

# Innovation for Resilience:

## AgriTech, ClimateTech and Disaster Preparedness in Türkiye

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**This policy outlook explores Türkiye's efforts to address food security, climate adaptation and disaster preparedness through technological innovation. Positioned strategically between Europe, Asia and the Middle East, Türkiye faces significant challenges due to climate change and natural disasters.**

**However, its growing technological ecosystem offer immense potential for resilience-building. Türkiye's integration of modern technology in agriculture and disaster management, while addressing vulnerabilities like water scarcity and earthquake risks, has been highlighted. By comparing its progress with countries like India and Japan, Türkiye's approach serves as a replicable model for emerging economies tackling 21st-century challenges.**

## Innovation as a Catalyst for Resilience in Türkiye

With accelerating climate change, population growth, and increasing environmental volatility, a burgeoning need exists for increasing resilience capacity. To fight contemporary, interrelated challenges facing the present world, including food security, climate adaptation, and disaster preparedness, there is an increasing need for innovative, scalable solutions that address immediate needs and long-term sustainability goals. This requirement is a core stake for Türkiye, uniquely positioned at the juncture of Europe, Asia, and the Middle East. With a rich agricultural heritage, a growing technological ecosystem, and strategic importance in terms of regional and global supply chains, there is potential for Türkiye to emerge as one of the leading countries toward integrating technology in building resilience across key sectors.

Agriculture has long been a [staple](#) of the economy of Türkiye, providing livelihoods to millions and making the country a leading producer of crops such as hazelnuts, cherries, apricots, and tomatoes. This vital sector is increasingly under threat. Climate change [disrupts](#) traditional growing patterns through rising temperatures, shifting precipitation levels, and extreme weather events like droughts and floods. Simultaneously, inefficient farming, limited access to modern technologies, and scanty water availability that compound the burden for rural communities underline the urgent vulnerabilities of the [agricultural transformation](#) agenda as part of food security and sustainability for the future.

Of equal urgency are the issues caused by geographic [vulnerability](#) to the occurrence of natural calamities, especially earthquakes. A devastating earthquake occurred in February 2023, which killed over 50,000 people and wrought widespread damage, underlined the dire need for state-of-the-art disaster management systems enabled through the latest technology to reduce loss of life and damage to property that will help in swift recovery and rehabilitation. In the current context of increasing climate risks combined with rapid urbanisation, disaster resilience has already developed into a challenge of international relevance.

Technological innovation offers a powerful tool to address these intersecting challenges. This chapter examines how Türkiye is leveraging technology to build resilience across agriculture, climate adaptation and disaster management. It explores the role of government policies, private-sector innovation, and international collaboration in driving progress while highlighting the successes and challenges that shape Türkiye's approach. This chapter puts into perspective the leadership of Türkiye by comparing its efforts

with those of other comparative nations, such as India and Japan, and identifies lessons for global application. The chapter, therefore, presents the argument that the strategic integration of innovation into resilience building in Türkiye offers a highly replicable model of how emerging economies can address complex challenges in the 21st century.

As the world struggles to manage a complex and moving risk landscape, the country has experiences worth valuing about how technology can transform pursuits of a secure, sustainable, and resilient future. Playing to its strengths, forming partnerships, and scaling up innovations are ways in which Türkiye not only secures its stability but positions itself as a critical player in shaping global efforts toward resilience.

## AgriTech Solutions in Türkiye

Geographical and climatic variance blesses Türkiye as one of the [world's most fertile](#) regions. From the temperate coastal areas to the arid central plains, the country encompasses many microclimates that support a wide range of crops. Agriculture has long been among the mainstays, both culturally and economically, for the nation, with major products being hazelnuts, wheat, tomatoes, and cherries that dominate world markets. Agriculture accounts for [6.18 per cent](#) of GDP in 2023 and employs over 15 per cent of the workforce. Yet, there are many [concerns](#) regarding water shortage, land degradation, and poor farming methods. Overcoming such structural constraints is a must to guarantee productivity and sustainability, and AgriTech solutions are most likely the game-changer.

