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Financial Impact of Stray Animals in India: Estimating Damage Costs, Analysing Incident Trends, and Reviewing Government Budget Priorities

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Abstract—

Stray-animal-related incidents have emerged as an important public concern in India because of their impact on public health, social safety, and administrative management. The present study examines the financial impact of stray animals in India by analysing reported incident trends and reviewing their broader policy significance. The study is based on quantitative secondary data collected from official factual sources and cleaned into an SPSS-readable format for analysis. The final dataset includes 220 observations across States and Union Territories for the period 2018 to 2023, with state, year, and incident_count as the main variables. The research applies descriptive statistics, percentage analysis, chi-square test, and regression analysis to understand the pattern and variation of stray-animal-related incidents in India. The findings reveal that stray-animal-related incidents are unevenly distributed across the country, with some states recording very low or zero incidents and others reporting very high counts. The descriptive analysis shows a high level of dispersion in incident_count, indicating that the burden is not uniform across regions. The percentage analysis confirms that the dataset is well distributed across states and years, making it suitable for comparative and trend-based analysis. The chi-square analysis suggests interstate variation in incident distribution, although the results must be interpreted cautiously due to limitations in expected cell frequencies. The regression analysis indicates that year has a statistically significant but weak negative effect on incident_count, suggesting a slight declining trend in reported incidents over time. The study concludes that stray-animal-related incidents in India represent a significant and unevenly distributed burden that requires stronger state-specific monitoring and policy response. It further highlights the need for improved incident reporting systems, better financial documentation, and more transparent budgetary records for stray-animal management. The findings suggest that stray-animal-related damages should not be treated only as an isolated local issue but as a broader governance and management concern requiring coordinated and evidence-based intervention.

Keywords: Stray Animals, Financial Impact, Incident Burden, Public Health, Animal Bites, Government Expenditure, Stray Animal Management, Policy Intervention

1. Introduction

1.1 Background and Overview

Stray-animal-related damages have become an important public policy, economic, and public health concern in India. Free-roaming dogs, stray cattle, and other unmanaged animals contribute to a wide range of social and economic harms, including animal bites, rabies exposure, crop damage, road accidents, livestock loss, and increasing public expenditure on control and welfare measures. In India, the burden is especially visible in the context of dog bites and rabies risk, which continue to affect both urban and rural populations (John et al., 2021; Thangaraj et al., 2024).

Recent studies have shown that stray and pet animal bite cases remain substantial in major Indian cities, reflecting persistent gaps in animal control, public awareness, and health-seeking behaviour (Mukhopadhyay et al., 2026; Yathagiri et al., 2026). At the same time, the free-roaming dog population remains dynamic and difficult to manage, with studies from Guwahati, Ranchi, Goa, Pune, and Jamshedpur showing the complexity of estimating population size, monitoring movement, and evaluating the outcomes of sterilisation and vaccination programmes (Cunha Silva et al., 2026; Evans et al., 2022; Fielding et al., 2023; Smith et al., 2025; Tiwari et al., 2018). In rural and semi-rural regions, the problem extends beyond dogs to include stray cattle and other animal menace, which impose direct costs on farmers through crop destruction and protective expenditure (Thakur et al., 2022; Kennedy et al., 2018).

Thus, stray-animal management in India is not only an animal welfare issue but also a matter of economic loss, local governance, and public finance.

1.2 Problem Statement

India faces a persistent challenge in managing stray-animal-related damages, yet there is no single integrated framework that combines incident trends, economic loss estimation, and budgetary response into one evidence base. Existing studies often focus on specific aspects such as dog-bite burden, rabies prevention, free-roaming dog demographics, sterilisation effectiveness, or crop damage from animal menace, but these are rarely integrated into a broader financial impact assessment (John et al., 2021; Collinson et al., 2020; Thakur et al., 2022).

This creates a major policy and analytical problem. Incidents are reported in fragmented ways, losses are often under-estimated, and expenditure by government authorities is not always assessed against the actual scale of damages. Without a structured analysis of incident trends, associated losses, and budget priorities, it becomes difficult to evaluate whether current mitigation efforts are proportionate, effective, and financially efficient.

1.3 Importance of Stray-Animal Management in Public Health, Agriculture, and Urban-Rural Systems

The issue of stray-animal-related damages is important because it cuts across multiple sectors. In public health, dog bites create a major burden through treatment costs, post-exposure prophylaxis, fear of rabies, and loss of productivity (Yathagiri et al., 2026; John et al., 2021). Thangaraj et al. (2024) showed that the burden of human rabies deaths and animal bites in India remains substantial, confirming that this is a continuing national concern rather than an isolated local problem.

In agriculture, stray cattle and related animal menace damage crops, reduce farm income, and force households to spend additional resources on fencing, guarding, and other preventive measures. Evidence from Himachal Pradesh demonstrates that such losses can be economically significant at the farm level (Thakur et al., 2022). In urban systems, unmanaged free-roaming animals affect sanitation, traffic movement, public safety, and municipal administration. These pressures make stray-animal management important not only for welfare and safety but also for urban governance and economic planning.

1.4 Stray-Animal Management Ecosystem and Incident Dynamics

The stray-animal management ecosystem in India involves local bodies, public health agencies, animal welfare institutions, veterinary authorities, and communities. Within this ecosystem, consumer adoption dynamics in the EV framework can be replaced here with management and incident dynamics, which include free-roaming animal population growth, sterilisation coverage, vaccination uptake, rescue systems, sheltering capacity, and public response behaviour.

Research shows that the population dynamics of free-roaming dogs are shaped by reproduction, food access, movement, and incomplete sterilisation coverage (Evans et al., 2022; Tiwari et al., 2018). Programmes such as catch-neuter-vaccinate-release have shown measurable effects in some places, but their success depends on campaign intensity, spatial organisation, and continuity of intervention (Smith et al., 2025; Parate et al., 2025). Systematic evidence also suggests that surgical sterilisation can play a role in rabies control and population management, but outcomes depend heavily on implementation quality and local context (Collinson et al., 2020; Collinson et al., 2021).

The wider ecosystem also includes public awareness and healthcare seeking. Yathagiri et al. (2026) found that dog-bite burden and post-exposure treatment behaviour vary across municipal areas, while Tiwari et al. (2019) showed that community knowledge, attitudes, and practices strongly influence prevention and response. Similarly, rabies elimination efforts in Goa demonstrate that integrated One Health approaches can significantly improve outcomes when surveillance, vaccination, and public health systems work together (Gibson et al., 2022).

