Int. j. adv. multidisc. res. stud. 2025; 5(2):654-659

Received: 27-01-2025
Accepted: 07-03-2025

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Nuclear Proliferation: A Cross-Cutting International Security Issue

[1] Michael Ang'anyo Onyango, [2] Dr. Thomas Otieno Juma

[1] Doctor of Philosophy Candidate in Political Science, Moi University/ University of Kabianga, Kenya

[2] PhD - Public Administration/ Lecturer Public Administration, Moi University/ University of Kabianga, Kenya

DOI: https://doi.org/10.62225/2583049X.2025.5.2.3883

Corresponding Author: **Dr. Thomas Otieno Juma**

Abstract

This paper discusses nuclear proliferation as a cross-cutting international security issues in contemporary. The paper addresses four pertinent themes which include: The nature of nuclear weapons and their effects; the global diffusion of nuclear and ballistic missile technology; Theorizing nuclear proliferation and non-proliferation, and; Other weapons of mass destruction (WMD) and their impact on world politics. Whereas nuclear itself is very useful commercially, we argue that nuclear weapons represent mankind's ultimate confrontation with the natural environment that sustains us. The purpose of these weapons is wholesale destruction on a massive scale, which affects most forms of life. It stands as a single human creation with such a great potential for harm. Such is the threat to life posed by nuclear weapons that the International Court of Justice, the world's highest legal authority, in its 1996 landmark ruling on the general illegality of these weapons, stated: "The destructive power of nuclear weapons is hard to be contained. They have the potential to destroy all civilization and the entire ecosystem of the planet." There are two overwhelming threats to life on earth as we know it. They are climate change and its security effects. The diffusion of nuclear weapons to additional countries might come about through indigenous development programs, through assistance from the present nuclear powers, or through a combination of both. This diffusion, sometimes called the "Nth country" problem, has been of great concern in discussions of disarmament and U.S. nuclear assistance programs. It has been widely held that the spread of nuclear capabilities is disadvantageous for U.S. security and that an effort to stop it should receive highest priority in disarmament policies. It is the purpose of this presentation to examine the validity of this proposition. To do so it will be necessary to estimate the political and military effects that might arise from a further diffusion of nuclear capabilities. Such an undertaking is necessarily fraught with great uncertainties. This paper also presents an analysis of the contemporary debate on the begging question, "is there a theory of nuclear proliferation?" The theoretical debate over how nuclear proliferation should be explained, and whether future nuclear proliferation can be predicted or not, has been given fresh impetus since the end of the Cold War. The debate has been particularly lively, as the new international environment has brought new challenges to conventional wisdom about the spread of nuclear weapons. However, although some very important contributions have been made, the dynamics of nuclear proliferation remain largely a mystery. This paper does not claim to have found the answers, but it does attempt to show the limitations of the existing debate, and in doing so, highlights areas which require further research. Finally the paper interrogates the questions; "With the rapid erosion of the prohibition on use by states of chemical weapons, and the rise of radical non-state groups seemingly willing to utilize whatever weapons of mass destruction they can obtain, what can the international community do to restrain their use? And what do advances in neuroscience portend for the development and use of new kinds of chemical control agents?"

Keywords: Nuclear, Proliferation, Security, Insecurity, Weaponization, Security Threats, International Security, etc.

1. Introduction

Across the academic and policy literature on international relations and national security topics, the term *proliferation* is generally understood to denote the spread or increase of *weapons of mass destruction* (WMD)—a term that often denotes chemical, biological, radiological, and nuclear (CBRN) munitions and their means of delivery. The actual or potential spread of these weapons—which, in even relatively low numbers, are capable of causing many casualties, social disruption, and, in

the case of nuclear weapons, widespread material destruction—has long represented a significant threat to international peace and security.

Nuclear Proliferation is a term used to describe the spread of nuclear weapons and weapons-applicable **nuclear** technology and information, to nations which are not recognized as "Nuclear Weapon States" by the Treaty on the Nonproliferation of Nuclear Weapons, also known as the Nuclear Nonproliferation Treaty or the NPT, 1968. The Nuclear Non-Proliferation Treaty was an agreement signed in 1968 by several of the major nuclear and non-nuclear powers that pledged their cooperation in stemming the spread of nuclear technology.

