CLAWS

ISSN 23939729

No. 119

2025

Deterrence, Disarmament and Dilemma: The Effectiveness of WMD Non-Proliferation Frameworks Today

MANEKSHAW PAPER

KTG Krishnan and Rajan Bakshi

CENTRE FOR LAND WARFARE STUDIES

Field Marshal Sam Hormusji Framji Jamshedji Manekshaw, better known as Sam "Bahadur", was the 8th Chief of the Army Staff (COAS). It was under his command that the Indian forces achieved a spectacular victory in the Indo-Pakistan War of 1971. Starting from 1932, when he joined the first batch at the Indian Military Academy (IMA), his distinguished military career spanned over four decades and five wars, including World War II. He was the first of only two Field Marshals in the Indian Army. Sam Manekshaw's contributions to the Indian Army are legendary. He was a soldier's soldier and a General's General. He was outspoken and stood by his convictions. He was immensely popular within the Services and among civilians of all ages. Boyish charm, wit and humour were other notable qualities of independent India's best known soldier.Apart from hardcore military affairs, the Field Marshal took immense interest in strategic studies and national security issues. Owing to this unique blend of qualities, a grateful nation honoured him with the Padma Bhushan and Padma Vibhushan in 1968 and 1972 respectively.

Field Marshal SHFJ Manekshaw, MC
1914-2008

CLAWS Occasional Papers are dedicated to the memory of Field Marshal Sam Manekshaw

MANEKSHAW PAPER No. 119, 2025

Deterrence, Disarmament and Dilemma: The Effectiveness of WMD Non-Proliferation Frameworks Today

KTG Krishnan and Rajan Bakshi

Centre for Land Warfare Studies
New Delhi

Editorial Team : CLAWS

ISSN : 23939729

Centre for Land Warfare Studies
RPSO Complex, Parade Road, Delhi Cantt, New Delhi 110010
Phone +91-11-25691308 Fax: +91-11-25692347
Email: **landwarfare@gmail.com**, website: **www.claws.co.in**
CLAWS Army No.33098

The Centre for Land Warfare Studies (CLAWS), New Delhi, is an independent Think Tank dealing with national security and conceptual aspects of land warfare, including conventional & sub-conventional conflicts and terrorism. CLAWS conducts research that is futuristic in outlook and policy-oriented in approach.

CLAWS Vision: To be a premier think tank, to shape strategic thought, foster innovation, and offer actionable insights in the fields of land warfare and conflict resolution.

CLAWS Mission: Our contributions aim to significantly enhance national security, defence policy formulation, professional military education, and promote the attainment of enduring peace.

Published in Bharat by

Sabre & Quill Publishers, New Delhi, India
www.sabreandquill.com/sabreandquill@gmail.com

Contents

Deterrence, Disarmament and Dilemma: The Effectiveness of WMD Non-Proliferation Frameworks Today

Abstract

This article critically assesses the global non-proliferation regime for weapons of mass destruction (WMDs), focusing on nuclear, chemical, and biological threats. While treaties like the NPT, CWC, and BWC have curbed the spread of WMDs, they suffer from structural flaws, enforcement weaknesses, and limited adaptability to emerging technologies and geopolitical shifts. Drawing on case studies and analysis, the article highlights major shortcomings, including the lack of verification for biological weapons, inconsistent implementation of safeguards, and limited tools to counter non-state actors and dual-use risks.

It also examines India's approach to CBRN security, underscoring the need for a unified national strategy that leverages advanced technology, inter-agency coordination, international partnerships, and public preparedness.

The article recommends revitalising disarmament efforts, strengthening verification mechanisms, and building inclusive governance frameworks. It concludes that while the existing regime has constrained the use of WMDs, its future effectiveness hinges on transparent, flexible, and collaborative global responses.

Introduction

The global security landscape in the 21st century is undergoing a profound transformation driven by geopolitical realignments, technological diffusion and the increasing prominence of non-state actors. Traditional hopes that the end of the Cold War would lead to lasting stability and economic prosperity have largely given way to a multi-polar and volatile international environment. In this context, weapons of mass destruction remain central to discussions on catastrophic threats, both from state and non-state entities.

Historically, WMD regimes were designed to manage proliferation among sovereign states through international treaties including the Nuclear Non-Proliferation Treaty (NPT), the Chemical Weapons Convention (CWC), and the Biological Weapons Convention (BWC). However, these frameworks were conceived in an era that did not anticipate the rapid pace of technological advancement, the erosion of state-centric warfare norms or the rise of ideologically motivated violent non-state actors (VNSAs)[1]. Terrorist groups today operate with strategic ambition, leveraging global interconnectivity and dual-use technologies to pose unprecedented threats to global peace and stability. Incidents like the Tokyo subway sarin attack[2], the attempted weaponisation of biological agents by extremist groups and state-sponsored chemical attacks have demonstrated the challenges of enforcing traditional arms control in a world of asymmetric and unconventional threats.

Moreover, the scope of what constitutes a WMD has broadened. Increasingly, there is a shift toward understanding "weapons of mass effect" (WME)[3], which prioritise the psychological, economic, and infrastructural impacts over sheer lethality. Disruptive technologies, ranging from synthetic biology and cyber capabilities to artificial intelligence and autonomous systems, have the potential to magnify the destructive capacity of WMDs or create novel hybrid threats that outpace current regulatory and enforcement mechanisms. In this evolving threat environment, the efficacy of non-proliferation regimes is being fundamentally tested.