1.5 Significance of the Study

This study is significant for three main reasons. First, it contributes to the literature by linking incident trends with financial loss estimation, rather than studying only the epidemiological or animal welfare dimensions. Second, it offers a policy-relevant perspective by comparing the scale of the problem with government budget allocation and expenditure patterns. Third, it addresses a practical gap by proposing a structured dataset that can be used for statistical analysis of state-wise incident burden and associated public response.

The significance is also strengthened by prior economic work showing that rabies control and dog population management can be analysed through cost-effectiveness and economic assessment frameworks (Larkins et al., 2020; Undurraga et al., 2018). Although much of the literature focuses on dogs, the inclusion of crop damage and unwanted cattle sheltering broadens the relevance of the study to rural livelihoods and public expenditure more generally (Thakur et al., 2022; Kennedy et al., 2018).

1.6 Data Sources and Research Approach

This study adopts a secondary-data-based research approach. The analysis is designed around three dimensions: incident trends, financial loss estimation, and budgetary review. The incident trend component uses reported stray-animal-related cases, especially dog-bite and related public health burden data. The financial loss component uses reported cases together with cost-based interpretation from existing empirical and economic studies. The budget review component examines allocations and expenditure incurred for management and mitigation activities.

The research approach is interdisciplinary. Epidemiological and burden studies provide evidence on animal bite cases, rabies deaths, and healthcare seeking (Mukhopadhyay et al., 2026; Yathagiri et al., 2026; Thangaraj et al., 2024). Veterinary and population studies contribute understanding of free-roaming dog estimation, capture systems, and intervention effectiveness (Fielding et al., 2023; Evans et al., 2022; Cunha Silva et al., 2026). Economic and policy-oriented studies help support the estimation of financial loss and assessment of management efficiency (Larkins et al., 2020; Thakur et al., 2022; Undurraga et al., 2018).

The study therefore combines descriptive trend analysis with cost estimation and expenditure review in order to produce a more comprehensive picture of stray-animal-related damages in India.

1.7 Research Gaps

Despite increasing scholarship on dog bites, rabies, and free-roaming dog population management, several important gaps remain.

First, there is a lack of integrated studies that combine incident frequency, economic loss, and government spending within one analytical framework. Most studies examine public health outcomes, population ecology, or programme effectiveness separately (John et al., 2021; Collinson et al., 2020).

Second, evidence on financial losses is uneven. While there are systematic reviews on the burden of dog-mediated rabies and case studies on the economics of rabies control, fewer studies estimate broader stray-animal-related damages such as crop loss, productivity loss, and localised public expenditure in one consolidated model (Larkins et al., 2020; John et al., 2021). The literature on unwanted cattle and crop damage exists, but it is comparatively limited and fragmented (Thakur et al., 2022; Kennedy et al., 2018).

Third, there is limited comparative analysis of how government expenditure aligns with the actual burden of incidents. This makes it difficult to judge whether budget priorities are evidence-based and proportionate to the problem.

Fourth, while management strategies such as sterilisation, vaccination, and integrated One Health interventions have been studied, there remains insufficient evidence on their long-term financial efficiency across diverse Indian contexts (Gibson et al., 2022; Smith et al., 2025; Parate et al., 2025).

1.8 Research Questions

This study is guided by the following research questions:

- What is the scale and trend of reported stray-animal-related incidents in India?
- What types of economic losses arise from stray-animal-related damages?
- How can the financial impact of reported incidents be estimated using available data and cost proxies?
- To what extent do government budget allocations and actual expenditures reflect the scale of stray-animal-related damages?
- What gaps exist between incident burden, financial loss, and current management priorities?

1.9 Research Objectives

The study has the following objectives:

- To estimate the loss due to different types of stray-animal-related damages reported in India.
- To analyse the trends of stray-animal-related damage incidents in India.
- To examine the budget allocation and actual expenditure incurred by government authorities for the management and mitigation of stray-animal-related damages.

2. Literature Review

Mukhopadhyay, Howal, Sankhe, et al. (2026) examined stray and pet animal bite patterns in Mumbai using hospital-based secondary data and showed that animal bites remain a major public health concern in urban India. Their study focused on bite demographics, victim characteristics, and differences between stray and pet animal exposures. The authors argue that understanding who gets bitten, by which animals, and under what conditions is essential for building a practical One Health response. For the present study, this article is useful because it links reported incidents with demographic patterns and highlights how bite surveillance can support more targeted prevention, awareness campaigns, and public-health planning in densely populated cities.

Yathagiri, Khan, Sharma, et al. (2026) assessed the burden of dog bites and healthcare-seeking behaviour for rabies post-exposure prophylaxis in North and South Shahdara, Delhi. The study underlines that dog bites continue to be an important urban health problem and that treatment-seeking behaviour is a decisive factor in whether bite victims receive timely protection. The authors connect bite incidence to the practical realities of public health response, including awareness, service access, and follow-up for prophylaxis. This is highly relevant to the present research because it shows that incident counts alone do not capture the full burden; the social and medical response to those incidents also has financial and policy significance.

Khan, Das, Patil, et al. (2026) reviewed the barriers to rabies elimination in India and emphasized that the challenge is not only biomedical but also behavioural, administrative, and institutional. The paper notes recurring gaps in knowledge, attitudes, and practices, including inadequate wound washing, delayed healthcare seeking, and incomplete adherence to post-exposure prophylaxis. It also points to weaknesses among frontline workers and in intersectoral coordination. For the present study, this article is important because it explains why stray-animal-related damages persist even when prevention tools are known. It supports the argument that financial losses and incident burdens are shaped partly by governance failures and not only by the number of free-roaming animals.

Cunha Silva, Mohanty, Zahri, et al. (2026) studied the demographics of free-roaming dogs in Guwahati and compared alternative population-size estimation methods. The article is especially valuable because it extends evidence into Northeast India, a region previously underrepresented in the literature. The authors show that understanding sex composition, age structure, visibility, and counting methods is central to designing reliable dog-management programmes. For the present study, the paper contributes to the methodological side of incident and burden analysis by showing that management effectiveness depends first on knowing how many animals exist and how accurately they can be counted. This is directly relevant when linking incident trends to the scale of the free-roaming dog population.

