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# Evolution of Indian Border Security Management: Technological Advancements and Policy Initiatives

Tahir Musta<sup>1</sup>, Md. Shahnawaz Abdin<sup>2</sup>, Matloob Hasan<sup>3</sup>

## ABSTRACT

India's expanding economy and complex 15,106.7 km border with seven neighbouring countries - Bangladesh, China, Pakistan, Nepal, Myanmar, Bhutan, and Afghanistan - pose unique challenges in border security. This is an extant review of the existing literature that builds on previous studies which suggest that with long and diverse boundary, often lacking natural demarcations, makes it vulnerable to illegal migration, smuggling, trafficking, and the circulation of counterfeit currency. The study found that as a policy matter, the Indian government is taking major initiatives to build a robust and modern border management infrastructure as it shares its borders with the neighbours with whom the country has historically a range of conflicts. As a critical policy tool to control infiltration, smuggling and illegal trade, the Indian government has initiated numerous projects to secure the borders, including fences, roads, floodlights, border posts, helipads, and footpaths, however, this fall short of the countermeasures to control the illegal activities at the borders.

Various studies have suggested that to enhance the security along the borders of the country, the Government of India is implementing several projects for the development of border infrastructure. Border management is a security function that calls for coordination and concerted action by various government agencies and the coordination of Central and State government to strengthen the border security. The recent development of the newly-formed West Bengal government's initiative to hand over the acquired land to Border Security Forces (BSF) for fencing using barbed wires and deployment of modern surveillance tools alongside the West Bengal border is expected to facilitate both traditional and modern methods of securing the borders.

Globally, countries like the U.S. have pioneered "smart borders" using advanced technology to enhance security and streamline operations. These technologies, equipped with AI and sensors, operate autonomously and detect objects from great distances, providing real-time data to border agents. The Indian government is now exploring similar technologies, such as virtual fencing, satellite surveillance, and movement detection sensors, to address its border challenges.



**Keywords:** surveillance, border management, smart borders



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## INTRODUCTION

For every country in the world, the security of borders is of immense significance to protect the lives of its citizen, the sovereignty of the nation and also its economic stability. An efficient and effective management of the country's borders and its security essentially entails regulation and control of the movement of people and goods. The two basic principles that guide the management of the borders are the porousness of borders for legal trade and movement of people and the non-porousness of borders for illegal trafficking and illegitimate businesses that could impact the security of the region.

<sup>1</sup> Research Scholar, Department of Management, SMBS, Jamia Hamdard, Delhi, [tahir5683@gmail.com](mailto:tahir5683@gmail.com)

<sup>2</sup> Professor, Department of Management, SMBS, Jamia Hamdard, Delhi, [msabdin@jamiyahamdard.ac.in](mailto:msabdin@jamiyahamdard.ac.in)

<sup>3</sup> Assistant Professor, Department of Management, SMBS, Jamia Hamdard, Delhi, [matloob.2007@gmail.com](mailto:matloob.2007@gmail.com)

An effective border management of any country implies facilitating trade of commodities and legitimate travel between countries and simultaneously preventing illegal activities including human trafficking and migration, smuggling and infiltration of terrorists and insurgents ([FICCI, 2016](#)). The unauthorized crossings and movements poses major threats to the security of the nations and challenges the fundamental aspect of national defence.

### Defence expenditure and security of borders

For the security of the borders and for retaining sovereignty, globally, countries spend a sizeable proportion of their GDP on defence every year. Currently, in response to the changing global dynamics led by geopolitical events, notably the COVID-19 pandemic, the Russia-Ukraine war and the Israel-Gaza conflict, global defence expenditure reached a record high of USD 2.4 trillion in 2023, a 9% increase from the previous year ([Al Jazeera, 2024](#)). In the year 2021, global defence spending stood at USD 2.1 trillion, despite the economic ramifications of the pandemic. India was among the largest five spenders in 2021 along with the US, China, the UK, and Russia, which together accounted for 62% of the global defence expenditure.

