

IAEA's New Climate Initiatives: How International Cooperation Is Evolving? – OpEd

By Hafsa Azam

Key Takeaways:

- The IAEA is expanding beyond nuclear power to apply isotopic tools for climate-smart agriculture, AI-enabled water forecasting, ocean microplastic monitoring and adaptation support in 146 countries, as shown at its COP30 Atoms4Climate Pavilion.
- Nuclear output hit a record ~2,702 TWh in 2025 and avoided ~210 million tonnes of CO2; Atoms4Food techniques have doubled or tripled cassava yields in several countries.
- Pakistan's reactors avoid nearly 15 million tonnes of CO2 yearly and, via IAEA-FAO work, have produced over 150 climate-resilient crop varieties while aiding water and soil management.

Climate Change is no longer only an environmental challenge. It is increasingly seen as a global crisis, including from the perspective of food and water security. The year 2025 reinforced this reality more forcefully. Global energy-related carbon dioxide (CO_2) emissions reached nearly 38.4 billion tonnes, an increase of about 145 million tonnes over 2024, while atmospheric CO_2 concentrations reached approximately 427 parts per million (ppm), around 50% above pre-industrial levels. At the same time, global nuclear electricity generation reached a record high in 2025, increasing by 1.2%, while nuclear power became an increasingly important component of the global low-carbon transition.

Against this backdrop, to meet the challenges of climate change, especially food and water security, the International Atomic Energy Agency (IAEA) is expanding its climate agenda beyond the traditional debate over nuclear power and carbon emissions. Its emerging approach increasingly connects nuclear science with net-zero energy systems, climate-smart agriculture, water security, ocean protection, pollution monitoring and climate adaptation. The IAEA delegation's presence at COP30 in Belém in November 2025 demonstrated this broader agenda: through its Atoms4Climate Pavilion, the IAEA held more than a dozen events covering Small Modular Reactors (SMRs), climate-smart agriculture, water and soil protection, fusion energy and blue-carbon ecosystems.

One of the IAEA's most significant climate initiatives is Atoms4NetZero, which seeks to help governments evaluate the contribution of nuclear energy to national decarbonization strategies. This approach has gained greater relevance as nuclear power enters a new phase of global expansion. According to World Nuclear Association, global nuclear plants generated approximately 2,702 TWh of electricity in 2025, surpassing 2,667 TWh of electricity generated in 2024. The global fleet also recorded an energy availability factor of 84.1% in 2025, compared with 83.8% in 2024.

The climate value of this expansion is measurable. The International Energy Agency (IEA) estimated that nuclear power avoided approximately 210 million tonnes of CO_2 emissions in 2025 compared with fossil-based generation. Collectively, the deployment of solar, wind, nuclear, electric vehicles and heat pumps since 2019 avoided about 3 billion tonnes of CO_2 annually.

The most important evolution in the IAEA's climate strategy is that it is no longer confined to nuclear energy. Nuclear and isotopic technologies are increasingly being applied to help countries adapt to climate change, an area particularly important for developing countries. In May 2025, the IAEA launched a new coordinated research project to integrate isotope tracers into hydrological and climate models. The objective is to improve forecasting of water availability and extreme hydrological events. Isotopes can reveal the origin, movement, age and mixing of groundwater and surface water information that conventional hydrological observations cannot always provide.

This initiative is particularly significant as climate change intensifies water insecurity. The next stage is even more technologically ambitious. In July 2026, the IAEA launched research exploring how AI can be combined with isotope hydrology and create digital twin, a real-time virtual replica, to improve water-resource management. Multiple digital twins can integrate satellite observations, sensors, hydrological models and isotope data to create virtual representation of water systems, through a larger digital transformation which is also known as Industrial Revolution 4.0 or Industry 4.0.

Agriculture represents another major pillar of the IAEA's climate work. Food systems are highly vulnerable to drought, heatwaves, changing rainfall patterns, soil degradation and water scarcity. The IAEA, together with the Food and Agriculture Organization (FAO), is applying nuclear and isotopic techniques to improve agricultural productivity while reducing environmental pressures.

The Agency's Atoms4Food approach uses techniques such as nitrogen-15 isotopes to determine how efficiently crops absorb fertilizer. This allows farmers to apply nutrients more precisely, potentially reducing fertilizer use, greenhouse-gas emissions and water pollution. Nuclear techniques are also being used in mutation breeding to develop crops with improved tolerance to drought, heat and disease.

The results have been substantial. IAEA-supported climate-smart agriculture projects have helped farmers in many countries including Burundi, the Central African Republic, Ghana, Nigeria, Rwanda, Zimbabwe and Laos to achieve double and triple cassava (a tropical staple crop) yields in some cases. In one example from Burundi, cassava production increased from approximately 11 tonnes per hectare to 30–33 tonnes per hectare after farmers adopted improved practices involving nuclear and isotopic techniques.

The IAEA reported in 2025 that its technical-cooperation projects were helping 146 countries address climate change adaptation through applications including plant breeding, animal production, food safety, health and insect-pest control.

In a major development, in July 2026, IAEA launched the Nuclear Technology for Controlling Plastic Pollution (NUTEC Plastics) Global Marine Monitoring Platform. Experts from 65 countries participated in its launch. The platform serves as an online repository for findings from marine-monitoring laboratories supported by the initiative, strengthening international cooperation on tracking the amount and distribution of micro plastics in marine and coastal environments. This is increasingly relevant to climate policy because ocean health, carbon sequestration and biodiversity are interconnected. The IAEA has emphasized the role of nuclear techniques in studying blue-carbon ecosystems, ocean acidification and marine pollution. At COP30, these issues formed part of the Agency's broader climate program.

The IAEA's participation in COP30 in 2025 represented another important development. For the fourth consecutive year, the Agency hosted an Atoms4Climate Pavilion, but the scope of its program had clearly expanded. Instead of focusing solely on nuclear energy, the pavilion presented nuclear science as a tool for clean energy, food security, water management, soil protection, ocean health and climate adaptation.

Pakistan already has an established nuclear-energy program. Pakistan operates six nuclear power reactors at two sites, with a combined capacity of 3,530 MWe, while C-5 reactor with the capacity of 1,200 MWe is under construction. Pakistan's nuclear program contributes to climate mitigation by avoiding nearly 15 million tonnes of CO_2 emissions annually. Besides energy generation, Pakistan is also leveraging nuclear science for food security through the IAEA-FAO Atoms4Food initiative. The August 2025 Atoms4Food assessment mission highlighted Pakistan's success in developing more than 150 high-yield, disease-resistant and climate-resilient crop varieties, while cotton varieties developed through FAO/IAEA-PAEC cooperation account for around 30% of Pakistan's cultivated cotton.

Nuclear techniques are also supporting Pakistan's efforts to address water scarcity, soil degradation and agricultural productivity. Isotope hydrology helps track water and fertilizer movement, improve resource efficiency and rehabilitate salt-affected soils. Together, these initiatives demonstrate how Pakistan's nuclear program extends beyond power generation to climate resilience, food security and sustainable resource management. Pakistan must move towards Industrial Revolution 4.0 to accrue optimum benefits of merging nuclear technology with AI.

For a world facing simultaneous energy insecurity, water scarcity, food insecurity and environmental degradation, IAEA's climate initiatives are strategically important. The climate challenge demands every credible low-carbon and adaptation technology available to be used. Nuclear science cannot solve climate change alone, but the developments witnessed during 2025 and 2026 demonstrate that the atom can contribute far beyond the reactor, and that may ultimately prove to be one of the IAEA's most consequential climate contributions.

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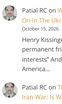
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