India V Pakistan: The Next Nuclear Holocaust?

Taqiya Ehsan

1. Introduction

Pulitzer Prize-winning author Richard Rhodes describes the particular gray morning during the Great Depression in his book *The Making of the Atomic Bomb*, when a 35-year-old Leo Szilard was walking through the streets of London and the epiphany of the foundation of the nuclear bomb came to him. According to Rhodes, Szilard saw it as "a way to the future, death into the world and all our woe, the shape of things to come."[1] Szilard's inspiration was H.G. Wells' 1932 novel *The World Set Free*, where Wells prophesized the destruction of all major cities of the world by the deployment of "atomic bombs."[1] Together with Enrico Fermi and Herbert Anderson, Szilard was able to construct a system of water and uranium oxide to model the first self-sustaining chain reaction. He was instrumental in building Chicago Pile-1, the first neutron reactor that had self-sustaining nuclear chain reaction capabilities. In collaboration with Fermi, Szilard was also able to deduct how uranium could sustain the chain reactions and be an effective tool for the creation of nuclear weapons. [2] As early as 1939, Fermi had met with the U.S. Navy to discuss the use of such fissionable materials for military purposes. In 1942, Brigadier Leslie Grove led a project to assemble the greatest minds in science and collectively harness the power of the atom as a means to bring a decisive end to the ongoing World War II – this came to be known as the Manhattan Project. The Project took final form on July 16, 1945, at Alamogordo, New Mexico, where the first successful atomic bomb was tested under the supervision of Robert Oppenheimer.[26] The existence and catastrophic potential of weaponized atomic energy became ever so palpable in 1945, after the U.S. deployed atom bombs on Hiroshima and Nagasaki on August 6 and 9 respectively, decimating almost 90 percent of the cities, collectively killing 120,000 people instantly and tens of thousands more over the next several years from radiation exposure – this came to be noted as the first nuclear holocaust of the world. The acquiring and testing of nuclear materials and weapons, spearheaded during the second world war, dawned in a new era of not only progress in the field of nuclear physics but also the terror of a new kind of existential threat that could potentially wipe out all of humankind.

2. Nuclear Weapons Proliferation

The U.S. was the first nation to successfully test and detonate nuclear weapons in 1945. In the years since then, more or less all nations have tried to acquire nuclear materials and weaponize them with different levels of success. Russia (then the Soviet Union) was the second nation to successfully test nuclear weapons in 1949, followed closely by the UK in 1952 and France in 1960. China was the first Asian country to conduct a successful nuclear test in 1964, after years of research aided by the Soviet Union. Israel is speculated to have built its first operational nuclear weapon in 1966 with India launching its first nuclear test almost 8 years later, in 1974. Pakistan followed India's footsteps and tested its first nuclear weapon in 1998. The newest addition to this list is North Korea, conducting its first successful test in 2006. [27] These nine countries armed with nuclear weapons are dubbed the "Nuclear Club."

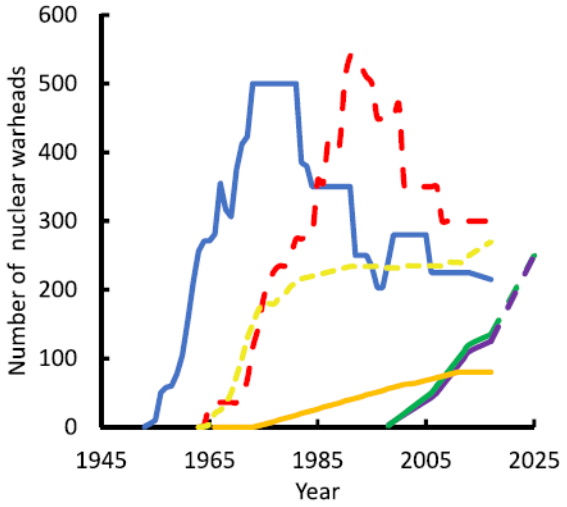

Figure 1: The number of warheads thought to be in the arsenals of Britain (blue), France (red dashed), China (yellow dashed), India (purple), Pakistan (green), and Israel (orange). North Korean weapons are not shown because it is uncertain whether they have an arsenal of useable weapons. [6]

