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Mine Warfare:
A Vital Tool
for India's
Deterrence
Strategy Along
the Northern Border

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Abstract

Mine warfare, since the World Wars, became an integral component of military war fighting strategy, and the recent conflict between Russia and Ukraine has once again highlighted its significance. In the initial stages of the Russian invasion, the Ukrainian Armed Forces effectively used landmines, resulting in significant delays and destruction. The Indian Army must analyse this and reassess its approach to mine warfare for potential future conflicts along the Northern Border. Currently, within the Indian Army, mine warfare is viewed primarily as a tool for counter-mobility, rather than as a comprehensive aspect of military strategy against a specific adversary. It is crucial for the Indian Army to refine its mine warfare approach to align it more closely with the overarching military strategy of deterrence along the Northern Border.

Keywords: Dissuasive Deterrence, Mine Warfare Approach, Fractional Exchange Ratio, Entanglement, Disrupting Force Ratio, Technology Infusion

You can no longer do anything with just a tank and some armour, because mine fields are too deep, and sooner or later, it will be stop, and then destroyed by concentrated fire.

— Chief Gen Valery Zaluzhny, Former Cdr-in-Chief, Ukraine Armed Forces
(Khurshudyan, I. and Hrabchuk, K., 2023)

Historical Background

Mine warfare was first employed to make a tunnel or breach underneath fortification of the enemy— either to collapse the building or to create a discrete passage. Due to technological advancement especially in the field of explosives, the focus of mine warfare shifted to resisting troops, vehicles and tanks. Both the World Wars witnessed extensive employment of mines. In July 1943, amid the Battle of Kursk, recognised as the largest armoured conflict in history, the Germans suffered the loss of an entire armoured division due to Russian (then Soviet Union) minefields— approximately 805 German tanks, constituting 50% of their tanks, were destroyed by mines and associated direct/ indirect fires during this battle (Crandley, F. et. al, 2002). Mine warfare since the World Wars has become an inseparable part of military war fighting concepts.

Mines continued to be employed in almost all the conflicts including the Six Days Arab - Israel war 1967, Yom Kippur War 1973, Gulf War 1990s and the recent Russia – Ukraine conflict. This itself is the testimony to the fact that, there is hardly any conflict which has not witnessed the employment of mines. As war fighting is graduating from manoeuvre warfare to multi-domain operations, characterised to be fast paced and violent, it is essential to have the desired counter mobile capability in land domain through land mine warfare as it cannot be substituted by any other fires.

Relevance of Land Mine Warfare in Present Battle Field Milieu

Land mine is an area weapon that serves to enhance the defensive aspect in both defensive and offensive operations. It has got unique capabilities of access denial, delay, disrupt and degrade. In addition, it can play an important role in destruction of enemy in coordination with other operational fires as also influences the cognitive domain coupled with far reaching effects in breaking the enemy's will to fight than any other weapon in the inventory.

The Russia - Ukraine conflict has once more underscored the importance of mine warfare. Ukrainian armed forces, effectively employed landmines, particularly the UMZ mine-layer of Soviet origin, during the initial Russian invasion in February-March 2022. This proved to be quite effective for Ukraine as it caused heavy losses and contributed to the restriction of Russian onslaught during the initial phase of war (Goldstein, L. and Waechter, N., 2023). On the other hand, Russia, post capture of partial territory of eastern region of Ukraine enhanced its defences by employing extensive mine fields thereby blunting Ukraine's counter offensive by adopting tactics of immobilising armoured vehicles inside minefields and thereafter destroying them by other operational fires including anti-tank missiles and attack helicopters.

As an application of operational philosophy, Russian forces have deployed extensive minefields featuring multiple initiation mechanisms, thus complicating breaching operations. The integration of defences with minefields posed a significant tactical challenge for Ukrainian offensive operations (Watling, J. and Reynolds, N., 2023). The Chief Intelligence Director of Ukrainian Defence Ministry, Kyrylo Budanov, stated in an interview that the number of armoured vehicles used in the battlefield has significantly fallen on nearly all key fronts because of anti-tank mine fields and First Person View (FPV) kamikaze drones, capable of wreaking havoc on expensive equipment (Lingana, G., 2023). Ukraine sees Russia's formidable mine fields as "insane" to navigate with as many as five mines per sqm (Porter, T., 2023) which is on a higher side. The use of such high density mine fields by Russian forces is

the testimony to the fact that land mine warfare is still very relevant in the present battlefield milieu.

