

Passenger and Operational Perceptions of Terminal Congestion, Waste Management, and Bird Strike Risk at a Capacity Constrained Hub Airport

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ABSTRACT

This paper presents findings from a cross sectional survey of passengers (N = 93) and two semi structured interviews with the Deputy Airport Manager (Operations) at JIA, conducted in December 2024, to explore the perceptions of the three pressures at JIA. Descriptive responses show a general lack of satisfaction with airport congestion, a strong positive response to infrastructure modernity, a majority believe there is a connection between waste accumulation in the area and the risk of birds striking an aircraft, and a more mixed opinion of the airport's environmental performance and comfort of the waiting areas. Staff reporting confirms that all wildlife is being patrolled reactively and that waste is being separated from the rest of the garbage but that there is no systematic work done to modify habitats or to communicate to the public the risks and potential hazards.

The 20-item survey instrument had good overall internal consistency (Cronbach's alpha = 0.88), however, the survey was convenience sampled with no sampling frame and 12 of the 17 responses were not completed, and the qualitative text is based on only two interviews. No claims are made. The paper is a documented, cited report of a data scarce case at a time of current capital investment, and a replicable protocol for a more rigorous study that this case still needs.



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1. Introduction

Jinnah International Airport (JIA; IATA: KHI) serves as Pakistan's second busiest airport as well as Pakistan International Airlines' main hub. It is one of the nation's most vital aviation hubs, and a key part of its national and international connectivity. The airport has been a part of an extensive infrastructure modernization initiative since 2024, spearheaded by the Pakistan Airports Authority (PAA). The project will include the upgrading and extension of the main runway to accommodate the use of Code 4F aircraft like the Airbus A380, as well as the construction of a new modern rescue and firefighting station and a new modern air traffic control tower (ATC). The investments are part of a comprehensive plan to expand the entire operation's capacity, safety, and future growth by augmenting passenger and aircraft traffic.

If the airport project is a large scale one, it is usually designed to expand the airport's capacity and enhance the quality of the services provided and long-term sustainability. But growth of physical infrastructure does not necessarily address operational issues like terminal congestion, environmental control or aviation safety. Based on the research of airport management, airport experience management, waste management and wildlife hazard management are recognised as inseparable aspects of airport performance that cannot be dealt with separately, but through an integrated approach in airport planning. Poorly managed wastes and wildlife attractants from the vicinity are also identified as important risk factors to bird strike by the International Civil Aviation Organization (ICAO) guidance, further highlighting the close relationship between environmental management and aviation safety.

Although there is increasing international research into airport service quality,

sustainability and dealing with wildlife hazards, the empirical work in developing-country airports is still relatively scanty. Previous studies have mostly focused on the airports in Europe, North America and some areas of East Asia, and little knowledge exists about the experience of such operational challenges in resource limited airports where the infrastructure is being extended. The situation is particularly stark in South Asia, where airports are frequently limited by financial, institutional and land use constraints, whilst constantly attempting to cater for the needs of their passengers.

These issues can be explored appropriately within the context of Jinnah International Airport. Apart from the huge investment in infrastructure, the airport is also coping with operational issues related to terminal congestion, solid waste management and bird strike risk. These are very interrelated issues. Terminal congestion affects passengers' experience and operational efficiency, and poor waste management can lead to problems with the environment and also draw more wildlife and pose a safety risk for aircraft. Studying these operational pressures as a whole, therefore, offers a comprehensive perspective on airport performance as opposed to studying each separately.

This paper presents an exploratory mixed-methods case study involving a cross-sectional passenger survey (N = 93) from 15 to 24 December 2024, complemented by two semi-structured interviews with JIA's Deputy Airport Manager (Operations) and Captain Shahbaz (AirSial). The study aims to have three goals. It first records the perceptions of passengers regarding congestion, waste management and risk of bird strikes at the airport during a period of active investment in the airport infrastructure. Secondly, it will make a comparative analysis of the perceptions with an operational point of view from airport management and find the points of convergence and divergence. Third, it discusses these results in the context of the

wider body of literature around airport service quality, environmental management, and wildlife hazard management to draw practical conclusions for airport planning and future research.

The findings of the study are based on the one exploratory case study, but its implications go beyond the description of Jinnah International Airport. The case highlights some general governance and operational issues that may well arise at resource limited or growth airports, as they attempt to expand their infrastructure. The study not only sheds light on the relationship between passenger experience, environmental management and aviation safety in a developing country context but also offers practical guidance for airport managers who wish to combine operational service quality, waste management and wildlife hazard mitigation in the infrastructure planning as one work stream.

2. Literature Review

2.1 Terminal Congestion and Airport Service Quality

The previous studies on airport terminal congestion can be categorized under three complementary approaches. The first one is the congestion as a service quality problem, mainly looking at the perceptions of passengers regarding waiting times, terminal comfort, accessibility and the efficiency of the terminal operations as a service. The latter deals with airport capacity planning, highlighting the effect of constraints on infrastructure, passenger demand and terminal layout on the level of service and passenger flow. A more recent stream takes an integrated operational management view of the issue, acknowledging that congestion is not solely caused by physical infrastructure issues, but is as much due to the effectiveness of the operational processes, resource allocation and passenger flow management.

Taken together, these views lead to the

conclusion that passenger perceptions offer valuable input to the objective operational measures in assessing airport performance, especially in situations of expansion or growing passenger numbers. The airport service quality literature is the most frequently used source to study passenger perception of terminal congestion. One of the influential frameworks is SERVQUAL of Parasuraman, Zeithaml & Berry (1988) that assesses perceived service quality based on five dimensions: Tangibles, Reliability, Responsiveness, Assurance, and Empathy. SERVQUAL was initially used for surveying customer satisfaction across a range of service industries, but it has been extensively applied in aviation research to measure passengers' satisfaction and to pinpoint the best and worst aspects of airport terminal operations. Since then, the study of airport service quality has developed from SERVQUAL.

Airport Service Quality (ACI) is a programme that involves airports in assessing passenger satisfaction, based on a broad range of indicators that include terminal comfort, queue times, accessibility, cleanliness, wayfinding, security processing and overall passenger experience. These measures acknowledge that the performance of airports is not solely a matter of physical infrastructure, but largely one of the effective management of the operational resources that are available along the passenger journey. Rocha et al. (2022) conducted a systematic literature review on airport service quality, and the results of the study, which included 61 studies, indicated that the field of airport service quality research has evolved over the last decades to a greater emphasis on comprehensive evaluation of airports that include both operational performance and passengers' perceptions. The review also highlighted a few important research gaps such as fewer empirical studies have been done on airports in developing countries and the lack of emphasis on

operational decision making, airport sustainability and infrastructure in airport service quality studies.