Over the years, acquiring nuclear weapons has been perceived to be a potent political, military, and social tool; national ownership of nuclear weapons has come to be equated with international status and insurance against aggression at a diffident monetary cost. [3] This became even more apparent with the popularization of the concept of nuclear deterrence, especially during the Cold War (1947 – 1991). Governments of different nations now see the scope of deterrence from a major war that nuclear weapons can provide. George Lee Butler, commander in chief of the U.S. Strategic Command during 1992–94, stated that: "We escaped the Cold War without a nuclear holocaust by some combination of skill, luck, and divine intervention, and I suspect the latter in greatest proportion."[4] On the other side of nuclear deterrence, however, is nuclear tension that has existed between adversaries possessing nuclear weapons for years. The most concerning of these in recent times are India and Pakistan, with their long history of military clashes including

serious recent ones, lack of progress in resolving territorial issues, densely populated urban areas, and ongoing rapid expansion of respective nuclear arsenals.[5]

2.1 India-Pakistan Conflict

Figure 2: **Geographical location of Kashmir and the Line of Control.** [15]

India and Pakistan both came into being as independent nations in August 1947, when the British monarchs left the Indian subcontinent after almost 200 years of colonization. Ever since their inception, the two neighboring nations have been at loggerheads concerning different issues at different points of time. They have fought four conventional wars (1947, 1965, 1971, and 1999) and had many skirmishes with substantial loss of life since the partition in 1947. [6] However, the longest-lasting point of conflict for them has been Kashmir -- the northernmost geographical region of the Indian subcontinent that was asymmetrically divided between India and Pakistan during the partition. The Indian-administered parts include territories of Jammu & Kashmir, and Ladakh, and the Pakistani-administered parts include Azad Kashmir and Gilgit-Baltistan. In July 1949, India and Pakistan signed an agreement to establish a ceasefire line, known as the Line of Control, as recommended by the UN and the region became divided. However, many in Kashmir do not want to be under the Indian administration, preferring either independence or union with Pakistan instead. Moreover, for years now, Kashmir has been speculated to be a nexus for terrorist groups that conspire against the Indian sovereignty. India blames Pakistan for stirring such unrest by backing separatist militants in Kashmir -- a charge its neighbor has perpetually denied. Militant groups have been the source of military conflict at the Line of Control for India and Pakistan since 1947. [15]

Anti-India sentiments have been brewing within Kashmiris since the 1980s, but the rescinding of Article 370 by the Indian Government in February 2019 has brought a fresh wave of dissatisfaction for the Indian-administered part of Kashmir. Article 370 was a clause in the Indian constitution that gave Kashmir significant autonomy – its own constitution, a separate flag, and independence over all matters except foreign affairs, defense, and communications. [15] On August 5, 2019, India revoked the seven-decade-long privileged status causing anew insurgence among the Kashmiris. Following the protests from Kashmir, the central government imposed various restrictions on the state including cutting off telephone and internet connections, banning public gatherings, asking tourists to return, and putting the two former Chief Ministers of Jammu & Kashmir under house arrest. According to the BBC, one of them, Mehbooba Mufti has since proclaimed that: "[This move has made] India an occupational force in Jammu and Kashmir." [15] Many critics of the ruling party in India see this move as the first step to change the demographic make-up of the sole Muslim majority state of India. Ms. Mufti has echoed the same sentiment to the BBC claiming that: "[They want to] reduce us to a minority and disempower us totally." [15] Pakistan has also fiercely criticized this move by India, going so far as to branding it "illegal" and vowing to exercise all possible options against it. Needless to say, this deteriorated the already frail diplomatic relations between the two nations. Things arrived at a knife-edge when a Pakistan-based militant group, Jaish-e-Mohammad claimed responsibility for the deaths of 40 Indian soldiers that same year. In retaliation, India launched airstrikes on Pakistan targeting their military bases. A day later, Pakistan shot down two Indian Air Force jets in its airspace, and captured a fighter pilot -- who was later returned unharmed to India thus deterring possible further attacks.[7] However, Pakistan's Prime Minister Imran Khan has vowed to challenge India's actions at the UN Security Council, and take the matter to the International Criminal Court.[15]

China is also a catalyst in India and Pakistan's ongoing nuclear tension. India and China have been disputing over a 2100-mile long border near Ladakh of India since the 1960s. The year 2020 was particularly violent as both sides fought their first fatal confrontation since 1975. [16] China has therefore become Pakistan's ally, with India as the common adversary. For years, China has been speculated to be aiding Pakistan's nuclear research, although both parties continually deny this.

