

MILITARY SCIENCES

THE PROLIFERATION OF NUCLEAR WEAPONS AS A GLOBAL PROBLEM OF THE MODERN ERA

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Abstract

The proliferation of nuclear weapons is one of the most serious global problems facing humanity today. Since the mid-20th century, the development of nuclear technologies has given people both a major source of energy and an unprecedented destructive power. However, the uncontrolled spread of these weapons poses a grave threat to world security. This problem is not only about armament but also has deep political, economic, environmental, and humanitarian consequences.

Nuclear weapons work through reactions that occur when atomic nuclei split or fuse. Their power is so great that the detonation of a single bomb can instantly kill tens of thousands of people and wipe cities off the face of the earth. The primary danger of these weapons is not only their explosive force but also the radiation, long-term environmental contamination, and genetic damage that accompany them.

Preventing the spread of nuclear weapons is the common duty of all humanity, not just of individual states.

Keywords: global problems, humanity, society, nature, nuclear weapons, wars.

In the modern era, world civilization is characterized by the further development of the interrelationship between society, humans, and nature. At the same time, social progress has given rise to a number of global, universal problems, upon the solution of which the fate of world civilization and the present and future of humanity largely depend. What are these global problems?

Global problems refer to issues of universal character that affect the interests of all humankind and every individual living in any part of the planet. It should be noted that sometimes their scope is extended to include all the current natural-scientific, scientific-technical, and social challenges. Viewed from this perspective, global problems appear to merge with all the tasks facing humanity [1].

In reality, however, global problems do not encompass every challenge humanity faces, but rather those most fundamental issues that are directly linked to its destiny.

The concept of a “global problem” began to be widely used in scientific literature starting from the 1950s. When discussing global problems, it is first necessary to clarify their essence -that is, which problems are considered global and why. Global problems are those that do not threaten or concern only individual countries or nations, but all states and the whole of humanity. In the modern era, there are many global problems. They differ sharply from other issues in terms of

their significance, scale, scope, and degree of danger [4].

Global problems can generally be characterized by the following features:

- they encompass all countries or at least the majority of them;
- they embody the contradictions of both natural and social systems;
- they pose a serious threat to the existence of world civilization;
- they become a major obstacle to social progress.

Global problems are those issues whose untimely resolution poses a serious threat to the future of humanity; therefore, they must be addressed without delay for the sake of the future progress of society. Global problems include such natural, scientific-technical, and socio-political challenges that can only be solved through the intense, collective effort and cooperation of all humankind. These problems cannot be resolved by the power of a single country or state, nor on a local or regional scale.

In order to develop and implement effective solutions to global problems, it is first necessary to study their nature and the causes of their emergence.

Throughout the entire history of humankind, global problems have gradually emerged, and in the modern era, they have manifested in an especially acute form. Their emergence has occurred in two main ways.

On the one hand, they are the result of human development and conscious activity, as well as the evolution of the relationship between humans and nature. This is reflected in the improvement of tools of labor, the advancement of material culture, and the development of production within society.

On the other hand, the emergence, deepening, and transformation of global problems into a threat to humanity's future can largely be explained by the contradictory nature of social progress. All global problems of the modern era are closely interconnected and mutually influence and condition one another.

The causes of modern global problems can be divided into three main groups:

First, the fundamental and objective contradictions of social development -the conflict between society, humanity, and nature;

Second, the intensification of the general crisis of an unjust society;

Third, the rapid development of the scientific and technological revolution in two different parts of the world. If we examine several global problems, we can see that they play a very significant role in the modern era.

The most acute problem facing humanity is the issue of war and peace. Since the appearance of humankind on Earth, countless wars have been fought over thousands of years with various types of weapons. These wars have mainly occurred for reasons such as seizing land, gaining control over natural resources, expanding territories, asserting religious dominance, or establishing ethnic and territorial superiority.

After the Second World War, the rapid development of science and technology led to the creation of new types of weapons. These weapons are now capable of destroying millions of people in a very short time.

1. Among the many global environmental problems today, the protection of peace, the prevention of war, disarmament, and especially the prevention of global nuclear conflicts hold a particularly critical place. The first and most devastating effect of a nuclear explosion is the mechanical nuclear wave, which causes the powerful destruction of both natural and artificial objects.

