

PROTECTION OF CIVILIAN INFRASTRUCTURE IN CONTEMPORARY ARMED CONFLICTS: A HUMANITARIAN LAW STUDY ON ATTACKS AGAINST WATER AND ENERGY FACILITIES IN GAZA AND UKRAINE

Elen Anedya Frahma

Universitas 17 Agustus 1945 Semarang

E-mail: elen-anedyafrahma@untagsmg.ac.id

Abstract

Contemporary armed conflicts exhibit increasingly complex patterns of attacks on vital civilian objects, including water and energy infrastructure. This study critically examines the legal protection of non-military civilian facilities such as hydroelectric power plants, reservoirs, and clean water systems from the perspective of International Humanitarian Law (IHL). Using a literature review method based on Human Rights Watch reports and international journal articles published since 2022, the research explores two primary case studies: the 2023 attack on the Dnipro Hydroelectric Power Plant in Ukraine and the destruction of clean water systems in Gaza during 2023–2024. The analysis reveals that both attacks potentially violate fundamental IHL principles, such as distinction and proportionality. Furthermore, the study identifies a normative gap in the explicit protection of vital civilian facilities that directly impact civilian survival. These findings underscore the urgent need for stronger enforcement and normative reform within international legal frameworks to ensure the protection of civilian infrastructure in times of conflict.

Keywords: International Humanitarian Law, Civilian Infrastructure, Hydropower, Clean Water, Armed Conflict.

INTRODUCTION

The issue of protecting civilian infrastructure in contemporary armed conflict has become increasingly critical, especially as vital objects such as water and energy supplies have become deliberate targets in modern warfare. Attacks on clean water facilities, power plants, reservoirs, and dams not only destroy physical assets but also severely disrupt the civilian population's ability to maintain a dignified standard of living. This study focuses on a significant gap in the discourse of international humanitarian law – namely, the insufficient legal attention given to vital non-military objects. The primary novelty of this research lies in its emphasis on underexplored facilities, particularly water and energy infrastructure, within the contexts of Gaza and Ukraine. The attacks in Gaza have included the destruction of water tanks, small reservoirs, and desalination facilities, which, according to Human Rights Watch analysis, have led to the loss of access to the majority of clean water reserves. Dozens of reservoirs were severely damaged due to engineered explosions by the military, several of which occurred in densely populated areas. Without electricity to operate pumping systems and desalination equipment, large parts of Gaza have faced a severe clean water crisis. In Ukraine, attacks on energy infrastructure have been carried out systematically since the onset of the Russian invasion in February 2022. Airstrikes, missiles, and loitering drones have routinely targeted thermal and hydroelectric power plants, as well as energy transmission and distribution systems, leaving

millions of civilians without electricity, water, or heating – and triggering scheduled blackouts lasting up to several hours each day. The UN Human Rights Monitoring Mission in Ukraine reported nine major waves of attacks on the power system between March and August 2024, damaging power plants, transmission lines, and energy distribution networks across 20 of Ukraine’s 24 regions. Water and sanitation infrastructure was also widely disrupted, exacerbating the humanitarian impact – particularly for vulnerable groups such as the elderly, people with disabilities, and low-income populations. Humanitarian law analysis highlights that these attacks potentially violate core principles of the law of armed conflict—namely, distinction, proportionality, and precaution. Power plants or water reservoirs targeted in such strikes often fail to meet the criteria of legitimate military objectives, even if they are partially.

used for military purposes. The harm inflicted on the civilian population is likely to outweigh any anticipated military advantage. The destruction of the Kakhovka Dam in June 2023 represents an extreme case of simultaneous damage to both water and energy infrastructure. The internal explosion triggered massive flooding, widespread environmental devastation, and the loss of access to clean water for hundreds of thousands of people. The World Health Organization (WHO) and various international bodies issued warnings about the heightened risk of a nuclear disaster, given the dam’s critical role in supplying cooling water to the Zaporizhzhia Nuclear Power Plant. This study explores how literature since 2022 has addressed attacks on hydroelectric power plants (HEPPs), power stations, and reservoirs in Gaza and Ukraine. Drawing primarily from Human Rights Watch reports and recent international journal articles, the research focuses on non-military civilian infrastructure that is essential for survival, yet often overlooked in contemporary international humanitarian law (IHL) discourse. In the context of Gaza, limited academic attention has been given to the legal implications of attacks on non-military water facilities such as reservoirs, local dams, or desalination plants. While Human Rights Watch has provided substantial data on the extent of damage, legal analysis concerning the principles of distinction and proportionality justification remains sparse. Using the framework of international humanitarian law, this study aims to enrich the existing literature by evaluating the extent to which the actions of warring parties comply with international legal standards. By emphasizing critical non-military infrastructure, it contributes to a deeper understanding and potential normative strengthening of civilian protection in future armed conflicts.