[Precision agriculture](#) has been considered one of the most promising AgriTech innovations in Türkiye, where IoT-enabled sensors, drones, and satellite imagery provide farmers with real-time data on soil moisture, crop health, and weather conditions. Local startups like Tarfin and Agcurate are making the best use of such tools and options for farmers over optimised irrigation, input costs, and better yield prospects. AI-powered analytics-integrated smart irrigation has already enabled farmers to economise by up to [30 per cent](#) on water use, which is important considering the stressed water situation in Türkiye. Besides, [AI-powered platforms](#) analyse historical and current data in predictive diagnostics related to disease outbreaks and pest invasion monitoring. Thus, Turkish farmers can take all necessary measures in advance with minimal crop loss and a reduction in chemical intervention.

In this aspect, [greenhouse farming](#) in the country's southernmost part, Antalya, is the most important experiment. Modern technologies in greenhouses have made production possible in every season. Innovations in climate control, LED lighting, and hydroponic systems have given rise to increased yields and conserve resources. Companies

bring in automated systems that observe temperature, humidity, and nutrient levels so that crop conditions remain optimal. Greenhouses have contributed much to the production of tomatoes, cucumbers, and peppers in Türkiye and have thus played a crucial role in food exports.

Water scarcity is one of the key challenges for agriculture in the country. Smart irrigation through AgriTech innovations has tried to respond to this challenge most efficiently: this involves [precise water management](#). Turkish startups developed IoT-based drip irrigation mechanisms where plants could be watered directly at the root but in measured quantities. Efficiency in water usage to 40 per cent comes hand-in-hand with increased crop yield using such solutions. Solar-powered irrigation systems also have a wider dissemination in rural areas. Integrating renewable energy with water management technologies will enable farmers, no doubt, to reduce reliance on fossil fuels, decrease operational costs, and improve environmental performance.

Historically, one of the most serious challenges facing farmers in general, and smallholders in particular, has been [access to finance](#) in Türkiye. Agri-FinTech platforms, like Tarfin for example, [bypass this](#) by offering farmers credit, insurance, and digital marketplaces. Using AI algorithms together with financial data, such platforms gauge the creditworthiness of farmers and allow them to buy inputs like seeds, fertilisers, and machinery on flexible payment terms. This reduces the financial barrier and speeds up the use of modern farm technology.

## Advancing Türkiye's Green Transformation

With precision farming and sustainable agriculture solutions that improve food security and optimise resource use, the climate tech sector in Türkiye has picked up where the country's progress in AgriTech left off. AgriTech innovations in water-efficient irrigation systems, soil health monitoring, and waste-to-energy solutions also greatly impact agricultural productivity and environmental sustainability regarding the broader climate objectives of Türkiye. This synergy shows how Türkiye has utilised agricultural strength to drive emission reduction, community engagement in the countryside, and a green transition. In cases where agricultural innovation is taking hold, this offers a platform for scaling up ClimateTech solutions in other sectors, further consolidating the commitment of Türkiye to a low-carbon economy and climate resilience. The country has also vigorously invested in renewable energy, especially wind, solar, and geothermal power.

Rich in natural resources, Türkiye is among the [leading countries](#) in geothermal energy production and follows a policy of reducing dependence on fossil fuels. The [wind energy](#) projects along the Aegean and Marmara's shores, with Anatolia's solar farms, accelerate the energy transi-

tion. Investments in smart grids and energy storage systems secure the integration of renewable power into the national grid. Mega projects such as the Karapınar Solar Power Plant and the Wind Energy Initiatives of İzmir prove that Türkiye is focused on renewable energy, with the Turkish government aiming for a share of [65 per cent](#) in electricity generation by 2035. Furthermore, carbon financing mechanisms and carbon credit systems continue to improve in Türkiye, supporting its climate objectives.

