

**A SUSTENANCE AND GROWTH MODEL FOR REGIONAL
AIRPORTS IN INDIA**

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**DEPARTMENT OF CIVIL ENGINEERING
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**A SUSTENANCE AND GROWTH MODEL FOR REGIONAL
AIRPORTS IN INDIA**

by

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Submitted

In fulfilment of the requirements of the degree of Doctor of Philosophy

to the



INDIAN INSTITUTE OF TECHNOLOGY DELHI

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Dedicated to

My parents, husband, and son.

CERTIFICATE

This is to certify that the thesis entitled “**A sustenance and growth model for regional airports in India**”, being submitted by **Ms. Nivea Thomas** to the Indian Institute of Technology Delhi for the award of the degree of **Doctor of Philosophy** is a bonafide record of the research work carried out by her under my supervision and guidance. The thesis work, in my opinion, has reached the requisite standard, fulfilling the requirements for the degree of Doctor of Philosophy.

The contents of this thesis, in full or in parts, have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Air travel is the fastest mode of transportation, giving it the ability to stretch access and mobility to remote areas, overcoming challenges of geography and topography. It is for these reasons that India has an extensive air transportation sector. The Indian aviation sector has experienced tremendous growth in the past few decades with deregulation, liberalization, and privatization. But the enormous demand for air travel has not been complemented by an equivalent increase in supply in India. A burgeoning population, developing economy, and growing middle class have put a massive strain on the major airports. As a result, the airport infrastructure is forced to stretch far beyond its existing capacities. This is where regional airports could help by alleviating traffic congestion in hub airports. Their efficient management could better exploit the existing airport infrastructure.

Despite India being the third-largest domestic civil aviation market globally and having massive potential due to its geographical spread, little research has been conducted on regional aviation. The regional airports are growing and relatively under-utilised due to inadequate infrastructure and limited demand. Although the new regional aviation policy in India-Regional Connectivity Scheme has connected regional and major airports, only around 40% of the routes allocated are operational after four rounds of bidding because airlines skip the majority of routes due to poor demand and infrastructural constraints. To address this problem, a structured approach is devised to evaluate the regional airports in India and sustain them through four objectives.

The first objective identified the driving factors for sustaining regional airports through literature review and expert opinion. A hierarchical model was developed amongst the factors. The population of the region, national subsidies, and airport infrastructure development have been found to be the strongest drivers for promoting regional airports. The identified driving factors point towards three criteria for the sustenance and growth of regional airports-demand,

efficiency, and profitability. The air traffic demand of Indian regional airports was analyzed in the second objective. The results highlighted that distance to the nearest airport and accessibility of the airport significantly affected traffic volumes in regional airports. The efficiency assessment in the third objective emphasized that most airports have increasing returns to scale. This implies that the landside and airside capacity of the airports needs to be upgraded with the growth in demand. Determining the efficiency of regional airports is critical because it helps in investigating existing airport problems, evaluating current airport performance, and developing strategies and action plans for improving efficiency. The factors which had a significant impact on the efficiency scores were distance to the closest airport, distance from the city centre, per capita income, accessibility, and profitability of the airport. The productivity growth of the sample airports over the same period was also calculated using Malmquist Productivity Index.

The effect of possible determinants on regional airport profits and revenue was studied in the fourth objective. Regional airports can expand their profits and revenue primarily by increasing domestic and international passenger flow. Lower levels of seasonality contribute to airport revenue. Airport capacity utilisation has a favourable and considerable impact on airport profits but not airport revenue. Civil enclaves and the number of direct connections substantially affect airport profits. These four objectives contribute towards the sustenance and growth of regional airports and provide managerial implications to policymakers and regional airport operators.

Keywords: Regional airports, sustenance, demand, efficiency, profitability.