Analysis of Mine Warfare by China: Taiwan Contingency

China has carried out a thorough analysis of land mine warfare of Russia-Ukraine Conflict and implemented the lessons in the action plan of Taiwan contingency (Goldstein, L. and Waechter, N., 2023). A gist of the analysis by China is as enumerated below:

- Mine Warfare: Still Relevant for static and manoeuvre warfare
- Mines played most vital role in stymieing the counter offensive of Ukraine
- Mine warfare will create difficulties in rapid manoeuvre warfare
- Mine Warfare: Concern for Taiwan invasion
- Taiwan may not use mine warfare extensively
- Taiwan has capability to lay extensive mine or procure equipment for rapid mine laying
- People's Liberation Army (PLA) to invest heavily in mine detection and clearance
- PLA to develop mine clearance unarmed aerial vehicles (UAV)
- PLA to invest in airborne/ helicopter capabilities to leapfrog mine fields
- PLA to adopt every possible measure to avoid static warfare

China's analysis of mine warfare in the backdrop of Taiwan contingency is nowhere related to India-China context but it reflects the fact that China acknowledges mine warfare, as an operational philosophy and is abreast with its effect on war fighting and the overall impact on achieving its military objectives. The Indian Army thus must take cognizance of the same and work on its mine warfare approach accordingly.

Indian Army's Present Approach to Land Mine Warfare

Mine warfare approach of the Indian Army is focussed and aimed mainly towards its western adversary. The Indian Army has laid extensive mine fields during 1947, 1965 ,1971 war and during Operation Parakram. On the other hand, the army has laid limited mine fields during 1962 war against China. Mine laying by the Indian Army is heavily manpower and time intensive and calls for technological advancements to effectively address emerging threats in the future.

Integrating natural and man-made obstacles with mine fields is one of the basic tenets of Indian Army's mine laying techniques, to enhance the obstacle's potential and increase the

complexities impacting mobility. Mine warfare in Indian Army's context is perceived simply as a 'counter mobility tool' rather than an 'overall part of military strategy against a specific adversary'. Despite having two distinct adversaries and two distinct strategies i.e. Punitive Deterrence for Western Adversary and Dissuasive Deterrence for Northern Adversary (Shivane, AB., 2021), the army's mine warfare approach remains the same and is not completely aligned to India's military strategy towards its now primary adversary at the Northern Border.

Need for Change

The Indian Army's mine warfare approach of 'one template fits all' may not be apt in case of its Northern adversary and it is prudent to completely align the mine warfare policy with India's overall military strategy, especially after the Galwan crisis. Attributes that suggest a de-novo look at mine warfare strategy for our northern boundary are as enumerated below:-

- ***Change in Operational Environment along the Northern Border.*** The Galwan faceoff has drastically changed the security and threat dynamics along the northern border and to an extent contributed to the prolonged round-the-clock deployment of troops under constant shadow of conflict. Hence, it is imperative to identify capability and capacity gaps and evolve a mine warfare strategy aligned to handle our northern adversary.
- ***Legacy of Claim Lines.*** Unlike the Western front where the international boundary (less PoJ&K) is defined, delineated and demarcated, the ultimate boundary solution at northern boundary is pending (Pandey, U., 2020) (except few areas) and has major implication in preparation of own defences and integrating mine fields to enhance the defensive architecture.
- ***Terrain.*** Terrain and weather conditions are extremely rugged and challenging which poses great difficulties to mine warfare as compared to the western front.
- ***Obstacle Systems.*** Due to legacy of unresolved border and military strategy, till recent years, there is comparatively less defensive infrastructure and obstacle system to counter the manoeuvre warfare of PLA. The northern border lacks planned manmade obstacle system in terms of ditch-cum-bund, defensive canal and anti-tank ditches compared to the western border and hence, in case of an all-out conflict, India will need to rely greatly on mine warfare.

- ***Time Criticality for Responsive and Reactive Mine Laying.*** The army's defence preparation, strategy and intelligence, surveillance, target acquisition and reconnaissance (ISR) at the western front provides adequate time for responsive and reactive mine laying ,hence there is heavy reliance on the same. However, same approach towards the northern front may not be prudent.
- ***Indian Army's Norther Border Strategy.*** Presently, India follows a strategy of Dissuasive Deterrence towards its northern adversary and is in the process of transforming it to Credible Deterrence. The same is difficult to achieve unless the army has robust defensive and offensive capability to deter the PLA in achieving its desired military objective. Mine warfare has proven itself again and again as a vital tool of deterrence and must be developed differently, based on the overall military strategy rather than applying a common template.
- ***Adversary's Capabilities.*** Capabilities of the northern adversary has increased manifold and its rise is likely to continue. In order to counter a more technological advanced adversary, the Indian Army needs to adopt a far more advanced mine laying approach.