Overview of Non-Proliferation Regimes

The Nuclear Non-Proliferation Treaty (NPT)

The NPT remains the foundation of the international nuclear non-proliferation regime. It is built upon three crucial pillars: - preventing the spread of nuclear weapons, promoting peaceful uses of nuclear energy and achieving nuclear disarmament. With 191 state parties, the NPT enjoys near-universal adherence, although notable exceptions include India, Israel, and Pakistan. Under Article I, nuclear-weapon states (NWS) agree not to transfer nuclear weapons to non-nuclear-weapon states (NNWS), and under Article II, NNWS agree not to receive, manufacture, or acquire such weapons. Article VI obligates all parties to pursue negotiations in good faith on disarmament.

The treaty is reviewed every five years through NPT Review Conferences, the most recent being held in 2022, which failed to adopt a consensus final document due to disagreements over issues including the status of nuclear weapons in conflict zones. The lack of significant progress on Article VI disarmament commitments has drawn criticism from NNWS [4].

The Role of the IAEA

The International Atomic Energy Agency (IAEA) is responsible for verifying states' compliance with their NPT commitments. It does so through safeguards agreements, which include regular inspections, material accountancy and remote monitoring. The 1997 Additional Protocol enhances the IAEA’s authority by granting access to undeclared facilities and increasing transparency. As of 2024, over 140 countries[4] have adopted the Additional Protocol, improving the agency's ability to detect undeclared nuclear activities. The IAEA additionally provides technical assistance for civilian nuclear applications under its Technical Cooperation Program.

Comprehensive Nuclear-Test-Ban Treaty (CTBT)

The CTBT, adopted in 1996, bans all nuclear explosions. It has 187 signatories and 178 ratifications but is not yet in force because crucial states, including the U.S., China, India, Pakistan, North Korea, Egypt, Iran, and Israel have not ratified it[4]. The CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organisation) maintains an International Monitoring System (IMS), comprising over 300 seismic, hydroacoustic, and radionuclide stations, to detect nuclear explosions worldwide. The IMS is operational and provides data even though the treaty is not in force. The U.S, while supporting the IMS, has expressed no intent to ratify the treaty under the recent administration.

Fissile Material Cut-Off Treaty (FMCT)

The FMCT aims to prohibit the production of fissile material for nuclear weapons[4]. Negotiations, primarily in the Conference on Disarmament, have been stalled for decades due to disagreements over verification and whether to include existing stockpiles. Pakistan continues to block consensus on a negotiating mandate, citing concerns over strategic parity with India. As a result, progress on the FMCT remains frozen despite broad international support.

Chemical Weapons Convention (CWC)

The CWC, which entered into force in 1997, prohibits the development, production, stockpiling, transfer, and use of chemical weapons. It mandates the destruction of existing stockpiles and production facilities. The Organisation for the Prohibition of Chemical Weapons (OPCW) is the implementing body, conducting inspections, maintaining a declarations system and verifying destruction. As of July 2023,[5] all declared stockpiles have been destroyed, including those of the United States. However, allegations of chemical weapon use by Syria and Russia have raised concerns about compliance and enforcement.

Biological Weapons Convention (BWC)

The BWC, which came into force in 1975, bans the development, production and acquisition of biological and toxin weapons. However, it lacks a verification mechanism, making enforcement difficult. Confidence-building measures and transparency efforts have been adopted instead of verification, but these remain voluntary and inconsistently applied. As of 2024, the BWC has 185[4] states parties, but compliance concerns remain, particularly regarding Russia, North Korea, Iran and China. A working group was established following the 2022 Review Conference to explore proposals for strengthening implementation.

United Nations Security Council Resolution 1540

UNSCR 1540, adopted in 2004, compels all UN member states to establish domestic controls to prevent non-state actors from acquiring WMDs. This includes legislation, border controls and export regulations. A Group of Experts supports implementation and a ten-year mandate extension was approved in 2022[6]. While over 90% of UN member states have submitted implementation reports, the quality and depth of compliance vary widely.

National Export Control Regimes

Multilateral export control arrangements, including the Nuclear Suppliers Group (NSG), Zangger Committee, Australia Group and Wassenaar Arrangement, coordinate restrictions on sensitive technology transfers[4]. These groups are voluntary and depend on national implementation. Recent years have seen increased focus on emerging technologies and dual-use research, with discussions underway to modernise control lists and improve outreach to the private sector.

Regional and Informal Mechanism

Efforts like the Proliferation Security Initiative (PSI), Global Initiative to Combat Nuclear Terrorism (GICNT) and G7 Global Partnership supplement formal treaties. These initiatives promote interdiction, capacity-building and threat reduction, especially against non-state actors. As of 2024, PSI has over 110 endorsing states, while the GICNT includes over 80 partner countries and international organisations, including INTERPOL and the IAEA[4]. These initiatives lack binding authority but offer flexible platforms for cooperation and information sharing.

