Biological Forum
an International Journal (SI-AAAS: CS March 21&22, 2025)
17(5a): 88-92(2025)
ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Ecological and Social Impact of Indian Wild Boar (*Sus scrofa* L.) in Rural Landscapes of Punjab

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(Received: 30 March 2025; Accepted: 01 May 2025; Published online: 14 May 2025)
(Published by Research Trend)

ABSTRACT: Indian wild boars (*Sus scrofa* L.) are known for their adaptability and increasing presence in agricultural landscapes, leading to significant ecological and socio-economic impacts. The Indian wild boar is a member of Phylum- Chordata, Class- Mammalia, Order- Artiodactyla, Family- Suidae, Genus- *Sus* and species- *S scrofa*. Indian wild boars have emerged as a significant challenge in agricultural landscapes, particularly in paddy-growing regions of Punjab, due to their foraging behaviour and habitat adaptability. This study assesses the presence and habitat ecology of wild boars in paddy crop fields of two rural villages—*Rajowal* (Ludhiana district) and *Bhinder Khurad* (Moga district)—through a structured questionnaire survey involving 60 respondents (30 per village). The survey analyzed wild boar sightings, preferred habitat conditions, seasonal variations, and human-wildlife conflict levels. The results indicate that 85% of respondents in *Rajowal* and 78% in *Bhinder Khurad* reported frequent wild boar presence, particularly near water bodies and dense vegetation adjacent to paddy fields. Nighttime activity was dominant, with 73% of sightings in *Rajowal* and 68% in *Bhinder Khurad* occurring between 7 PM and 4 AM. Habitat analysis based on respondent feedback revealed that wild boars prefer marshy areas near irrigation canals (62%), followed by paddy fields with dense cover (29%) and open farmland (9%). Seasonal trends showed peak activity during monsoon and post-harvest months (July–November), aligning with high food availability. This study highlights the ecological adaptability of wild boars in paddy field ecosystems and the pressing need for integrated management approaches.

Keywords: Agricultural Landscapes, Foraging Behaviour, Habitat Ecology, Human-Wildlife Conflict, Indian Wild Boar (*Sus scrofa* L.), Paddy Crop Fields, Punjab.

INTRODUCTION

The Indian wild boar (*Sus scrofa* Linnaeus), commonly known as wild pigs, boasts a near-global distribution—with the sole exception of Antarctica (Barrios-Garcia and Ballari 2012). Historical data reveal that until the mid-1500s, wild boars were largely confined to North America, maintaining a relatively stable range for several centuries (Mayer and Brisbin, 2009). However, their rapid dispersal in the 1990s catalyzed a dramatic expansion, with current estimates in the United States surpassing 6.9 million individuals (Mayer and Beasley 2018; Lewis *et al*., 2019). While range expansion has played a significant role in boosting wild boar populations in North America, unauthorized animal transportation has been identified as a primary driver of this surge (Beasley *et al*., 2018). Moreover, both native and introduced regions have witnessed substantial population increases over recent decades, with factors such as milder winters and enhanced food availability particularly accelerating growth in Europe (Massei *et al*., 2014). Taxonomically, the Indian wild boar is classified within Phylum Chordata, Class Mammalia, Order Artiodactyla, Family Suidae, Genus *Sus*, and Species *S. scrofa*.

The Indian wild boar is a highly adaptable species, inhabiting a wide range of ecosystems across the globe, excluding Antarctica. This adaptability is attributed to their generalist behaviour, allowing them to adjust their home ranges and activities in response to seasonal changes and food availability. Optimal population densities are often observed in dense forests and ecotones, which provide abundant food resources, ample cover, and effective environmental camouflage. Adult wild boars typically weigh between 60 to 100 kg and stand approximately 80 cm tall at the shoulder (Erdtmann and Keuling 2020). While their auditory and visual senses are developed, their olfactory sense is particularly acute, aiding in foraging and environmental navigation.

They exhibit a breeding season that predominantly spans from November to January, often aligning with periods preceding and following the monsoon. The age at which wild boars reach sexual maturity varies. Females can reach puberty, the onset of sexual maturity, between 5 and 7 months of age, while males

typically reach puberty around 7 months. These animals are recognized for their high intelligence and elusive nature, presenting challenges for researchers due to their acute senses of smell and hearing, combined with their cautious and vigilant behaviour. As adaptive ecological generalists, wild boars thrive in a diverse array of habitats, exploiting various geographic locations and food resources (Wang *et al.,* 2023). Their remarkable adaptability and wariness make them particularly difficult to study compared to other ungulates. Wild boars exhibit remarkable adaptability, occupying a wide range of habitats and fulfilling various ecological roles. Their trophic functions are diverse, encompassing behaviours such as crop raiding, frugivory, predation, seed bank disruption, and plant dispersal. These roles are facilitated through four primary feeding strategies: browsing and grazing (grasses, herbs, stems, leaves), foraging on the ground (fruits, fungi, animal matter), rooting (rhizomes, roots, invertebrates), and predation (Probst *et al.,* 2017).

