244-260

DRONES AND BORDER MANAGEMENT: THREATS, CHALLENGES AND OPPORTUNITIES

Gp Capt (Dr) Swaim Prakash Singh

INTRODUCTION

Among the many utilities of drones, border management is where drones hold significant potential as a transformative technology. Effective border management is essential for national security in a country as vast and diverse as India. It can be utilised in protecting against unauthorised crossings, smuggling, and other threats. Drones provide enhanced surveillance, rapid response, and cost-effectiveness in monitoring and securing the nation's borders, thereby enhancing security measures. Drones are equipped with sophisticated sensors, cameras, and communication systems, allowing them to collect real-time data, conduct aerial surveillance, and aid in intelligence gathering. This makes them valuable assets in border management, where monitoring vast border stretches, detecting threats, and acting swiftly are essential requirements.

The evolving nature of the threats faced by India highlights the significance of drones in border security. Drones are used by criminals and smugglers to circumvent physical barriers and conventional detection methods, transporting contraband, narcotics etc across border regions. In addition to using drones for reconnaissance and intelligence gathering, adversarial entities also survey border security infrastructure, troop movements, and sensitive installations. Integrating drones into border

management systems is difficult, even though they present a wealth of opportunities. It is crucial to establish robust regulatory frameworks and legal guidelines for drone usage to ensure safety and responsible operation. The development of effective counter-drone systems is necessitated by technological limitations, such as detecting and intercepting small drones with advanced manoeuvrability. In addition, the training and development of personnel involved in the operation and maintenance of drones are essential for maximising their potential in border management.

Despite these challenges, the advantages and opportunities of deploying drones for border management are substantial. In addition, integrating automation and artificial intelligence technologies with drones has enormous potential for advanced data analysis and decision-making processes. In India, initiatives and efforts have been undertaken to exploit the potential of drones in border management. The government has implemented policies and regulations to streamline drone operations, ensure their security, and facilitate their use in border patrol. Border security agencies have acquired and deployed drones for surveillance, intelligence collection, and border patrol, thereby enhancing their operational capabilities.

This article examines the threats, difficulties, and opportunities posed by drones in India's border management. Through analysis, this paper aims to illustrate how drones can bolster border security measures, improve situational awareness, and contribute to effective border management in India. By addressing obstacles, capitalising on opportunities, and fostering collaboration, India can increase border security and maintain the integrity of its borders by leveraging the potential of drones.

OVERVIEW OF BORDER MANAGEMENT IN INDIA

Border management is a complex and critical aspect of national security in India. India faces unique challenges in ensuring the integrity and security of its borders due to its vast geographical expanse and diverse borders shared with multiple neighbouring nations. The primary objectives of border management in India are:

- The prevention of unauthorised border crossings.
- The suppression of smuggling and trafficking.
- The prevention of hostile infiltration.
- The maintenance of peace and security in border regions.

India has 15,106.7 kilometres of land border and 7,516.6 kilometres of coastline, including island territories. In response to the recommendations of the Group of Ministers on Border Management, the Department of Border Management was established within the Ministry of Home Affairs (MHA) in January 2004 to focus on the management of borders and coastlines.[1] Each border presents its own unique challenges and requires individualised management strategies and resources. The border areas include mountainous regions, riverine regions, dense forests, and arid deserts, which further complicate border management.