Evolving Threat Landscape

CBRN Threats from Non-State Actors

The contemporary threat posed by non-state actors in the realm of CBRN weapons has significantly evolved, reflecting broader transformations in the global security environment. Historical incidents such as the 1995 sarin gas attack by Aum Shinrikyo in Tokyo[7], the 2001 anthrax mailings in the United States[8] and the use of improvised chemical weapons by ISIS[9] in Syria and Iraq illustrate the persistent and growing ambition of violent extremist groups to acquire and employ WMDs. This trajectory marks a clear departure from traditional, state centric proliferation models.

Analysts increasingly refer to this shift as the advent of "new terrorism"[3] characterised by strategic intent, organisational diffusion, technological agility and a pronounced reduction in operational constraints. Unlike the terrorist groups of the late 20th century, many of which relied on state sponsorship and operated within hierarchical command structures, contemporary non-state actors function through loosely networked or entirely decentralised cells. These groups exploit ungoverned spaces, failed states, and digital ecosystems to plan, coordinate and disseminate operations with minimal detectability. The result is a more agile, resilient and ideologically unrestrained form of terrorism that challenges conventional counter-proliferation strategies.

The diffusion of power away from the state has been accelerated by technological innovation and the erosion of traditional institutional monopolies. Emerging technologies such as 3D printing, synthetic biology, encrypted communication platforms and digital currencies have significantly lowered the barriers to CBRN acquisition and use. These tools enable actors with relatively limited resources to independently develop or acquire the components necessary for WMD construction and deployment. For instance, lone individuals have accessed open-source materials to produce biological agents, as demonstrated in the 2018 Cologne ricin plot[10].

Moreover, the strategic logic underpinning new terrorism increasingly decouples violence from political negotiation. While, earlier terrorist movements often sought political recognition or concessions, many of today's groups pursue destruction as an end in itself. This shift is facilitated by a reduced reliance on state sponsors, thereby removing the moderating influence that such relationships historically exerted. Financial independence achieved through illicit trade, anonymous donations and the use of cryptocurrencies has further insulated these actors from external accountability.

Concurrently, the organisational structures of groups like Al-Qaeda have transformed from centralised hierarchies into diffused networks of affiliates and inspired individuals. The adoption of encrypted digital communication, the promotion of autonomous operations, and the ability to conceal intent and movement within the digital noise of modern society have rendered many traditional counter-terrorism measures less effective. Calls for independent action disseminated via online platforms have encouraged a model of leaderless resistance, minimising the need for coordination and significantly reducing the risk of pre-emptive disruption.

The convergence of these factors has profoundly altered the nature of the CBRN threat from non-state actors. In an era where the modus operandi of non-state actors has reached new levels and where technological means outpace regulatory and intelligence capabilities, the threat of CBRN terrorism can no longer be viewed as a hypothetical risk but as an urgent and dynamic challenge to international security.

Emerging Technology and the WMD Threat Landscape

The broader landscape of WMD is undergoing a profound and rapid transformation, driven by the convergence of emerging technologies and evolving strategic dynamics. Innovations in artificial intelligence (AI), large language models (LLMs), synthetic biology, additive manufacturing (3D printing), and autonomous systems are collectively reshaping the contours of proliferation[11]. These technologies are significantly lowering technical barriers, broadening access to sensitive capabilities and enabling a wider range of actors to engage in WMD development.

AI and LLMs now provide low-skill users with access to complex scientific and engineering knowledge, including methodologies for the design of chemical and biological weapons. Advanced generative models, such as ProtGPT2 are capable of simulating protein structures and facilitating the theoretical design of toxins. This raises legitimate concerns over the potential creation of highly tailored or undetectable biological agents.

Simultaneously, 3D printing technologies enable decentralised manufacturing of critical weapon components, thereby circumventing traditional arms control regimes and export controls. The inherently dual-use nature of these technologies complicates regulation. For example, while CRISPR was developed for therapeutic and scientific breakthroughs, it can also be exploited to engineer pathogens with enhanced virulence, resistance or stealth. Similarly, commercial drones and AI-enabled navigation systems originally intended for civilian applications can be readily modified for weaponised deployment. The 2013 attempted sarin gas delivery using a drone in Iraq[12] exemplifies the operational plausibility of such scenarios.

In the nuclear domain, technological advancements such as Laser Isotope Separation (LIS) introduce additional proliferation risks. Compared to conventional centrifuge methods, LIS offers faster and more covert uranium enrichment capabilities. This presents significant challenges for detection and interdiction, particularly in technologically advanced or opaque states and raises concerns about the effectiveness of existing monitoring and verification systems.

Cyber capabilities introduce yet another dimension of complexity to the WMD threat environment. Sophisticated cyber tools can be used to sabotage critical infrastructure, disrupt containment systems or disable nuclear safeguards remotely. The Stuxnet cyberattack on Iran's nuclear facilities stands as a stark example of the strategic impact that cyber operations can exert without direct kinetic force. These developments underscore the increasingly mobile, anonymous and asymmetric nature of modern WMD threats.

Compounding these risks is the lack of comprehensive international governance frameworks capable of addressing the rapidly evolving threat spectrum. Existing arms control instruments such as NPT, BWC and CWC were established in a different technological era and remain inadequately equipped to regulate emerging domains such as synthetic biology, AI, or cyber operations.