These observations are especially important for Jinnah International Airport where continued investment on infrastructure offers a chance to look at passengers' perception and operational issues. An understanding of the congestion experienced by passengers on a time of airport expansion can give practical evidence to help inform airport infrastructure planning, service quality improvement and operational decision-making practices on resource constrained hub airports.

2.2 Airport Solid Waste Management

The current studies regarding airport waste management can be categorized into three related areas. The first focuses on waste generation, characterisation and disposal, with a special focus on the amount of waste generated, recycling rates and treatment techniques at the individual airports. The second is related to environmental sustainability, highlighting the importance of integrated airport waste management systems, circular economy principles, waste minimisation and strategies for achieving zero waste as part of sustainable airport operations. A third important view sees waste management as an operational problem, not just an environmental one, and considers its effects not only on the environment, but also on airport safety, regulatory compliance and wildlife hazard management. ICAO guidance suggests poor waste management practices, especially organic waste and nearby landfill sites, are significant factors that are attractive to birds and other wildlife, which can increase the likelihood of wildlife strikes. These studies collectively highlight the importance of airport waste management, not just for environmental sustainability, but also for operational efficiency and aviation safety.

While these gains have been realized, the

bulk of the detailed empirical evidence comes from high-income European cities, such as Copenhagen and Istanbul, and large airports, where financial, technological and institutional resources for waste management are relatively plentiful. There is limited empirical research about the impact of waste management on the passenger experience, operational issues and wildlife hazard management in resource constrained airports in developing countries, especially in the context of airport growth. The issue of waste management at airports has been well documented in a few well-resourced airports. Baxter, Srisaeng and Wild's case study of the Copenhagen Airport showed that between 72 percent of waste was incinerated, 15 percent recycled and 13 percent land-filled; the proportion of waste disposed of in landfills had reduced over 17 years in keeping with EU waste hierarchy policy. The same pattern of a small proportion of waste in the MSW stream being recycled and a high proportion being landfilled was observed in the Ozbay and Gokceviz study of the waste streams from Istanbul Airport, with a measurable change in the proportion of waste type being disposed of during the COVID 19 period.

Previous research by Pitt and Smith with UK airports began to separate the concern for waste management efficiency from environmental and facilities management consideration, and considered it as a legitimate focus of research in airport management literature. Another common observation in this literature is that proximity to runways and flight paths is not only an environmental issue but also an operational and safety one; for instance, ICAO's guidance on Eco Airport waste management explicitly notes that landfills near airports are an established risk factor for bird strikes. Nearly all of the detailed, quantified case studies presented in this literature (Copenhagen, Kansai, Istanbul) are drawn from higher income airports and there is little similar documentation from airports

in South Asia or other developing regions, despite the fact that these airports may often have more severe space, funding, and regulatory capacity limitations.

2.3 Bird Strike Risk and Its Link to Waste Management

There has been a shift in the literature from reporting bird strike occurrences to implementing proactive and integrated wildlife hazard management strategies. There are three general solutions. The first reviews wildlife hazard management programmes, based on the historical bird strike data, to determine the effectiveness of the operational interventions and reporting systems. The second focuses on the development of quantitative risk assessment techniques such as probabilistic models, risk indices and spatial analyses to assess the probability of bird strike and to provide evidence-based decision making. A third focus is on the use of preventative measures, such as habitat management, land-use planning and waste management, to eliminate wildlife attractants in and around airports to minimise the bird strike hazard at source as well as with deterrence measures. Together, these represent a move from a reactive attack response to a proactive risk management approach, presenting a new approach that is both operational, ecological, and environmental. Notwithstanding these developments, however, most empirical work has come from North America and Europe, and comparatively little peer-reviewed research has evaluated the issues of bird strike risk management at airports in the resource constrained context of South Asian airports or elsewhere in the developing world.

Altringer, Where Altringer, Begier, Washburn, and Shwiff looked at the variable uptake of a federal wildlife hazards management programme across United States joint use airports, they measured impacts to realised wildlife strike risk, and

warned that raw wildlife strike count data is difficult to interpret because of imperfect reporting of strikes, especially at airports that do not rely on a voluntary or informally compiled strike log. Teunizen et al., van Gasteren, and Krijgsveld's count based risk mitigation technique, which is based on 30 years of data at Dutch airfields, provides a replicable and practical Bird Strike Risk Index, based on counts of birds on the airfield and does not require a large historical strike database to be used, which could be a useful approach for data scarce airports like JIA.

The regulatory response implemented around Lahore Airport in 2025 reflects the same underlying principle. Rather than prioritising technological deterrence measures, authorities focused on reducing off-airport attractants through stricter waste management and control of commercial activities likely to generate food waste. This approach is consistent with the wider wildlife hazard management literature, which identifies waste management and habitat modification as upstream, modifiable determinants of bird strike risk. Because these environmental conditions can be managed more directly than bird behaviour itself, they are widely regarded as key elements of effective, preventive wildlife hazard management.

2.4 Positioning of the Present Study

Previous studies of airport congestion, waste management and wildlife hazard management have tended to focus on one of these issues in isolation, and have been conducted largely at well-resourced airports in developed economies. Less attention has been given to the interaction between these operational challenges within the context of capacity constrained airports in the midst of infrastructure expansion, especially in developing countries where financial, institutional and land-use constraints reduce flexibility in airport operations.

This study makes a unique contribution to the literature in three ways. First, it does not consider the perception of congestion, waste management and birds strike risk as separate problems, but rather as a single integrated case. Second, it analyses these perceptions in the midst of an active infrastructure investment programme, giving concrete evidence on operational questions that can only be ignored during the expansion program of an airport. Third, the study, conducted at one airport, highlights some of the governance issues of airports with limited resources, such as the need to consider the quality of services of airport operations, environmental management and the mitigation of wildlife hazards as part of airport infrastructure planning.

Thus, this study is not only about the documentation of Jinnah International Airport but also it has used this case to highlight the potential of airport expansion projects to incorporate operational and environmental enhancements in addition to the physical construction in developing country settings.

3. Research Methodology

The study was conducted in JIA using a mixed method, single case design: A cross sectional passenger survey conducted in JIA and one semi structured interviews conducted with the Deputy Airport Manager (Operations) of JIA and Capt Shahbaz who is the pilot of AirSial in December 2024. The design is exploratory and descriptive. It was not intended, and should not be read, as a hypothesis testing or causally inferential study. The data collection was started after obtaining approval from the project supervisor at KIET University and permission from the management of Jinnah International Airport.

