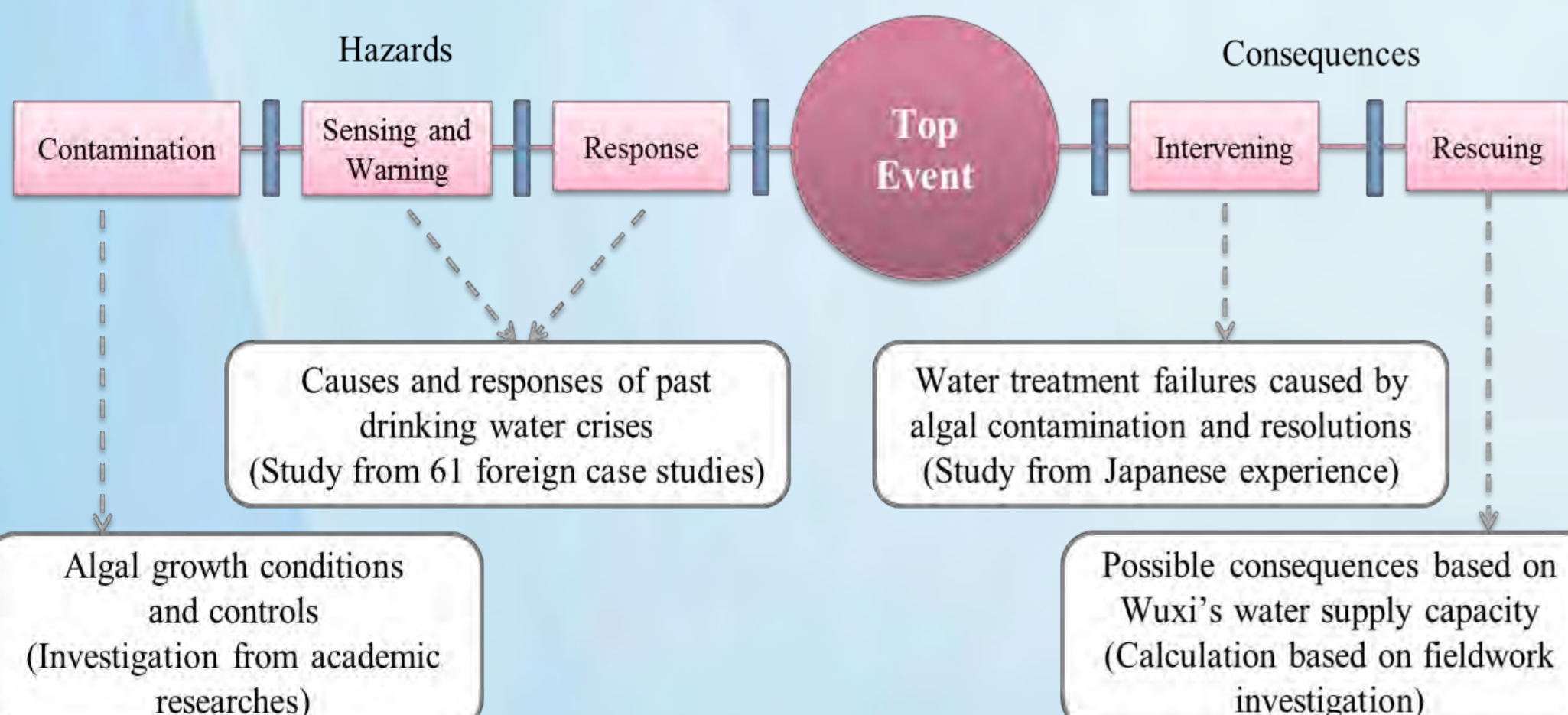
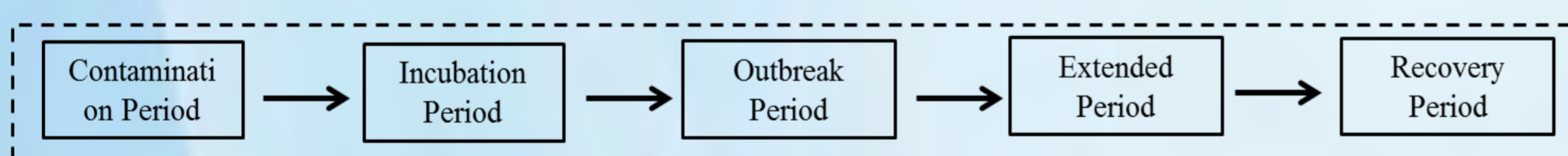


Concepts of Bowtie Diagram (Source: International Association of Oil & Gas Producers, 2008)

OUTPUT AND RESULTS

<Bowtie Diagram for Wuxi City's water supply system>

Lifecycle of a drinking water crisis



Identified events: 36

Barrier Options: 65

- ◆ 15 root causes of a drinking water crisis in Wuxi City have been identified from Wuxi City's Bowtie Diagram.
- ◆ A drinking water crisis like that seen in 2007 will not occur again in the future, but in the worst case, 22% of drinking water would be unavailable and industrial water would be cut off.
- ◆ The remedies implemented by Wuxi City after 2007 definitely improved risk tolerability of the system, but there are still vulnerable parts of the system without barriers.

PROPOSALS

- ◆ Establishment of an organization for risk management
A specific organization should be established or designated to implement risk analysis and risk evaluation according to a guideline formulated by local government.
- ◆ Decision making on risk reduction options
It is difficult to establish barriers for all the events in a short time, so a priority in the decision-making on risk reduction options is important.
The root causes without barriers have a priority over other events:

Events	Barrier options
Failure to conduct routine monitoring	Staff training Establishment of monitoring manuals Periodical report and inspection of monitoring operation
Mistaken belief in the security of the system	Instruction of the security of the system
A lack of identification of risk tolerability	Implementation of risk analysis and evaluation
Mistaken evaluation of the warnings	Implementation of risk analysis and evaluation
False alarms on failures	A second investigation of the warnings

- ◆ Approach to quantitative evaluation
It is also possible to evaluate the risk quantitatively by using the bowtie diagram and to decide more specific priority of risk reduction options, if probability of each event is obtained by way of monitoring.