Nuclear weapons proliferation, whether by state or non-state actors, poses one of the greatest threats to international security today. Iran's apparent efforts to acquire nuclear weapons, what amounts to North Korean nuclear blackmail, and the revelation of the A.Q. Khan black market nuclear network all underscore the far-from-remote possibility that a terrorist group or a so-called rogue state will acquire weapons of mass destruction or materials for a dirty bomb.

The problem of nuclear proliferation is global, and any effective response must also be multilateral. Nine states (China, France, India, Israel, North Korea, Pakistan, Russia, the United Kingdom, and the United States) are known or believed to have nuclear weapons, and more than thirty others (including Japan, Germany, and South Korea) have the technological ability to quickly acquire them. Amid volatile energy costs, the accompanying push to expand nuclear energy, growing concerns about the environmental impact of fossil fuels, and the continued diffusion of scientific and technical knowledge, access to dual-use technologies seems destined to grow.

In the background, a nascent global consensus regarding the need for substantial nuclear arms reductions, if not complete nuclear disarmament, has increasingly taken shape. In April 2009, for instance, U.S. president Barack Obama reignited global nonproliferation efforts through a landmark speech in Prague. Subsequently, in September of the same year, the UN Security Council (UNSC) unanimously passed Resolution 1887, which called for accelerated efforts toward total nuclear disarmament. In December 2011, the number of states who had ratified the Comprehensive Test Ban Treaty increased to 157, heightening appeals to countries such as the United States, Israel, and Iran to follow suit.

Overall, the existing global nonproliferation regime is a highly developed example of international law. Yet, despite some notable successes, existing multilateral institutions have failed to prevent states such as India, Pakistan, and North Korea from "going nuclear," and seem equally ill-equipped to check Iran as well as potential threats from non-state terrorist groups. The current framework must be updated and reinforced if it is to effectively address today's proliferation threats, let alone pave the way for the "peace and security of a world without nuclear weapons."

1.1 The nature of nuclear weapons and their effects

Nuclear weapons represent mankind's ultimate confrontation with the natural environment that sustains us. The purpose of these weapons is wholesale destruction on a massive scale, which affects most forms of life. No other single human creation has such potential for harm. Such is the threat to life posed by nuclear weapons that the International Court of Justice, the world's highest legal authority, in its 1996 landmark ruling on the general illegality of these weapons, stated: "The destructive power of nuclear weapons cannot be contained in either space or time. They have the potential to destroy all civilization and the entire ecosystem of the planet."

There are two overwhelming threats to life on earth as we know it. They are climate change and nuclear weapons. The Governor of California Arnold Schwarznegger said in October 2007: "The attention focused on nuclear weapons should be as prominent as that of global climate change…..A nuclear disaster will not hit at the speed of a glacier melting. It will hit with a blast. It will not hit with the speed of the atmosphere warming but of a city burning."

It is certainly not Schwarznegger's intention, nor is it the intention of this presentation, to divert attention from the need to avert further climate change. That must remain an urgent imperative. However we must also recognize the gravity of the threat posed by the world's 26,000 nuclear weapons, and respond with a similar sense of urgency. If we do not, these weapons will be used again, with catastrophic consequences.

The effects of nuclear proliferation can be understood by examining some of the human and environmental implications of: The raw material - uranium; Nuclear weapons testing; Nuclear weapons facilities and their environs; The biological effects of radiation exposure; The use of nuclear weapons; Climatic effects of nuclear weapons use; Nuclear waste, and; The role of human error, human malevolence and human wisdom.

1.1.1 The raw material - uranium

Nuclear weapons require either enriched uranium or plutonium as their fuel. As plutonium is found in only minute quantities in nature, virtually all the plutonium in the world is derived from nuclear reactors, with uranium as the original reactor fuel. Therefore uranium is the starting point for all nuclear weapons.