Evaluation of Response of Existing Non-Proliferation Regimes

Nuclear Non-Proliferation Treaty (NPT)

- **Successes** The NPT is widely recognised for its remarkable success in preventing the spread of nuclear weapons. Other than the five nuclear-weapon states officially recognised by the treaty, only four others i.e. India, Israel, North Korea and Pakistan have developed nuclear arsenals, keeping the total number of nuclear-armed states at nine[13].

  Several notable case studies underscore the treaty's success. South Africa, in the early 1990s[14], voluntarily dismantled its nuclear arsenal and joined the NPT as a non-nuclear-weapon state, making it the only country to have reversed its nuclear weapons program completely. Following the collapse of the Soviet Union, Kazakhstan, Belarus, and Ukraine relinquished Soviet-deployed nuclear weapons and joined the NPT under security assurances, further demonstrating the treaty's ability to influence nuclear restraint. In 2003, Libya[15], under intense international pressure, abandoned its clandestine WMD programs and invited IAEA inspectors, further showcasing the treaty's conflict resolution potential. Institutionally, the International Atomic Energy Agency (IAEA) has strengthened the treaty's verification capabilities, especially with the introduction of the Additional Protocol, which has enhanced monitoring and deterred diversion of civilian nuclear programs toward weapons development.

- **Failures** Despite these accomplishments, the NPT has faced several failures. It has not succeeded in achieving universality, with India, Pakistan, and Israel remaining outside the treaty and developing nuclear weapons. These nations criticise the treaty's discriminatory nature. North Korea's withdrawal[16] in 2003 and subsequent nuclear tests highlighted a critical legal loophole and exposed the treaty's limited deterrent effect on determined proliferators. The IAEA, though crucial, is often hampered by a limited mandate and resource constraints, resulting in delays in detecting and verifying violations as seen in Iran's prolonged investigations and Syria's suspected reactor activities[13].

- Additionally, the disarmament obligation under Article VI has seen little progress. Nuclear-weapon states have largely resisted implementing concrete disarmament steps, justified by the ambiguous and non-time-bound phrasing of Article VI. Moreover, around 30 non-nuclear-weapon states remain under a 'nuclear umbrella,' depending on allied nuclear arsenals for their security. This imbalance has generated frustration among non-nuclear states, leading to the creation of the 2017 Treaty on the Prohibition of Nuclear Weapons (TPNW)[17], which faces resistance from nuclear states and their allies.

Chemical Weapons Convention (CWC)

- **Successes** The CWC has been highly effective in eliminating large chemical weapons stockpiles and establishing a robust global verification architecture. The United States and Russia, the two largest chemical weapons possessors, have completed the verified destruction of their declared arsenals, with the U.S. concluding its process in 2023[18].

Another significant success came in 2013 when the OPCW-UN joint mission successfully dismantled Syria's declared chemical arsenal during an ongoing civil war.

The CWC's verification system, implemented by the Organisation for the Prohibition of Chemical Weapons (OPCW), allows for regular on-site and challenge inspections[19]. OPCW experts, who are highly trained professionals, conduct inspections and oversee the safe destruction of chemical weapons. The OPCW's recognition through the 2013 Nobel Peace Prize[20] further attests to the success of the treaty's mechanisms.

- **Failures** Despite these achievements, the CWC continues to face enforcement and compliance challenges[21]. Syria, although a state party, has repeatedly been found responsible for chemical attacks post 2013, revealing the treaty's enforcement limitations and the political barriers within the UN Security Council. The use of chemical weapons by non-state actors, notably ISIS in Iraq and Syria, exposed the regime's inability to address threats from armed groups or monitor the trade of dual-use chemical precursors in conflict zones.

  Furthermore, a few states, including Egypt, Israel and North Korea have not joined the CWC, undermining its universality.

  Operational implementation is also challenged by misconceptions regarding permitted substances such as riot control agents and Schedule 3 chemicals, as highlighted in VERTIC's 2023 assessment.

Biological Weapons Convention (BWC)

- **Successes** Although the BWC lacks a formal verification mechanism, it has successfully established a strong global norm against biological weapons. With 184 member states, it has achieved wide, though not universal, acceptance. No state today openly endorses biological weapons, a sharp contrast to Cold War attitudes. The BWC's normative strength is evidenced by states' reluctance to engage in or admit to biological weapons activities due to the risk of global condemnation. South Africa's Project Coast serves as a notable example of norm-induced disarmament, wherein the country dismantled its offensive biological program in the 1990s. UN inspections post-Gulf War uncovered Iraq's concealed biological weapons program, leading to renewed commitment to the BWC, even though the discovery relied on other mechanisms. BWC Review Conferences and Confidence-Building Measures (CBMs) have helped sustain international cooperation on bio-safety and peaceful research[22].