Table 1: Analysis of Factors of the Northern Adversary

Attributes	Impact	Pre-requisite
Change in Operational Environment	Activation of dormant northern border	Change in approach to mine warfare
Legacy of Claim Lines	No viable forward zone or Fighting at Limit of Penetration	Rapid mine laying capability
Terrain	Difficulty in mine laying and time penalty	Technology suited for High Altitude Areas with emphasis on mechanical/ remotely delivered means
Lack of Obstacle System	Inadequate counter mobility capability and heavy reliance on mine warfare	Pre-emptive mine laying with initiation control
Time Criticality for Responsive and Reactive Mine Laying	Inadequate defence preparation and large gaps	Aerial delivery means/ Remotely Delivered Mine Laying System (RDMS)

Indian Army's Northern Border Strategy	Requirement of credible defences/obstacle systems	Mine warfare to delay, degrade and later destroy by direct or indirect operational fires
Adversary's Capability	Technological advanced adversary with an intent to avoid contact and static warfare	Advance mine warfare to include activation control mine, mine UAVs and self-destructing mines.

Source: Compiled by Author

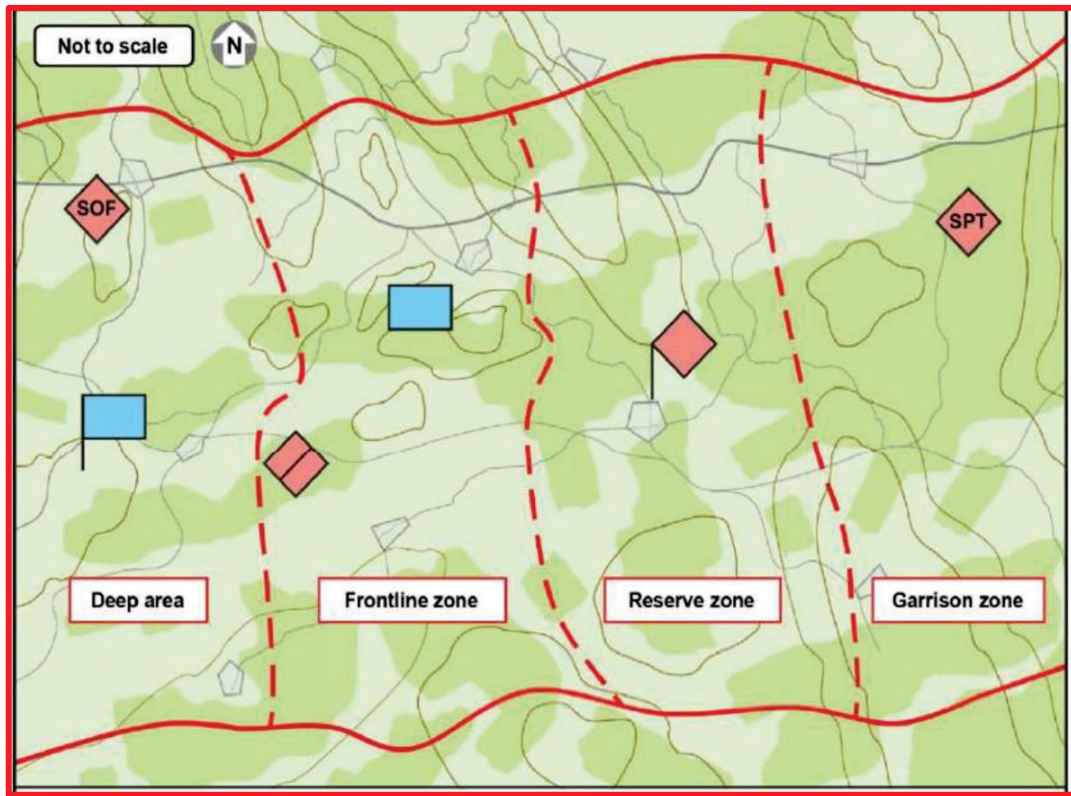
Adversary's War Fighting Concept and Capabilities