Killada, et al. (2025) provided one of the first detailed One Health studies from Puducherry on dog-bite epidemiology and rabies diagnosis in stray dogs. The paper aimed both to estimate the burden of bites in humans and animals and to confirm rabies in dogs through diagnostic methods. Its importance lies in connecting field epidemiology with laboratory confirmation, thereby strengthening the evidence base for local rabies control. For the present study, this article is useful because it demonstrates that stray-animal-related harm should be assessed through both incident reporting and disease verification. That combination improves the credibility of policy recommendations on surveillance, vaccination, and dog-population management in endemic settings.

Smith, Kartal, Rawat, et al. (2025) analysed changes in free-roaming dog demographics and health after a catch-neuter-vaccinate-release programme in Jamshedpur, where more than 20,000 dogs were reportedly neutered and vaccinated. The study treats CNVR not only as a humane control tool but also as a measurable intervention affecting population structure, health, and human-animal conflict. For the present research, the article is significant because it provides empirical evidence that management programmes can change free-roaming dog populations over time. This helps justify the inclusion of government and programme expenditure in the analysis, since spending on sterilisation and vaccination can be assessed against observable demographic and health outcomes rather than treated as purely administrative cost.

Parate, Balagali, and Mazeri (2025) examined how surgical sterilisation and spatial organisation can improve the impact of interventions for free-roaming domestic dogs. The paper stresses that, despite substantial investment in sterilisation programmes, there has been limited evidence on their actual population-level impact. By focusing on where and how interventions are organised, the study adds an operational dimension that is often absent from broader

policy discussions. For the present study, this reference is especially useful because it indicates that management efficiency is shaped not only by total spending but also by programme design. This supports a more critical review of whether budget allocations are producing meaningful reductions in conflict, disease risk, and stray-animal-related damages.

Thangaraj, Krishna, Devika, et al. (2024) estimated India's burden of human rabies deaths and animal bites for 2022–23 and concluded that, although rabies mortality has declined substantially over the past two decades, India must accelerate action to eliminate dog-mediated human rabies by 2030. The authors emphasize a focused One Health approach, integrating human and animal surveillance, timely completion of post-exposure prophylaxis, and faster dog vaccination. This paper is one of the strongest national-level references for the present study because it provides a broad empirical foundation for analysing the scale and trend of animal-bite incidents. It also supports the need to relate incident burden to prevention systems and public expenditure.

Fielding, Fernandes, Amulya, et al. (2023) investigated the capture of free-roaming dogs for sterilisation in a multi-site study in Goa. The study points out that sterilisation and rabies vaccination programmes often depend on successful dog capture because permanent remote methods are not yet widely available. By examining operational challenges in catching dogs across sites, the authors highlight a practical bottleneck in programme delivery. For the present study, this article is valuable because it explains why management expenditure may not always translate directly into outcomes: implementation constraints can limit programme reach. It therefore supports a more grounded evaluation of stray-animal management budgets by recognising that operational feasibility matters as much as policy intent.

Gibson, Yale, Corfmat, et al. (2022) evaluated an integrated One Health rabies-control programme in Goa and found that the state achieved major reductions in canine rabies through sustained dog vaccination, surveillance, and coordinated intervention. The article makes a strong case that focusing only on human post-bite treatment is insufficient because it does not reduce the canine reservoir of infection. For the present study, this is a highly important reference because it demonstrates how sustained investment in animal vaccination and surveillance can generate measurable public-health gains. It also provides a useful model for discussing expenditure effectiveness, since programme costs can be interpreted alongside declines in canine rabies and improved prospects for human rabies elimination.

Evans, Gibson, Fielding, et al. (2022) analysed free-roaming dog population dynamics in Ranchi and highlighted the importance of understanding local demographic processes when planning rabies control and population-management measures. The paper situates dog population dynamics within the wider context of India's large rabies burden and notes that sustained high-coverage intervention requires reliable knowledge of how dog populations change over time. For the present study, this reference is useful because it strengthens the analytical link between incident trends and underlying animal population dynamics. Without understanding births, deaths, migration, and visibility, policy responses may underestimate the scale of control needed. Thus, the article supports more evidence-based interpretation of incident data and management budgets.

Thakur, Walia, Mehta, et al. (2022) assessed crop damages caused by animal menace in the mid-hill regions of Himachal Pradesh and directly estimated the economic burden on farm households. The study found that total economic losses included both reduced production and increased cultivation costs arising from the need to manage animal menace, with production losses contributing slightly more than half of total loss. This reference is particularly important for the present project because it broadens the literature beyond dog bites and rabies to include rural livelihood impacts from stray cattle and similar animals. It shows that stray-animal-related damages should be treated as an agricultural-economic issue as well as a public-health concern.

John, Royal, and Bharti (2021) conducted a systematic review of the burden of illness from dog-mediated rabies in India and concluded that the country carries a disproportionately high share of the global burden. Their review highlights that the problem extends beyond mortality to include treatment needs, economic loss, and human suffering. The authors also note the lack of comprehensive national evidence on the economic and humanistic burden of rabies, pointing to an important knowledge gap. For the present study, this paper is central because it justifies the financial-impact approach: estimating stray-animal damage cannot stop at incident counts and must include broader illness burden, cost of care, and indirect losses experienced by households and communities.

Collinson, et al. (2020) systematically reviewed the role of surgical sterilisation in canine rabies control and found that annual vaccination of at least 70% of the dog population remains the standard benchmark for eliminating canine rabies. The review argues that the additional value of sterilisation for rabies control is still debated because evidence on its incremental effect beyond vaccination is limited. For the present study, this article is highly relevant because it cautions against assuming that all forms of stray-dog spending are equally effective. It supports a more critical review of management budgets by distinguishing between interventions with strong epidemiological backing and those whose contribution, though potentially useful, is less clearly established in the evidence base.

Larkins, Reece, Shaw, and Thrusfield (2020) presented an economic case study on controlling dog-mediated rabies through an animal welfare organisation in Jaipur, India. The article situates the study within the global strategic plan to eliminate dog-mediated human rabies deaths by 2030 and focuses on the cost-effectiveness of control strategies, especially dog vaccination. For the present research, this paper is especially useful because it links operational rabies control to economic evaluation. It shows that the management of free-roaming dogs can be assessed through costs and benefits rather than only through welfare or disease-control narratives. This strengthens the current study's effort to examine expenditure patterns against the magnitude of reported damages and the expected benefits of intervention.