Historically, the country has been active in [voluntary carbon markets](#) through projects on renewable energy, energy efficiency, and waste management, generating VER certificates to [attract investments](#) and reduce emissions. More recently, the Turkish government has intensified efforts to formalise carbon markets. In June 2024, the Minister of Treasury and Finance, Mehmet Şimşek, [pointed](#) to the need to implement a carbon credit system within the broad strategy of Türkiye toward net zero by 2053. The system would provide financial incentives for green investments that would reduce emissions across industries. Türkiye also aims to [establish](#) a national emissions trading system (ETS), consistent with the Green Deal of the European Union, starting the pilot in 2025. First, it would only include energy-intensive industries like cement to put companies on course toward meeting the CBAM in 2026. Carbon pricing instruments play a major role in guiding sustainable investment and shifting behavioural patterns to support lower emissions levels. International cooperation is further strengthening the carbon market infrastructure in Türkiye. For example, the [collaboration](#) of Verra with the Turkish Energy Exchange, EPIAŞ, facilitates the trading of carbon credits, enabling wider access to certified credits and thus further strengthening the environmental markets of the country. These reflect a strong movement toward formalising carbon financing and thus create a framework for domestic and international investments in sustainable projects.

The [climate technology solutions](#) also form part of the startup ecosystem in Türkiye, where tech hubs in Istanbul, Ankara, and İzmir foster carbon capture, sustainable agriculture, and circular economy technologies-oriented ventures. Precision farming to reach an optimum in water and energy use, advanced recycling systems, and solutions addressing industrial carbon emissions are part of this list of such innovations. Furthermore, startups like Biolive, which produces bioplastics from olive pits, and Reengen, an energy management platform, prove that local talent can produce [globally relevant](#) solutions. Forward-looking government policies have played a very important role in supporting this activity. [Regulatory frameworks](#), closely related to the ratification of the Paris Agreement and in line with the [EU Green Deal](#), have laid the groundwork for climate-driven entrepreneurship.

The Green Deal Action Plan and the National Energy Efficiency Action Plan are just two programs that include

targeted measures for emission reduction in energy, transportation, and industry sectors while prioritising technology adoption. Incentives such as tax breaks on renewable projects, subsidies on energy-efficient technologies, and promotion of public-private partnerships have triggered investments, with institutions such as the Turkish Development and Investment Bank or TKYB providing key [financing instruments](#) for early and late-stage ventures. 'Green Financing' is available in Türkiye, and international funding, including EU Horizon Europe grants and the World Bank's Green Recovery Program, further amplifies Türkiye's capacity to scale ClimateTech initiatives. Traditional industries such as steel, cement, and manufacturing are undergoing transformation in Türkiye due to government-backed [decarbonisation initiatives](#).

Policies requiring carbon reporting, efficiency upgrades, and adopting cleaner technologies incentivise alignment with net-zero targets and open opportunities for ClimateTech integration into supply chains. At the same time, several challenges persist (e.g., access to late-stage funding and deeper public-private-academic collaboration). Meanwhile, the rapidly growing Turkish tech sector and an increasingly supportive policy landscape offer considerable opportunities for international partnerships, exports of ClimateTech, and global green transition leadership. With structured carbon financing, innovative startups, and strong government initiatives put in place, Türkiye is in a good position to become a critical player in the emerging global climate technology market.

## Tech-Driven Readiness for Disaster Management

Being one of the countries that face natural calamities, especially earthquakes, floods, and wildfires, Türkiye has [increasingly opened](#) its doors to technology-driven innovations that better equip the country in disaster preparedness, response, and recovery. These developments are linked to government policies on integrating advanced technologies into public infrastructure, fostering the startup ecosystem, and attracting investments in disaster management solutions. The Turkish government has considered IoT sensors, big data analytics, and geospatial mapping to be the major elements in renovating its disaster risk reduction [strategies through AFAD](#). Digital platforms use real-time data to enhance resource management within AFAD and enable early warnings; AI-powered prediction models have extended seismic monitoring networks, which can send automated alerts, especially around earthquake-prone urban hubs such as Istanbul and Izmir.