PLA has carried out CABisation or Mechnisation of its armed forces. Combined Armed Brigades (CABs) are the primary fighting force and as per its war fighting concept, CABs will execute rapid manoeuvre and leap frogging of obstacle/ enemy's defence or forces to achieve decisive victory during limited war under condition of intelligentisation. Large part of Eastern Ladakh and North Sikkim provides the opportunity for PLA to execute its manoeuvre warfare. PLA doctrine is designed to defeat, suppress or neutralise enemy's manoeuvre force before close contact. Appreciating that, close contact operations are inevitable; PLA's operational approach for close combat mainly consists of three steps (Haider, SF. et al, 2020).

- **Getting Close to Enemy** by capitalising on weather, geography and degrading enemy's ISR and through flexible deception.
- **Entanglement** or the close quarter battle, which PLA considers as the biggest risk and is of great concern. PLA at any cost likes to avoid the same through various engagements and multiprong attacks. The Indian Army needs to exploit this situation to degrade and destroy the PLA through mine warfare and integrate it with direct and indirect operational fires.
- **Annihilation and Destruction** through concentration at enemy's weak points. Hence, the army can attack these weak points by using mine warfare as means of force preservation.
- **PLA's Operational Frame Work for offensive Operations (US DoD)** divides the battle area into four zones. 'Deep Area' which is beyond integral resources of CAB and approx. 35-40 km deep; 'Frontline Area' in accordance to enemy's main defence line; 'Reserve Zone' which initially houses deep attack groups,

command groups, fire power groups and support groups; and ‘Garrison Zone’ which houses logistics, electronic warfare systems and long-range artillery.

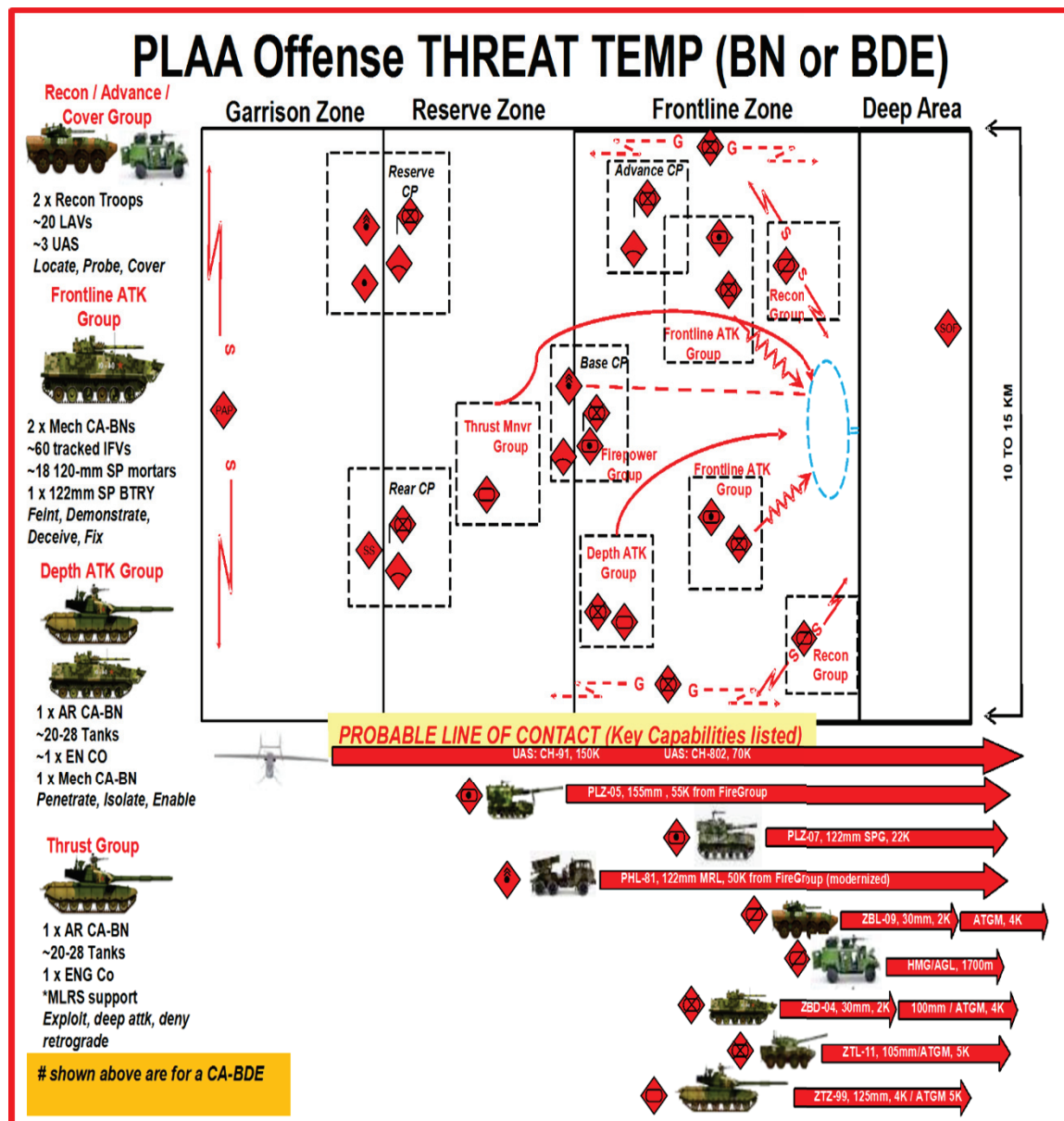
Figure 1: PLAA Offensive Zone (Conceptual)