सारांश

हवाई यात्रा परिवहन का सबसे तेज साधन है, जो इसे भौगोलिक और स्थलाकृति की चुनौतियों पर काबू पाने के लिए दूर-दराज के क्षेत्रों तक पहुंचना और गतिशीलता प्रदान करने की क्षमता प्रदान करता है। इन्हीं कारणों से भारत में व्यापक हवाई परिवहन क्षेत्र है। भारतीय विमानन क्षेत्र ने पिछले कुछ दशकों में विनियमन, उदारीकरण और निजीकरण के साथ जबरदस्त वृद्धि का अनुभव किया है। लेकिन हवाई यात्रा की भारी मांग को भारत में आपूर्ति में समान वृद्धि से पूरा नहीं किया गया है। बढ़ती आबादी, विकासशील अर्थव्यवस्था और बढ़ते मध्यम वर्ग ने प्रमुख हवाई अड्डों पर भारी दबाव डाला है। नतीजतन, हवाई अड्डे के बुनियादी ढांचे को अपनी मौजूदा क्षमताओं से कहीं अधिक विस्तार करना पड़ता है। इस सठिठी में हब हवाई अड्डों में यातायात की भीड़ को कम करके के लिए क्षेत्रीय हवाई अड्डे मदद कर सकते हैं। उनका कुशल प्रबंधन मौजूदा हवाई अड्डे की प्रणाली को बेहतर कर सकता है।

भारत विश्व स्तर पर तीसरा सबसे बड़ा घरेलू नागरिक उड्डयन बाजार होने और इसके भौगोलिक विस्तार के कारण व्यापक क्षमता होने के बावजूद, क्षेत्रीय विमानन पर बहुत कम शोध किया गया है। अपर्याप्त बुनियादी ढांचे और सीमित मांग के कारण क्षेत्रीय हवाई अड्डे अपेक्षाकृत कम उपयोग हो रहे हैं। यद्यपि भारत-क्षेत्रीय कनेक्टिविटी योजना में नई क्षेत्रीय विमानन नीति ने क्षेत्रीय और प्रमुख हवाई अड्डों को जोड़ा है, आवंटित मार्गों में से केवल लगभग 40% मार्ग चार दौर की बोली के बाद परिचालन कर रहे हैं क्योंकि एयरलाइनें खराब मांग और बुनियादी ढांचे की बाधाओं के कारण अधिकांश मार्गों को छोड़ देती हैं। इस समस्या का समाधान करने के लिए, भारत में क्षेत्रीय हवाई अड्डों का मूल्यांकन करने और उन्हें चार उद्देश्यों के माध्यम से बनाए रखने के लिए एक संरचित दृष्टिकोण तैयार किया गया है।

पहले उद्देश्य ने साहित्य समीक्षा और विशेषज्ञ राय के माध्यम से क्षेत्रीय हवाई अड्डों को बनाए रखने के लिए ड्राइविंग कारकों की पहचान की। कारकों के बीच एक पदानुक्रमित मॉडल विकसित किया गया था। क्षेत्रीय हवाई अड्डों को बढ़ावा देने के लिए क्षेत्र की आबादी, राष्ट्रीय सब्सिडी और हवाई अड्डे के बुनियादी ढांचे के विकास को सबसे मजबूत ड्राइवर के रूप में पाया गया है। पहचान किए गए कारक क्षेत्रीय हवाई अड्डों के निर्वाह और विकास के लिए तीन मानदंडों की ओर इशारा करते हैं- मांग, दक्षता और लाभप्रदता। दूसरे उद्देश्य में भारतीय क्षेत्रीय हवाई अड्डों की हवाई यातायात मांग का विश्लेषण किया गया। परिणामों ने उजागर किया कि निकटतम हवाई

अड्डे की दूरी और हवाई अड्डे की पहुंच ने क्षेत्रीय हवाई अड्डों में यातायात की मात्रा को महत्वपूर्ण रूप से प्रभावित किया। तीसरे उद्देश्य में दक्षता मूल्यांकन ने इस बात पर बल दिया कि अधिकांश हवाईअड्डों के पैमाने पर प्रतिफल बढ़ रहा है। इसका तात्पर्य यह है कि मांग में वृद्धि के साथ हवाईअड्डों की भूमि और यातायात मार्गों की क्षमता को उन्नत करने की आवश्यकता है। क्षेत्रीय हवाई अड्डों की दक्षता का निर्धारण महत्वपूर्ण है क्योंकि यह मौजूदा हवाईअड्डे की समस्याओं की जांच करने, वर्तमान हवाईअड्डे के प्रदर्शन का मूल्यांकन करने और दक्षता में सुधार के लिए रणनीति और कार्य योजना विकसित करने में मदद करता है। दक्षता स्कोर पर जिन कारकों का महत्वपूर्ण प्रभाव पड़ा, वे निकटतम हवाई अड्डे से दूरी, शहर के केंद्र से दूरी, प्रति व्यक्ति आय, पहुंच और हवाई अड्डे की लाभप्रदता थे। इसी अवधि में कुछ हवाई अड्डों की उत्पादकता वृद्धि की गणना भी मालमक्विस्ट उत्पादकता सूचकांक का उपयोग करके की गई थी।