2. The second effect is intense thermal radiation, which triggers fires and burns or annihilates all living beings. Another catastrophic consequence is radioactive gamma radiation, which can occur at a dose of 400–1000 BER (the main lethal effect). This leads to contamination of the environment with radioactive isotopes - up to 10 curies per square kilometer - a dose that is fatal for all living organisms.

3. The third danger of a nuclear explosion is high-level radioactive contamination.

Thus, beginning from the second half of the 20th century, peace and disarmament have become the most crucial problems facing humanity.

A nuclear war is a large-scale conflict that involves the mutual use of nuclear weapons by at least two states. The consequences of such a war would produce irreversible damage not only in military and political spheres but also for humanity and nature.

Nuclear weapons are those whose destructive power derives from the release of energy from within

atomic nuclei. The energy produced during nuclear transformations is called nuclear energy. Known nuclear weapons employ explosions by two methods: in atomic (fission) weapons, heavy chemical-element nuclei split into lighter atoms and nuclei - a process called fission; in hydrogen (thermonuclear) weapons, light-element nuclei fuse to form heavier nuclei - a process called fusion. Chain reactions in nuclear munitions are driven by the elements uranium and plutonium. Because these substances are highly radioactive, their nuclei can split spontaneously, emitting particles.

The explosive power of a nuclear munition is characterized by its TNT equivalent. The TNT equivalent is the mass (in tons) of conventional explosive (TNT) that would produce an amount of energy equal to that released by the nuclear detonation. The yield of a nuclear charge is therefore measured in tons, kilotons, or megatons of TNT equivalent.

Nuclear warheads are mounted on the following delivery vehicles: ballistic missiles (in their warhead sections); surface-to-air and cruise missiles (in their warheads); aerial bombs; artillery shells and mines; torpedo warheads; and combat/engineering mines.

The destructive effects of nuclear explosions on human populations are complex in nature, cover large areas, and persist for a long time. The damaging factors of a nuclear explosion are distributed approximately as follows: about 50% of the released energy goes into the blast (shock) wave, 35% into thermal (light) radiation, 10% into radioactive contamination of the area, 4% into penetrating (ionizing) radiation, and about 1% into an electromagnetic pulse.

Throughout the history of humankind, there have been countless wars. According to approximate estimates, over the past 5,500 years, about 15,000 wars and military conflicts have taken place on Earth - more than half of them in Europe - bringing immense suffering and hardship to nations. During its entire existence, humanity has known only about 292 years without war.

In the first half of the 20th century, humanity twice endured devastating wars that were exceptionally bloody and destructive. As military technology advanced, the destruction of civilian populations also increased. The ratio of civilian to military deaths has evolved as follows: in the First World War - 1:20; in the Second World War - 1:1; in the Korean War (1950–1953) - 5:1; in the Vietnam War (1964–1968) - 20:1. If modern weaponry were to be used even in a local war today, the number of civilian deaths would be one hundred times greater than that of soldiers (100:1). Such a war would, in essence, be a war against civilians.

Thus, modern warfare has become a truly global problem for all humanity. The global nature of the war problem is directly linked to the massive accumulation of weapons around the world. The total explosive power of existing nuclear arsenals today exceeds by several thousand times the combined destructive force of all the munitions used in past wars.

At present, various countries possess vast stockpiles of nuclear weapons. The overall power of these weapons is millions of times greater than that of the bombs dropped on Hiroshima and Nagasaki in August 1945. On August 4 and 8, 1945, the United States

dropped atomic bombs on the Japanese cities of Hiroshima and Nagasaki. Within seconds, Hiroshima was completely leveled, and around 300,000 people faced catastrophic consequences.

As a result of the bombing of Hiroshima, more than 200,000 people were killed, about 40% of the city was reduced to ashes, and the remaining area was left in an unrecognizable, devastated state. The tragic consequences of those atomic bombings are still observed in Japan today.

The environmental effects of nuclear weapons.