Source: US Army ATP 7-100.3

- PLA offensive threat template (US DoD)** indicates a 4:1 advantage force ratio for manoeuvre forces, 5:1 to 7:1 for artillery and three anti-tank system for one enemy's tank respectively. Advance group provides security to main body, screen and counter reconnoitre actions. Frontline attack group conducts initial attack, breaching and penetration, while Deep attack group advances deep and seize critical terrain. Thrust manoeuvre group is an exploitation force seeking to isolate and conduct pursuit and finally, Combat reserve group which has anti-tank and engineer's capabilities and therefore can reinforce any group.

Figure 2: PLA Offensive Threat Template

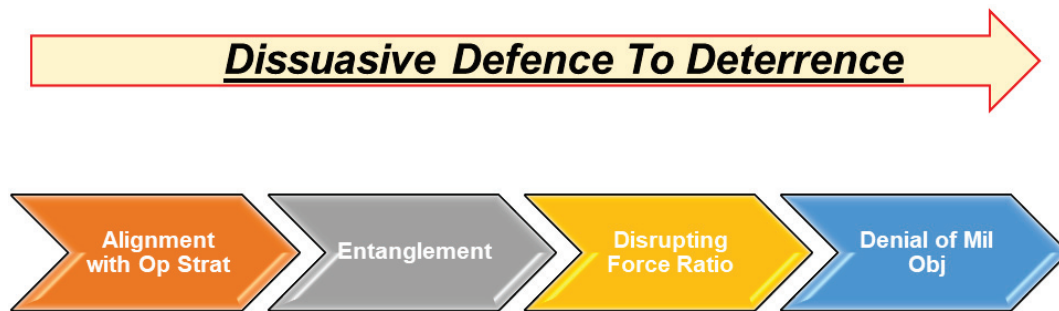


Source: US Army ATP 7-100.3

Proposed Land Mine Warfare Approach of the Indian Army

Present mine warfare approach of the Indian Army needs to be evolved to meet the requirements of immediate threat and future conflicts at the northern border. However, there are large capability gaps which needs to be addressed on priority at a rapid pace. Mine warfare approach must cater for the pre-requisites posed by the implications/impacts of the factors concerning northern border and must exploit the weakness in the PLA's offensive threat template and framework. Proposed approach is as enumerated:-