Thus, in its entanglement with Pakistan, India is also preoccupied with China -- Indian nuclear deployment would need to be adequate to maintain credible deterrence against China even after the attrition of a grave exchange with Pakistan. [8] In a nutshell, nuclear developments associated with the India-Pakistan dyad are reciprocally related to China. [9]

2.2 The Increased Likelihood of Conventional Indo-Pakistan War due to Nuclear Power

The conflicting status quo between India and Pakistan regarding Kashmir has only become more unstable since both the nations built their own nuclear stockpile. Many speculated that nuclear arsenals in the two nations would result in a successful deterrence, like it did during the Cold War. Instead, nuclear weapons have made Pakistan less fearful of India's conventional military forces, and therefore help explain recent conflicts between them.[10] During a recent infiltration, Pakistani and Indian troops exchanged more fire than during their last two wars combined.[9] Nuclear proliferation pessimists estimate that nuclear weapons have helped Pakistan compensate for the conventional superiority of India, and so Pakistan has been interested in using military force to upset the status quo in Kashmir to pressurize Indian leadership and get their way. General Khalid Kidwai, the Director of the Strategic Plans Division of the Pakistani Army, has been quoted saying that Pakistan would use nuclear weapons against India if "India conquered a large part of Pakistan's territory, destroyed a large part of its military forces, strangled Pakistan economically or caused large scale internal subversion in Pakistan."[10] Since the Kargil war of 1999, Pakistani leadership has inferred that it was somehow their nuclear arsenals that kept the Indian military at bay despite it being Pakistan who initiated the incursion in the northern reaches of the Line of Control taking India by complete surprise. During such attacks in the pre-nuclear era, India had resorted to horizontal escalation within a week of the onset. But with Kargil, the Indian military held off from strikes to completely disarm Pakistan. A prominent Pakistani civilian analyst, Ayesha Siddqqa-Agha, wrote: "The basic understanding in Islamabad at the time [of Kargil] was that given the nuclear umbrella, Pakistan could push its political agenda in Indian-administered Kashmir without invoking a response from India like it did in 1965."[10] India's commitment to its no-first use of nuclear weapons policy, as evident during the escalation of 2001-02, has further

incentivized Pakistan's impression that India was no longer able to inflict significant military damage to Pakistan through conventional means. [10]

2.3 Nuclear Arsenals Under the Control of Pakistan & India

Pakistan started developing nuclear weapons in 1972 under Prime Minister Zulfikar Ali Bhutto, after losing East Pakistan in 1971's Bangladesh Liberation War. Chairman of the Pakistan Atomic Energy Commission, Munir Ahmed Khan headed the project. On May 1998, Pakistan conducted its first successful nuclear test by detonating five nuclear devices. A sixth device that was detonated two days later at the same place was a sophisticated, compact, and powerful plutonium bomb designed to be carried by aircrafts, vessels, and missiles. As of 2020, Pakistan has a stockpile of 160 warheads. [11] In 2019, Pakistan was reported to have 36 warheads for its nuclear-capable aircrafts (F-16A/B and Mirage III/V) with ranges from 1600 - 2100 km. They also have approximately 102 land-based missiles, 8 types of land-based ballistic missiles with possible ranges up to 2750 km, and 2 types of cruise missiles with ranges up to 350 km. As of 2017, Pakistan is also developing capabilities for sea-based nuclear weapons. [6] In February 2021, Pakistan tested a short-range ballistic missile, capable of carrying a nuclear or conventional warhead over 289 kilometers. [12]