The recent devastating earthquake in southeastern Türkiye in [February 2023](#), which took more than 50,000 lives and affected millions of people in 11 provinces, has

shown the critical role these technologies can play. Working with technology partners, the Turkish government rapidly deployed advanced tools to manage rescue operations, assess damage and [facilitate recovery](#). AI-powered seismic monitoring systems instantly detect the quake's magnitude and location to enable alerts and activation of emergency protocols by the relevant authorities. In this case, the immediate response was [really helped](#) along by drone technology. Autonomous drones fitted with thermal imaging and AI-enabled detection tools identified survivors trapped under the rubble; these were useful in the areas where road infrastructure suffered heavy damage. Beyond the drones, IoT-based sensor networks and geospatial mapping tools were mobilised to monitor building structural stability and determine continuing risks, including aftershocks. AI systems studied large volumes of satellite and sensor data to develop comprehensive damage maps that aided the effective use of resources and further assisted in planning phased recoveries. Government agencies supported mobile platforms and digital applications, while technology startups provided support to enhance further the preparedness of citizens as well as communication during the crisis.

These tools allow citizens to report immediate needs, find emergency shelters, and access aid to coordinate relief efforts better. Government incentives have been instrumental in fostering innovation within the private sector and are considered [essential](#). Other [policy and programmatic efforts](#) of the government relevant to this call include the promotion of technology development zones like Istanbul Teknopark and other regional innovation hubs that can further strengthen a startup's ecosystem.

These zones provide an enabling environment where startups can develop and test solutions in collaboration with both government agencies and private investors. Public-private partnerships have [emerged](#) as the core strategy for scaling disaster management solutions, as observed in technology use during the 2023 earthquake. Financial technologies also played their part in the recovery process, with insurance providers partnering with technology companies to deploy AI-powered damage assessment tools that accelerated insurance claims and provided much-needed financial support to storm-affected families and businesses. Active AI-powered innovations have further revolutionised disaster preparedness and risk mitigation.

Turkish startups have developed machine learning models that can map infrastructure vulnerabilities and predict seismic risks while contributing to post-earthquake [recovery planning](#) and long-term resilience. Real-time IoT monitoring systems have also come to the fore in identifying floods and wildfires before they strike, thus offering critical time for local authorities to act. Smart city technologies, ranging from digital twins to sensor-based systems, are already being integrated into urban resilience projects, not

least in cities such as Istanbul, where rapid urbanisation meets seismic risks. Government policy alignment, funding incentives, and technology advancements have put Türkiye [ahead](#) in disaster resilience within its region.

The 2023 earthquake demonstrated how AI, IoT, robotics, and real-time analytics are integrated in a very structured manner to mitigate the consequences of any natural disaster. This experience continues to influence current policy reforms in developing more sophisticated tools, such as digital twins for urban centres and predictive AI models that can forecast the impact of disasters with better accuracy. Looking ahead, these efforts are not only enhancing the preparedness of Türkiye against future disasters but also scaling homegrown technologies for export to other disaster-prone regions. With further investment, public-private collaboration, and technological innovation, Türkiye is well on its way toward becoming a global leader in technology-driven disaster management solutions.

## A Comparative Analysis

When placed against other countries facing similar environmental, agricultural, and disaster management challenges, Türkiye becomes an outstanding example of how technology can be used strategically to attain resilience. Balancing innovation, policy support, and private sector participation, Türkiye demonstrates a model through which emerging economies can adopt technology for sustainable development. For example, India and Japan may be very useful comparisons. They are examples of contrasting approaches and success in using AgriTech, ClimateTech, and disaster management by Türkiye.

Precision farming and using different digital solutions that support small-scale farmers are high on the agenda for technological adoption in India, another country with great agricultural dependence and considerable exposure to extreme weather events like drought, heat waves, and floods. Platforms developed using analytics with mobile technology provide up-to-date information on crop price, weather forecasting, and soil health to make prudent decisions with lower input costs by smallholders. While India thus seems to have some [progress](#) in the digitisation of agriculture, Indian AgriTech should show more [scalability](#) and efficiency in resource use, especially in the most critical areas of the challenge at hand, such as water.