Tiwari, O'Dea, Robertson, and Vanak (2019) studied knowledge, attitudes, and practices related to rabies and free-roaming dogs in a rural village in western India. The authors found that trust in traditional healing practices and the influence of social, cultural, and religious beliefs can shape responses to animal bites and perceptions of free-roaming dogs. This is important because effective rabies prevention requires not only vaccines and treatment availability but also changes in community behaviour. For the present study, the paper is relevant because it explains why reported incidents and health outcomes are partly mediated by public awareness and social norms. It therefore supports including behavioural and informational gaps when interpreting the burden of stray-animal-related damages.

Tiwari, Vanak, O'Dea, Gogoi-Tiwari, and Robertson (2018) compared enumeration techniques for free-roaming dogs in rural Baramati, Pune district, and addressed a methodological issue that is central to dog population management: how to count animals accurately. The value of this study lies in showing that different counting approaches can produce different estimates, which has direct implications for planning vaccination, sterilisation, and surveillance programmes. For the present study, this reference is useful because any attempt to assess incident burden, intervention coverage, or financial adequacy depends on credible population denominators. The paper strengthens the methodological foundation of the project by showing that population estimation is not a minor technical issue but a key policy variable.

Kennedy, Sharma, and Phillips (2018) reviewed the sheltering of unwanted cattle in India and linked the issue to cultural, religious, social, and political factors that have produced a large population of unproductive surplus cattle, many of which either roam freely or end up in shelters. The review discusses gaushalas as distinctive institutions in India and notes their socio-economic and welfare implications. For the present study, this article is highly relevant because it expands the focus from dogs to stray and abandoned cattle, which are directly connected to crop damage, traffic hazards, urban nuisance, and public expenditure. It helps frame stray-cattle management as both a cultural-policy issue and an economic-management challenge.

Undurraga, et al. (2018) developed RabiesEcon, a spreadsheet-based tool to estimate the cost-effectiveness of dog rabies vaccination programmes in East Africa. The model estimates rabid dog cases averted, human deaths averted, and the cost per year of life gained under different vaccination scenarios. Although the empirical setting is East Africa rather than India, the paper is still valuable for the present study because it offers a strong economic-evaluation framework for analysing stray-dog management. It shows how program costs can be translated into comparable outcome measures, which is useful when discussing whether public spending on vaccination and related control activities is proportionate to the burden of incidents and expected health gains.

Yoak, Reece, Gehrt, and Hamilton (2016) used agent-based modelling to examine how free-roaming dog control programmes can be optimized under different management scenarios. The study argues that programmes in developing-world cities are often fragmented across governments, veterinarians, and NGOs, and that lethal removal tends to be less effective than fertility-control-based approaches in reducing population size. It also suggests that periodic surveys of dog locations can improve intervention effectiveness.

For the present study, this article is useful because it introduces a systems perspective: control outcomes depend on strategy choice, data quality, and spatial targeting. This supports the project's broader argument that expenditure should be judged not only by amount spent but by how intelligently programmes are designed.

3. Research Methodology

3.1 Introduction

Selection of a suitable research methodology is important so that the validity, reliability, and accuracy of the research study may be ensured. Research methodology is a systematic process that guides the researcher in conducting the investigation in a logical, structured, and ethical manner. It offers an organized way of collecting, analysing, and interpreting data in order to achieve the objectives of the study. For the present study, an appropriate research methodology has been designed to examine the financial impact of stray animals in India through analysis of reported incidents, estimated loss, and government budget priorities.

The main objective of the study is to understand the extent to which stray-animal-related incidents create economic, social, and administrative burdens. The study also attempts to analyse how reported incidents vary across states and years and how government budget allocation and actual expenditure are aligned with the problem. Stray-animal-related damages affect multiple areas such as public health, agriculture, road safety, and urban management. Therefore, a structured methodology is necessary to capture these dimensions in a systematic and meaningful way.

In this research work, secondary data has been collected from official and factual sources and then cleaned in a format suitable for statistical analysis. The data collected indicate that the objectives of the study are quantitative in nature. The dataset used for analysis includes information related to states, years, and reported incident counts. This enables the researcher to investigate patterns, trends, and differences in the stray-animal-related burden across India.

The research design, data collection process, sampling technique, and statistical tools for data analysis are highlighted in this chapter. Similarly, ethical considerations are also discussed, which were taken into account during the research in order to ensure transparency, integrity, and factual accuracy. This structured methodological framework aims at generating reliable, valid, and meaningful insights into the financial impact of stray animals in India.

3.2 Research Design

A research design is a blueprint that brings together the different parts of the research study in a logical and coherent manner. By employing a suitable research design, the research problem can be addressed effectively, relevant data can be collected, and appropriate analysis can be carried out to accomplish the research objectives. An effective research design improves the quality of the study, reduces the chances of error, and ensures that the findings are meaningful and dependable.

The present study adopts a quantitative research design, as it allows the researcher to analyse numerical data related to stray-animal incidents and related economic implications. Quantitative research is appropriate for this study because it enables objective measurement of trends and differences across states and years and allows the use of statistical tools for analysis. Since the study is based on recorded incident data and numerical comparisons, the quantitative method is the most suitable approach.

The nature of the research design is both descriptive and analytical. The descriptive aspect of the study concerns outlining the pattern of stray-animal-related incidents across different States and Union Territories and over different years. It helps in identifying which states report a higher or lower burden and whether the incidents are increasing, decreasing, or fluctuating over time.

The analytical aspect of the study focuses on interpreting the relationship between incident burden, estimated financial loss, and public expenditure priorities. In the broader framework of the study, incident burden is treated as the central measurable variable, while estimated loss and government spending are interpreted as associated economic and policy dimensions. This analytical approach helps in understanding whether the available management efforts are aligned with the scale of the problem.

The framework of the study is based on multiple dimensions that contribute to stray-animal-related damages and their management.

Incident Dimension

This includes reported stray-animal-related cases across different states and years. Incident count forms the core variable of the study and reflects the measurable burden of the problem.