A nuclear weapon (atomic bomb) is an explosive device whose destructive effect results from the large amount of internal nuclear energy released within a confined space as a result of nuclear reactions. The energy released per unit mass of matter in these reactions is 20–80 million times greater than that released by conventional explosives. The extremely rapid and massive release of energy appears as a nuclear explosion and, because of its power and the nature of its damaging factors (blast wave, thermal radiation, penetrating/ionizing radiation, radioactive contamination, and electromagnetic pulse), it differs fundamentally from the explosion of ordinary munitions.

A nuclear weapon is the most powerful means of mass destruction: it is designed to destroy administrative centers, industrial and military facilities, annihilate manpower, ignite fires, contaminate the environment with radioactivity, and so on. Nuclear weapons also exert a powerful moral and psychological impact on people. At present, Russia, the United States, the United Kingdom, France, and China officially possess nuclear weapons.

The bombings of Hiroshima and Nagasaki make it possible to study directly the effects of nuclear detonations in urban areas. These tragic events have provided various data on the potential physical, biological, and social consequences of nuclear war. It should be noted, however, that each of those cities was subjected to only a single atomic detonation, and the power of the bombs dropped there is very small compared with the explosives currently concentrated in the world's nuclear arsenals. As a result, there are now some 50,000 nuclear weapons, and each of them is many times (about 500 times) more powerful than the bomb detonated over Hiroshima. The power of a single modern nuclear bomb can be 100,000 times greater than the most powerful bomb used in the Second World War [6].

The continuous development of ever more powerful new types of weapons raises a disturbing question: if such weapons were to be used, what would happen?

As a result of the massive fires triggered during nuclear bombings, the smoke produced could lead to global changes in the Earth's atmosphere and climate. Research indicates that if a large-scale war were to occur and major cities around the world were bombarded, vast regions of the planet could be covered by smoke and dust for weeks or even months. Sunlight would be blocked by the immense clouds of particles produced during the fires. The most severe effects would occur in the Northern Hemisphere, where atmospheric contamination would be strongest. In some regions, average temperatures could drop several degrees Celsius below

freezing. Such conditions could persist for weeks or even months after the cessation of military operations.

Climate disruption would also affect countries not directly involved in the war, with consequences becoming apparent over several years. A reduction in precipitation in certain parts of the world is also possible. Changes in temperature and rainfall would be observed in tropical regions and the Southern Hemisphere, though to a lesser extent than in the Northern Hemisphere. Significant cooling could also occur in tropical and subtropical areas.

These disasters would not spare global agriculture or major ecosystems, including forests, steppes, and marine areas. Plant and animal populations would be subjected to rapid and dramatic environmental changes. Harvesting crops would be extremely difficult due to abrupt climate fluctuations as well as disruptions in the supply of energy, machinery, and fertilizers. This would lead to a global food crisis affecting both warring and neutral countries. The destruction of production systems and the distribution of food would result in a significant decrease in the Earth's population.

In addition to potential climate changes, large-scale nuclear strikes would cause widespread fires, explosions, and radioactive fallout, devastating extensive areas. Other consequences would include the failure of energy supply systems; depletion of the ozone layer, which protects life on Earth from harmful ultraviolet rays; intense local radioactive precipitation and long-term global atmospheric contamination; and poisoning of water and air by large quantities of toxic substances and gases.

Thus, a nuclear conflict would trigger severe climate and other ecological disruptions on Earth. Even under moderate scenarios, the impact of nuclear conflicts on global agriculture, natural ecosystems, and ultimately humanity itself would be extremely dangerous.

Climate Effects of a Nuclear Conflict. If the world's major cities, especially energy supply systems operating on fossil fuels, were subjected to nuclear strikes, global climate disruption would be inevitable. It is highly likely that in the event of a large-scale nuclear conflict, the bombing of cities and surrounding military and industrial facilities would devastate the main industrial regions of the Northern Hemisphere.

The immediate effects of a nuclear explosion are associated with ionizing radiation, blast waves, and thermal radiation. These cause the instant death of people and the catastrophic destruction of areas the size of large cities. In addition, nuclear detonations would inevitably trigger massive fires in urban areas, and the resulting dense smoke would carry huge amounts of soot into the atmosphere. Nuclear explosions lift enormous quantities of dust, debris, and soil into the air from the Earth's surface. The presence of radioactive particles in the atmosphere would result in radioactive fallout both in nearby regions and across the entire planet. Dust particles that rise into the upper layers of the atmosphere can cause severe climate disruptions.