Problem Formulation

The central problem addressed in this research is how attacks on vital civilian infrastructure – particularly water and energy facilities – can be classified as violations of the core principles of International Humanitarian Law: distinction, proportionality, and the obligation of precaution. This study analyzes two real-world cases: the attack on the Dnipro Hydroelectric Power Plant in Ukraine in 2023 and the destruction of clean water systems in Gaza during the 2023–2024 period. The aim is to evaluate the extent to which these actions breach international legal norms and to examine how current legal frameworks respond to the targeting of essential non-military infrastructure in the context of armed conflict.

RESEARCH METHODS

The research method used in this study is library research, which involves examining various documents, reports, and scholarly articles relevant to the protection of civilian infrastructure during armed conflict, with a particular focus on water and energy facilities. The primary sources are derived from investigative reports by Human Rights Watch and peer-reviewed international journal articles published between 2022 and 2024 that discuss attacks on power plants, hydroelectric dams, and reservoirs in Gaza and Ukraine. The study aims to assess the extent to which such attacks on vital non-military objects can be classified as violations of international humanitarian law, particularly under the principles of distinction, proportionality, and precaution. Data collection was conducted through the exploration of reputable international journal databases such as JSTOR, HeinOnline, Taylor & Francis, and ScienceDirect, using keywords like “civilian infrastructure,” “IHL,” “hydropower attacks,” “energy facilities conflict,” “Gaza,” and “Ukraine.” Reports from Human Rights Watch served as primary sources to support factual accounts of the impact of attacks on public facilities. All documents were then analyzed qualitatively using a descriptive-analytical approach to interpret the relevance of findings in light of applicable international humanitarian law norms, and to identify legal gaps and practical implications for civilian protection in armed conflict.

Discussion and Findings

Violations of the Principles of Distinction and Proportionality in Attacks on Civilian Infrastructure

Literature reviews indicate that attacks on vital infrastructure such as water and energy facilities in Gaza and Ukraine often violate the principle of distinction under international humanitarian law. This infrastructure, although critical to civilian life, does not always hold legitimate military value. In many cases, these targets are attacked despite having no direct military contribution. This clearly violates the obligation to distinguish between military and civilian objects, as well as the duty to protect the civilian population from the effects of unlawful attacks. The damage caused is not limited to the infrastructure itself, but also has a direct impact on the lives of millions of civilians. The drastic decline in electricity supply in Gaza has caused water pumping systems, desalination plants, and sanitation facilities to cease operation. As a result, the production of drinking water dropped to an extremely low level around 5 percent of pre-conflict capacity due to power and fuel cuts. This situation has exacerbated outbreaks of diseases such as diarrhea, hepatitis A, and malnutrition. In the Ukraine conflict, the attack on the Dnipro Hydroelectric Power Plant in March 2024 resulted in the loss of one-third of its energy generation capacity and caused environmental damage estimated at US\$3.5 million. This destruction severely disrupted electricity flow and downstream water supply, hindering the operation of civil services and local agriculture in the Zaporizhzhia region and its surroundings.