- **Failures** The BWC's lack of a verification regime presents a significant weakness[23]. Unlike the NPT and CWC, the BWC depends on voluntary CBMs, making it difficult to verify compliance or investigate violations. Concerns about clandestine programs in Russia and North Korea persist, as the failure of 2001 protocol negotiations left the treaty without investigatory authority. Recent disinformation campaigns have further eroded trust in the BWC by spreading false accusations about offensive bio-weapons labs. Institutionally, the BWC is supported by only a small Implementation Support Unit (ISU), which cannot manage crises or coordinate responses. Another limitation is the treaty's narrow scope, which covers only weapons and not other biological risks such as accidental pathogen releases or natural outbreaks. Since it may not be immediately clear whether an outbreak is natural or deliberate, the treaty's separation of these scenarios complicates international responses. Coordination between security and public health agencies remains politically and logistically challenging.

Cross-Cutting Limitations of Non-Proliferation Regimes

Discriminatory Framework of the NPT

A core limitation of the NPT is its acceptance of only five nuclear-weapon states, which effectively institutionalises nuclear inequality. This creates a two-tiered global security architecture that contradicts the disarmament objective of the treaty. Non-nuclear-weapon states argue that the NWS have failed to meet their Article VI obligations to negotiate in good faith toward complete disarmament, leading to growing dissatisfaction and weakening the NPT's normative authority[24].

BWC's Verification Deficit

The BWC lacks any formal mechanism to verify compliance[25], making it the weakest among the WMD treaties. This verification gap enables the covert development of biological weapons, particularly in the context of dual-use biotechnology. Proposals to introduce verification protocols have repeatedly failed due to opposition from major powers, often citing concerns about commercial confidentiality and national security.

CTBT's Legal Limbo

The Comprehensive Nuclear-Test-Ban Treaty (CTBT), despite widespread support, has not entered into force due to the non-ratification by eight states, including the United States, China, India, and Pakistan. This undermines the global norm against nuclear testing and leaves the International Monitoring System (IMS) without full authority to conduct on-site inspections.

Limited Enforcement Mechanisms

Enforcement across all regimes relies heavily on the political will of member states and lacks binding punitive tools. The repeated use of chemical weapons by Syria and the geopolitical shielding it receives from Russia highlight the failure of enforcement. Similarly, North Korea's withdrawal from the NPT and subsequent nuclear tests exposed critical weaknesses in compliance mechanisms.

Geopolitical Deadlocks

Great power rivalries have paralyzed crucial disarmament and non-proliferation forums including the Conference on Disarmament. The consensus-based decision-making model enables any single state to block progress, resulting in decades of stagnation, as seen in the failure to advance negotiations on the Fissile Material Cut-Off Treaty (FMCT).

Countering Non-State Actors and Terrorism

Traditional non-proliferation frameworks are predominantly state-centric and are ill-equipped to manage the growing threat posed by non-state actors. Terrorist organizations seeking to exploit nuclear, chemical, or biological materials represent a significant challenge. Although UNSCR 1540 was adopted to address this issue, many countries lack the legislative and technical capacity to implement its requirements effectively.

Technological Disruption

Advancements in fields including synthetic biology, artificial intelligence, additive manufacturing, and cyber warfare present new proliferation pathways. These technologies are often dual-use and rapidly evolving, making them difficult to monitor and regulate under existing treaty frameworks. The lag in updating legal instruments and verification protocols leaves critical gaps in global security.

Proliferation via Civilian and Commercial Channels

Globalised trade and open-source scientific collaboration have expanded access to sensitive materials and knowledge. The acquisition of dual-use technologies through commercial and academic channels poses a growing proliferation risk. Export control regimes, including the Wassenaar Arrangement and the Nuclear Suppliers Group, are often fragmented and inconsistently enforced, particularly in states with limited regulatory infrastructure.

Institutional Capacity Deficits

With limited funding and personnel, enforcement agencies, including the BWC's Implementation Support Unit (ISU) struggle to conduct outreach, verification support[26], and technical training. Comparatively, the IAEA and OPCW are better resourced, yet still face budgetary constraints that hinder comprehensive monitoring in volatile or less developed regions. Multilateral funding commitments remain inconsistent, reducing the operational resilience of the regimes.

These cross-cutting limitations demonstrate the urgent need for reforms to make non-proliferation regimes more equitable, responsive, and resilient. Integrated responses that bridge legal, scientific, and political domains are essential to reinforce the non-proliferation architecture against evolving 21st-century threats.

Indian Perspective on International Control Regimes

India's nuanced position within the global non-proliferation landscape reflects both strategic imperatives and a historical critique of discriminatory norms. As a non-signatory to the NPT and CTBT, India has maintained a consistent policy opposing unequal nuclear hierarchies that legitimise some arsenals while denying others. Yet, India has additionally demonstrated responsible nuclear stewardship by upholding a voluntary moratorium on nuclear testing, committing to a no-first-use doctrine and maintaining robust export control systems aligned with international regimes, including the MTCR and the Wassenaar Arrangement[27].

From an Indian standpoint, the exclusion from the NPT's framework, despite possessing a credible nuclear deterrent and a clean non-proliferation record, underscores the treaty's failure to adapt to geopolitical realities. The India-U.S. Civil Nuclear Agreement and India's waiver from the Nuclear Suppliers Group (NSG) are partial rectifications of this anomaly, but have not translated into full NSG membership or global acceptance within the regime's core. India's domestic legal and regulatory institutions, including the Atomic Energy Regulatory Board (AERB) and National Authority for Chemical Weapons Convention (NACWC), function in line with global non-proliferation goals, despite the country being outside certain formal treaty structures.