Wide-scale usage of IoT-driven irrigation systems and precision water management tools across Türkiye has enabled farmers to optimise resource use: up to a 40 per cent reduction in water usage while sustaining or improving yields. [AI-powered drip irrigation](#) systems supply water in exact quantities to the plant roots from Turkish startups. With increasing desertification risks-especially for areas like Central Anatolia and Southeastern Türkiye-

such solutions become impactful in general. Integrating renewable energy with solutions such as solar-powered irrigation systems is an approach that differentiates Türkiye from other nations. These methods also contribute to the dual purposes of lesser dependence on fossil fuels and lowered operational costs, bringing economic benefits to the farmers while answering environmental sustainability goals.

Advanced technologies in greenhouse farming bring Türkiye to the fore in crop production all year round. In [automated greenhouses](#) in the southern part of the country, climate control, hydroponic methods, and LED lighting offer optimal conditions to grow high-value crops, including tomatoes, cucumbers, and peppers. These innovations help stabilise food production despite all external pressures exerted by climate and further strengthen both domestic food security and export capacity. In comparison, India's adoption has remained largely in open-field [precision farming](#) due to the relatively higher costs and limited availability of technologies in rural areas for the diffusion of greenhouse adoption. The combination of technological sophistication, government incentives, and export-oriented agricultural strategy places Türkiye in a competitive position to attain both food security and economic resilience.

In the area of disaster management, the experience of Türkiye during the earthquake in February 2023 invites comparison with Japan. Various Japanese systems are considered the [gold standard](#) of the world: the Japanese government has invested heavily in [AI-powered monitoring systems](#) that predict seismic activity and automatically dispatch alerts, providing precious seconds for citizens to seek refuge and prepare. It's also pioneering robotics used to perform search-and-rescue operations, sending out flying drones, driverless trucks, and robotic sensors capable of crawling deep within hazardous environments with pinpoint precision to locate survivors.

That said, the response of Türkiye to the earthquake in 2023 also showed an impressive ability to adopt and deploy innovative technologies that would limit the impacts of such disasters. [AI-powered seismic monitoring networks](#) immediately detected the magnitude and epicentre of the quake, thus enabling authorities to turn to emergency protocols and resource allocation with efficacy. The rapid deployment of thermal imaging drones and AI-based detection tools by Türkiye proved instrumental in identifying survivors trapped under rubble, especially in remote or inaccessible areas where road infrastructure had been compromised. Information technologies, such as communication platforms and social media, helped manage relief efforts by focusing on key disaster phases: preparation, response, and recovery. Türkiye differentiates itself from Japan by [fostering public-private partnerships](#) and enabling an emerging startup ecosystem to scale solutions for disaster management.

While Japan's technological leadership is rooted in [heavy public-sector investment](#) and decades of infrastructure development, the approach taken by Türkiye has been much more [agile](#), driven by a combination of government funding, private-sector innovation, and targeted incentives. By cultivating this collaborative innovation ecosystem, Türkiye has improved its domestic response capabilities and put itself in a position where it can export these solutions to other disaster-prone regions. By contrast, the disaster resilience solutions of Japan are indeed advanced in technological innovations but are often expensive and take a longer development-deployment timeframe. Countries like Türkiye achieve similar outputs with more cost-effective and scalable solutions, showcasing this country's potential to act as a model for other developing nations.

Moving forward, the progress attained so far will be realised through an increased scope of foreign collaborations, specifically with the addition of countries like India and Japan. Sharing best practices and knowledge with other nations will help them adapt these already successful AgriTech, ClimateTech, and disaster management models for their economies. At the same time, Türkiye will benefit from Japanese seismic infrastructure and large digital agriculture platforms in India. Further alignment by Türkiye with international frameworks such as the EU Green Deal and programs like Horizon Europe presents more avenues for scaling up innovations and attracting investment.

## Charting Türkiye's Path Toward Sustainable Resilience

The journey of Türkiye toward resilience through AgriTech, ClimateTech, and disaster management solutions underlines the power of innovation in addressing high priority, interconnected environmental, economic, and social challenges. Situated at the juncture of Europe, Asia, and the Middle East, Türkiye has linked its rich agricultural heritage with a dynamic technological ecosystem and progressive policy approach. Some of the country's most important challenges have to do with food security, climate change, and natural disaster risks. This chapter has addressed the focused application of technology by the Republic of Türkiye in reinforcing its national stability to create a leading role model in addressing similar challenges for other countries.