3.1 Passenger Survey

A self-administered, 20 item Likert style survey (strongly disagree to strongly agree) was given to a convenience sample of JIA

passengers on 15-24 December 2024, and 93 valid and complete responses were received. Questions Q1 to Q4 addressed operational efficiency and terminal layout, questions Q5 to Q7 dealt with waste management, questions Q8 to Q11 focused on the perception of bird strike and wildlife management and questions Q12 to Q15 discussed environmental sustainability, while questions Q16 to Q20 were related to the amenities and comfort provided to the passengers. Demographic data recorded age, gender, trip frequency and purpose and overall experience rating; an open-ended question also asked respondents to state which of five areas (passenger flow, facilities, cleanliness, safety, or other) required improvement the most.

No formal sampling frame was established, there is no sample rate because the total number of passengers approached is unknown and no non-response analysis is possible. Prior to administration, the instrument was not piloted, but was evaluated for internal consistency following collection with a Cronbach's alpha of 0.88 for all 20 items and a range of subscale alphas from 0.63 (bird strike and wildlife management) to 0.75 (operational efficiency). The instrument as a whole fare well with the criterion, and the bird strike subscale is just below the acceptable threshold, which is not surprising as it blends the perceived risk with the perceived response to airport by the birds, two somewhat different sets of constructs. This statistic only applies to the internal consistency of the instrument; it does not apply to content or construct validity because it was not tested against an external criterion.

3.2 Interview

Two semi-structured interviews were held to gain complementary operational perspectives on the issues addressed in this study. The first interview was with the

Deputy Airport Manager (Operations) at Jinnah International Airport and the second interview was with an AirSial captain who frequently had flights to and from Jinnah International Airport.

The interviewees were chosen purposively as they represented two critical stakeholder groups associated with airport operations, that is, the airport management and flight operations. The interviews covered four general areas: operational efficiencies and terminal layouts, waste management, bird strike/wildlife management and sustainability programs. The interviews were held face to face with the participants, and the results were recorded in a written format. The interviews were not analysed as a separate qualitative study, but rather were utilized to support operational perspective, which placed the findings of the passenger survey into context and compared with it.

The qualitative dimension is exploratory and illustrative in nature, not aimed at the thematic saturation. No formal coding framework, qualitative analysis software or inter-rater reliability procedures were used and there is no claim of formal thematic analysis. The evidence from the interviews is then presented descriptively to serve to confirm, explain and/or, if applicable, to contrast with the quantitative survey results. This method is similar to the use of key informants in exploratory transport policy case studies where interviews are conducted to either freshen the interpretation of quantitative or documentary data rather than to produce an independent qualitative theory.

3.3 Analysis

Data obtained from the surveys was analyzed descriptively using frequencies, percentage, mean and standard deviation for 93 passengers. In some cases, the internal consistency reliability was estimated by Cronbach's alpha. The exploratory nature of the study and the convenience sampling did

not call for statistical generalisation to the wider passenger population but for describing the perceptions of passengers. Therefore, no causal and predictive analysis was conducted, and the results obtained must be considered as a preliminary measure of passenger perception at Jinnah International Airport during the period of the study.

3.4 Ethical Considerations and Data Handling

Participation in both the survey and interviews were voluntary. All respondents' names have been removed from the working data set used for this analysis, and all descriptive and reliability statistics presented here were derived from the Likert item responses only; no field is available in the analysis file to identify an individual respondent. There are also a few inconsequential, off-topic responses in the free text section of the data, especially in the travel purpose field, reflecting the convenience sample of respondents recruited through the authors' personal and social networks rather than an intercept process (see Section 6 for a full disclosure of this as a limitation on data quality).

Data collection was not carried out as part of an ethics board approved research protocol therefore formal institutional ethical approval is not obtained, and future data collection for intended publication in a peer reviewed journal should obtain prior approval from an ethics board.^{[17][18][19]} Data on airport development and operational projects were gathered from public documents, announcements and official reports. These secondary sources have been consulted only as a background to context and have not been analysed as research data.

4. Findings

4.1 Respondent Profile

Respondents were almost evenly split by gender (49.5 percent male, 49.5 percent

female, with 1.1 percent preferring not to disclose gender; Table 1). The sample skewed young: 61.3 percent were aged 18 to 25, 22.6 percent were 26 to 35, 7.5 percent were 36 to 50, and 5.4 percent were 50 or older, with 3.2 percent under 18. Most respondents were occasional (45.2 percent) or rare (38.7 percent) travellers through JIA, with only 16.1 percent describing themselves as frequent travellers. The main travel motive was leisure (66.7 percent); business travel was the second highest at 15.1 percent; and 18.3 percent indicated other travel motives, such as traveling for family reasons, transit, and pilgrimage. The overall experience rating

Table 1: *Respondent Demographics (N = 93)*

Characteristic	n	%
Gender: Male	46	49.5
Gender: Female	46	49.5
Gender: Prefer not to say	1	1.1
Age: Under 18	3	3.2
Age: 18 to 25	57	61.3
Age: 26 to 35	21	22.6
Age: 36 to 50	7	7.5
Age: 50 and above	5	5.4
Travel frequency: Occasional	42	45.2
Travel frequency: Rare	36	38.7
Travel frequency: Frequent	15	16.1
Travel purpose: Leisure	62	66.7
Travel purpose: Business	14	15.1
Travel purpose: Other	17	18.3
Experience rating: Excellent	5	5.4
Experience rating: Good	24	25.8
Experience rating: Neutral	44	47.3
Experience rating: Poor	18	19.4
Experience rating: Very poor	2	2.2

Note. *Percentages within each characteristic may not sum to exactly 100 because of rounding.*