Economic Dimension

Stray-animal-related incidents can create direct and indirect losses in the form of medical expenditure, crop

damage, productivity loss, property damage, and public management cost. This dimension supports the financial interpretation of the problem.

Administrative and Budgetary Dimension

Government authorities incur expenditure for the management and mitigation of stray animals through control measures, shelters, sterilisation, vaccination, and welfare-related interventions. The study considers budget allocation and actual expenditure as important policy dimensions.

Trend and Comparative Dimension

The study also compares the variation in incident burden across states and across years. This makes it possible to identify high-burden regions, changing patterns, and possible pressure points for policy action.

The integration of these dimensions in the research design provides a structured and coherent understanding of stray-animal-related damages as a public health, economic, and governance issue.

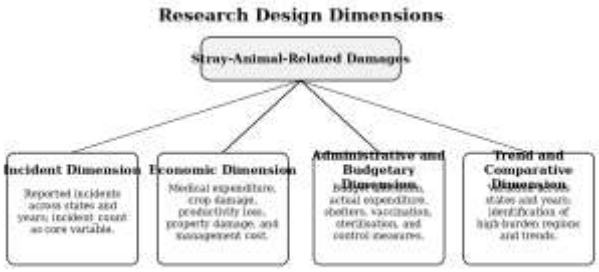


Fig. 1. Research design dimensions derived from the study framework.

3.3 Data Collection Methodology

Data collection is one of the most essential parts of any research study. In addition, analysing the research problem through appropriate data collection is highly important. The present study is based on secondary data collected from official and publicly available sources. Since the research focuses on factual incident trends and public expenditure, the use of secondary data is suitable for ensuring objectivity and consistency.

The data used in this study was collected from official records and then cleaned and reorganized into an SPSS-friendly format. The final cleaned dataset used for analysis contains the following variables:

- state
- year
- incident_count

The unit of analysis in the study is state-year, which means that each row of data represents one State or Union Territory for one particular year. The final dataset covers the period from 2018 to 2023 and includes 220 observations across 37 States/UTs, with two state-year records not available in the final cleaned file.

The first section of the dataset contains the name of the state or union territory, which helps in state-wise comparison. The second variable is year, which is used for time-trend analysis. The third and most important variable is incident count, which refers to the number of reported stray-animal-related incidents for that state in that year, based on the collected official records.

Before analysis, the data was carefully cleaned to ensure that it could be read and analysed properly in SPSS. Data cleaning included standardisation of variable names, correction of spelling inconsistencies, removal of unnecessary formatting, and conversion of year and incident values into numeric form. This ensured consistency, readability, and analytical suitability of the dataset.

The study is based only on actual factual data. No fabricated values were inserted into the final incident dataset. Wherever financial loss or government expenditure figures were not available in comparable state-year form, such values were not artificially created. This was done to maintain factual accuracy and research integrity.

3.4 Sampling Technique and Sample Size

Sampling refers to the process of selecting a smaller group of observations from a larger population for the purpose of research. However, in the present study, the conventional sampling method has not been used because the research is based on secondary data rather than survey responses. Instead, the study adopts a census-based inclusion approach, in which all available observations from the collected dataset were included for analysis.

Since the dataset represents all available state-year records for the selected time period, no random or non-random sample selection was required. This method is appropriate because the study aims to analyse the complete available pattern of reported incidents rather than the opinions or experiences of selected respondents.

The final sample size for this study is:

- 220 observations
- 37 States and Union Territories
- 6 years (2018–2023)

In a complete panel dataset, 37 States/UTs over 6 years would normally produce 222 observations. However, the final cleaned dataset contains 220 observations because two state-year combinations were not available in the collected data. Even so, the size of the dataset is sufficient for conducting descriptive statistics, trend analysis, state-wise comparison, and basic quantitative analysis in SPSS.

The use of full available observations strengthens the study because it avoids the bias that may arise from selective inclusion. It also increases the reliability of state-wise and year-wise comparisons. Therefore, although conventional sampling is not used, the data coverage remains adequate and appropriate for the objectives of the study.

3.5 Data Analysis Framework

After the collection and cleaning of data, the dataset was organized, coded, and analysed using appropriate statistical techniques in SPSS. The purpose of the data analysis framework is to convert the collected raw data into meaningful findings that support the objectives of the study. Since the present research is based on quantitative secondary data, the analysis focuses on identifying the pattern, variation, and trend of stray-animal-related incidents across different States and Union Territories of India during the period 2018 to 2023.

The final cleaned dataset used for analysis contains three variables: state, year, and incident_count. Therefore, the analysis framework has been designed in accordance with the nature of the available data. The statistical methods selected for this study include descriptive analysis, percentage analysis, chi-square test, and regression analysis. These techniques are appropriate for examining the distribution of incidents, interstate variation, year-wise trend, and the time-related relationship between year and incident count.

Descriptive Analysis

Descriptive statistics are used to provide an overall understanding of the collected data. This includes the number of observations, minimum value, maximum value, mean, and standard deviation of incident counts. Descriptive analysis helps in identifying the general magnitude of stray-animal-related incidents and the extent of variation across the dataset. It also provides a basic summary of the structure of the data and supports the interpretation of the burden of incidents in India.

Percentage Analysis

Percentage analysis is used to understand the proportional distribution of observations across different states and years. It helps in identifying the percentage contribution of each state and each year to the total dataset. In addition, percentage analysis is useful for examining the spread of incident counts and identifying whether the data is balanced across the study period and regions. This method helps present the data in a simple and interpretable form and supports comparative analysis.

Chi-Square Test

The chi-square test is used to examine whether there is any association between categorical variables in the study. In the present research, chi-square analysis is applied to examine the relationship between state and incident_count and between year and incident_count through crosstabulation. This test helps in assessing whether the distribution of incident counts differs across states and across years. However, since the incident count variable is numerical and highly scattered, the chi-square results are interpreted with caution, especially where the assumptions related to expected cell frequency are not fully satisfied. Even so, the chi-square test provides useful support for understanding whether the variation observed in the dataset is statistically meaningful.

Regression Analysis

Regression analysis is used to examine the influence of year on incident_count. In this model, incident count is treated as the dependent variable and year is treated as the independent variable. The purpose of regression analysis is to assess whether incident counts show an increasing or decreasing trend over time. The model helps in identifying the direction and significance of the relationship between time and reported incidents. It also shows the extent to which year explains variation in incident count. Since only one predictor variable is used, the regression model is simple in nature and mainly supports trend-based interpretation rather than complex causal explanation.