Figure 3: Proposed Mine Warfare Approach

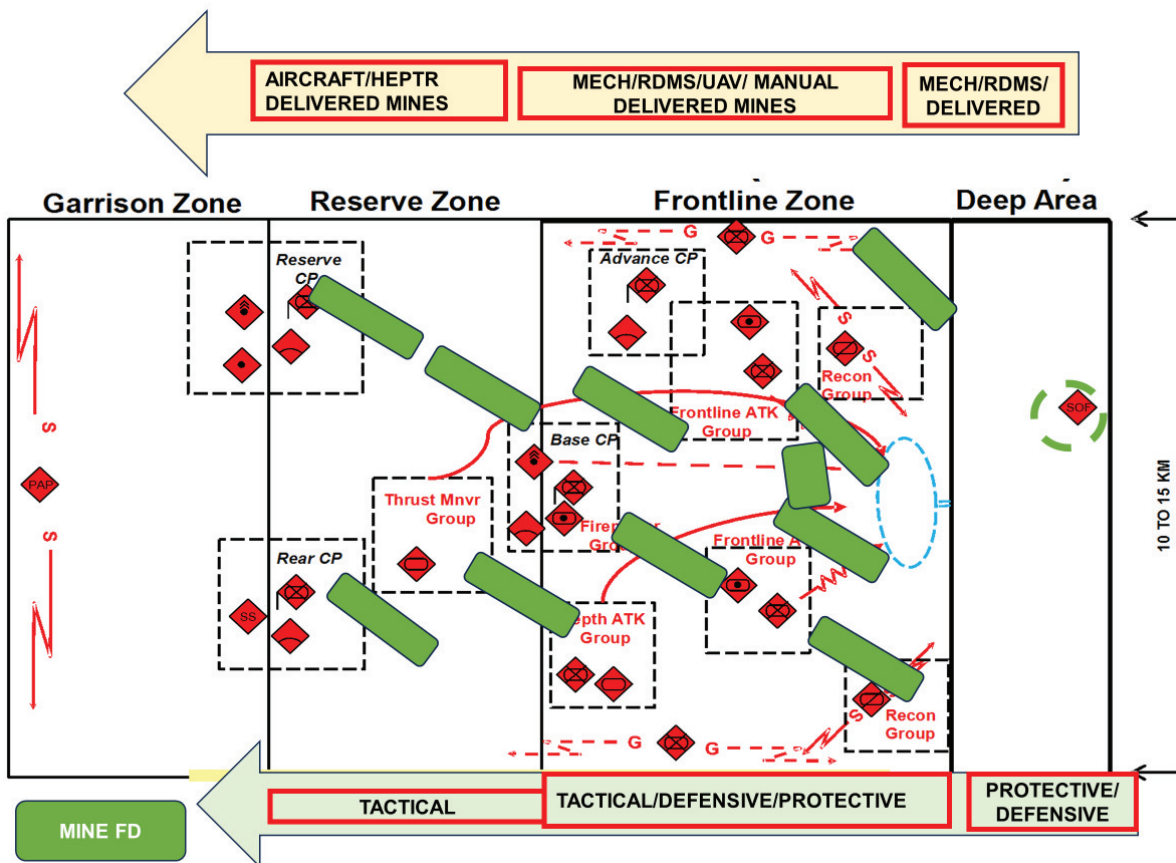


Source: Prepared by the Author

- Alignment with the Operation Strategy.** In order to pursue strategy of dissuasive defence, the army must develop capability for effect based mine laying at a very rapid rate. To provide ‘formidable defensibility’, cover large frontage with limited forward zone devoid of obstacle system at large portion of the northern boundary existing mine warfare capability which is heavily manpower intensive is not prudent.ⁱ Hence, mine laying capabilities needs to be aligned to lay effect based rapid mine fields through mechanical means, RDMS, aerial means, mine UAVs, helicopters and aircrafts based dispensing systems. Large portion of the northern border is uninhabited and barren, hence in order to overcome for less/limited mine laying time available during conflict, mine fields with activation control needs to be inducted and laid well in advance.
- Entanglement.** PLA war fighting concept considers entanglement or close quarter battle as most dangerous and prefers to avoid/ limit the same to the extent possible. The Indian Army hence, must exploit this weakness or apprehension of the PLA. Land mines are the most suitable weapon, which can create conditions not desirable for PLA and can contribute immensely in delay, degrade and disruption of enemy’s capabilities and forces. In order to entangle the PLA through mine warfare, the Indian Army must develop capabilities to lay mine fields in all zones of battle field and at any time during conflict.

ⁱ To pursue strategy of dissuasive defence, the Indian Army must create formidable defences and obstacle belt through modern and advanced mine warfare over a large frontage in a short period of time where very limited forward zone is available. The present Indian Army mine warfare, capability which is more manpower intensive, with moderate/old technology is not prudent to provide formidable obstacle belt in short time frame, thereby mine warfare needs to be aligned to the present adopted operational strategy.