If the impact on civilians far outweighs the potential military advantage gained from the targeted attack, then the principle of proportionality is violated. Attacks on facilities such as dams, power plants, or water distribution systems often appear to occur without adequate assessment of the risks to civilian populations. In the context of Gaza, the rising death toll resulting from the water and sanitation crisis indicates civilian consequences that far exceed the claimed military value of the targets by the parties to the conflict. Experts in humanitarian law emphasize that even if civilian facilities are partially used for military purposes, this does not nullify the civilian protection to which they are entitled. If the military advantage gained from an attack is disproportionate to the harm inflicted on the civilian population, such an attack remains unlawful. In the cases of Gaza and Ukraine, the widespread damage was often not accompanied by clear evidence of concrete military gains, thereby raising strong suspicions of violations of international law. In the context of Gaza, reports by Human Rights Watch indicate that the power cuts and destruction of water infrastructure were carried out deliberately and systematically, not merely as incidental consequences of combat operations. These actions effectively prevented civilians from accessing basic necessities, including clean water and sanitation. This implies that the attacks were not solely military in nature but also aimed at inflicting widespread civilian suffering.

The Human Rights Watch (HRW) report also details that these actions included the cutting off of water supplied by the Mekorot pipelines, which provide more than 70% of Gaza's drinking water needs. Such attacks directly affected hundreds of thousands of people, including those who relied on desalination facilities that ceased operations due to power outages. These shutdowns occurred in the context of a systemic blockade that further deteriorated water and sanitation conditions for months. The health impacts resulting from Gaza's water crisis have been extremely severe. Data indicates over one million cases of waterborne and sanitation-related diseases, along with thousands of child fatalities due to the loss of access to basic necessities. In such circumstances, attacks on civilian infrastructure constitute grave violations as they directly contravene obligations to protect and uphold fundamental rights such as the right to life and an adequate standard of living.

Legal analysis also highlights that the use of blockade tactics in Gaza – including the deliberate cutoff of electricity, water, fuel, and humanitarian aid – represents a collective punishment mechanism targeting the entire civilian population. This approach conflicts with the positive obligations incumbent upon occupying powers or conflict parties to ensure the basic needs of civilians during armed conflict. In Ukraine, meanwhile, the attack on the Dnipro Hydropower Plant (HPP) caused long-term environmental damage – pollution of the Dnipro River from oil leaks, ecosystem destruction, and threats to agrarian water supply systems. Such interventions could be categorized as violations of the precautionary principle due to their widespread and disproportionate effects on civilians and the surrounding environment. Taken together, these findings demonstrate a consistent pattern: systematic attacks on water and energy infrastructure in both conflicts exhibit a failure to adequately distinguish between military and civilian targets and neglect to consider the severe humanitarian consequences for the civilian population. Violations of the

principles of distinction and proportionality are clearly evident in both contexts. Therefore, a stricter legal interpretation and policies ensuring accountability for such attacks are urgently needed.

Attacks on the Dnipro Hydropower Plant (Ukraine 2023/2024) and the Destruction of Clean Water Infrastructure in Gaza (2023–2024)

Literature studies note that in March 2024, the Russian attack on the Dnipro Hydropower Plant resulted in fires caused by drones, an oil spill of up to 0.5 tons into the Dnipro River, and damage to the aquatic ecosystem in the Zaporizhzhia region. The plant lost approximately one-third of its power generation capacity, with water-related damages estimated at around US \$3.5 million. Recovery is expected to take several years. The impact of the attack extended downstream, particularly affecting the water system in Bilenke, leading to the suspension of water supply and disruption of local agricultural systems. This damage hindered sanitation operations and water distribution for the civilian population, potentially triggering a medium- to long-term public health crisis and disruption of civilian life. International humanitarian law literature emphasizes that hydropower plants (HPPs) are protected civilian objects unless they are used exclusively for military purposes. In many cases, claims of military use as justification are insufficient without clear evidence of tangible military advantage. In this context, the military benefit of the attack appears minimal compared to its impact on civilians. The central legal concern lies in the application of the principle of precaution. Attacks on HPPs that result in environmental pollution, oil spills, and water system disruption indicate a lack of preventive measures to minimize risks to civilians and the environment. This constitutes a violation of the obligation to avoid excessive damage.