Uranium mining and milling produces enormous volumes of tailings, or waste, which contain over 85% of the radioactivity of the original ore. (This is because they contain radioactive breakdown products of uranium that have accumulated over many thousands of years.) A severe example of the impact of uranium mine tailings is at the Jadugoda mine in India. A study conducted in 2007 by Indian Doctors for Peace and Development found increased rates of congenital deformities, cancers and sterility in those living in the vicinity of the mine.

1.1.2 Nuclear weapons testing

Approximately 1,900 nuclear tests have been conducted, of which just over 500 were in the atmosphere, underwater or in space, and the remaining 1,400 were underground. Radioisotopes produced by nuclear tests, such as carbon-14, caesium-137, strontium-90 and plutonium-239, pose risks to current and future generations by ingestion, inhalation and external radiation. Test sites around the world remain contaminated, including the Maralinga site in South Australia.

In 1991, International Physicians for the Prevention of Nuclear War and the Institute for Energy and Environmental Research published "Radioactive Heaven and Earth: The health and environmental effects of nuclear weapons testing in, on and above the earth". This study estimated that the radiation exposure from carbon-14 (integrated over infinity) would result in a total of 2.4 million human cancer deaths. The study concluded that "Many aspects of nuclear weapons testing have been characterized by a disregard, sometimes

willful, of public health and environment".

1.1.3 Nuclear weapons facilities and their environs

Evidence has accumulated of major health, safety and environmental problems at nuclear weapons complexes around the world. This is most apparent in the two nations that are responsible for approximately 96% of the world's nuclear weapons, the USA and Russia. In the US, Physicians for Social Responsibility has reported on the task of dealing with the toxic and radioactive legacy of 50 years of nuclear weapons production, which "is said to be the most technologically challenging and costly public works project ever conceived". In Russia, the situation is probably worse than in the US. Vast quantities of radioactive waste, including nuclear reactors, from Soviet and Russian nuclear-powered ships and submarines were dumped into the Pacific and Arctic Oceans.

While the USA and the former Soviet Union, due to the sheer number of nuclear weapons produced, present by far the most disturbing pictures of radioactive contamination from weapons production, the problem is not confined to those two countries. Radioactive contamination globally from nuclear weapons production will take an incalculable but heavy human and environmental toll for a very long time.

1.1.4 The biological effects of radiation exposure

Studies on both plants and animals have repeatedly shown that exposure to ionizing radiation causes genetic mutations, and we know that mutations can lead to the development of cancers. Cancer rates among Hiroshima and Nagaskai survivors are significantly increased, and, over 60 years after the bombings, they have not yet reached their peak. Rates of microcephaly and intellectual disability were also increased among those who were in utero at the time of the bombings.

It is important however to understand the difficulties encountered in assessing the biological effects of radioactivity, especially low-level radioactivity. Attributing with certainty a specific cancer to a specific episode of radiation exposure is generally not possible, for a number of reasons including the fact that: Cancers may occur decades after the exposure; there is no way of distinguishing a cancer caused by radiation from any other cancer; cancer is a common illness, with many other possible triggers; individuals' susceptibility to cancer will vary according to their health and genetic inheritance, and that; radiation can spread over large distances, depending on weather patterns, and be dispersed in such a fashion that determining the dose received by specific people or animals is extraordinarily difficult.

Hard statistical evidence of genetic damage from radiation exposure being passed on to progeny in humans has long been lacking, despite overwhelming evidence of radiation-induced mutations in plant and animal experiments. Specifically, such damage in the descendants of Hiroshima and Nagasaki survivors has not been demonstrated thus far. However new evidence from New Zealand on survivors of the 1957-58 UK Operation Grapple nuclear tests in the Pacific shows three times the frequency of total chromosome changes (translocations) in the test veterans as in a control group. Statistically, this is very significant, and indicates the potential to result in intergenerational effects. More research in this area is needed.

1.1.5 The use of nuclear weapons

Nuclear weapons are indiscriminate in every sense, and the ultimate weapon of mass destruction. Their effects cannot be contained in time or space, nor do these weapons discriminate between children and adults, humans and any other species, combatants and non-combatants or according to any other criteria.

