

**MITIGATING MEASURES FOR WILDLIFE MORTALITY IN  
AGRICULTURAL LANDSCAPES TO PREVENT ACCIDENTAL  
FALLS INTO OPEN WELLS IN MAHARASHTRA, INDIA: A  
RETROSPECTIVE STUDY**

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**ABSTRACT**

*Open wells in agricultural regions of India pose a critical, yet underreported threat to terrestrial wildlife. This study investigates incidents of wildlife falls into open wells across Pune and Ahmednagar districts of Maharashtra between 2009 and 2024. Indian leopards (*Panthera pardus fusca*) were the most frequently affected species, accounting for 67.6% of the 68 documented cases. Temporal trends indicate an increasing frequency, with peaks in 2019 and 2023. Other species affected include golden jackals, small Indian civets, Asian palm civets, striped hyaenas, and sambar deer. All animals were successfully rescued and released through operations led by Wildlife SOS and the Maharashtra Forest Department. Twenty-one high-risk wells were covered as part of mitigation efforts. The findings underscore the urgency for expanded, proactive programs to cover the wells to reduce wildlife mortality and foster coexistence in human-dominated landscapes.*

**Keywords:** human-wildlife conflict, leopard conservation, mitigation measures, open wells, wildlife rescue

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**INTRODUCTION**

Agriculture remains a cornerstone of India's economy, contributing approximately 17% to GDP and supporting nearly 60% of the population (Das and Rout, 2020). Over 70% of India's food grain production depends on irrigation, with groundwater as the primary source (Gandhi and Bhamoriya, 2011). Consequently, open

wells are widespread, particularly in western India, where they are often unprotected and unmarked.

These open wells pose significant threats to both human and wildlife safety. Wild animals, especially large carnivores like leopards, may fall into these wells while pursuing prey or fleeing from disturbances (Ghule *et al.*, 2014; Gubbi *et al.*, 2019). Such incidents often lead to injury, prolonged stress, or mortality for these animals (Gubbi *et al.*, 2019) some of which are in the endangered category. Despite the growing incidences of this issue, systematic documentation and implementation of mitigation strategies have been limited.

This retrospective study aims to (1) document the frequency and distribution of wildlife ‘falls’ into open wells, (2) analyze species vulnerability and spatio-temporal trends, and (3) assess the effectiveness of mitigation interventions implemented in response to these incidents.

## MATERIALS AND METHODS

### Study area

The retrospective study was conducted in the Pune and Ahmednagar districts of Maharashtra, located on the Deccan Plateau (Fig. 1). The landscape includes hilly terrain, scrublands, and mixed agricultural land, interspersed with human settlements. These areas are ecologically significant and support a range of wildlife, including large carnivores and ungulates (Sharma *et al.*, 2015).

### Rescue operations

Wildlife SOS has operated the Manikdoh Leopard Rescue Centre in Junnar since 2007, in collaboration with the Maharashtra Forest Department. Wildlife fall incidents (Fig. 2), typically reported by local residents, were addressed by Mobile Veterinary Units (MVUs). Standardized rescue protocols were employed, including tranquilization where necessary, health assessments, and post-rescue release into suitable habitats.

### Data collection and analysis

Records maintained at Wildlife SOS from 2009 to 2024 were compiled, documenting incident dates, GPS locations, species involved, individual health status, and post-incident mitigation. Incident hotspots were mapped, and descriptive statistics in Microsoft Excel and R (version 4.5.0) were used to identify trends and evaluate species-specific vulnerability. Wells that were subsequently covered were noted as part of mitigation efforts (Fig. 1).

## RESULTS AND DISCUSSION

### Wildlife fall incidents

A total of 68 wildlife falls into open wells were documented. Indian leopards accounted for 46 cases (67.6%), with a noticeable increase post-2014 (Fig. 3). Incident frequency peaked in 2019 and 2023. Other affected species included golden jackals (11.8%), sambar deer (5.9%), striped hyaenas, Asian palm civet, and small Indian civets, each accounted 2.9% of cases.

These data suggest an alarming trend of increasing wildlife falls into open wells, likely due to landscape fragmentation, urban sprawl, and encroachment into natural habitats. Leopards, being highly adaptable and wide-ranging, are particularly vulnerable.

### **Rescue and mitigation outcomes**

All 68 animals were successfully rescued and released, indicating effective operational protocols. Following high-incidence events, 14 wells were covered using chain-link fencing, iron angle supports, and galvanized mesh barriers, without compromising water access for local communities (Fig.4).

Despite these successes, many high-risk wells remain uncovered, highlighting the need for a comprehensive well-covering strategy. Community involvement and governmental support are critical for scaling these interventions.