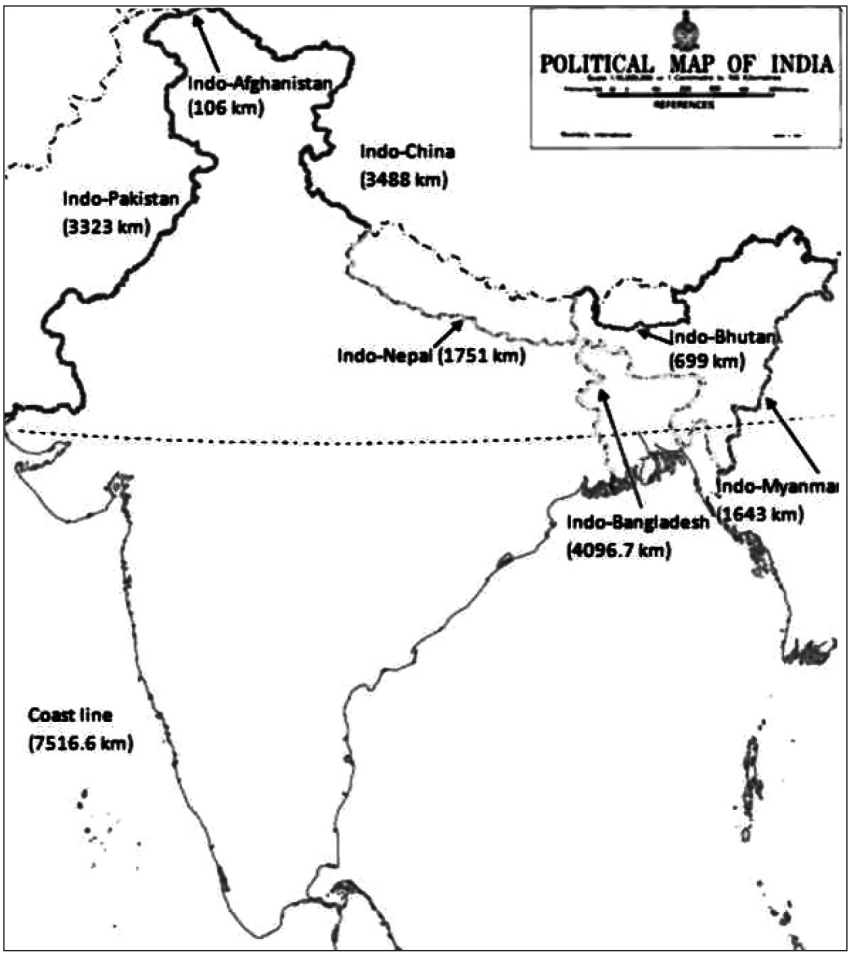
Border management in India is the responsibility of MHA agencies, particularly the Border Security Force (BSF), the Indo-Tibetan Border Police (ITBP), Sashastra Seema Bal (SSB), and Assam Rifles.

A variety of measures and strategies are employed to guarantee effective border management. Physical barriers, such as fences, walls, and border outposts (BOPs), serve as deterrents against unauthorised border crossings.

Technological advancements have significantly improved India's border management capabilities. Along the borders, sophisticated surveillance systems, such as radar networks, sensors, and camera installations, are deployed to monitor and detect suspicious movements. Communication networks are established so security forces can share information in real-time. In addition, aircraft, helicopters and drones are used for border patrol and aerial surveillance in heightened situations, resource availability.

The Border Management-I (BM-I) Division of the MHA has undertaken a number of initiatives as part of its strategy to secure the country's borders and build infrastructure in its border regions. India shares borders with the countries as depicted in **Figure 1** below:[2] To manage such vast borders, the BM-I division undertakes various systems and schemes.

Figure 1: International Boundary with Neighbouring Countries



Source: "Annual Report 2021-22," *Ministry of Home Affairs*, Government of India, https://www.mha.gov.in/sites/default/files/AnnualReport202122_24112022%5B1%5D.pdf accessed on July 9, 2023.

The CIBMS has been installed as a pilot project on two stretches of the international border in Jammu, each spanning approximately 5 kilometres, and a 61-kilometre project is nearing completion in Dhubri, Assam.[3] The 61 kilometres of the border area in Dhubri, where the Brahmaputra enters

Bangladesh, consist of vast char lands and countless river channels, making border patrol difficult, particularly during the monsoon season.

To address these issues, the MHA has decided to employ technological solutions to enhance the manpower capabilities of the BSF on the ground. As part of CIBMS, these two projects will aid in integrating manpower, sensors, networks, intelligence, and command and control solutions to improve situational awareness at various levels of hierarchy and facilitate prompt and well-informed decision-making and rapid responses to emerging situations.

CIBMS entails the deployment of a variety of cutting-edge surveillance technologies, including thermal imagers, infrared and laser-based intruder alarms, aerostats for aerial surveillance, unattended ground sensors that can help detect intrusion attempts, radars, sonar systems to secure riverine borders, fibre-optic sensors, and a command and control system that will receive data from all surveillance devices in real-time. Implementing CIBMS projects along the Indo-Pakistan and Indo-Bangladesh borders will significantly improve the capabilities of the BSF. Stages II and III will include 153 kilometres and 1,802 kilometres, respectively, of riverine, delta, and estuary areas, waterlogged and swampy areas, creek areas, plain areas prone to heavy fog, densely populated border areas, hilly regions, tropical jungle areas and deserts.[4]