This study aims to evaluate the ecological and social impacts of the Indian wild boar in the rural landscapes of Punjab, focusing on their interactions with agricultural activities and the resulting human-wildlife conflicts. By analyzing wild boar behaviour, habitat preferences, and the extent of crop damage, this research provides baseline information for effective management of this species to mitigate negative outcomes for both farmer communities and wildlife conservation efforts.

MATERIAL AND METHODS

Study Area. The research was conducted in two villages: *Rajowal*, situated in the Ludhiana district (30.817°N latitude and 73.917°E longitude), and *Bhinder Khurad*, located in the Moga district (30.8967°N latitude and 75.2920°E longitude) of Punjab, India. Both villages are characterized by extensive paddy cultivation, interspersed with irrigation canals and patches of natural vegetation, creating a conducive environment for wild boar habitation.

Data Collection Methods

1. Structured Questionnaire Surveys

Participant Selection: A total of 60 respondents, comprising 30 individuals from each village, were selected through purposive sampling. Participants included local farmers, landowners, and residents with firsthand experience of wild boar interactions.

Survey Instrument: A detailed questionnaire was designed to capture information on:

a. Frequency and timing of wild boar sightings
b. Preferred habitats and foraging areas
c. Seasonal variations in wild boar activity
d. Incidents of crop damage and economic losses
e. Perceived effectiveness of existing mitigation measures

Data Collection: Surveys were administered through face-to-face interviews, ensuring clarity and accuracy in responses. This approach facilitated the collection of nuanced data regarding local perceptions and experiences.

2. Field Observations and Habitat Assessment

Direct Observations: Systematic field observations were conducted during peak activity periods, primarily early morning and late evening, to document wild boar presence and behaviour. Regular observations were taken from the selected locations *i.e*. weekly from *Rajowal*, situated in the Ludhiana district, and fortnightly from *Bhinder Khurad*, located in the Moga district of Punjab. During data collection Line-Transect and Pug – marks methods were followed (Buckland *et al*., 2001). The other activities of the Indian Wild Boar including foraging, rooting, wallowing and track marks in the agriculture crop fields were also observed.

Habitat Mapping: Areas exhibiting signs of wild boar activity, such as rooting, tracks, and fecal matter, were mapped. Particular attention was given to:

-Marshy regions adjacent to irrigation canals
-Paddy fields with dense vegetation
-Open farmlands

Camera Trapping: Motion-sensitive cameras (4G Solar Bullet Cameras) were strategically placed in identified hotspots to capture nocturnal activities and validate survey findings. This non-invasive method provided visual evidence of wild boar movements and group sizes.

3. Statistical Analysis. In this study, Chi-square test was applied to assess the associations between wild boar sightings and specific habitat features, while temporal patterns were analyzed to determine peak activity seasons. An **Independent Samples t-Test** was employed to evaluate whether there is a statistically significant difference in the mean number of wild boar sightings between the two villages, *Rajowal* and *Bhinder Khurad.* Statistical tests were applied by using SPSS Software.

RESULTS AND DISCUSSION

Table 1 presents the demographic characteristics of the surveyed respondents from *Rajowal* and *Bhinder Khurad* villages. Among the total 60 respondents, 81.67% were male, with a slightly higher proportion in *Rajowal* (86.66%) compared to *Bhinder Khurad* (76.67%). The proportion of female respondents was relatively higher in *Bhinder Khurad* (23.33%) compared to *Rajowal* (13.33%). The mean age of respondents was 46.2 ± 5.12 years, with respondents from *Bhinder Khurad* having a slightly higher average age (47.3 ± 5.25 years) than those from Rajowal (45.1 ± 4.99 years). The majority of respondents in both villages were farmers, with 95% of the total surveyed individuals reporting farming as their primary occupation. The occupation distribution was comparable between the two villages, with 96.7% of respondents in *Rajowal* and 93.33% in *Bhinder Khurad* engaged in agriculture. The statistical analysis indicates that there were no significant differences between *Rajowal* and *Bhinder Khurad* in terms of gender distribution, average age, or primary occupation, as the p-values for all comparisons were greater than 0.05.