In the biological and chemical arenas, India is a party to both the CWC and BWC and actively engages in CBMs and bio-safety initiatives. However, India too faces challenges posed by dual-use technologies and must invest more in bio-surveillance, laboratory certification, and inter-agency coordination. The Indian strategic community increasingly recognises the threats posed by non-state actors acquiring WMD capabilities, especially in the context of regional instability and porous borders.

Overview of Governance Tools for CBRN and Non-Proliferation in India

India has established a range of tools and legal frameworks to govern its responsibilities concerning chemical, biological, radiological, and nuclear (CBRN) security[28]. These tools reflect the country's adherence to international conventions while outlining national deterrence, response and regulatory mechanisms.

Weapons of Mass Destruction and their Delivery Systems Act, 2005 This serves as the overarching legal mechanism prohibiting the development, production, stockpiling and transfer of chemical, biological, radiological and nuclear weapons, including financing and facilitation of such activities. The Act aligns closely with India's international commitments on non-proliferation. However, it lacks a designated oversight body and offers limited focus on prevention, mitigation and awareness initiatives, creating a gap in operational preparedness[28].

Radiological and Nuclear Governance Ecosystem Within radiological and nuclear governance, the Atomic Energy Act of 1962 forms the foundation, empowering the central government to regulate nuclear technology. Supporting rules such as the Atomic Energy (Radiation Protection) Rules, 1971 and Safe Disposal of Radioactive Wastes Rules, 1987 ensure the safe handling of nuclear material. The proposed Nuclear Safety Regulatory Authority (NSRA) Bill, 2011[29], seeks to establish an independent authority, replacing the current Atomic Energy Regulatory Board (AERB). Though the system is well-governed overall, gaps remain, including the absence of early warning systems (EWS) and insufficient cyber security for nuclear material databases.

India's Nuclear Doctrine India's nuclear doctrine, centred on a 'No First Use' policy and massive retaliation, prioritises credible minimum deterrence. While this approach has strategic merit, its ambiguity about what constitutes a 'massive' attack and lack of proportional or escalatory response options reduces its flexibility. Additionally, the doctrine remains siloed from conventional military operations, limiting strategic integration[30].

Chemical Weapons Governance For chemical weapons governance, the Chemical Weapons Convention Act of 2000[31] enshrines India's international commitments into domestic law. It mandates destruction of chemical stockpiles and outlines roles for various national authorities. While the framework is comprehensive, it is technologically outdated and lacks provisions to counter advancements in low-cost chemical synthesis or non-traditional chemical threats.

Chemical Detection and Management Systems India has deployed a range of chemical detection and decontamination tools, utilized by both military and civilian agencies. Nonetheless, outdated equipment and inadequate mass decontamination capabilities during emergencies persist as significant vulnerabilities. Although the National Action Plan on Chemical Industrial Disaster Management (NAP-CIDM) offers a response framework, it has yet to be implemented uniformly across all states.

Biological Weapons Policy Regime On the biological front, India is a signatory to the Biological Weapons Convention (BWC), committing to the prohibition of biological weapons. Despite this, the country lacks a singular, overarching bio-security and bio-safety policy. Governance is instead distributed across multiple frameworks and institutions. Detection systems are in place and are connected to public health surveillance networks however, field availability and accessibility of bio-detectors remain limited[28]. This contributes to weak integration at the primary healthcare level, despite attempts to address this via the Integrated Disease Surveillance Project (IDSP).

In conclusion, while India's CBRN governance architecture is robust in terms of legal frameworks and treaty adherence, it requires significant enhancements in technology integration, coordination, and policy clarity. Addressing these gaps through an overarching national CBRN strategy would streamline responsibilities, increase inter-agency efficiency and improve readiness against emerging and non-conventional threats.

Policy recommendations for Indian CBRN Governance

Technological Advancements and Modernisation

The rapidly evolving nature of CBRN threats demands continuous investment in advanced detection, diagnostics and response technologies. This includes multi-spectral imaging, AI-powered analytics, portable diagnostic devices and autonomous robotics. These tools can provide early warnings, improve situational awareness and enhance the speed and accuracy of response operations.

Given the dual-use nature of emerging technologies, particularly in synthetic biology and AI, India must additionally bolster its cybersecurity infrastructure and industrial resilience. Regular upgrades to CBRN technologies should be supported by dedicated funding and indigenous innovation should be incentivised through robust public-private partnerships.

Strengthening Coordination and Unified Command Structures

A robust CBRN deterrence and response framework requires seamless coordination among various stakeholders, including the military, law enforcement, emergency services and public health agencies. While organisations like the National and State Disaster Response Forces (NDRF and SDRF), the National Disaster Management Authority (NDMA) and the Central Industrial Security Force (CISF) participate in joint exercises, the inclusion of local police, civil defence, and healthcare professionals is critical to ensure effective, on-ground responsiveness.

To this end, India should institutionalise standard operating procedures (SOPs) and develop integrated communication platforms for real-time data sharing and joint decision-making. Regular multi-agency drills and tabletop exercises will ensure that all actors understand their roles and can function cohesively during emergencies especially in peacetime incidents or events occurring in civilian areas.