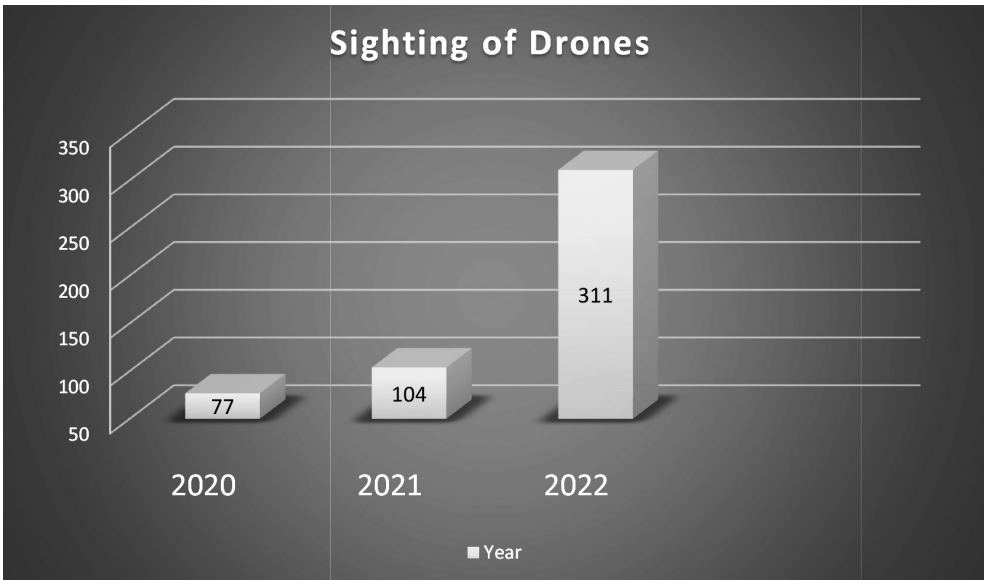
Drones are valuable assets for monitoring remote areas, detecting infiltrations, and enhancing the overall situational awareness of border security forces due to their adaptability, manoeuvrability, and cost-effectiveness. In recent years, the government has acknowledged the potential of drones in border management and taken steps to integrate them into the existing security infrastructure. With the implementation of the Drone Rules 2021, which define operational boundaries, licencing requirements, and safety protocols, the regulatory framework for the use of drones has been strengthened. Border security agencies have acquired and deployed drones for surveillance, intelligence collection, and border patrol, enhancing their operational capabilities. Collaborations with technology firms and startups promote innovation and customised border management solutions. Research

and development efforts continue to advance border security technologies and strategies.

THREATS POSED BY DRONES IN BORDER MANAGEMENT

While drones present numerous opportunities and benefits for border management, they also pose significant threats that must be addressed. In the context of India, where terrain, topography, and altitude vary along the border, its security is of the utmost importance. Identifying, comprehending, and mitigating these threats is essential. Individuals and criminal networks can use drones to circumvent physical barriers and traditional surveillance systems in order to cross borders illegally. This presents a formidable obstacle for border security forces tasked with detecting and interdicting such illegal activities. Not only does this undermine national security, but it also bolsters illicit networks and organised crime.

Figure 2: Unauthorised Drone Incursions into Indian Territory (2020-2022)



Source: Authors articulation information culled out of an article by ANI.[5]

The information depicted in **Figure 2** depicts unauthorised drone incursions into Indian territory. Drone sightings have increased along the International Boundary (IB) and the Line of Control (LoC) in Jammu and Kashmir in recent years. A total of 492 drone sightings were reported by the BSF, including 311 in 2022, as compared to 104 in 2021 and 77 in 2020.[6] This trend demonstrates that drones are Pakistan's primary weapon in its proxy war with India. Drones are used for both kinetic and non-kinetic operations.