Shifting focus to Gaza, from October 2023 to September 2024, Human Rights Watch reported that over 84% of water and sanitation infrastructure was damaged or destroyed, including four out of six major wastewater treatment facilities, water pipes, and wells. Daily access to drinking water for residents dropped drastically below the UN emergency minimum threshold, averaging only 2 to 9 liters per person per day. A series of measures including electricity and fuel cut-offs, destruction of solar panels, spare parts warehouses, and attacks on technicians repairing water systems indicates a deliberate pattern of infrastructure destruction. Human Rights Watch emphasizes that these are intentional actions, not merely incidental damage resulting from broader military operations. Other organizations, such as the Palestinian Centre for Human Rights (PCHR) and Oxfam, reported that the Israeli Occupation Forces (IOF) cut off the Mekorot pipeline—responsible for supplying approximately 70% of Gaza’s water needs—in April 2025. Additionally, they halted electricity supply to desalination facilities that previously provided 18,000 m³ of water per day, affecting around 600,000 people in Deir al Balah and Khan Younis. As a result of this systemic destruction, Gaza residents have access to only around 5 liters of water per day. Sanitation-related illnesses—such as diarrhea, hepatitis A, and polio have risen sharply, primarily affecting children and other vulnerable groups. The Human Rights Watch (HRW) report also explicitly states that acts such as damaging water treatment facilities and obstructing repairs constitute a “crime against humanity of extermination,” and may even qualify as acts of genocide under the 1948 Genocide Convention, as they create living conditions intended to physically destroy part of Gaza’s population. In the context of humanitarian law, complexity arises when vital civilian objects are perceived to provide military support, even though the primary impact falls on the civilian population. Literature studies and Human Rights Watch reports indicate that

the alleged military advantage of such targets has never been proven to outweigh the resulting humanitarian consequences. Furthermore, the use of blockade strategies—including the collective cutting of water, electricity, and fuel—violates the occupying power’s positive obligations to ensure the basic needs of the civilian population. This includes the right to water as part of the right to life and an adequate standard of living under international law. These findings reflect that in both Ukraine and Gaza, attacks targeting non-military vital infrastructure such as hydropower plants and water systems have had civilian consequences that far outweigh military considerations. This highlights the need for specific legal protections and accountability for those responsible for such attacks. Thus, the cases of the Dnipro Hydropower Plant and the destruction of Gaza’s water infrastructure clearly represent legal challenges in protecting non-military vital objects and illustrate normative gaps that allow systemic attacks on civilians’ basic needs to occur without sufficient legal oversight.

Conclusion

Attacks on vital civilian infrastructure—such as hydroelectric power plants, reservoirs, and clean water distribution systems—in Gaza and Ukraine highlight the failure of armed actors to adhere to the fundamental principles of International Humanitarian Law. In both the destruction of the Dnipro Hydroelectric Power Plant by Russian forces and the cutting off of clean water supplies in Gaza by the Israeli military, there appears to be a disregard for the principle of distinction between military targets and civilian objects, as well as a disproportionate balance between anticipated military advantage and the humanitarian impact on civilian populations. These cases underscore the urgent need for stronger enforcement of legal norms and international accountability for violations of basic rights to water and energy. Furthermore, the findings of this study reveal that vital non-military objects such as water and electricity infrastructure remain underrepresented in contemporary humanitarian law literature. Yet, damage to such infrastructure carries severe humanitarian consequences—particularly for vulnerable groups such as children, the elderly, and the wounded. Therefore, there is a pressing need to strengthen the international legal framework with explicit protections for critical civilian facilities in armed conflict, along with the establishment of effective monitoring and accountability mechanisms to address ongoing violations.

Reference

- Brandon, Emma. “Hopeless, Starving, and Besieged.” *Human Rights Watch* 6, no. 2 (November 14, 2024): 107–24. <https://doi.org/10.18261/ISSN.2387-3299-2019-02-03>.
- “Dnieper Hydroelectric Station - Wikipedia.” Accessed July 19, 2025. https://en.wikipedia.org/wiki/Dnieper_Hydroelectric_Station?
- El-Khozondar, Hala J., and Fady El-batta. “Solar Energy Implementation at the Household Level: Gaza Strip Case Study.” *Energy, Sustainability and Society* 12, no. 1 (December 1, 2022). <https://doi.org/10.1186/S13705-022-00343-7>.
- “Electricity: A Strategic Issue in the Ukraine and Gaza Conflicts - Alternatives Humanitaires.” Accessed July 19, 2025. <https://www.alternatives-humanitaires.org/en/2024/11/27/electricity-a-strategic-issue-in-the-ukraine-and-gaza-conflicts/>
- “Environmental Damage after Russian Attack on Dnipro Hydroelectric Power Plant Reaches over US\$ 3.5 Million | Ukrainska Pravda.” Accessed July 19, 2025. <https://www.pravda.com.ua/eng/news/2024/03/27/7448437/>.
- “Extermination and Acts of Genocide: Israel Deliberately Depriving Palestinians in Gaza of Water | HRW.” Accessed July 19, 2025.