Deepening International Collaboration

India has consistently championed non-proliferation and disarmament through its participation in global forums including the United Nations, the Conference on Disarmament and the Non-Aligned Movement (NAM).

To enhance this international engagement, India should leverage emerging alliances including the Quad and pursue the establishment of a regional cooperative framework in Southeast Asia. This could involve intelligence sharing, joint research projects and harmonised CBRN regulations. Collaborating with allies and international organisations will ensure coordinated responses to CBRN incidents especially those perpetrated by non-state actors and promote a unified regional security architecture.

Promoting Public Awareness and Community Preparedness

Public education and awareness are indispensable elements of a resilient CBRN defence strategy. Governments should introduce comprehensive outreach programmes to educate citizens on CBRN risks and emergency responses. These efforts could include school curricula integration, local workshops for law enforcement and healthcare professionals and tailored community specific campaigns addressing regional vulnerabilities.

Boosting R&D and Innovation Ecosystems

Sustained investment in research and development is crucial to anticipating and mitigating future CBRN threats. Priority areas should include synthetic biology, nanotechnology, and advanced sensor technologies, all of which have transformative potential in detection and response mechanisms.

Public-private partnerships may assist in bridge the gap between laboratory research and operational deployment, ensuring timely integration of cutting-edge innovations into national defence capabilities. These initiatives should be aligned with India's broader science and technology roadmap to maximise synergy.

Fostering Self-Reliance in Chemical and Biological Detection and Management Systems

India must prioritise indigenous development of chemical and biological detection, diagnostics, decontamination and protective systems to enhance preparedness and reduce import dependence. This includes early-warning platforms, bio-surveillance tools, PPE and portable detection units for civil and military use.

Leveraging *Make in India* and *Atmanirbhar Bharat*, targeted investments should support domestic manufacturing, resilient supply chains and innovation through biotechnology hubs and defence R&D. Deploying indigenous testing kits, decontamination units and biosensors will enable rapid, decentralised response.

Integrating these capabilities with national health and disaster frameworks is essential for long-term sustainability and operational readiness.

Conclusion

The accelerating pace of technological diffusion, the rise of decentralised actors and shifting strategic paradigms necessitate a fundamental reassessment of the global non-proliferation architecture. Treaties such as the NPT, BWC and CWC retain value through credibility and adaptability, yet their premise of state-centric WMD control is undermined by dual-use innovation and empowered non-state entities. The international community must therefore modernise verification mechanisms, democratise treaty structures and cultivate partnerships that include industry, academia and civil society.

India exemplifies the balance between strategic autonomy and global engagement. To effectively address emerging challenges, India must strengthen inter-agency coordination through a unified nodal authority and scale up indigenous R&D under *Make in India* and *Atmanirbhar Bharat* to achieve technological self-reliance.

By aligning political will, institutional innovation and scientific endeavour, India and the wider international community can ensure that non-proliferation remains a living, dynamic bulwark of international peace and security.

1 A Descriptive Analysis of the Use of Chemical, Biological, Radiological, and Nuclear Weapons by Violent Non-State Actors and the Modern-Day Environment of Threat. Prehosp Disaster Med. 2023 Jun by Tin D, Cheng L, Shin H, Hata R, Granholm F, Braitberg G, Ciottone G https://www.cambridge.org/core/journals

2 Report on 640 Victims of the Tokyo Subway Sarin Attack by Tetsu Okumura and others,Annals of Emergency Medicine https://www.sciencedirect.com/science article

3 Preventing Catastrophic Terrorism by RaymondLindsay https://researchcentre.army.gov.au/library

4 Arms Control and Nonproliferation: A Catalog of Treaties and Agreements. (2025, June 21). https://sgp.fas.org/crs

5 https://www.opcw.org/media-centre/news/2023

6 The 1540 Nonproliferation Regime and United Nations Security Council Resolution 2663 (2022): What's Been Achieved and What Lies Ahead by Scott Spence https://strategictraderesearch.org

7 What lessons can we learn from the Japanese sarin attacks? Vale A. https://pubmed.ncbi.nlm.nih.gov

8 Anthrax bioterrorism: lessons learned and future directions by Hughes JM, Gerberding JL. https://pmc.ncbi.nlm.nih.gov/articles

9 The Islamic Republic and its Axis of Resistance's Chemical Weapons Threat by Mohammadreza Giveh and David Albright https://isis-reports

10 Ricin Plot: A New Threshold in Jihadi Bio Terror by Florian Flade https://ctc.westpoint.edu/june-2018-cologne attk

11 Emerging Technologies in the Development and Delivery of CBRN Threats by Shravishtha Ajaykumar https://www.orfonline.org/research

12 Off the Shelf: The Violent Nonstate Actor Drone Threat by Kerry Chávez , Dr. Ori Swed https://www.airuniversity.af.edu

13 Success and failures of the Non-Proliferation Treaty demonstrated in history by A. Windt https://inis.iaea.org/records

14 Nuclear Disarmament South Africa Fact Sheet https://www.nti.org/analysis

15 Was Libyan WMD Disarmament a Significant Success for Nonproliferation? Report by Sammy Salama https://www.nti.org/analysis