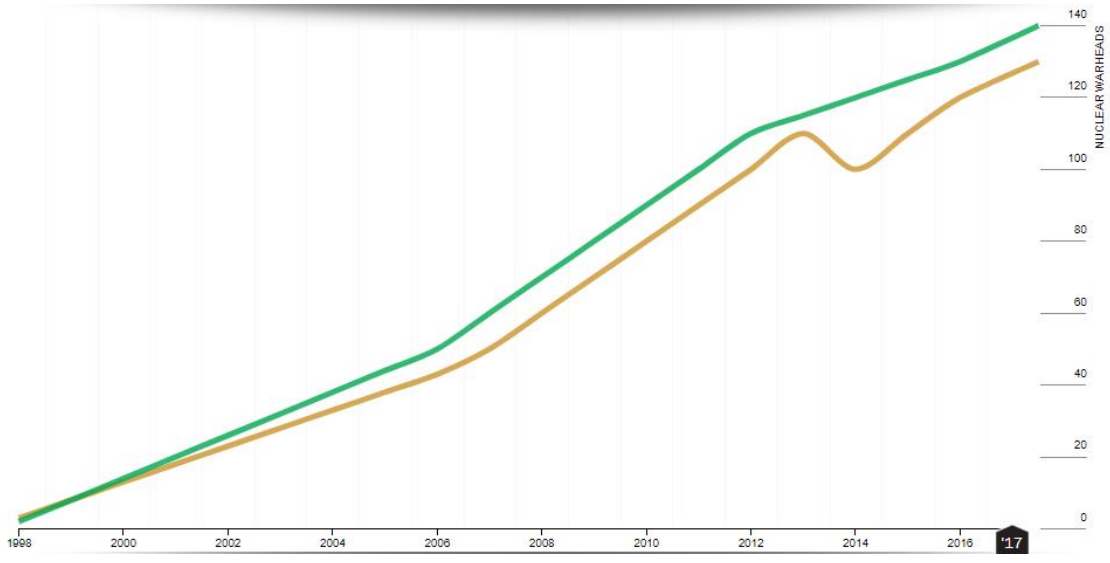

Figure 3: **Stockpiled warhead count by year (up to 2017) of India (orange) and Pakistan (green)** [as of April 9, 2021 according to https://thebulletin.org/nuclear-notebook/]. [28]

On the other hand, nuclear programs in India date back to the 1940s with the foundation of the Tata Institute of Fundamental Research. However, it wasn't until 1956 when India built its first research reactor and 1964 when its first plutonium processing plant was built – by then India was in a position to develop nuclear weapons. Their first successful test of a nuclear device was in 1974, under Prime Minister Indira Gandhi, where they used plutonium produced in the CIRUS reactor. As of 2020, India has a stockpile of 150 warheads.[13] India possess 48 nuclear gravity bombs that can be dropped using nuclear-capable aircrafts including Mirage 2000H and Jaguar IS/IB, with ranges up to 1850 km. It is also reported that India is developing a ground-launched cruise missile (GLCM) that looks similar to the American tomahawk.[14] This missile has the potential to be both air- and sea-based deployable. India also has four types of land-based ballistic missiles and an estimated 70 warheads that can be deployed with ranges up to 3200 km and 2 others that are under development with range up to 5200 km. It tested its newest and most advanced intercontinental ballistic missile (ICBM), with a 10,000 km range, in December 2018 [15]. India also has one deployed ship-based ballistic missile and two submarine-based missiles in development, the latter with ranges from 700 to 3500 km. [6]

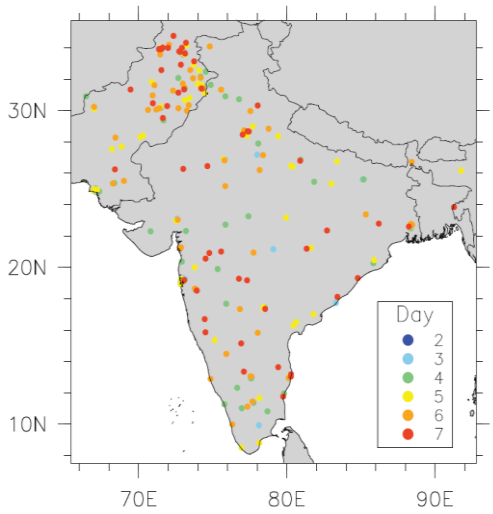

Figure 4: **Urban targets in a hypothetical India-Pakistan war scenario.** Different colors represent different days of the war. No urban targets are attacked on day 1. In dense urban areas, some of the dots overlap, for instance in Karachi on the southern coast of Pakistan. [5]

3. A Hypothetical War

In the face of an actual nuclear war, strategists speculate that Pakistan could potentially attack slightly more than one-third of all moderate- and large-sized cities in India with their current arsenal and India could potentially attack each moderate- or large-sized city in Pakistan with two nuclear warheads and its current arsenal. Although India does not need so many weapons to attack Pakistan, it is also concerned about China [6] -- Pakistan could use all its weapons, while India would have to reserve at least 100 of them to defend against future attacks from China, which is the main reason the Indians obtained them in the first place. [5]