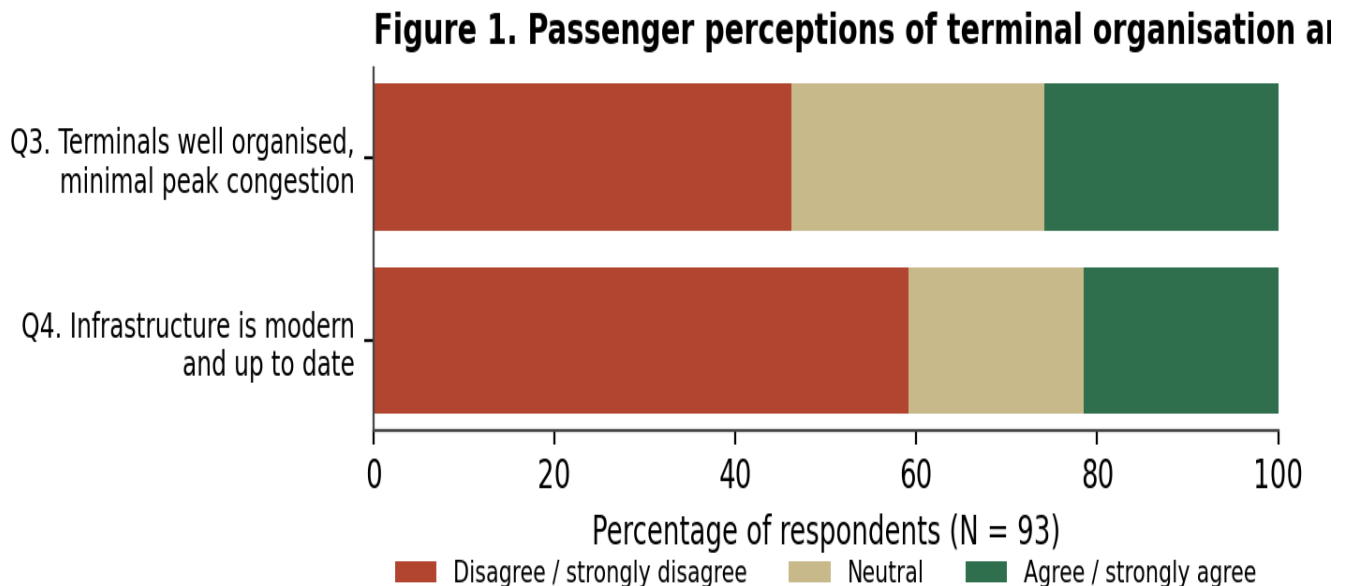
for the respondents at JIA was neutral to negative: 47.3 percent rated their experience as neutral, 25.8 percent of the respondents rated their experience as good, 19.4 percent rated their experience as poor, 5.4 percent as excellent and 2.2 percent as very poor. When asked which of five areas most needed improvement, the most common responses were facilities (57.0 percent), passenger flow (44.1 percent), cleanliness (39.8 percent), and safety (33.3 percent) (not a mutually exclusive group—percentages total more than 100).

4.2 Terminal Congestion and Infrastructure

Sentiment relating to the organisation of the terminals during peak periods was very negative. 46.2 per cent disagreed or strongly disagreed with the statement that terminals are well organised with minimal congestion during peak hours (Q3), while 28.0 per cent neither agreed nor disagreed, and 25.8 per cent agreed or strongly agreed. JIA's overall infrastructure was found to be less modern and up to date with international standards (Q4) with a more negative distribution (59.1 percent combining disagreement with 21.5

percent combined agreement and 19.4 percent neutral). Two other related items in Table 2 support this picture: opinion of the current runway layout to facilitate smooth passenger movement (Q1) was split closely, while whether runway capacity is adequate for flight volume (Q2) was the only infrastructure item with more than half of the combined agreement. When the two headline items Q3 & Q4 are combined, there is a consistent perception of a problem with the runway capacity and infrastructure strain, despite a somewhat more positive view of the runway capacity.

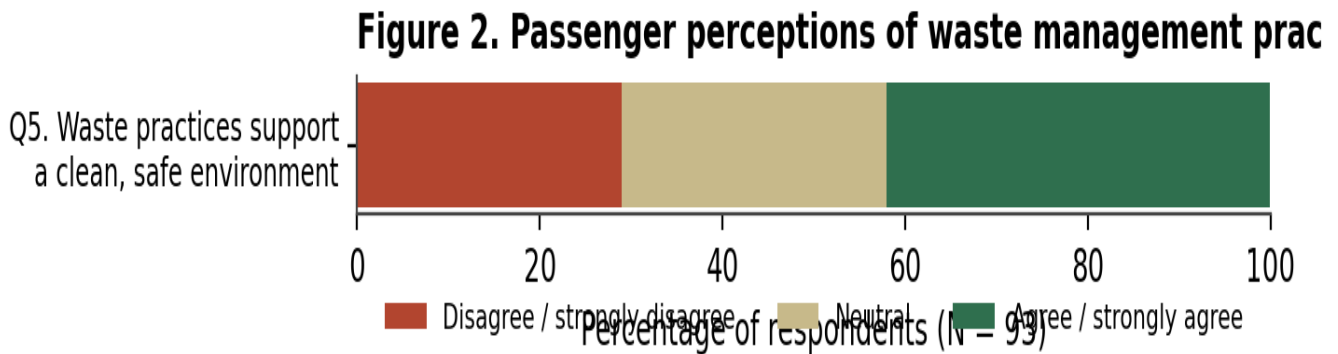
Figure 1: Passenger Perceptions of Terminal Organisation (Q3) And Infrastructure Modernity (Q4).



4.3 Waste Management

Perceptions of waste management practices were more divided than terminal congestion perceptions. On whether current waste practices contribute to a clean and safe environment (Q5), responses were close to evenly split three ways: 41.9 percent agreed or strongly agreed, 29.0 percent disagreed or strongly disagreed, and 29.0 percent were neutral. Two related items in Table 2 were

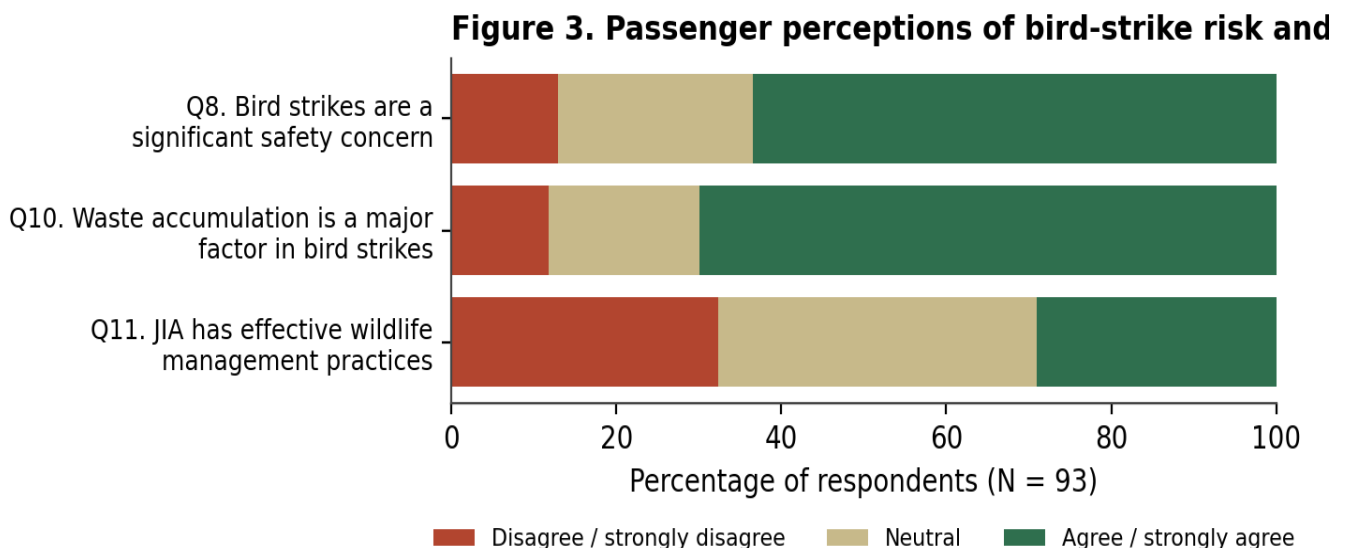
rated somewhat more favourably: 31.2 percent agreed that JIA has sufficient waste collection and recycling infrastructure (Q6), and 45.2 percent agreed that the airport's waste management system has a positive impact on the surrounding environment (Q7), suggesting perceptions of downstream environmental impact are somewhat more favourable than perceptions of the airport's basic waste infrastructure and processes.