It is estimated that if one-quarter of the flammable materials in large Northern Hemisphere cities were ignited by nuclear explosions, approximately 50–150

million tons of particles would be released into the atmosphere, of which about 30 million tons would consist of carbon-rich soot capable of efficiently absorbing sunlight. Soot particles are primarily produced during the burning of oil, gasoline, crude oil, and petrochemical products such as plastics, rubber, and asphalt.

In contrast, smoke from fires in forests, steppes, and open fields contains much less soot, so its impact on the climate is likely secondary compared with “industrial” smoke. During intense fires, rising air currents can carry the smoke particles into the 10–15 km layer of the troposphere and even into the stratosphere. In many cases, these smoke plumes can be trapped by storm clouds located at lower altitudes [3].

Over Hiroshima and Nagasaki, rising smoke clouds trapped and absorbed these particles, resulting in “black rain” composed of soot, dust, and ash mixed with water, which fell for several hours after the atomic bombings.

Recent studies suggest that during rainfall, within a few hours or days, approximately 30–50% of the particles produced by fires triggered during an atomic bombing fall to the ground. As noted, soot-laden smoke intensely absorbs sunlight. Dense clouds of soot mix high in the atmosphere, “trapping” a large portion of solar energy and creating a barrier that prevents it from reaching the surface. This causes the upper layers of the atmosphere to heat up while the lower layers cool.

If 30 million tons of soot particles were dispersed across the mid-latitude regions of the Northern Hemisphere, the amount of sunlight reaching the Earth’s surface could decrease by no less than 90%. Initially, soot particles aggregate into massive, flat “clumps” and are carried over long distances by wind. Subsequently, abrupt weather changes could occur, leading to a short-term but intense cooling.

Within several days after a nuclear detonation, atmospheric processes are unlikely to clear the sky. After a few days, the upper layers of the troposphere may stabilize, warming the soot-laden clouds. As a result, soot particles rise even higher and can no longer be removed effectively by rainfall. Within a few days, smoke clouds and soot particles could cover one continent and large portions of North America, Europe, and Asia.

Other Consequences of a Nuclear Explosion. 1. Nitrogen oxides produced during a nuclear explosion can rise into the atmosphere and contribute to the depletion of the ozone layer. Calculations suggest that in the Northern Hemisphere, the ozone layer could decrease by 20–30% over six months to a year. In the short term, “ozone holes” could also form, where the thickness of the ozone layer might reach only about 30% of the normal level. This would increase the intensity of harmful ultraviolet radiation in open areas, although the presence of smoke in the atmosphere for several months could act as a temporary barrier. However, the entry of soot into the atmosphere can directly, or indirectly through changes in air temperature and atmospheric circulation, lead to further destruction of the ozone layer.

2. After a nuclear strike, vast amounts of chemical substances—including carbon oxides, various hydrocarbons, nitrogen and sulfur oxides, sulfuric acid, heavy metals, and other toxic compounds—would be released

into the atmosphere, causing severe environmental pollution. These substances would inflict significant harm on humans and all living organisms both directly and indirectly, with effects that could last for years. Depending on various factors, the acidity of rainwater would increase significantly; in polluted industrial regions, acid rain levels could rise tenfold within just one month. The Earth’s surface would be shrouded in “acidic smog” for a month. Slowly burning (non-flaming) fires would produce toxic mixtures in the air, which would pose a serious risk to human health.

3. Even in the first days following major nuclear strikes, intense local radioactive fallout would occur at the sites of the explosions. Lethal doses of gamma radiation would spread across vast areas of the warring states. In the absence of specialized shelters, less intense but widespread radioactive fallout could persist for a long time, leading to the spread of cancer and other serious diseases.

Radioactive particles would enter the human body through food, water, and air (inhalation). Among survivors of a nuclear bombing, the effects of radiation would be particularly severe—first, because their health would already be compromised by other harmful impacts and the deterioration of environmental conditions, and second, because medical assistance would be minimal.