चौथे उद्देश्य में क्षेत्रीय हवाई अड्डे के मुनाफे और राजस्व पर संभावित निर्धारकों के प्रभाव का अध्ययन किया गया। क्षेत्रीय हवाईअड्डे मुख्य रूप से घरेलू और अंतरराष्ट्रीय यात्री प्रवाह को बढ़ाकर अपने लाभ और राजस्व का विस्तार कर सकते हैं। हवाईअड्डे के राजस्व में मौसम का भी योगदान है। हवाई अड्डे की क्षमता के उपयोग का हवाई अड्डे के मुनाफे पर अनुकूल और काफी प्रभाव पड़ता है, लेकिन हवाई अड्डे के राजस्व पर नहीं। सिविल एन्क्लेव और सीधे कनेक्शनों की संख्या हवाईअड्डे के मुनाफे को काफी हद तक प्रभावित करती है। ये चार उद्देश्य क्षेत्रीय हवाई अड्डों के निर्वाह और विकास में योगदान करते हैं और नीति निर्माताओं और क्षेत्रीय हवाई अड्डे के संचालकों को प्रबंधकीय प्रभाव प्रदान करते हैं।

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LIST OF ABBREVIATIONS

AAI	Airports Authority of India
AERA	Airports Economic Regulatory Authority
AIP	Airport Improvement Program
ANS	Air Navigation Services
ANSP	Air Navigation Service Providers
AOC	Air Operator's Certificate
APAO	Association of Private Airport Operators
ASGC	Australian Standard Geographical Classification
ASKM	Available Seat Kilometres
ATF	Aviation Turbine Fuel
CAGR	Compound Annual Growth Rate
CISF	Central Industrial Security Force
CLD	Causal Loop Diagram
CRS	Constant Returns to Scale
CUTE	Common User Terminal Equipment
DEA	Data Envelopment Analysis
DGCA	Directorate General of Civil Aviation
DMU	Decision-Making Units
DRS	Decreasing Returns to Scale
DTTIPL	Deloitte Touche Tohmatsu India Private Limited
EAS	Essential Air Services
FDI	Foreign Direct Investment
FSC	Full-Service Carriers
GDP	Gross Domestic Product

IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IRS	Increasing Returns to Scale
ISM	Interpretive Structural Modeling
LCC	Low-Cost Carriers
LFG	Load Factor Guarantee
LPH	Landing, Parking, and Housing
MoCA	Ministry of Civil Aviation
MPI	Malmquist Productivity Index
MPPA	Million Passengers Per Annum
MRO	Maintenance, Repair, and Overhaul
NCAP	National Civil Aviation Policy
NSSO	National Sample Survey Office
NTDPC	National Transport Development Policy Committee
PFC	Passenger Facility Charges
PLF	Passenger Load Factor
PPP	Purchasing Power Parity
PSF	Passenger Service Fee
PSO	Public Service Obligations
RAS	Rural Air Services
RASS	Remote Air Service Subsidy
RCF	Regional Connectivity Fund
RCS	Regional Connectivity Scheme
RDG	Route Dispersal Guidelines
RNFC	Route Navigation and Facilitation Charges

SFA	Stochastic Frontier Analysis
SSIM	Structural Self-Interaction Matrix
TFP	Total Factor Productivity
TISM	Total Interpretive Structural Modeling
TNLC	Terminal Navigation Landing Charges
UDAN	Ude Desh Ka Aam Nagrik (Let the common citizen of the country fly)
UDF	User Development Fees
VAT	Value-Added Tax
VFR	Visual Flight Rules
VGF	Viability Gap Funding
VIF	Variance Inflation Factor
VRS	Variable Returns to Scale