Title: From detection chains to prevention trends: An AI governance framework for terrestrial and marine food-safety systems

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Abstract: Background Artificial intelligence (AI) technologies are fundamentally transforming food safety from reactive contamination detection toward predictive prevention systems, yet their deployment encounters governance deficits that threaten equitable adoption. Scope and approachThis paper analyses 1766 publications (2015–2025) to evaluate AI detection systems, predictive analytics, and blockchain traceability across terrestrial and marine supply chains. Key findings and conclusions Computer vision achieves 95–99 % accuracy in pathogen detection, while blockchain enables traceability from days to seconds. Our analysis reveals a critical technology-to-governance imbalance (ratio 7.5:1) and severe under-representation of marine systems (terrestrial dominance 2.3:1; IUU-fishing research deficit 57:1), even though aquatic foods provide 17 % of global animal protein to 3.3 billion people. Fragmented regulatory frameworks across the European Union, the United States and the Asia-Pacific region create deployment uncertainty, especially for small and medium-sized enterprises. Marine food systems remain critically underserved despite their contribution to global animal protein, and governance fails to adequately address harmful algal blooms, heavy-metal bioaccumulation, and illegal fishing. We propose an AI governance framework for terrestrial and marine food-safety systems that incorporates adaptive regulatory mechanisms.

Key words: Artificial intelligence; Food safety governance; Marine food systems; Predictive analytics; Supply chain digitalisation; Blue economy

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