India's defence spending was the fourth highest in 2023 and it was higher than China as a share of GDP. However, China spends over 3.5 times as much as India in absolute terms as it has a larger economy ([Arthur, 2024](#))

India has steadily increased its defence budget over the past four years, which reflects its strategic recalibrations, geopolitical shifts and economic challenges ([Bajpai et al., 2014](#)). The country's flagship "Atmanirbhar Bharat" initiative has been shaping its defence spending strategies. The security challenges especially the standoff at the Line of Actual Control, the caretaker government in Bangladesh, border tensions along Jammu and Kashmir and also its strategic focus on indigenous manufacturing of defence equipment underscores the country's commitment to strengthen its defence capabilities.

The two important factors that is playing a vital role in the increasing budgetary allocation by the Indian government on the security of international borders is the threat of terrorism and illegal migration and also the low volume of inter-regional trade. The government has kept the borders under-developed with the intention of making it easily inaccessible so that it could act as a buffer against conventional threats ([Das, 2021](#)). The South Asian Association for Regional Cooperation (SAARC), which was formed in 1998 to facilitate trade among the member countries including Pakistan, Bangladesh, Sri Lanka has almost lost its relevance. The volume of trade among the SAARC countries is as low as 5% of the total trade in the region.

### Historical conflicts with neighbouring countries

India shares a complex and very large border covering around 15,106.7 km as presented in Table I with adjacent countries including Bangladesh, China, Pakistan, Nepal, Myanmar and Bhutan, as well as a small portion with Afghanistan. ([Das, 2010](#)).

**Table 1:** Indian International Border with Adjacent Countries

Neighbouring Country	Border Length (km)	Dominant Terrain Type
Bangladesh	4,096.7	Riverine plains, deltaic terrain, wetlands
China	3,488	High mountains, glaciers, plateaus
Pakistan	3,323	Desert, plains, marshes, mountains
Nepal	1,751	Himalayan foothills, river plains
Myanmar	1,643	Hills, forests, mountain ridges
Bhutan	699	Himalayan mountains and valleys
Afghanistan	106*	High mountains

Source: Ministry of Home Affairs

Note: \*India recognizes a 106 km border with Afghanistan through the region currently under Pakistani control (Gilgit-Baltistan/PoK).

Historically, India's concerns related to the security of its borders have been shaped by conflicts with its neighbouring countries in the post-independence era. The Radcliffe Line, that demarcates India's boundary with Pakistan, and the McMahon Line, separating its border with China, have seen conflicts since its inception. The conflicts with Pakistan over the issue of Jammu and Kashmir, and its war with China in 1962 have underscored the significance of a strong border management ([Chester, 2017](#)). These historical events necessitates the need for building a robust border management infrastructure to monitor and control the illegitimate activities including cross-border terrorism, smuggling and illegal migration ([Singh, 2019](#)).

### ***Indo-China Border Issues***

India faces different set of challenges in its Northern borders with China. The two nuclear powers have serious differences related to the disputed territories of Aksai Chin and Arunachal Pradesh and frequent altercations along the international borders ([Banerjee, 2022](#)). The 4000-km Sino-Indian international border also known as the Line of Actual Control (LAC), which passes through unpopulated and difficult terrains witnesses many skirmishes and clashes and the most recent clashes occurred in the Galwan Valley in 2020, which claimed several lives from both the sides ([Joshi, 2022](#)). The two countries have been trying to resolve the border disputes through diplomatic channels, but are also strengthening their borders with increasing deployment of troops and strengthening its military infrastructure.

### ***Indo-Pakistan Border: Critical Challenges***

Along its western frontier, India faces more critical challenges along the borders sharing with Pakistan. India and Pakistan, the two countries, once a part of the Indian sub-continent, partitioned in 1947 but continues its bitterness of division and it is reflected in infiltration along the Line of Control (LoC) in Jammu and Kashmir. The defence expenditure along the LoC, if diverted to socio-economic activities, could have benefitted both the nations. There does not seem any possibility of resolution of the Kashmir conflict and this is also the reason that the South Asian region is the least integrated among all the regional trading blocks of the world ([Kuszevska, 2022](#)). However, Stanley Wolpert, in his book 'India and Pakistan: Continued Conflict or Cooperation' suggests that the conflict between the two countries could be resolved only through mutual cooperation, dialogue, trade, educational and cultural exchange and with support from the United Nations and SAARC countries.