Nuclear weapons tests conducted by both India and Pakistan at different points of time indicate that the yield of the warheads would be similar to the 15-kiloton explosive yield (equivalent to 15,000 tons of TNT) of the bomb the U.S. used on Hiroshima.[17] As a matter of fact, even a "small" nuclear war between India and Pakistan, with each country detonating 50 Hiroshima-size atom bombs -- only about 0.03 percent of the global nuclear arsenal's explosive power -- could produce so much smoke that temperatures would fall below those of the Little Ice Age of the 14th to 19th centuries, shortening the growing season around the world and threatening the global food supply.[18] The 50 bombs exploded in Pakistan would produce 3 teragrams of smoke, and the 50 bombs hitting India would generate 4 teragrams (1 teragram = 1 million metric tons).[17] As a result, there would be massive ozone depletion, allowing more ultraviolet radiation to reach Earth's surface, agricultural production in parts of the United States and China would decline by about 20 percent for four years, and by 10 percent for a decade.[18]

3.1 Anthropocentric Impact

Studies of the consequences of full-scale nuclear war show that indirect effects of the war could cause more casualties than direct ones, perhaps eliminating the majority of the world's population [16]. It would also threaten much of the world's population by causing societal chaos and the loss of transportation and energy production.[18] Such effects of a nuclear war were evident when the U.S. bombed Hiroshima and Nagasaki -- besides the people who died by direct impact of the bombings, many more lost their lives to the after-effects, especially exposure to radiation. Such an exchange between India and Pakistan could produce about half as many casualties as occurred globally during World War II [16] -- an estimated 50 to 125 million people could die in total, depending on whether the weapons used had yields of 15, 50, or 100 kilotons [13]. The direct effects of thermal radiation and nuclear blasts, as well as gamma-ray and neutron radiation within the first few minutes of the blast, would cause the most casualties. Furthermore, there would be extensive damage to infrastructure, contamination by long-lived radionuclides, and psychological trauma most likely resulting in the indefinite abandonment of large areas, leading to severe economic and social repercussions.[3] Strategists also estimate that India would suffer two to three times more fatalities and casualties than Pakistan (as seen in fig. 5).[6] Besides, the one billion

people worldwide living on marginal food supplies, right now, would be directly threatened with starvation by a nuclear war between India and Pakistan.[17]

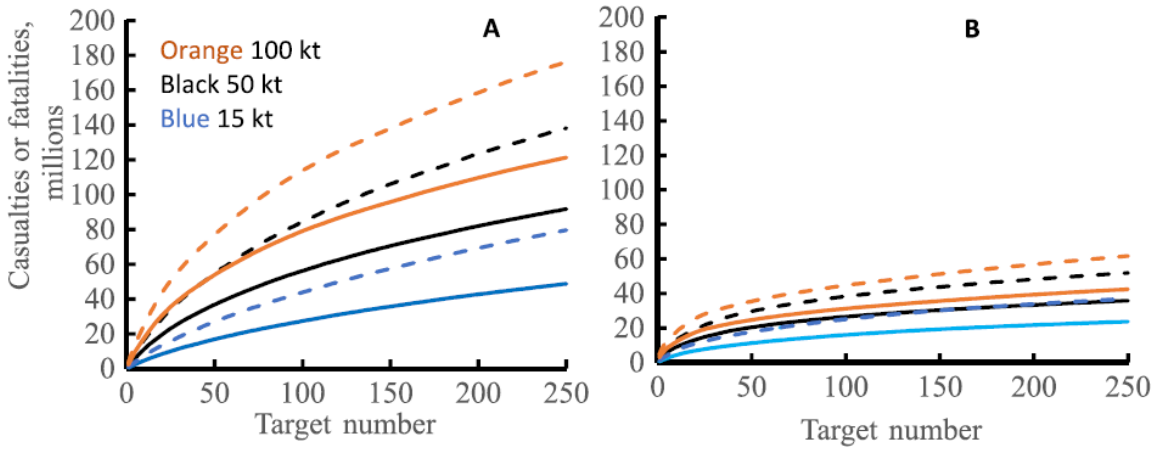

Figure 5: The fatalities (solid lines) and total casualties (dashed lines) in millions, immediately following nuclear attacks, versus the number of targets. Results for **(A)** India and **(B)** Pakistan. Colors correspond to the yield assumed. [6]