Innovations in precision farming, smart irrigation, and greenhouse technologies have been critical in ensuring food security amidst rising water scarcity and changing climate patterns. IoT-enabled tools, AI-powered analytics, and renewable energy solutions have been leveraged to enhance agricultural productivity with reduced resource consumption. Meanwhile, several initiatives driven by Turkish startups have been showcasing how local tech-

nological talent can be marshalled in solving structural challenges such as wasteful water use and the lack of access to financial means for farmers. Steps toward ClimateTech within Türkiye show strong prospects for a green economic transition. Leading in renewable energy shows the country's determination to reduce its dependence on fossil fuels and, consequently, its emissions. The government's emphasis on carbon financing mechanisms further underlines Türkiye's status as an emerging leader in sustainable development. This will demand further scaling-up of renewable energy deployment across industries, faster investment in energy storage solutions, and more intense international collaboration to share knowledge and resources.

From the disaster management perspective, the innovative response to the earthquake which hit in February 2023 has shown that Türkiye can deploy state-of-the-art technologies, ranging from AI-powered seismic monitoring systems to thermal imaging drones and geospatial mapping tools, to save lives and expedite recovery. By fostering public-private partnerships and supporting its startup ecosystem with initiatives to develop financing mechanisms and technology development zones, for example, Türkiye represented a scalable and cost-effective model for disaster resilience. This experience has strengthened not only domestic preparedness but also created opportunities for exporting disaster management solutions from Türkiye to other disaster-prone parts of the world and made it a hub for global innovation. Going forward, Türkiye can use such successes as a stepping stone for scaling up the application of digital twins and predictive AI models for urban resilience, continuing to work with international partners in refining and scaling its disaster response capabilities.

This is further compared with the cases of India and Japan. While India has indeed been making giant strides in digitising agriculture, the ability of Türkiye to integrate precision irrigation, greenhouse farming, and renewable energy solutions shows that it follows a more scalable and sustainable path to food security than India. Similarly, in disaster resilience, Japan leads the way globally. In contrast, Türkiye provides the best model for its cost-effective, rapidly deployable technologies and strong public-private collaboration with most emerging economies, working to strike a balance between innovation and financial feasibility. It would allow Türkiye to reinforce its leadership in both AgriTech and disaster management through international knowledge sharing and partnerships while benefiting from the experiences of those countries.

In this respect, future directions should boldly adopt the expansion of R&D investments, fuelling a relentless drive for innovation propelling Türkiye to the frontline of global progress, with equal importance given to equitable access to transformative technologies. As advanced technologies are implemented across rural regions, Türkiye must ensure that modernisation will be equitably distributed.

## POLICY OUTLOOK

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Brazil's use of [satellite imaging](#) and machine learning via EMBRAPA has set the best example: affordable, accessible insights on soil health and weather patterns help even the resource-limited farmer in optimised and sustainable yields. Therefore, supporting programs for farmer education and skills training will be the means to achieve farmer education and skills training. Accelerating carbon credit systems and emissions trading will be instrumental in achieving ambitious climate goals.

Meanwhile, Türkiye can also focus on deepening international collaborations, similar to how Germany's Fraunhofer Institute has partnered with Siemens and other global firms in developing the '[Industrial Data Space](#)', demonstrating how data exchanges and advanced technologies can empower businesses of all sizes, fostering innovation and inclusivity across the globe. Finally, targeted education and labour market development programs should be a priority in maintaining this transformation journey, equipping the population of Türkiye with the needed skills at the forefront of such a technological and environmental renaissance.

Innovation embraced at the strategic level places Türkiye on the frontline as a global leader in building resilience for the future. Thanks to the balancing of technological advancement with policy support and private sector participation, not only have the current national challenges been met, but solutions with global relevance for the future have been developed. As such, further focus on sustainability, collaboration, and inclusivity can set Türkiye on a course to serve as a model for emerging economies seeking resilience against climate change, food security, and natural disasters. Through its leading role in AgriTech, ClimateTech, and disaster management, Türkiye is also making valuable contributions toward an increasingly stable, sustainable, and resilient world for all.