Figure 2: *Passenger Perceptions of Waste Management Practices (Q5).*

4.4 Bird Strike Risk Perception

Bird strikes were widely perceived as a safety concern: 63.4 percent of respondents agreed or strongly agreed that bird strikes represent a significant threat to safety at JIA, against 12.9 percent combined disagreement and 23.7 percent neutral. The perceived link between waste accumulation and bird strike risk specifically was endorsed even more strongly: 69.9 percent combined agreement that waste accumulation near the airport is a major contributing factor to bird strikes,

against 11.8 percent combined disagreement. Confidence in the airport's existing wildlife management precautions was comparatively low: only 29.0 percent agreed or strongly agreed that JIA has effective wildlife management practices, against 32.3 percent combined disagreement and 38.7 percent neutral, the largest neutral share of any item in this subscale and a plausible signal that many respondents simply do not know what precautions, if any, are in place.

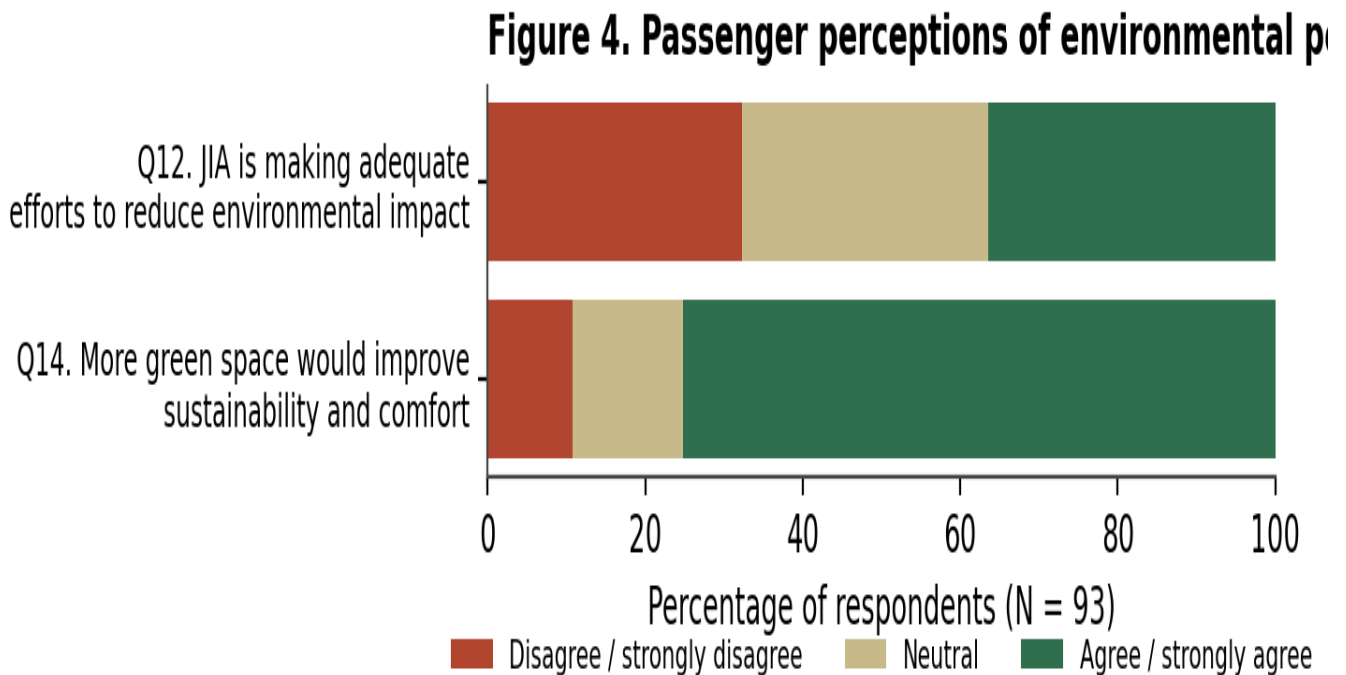
Figure 3: *Passenger Perceptions of Bird Strike Risk and Current Precautions (Q8, Q10, Q11).*

4.5 Sustainability and Green Space

The question of whether JIA is doing enough to minimize its environmental impact (Q12) had a truly mixed response, with 32.3 per cent disagreeing or strongly disagreeing, 36.6 per cent agreeing or strongly agreeing, and 31.2 per cent being neutral, a balance between agreeing and disagreeing rather than the all-pervading scepticism that might be expected from the disagreement figure alone. By contrast, the respondents were clearly and strongly in favour of an increase of greenery for JIA in particular: 75.3 % agreed that "More greenery around JIA"

would improve the sustainability and comfort for passengers, while 10.8 % disagreed. The two most strongly and consistently endorsed items in the entire instrument were two additional items in Table 2 that showed a positive endorsement: 75.3 percent agreed or strongly agreed that JIA should invest more in green initiatives (Q13) and 78.5 percent agreed or strongly agreed that JIA should implement eco-friendlier initiatives for long term sustainability (Q15).