The data analysis framework has been developed in line with the objectives of the study. For the objective related to understanding incident burden, descriptive and percentage analysis are most relevant. For the objective related to trend analysis, descriptive statistics, percentage analysis, chi-square test, and regression analysis are applied. Since the present dataset is limited to factual incident records and does not contain complete state-wise financial loss, budget allocation, or actual expenditure variables, advanced financial and budgetary analysis is not included in the main SPSS framework. Therefore, the present study focuses

primarily on the statistical analysis of incident trends and their interpretation.

Overall, the use of these statistical techniques ensures a systematic, objective, and meaningful analysis of the collected data. The framework is appropriate for the present study because it is based on the actual structure of the dataset and supports clear interpretation of stray-animal-related incident patterns in India.

3.6 Ethical Consideration

During the study, significant attention was given to ethical considerations so that the credibility, integrity, and reliability of the research could be maintained. Since the study is based entirely on secondary, aggregated, and non-personal data, the ethical risk associated with the research is minimal. No personal identifying information, confidential records, or direct human responses were used in the analysis. However, ethical responsibility was still maintained in several ways. First, only factual and officially available data were used for the analysis. Second, the researcher ensured that no values were fabricated or manipulated to fill unavailable data points. Third, the data cleaning process was carried out only to improve analytical usability and not to change the meaning of the original information. Fourth, the findings are presented honestly, with recognition of the limitations of the dataset, especially where the available data may reflect only reported incidents and not the complete actual burden. The data collected for the research has been used solely for academic and research purposes. Care has been taken to interpret the findings responsibly, without overstatement or unsupported conclusions. During the research, ethical practices ensured that transparency, factual accuracy, and academic honesty were preserved throughout the study.

3.7 Summary of Research Methodology

4. Data Analysis and Interpretation

4.1 Introduction

This chapter presents the analysis and interpretation of the data collected for the study titled "Financial Impact of Stray Animals in India: Estimating Damage Costs, Analysing Incident Trends, and Reviewing Government Budget Priorities." The purpose of this chapter is to examine the available data in a systematic manner and to interpret the findings in relation to the objectives of the study. Since the study is based on quantitative secondary data, the analysis focuses on reported incident counts across different States and Union Territories over the period 2018 to 2023.

The chapter uses statistical tools and tabular presentation to identify patterns, trends, and variations in stray-animal-related incidents. The analysis includes descriptive statistics, percentage analysis, chi-square test, and regression analysis, as these methods are suitable for understanding the scale of incidents, year-wise changes, state-wise variation, and trend relationships in the data. The purpose of interpretation is not only to present numerical values but also to explain what these values indicate about the growing burden of stray-animal-related damages in India.

Through this chapter, the researcher aims to convert raw data into meaningful findings. The results obtained from the analysis help in understanding the nature of incident trends and provide an empirical basis for discussing the broader economic and policy implications of stray-animal management in India.

4.2 Descriptive Analysis

Table I. Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
year	220	2018	2023	2020.48	1.708
incident_count	220	0	2021103	126224.80	245145.298
Valid N (listwise)	220				

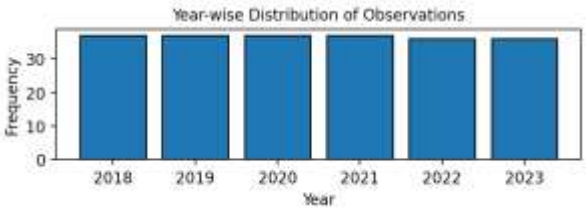


Fig. 2. Year-wise distribution of observations from 2018 to 2023.

Interpretation

The descriptive statistics provide a general overview of the dataset used in the study. A total of 220 valid observations were included in the analysis, which means that all available state-year records were successfully used without any missing values in the selected variables. For the variable year, the minimum value is 2018 and the maximum value is 2023, with a mean of 2020.48 and a standard deviation of 1.708. This indicates that the dataset is evenly spread across the six-year study period from 2018 to 2023. The mean year of 2020.48 shows that the observations are centered around the middle of the study period, confirming that the data covers the selected time frame in a balanced manner. For the variable incident_count,

the minimum value is 0 and the maximum value is 2,021,103, which shows a very wide variation in reported stray-animal-related incidents across states and years. The mean incident count is 126,224.80, indicating that, on average, each state-year observation recorded about 126 thousand incidents. However, the standard deviation is 245,145.298, which is much higher than the mean. This suggests a high level of dispersion in the data, meaning that incident counts differ considerably across different states and years. The large gap between the minimum and maximum values, along with the high standard deviation, indicates that the burden of stray-animal-related incidents is not uniform across India. Some states or years reported very low or even zero incidents, while others reported extremely high incident counts. This reflects substantial interstate and intertemporal variation in the data. Overall, the descriptive statistics show that stray-animal-related incidents constitute a significant and unevenly distributed issue, thereby justifying further analysis through percentage analysis, chi-square testing, and regression analysis.

4.3 Percentage Analysis

Table II. State-Wise Distribution of Observations

Category	Frequency	Percent	Interpretation
Most States/UTs	6	2.7	Data available for all six years (2018-2023)
Daman and Diu	4	1.8	Data not available for all six years
Total	220	100.0	Broadly balanced state-wise structure

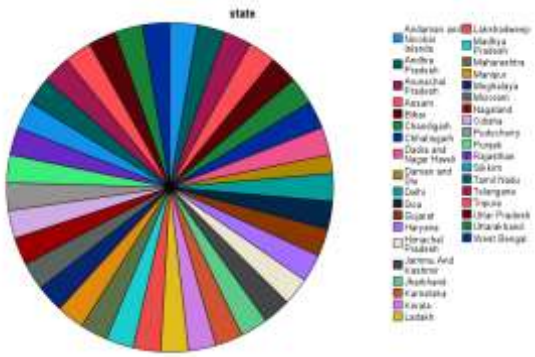
Table III. Year-Wise Distribution of Observations

Year	Frequency	Percent	Cumulative Percent
2018	37	16.8	16.8
2019	37	16.8	33.6
2020	37	16.8	50.5
2021	37	16.8	67.3
2022	36	16.4	83.6
2023	36	16.4	100.0

Interpretation

State

The percentage analysis of the state variable shows that the dataset is almost equally distributed across the States and Union Territories. Most states have a frequency of 6 observations each, representing 2.7 percent of the total sample, which means that data is available for all six years from 2018 to 2023 for most of the states. This indicates a balanced state-wise structure of the dataset and makes the data suitable for interstate comparison. However, Daman and Diu has only 4 observations, accounting for 1.8 percent of the sample, which suggests that data for this state is not available for all six years. Overall, the state-wise percentage distribution confirms that the dataset is broadly balanced and appropriate for comparative analysis across different regions.