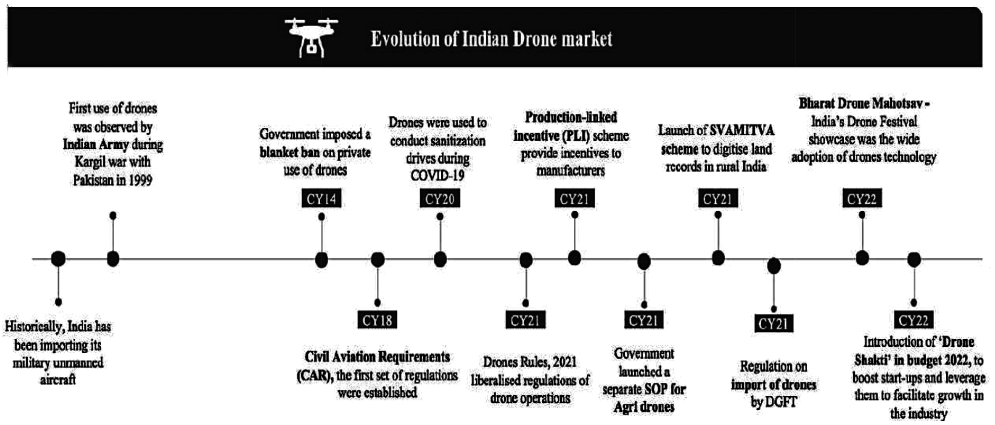
The use of surveillance and intelligence-gathering drones by hostile entities poses a threat to border security infrastructure, troop movements, and sensitive installations. To their advantage, adversarial actors, such as terrorist organisations and hostile nations, can use drones to gather real-time information on border security measures. Due to their small size, low-altitude flight, and advanced manoeuvrability, detecting and intercepting drones is technologically challenging. Traditional radar systems might have difficulty detecting drones, particularly those flying at low altitudes. In addition, drones can use techniques such as terrain masking and swarming to avoid detection and interception, making it difficult for border security forces to neutralise them effectively.

EVOLUTION OF DRONE INDUSTRY

Till 2014, the Directorate General of Civil Aviation (DGCA) under the Ministry of Civil Aviation (MoCA) banned the use of commercial drones in India until it formulated proper rules and regulations to govern their usage. In 2018, the DGCA released the Civil Aviation Requirements (CAR), which established a paperless procedure for filing permits for drone activities and registering licences for drones, owners, and pilots. Apart from defence, drones came into commercial action after 2018. With the new Drone Rules 2021', individuals and organisations in India are set to find it easier to own and operate drones, setting the stage for the broader use of drones in the country. As a part of reforms to make India a global drone hub by 2030, the government also launched the Production-Linked Incentive (PLI) scheme for drones and drone component companies in September 2021 to enable

drone manufacturing in India. The pictorial depiction in **Figure 3** below sums it up.

Figure 3: Evolution of the Indian Drone Market



Source: Drone Industry Report. Indian UAV/Drone Industry, June 9, 2023, p. 43. https://ideaforgetech.com/investor-relations/industry-report accessed on July 11, 2023.

CHALLENGES IN BORDER MANAGEMENT

There are several challenges that must be overcome before drones can be utilised to their fullest extent in border management, despite their enormous potential. These challenges include regulatory frameworks, interoperability, technological limitations, and capacity building. To address these threats, multiple mitigating measures must be implemented.

COUNTER-DRONE CAPABILITIES AND MEASURES

It is imperative to develop effective drone countermeasures. Implementing robust detection systems that employ radar, acoustic sensors, radio frequency (RF) detection, and electro-optical technologies can aid in identifying and tracking unauthorised drones. Such systems must be able to detect small, low-flying drones to provide complete border coverage. This can include using radio frequency (RF) jammers to interfere with the drones' control signals and kinetic interception mechanisms such as net guns or

directed energy weapons to disable or destroy the drones. Additionally, the regulatory framework should address the utilisation of counter-drone technologies for border management. The establishment and dissemination of policies and procedures should be prioritised. To prevent unauthorised drone interference, regulations should ensure that counter-drone measures are implemented within legal parameters and punitive provisions.

Enhancing Collaboration and Information Sharing

Improving collaboration and information sharing between border security agencies, intelligence agencies, and technology providers is essential for staying abreast of emerging threats, sharing best practices, and developing effective countermeasures. Regular intelligence sharing and joint training can assist in the development of a proactive defence against drone threats. Currently, all security agencies utilise a few time-tested and evolving mechanisms. However, there needs to be more real-time interoperability and a connected network along the border due to the extensive border length, the absence of a common communication and data network, and the deployment of multiple security agencies all along the border and in its immediate depth. Complexity exists in integrating drones into existing border management systems. Integrating data, sharing information, and facilitating interoperability between drones and ground-based surveillance systems is essential. Compatible communication protocols, data standards, and analytic frameworks must be developed to enable real-time collaboration and decision-making.