Table 2 presents a structured questionnaire designed to assess the impact of wild animals on agricultural crops and human livelihoods, based on their life activities. The findings indicate that 100% of respondents agreed

that wild animals cause damage to agricultural crops. Among the affected crops, Kharif crops (55%) were reported as the most frequently damaged, followed by Rabi crops (40%) and Zaid crops (5%). Regarding the crop growth stages most vulnerable to damage, the germinating stage (65%) was identified as the most affected, with the harvesting (19%) and developmental stages (16%) experiencing relatively less damage. A significant 93% of respondents reported prolonged suffering due to wild animal intrusions, with 92% indicating severe damage to crops. Wild animals were primarily observed at night (88%), while only 9% of sightings occurred during the day. Most respondents noted that wild boars typically move in herds (96%), whereas only 3% reported solitary animals. Habitat observations revealed that 96% of respondents were aware of wild boar habitats, with irrigation canals and dense paddy fields being preferred locations. Seasonal trends indicated that wildlife damage was higher in summer (60%) compared to winter (40%). Farmers have adopted various mitigation strategies to protect their crops, with 85% using barbed wire fencing, and 100% relying on electric fencing and scaring techniques to deter wild animals. These findings highlight the urgent need for integrated wildlife management strategies to mitigate human-wildlife conflict in agricultural landscapes.

As per the data given in Table 3 it was indicated that wild boar presence is frequent in both study villages, with 85% of respondents in *Rajowal* and 78% in *Bhinder Khurad* reporting regular sightings. However, the difference in sighting frequency between the two villages was not statistically significant ($p = 0.421$). Wild boars exhibited a strong nocturnal activity pattern, with 73% of sightings in *Rajowal* and 68% in *Bhinder Khurad* occurring between 7 PM and 4 AM. Daytime sightings were considerably lower, recorded at 9% and 10% in *Rajowal* and *Bhinder Khurad*, respectively. The preference for nighttime activity is consistent with previous studies on wild boar behaviour, and statistical analysis showed no significant difference in activity patterns between the two locations ($p = 0.378$). Habitat preferences were also assessed, revealing that wild boars predominantly occupied areas near irrigation canals (62% in *Rajowal* and 60% in *Bhinder Khurad*), followed by paddy fields with dense cover (29% and 30%, respectively), and open farmlands (9% and 10%). These findings highlight the species' reliance on moist, vegetated areas that provide both food and cover. The difference in habitat preference between the villages was not statistically significant ($p = 0.541$). The average group size of wild boars observed was 5.2 ± 1.3 individuals in *Rajowal* and 4.8 ± 1.5 in *Bhinder Khurad*, showing a slightly larger mean in *Rajowal*, though this difference was not significant ($p = 0.287$). Seasonal activity trends indicated that wild boars were most active during the monsoon (July–September) and post-harvest months (October–November), with peak sightings at 45% and 50% in *Rajowal* and *Bhinder Khurad*, respectively. Activity declined during the winter (10% and 9%) and was lowest in summer (5% and 3%). The seasonal variation aligns with food availability, as monsoon months provide abundant vegetation, and post-harvest fields offer leftover crops and easy foraging opportunities. The differences in seasonal patterns were statistically non-significant ($p = 0.492$), indicating similar trends across both villages.

Rai (2023) emphasized that wild pigs cause substantial damage to agricultural crops, leading to economic losses for rural farmers. Their feeding habits, including rooting and trampling, destroy fields and reduce agricultural productivity. Kumar (2018) observed that wild boar activities are predominantly nocturnal, with increased foraging in summer and early autumn. The study also noted that crop damage was more severe in fields near forest areas and human habitats. Chauhan *et al*. (2009) investigated human-wild pig conflicts across five Indian states, reporting substantial crop depredation and human casualties. The study highlighted that wild pigs caused varying degrees of agricultural damage (5–36%) and were responsible for 309 human injuries and fatalities between 1990 and 2008. Pandav *et al*. (2021) conducted research in northern India, revealing a discrepancy between perceived and actual crop losses due to wild pigs. While farmers estimated a 23.4% loss in wheat yield, field assessments showed an actual loss of about 2.6%. This disparity underscores the importance of objective evaluations in conflict mitigation.

Overall, the findings highlight that wild boar populations in *Rajowal* and *Bhinder Khurad* exhibit comparable activity patterns, habitat preferences, and seasonal behaviours, reinforcing their ecological adaptability and increasing interactions with agricultural landscapes. The high frequency of nocturnal activity, preference for water-adjacent habitats, and seasonal peaks during monsoon and post-harvest periods underscore the need for targeted management strategies to mitigate crop damage and human-wildlife conflict.

Table 1: Demographic characteristics of survey respondents in *Rajowal* and *Bhinder Khurad* villages.