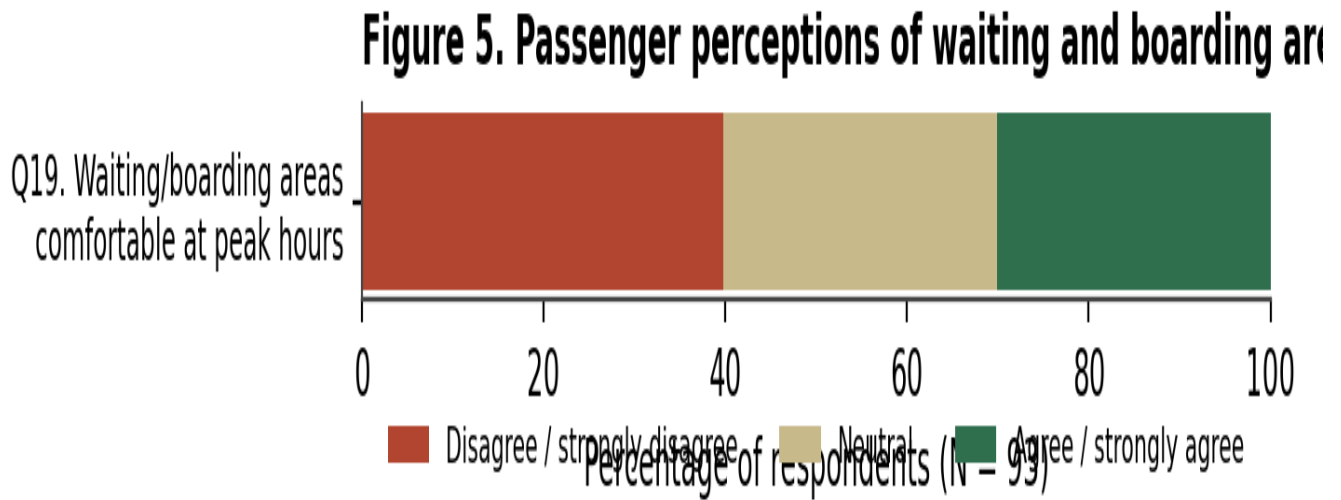
Figure 4: Passenger Perceptions of Environmental Performance (Q12) And Support for Green Space (Q14).



4.6 Waiting and Boarding Comfort

During peak hours (Q19), the level of comfort that passengers experience in waiting areas and on the platform when boarding or alighting was split and split evenly, with 39.8 percent disagreeing or being unsure of their

response, and 30.1 percent agreeing or neutral. This is a more real mixed finding than the congestion items mentioned above and indicates that dissatisfaction with the organisation of the terminals in general does not always lead to dissatisfaction with all the individual facilities.

Figure 5: *Passenger Perceptions of Waiting and Boarding Area Comfort During Peak Hours (Q19).*

4.7 Operational Perspective

Passenger traffic control at check in, security and boarding gates was the major day to day operational challenge at the airport, and measures implemented to overcome this include extra check in counters, self-service kiosks, increased waiting area capacity and a mobile application that will allow passengers to better manage their time at the airport so they do not arrive at the same time. Regarding Waste and Wasteful Management, the interviewee explained colour-coded segregated bins, scheduled collection and a particular attention on areas close to runways and terminals, and day and night

surveillance by a dedicated wildlife management team, particularly during the migration periods, using bird repellent measures and cooperation with the local environmental agencies. The interviewee explicitly associated food waste disposal in close proximity to the flight paths with the risk of attracting birds, which aligned with the survey respondents' perception and explained the current sustainability measures, energy efficient lighting, some solar installations and water saving measures as a good start but there is room for more further down the line, due to high initial costs and limited land in the area.

Table 2: Descriptive Statistics for All 20 Survey Items (N = 93)

Item	Mean	SD	% Dis.	% Neu.	% Agr.
Q1. Layout supports smooth passenger movement	3.04	1.07	33.3	31.2	35.5
Q2. Sufficient runway capacity for flight volume	3.40	0.93	19.4	26.9	53.8
Q3. Terminals well organised, minimal peak congestion	2.80	1.04	46.2	28.0	25.8
Q4. Infrastructure is modern and up to date	2.44	1.26	59.1	19.4	21.5
Q5. Waste practices support a clean, safe environment	3.08	1.07	29.0	29.0	41.9
Q6. Sufficient waste collection and recycling infrastructure	3.00	0.96	26.9	41.9	31.2
Q7. Waste system positively impacts surrounding environment	3.32	0.99	17.2	37.6	45.2
Q8. Bird strikes are a significant safety concern	3.68	1.04	12.9	23.7	63.4
Q9. Sufficient measures taken to prevent bird strikes	3.23	1.10	23.7	35.5	40.9
Q10. Waste accumulation is a major factor in bird strikes	3.78	1.04	11.8	18.3	69.9
Q11. JIA has effective wildlife management practices	2.97	0.97	32.3	38.7	29.0
Q12. JIA is making adequate efforts to reduce environmental impact	3.06	1.13	32.3	31.2	36.6
Q13. JIA should invest more in green initiatives	3.97	1.16	11.8	12.9	75.3
Q14. More green space would improve sustainability and comfort	3.99	1.15	10.8	14.0	75.3
Q15. JIA should implement more ecofriendly initiatives	4.05	1.06	10.8	10.8	78.5
Q16. Satisfied with amenities (restrooms, seating, restaurants)	2.96	1.19	39.8	21.5	38.7
Q17. Satisfied with cleanliness and environmental practices	2.90	1.11	33.3	34.4	32.3
Q18. Sufficient signage and directions for navigation	3.12	1.03	26.9	32.3	40.9
Q19. Waiting and boarding areas comfortable at peak hours	2.81	1.16	39.8	30.1	30.1
Q20. Improved efficiency and sustainability would enhance travel	3.85	1.17	14.0	15.1	71.0

Note. Scale: 1 = strongly disagree to 5 = strongly agree. Percent disagree and percent agree combine the strongly and non-strongly response categories; rows may not sum to exactly 100 because of rounding. n = 93 for every item.

Table 3: Internal Consistency Reliability by Subscale

Subscale	Items	n	Cronbach's alpha
Operational efficiency	Q1 to Q4	93	0.75
Waste management	Q5 to Q7	93	0.73
Bird strike and wildlife management	Q8 to Q11	93	0.63
Environmental sustainability	Q12 to Q15	93	0.74
Passenger experience and comfort	Q16 to Q20	93	0.74
Full instrument	Q1 to Q20	93	0.88

Note. Alpha of 0.70 or above is conventionally treated as acceptable and 0.80 or above as good. This statistic reflects internal consistency only; the instrument was not piloted or validated against an external criterion.

Table 4. Self-reported Priority Areas for Improvement (N = 93, Not Mutually Exclusive)

Area	n	%
Facilities	53	57.0
Passenger flow	41	44.1
Cleanliness	37	39.8
Safety	31	33.3
Other	7	7.5

Table 5: Discussion Points and Their Supporting Evidence

Discussion point (Section 5)	Survey items	Other evidence
Terminal congestion is a consistent, not isolated, perception	Q3, Q4; Table 4 (Facilities cited by 57.0%)	Corroborating item: Q16 (amenities, mean 2.96)
Waste and bird strike linkage is perceived and operationally corroborated	Q8, Q10, Q11	Interview (Section 4.7); PCAA airport wise incident data and 2025 waste control report (Section 5, paragraph 2)
Environmental performance and comfort Q12, Q19 are genuinely mixed, not uniformly negative		Contrasted with Q13 to Q15 (green space demand, all above 75% agreement)
Capital investment window is a low cost opportunity to embed waste and wildlife planning	Q13, Q14, Q15	PAA runway and ATC tower project timeline (Section 1); developing country SWM literature (Section 2.2)

Note. This table is provided for reviewer convenience and maps each discussion point to the specific items, tables, or external sources it draws on.