Compliance and Enforcement

To ensure adherence to the regulatory framework, it is essential to develop compliance monitoring and enforcement mechanisms, especially for border management. This requires regular inspections, audits, and evaluations of drone operators to ensure compliance with licencing requirements, airspace rules, and privacy protection measures. Clearly defined and implemented enforcement actions are required, such as penalties for noncompliance or

unauthorised operations. Additionally, regulations should mandate the implementation of counter-drone technologies for border infrastructure protection. Fortunately, the liberalised Drone Policy 2021 has been able to cover most of these regulatory frameworks to a large extent. This policy may be further refined every two years to make it more punitive.

Technological Limitations and Infrastructure Requirements

Utilising drones for border management effectively necessitates the application of advanced technologies and a robust infrastructure. Effective drone operations require high-resolution cameras, real-time data transmission, secure communication networks, and dependable power sources. Establishing drone operation centres, charging stations, maintenance facilities, and secure data storage and processing facilities are included in the infrastructure development. Infrastructure must be strategically positioned to provide optimal coverage and facilitate drones' rapid deployment and maintenance. Moreover, dependable power sources and communication networks are essential for drone operations to continue uninterrupted.

Training and Capability Building

It is essential to ensure the availability of trained personnel and develop their capability to operate and maintain drones effectively. In addition to counter-drone technologies, training programmes should cover drone operation, data analysis, and interpretation. Essential to a successful implementation is the development of a skilled workforce capable of handling drone operations and responding to potential security threats. Conducting pilot projects and field trials to validate the efficacy of drones in border management operations and establish best practices is essential today. Combining theoretical instruction, practical exercises, simulated scenarios, and hands-on training with actual drones can facilitate training and capacity building. Collaborations with training institutions, industry experts, and seasoned drone operators can improve the quality and applicability of training programmes. By investing in comprehensive

training and capacity-building initiatives, India can cultivate a workforce capable of utilising drones for border management. This ensures the safe, efficient, and responsible deployment of drones, improves border security operations, and enables effective responses to emerging threats and challenges. Indian Air Force (IAF) can take the lead in training the security agencies, as is being done in isolated cases.

Incident Reporting and Investigations

Establishing incident reporting and investigation procedures is required to monitor and address any safety or security incidents involving drones. This includes requirements for reporting accidents, near-misses, and unauthorised drone activities. Developing a centralised reporting mechanism ensures that incidents are thoroughly investigated, lessons are learned, and risks are mitigated as required.

Secure Communication Networks

It is essential for border management to provide secure and dependable communication networks for drone operations. Drones rely on communication links to transmit real-time data, receive commands, and stay connected to ground control stations. Establishing encrypted and interference-resistant communication systems prevents hostile entities from gaining unauthorised access, jamming signals, or intercepting data.

Data Management and Processing

During border surveillance operations, drones generate vast quantities of data with the help of sensors and cameras. Real-time analysis and interpretation of this data require efficient data management and processing systems. Implementing advanced data analytics, artificial intelligence (AI), and machine learning techniques can facilitate the extraction of actionable insights and the prompt execution of decisions.

India can strengthen its border security and reduce the risks posed by drones by addressing these threats and adopting a multi-layered approach

to counter-drone measures. Investing in the research and development of anti-drone measures is essential to stay ahead of emerging threats, foster collaborations with technology firms, and continuously adapt border security strategies to effectively manage the challenges posed by drones in border management.

OPPORTUNITIES THROUGH DRONES IN BORDER MANAGEMENT

Drones have emerged as a crucial technology in border security, with capabilities that improve surveillance, response, and the overall efficacy of border management. The significance of drones in India, a country with extensive and diverse borders, cannot be overstated. Utilising drones for border administration offers numerous opportunities to improve security, efficiency, and efficacy. Drones provide unique capabilities that complement conventional border security measures and provide valuable information for decision-making. Utilising such opportunities can substantially enhance India's border management operations. Drones can revolutionise border security operations by creating new opportunities for surveillance, interdiction, and intelligence collection. The advantages that drones offer to border management are discussed in detail below.

Enhanced Situational Awareness

Drones equipped with sophisticated cameras, sensors, and imaging technologies provide a bird's-eye view of border regions. They provide capabilities for real-time aerial surveillance, increasing situational awareness along India's borders. By providing a bird's-eye view, drones allow for a rapid and precise assessment of border situations. They can traverse vast swaths of boundary regions, including remote and inaccessible regions, posing difficulties for ground-based patrols.