The weapons that destroyed Hiroshima and Nagasaki were approximately 15 and 21 kilotons respectively (a kiloton being 1,000 tons of TNT equivalent). The two cities were destroyed. Nuclear weapons built since then have been up to many megatons (million tons of TNT equivalent). The largest US and Soviet nuclear tests were, respectively, a 15 megaton test (codenamed Bravo) in 1954, and a 50 megaton test in 1961.

Nuclear weapons cause an initial intense (often blinding) flash of light, then an enormous fireball, which generates heat in the order of tens of millions of degrees centigrade. The fireball rises and cools, forming the characteristic mushroom cloud appearance. A powerful blast wave causes the collapse of buildings and flying debris. Firestorms, fanned by hurricane force winds, break out. In addition, there is an electromagnetic pulse that destroys electrical equipment. Initial radiation is emitted at the moment of the explosion, and causes radiation sickness. Radioactive particles called fallout will be present immediately, but they can also travel the globe and have much delayed effects, causing increased cancer rates and genetic changes, as explained above.

1.1.6 Climatic effects of nuclear weapons use

Recent studies have resurrected the "nuclear winter" fears of the 1980s. It is estimated that the use of just 100 Hiroshima-sized weapons in urban areas, for example a war between India and Pakistan where each side used 50 weapons, could cause severe global climatic consequences. Fires ignited would release copious amounts of light-absorbing smoke and debris into the upper atmosphere, causing persistent surface cooling even a decade later.

In such a scenario, there would be decreases in growing seasons in many of the most important grain producing parts of the world, with severe reductions in food production. A scenario of this magnitude could lead to a total global death toll of one billion from starvation alone, major epidemics of infectious disease, and immense potential for war and civil conflict.

1.1.7 Nuclear waste

Not a single country, anywhere, has in place a satisfactory long term solution to the problem of nuclear waste. Unless a solution is developed, all future generations of humans will inherit this problem. In the US alone, nuclear waste has accumulated at 120 sites around the country. This includes approximately 55,000 tons of high level waste from civilian reactors, and 15,000 tons from nuclear weapons production. All of them are intended as temporary sites, but there is currently nowhere for the waste to go. The proposed Yucca Mountain site has experienced prolonged delays, and is still not approved, despite many billions of dollars of research.

Because the nuclear waste problem is not resolved, some eyes scan the globe for a place that is less densely populated, in which it could be dumped, and look to Australia as a possibility. While both the previous and current governments have ruled out Australia accepting high-level waste from other countries, it is likely that pressure for such a facility will surface from time to time. Australia already had an unresolved problem of what to do with their low and medium level nuclear waste, including

reprocessed waste that would return there from France and Scotland (Dounreay) from about 2011.

1.1.8 The role of human error, human malevolence and human wisdom

Nuclear weapons have not been used (except as a political tool) since 1945. Some commentators attribute this to the role of "deterrence", the notion that nuclear devastation is so unthinkable, and the threat of nuclear retaliation so unacceptable, that the weapons will remain forever unused. These assumptions are flawed. They assume that leaders will always, without exception, care what happens to their own country and all its people.

We can think of instances where this is not the case. And they assume that no major errors of judgment will be made, nor accidents in the monitoring and oversight of nuclear weapons will occur. This is contrary to what we know of human nature, which is that people make errors, especially when working under intense pressure. There are well-documented instances where the world has come frighteningly close to nuclear conflict.

During the 1962 Cuban Missile Crisis, there were huge miscalculations on both sides. Former US Defense Secretary Robert McNamara says of those 13 days, "We were a hair's breadth from absolute disaster." The 1996 report of the Canberra Commission on the Elimination of Nuclear Weapons stated, "The proposition that nuclear weapons can be retained in perpetuity and never used – accidentally or by decision – defies credibility."