In the Southern Hemisphere, local radioactive fallout would only pose a threat within several hundred kilometers of the nuclear detonation sites. The likelihood of widespread, high-dose global radioactive fallout is relatively low.

4. If nuclear explosions occur in the upper layers of the atmosphere, large areas of the Earth would be subjected to intense electromagnetic radiation, which would disrupt or completely disable communications, power, and electronic systems. The loss of these systems at the outset of a war would create panic and chaos at a time when sober, responsible decisions about the use of nuclear weapons are urgently needed.

The continued refinement and production of nuclear weapons and the missiles that deliver them demonstrate that nuclear war remains a real threat to humanity. Scientists have calculated that the explosive power of the nuclear weapons currently in existence would be sufficient to destroy life on our planet several times over. Research in this field indicates that a nuclear war could also produce a catastrophic ecological disaster capable of rendering the Earth uninhabitable. Therefore, the progress of humanity and a peaceful, prosperous future are incompatible with the continued existence of nuclear arms.

All this shows that the manufacture of atomic bombs and other similar weapons of mass destruction amounts to a plot against humanity itself. In conditions where such weapons exist, it is extremely difficult to guarantee that nuclear war will never occur.

To prevent the danger of nuclear war, the first priority must be to halt the arms race and stop the production of nuclear weapons; chemical and bacteriological weapons should be completely banned. This is crucial because vast military establishments and the enormous stockpiles of nuclear weapons concentrated in the

hands of several states constitute the greatest sources of danger to humankind.

Currently, the main supervisory functions in this field are carried out by the International Atomic Energy Agency (IAEA). Key international legal frameworks include the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), adopted in 1968, and the Comprehensive Nuclear-Test-Ban Treaty (CTBT). However, in practice, these mechanisms face several challenges:

Some states do not fully facilitate inspections;

International oversight is applied selectively;

Technological monitoring capabilities are insufficient.

To address these weaknesses, the following measures are proposed:

1. Implementation of digital monitoring systems – real-time data transmission via satellites and sensors, with tracking using blockchain technology.

2. Establishment of a multilateral monitoring structure – involving not only the UN but also regional organizations in oversight.

3. Public disclosure and scientific oversight – annual state reports to be independently evaluated by expert reviewers.

4. Uniform and fair application of sanctions and legal pressure – systematic measures against states that violate the NPT and CTBT.

5. Education and technological analysis – training of qualified personnel in nuclear safety and raising public awareness.

In the system of global problems, preventing the threat of nuclear war and ensuring peace occupies a central place. It should also be noted that the issue of war and peace strongly affects other global problems. First and foremost, the continuous increase in military expenditures reduces the resources available for addressing other critical tasks facing humanity. Currently, military spending has increased fiftyfold compared to 1900, reaching one trillion dollars per year. Humanity now spends up to two million dollars per minute on military purposes.

The problem is that rapid militarization increasingly involves developing countries within its sphere of influence. As a result, solving the problem of overcoming the weak development levels of these countries becomes even more difficult. In developed capitalist countries, rapid increases in military spending create serious obstacles to addressing socio-economic problems and exacerbate difficulties related to energy and raw materials. On one hand, rising military expenditures reduce funds allocated to increasing energy and

raw material resources; on the other hand, an ever-growing portion of these resources is diverted for military purposes.

All this demonstrates that if a nuclear war were to occur, there would be neither winners nor losers; it could result in the annihilation of all humanity. Therefore, to prevent the threat of nuclear war, it is essential that all states, especially those possessing nuclear weapons, combine their efforts.

The time to create a “nuclear-free world” and to ensure peace and security on Earth has long since arrived. Unfortunately, humanity has not yet achieved this goal.

For example, bridging the growing gap in economic and cultural development between developed Western countries and less developed countries in Asia, Africa, and Latin America, and meeting the increasing demand for natural resources and raw materials—both renewable and non-renewable—as well as sufficient quantities of quality food and energy, which are essential for the development of humanity, can to some extent mitigate the negative aspects in solving global problems. Many global problems have existed before, but they did not assume such an acute form as they do under current conditions.

An axiom should be remembered by people: "We did not inherit the Earth from our ancestors, we borrowed it from our children." In this regard, our planet should be kept clean, free, and healthy for future generations [5].

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