

Analysis of Peak Flood Levels and Rainfall Patterns: A Case Study of the Nilwala River Basin

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Abstract

The importance of analysing peak water levels and rainfall patterns lies in its ability to enhance flood risk management and preparedness. Understanding the relationship between rainfall and flooding trends helps identify high-risk areas, guide infrastructure planning, and inform early warning systems, ultimately mitigating the impact of future flood events and protecting communities and resources. The objective of the present study was to investigate a recent anomaly in flood patterns observed in areas located within the Nilwala River Basin (NRB), southern province, Sri Lanka. Although the area typically experiences monsoon-related flooding, an unusual persistent flooding condition was reported recently. The NRB consists of main four gaging stations (GS) named, Thalgahagoda, Panadugama, Pitabeddara, and Urawa. Water levels (WL, m) and rainfall (RF, mm) data were collected from each GS of September, October, November, and December in three consecutive years (2021, 2022, and 2023). Data were analyzed using one-way ANOVA and DMRT to investigate the differences of WL and RF among stations and correlation analysis was conducted to investigate the relationship between RF and flooding patterns. In 2023, all stations recorded their highest peak WLs, with Thalgahagoda (1.69 ± 0.47), Panadugama (5.35 ± 0.99), Pitabeddara (1.84 ± 0.68), and Urawa (1.17 ± 0.51) showing significant increases from previous years ($P=0$ at all GSs), indicating a potential rise in flood intensity. Results showed no statistically significant differences in RF amounts across years at Thalgahagoda, Panadugama, Pitabeddara, and Urawa stations ($P=0.14$, $P=0.32$, $P=0.76$, and $P=0.62$ respectively), with mean rainfall values varying slightly. This suggests that although rainfall did not vary significantly year-on-year, increased rainfall in certain areas may contribute to the elevated flood levels observed. Overall, the results highlight a weaker correlation between rising water levels during flood events and consistent rainfall patterns, emphasizing the need for enhanced flood management strategies and investigation of potential contributing factors, particularly in high-risk areas like Thalgahagoda and Panadugama.

Keywords: Water Level, Rainfall, Flood Patterns, Nilwala River Basin, Flood Risk