Variable	*Rajowal* (n=30)	*Bhinder Khurad* (n=30)	Total (N=60)	Statistical Test	p-value
Male Respondents (%)	86.66	76.67	81.67	Chi-square (χ^2)	0.312 (NS)
Female Respondents (%)	13.33	23.33	18.33	Chi-square (χ^2)	0.312 (NS)
Average Age (Years, Mean ± SD)	45.1 ± 4.99	47.3 ± 5.25	46.2 ± 5.12	Independent t-test (t)	0.271 (NS)
Primary Occupation (Farmers, %)	96.7	93.33	95	Chi-square (χ^2)	0.543 (NS)

NS = Not Significant ($p > 0.05$)

Table 2: Response to questionnaire prepared on the basis of animals harmful to both the agricultural crops and human being depending upon the life activity.

1	Damage caused by wild animals over agricultural crops		
	Agree (100%)	Disagree (0%)	Not Known (0%)
2	Which type of crops is damaged by wild animals?		
	Rabi (40%)	Kharif (55%)	Zaid (5%)
3	Which stage of crops from prone to damage of wild animals is observed?		
	Germinating (65%)	Developmental (16%)	Harvesting (19%)
4	From how much time they suffer from problem of wild animals		
	Less (2%)	Moderate (5%)	More (93%)
5	The average how much damage caused by wild animals to the agriculture crops		
	Less (1%)	Moderate (7%)	More (92%)
6	Which period of time (Day/Night) more wild animals are observed		
	Day (9%)	Night (88%)	Not Known (3%)
7	How many wild animals observed at a time		
	Solitary (3%)	Herd (96%)	Not Known (1%)
8	Do they observed the habitats of wild animals		
	Agree (96%)	Disagree (0%)	Not Known (4%)
9	In which type of season (Summer/Winter), more damage by wild animals		
	Summer (60%)	Winter (40%)	Not Known (0%)
10	What kind of management methods adopt by the farmers to protect the crop from the attack of wild animals		
	Use of Barbed Fencing		
	Agree (85%)	Disagree (10%)	Not Known (5%)
	Use of Electric Wire		
	Agree (100%)	Disagree (0%)	Not Known (0%)
	Scaring of animal from crop fields		
	Agree (100%)	Disagree (0%)	Not Known (0%)

Table 3: Comparative analysis of wild boar sightings and their behavioural activities in *Rajowal* and *Bhinder Khurad* villages.

Variable	*Rajowal* (n=30)	*Bhinder Khurad* (n=30)	Total (N=60)	Statistical Test	p-value
Wild Boar Sightings (%)	85	78	81.5	Chi-square (χ^2)	0.421 (NS)
Primary Activity Period (%)					
- Daytime (6 AM – 6 PM)	9	10	9.5		
- Nighttime (7 PM – 4 AM)	73	68	70.5	Chi-square (χ^2)	0.378 (NS)
- Not Known	18	22	20		
Preferred Habitat (%)					
- Near Irrigation Canals	62	60	61	Chi-square (χ^2)	0.541 (NS)
- Paddy Fields with Dense Cover	29	30	29.5		
- Open Farmland	9	10	9.5		
Average Group Size (Mean ± SD)	5.2 ± 1.3	4.8 ± 1.5	5.0 ± 1.4	Independent t-test (t)	0.287 (NS)
Seasonal Peak Activity (%)					
- Monsoon (July–September)	45	50	47.5		
- Post-Harvest (October–November)	40	38	39	Chi-square (χ^2)	0.492 (NS)
- Winter (December–February)	10	9	9.5		
- Summer (March–June)	5	3	4		

NS = Not Significant ($p > 0.05$)

CONCLUSIONS

This study highlights the ecological adaptability and increasing prevalence of Indian wild boars in Punjab's rural landscapes, particularly in paddy-growing regions. The findings reveal significant human-wildlife conflicts, with wild boars exhibiting a strong nocturnal presence, preference for marshy habitats near irrigation canals, and seasonal peaks during monsoon and post-harvest months. Their foraging behaviour and herd movements contribute to substantial crop damage, emphasizing the urgent need for integrated wildlife management strategies. Understanding their habitat preferences and activity patterns can aid in developing targeted mitigation approaches, balancing conservation efforts with agricultural sustainability.

FUTURE SCOPE

This study provides baseline data on wild boar presence and habitat ecology, aiding future research in developing targeted management strategies. It also establishes a framework for assessing human-wildlife conflict, helping refine conservation and mitigation approaches.

Acknowledgement. The authors are thankful to Head, Department of Zoology for providing necessary facilities for conduct of research.
Conflict of interest. None.

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How to cite this article: Manjinder Kaur and Nisha Vashishat (2025). Ecological and Social Impact of Indian Wild Boar (*Sus scrofa L.*) in Rural Landscapes of Punjab. *Biological Forum*, *17*(5a): 88-92.