5. Discussion

Three points from this exploratory case merit

discussion in relation to the literature reviewed in Section 2.

First, the results on terminal congestion, although broad and indicative, are consistent with the international service quality literature that predicts that service quality problems during periods of high demand are a major cause of airline passenger dissatisfaction at congested hubs, and with the findings reported for Ninoy Aquino International Airport, another developing country hub of similar size. The commonality of this negative response on the independently worded items is that both the item that was worded directly to ask about congestion (Q3) and the more general item about the modernity of infrastructure (Q4) yielded majority disagreement; facilities was also the most frequently cited priority for improvement, particularly in the open-ended item (57.0 percent, Table 4), which aligned with the lowest mean score on the corresponding item (Q16, mean 2.96). This "cross-over" between the differently worded closed items and an open-ended item is a very weak signal of convergence that is a bit more convincing than any closed item separately, but it is not a representative estimate since there is no sampling frame to record. The results also highlight from a transport policy perspective that the expansion of airport infrastructure cannot be assessed only on the basis of the extension of the runway or the building of a terminal. During the process of upgrading an airport, operational efficiency and terminal functionality are still perceived as crucial aspects of airport performance. The use of passenger experience measures in infrastructure planning could then help airport operators decide on operational inefficiencies before they are institutionalized in new airport facilities.

Secondly, the relationship between waste and bird strikes that passengers notice, and the Deputy Airport Manager (Operations) described in a mechanistic way, is consistent with the mechanism described in the ICAO Eco Airport waste management guidance and

with the literature on wildlife hazard management in general, and consistent with the Lahore intervention discussed in Section 2.3, where off airport waste and vendor control were the primary, rather than secondary, response. This perception is not just attitudinal. According to a report submitted by Pakistan Civil Aviation Authority for the period 2018-2022, JIA recorded 192 bird strike incidents during these five years, which was the second highest figure among all other airports in Pakistan after Lahore with 198 bird strikes. JIA's Environmental Control Committee also reported that bird aircraft collisions at the airport had reduced by over 15 percent in 2024, citing habitat control measures, such as cleaning garbage collection points around the airfield and engaging the community by reaching out to the local residents. The figures in this report are derived from the trade press reports of PCAA or airport committee statements rather than from a primary incident level data set gathered for this study and therefore do not constitute a statistical relationship between waste proximity and the numbers of strikes reported at JIA, but do, however, back up and support (with real numbers of published incidents, and not just passenger opinion) that the bird strike is a significant issue and an actively managed problem at this particular airport, and that waste control is already recognised by airport management as one of the reasons for the reduction in the number of incidents. JIA's described practices and patrols, and repellents and segregated bins, were more akin to a reactive, operational risk management stance than to the more upstream, precautionary approaches of systematic habitat modification and buffer zone landscaping, or to the discursive, passenger facing risk communication practices that the international literature considers to be layers of a mature wildlife hazard programme. This reactive posture interpretation is supported by passengers' relatively low level of trust in

current precautions (29.0 percent combined agreement, Section 4.4) and the high neutral answer rate on the question (38.7 percent). This study did not also get the primary, incident by incident dataset from JIA or from Pakistan Civil Aviation Authority (PCA) coded for proximity of waste sites, season or weather, therefore the causal mechanism itself, rather than its plausibility, remains unproven, and the recommendation to get such dataset in Section 7 still stands. The findings also demonstrate the need to incorporate waste management into aircraft safety policy. Preparation for wildlife hazards is typically considered a pre-emptive operational task, but with this case, the management of the environment and waste could also be part of an airport safety strategy. In cases of airports with financial and institutional limitations, the enhancement of the waste management practice may be a comparatively low cost alternative to conventional bird deterrence.

Thirdly, the result of the environmental performance and the green space studies narrows rather than widens the focus of the practical observation that is central to the paper. Respondents are not uniformly unhappy with the current performance of JIA's environment (Q12), or with waiting and boarding comfort (Q19), which is close to a three-way split. They agree highly on support for more green space and eco-investment (Q13–Q15) in one of the most consistent results in the entire data set, with more than 75 percent of the combined agreement on each of these three items. But it is important that the preference is practical, apart from its statistical significance. JIA is currently in the middle of a runway expansion project and is now starting to construct a new air traffic control tower and rescue and firefighting station. Such windows of opportunity for capital investment are known in the airport management literature as a time when wildlife hazard planning and waste management can be integrated into the

broader infrastructure programme rather than planned as separate workstreams to be tackled at a later stage in the programme; the wider literature on solid waste management in developing countries highlights fragmented and siloed planning as a recurring challenge for improvement. Passengers' consistent and compelling signal of preference for more green space is a readily actionable indicator that landscaping choices made at this stage of the project—when the site is in active construction, may simultaneously contribute to the goals of sustainability and wildlife hazard mitigation. However, it is provided here for consideration as a practical implication and is not a validated recommendation. Overall, the case illustrates how opportunities exist in the infrastructure investment window to incorporate sustainability goals during the design of airports. To gain operation and financial efficiencies, airport management can incorporate waste management, green infrastructure, and wildlife hazard mitigation from project inception.

6. Limitations

There was no sampling frame, calculation of the response rate or bias assessment for non-responses, so the results are limited in their representativeness even with respect to JIA's own passenger population.

There was no piloting of the survey instrument before it was administered. Overall, internal consistency was acceptable ($\alpha = 0.88$), and acceptable for four of five subscales, though the bird strike subscale had an alpha of 0.63 which was just below the commonly accepted standard for content and construct validity, and internal consistency is not a proof of content or construct validity.

A small number of open text responses in the dataset are facetious, rather than substantive, most prominently in the field on travel purpose. This is consistent with the methodology of recruitment based on

personal and social networks as opposed to a controlled intercept methodology, and it raises the reasonable question of the seriousness of engagement among at least some respondents, although the closed ended Likert items (as opposed to free text) are less prone to the failure mode of recruitment for this reason.