### ***Indo-Bangladesh Border: Indian Government's Initiatives***

India shares its eastern border with Bangladesh, a country that carved its fortune as an independent nation after it separated from Pakistan in 1972. The instability in Bangladesh, run by a caretaker government, backed by the army after the ouster of the Prime Minister Sheikh Hasina Wajid ([Dutta, 2024](#)), did not bode well for India that shares its longest boundary with the country. Bangladesh hold general elections early in 2026 and is currently governed by Bangladesh Nationalist Party (BNP) with Mr. Tarique Rahman as Prime Minister of the country. However, India faces the critical issues of illegal migration, smuggling and human trafficking along the borders sharing with Bangladesh with data suggesting around 1100 infiltration attempts along the border in 2025 ([Rashid, 2025](#); [TBS Report, 2026](#)).

As a policy measure, the Central Government considers fencing its borders alongside West Bengal mandatory to curb cross-border infiltration, smuggling of cattle and fake currency and an overall method to strengthen its border security. Indian shares a border of 4097 kilometres with Bangladesh and West Bengal alone accounts for more than 54 percent (2200 kilometres) of this border as presented in Table II.

The major issue of permanent fencing along the borders of West Bengal is very challenging because of the fact that the major portion of the border passes through difficult terrains that include rivers, marshes and forests. Channing courses of the rivers and floodwater poses serious challenges to these efforts ([PIB, Ministry of Home Affairs, 2021](#)).

**Table 2:** India–Bangladesh Border Length by Indian States

Indian State	Border Length with Bangladesh (km)	Share of Total Border (%)
West Bengal	2,216.7	~54.1%
Tripura	856	~20.9%
Meghalaya	443	~10.8%
Mizoram	318	~7.8%
Assam	263	~6.4%

Source: Ministry of Home Affairs

As a security policy measure, the Central government is striving for complete fencing of this border using barbed wires to curb unfair practices. The acquisition and transfer of land to the Border Security Force for securing the borders falls under the purview of the state government. However, different political parties at the State and Central levels created challenges in the form of approvals, delays and transfer formalities. In January 2026, the Calcutta High court intervened to initiate the process of transferring the acquired land to the BSF ([Chattora, 2026](#)). Lately, in May 2026, the new state government of West Bengal led by Chief Minister Suvendu Adhikari took the decision in its first cabinet meeting to transfer land to the BSF within 45 days for fencing of borders adjoining the state. The Central government has allocated huge funds on this project and the allocation of land to BSF is likely to strengthen the much-needed requirement for barbed-wire fencing, deployment of surveillance technology and increased patrolling and monitoring ([Jayatri Nag, 2026](#)).

### Need for integrated approach to border management

Research studies suggest an integrated approach to border management. This could be viewed as a large set of activities aimed at solving the strategic challenges in border management. An integrated approach implies strong coordination among the stakeholders. There should be coordination between the defence ministry and the armed personnel. There should also be coordination among armed forces, ministries and other stakeholders responsible and competent to provide border management services. Also, as part of integrated border management, there should be international coordination, which means local, bilateral and multilateral coordination with neighbouring countries for issues pertaining to border management. A research study on India's International borders with Bangladesh and Myanmar, conducted by [Wahab \(2024\)](#) recommends deployment of advanced technological solutions coupled with multilateral cooperation with neighbouring nations. The findings of the study strongly support an integrated strategy that combines security measures with regional collaboration. ([Manoharan et al., 2020](#))

A research conducted by [Deutschmann et al. \(2023\)](#) suggests that economic inequality plays an important factor in border permeability i.e. the mobility of both humans and commodities. The countries that are densely populated and the countries that shares borders with high income inequality are more likely to witness increased mobility. The borders of very rich and very poor countries, for example, Europe and African countries have higher level of permeability than the American countries. The European region has the higher level of permeability, as suggested by this study, and it is in line with the region being the highly integrated regional block and the pioneer of free flow of goods and people across its borders.