### **CONCLUSION**

This study highlights the ongoing threat posed by open wells to wildlife in human-dominated agricultural landscapes. The sharp increase in incidents, particularly involving leopards, underscores the need for proactive and sustained mitigation. Covering high-risk wells is a viable and effective strategy, but broader implementation is needed. Policies that integrate conservation objectives into rural development and infrastructure planning are essential to ensuring long-term wildlife safety and coexistence.

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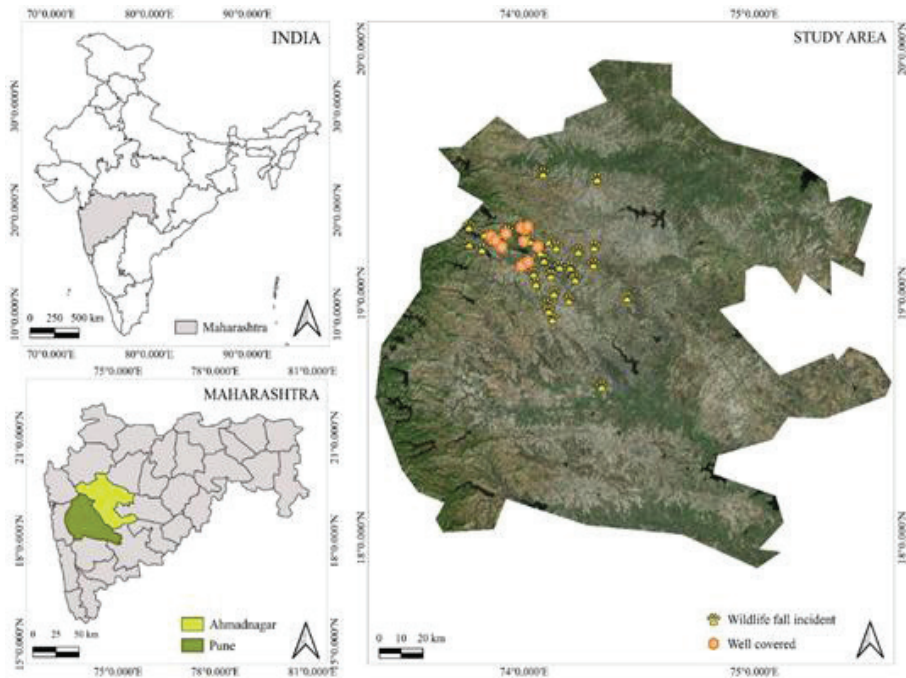
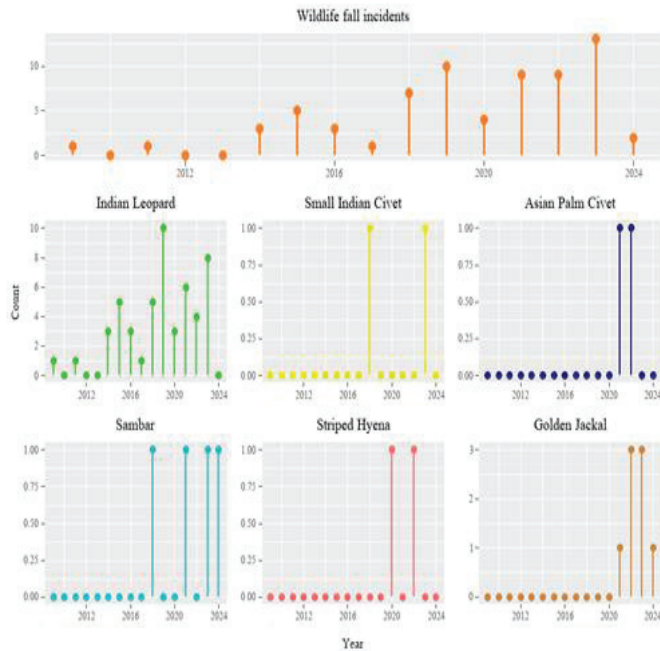


Fig.1. Geospatial distribution of open well-related wildlife fall incidents and mitigation measures (covering wells) in the Pune and Ahmednagar districts of Maharashtra, India



Fig.2. Representative wildlife species rescued from open wells following accidental falls: (a) Two sub-adult Indian leopards (*Panthera pardus fusca*), (b) striped hyaena (*Hyaena hyaena*), (c) sambar deer (*Rusa unicolor*), and (d) small Indian civet (*Viverricula indica*)



**Fig.3.** Temporal distribution of wildlife fall incidents into open wells (2009–2024), showing total annual incidents (top panel), and species-wise trends (middle and bottom panels)



**Fig.4.** Mitigation measures implemented to prevent accidental wildlife falls; pre-intervention images (a, c, e) depict open wells at high-incident zones, post-intervention images (b, d, f) illustrate successful installation of lids and protective barriers

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