Effective Border Surveillance and Mapping

Drones can cover vast areas efficiently, overcoming geographical obstacles and reaching remote border regions inaccessible to ground-based patrols.

With their aerial mobility and agility, drones enhance border security agencies' surveillance capabilities and resource allocation. Drones aid in the mapping and monitoring border regions by producing detailed maps and 3D models. These facilitate resource planning, infrastructure development, and the identification of areas of vulnerability. Regular drone surveillance also helps track changes in border landscapes, such as illicit activities, incursions, or natural disasters, enabling timely interventions.

Counter-Smuggling and Anti-Terrorism Operations

Drones play a crucial role in detecting and intercepting illicit activities and combating terrorism along the border. They can identify concealed tunnels, detect contraband, and aid in interdiction. Drones with thermal imaging cameras and advanced sensors can detect heat signatures and trace movement in low-light conditions. By utilising the capabilities of drones, border management agencies can improve their anti-smuggling efforts and the overall security of border regions, particularly in the J&K, Punjab, Rajasthan, and Kutch regions.

Rapid Response and Mobility

Drones offer swift and mobile capabilities for addressing threats at the border in a timely manner. They can be rapidly deployed to monitor suspicious activity, respond to illegal border crossings, and support search and rescue operations. Drones with real-time video streaming enable border security personnel to assess potential threats remotely, make informed decisions, and effectively allocate resources. Drones are valuable assets for addressing dynamic border security challenges due to their agility and mobility.

Intelligence Gathering

Border management uses drones as intelligence-gathering tools, collecting data, imagery, and video footage, providing valuable insights for analysis and decision-making. Advanced data analytics and visualisation techniques

can be applied to drone-captured data to identify patterns, detect anomalies, and extract intelligence that can be implemented. This allows border security agencies to respond proactively to new threats and make informed operational decisions.

Technological Advancements

Utilising drones for border management promotes technological advancement and innovation. As drone technology evolves, new features and functionalities emerge, enhancing border security capabilities. This encourages the development of advanced sensors, communication systems, autonomous navigation, and artificial intelligence (AI) algorithms, making it possible for drones to operate for longer durations, carry advanced payloads, navigate complex terrains, and analyse vast amounts of data in real-time. Integrating geospatial technologies and geographic information systems (GIS) improves the capabilities of mapping, spatial analysis, and geolocation capabilities. Such partnerships enhance the efficacy of drones in border management and permit proactive, intelligence-driven decision-making. Expanding the drone industry provides opportunities for collaborations with technology companies, start-ups, and research institutions, resulting in customised border management solutions. Border management agencies can unlock new opportunities to enhance security if they remain at the forefront of technological advancements.

Cost-Effectiveness

Border surveillance with drones is more cost-effective than traditional methods. They can efficiently cover large areas, reducing the need for manpower and physical infrastructure. This cost-effectiveness enables border management agencies to strategically allocate resources, optimise manpower utilisation, and invest in other crucial aspects of border security. According to a study by the MHA, using drones for border surveillance can save up to 60 per cent compared to conventional ground-based surveillance methods.

CONCLUSION AND RECOMMENDATIONS

The increasing recognition of the importance of drones in border security is reflected in the initiatives taken by the government. The Drone Rules 2021 and the proactive adoption of drones by border security agencies demonstrate a commitment to harnessing the potential of drones in border management. The government has acknowledged the value of drones in border security, leading to increased procurement and deployment by border security agencies such as the BSF and the Indian Coast Guard (ICG).

Having seen the complexity of border management, threats, challenges, and opportunities in the revolutionary drone sector, it is essential to analyse the mitigating measures to contain the misuse and misadventure of drones by inadvertent or deliberate use by non-state actors. Certainly, the entire length of the international boundary cannot be defended with the help of drones due to the vast, varied, and harsh terrain. Any amount of effort would be less than having impregnable borders. Notwithstanding this caveat, a phenomenal scope exists for strengthening the government and MHA's initiative towards secure borders. A few of the steps are mentioned below.

Focus on Counter-Drone Capabilities

The liberalised drone policy and ease of access, both economically and operationally, have yielded the possession of drones by anyone who desires. It is evident from the boom in the drone manufacturing or assembly industry. A vision of India becoming a drone hub for the world by 2030 is helping the drone industry grow on a daily basis. However, similar proportional growth is not seen in the counter-drone capability. Security agencies like the BSF, Armed Forces, and state police would require huge numbers of potent counter-drone capabilities with longer ranges and both hard and soft kill capabilities in tandem. Apart from hard and soft kill measures, the Russia-Ukraine conflict has also showcased the relevance of electronic warfare (EW) capabilities, which need to be embedded into counter-drone equipment. Research and development in this field should also be the key results for drone manufacturers.

