



## **National Levee Database: monitoring, vulnerability assessment and management in Italy**

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A properly designed and constructed levees system can often be an effective device for repelling floodwaters and provide barriers against inundation to protect urbanized and industrial areas. However, the delineation of flooding-prone areas and the related hydraulic hazard mapping taking account of uncertainty (Apel et al., 2008) are usually developed with a scarce consideration of the possible occurrence of levee failures along river channels (Mazzoleni et al., 2014). Indeed, it is well known that flooding is frequently the result of levee failures that can be triggered by several factors, as: (1) overtopping, (2) scouring of the foundation, (3) seepage/piping of levee body/foundation, and (4) sliding of the foundation. Among these failure mechanisms that are influenced by the levee's geometrical configuration, hydraulic conditions (e.g. river level and seepage), and material properties (e.g. permeability, cohesion, porosity, compaction), the piping caused by seepage (ICOLD, <http://www.icold-cigb.org>) is considered one of the most dominant levee failure mechanisms (Colleselli F., 1994; Wallingford H. R., 2003). The difficulty of estimating the hydraulic parameters to properly describe the seepage line within the body and foundation of the levee implies that the study of the critical flood wave routing is typically carried out by assuming that the levee system is undamaged during the flood event. In this context, implementing and making operational a National Levee Database (NLD), effectively structured and continuously updated, becomes fundamental to have a searchable inventory of information about levees available as a key resource supporting decisions and actions affecting levee safety.

The ItaliaN LEvee Database (INLED) has been recently developed by the Research Institute for Geo-Hydrological Protection (IRPI) for the Civil Protection Department of the Presidency of Council of Ministers. INLED has the main focus of collecting comprehensive information about Italian levees and historical breach failures to be exploited in the framework of an operational procedure addressed to the seepage vulnerability assessment of river reaches where the levee system is an important structural measure against flooding. For its structure, INLED is a dynamic geospatial database with ongoing efforts to add levee data from authorities with the charge of hydraulic risk mitigation. In particular, the database is aimed to provide the available information about: i) location and condition of levees; ii) morphological and geometrical properties; iii) photographic documentation; iv) historical levee failures; v) assessment of vulnerability to overtopping and seepage carried out through a procedure based on simple vulnerability indexes (Camici et al. 2014); vi) management, control and maintenance; vii) flood hazard maps developed by assuming the levee system undamaged/damaged during the flood event. Currently, INLED contains data of levees that are mostly located in the Tiber basin, Central Italy.

### References

- Apel H., Merz B. & Thieken A.H. Quantification of uncertainties in flood risk assessments. *Int J River Basin Manag* 2008, 6, (2), 149–162.
- Camici S., Barbetta S., Moramarco T., Levee body vulnerability to seepage: the case study of the levee failure along the Foenna stream on 1st January 2006 (central Italy)", *Journal of Flood Risk Management*, in press.
- Colleselli F. Geotechnical problems related to river and channel embankments. Rotterdam, the Netherlands: Springer, 1994.
- H. R. Wallingford Consultants (HRWC). Risk assessment for flood and coastal defence for strategic planning: high level methodology technical report, London, 2003.
- Mazzoleni M., Bacchi B., Barontini S., Di Baldassarre G., Pilotti M. & Ranzi R. Flooding hazard mapping in floodplain areas affected by piping breaches in the Po River, Italy. *J Hydrol Eng* 2014, 19, (4), 717–731.