Qualitative evidence was obtained by means of two semi-structured interviews, one with the airport management and the other with the flight operations. These interviews gave some different operational views, but are not an account of stakeholder views in which the themes are explored in depth. Formal thematic analysis was not used for the interviews and a descriptive analysis was instead performed. [L]
[SEP]

No primary, incident by incident bird strike data was available from JIA or Pakistan Civil Aviation Authority. Published incident counts (Section 5) indicate that bird strikes are a significant issue at JIA, one which is actively monitored by airport management, and that there has been a decrease in bird strikes in recent years at the site, but the aggregate data is provided by the trade press on the basis of official data provided by airport management, and does not form the basis of the tests undertaken in this paper for the prediction of strike frequency at JIA, as a function of proximity to waste sites, season or weather. However, the central tenet of the theory that waste brings birds into the vicinity of JIA is supported by actual published figures of incidents and by the testimony of staff, but not by this study by itself against a primary incident record.

The design is cross sectional and single case. No statements of cause and effect are made or implied and no claims of generalisability to other airports can be made. [L]
[SEP] The study was carried out as a part of the approved undergraduate research project at Karachi Institute of Economics and Technology (KIET). Airport management gave permission

for conducting the study at Jinnah International Airport. The passenger survey and both semi-structured interviews were voluntary and informed consent was obtained before the data collection.

No personal information was solicited or stored from survey respondents. In order to maintain confidentiality, the Deputy Airport Manager (Operations) has been anonymised however, the Airport Manager (AirSial) consented to his name and professional affiliation being used in this study. Passenger perceptions of a waste and bird strike link are consistent with the documented mechanism in the published literature, but are not evidence based in JIA and should not be used as a substitute for ecological or incident based evidence.

In view of these constraints, the paper is placed in a context of exploratory case study suitable for a case study format outlet like Case Studies on Transport Policy, where empirical material documenting field experiences and operational detail is welcome without the inferential apparatus of statistics and/or the novelty of theory as is required in a hypothesis testing study. It is not disposed to sit, and should not sit, in a journal that would normally expect documented probability sampling or causal inference and the question above about consent and dealing with data is not a caveat to be disclosed in the journal but an assumption to be met before it is submitted.

7. Recommendations for Future Research

Define a sampling frame and determine a response rate for any future JIA passenger survey. This dataset has no documentation of a sampling frame or response rate, and sample size and internal consistency statistics are now available for this data set and should be given careful consideration when replicating it.

Record several interviews across the stakeholder types covered by the stakeholder's concerns pertaining to terminal

operations, waste management, and wildlife management, using a code book and preferably with a second coder for a true thematic analysis.

Get incident level bird strike data from Pakistan Civil Aviation Authority and use the data to test not to presume the significance of proximity to the waste site and seasonal and weather related factors predicting the frequency of bird strikes at JIA specifically.

In the future, seek institutional ethics review before any data collection is to be published in a peer reviewed article, and do not ask for an optional name field or other information that will identify the individual in any future survey instruments without having an established consent and data management agreement first.

Adopt a risk index method based on the number of strikes, like the Bird Strike Risk Index method, that doesn't need a big historical strike database and can perhaps be implemented at a data sparse airport like JIA.

8. Conclusion

This exploratory case study uses a verified sample of 93 passenger respondents and two staff interviews to document the perceptions of passengers and staff about the congestion in the terminal, waste management and bird strike risk at Jinnah International Airport during the period of active infrastructure investment at the airport. A high level of public discontent was reported regarding the congestion and modernity of the terminals, and a high level of public perception that airport adjacent waste is related to bird strike risk, which was confirmed in mechanism, but not in statistical weight, by the Deputy Airport Manager (Operations)'s

independent account of current wildlife management practice. Those found to be more mixed in their perceptions of JIA's environmental performance and waiting area comfort were more genuine, while the most consistent and strongly positive was support for more green space and eco-friendly investment in the data set as a whole. These findings are presented with explicit limitations, convenience sampling, two interviews, no incident level data on bird strikes, and an unresolved question of the handling of the participant data that must be resolved prior to sharing this data further.

The practical effect of this paper is not as broad as a theoretical one, but just as concrete and less nuanced: it provides a citation worthy, albeit provisional sign for PCAA and JIA management to know that there are areas of relative tolerance for passengers (e.g. environmental information, comfort on board) and areas of clear convergence of demand (e.g. investment in green space, facilities upgrading) which are precisely at the moment that runway and terminal works are being implemented, and landscaping and site planning decisions remain open. This is in accordance with the general guidance in the literature on making airport sustainability in developing countries and is far more economical to implement before the concrete is laid than once it is completed. For researchers, it's a protocol, which has been tried and tested and found to have specific and nameable flaws, a sampling frame, an ethics review, incident data, multiple informants, and which the next study at JIA or a similar centres can borrow wholesale without having to develop it from the ground up.

References

Altringer, L., Begier, M. J., Washburn, J. E., & Shwiff, S. A. (2024). Estimating the impact of airport wildlife hazards management on realized wildlife strike risk. *Scientific Reports*,

14, 29018. <https://doi.org/10.1038/s41598-024-79946-3>

Aslam, M. (2025, December 5). Explained: How airports manage wildlife hazards. *Airways Magazine*.

Baxter, G., Srisaeng, P., & Wild, G. (2018). An assessment of airport sustainability, Part 1: Waste management at Copenhagen Airport. *Resources*, 7(1), 21.

<https://doi.org/10.3390/resources7010021>

Business Recorder. (2025, June 4). Karachi Airport's main runway upgrade reaches 53%, says PCAA.

Daily Times. (2025, May 22). Karachi Airport cuts bird strike incidents by 15%, downward trend continues in 2025.

Dawn. (2025, November 28). New air traffic control tower to be built at Karachi's Jinnah International Airport.

International Civil Aviation Organization. Waste management at airports. *Eco Airport Toolkit*.

Mehta, D. (2022, July 4). Industry issue: 30 PIA aircraft have had bird strikes this year. Simple Flying. (Reporting Pakistan Civil Aviation Authority and Pakistan International Airlines data via ARY News.)

Ozbay, I., & Gokceviz, N. A. (2022). Towards zero waste airports: A case study of Istanbul Airport. *Journal of Material Cycles and Waste Management*, 24(1), 134 to 142. <https://doi.org/10.1007/s10163-021-01308-2>

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12 to 40.

Pitt, M., & Smith, A. (2003). Waste management efficiency at UK airports. *Journal of Air Transport Management*, 9(2), 103 to 111. [https://doi.org/10.1016/S0969-6997\(02\)00063-7](https://doi.org/10.1016/S0969-6997(02)00063-7)

Teunizen, A. M., van Gasteren, H., & Krijgsveld, K. L. (2025). A practical method to assess bird strike risk in air operations using a count based risk mitigation tool. Risk Analysis.

<https://doi.org/10.1111/risa.70101>

The Nation. (2025, February 1). Karachi airport being upgraded.

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