Joint Response Mechanism

Due to the peculiarities of borders being divided into IB, LoC, LAC, etc., the responsibility of guarding the border differs from place to place. There are multiple agencies, such as the Indian Army, BSF, ITBP, SSB, Assam Rifles, and Coast Guard, involved in the common objective of securing borders. Above all, the IAF is responsible for protecting Indian airspace as per the Union War Book. It is necessary to make the joint working and response mechanisms well known and to lay down policies for all concerned. It is also pertinent that the standard operating procedures be firmed up and practised regularly, to the extent of once a fortnight, which will ensure a foolproof response mechanism functioning within a few years' time.

Creation of Drone Air Space Management Cell (DASMC)

The Air Defence Identification Agency (ADIA) of the IAF currently manages a staggering number of flight plans at any given moment. Low-flying and difficult-to-track drones necessitate the establishment of a parallel airspace authority within the ADIA at geographically dispersed locations. It can be called the "Drone Air Space Management Cell" (DASMC).[7] The DASMC could be established at the respective security agency's Zonal Headquarters, fully integrated with the ADIA of the IAF, to defend the nation's skies in the designated areas and corridors. The cell would have to collaborate with the IAF's command and control centres, coordinating with the existing ADIA systems and the newly implemented Digisky platform. There should be a requirement that all sensors are always connected to this network. The sensors would remain switched on throughout the highly intense and vulnerable zones. In other areas, it could be activated along a filled flight path or in response to intelligence inputs. To equip the DASMC, the government and security establishment must establish a comprehensive need for sensors and anti-drone systems and recruit trained personnel. With a failsafe air space management strategy, this concept is feasible and implementable, despite the large number of DASMC that would be required.

Public Outreach and Trust Building

Last but not least, the integration of drones in border control relies heavily on public acceptance, knowledge, and support. The public should be educated about the advantages, vulnerabilities, and responsibility measures of drone use via public outreach programmes. Transparency in drone operations and clear parameters for data gathering and utilisation are likely to contribute to the development of public trust and collaboration. Engaging in proactive communication with the public is necessary via awareness campaigns, community engagement initiatives, and public consultations.

Gp Capt Swaim Prakash Singh is a cat AYE, MFC, Command Examiner, qualified APM, and AWACS Mission Commander with over 1000 hours of flying. He has also been Directing Staff at DSSC, Wellington.

NOTES

1. Ministry of Home Affairs, BM-II Division, Mandate. https://www.mha.gov.in/sites/default/files/2022-08/BM_II_Mandate_18062019%5B1%5D.pdf Accessed on July 6, 2023.
2. Border Management-I Division. Ministry of Home Affairs. https://www.mha.gov.in/en/divisionofmha/border-management-i-division Accessed on July 6, 2023.
3. Government of India Ministry of Home Affairs Rajya Sabha Unstarred Question No. 2293 to be answered on the 23rd March, 2022/ Chaitra 2, 1944 (Saka) Infiltration from Bordering Countries 2293. Shri Anil Desai. https://www.mha.gov.in/MHA1/Par2017/pdfs/par2022-pdfs/RS23032022/2293.pdf Accessed on July 11, 2023.
4. Press Information Bureau. "Union Home Minister Launches Smart Fencing on Indo-Bangladesh border, an effective deterrence against illegal infiltration" Government of India, Ministry of Home Affairs. 05 March 2019, Delhi. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1567516 Accessed on July 13, 2023.
5. "Rajnish Singh. "Drone sighting along border with Pak tripled in one year; 311 observations in 2022" ANI, December 26, 2022. https://www.aninews.in/news/national/general-news/drone-sighting-along-border-with-pak-tripled-in-one-year-311-observations-in-202220221226201312/Accessed on July 7, 2023.
6. Ibid.
7. Author Swaim Prakash Singh has proposed this concept in "Concerns for Drone Proliferation in India and Challenges to Air Space Management" ISSN 0976-1004 print © 2022 Manohar Parrikar Institute for Defence Studies and Analyses Journal of Defence Studies, Vol. 16, No. 4, October–December 2022, pp. 203-219.