We also know however that humans have profound capacity for wisdom and discernment. Jonathan Schell reminds us that our past need not determine our future: "Whether [nuclear weapons] are merely a monstrous leftover from a frightful era that has ended, and will soon follow it into history, or whether, on the contrary, they are seeds of a new, more virulent era, in which nuclear weapons are held more widely and rooted more deeply, is not a matter of prediction; it is a matter of choice."

1.2 The global diffusion of nuclear and ballistic missile technology

The diffusion of nuclear weapons to additional countries might come about through indigenous development programs, through assistance from the present nuclear powers, or through a combination of both. This diffusion, sometimes called the "Nth country" problem, has been of great concern in discussions of disarmament and U.S. nuclear assistance programs. It has been widely held that the spread of nuclear capabilities is disadvantageous for U.S. security and that an effort to stop it should receive highest priority in disarmament policies. It is the purpose of this paper to examine the validity of this proposition. To do so it will be necessary to estimate the political and military effects that might arise from a further diffusion of nuclear capabilities. Such an undertaking is necessarily fraught with great uncertainties.

Ballistic missiles and nuclear weapons are complementary technologies that dramatically enhance each other's strategic utility. To date, explanations of how these military technologies proliferate have largely considered their developmental paths as separate from one another. In this paper, the argument is that mastering missile technology provides states with significant advantages in acquiring nuclear weapons. Both missile programs and nuclear weapons programs are costly, scientifically challenging endeavors that require the mastery of a significant body of tacit knowledge.

However, missile programs are less expensive, less risky, and pose lower scientific entry barriers compared to nuclear programs. By investing in the mastery of rocket technology, states cultivate Scientific-Military Industrial Complexes (SMICs) that increase the research infrastructure and scientific and technical human capital within their countries that can also aid in nuclear weapons acquisition efforts. Furthermore, such programs provide governments with cross-applicable experience in managing expansive, interdisciplinary weapons acquisition projects.

Lastly, military rocketry SMICs have significant incentives to lobby on behalf of acquiring nuclear weapons, which could spur significant additional investments in their own programs. In a research done in the year 2012, Way Christopher and Early Bryan tested their theory with a large-n analysis of the factors affecting the acquisition of nuclear weapons in 154 countries from 1945-2000[1]. Their results provide strong support for a theory which demonstrates that mature military rocketry programs substantially contribute to countries' ability to acquire nuclear weapons.

1.3 Theorizing nuclear proliferation and non-proliferation

The theoretical debate over how nuclear proliferation should be explained, and whether future nuclear proliferation can be predicted or not, has been given fresh impetus since the end of the Cold War. The debate has been particularly lively, as the new international environment has brought new challenges to conventional wisdom about the spread of nuclear weapons. However, although some very important contributions have been made, the dynamics of nuclear proliferation remain largely a mystery. This paper does not claim to have found the answers, but it does attempt to show the limitations of the existing debate, and in doing so, highlights areas which require further research.

Those involved in the debate have focused on trying to find solutions to what has been called the "proliferation puzzle." But exactly what is meant by this term is not always made clear, and this lack of academic rigor has led to the misinterpretation of key contributions, and, ultimately, to theoretical confusion. Three problems lie at the root of this confusion. Firstly, the concept of nuclear proliferation has not been adequately defined, making a rigorous approach more difficult. Secondly, the word "puzzle" has been used to refer to different aspects of nuclear proliferation, such as its causes and effects, and it is not always obvious which aspect is being addressed. To further complicate matters, theoretical debates exist within the nuclear proliferation debate, as both the levels of analysis problem and the agent-structure problem – subjects of debate in their own right are also involved centrally in the proliferation debate.

The debate has also been hampered by the difficulty of trying to acquire evidence about such a sensitive subject, causing doubts over the adequacy of our knowledge and questions about whether nuclear proliferation can be separated from other processes and phenomena, such as

[1] Way, Christopher and Early, Bryan R., Launching Nukes: The Spread of Ballistic Missile Technology and Nuclear Weapons Proliferation (2012). APSA 2012 Annual Meeting Paper. Available at SSRN: https://ssrn.com/abstract=2106698

arms racing and domestic coalition building. The fundamental question is: What actually constitutes knowledge in the area of nuclear proliferation? Official documents on the subject are scarce, and it is difficult to establish which kinds of evidence can be relied upon. These empirical difficulties have caused the debate over proliferation dynamics to be particularly abstract; have led to doubts over whether positivist approach to the study of nuclear proliferation is possible, and have left the debate open to criticism on epistemological and ontological grounds.