- [https://www.hrw.org/report/2024/12/19/extermination-and-acts-genocide/israel-deliberately-depriving-palestinians-gaza?](https://www.hrw.org/report/2024/12/19/extermination-and-acts-genocide/israel-deliberately-depriving-palestinians-gaza?utm_source=chatgpt.com)
- “Extermination and Acts of Genocide: Israel Deliberately Depriving Palestinians in Gaza of Water | HRW,” 2023. https://www.hrw.org/report/2024/12/19/extermination-and-acts-genocide/israel-deliberately-depriving-palestinians-gaza?utm_source=chatgpt.com.
- FIDH. “Ukraine: Russia’s Attacks against Energy Infrastructure Violate International Humanitarian Law,” December 2022. <https://www.fidh.org/en/region/europe-central-asia/ukraine/russia-attacks-against-energy-infrastructure-ukraine?>
- “Gaza’s Water Infrastructure Desperately Needs to Be Rebuilt | Human Rights Watch.” Accessed July 19, 2025. <https://www.hrw.org/news/2025/02/13/gazas-water-infrastructure-desperately-needs-be-rebuilt?>
- “‘Hopeless, Starving, and Besieged’: Israel’s Forced Displacement of Palestinians in Gaza | HRW.” Accessed July 19, 2025. <https://www.hrw.org/report/2024/11/14/hopeless-starving-and-besieged/israels-forced-displacement-palestinians-gaza?>
- “Human Rights Watch Finds Israel Guilty of Extermination and ‘Acts of Genocide’ | MR Online.” Accessed July 19, 2025. <https://mronline.org/2024/12/21/157010/?>
- “Israel’s Crime of Extermination, Acts of Genocide in Gaza | Human Rights Watch.” Accessed July 19, 2025. <https://www.hrw.org/news/2024/12/19/israels-crime-extermination-acts-genocide-gaza?>
- “Israel Accused of Act of Genocide over Restriction of Gaza Water Supply | Israel | The Guardian.” Accessed July 19, 2025. https://www.theguardian.com/world/2024/dec/19/israel-accused-of-act-of-genocide-over-restriction-of-gaza-water-supply-human-rights-watch?utm_source=chatgpt.com.
- “Israeli Forces’ Conduct in Gaza | Human Rights Watch.” Accessed July 19, 2025. <https://www.hrw.org/news/2024/03/19/israeli-forces-conduct-gaza?>
- “It’s Vital to Protect Water Infrastructure During War | TIME.” Accessed July 19, 2025. https://time.com/6285314/ukraine-dam-destruction-water-war-essay/?utm_source=chatgpt.com.
- Musallam, Iyad, Yangxiao Zhou, and Graham Jewitt. “Simulation of Groundwater Flow and Seawater Intrusion in Response to Climate Change and Human Activities on the Coastal Aquifer of Gaza Strip, Palestine.” *Hydrogeology Journal* 31, no. 7 (November 1, 2023): 1953–69. <https://doi.org/10.1007/S10040-023-02694-7>.
- “Sept. 2024 – Attacks on Ukraine’s Energy Infrastructure: Harm to the Civilian Population | UN Human Rights Monitoring Mission in Ukraine.” Accessed July 19, 2025. <https://ukraine.ohchr.org/en/Attacks-on-Ukraines-Energy-Infrastructure-Harm-to-the-Civilian-Population?>
- “Urgent Appeal To End Israel’s Deliberate Deprivation of Water for Gaza’s Population and Ensure Access to Safe Drinking Water | Palestinian Centre for Human Rights.” Accessed July 19, 2025. <https://pchrgaza.org/urgent-appeal-to-end-israels-deliberate-deprivation-of-water-for-gazas-population-and-ensure-access-to-safe-drinking-water/?>