Figure 4: Employment of Mine Warfare

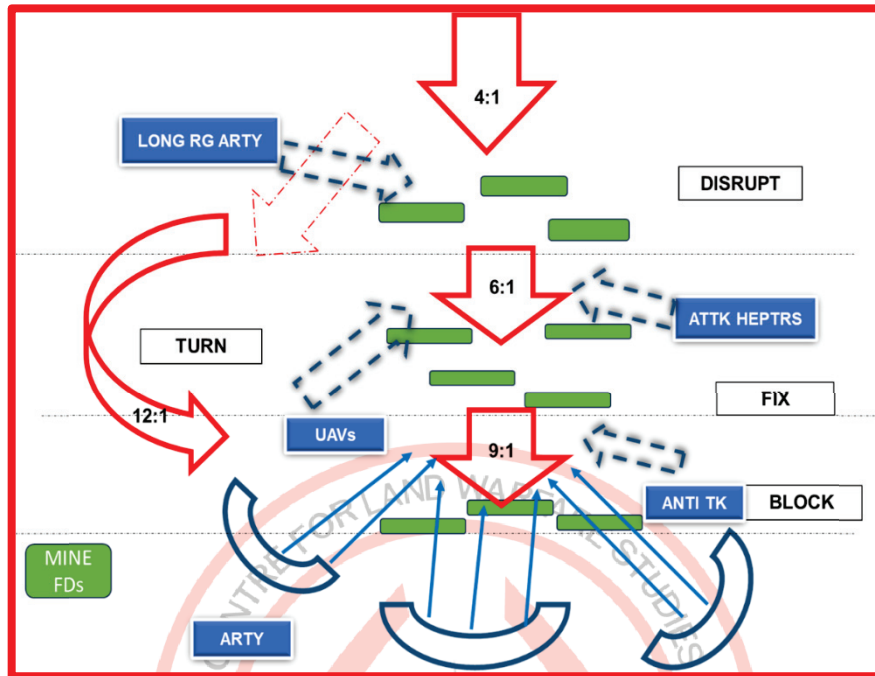


Source: Author's Visualisation & US Army ATP 7-100.3

- **Disrupting Force Ratio.** A critical measure of degree of success in close quarter engagements is the **Fractional Exchange Ratio [FER]** (Crandley, F. et. Al, 2002). It is the ratio of percentage of loss of attacking forces vs percentage loss of defending forces. If FER is one, then both sides are losing forces at the same rate. If it is above, one then attacker is losing forces at a faster rate resulting in success to the defender. PLA, as per its offensive template, subscribes to 4:1 ratio of manoeuvre force and 9:1 ratio of artillery to seek favourable FER (**US DoD**). In order to defend, deter and impose heavy casualties and cost on the adversary, the Indian Army must disrupt the force ratio and achieve FER in its favour. Mine warfare should be adopted in the manner wherein mine fields would contribute in force preservation of the Indian Army and destroy enemy's forces— hence there is a need to enhance mine field density. Laying of mine fields rapidly even at the face of enemy to disrupt, block, fix and turn will force him to commit more forces or lead to losses unless force ratios are enhanced. One of the lessons from the Russian-Ukraine war is the use of very high density of mines. The

application of existing template in northern boundary scenario may therefore not be prudent.

Figure 5: Enhancement of Fractional Exchange Ratio



Source: Prepared by the Author

- Denial of Military Objectives.** Denial of critical space, which is required for deep attack, and thrust manoeuvre group for conduct of decisive operations can be achieved through mine warfare. Mine warfare can act as force multiplier with integration of operational fires of other arms and air force which will not only degrade, disrupt and destroy enemy's capabilities but will also lead to protracted war that will eventually result in denial of military objectives.

Way Forward

- Conceptual and Doctrinal Change in Mine Warfare.** The Indian Army needs to recognise the need for conceptual and doctrinal change in mine warfare approach, and its successful application to execute the overall strategy of Dissuasive Defence along the northern border. The mine warfare template of Western front — designed for a weaker adversary, is not suitable for the northern border with a stronger adversary. Hence, there is a need to develop new mine warfare philosophy/ strategy for the northern boundary comprising of *Rapid Mine Laying capabilities, remote delivery, high*

density mine fields and ab-initio laying of mine fields with activation control. Moreover, re-consideration of percentage of initial laying vs responsive/reactive mine fields is also imperative.