Traditionally, India has relied on human patrols and physical barriers for border surveillance. The operational aspect of border management in India is primarily handled by paramilitary and specialized forces. The Border Security Force (BSF) oversees the India-Pakistan and India-Bangladesh borders, while the Indo-Tibetan Border

Police (ITBP) monitors the Sino-Indian frontier. Other forces, such as the Sashastra Seema Bal (SSB) and Assam Rifles, manage borders with Nepal, Bhutan, and Myanmar, respectively ([Ministry of Home Affairs, 2021](#)). These forces have been instrumental in maintaining vigilance across India's land borders.

However, the limitations of human-intensive methods, including susceptibility to fatigue, harsh environmental conditions, and vast unmanageable stretches of terrain, have driven the adoption of modern technologies ([Das, 2022](#)). The Indian government's policy measures are directed towards implementation of smart technologies for effective surveillance due to the difficult terrains, especially along the Indo-Bangladesh border ([Jamwal, 2004](#)).

### Technological advancements and smart borders

Over the past few years, many countries have invested heavily in 'smart border technologies' to enhance border security, improve efficiency, and streamline operations. Technological advancements have played a crucial role in modernizing India's border security management also. India introduced the concept of Comprehensive Integrated Border Management System (CIBMS), post the Balakot strikes for seamless integration of technologies in border management systems. The CIBMS integrates surveillance technologies such as thermal imaging, ground sensors, and drones to curb cross-border infiltration and smuggling ([Goel, 2020](#); [Press Information Bureau, 2019](#)). Drones and unmanned aerial vehicles (UAVs) further augment CIBMS by offering aerial surveillance and the ability to access difficult terrains, especially along the India-China and India-Pakistan borders ([Tyshchuk, 2024](#)).

A research study on the current Wireless Sensor Network (WSN) techniques related to intruder detection and border surveillance conducted by D. Arjun et al. in 2017 suggests that the conventional border patrolling lacks an integrated multi-sensing system. The study concluded that various technologies for surveillance and detection of human intruder movement is required in the different border scenarios: flat surface movement, river/pond crossing and dry leaves movement and WSN could be deployed for better results ([Arjun et al., 2017](#)).

Technological innovations in communication systems have also bolstered border surveillance. Real-time data transmission through secure networks ensures seamless coordination between field units and command centers. Mobile surveillance vehicles equipped with radar and communication systems enhance flexibility and responsiveness in border monitoring operations ([Kumar, 2024](#)). A study conducted by Siham Boukhalfa et al. in Algeria in 2022 proposed a border surveillance and security system for detection and tracking of intruders trespassing into the monitoring area along the border which triggers alerts and valuation necessary for the catch of efficient measurements in case of a threat. The system is based on the classification of the human gestures drawn from videos envoy by drones equipped with cameras and sensors in real-time. This particular technology enables the soldiers to watch the borders at each and every moment effectively and at low cost.

A qualitative research paper titled 'Technological Innovations In Border Surveillance: A look into India's China strategy' authored by [Kumar \(2024\)](#) suggests that technological advancements have transformed border security surveillance, allowing countries like India to take preventive measures to protect their borders. India's deliberate efforts to use advanced surveillance technologies demonstrate its commitment towards safeguarding its borders and upholding peace and stability along the border with China.

**Table 3:** Relevant Research Papers on Border Management

Title	Author(s)	Year	Key Findings
Technological Innovations in Border Management: The Case of India-Bangladesh Border	Jamwal, N. S.	2004	Highlights innovative technologies used for managing the India-Bangladesh border, focusing on security and efficiency.