Year

The percentage analysis of the year variable indicates that the observations are also evenly distributed across the study period. The years 2018, 2019, 2020, and 2021 each have 37 observations, representing 16.8 percent of the total sample, while the years 2022 and 2023 have 36 observations each, accounting for 16.4 percent each. This shows that the dataset is almost uniformly spread across the six-year period and does not suffer from major imbalance in year-wise coverage. Such a distribution is useful for trend analysis, since each year contributes nearly the same proportion to the total dataset. Therefore, the year-wise percentage analysis suggests that the data is appropriate for examining changes and variations in incident counts over time.

Incident Count

The percentage analysis of incident_count shows that the values are highly scattered and widely distributed across the dataset. Most incident count values appear only once, each contributing 0.5 percent of the total sample, while the value 0 appears 6 times, representing 2.7 percent. This indicates that there is no single dominant incident level repeated throughout the dataset. Instead, the incident counts vary greatly across states and years, with some observations recording no incidents and others reporting very high counts. The percentage distribution therefore reflects substantial variation in the burden of stray-animal-related incidents in India. This wide spread of values suggests that the problem is not uniform across all states and years, and it supports the need for further analysis through descriptive statistics, chi-square testing, and regression analysis.

4.4 Chi-Square Test

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1064.049[a]	1065	.502
Likelihood Ratio	764.064	1065	1.000
Linear-by-Linear Association	10.321	1	.001
N of Valid Cases	220		

a. 1284 cells (100.0%) have expected count less than 5. The minimum expected count is .16.

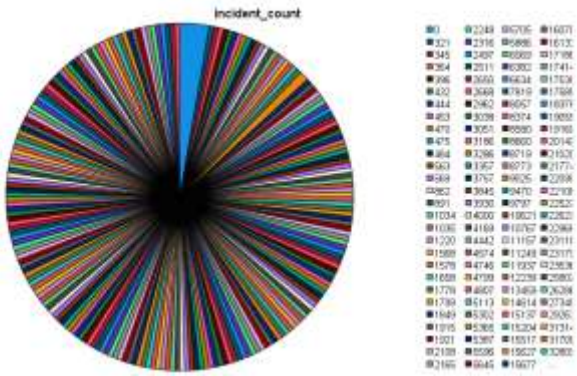
Interpretation

State × Incident Count

A Chi-Square test was conducted to examine the relationship between state and incident_count. The Pearson Chi-Square value is 7874.167, with 7668 degrees of freedom and p = 0.049, which numerically suggests a statistically significant association between state and incident count. This means that the pattern of reported stray-animal-related incidents appears to vary across different States and Union Territories. The crosstabulation also shows that incident counts are not evenly distributed, as some states report very low counts while others show comparatively high values. However, this result should be interpreted with caution because 100.0 percent of the cells have expected counts less than 5, which violates the basic assumption of the chi-square test. Therefore, although the table indicates interstate variation in incident burden, the chi-square result is statistically weak and should be treated as indicative rather than conclusive.

Year × Incident Count

A Chi-Square test was carried out to identify the relationship between year and incident_count. The Pearson Chi-Square value is 1064.049, with 1065 degrees of freedom and p = 0.502, which indicates that there is no statistically significant relationship between year and incident count. This means that the distribution of incident counts does not differ significantly across the years considered in the study. In other words, the variation in reported incident levels over time is not strong enough to establish a significant association through the overall chi-square test. At the same time, the Linear-by-Linear Association is significant at p = 0.001, which suggests the presence of a possible linear time-related pattern. Still, this result must also be interpreted carefully because 100.0 percent of the cells have expected counts less than 5, meaning the chi-square assumptions are violated. Hence, the test suggests no strong year-wise association overall, and a categorized incident variable would provide a more reliable basis for chi-square analysis.



4.5 Regression Analysis

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	year[b]	.	Enter

a. Dependent Variable: incident_count

b. All requested variables entered.

Interpretation

A linear regression analysis was performed to examine the influence of year on incident_count in the study of stray-animal-related incidents in India. The purpose of the regression was to understand whether the passage of time has any significant effect on the number of reported incidents. In this model, incident_count was taken as the dependent variable, while year was entered as the independent variable. Thus, the analysis was intended to identify whether incident levels have increased or decreased over the period covered in the dataset.

According to the model summary results, the correlation coefficient value of R = 0.217, which indicates a weak relationship between year and incident_count. The R^2 value of 0.047 implies that year explains only about 4.7% of the variation in incident_count, while the remaining variation is influenced by other factors not included in the model. The adjusted R^2 value of s0.043 shows only a slight reduction after adjustment, suggesting that the explanatory power of the model remains low. However, the ANOVA results show an F-value of 10.782 with significance p = 0.001, which means that the regression model as a whole is statistically significant at the 1 percent level.

The coefficients table indicates that year has a statistically significant negative effect on incident_count. The unstandardized coefficient for year is B = -31156.807 with p = 0.001, which means that for every one-unit increase in year, the predicted

incident_count decreases by about 31,156.81 cases on average. The standardized beta value (Beta = -0.217) also confirms a weak negative relationship. This suggests that the number of reported stray-animal-related incidents tends to decline over time in the dataset.

In addition, the collinearity statistics show that the Tolerance value is 1.000 and VIF is 1.000, which indicates that there is no multicollinearity problem in the model. This is expected because only one predictor variable has been used. The residual statistics, however, show that there is still considerable unexplained variation in the data, indicating that year alone is not sufficient to fully explain differences in incident_count.

Overall, the regression results indicate that year is a significant predictor of incident_count, but its explanatory power is limited. The findings suggest that stray-animal-related incidents show a declining trend over time, although the change is weak and much of the variation is likely due to state-level differences and other unobserved factors not included in the present model.