- ***Employment of Mine Warfare (DoD, 2018).*** In the envisaged conceptual and doctrinal evolution, mine warfare is to be employed across all levels of war fighting as mentioned below: -
 - **Strategic.** Defensive mine laying/ mine employment is a vital tool of deterrence without showcasing offensive intent and escalation of the situation thereby demonstrating resolve of thwarting any military aggression. Post commencement of hostilities, it is imperative to employ offensive tactics involving aerial deployment of scatterable mines covered by direct/ indirect fires of air force/ artillery/ attack helicopters, to impede or restrict the strategic mobility and sustainability of the adversary.
 - **Operational.** Minefield employment at this level is to preserve own forces as well as to protect lines of communications (LOCs), vital command & control centres and free manoeuvre forces for offensive operations. The main focus of mine warfare at this level is to prevent or restrict enemy manoeuvre and facilitate own manoeuvre.
 - **Tactical.** Employment of mine warfare at the tactical level is more defensive in nature to protect own forces and facilitate concentration of direct or indirect fires to entangle the enemy thereby delay, degrade and destruct.
- ***Capacity and Capability Development.*** There is a huge gap in capacity and capability development which needs to be covered at the earliest. The capability gap can be highlighted by the fact that the New Family of Mines (NFM)—the main arsenal of mine warfare is in the process of either design/ development or production by Defence Research and Development Organisation (DRDO). This project is already delayed by decades despite the efforts of MoD and DRDO (CAG Audit Report, 2011-2012). Concerned agencies must bear the responsibility for reducing the Indian Army mine warfare capability gap that occurred due to prolong delay in developing present and futuristic mine warfare capabilities and accordingly fast track the projects. The Army's present mine warfare is not technologically advanced as compared to best armies of the world and presently is inadequate to cater for futuristic challenges at the northern border.

- Technology Infusion.** All recent conflicts have witnessed infusion of new technologies. Even mine warfare has seen a quantum jump in technology upgradation wherein countries are using mine-laying vehicles with satellite navigation linked to an automated control system, while the Indian Army is still developing old technologies to include persistence and victim/target initiated land mines. The existing focus is still on manual laying or newly developed mine burrier (DRDO) rather than remote and aerial delivery system. To cater for future challenges, the army needs to focus on the following advanced mine laying technologies:-

Table 2: Proposed Modern Technologies

Technology	Illustration	Effect
Smart Mine	Russian POM-3 mines distinguish between soldiers and civilians.	Compliance with international law
Controlled Activation of Mine Fields	USA: Anti Personal Spider System	Control access to own forces - To overcome time criticality, can be laid during peace time
Directional/ Top Attack Anti-Tank Mines	Russian PTKM 1 R	- Smart/ intelligent mine - Rapid placement
Off Route/ Side Attack Mines	ARGES/ MACPED/ACEATM USA, UK, France & Germany	Increased Lethality
Wide Area Mines	US XM 93/M 93 Hornet	Cover large frontage in lesser no of mines
Self De-Activating/ Destruct Mines	XM 204 & XM 343,	Mines to self de-active/ destruct based on certain criterion
RDMS	Russian ISDM 8x8 truck e laying system - M139 volcano mine dispenser	Rapid placement of mines Laying during engagement possible - Large frontage

Technology	Illustration	Effect
Aerial Delivery of Mines (UAV, Helicopter Dispenser)	China likely to have developed the UAV based mine dispensing capability	- Rapid placement of mines - Large Frontage - Extn of zones
GPS Based Mine Recording	GPS & GIS based mine field recording system	- Ease in recording and de-mining - Access to own forces

Source: Author's Own

- **Procurement.** Presently, the Indian Army is on the right path of self-reliance and developing technologies and equipment through Indigenous Research & Development (IR&D). However, the capability gap in mine warfare is comparatively high and to cover the same in short period, a multi- prong approach including emergency acquisition through import via govt-to-govt agreements and transfer of technology basis is suggested.

Conclusion

Mine warfare is a multifaceted domain within military strategy that demands nuanced integration into broader operational concepts to realise its full potential as it cannot achieve desired result or end state by being a standalone strategy. Mine fields will always remain a threat due to their psychological impact and must be exploited to create a fear psychosis to break the will to fight. Mine warfare, as a tool of deterrence, extends beyond its immediate battlefield impact; its ability to cause heavy penalties in terms of casualties, logistical delays, disruption and denial of military objectives underscore its significance in strategic calculus. Therefore, a holistic perspective that integrates mine warfare into overarching military strategies is imperative for optimising its deterrent capabilities.

Everything that is shot or thrown at you or dropped on you in war is most unpleasant but of all horrible devices, the most terrifying. . . is the land mine.

—Sir William Slim, Unofficial History, 1959 (DoD, 2018)

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