16 North Korea's Withdrawal From the NPT: A Reality Check by Jean du Preez and William Potter https://nonproliferation.org/north-koreas-withdrawal

17 Treaty on the Prohibition of Nuclear Weapons Fact Sheet https://www.nti.org

18 https://www.opcw.org/media-centre/news

19 The Chemical Weapons Convention Is Stronger Than You Think By Stefano Costanzi https://www.armscontrol.org

20 https://www.opcw.org/about-us/nobel-peace-prize

21 The CWC at 25: from verification of chemical-weapons destruction to attribution of their use by Kelle, A.www.tandfonline.com/doi/epdf

22 Addressing misconceptions about biological and chemical weapons and related legal frameworks https://www.vertic.org

23 The BWC Protocol: Manadate For Failure by Kenneth.D.Wardhttps://www.nonproliferation.org

24 Problems and Prospects of Non-Proliferation Regime by Dr. Sadaf Farooq https://thesvi.org

25 The Biological Weapons Convention (BWC) At A Glance https://www.armscontrol.org/factsheets

26 International Law and the Proliferation of Weapons of Mass Destruction, Chapter 2 by Daniel Joyner https://scholarship.law

27 India and non-proliferation export control regimes by Rakesh Sood https://www.orfonline.org/research

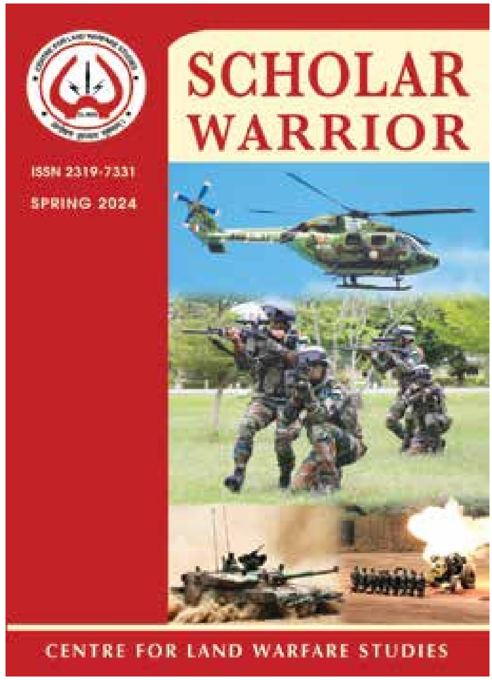
28 Strengthening CBRN Security in India: Domestic Strategies and Global Collaborations by Shravishtha Ajaykumar https://www.orfonline.org/research

29 Nuclear Safety Regulatory Authority Bill https://indianexpress.com/article

30 India's Nuclear Doctrine: The Basis For Credible Deterrence by Manpreet Sethi https://capsindia.org

31 Handbook On Chemical Weapons Convention For Indian Chemical Industry And Chemical Traders https://chemicals.gov.in

SUBSCRIBE NOW



SUBSCRIPTION RATES

IN INDIA
☐ Rs.500/- per copy

☐ Rs.1000/- Annual Subscription (2 issues)

SAARC COUNTRIES
☐ US $ 15 per copy

OTHER COUNTRIES
☐ US $ 20 per copy

TO SUBSCRIBE SEND YOUR REQUEST TO

Centre for Land Warfare Studies (CLAWS)
RPSO Complex, Parade Road, Delhi Cantt, New Delhi - 110010
Tel: +91-11-25691308
• Fax: +91-11-25692347 • Army: 33098
E-mail: landwarfare@gmail.com
www.claws.co.in

The article reviews the global non-proliferation framework for weapons of mass destruction, identifying key weaknesses such as poor enforcement, limited verification, especially for biological weapons and challenges from emerging technologies and non-state actors. It also examines India's approach to CBRN security and calls for a unified national strategy. The article recommends revitalising disarmament, enhancing verification, and promoting inclusive global governance. It concludes that the regime's future success depends on greater transparency, adaptability, and international cooperation.

• • •

Major General KTG Krishnan, SM, VSM, is a PhD scholar at Amity Institute of Defence and Strategic Studies and is presently commanding a Division in the Indian Army. He has extensive operational experience in all terrains.

Colonel (Dr) Rajan Bakshi is a former military officer and currently holds the position of Director at the Amity Centre for Defence and Strategic Analysis. He is also an Associate Professor at the Amity Institute of Defence and Strategic Studies. His academic and professional expertise encompasses nuclear policy, international relations, and India's security challenges.

The Centre for Land Warfare Studies (CLAWS), New Delhi, is an independent Think Tank dealing with contemporary issues of national security and conceptual aspects of land warfare, including conventional & sub-conventional conflicts and terrorism. CLAWS conducts research that is futuristic in outlook and policy oriented in approach.

CLAWS Vision: To be a premier think tank, to shape strategic thought, foster innovation, and offer actionable insights in the fields of land warfare and conflict resolution.

CLAWS Mission: Our contributors aim to significantly enhance national security, defence policy formulation, professional military education, and promote the attainment of enduring peace.

Website: www.claws.co.in Contact us: landwarfare@gmail.com

SABRE & QUILL

MRP: ₹ 100.00 US$ 5.00