4.6 Result and Discussion

The analysis of the dataset provides important insights into the pattern of stray-animal-related incidents in India during the study period from 2018 to 2023. The descriptive statistics showed that the dataset consists of 220 valid observations, with incident counts ranging from 0 to 2,021,103, a mean value of 126,224.80, and a high standard deviation of 245,145.298. This indicates that the burden of stray-animal-related incidents is highly uneven across different states and years. Some states reported very low or zero incidents, while others recorded extremely high numbers. Thus, the problem is not uniformly distributed and varies substantially across the country.

The percentage analysis further confirmed that the dataset is almost equally distributed by state and year, making it suitable for comparative analysis. Most states contributed six observations each, while most years also had nearly equal representation. However, the percentage distribution of incident_count revealed that most values occur only once, showing that incident counts are highly scattered. This wide variation reflects the differing intensity of stray-animal-related problems across regions and supports the view that the issue is influenced by location-specific conditions, reporting practices, and population differences.

The chi-square analysis was used to examine the association of incident counts with state and year. In the case of state and incident_count, the Pearson Chi-Square value was 7874.167 with p = 0.049, suggesting a statistically significant association. This implies that incident levels differ across states. However, because all expected cell counts were below the required threshold, the result is statistically weak and must be interpreted cautiously. For year and incident_count, the Pearson Chi-Square value was 1064.049 with p = 0.502, indicating no statistically significant association overall. This suggests that year-wise differences in incident counts are not strong enough to establish a clear association through chi-square analysis, although the linear-by-linear result hinted at a possible trend.

The regression analysis provided a clearer understanding of the time-related pattern in incidents. The regression model was statistically significant, with F = 10.782 and p = 0.001. The coefficient for year was negative (B = -31156.807), indicating that incident counts tend to decline over time. However, the R^2 value of 0.047 shows that year explains only 4.7 percent of the variation in incident counts. This means that although time has a significant effect, it is only a weak predictor, and most of the variation in incidents is likely due to other factors not included in the present model.

Overall, the findings show that stray-animal-related incidents in India are marked by strong interstate variation and only a weak time-based decline. The discussion suggests that the burden of incidents is influenced more by regional differences than by year alone. Therefore, policy responses should be more state-specific and targeted rather than relying only on general national trends. These results support the argument that stray-animal management in India requires stronger regional monitoring, more consistent reporting systems, and better alignment of intervention strategies with local burden levels.

5. Recommendation

Government authorities should make conscious and systematic efforts to reduce stray-animal-related incidents through better reporting systems, preventive control measures, and stronger financial planning for management programmes. One of the most important steps would be the development of a uniform and comprehensive incident reporting system across all States and Union Territories. Such a system should record state-wise and year-wise data on stray-animal-related incidents in a standardized manner so that comparisons can be made more accurately. A more reliable reporting framework would help government agencies identify high-burden states, monitor changes

over time, and design evidence-based policy interventions. In addition, authorities should ensure that reported data is regularly updated and made publicly accessible for administrative planning and academic research purposes.

Apart from reporting improvement, government institutions should strengthen preventive and control mechanisms such as sterilisation drives, vaccination programmes, rescue services, shelter management, and local monitoring systems. These measures can reduce the long-term burden of stray-animal-related incidents and improve public safety. Public awareness campaigns should also be introduced to educate communities about responsible waste disposal, safe human-animal interaction, and timely reporting of incidents. Such initiatives can reduce avoidable conflict between people and stray animals and improve the effectiveness of local management systems. Preventive measures should be targeted more strongly in states with higher reported incident counts so that resource use becomes more efficient and outcome-oriented.

From the administrative and financial point of view, greater attention should be given to budget transparency and expenditure tracking for stray-animal management. Government departments should maintain separate and clearly documented records of budget allocation, actual expenditure, and utilization related to stray-animal control and mitigation programmes. This would make it easier to evaluate whether public funds are being used effectively and whether management priorities are aligned with the burden of incidents. A transparent budget framework would also support better policy accountability and allow future researchers to examine the relationship between incident levels and expenditure more accurately. Thus, authorities should adopt a holistic approach that combines better data reporting, targeted preventive action, and stronger financial management. In the future, research may include additional variables such as stray animal population, urbanization level, healthcare burden, crop damage, and public expenditure, which would provide a broader understanding of the financial and policy dimensions of stray-animal-related damages in India.

6. Conclusion

This study examined the financial impact of stray animals in India, the pattern of reported incidents across States and Union Territories, and the broader policy relevance of government management efforts. The findings show that stray-animal-related incidents represent an important public concern in India and that the burden is unevenly distributed across regions. The descriptive results indicate substantial variation in reported incident counts, with some states recording very low or zero incidents and others reporting extremely high values. This wide difference suggests that the burden of stray-animal-related damages is not uniform and is likely influenced by regional factors such as population density, local management systems, reporting practices, and state-level conditions.

The findings further reveal that the dataset is well distributed across states and years, making it suitable for comparative and trend-based analysis. The percentage analysis confirms that the observations are almost equally spread across the study period, while the incident_count variable shows a highly scattered pattern, indicating considerable diversity in the scale of incidents. The chi-square analysis suggests that incident burden varies across states, although this result must be interpreted carefully because the assumptions of the chi-square test were not fully satisfied. In the case of year-wise association, the chi-square results do not show a strong overall relationship between year and incident_count, although there is some indication of a time-related trend.

The regression findings indicate that year has a statistically significant but limited effect on incident_count. The negative coefficient suggests that the number of reported stray-animal-related incidents shows a declining tendency over time. However, the explanatory power of the model is low, which means that year alone cannot explain most of the variation in incident levels. This indicates that stray-animal-related incidents are shaped by multiple factors beyond time, including regional and administrative differences that are not captured in the current model.

On the whole, it can be concluded that stray-animal-related incidents are an important and unevenly distributed issue in India, with significant implications for public management and policy planning. The study shows that the burden of incidents cannot be understood only at the national level and requires stronger state-specific monitoring and intervention. It also highlights the need for better financial documentation, improved reporting systems, and more comprehensive datasets in order to assess the economic impact and budget priorities more effectively. Thus, the study concludes that stray-animal management should be approached through a more integrated framework that combines accurate reporting, targeted intervention, and evidence-based policy support.

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