3.2 Geopolitical Impact

The principle factor that has determined distribution of power and the dynamics of conflict interaction in the international system since 1945 has been possession of nuclear weapons. Any nation with nuclear arsenals have an advantage not only from a military standpoint, but also from a psychological aspect as in the event of armed conflict, the nation with no nuclear weapons would naturally hold back so as to avoid nuclear attacks on them. [9] That said, the volatility of regional conflict, where both sides possess nuclear weapons, becomes more worrying than any global conflict. This was supported by both Kumar and Parasiliti's articles, as cited by Daniel Geller, demonstrating that the periodicity of the regional power cycles is shorter and the amplitude is higher, that is military-strategic volatility is likely to be greater at the regional level than at the global level.[9] Such is the case with India and Pakistan. Power cycle theory suggests that nuclear weapons would make adjustment to any structural changes in South Asia difficult to handle and these changes can already be seen throughout Asia as well as the globe. The nuclear competition between Indo-Pakistan is gradually promoting India to the "global superpower" status, making China insecure and thus pushing it through a critical point in its power circle. This in turn is affecting the nuclear projects and foreign policy expectations of Russia and the U.S.[9] Given status quo, a

full-scale nuclear exchange between India and Pakistan might shift the power dynamics completely by prompting China to multiply its nuclear strength, making U.S. and Russia insecure and in need of adding to their nuclear artillery.

3.3 Environmental Impact

Alan Robock and Owen Toon conducted a study where they simulated a nuclear war between India and Pakistan, involving 50 atom bombs dropped on each side, to gauge its environmental effects.[5] Their research showed that such an exchange could result in emission of 1 to 5 million tons of carbonaceous smoke particles,[3] crippling global agriculture completely.[17] Around 150 million tons of smoke would be lofted to very high altitudes in the atmosphere (about 45 km), drastically reducing precipitation by 45 percent of global average, and temperatures would fall by 7 to 8 degrees Celsius on average for several years. In important grain-growing regions of the northern mid-latitudes, precipitation would decline by up to 90 percent, and temperatures would fall below freezing point and remain there for several years.[18] Richard Turco's coined term "nuclear winter" aptly describes this situation predicted by Robock and Toon's hypothesized full-scale India-Pakistan nuclear war.[19] Modern climate models, including Alan Robock's model, prove the legitimacy of nuclear winter theory and predict that these effects would last for more than a decade.[18]

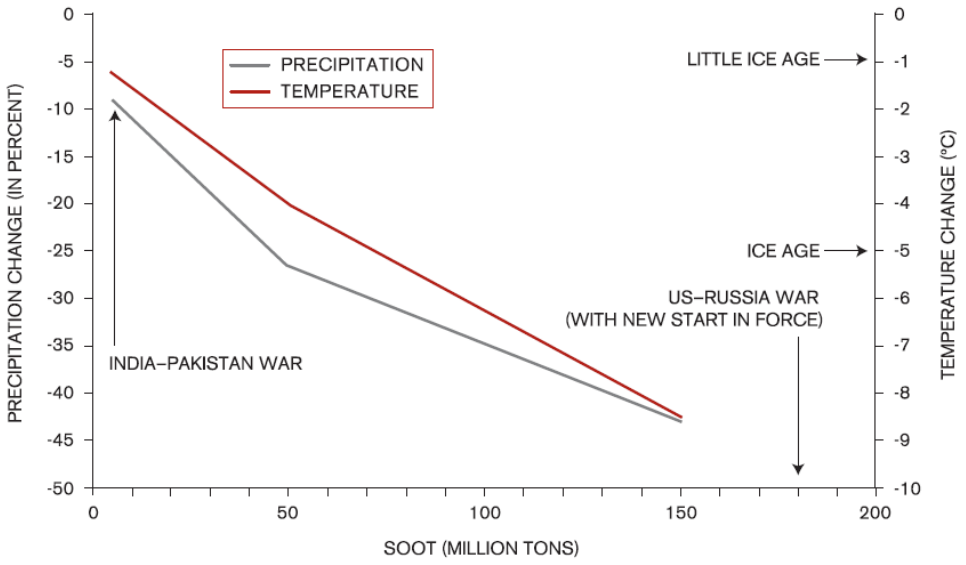

Figure 6: Global precipitation and temperature changes as a function of smoke emitted. [18]