In "Why Do States Build Nuclear Weapons: Three Models in Search of a Bomb", Sagan discusses the three theoretical models that affect a states' decision to build a nuclear arsenal. Although the three "theoretical frameworks"/models share common features with the well-known international relations theories (that is, realism, liberalism, institutionalism), it's interesting to look at and analyze each of them individually.

The Security Model: The concept of balance of power is central. Sagan argues that states use nuclear weapons as a deterrent tool or as a coercive tool to force a change in the status quo. Sagan also suggests that "every time one state develops nuclear weapons to balance against its main rival, it also creates nuclear threat to another state in the region"[2] causing a domino effect. Is this always true or only when states feel directly threatened? Why didn't Ukraine or the post-Soviet Union states develop a nuclear weapons arsenal?

The Domestic Model: Like liberalism, argues that state behavior is dictated by state preferences, in this case by: State's nuclear establishment; Units in the military, and; Politicians. Nonetheless the author fails to identify under which conditions these three actors come together and produce the desired outcome. The begging questions therefore are: How do you think these actors come together? Of these three actors who do you think is more decisive?

The Norms Model: Stresses the importance of "nuclear symbolism". According to this model states build nuclear arsenals because "they are part of what modern states believe they have to possess to be legitimate, modern states"[3]. The further begs the question: Do you think the same principle could apply to terrorist groups (for instance, the ISIS)?

1.4 Other weapons of mass destruction and their impact on world politics

One of the leading specialists in the problems of chemical and biological weapons Professor Mathew Meselson of Harvard University, more than two decades ago put the issue in perspective when he wrote: "…During the century ahead, as our ability to modify fundamental life processes continues its rapid advance, we will be able not only to devise additional ways to destroy life but will also become able to manipulate it – including the processes of cognition, development, reproduction and inheritance…. Therein could lie unprecedented opportunities for violence, coercion, repression, or subjugation…"

In particular, he argued further that: "…Unlike the technologies of conventional or even nuclear weapons, biotechnology has the potential to place mass destructive capabilities in a multitude of hands and, in coming decades, to reach deeply into what we are and how we regard ourselves. It should be evident that any intensive exploitation of biotechnology for hostile purposes could take humanity down a particularly undesirable path." Written before the 9/11 attacks and all that has followed since, not least the growth of irregular warfare and radical paramilitary movements willing to use extreme methods, his comments have even greater salience, making the need for positive action.

The world today faces a confused and potentially extremely dangerous situation in its current contradictory treatment of nuclear, biological and chemical weapons-commonly referred to collectively as weapons of mass destruction (WMD). A worldwide norm has been established which prohibits use and even possession of biological weapons (BW) and chemical weapons (CW), while possession and some uses of nuclear weapons by the five nuclear-weapon states remain legal, and the nuclear weapons potential of the "threshold" states-India, Israel and Pakistan-are tacitly accepted by the nuclear powers. Thus, nuclear weapons, which have been demonstrated to be by far the most destructive of the three classes of weapons, remain legitimate within certain restrictions while biological and chemical weapons, with more limited and problematic effectiveness, have been outlawed.

In addition to their differing legal status, these three classes of weapons are very diverse in their technical nature and military significance. Progress in controlling each category of weapons and resolution of the contradictions in the existing non-proliferation regime is made more difficult by lumping biological, chemical and nuclear weapons together under the banner of WMD.

The contradictory nature of these international norms raises questions with far-reaching consequences. First, what should U.S. policy be on the use, or threatened use, of nuclear weapons as a deterrent or response against possession or use of BW and CW? The United States has agreed to give up all biological and chemical weapons and, therefore, cannot threaten retaliation against the use of biological and chemical weapons *in kind*. Consequently, U.S. deterrence against the use or threatened use of such weapons has to be based either on conventional military superiority or through an expressed or tacit nuclear threat.