A Model for International Border Management Systems	Ruth Ann Duggan	2008	Proposes a systems engineering approach to model and analyze border management systems, emphasizing the need for countries to understand border activities as integrated systems to enhance security and control.
Coordinated Border Management: From Theory to Practice	Erich Kieck	2010	Discusses institutional and practical border arrangements in various countries, highlighting strategies for implementing Coordinated Border Management (CBM) to improve efficiency and security at borders.
Border Management Modernization	Gerard McLinden, Enrique Fanta, David Widdowson, Tom Doyle	2011	Provides a comprehensive survey of key developments and principles for improving trade facilitation through modernized border management, offering policymakers guidance on reform strategies.
India's Border Security: Evolving Trends and Future Prospects	Bajpai, K., Basit, S., & Krishnappa, V.	2014	Analyzes trends in India's border security and provides a roadmap for future advancements.
Managing International Borders	Blas Nuñez-Neto, Edward Alden	2016	Proposes opportunities to strengthen security while improving the flow of legitimate travelers and goods, based on lessons from countries like Jordan, Saudi Arabia, Niger, and Morocco, emphasizing the balance between security and economic vitality.
Border Surveillance and Intruder Detection using Wireless Sensor Networks	D. Arjun, P. K. Indukala and K. A. U. Menon	2017	Describes the application of wireless sensor networks for intruder detection and border surveillance, highlighting current techniques and future research directions.
Border surveillance and intruder detection using wireless sensor networks: A brief survey	D. Arjun, P. K. Indukala, K. A. U. Menon	2017	Explores the use of wireless sensor networks for border surveillance, highlighting techniques for intruder detection.
Satellite Surveillance in India's Border Security Framework	Katara, S. K., & Pokhriyal, A.	2017	Examines the integration of satellite surveillance into India's border security strategy.
India's Borders: Challenges and Opportunities	Singh, K. D. P.	2019	Examines the strategic challenges and opportunities in managing India's diverse borders.
Illegal Border Cross Detection and Warning System Using IR Sensor and Node MCU	Afsana Tasnim, Shawan Shurid, AKM Bahalul	2020	Introduces a system utilizing infrared sensors and Node MCU for detecting illegal border crossings, providing real-time alerts to enhance border security.
Automatic Border Surveillance Using Machine Learning in Remote Video Surveillance Systems	Ayush Goyal, et al.	2020	Develops a machine learning-based approach for automatic detection of intrusions in remote video surveillance systems, enhancing the capability to monitor and secure border areas.
Cybersecurity Challenges in Border Surveillance Systems	Goel, S.	2020	Discusses the increasing cybersecurity risks in border surveillance systems and offers strategies to mitigate them.

Border and Conflict Management in South Asia	Bajpai, K.	2020	Explores border and conflict management challenges in South Asia, focusing on India's strategies.
Border Area Development Programs: Strategic Imperatives for India	Manoharan, N., Saravanan, D., Saini, V., & Karnatak, S.	2020	Highlights the importance of development programs in enhancing border security and fostering regional stability.
Risk Assessment in the Face-based Watchlist Screening in e-Border	Kenneth Lai, Svetlana N. Yanushkevich, Vlad Shmerko	2020	Introduces a cost-based model for traveler risk assessment in automated border control systems using facial recognition technology, aiming to mitigate misidentification and impersonation issues in e-border scenarios.
Cross-Border Terrorism and India's Counter-Strategies	Das, P.	2021	Discusses India's approach to countering cross-border terrorism through strategic and operational measures.
Technological Modernization in Border Security	Ministry of Home Affairs	2021	Highlights advancements in technology to improve India's border security and operational efficiency.
Annual Report 2020-21	Ministry of Home Affairs	2021	Reviews India's border security strategies, emphasizing modernization and collaboration with neighboring countries.
The Challenge of Coordinating Border Management in the European Union and the Maghreb	Marco Funk	2021	Examines border security in the Maghreb region and the EU's efforts to collaborate with regional partners, identifying structural factors that impede effective border security and offering lessons for future cooperation.
Optimization for Secure and Humane Border Operations	Fatemeh Farajzadeh, Andrew C. Trapp	2022	Identifies operational challenges in border management and discusses how advanced optimization techniques can address these issues, aiming to improve both security and humanitarian aspects of border operations amid migration flows.
A Comparison of Primary Stakeholders' Views on the Deployment of Biometric Technologies in Border Management: Case Study of Smart Mobility at the European Land Borders	Mohamed Abomhara, Sule Yildirim Yayilgan, Livinus Obiora Nweke, Zoltan Szekely	2022	Compares perspectives of travelers and border authorities on biometric technologies in border control, revealing travelers' privacy concerns and authorities' views on enhanced security, to facilitate acceptance of such technologies for secure and convenient border crossing.
The Sino-Indian Conflict: Historical Perspectives and Contemporary Challenges	Banerjee, M.	2022	Analyzes historical and contemporary issues in Sino-Indian border conflicts, focusing on strategic implications.
Modernizing Border Surveillance: Challenges and Opportunities	Das, P.	2022	Evaluates technological and operational challenges in modernizing border surveillance systems in India.
A Deep Learning Approach to Predict the Number of k-Barriers for Intrusion	Abhilash Singh, J. Amutha, Jaiprakash	2022	Proposes a deep learning model to predict the number of k-barriers in wireless sensor networks for intrusion