Robock and his colleagues simulated such a situation on his climate model based on the same hypothetical nuclear war between India and Pakistan. They released 5 teragrams of smoke in the upper troposphere of the model, and within 2 weeks all continents were covered with smoke, the black soot absorbed sunlight and rose to the stratosphere, rainfall stopped in South Asia and dropped by 40 percent in Asian monsoon regions, with a 10 percent drop in precipitation worldwide, and drought was largely concentrated at lower altitudes of the world. Temperatures fell drastically to levels lower than experienced in the past 10,000 years and the global average cooling was about 1.25 degrees Celsius -- the closest instance of such a drastic temperature drop happened 200 years ago during the Tambora eruption in Indonesia. At that time, average summer temperatures dropped only a few degrees in New England, but crop-killing frosts occurred every month even after farmers planted new crops. [17]

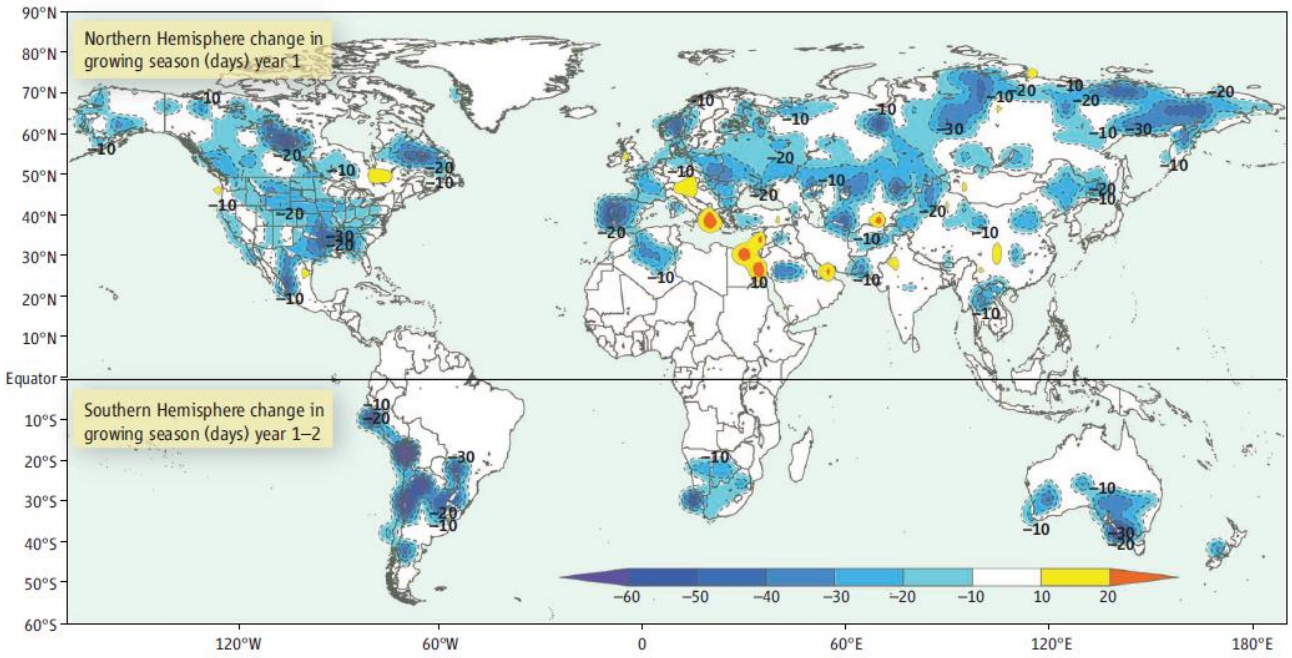

Figure 7: Change in growing season (period with freeze-free days) in the first year after smoke release from 100 15-kt nuclear explosions. [3]

Michael J. Mills at the University of Colorado in Boulder ran a completely different climate model simulation but found results similar to Robock's – the stratosphere was heated by more than 50 degrees Celsius which modified the winds and carried ozone-destroying nitrogen oxides into the stratosphere's upper reaches. High temperatures and nitrogen oxides together reduced ozone to

the same dangerous levels as experienced below the ozone hole above Antarctica every spring. Besides, UV radiation on the ground increased significantly because of the diminished ozone. [17]

Although the environmental effects of these simulations are mostly theoretical and real-life impacts would depend heavily on particular crops, soils, agricultural practices and regional weather patterns, there is no denying that nuclear winter is inevitable in the event of a nuclear exchange between India and Pakistan. Climatologists and strategists predict that both nations would suffer more casualties as a result of the effects of smoke and ozone depletion rather than because of the direct explosion. [4]

4. Current State of Affairs

The principle idea behind weaponizing nuclear reactors had been to ensure deterrence of warfare between nations. [5] But the reality of the existing status quo is not that – the ever-rising nuclear tensions between India and Pakistan are testament to this. Right now, the entire world is on edge every time there is a skirmish between the two nations in the fear that one of them might decide to drop an atom bomb on the other and the retaliations that would follow would take down all of humankind with it.