A second, more profound, question is: How will the role of nuclear, biological and chemical weapons evolve from the present situation, with its fundamental discriminatory nature and internal inconsistencies with regard to nuclear weapons. One can surmise four potential future paths; two are damaging to the security interests of the United States and the world, while the other two would potentially reduce the threat posed by the existing imbalance in non-proliferation efforts.

On the negative side, the United States faces the risk that the existing prohibitions over BW and CW will unravel as nuclear weapons remain in the hands of the nuclear-weapon states and possibly new nuclear proliferates; or, that the existing nuclear non-proliferation regime will be undermined as other states seek a nuclear option as a deterrent to BW and CW. On the positive side, the United States can hope that the present pattern, with its prohibitions

[2] Scott D. Sagan., (1996): Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb. International Security. Vol, 21 No.3 (Winter, 1996-1997). The Massachusetts Institute of Technology. P. 58.

[3] Ibid. P. 74.

against BW and CW, will endure as the nuclear-weapon states and threshold states gradually reduce their dependence on nuclear weapons; or, that the international community will be persuaded to extend the norm prohibiting BW and CW possession and use to nuclear weapons worldwide as well.

2. Conclusion

Nuclear proliferation became an increasingly major concern after France and then China joined the nuclear "club" in the 1960s. However, it was not until India's "peaceful nuclear explosive" test of 1974 that a real sense of potential worldwide crisis emerged, which also spawned a substantial amount of serious writing on the issue. The basic puzzle facing the study of nuclear proliferation is why there is a considerable and persistent disparity between the number of nuclear weapons-capable states and the number of actual nuclear weapons states.

Three early works that represented crucial conceptual breakthroughs in the struggle toward a proper descriptive inference of the dynamics of proliferation are William Epstein's *The Last Chance* (1976), Stephen M. Meyer's *The Dynamics of Nuclear Proliferation* (1984), and *Opaque Nuclear Proliferation* (1991), edited by Benjamin Frankel. More contemporary political science work features attempts by each of the major international relations paradigms to tackle the proliferation puzzle: realism, psychological constructivism, neoliberal institutionalism, liberalism, and sociological constructivism.

While scholars disagree over a host of issues, a consensus on the dynamics of nuclear proliferation may be discerned. In particular, there are five points on which most recent works converge: that proliferation has been historically rare; that we cannot take the demand for nuclear weapons for granted; that domestic politics and identity considerations play a crucial role in shaping proliferation choices; and that theory-guided, in-depth comparative case studies are the most appropriate means of advancing the state of our knowledge at this point in time.

3. References

1. Helfand I. An Assessment of the Extent of Projected Global Famine Resulting from Limited, Regional Nuclear War. Presented at "Nuclear Weapons: The Final Pandemic" conference. October 3-4, 2007, London, 2007.
2. Nuclear pursuits. Bull At Scientists. Sept/Oct, 2003.
3. Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and its Health and Environmental Effects. MIT Press, 1995.
4. Steven L Simon, Andre Bouville, Charles EL. Fallout from nuclear weapons tests and cancer risks. American Scientists online. 2001; 94(1).
5. Rowland RE *et al*. Elevated chromosome translocation frequencies in New Zealand nuclear test veterans. Cytogenetics and Genome Research. 2008; 121:79-87.
6. Robock A, *et al*. Climatic consequences of regional nuclear conflicts. Atmospheric Chemistry and Physics Discussion 2006, 1997.
7. Scott D Sagan. Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb. International Security. Vol, 21 No.3 (Winter, 1996-1997). The Massachusetts Institute of Technology, 1996.
8. Way Christopher, Early Bryan R. Launching Nukes: The Spread of Ballistic Missile Technology and Nuclear Weapons Proliferation (2012). APSA 2012 Annual Meeting Paper, 2012. Available at SSRN: https://ssrn.com/abstract=2106698