Detection over a Circular Region using Wireless Sensor Networks	Nagar, Sandeep Sharma		detection, enhancing surveillance capabilities in circular regions.
Enhancing Border Security and Countering Terrorism Through Computer Vision: a Field of Artificial Intelligence	Tosin Ige, Abosede Kolade, Olukunle Kolade	2023	Develops a model using computer vision and machine learning algorithms to detect and assess potential threats at borders, aiming to prevent illegal movements and enhance security through automated surveillance systems.
Deep Learning-based Border Surveillance System using Thermal Imaging	Saurav Kumar, Sarthak Malik & Sumathi Parasuraman	2023	Proposes a framework for a smart border surveillance system utilizing machine learning and thermal imaging to detect intrusions, enhancing security measures along borders.
Smart Border Surveillance System using Wireless Sensor Network	N. Bhadwal, V. Madaan, P. Agrawal, A. Shukla and A. Kakran	2023	Presents a system employing wireless sensor networks for real-time border surveillance and intruder detection, aiming to improve monitoring efficiency in remote areas.
Emerging Security Threats and Strategic Countermeasures along India's International Borders with Bangladesh and Myanmar	Wahab Imran	2024	Identifies emerging security threats along the India-Bangladesh and India-Myanmar borders and suggests countermeasures.
Technological Innovations in Border Surveillance: A Look into India's China Strategy	Kumar, S.	2024	Discusses India's advancements in border surveillance technology, emphasizing the integration of artificial intelligence and its impact on security, diplomatic relations, and regional stability, particularly concerning the India-China border.
Technological Interventions in Border Management	Kumar, S.	2024	Discusses technology's role in improving border management, including surveillance and security measures.
Role of UAVs in Enhancing India's Border Security	Tyshchuk, V. V.	2024	Explores the use of UAVs (drones) in securing India's borders and improving surveillance capabilities.
Challenges of Illegal Migration: The Case of India-Bangladesh Border	Rashid, M.	2025	Analyzes illegal migration challenges along the India-Bangladesh border and suggests policy solutions.

## CONCLUSION

In India, there have been adoption of several technologies, but despite these advancements, India's border surveillance infrastructure faces several challenges. Harsh climatic conditions, difficult terrains, and gaps in technological integration impede the effectiveness of surveillance systems. Budgetary constraints and the need for frequent technological upgrades further complicate the situation. Additionally, cyber vulnerabilities pose risks to the secure operation of surveillance networks (Goel, 2020).

India's border surveillance techniques have evolved significantly, leveraging a blend of traditional methods and cutting-edge technologies. While considerable progress has been made, continued investment in research, development, and inter-agency coordination is essential to address emerging threats and enhance border security comprehensively.

## AUTHOR DECLARATIONS

### CRedit Author Statement / Author contributions

**Tahir Musta:** Conceptualisation; Formal Analysis; Investigation; Writing – Original Draft.

**Md. Shahnawaz Abdin:** Conceptualisation, Supervision.

**Matloob Hasan:** Writing – Data Curation; Review & Editing; Resources.

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