The United Nations has introduced different policies to reduce the number of nuclear weapons in the world. Most recently on January 2021, the UN implemented the Treaty on the Prohibition of Nuclear Weapons that states a comprehensive set of prohibitions on participating in any nuclear weapon activities -- including undertakings not to develop, test, produce, acquire, possess, stockpile, use or threaten to use nuclear weapons, prohibitions on the deployment of nuclear weapons on national territory and the provision of assistance to any state in the conduct of prohibited activities.[20] However, none of the members of the nuclear club have signed this latest treaty. The Nuclear Non-Proliferation Treaty (NPT) is perhaps the UN's most prominent nuclear disarmament endeavor. The objective of NPT is "to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in peaceful uses of nuclear energy, and to further the goal of achieving general and complete nuclear disarmament,"[25] i.e. NPT aims to eliminate

even the slightest possibility of a nuclear winter and the deliberate extinction of humans. Realizing that diplomacy and such nonproliferation agreements are the way forward to having fewer nuclear weapons in the world, [21] so far 191 countries have signed the treaty, including 5 nuclear-weapons states. However, India and Pakistan are among the nations that are yet to sign NPT.[22] Both nations have also not signed the Comprehensive Test-Ban Treaty of 1996, aimed to ban all nuclear tests – civilian or military [4]. These factor in on the possibility, no matter how slim, of either nation ever waging nuclear war on the other. The volatility of the conflict regarding Kashmir tends to escalate quite fast, as evident from their history, and current statistics show that both parties have become comparatively more aggressive since joining the nuclear weapons club. [9] In 2013 for instance, at the peak of heightened tensions, officials of Indian-administered Kashmir sent out warnings to residents "to build bomb-proof basements, collect two weeks' worth of food and water and be prepared for a possible nuclear war."[23] This only goes to show how the Indo-Pakistan relation is treading a fine line, on the other side of which is a nuclear holocaust.

5. Conclusion

Nuclear deterrence was thought to be a major consequence of Mutually Assured Destruction (MAD) -- if country A attacks country B, the retaliation from country B will be so devastating that a first strike by country A would be suicidal. [18] However, with both India and Pakistan's current leadership hurling threats of nuclear attack at each other, the MAD strategy seems to be failing for these two South Asian nations. On the other side, Nuclear Winter Theory concretely shows that it would be suicidal for country A to launch a full-scale nuclear attack on country B regardless of whether country B responds in kind – this may be termed Self-Assured Destruction (SAD). [18] Either strategy would lead the two countries, and the rest of the world with them, into the abyss of a post-apocalyptic era only seen in fictional cinema until now. To successfully dissuade the possibility of such a reality, banning the weaponization of nuclear reactors and dismantling of already existing stockpiles are of utmost significance. However, the less prominent nations of the nuclear club, like India and Pakistan, often defend their expansion of nuclear arsenals by pointing to the larger caches held by prominent nations as the U.S., Russia, and the UK. [18] These prominent nations, though, are even more reluctant to abandon their nuclear weaponry – in recent news,

the U.S. Air Force is planning to order 600 sets of a new weapon of mass destruction, a nuclear missile that will be able to travel 6,000 miles carrying a warhead more than 20 times more powerful than the atomic bomb dropped on Hiroshima, capable of killing hundreds of thousands of people in a single shot.[24] Despite the catastrophic effects of even a small-scale nuclear exchange, why these influential nations are hesitant to pioneer nuclear non-proliferation, like Sweden did in 1952 after 20 years of building a domestic nuclear infrastructure,[21] involves deep-rooted power politics and years of rusty diplomatic relations that are beyond the scope of this paper. Future research may come up with prospective diplomatic solutions that can be a positive step forward to wiping nuclear weapons off of the face of the Earth. However, for now, the only way to sustain the existence of the human race is to ensure regional conflicts, most urgently between India and Pakistan, do not escalate to the point of a nuclear holocaust and the consequent extinction of humankind.

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