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Turkmenistan, Water Scarcity

Desert, Dehydration, and Dictatorship

One of the most obscure and unique countries in the world, Turkmenistan is struggling to modernize its economy and feed its people. Declaring independence from the USSR in 1991 (the second to last country to do so), Turkmenistan covers 488,000km^2 or 188,000mi^2—15% larger than California. Despite its large landmass, it has a population of 7.7 million (similar to Arizona) due, at least in part, to the vast Karakum Desert which covers about 80% of the country. The nation is also known as one of the world's last dictatorships, being authoritatively controlled since its exit from the Soviet Union.

It has struggled with food insecurity and water scarcity especially after the fall of the USSR. Several key strategies can be used to help absolve Turkmenistan of these problems. Firstly, the government can exercise its control to gather data which it can use to determine where exactly water is being used disproportionately and allocate resources accordingly. Next, they can educate their workforce on sustainable farming. Farmers in Turkmenistan receive little education and have no incentive to conserve water, but mass education campaigns are low in cost and can have large impacts. Lastly, drip irrigation techniques have been proven extremely cost and resource effective and implementation could increase yields dramatically without using more water.

Turkmenistan is situated in Central Asia bordering Kazakhstan and Uzbekistan to the north, Afghanistan to the east, Iran to the south, and the Caspian Sea to the west. The nation is home to not only deserts but also to an expansive mountain range in the south. Temperature varies greatly based on location and time of year. In the southern part of the country temperatures have been recorded as high as 50°C or 122°F and as low as -33°C or -27°F (Smith et al., 2026).

The people of what is now Turkmenistan had a unified culture as early as 2500 BC and spent most of their long history controlled by a foreign power. They were conquered by the Persian Empire under Cyrus the Great, Macedon under Alexander the Great, the Arabs, the Mongols under Genghis Khan, the Uzbecks, the Persians (again), and the Russian Empire (British Broadcasting Corporation [BBC], 2018). Their economy subsisted primarily off of agriculture and marauding passing caravans travelling on the silk road up until the twentieth century. The Turkmen strongly resisted Russian expansion efforts of the 1800s and helped in the 1916 revolt against the Russian imperialist Tsar Nicholas II (BBC, 2018). In 1925 the country officially became a constituent republic of the Soviet Union (Smith et al., 2026).

Under the centralized Soviet state, Turkmenistan benefited from a new and improved education and healthcare system. The USSR applied Adam Smith’s idea of specialization to the different republics. Russia was in charge of heavy industry and administration, Ukraine was in charge of grain and coal mining, Kazakhstan was in charge of mining and the space program, *et cetera*. Turkmenistan had little to offer economically or industrially throughout history, however it was discovered that Turkmenistan contains the sixth largest natural gas reserves in the world. Between 1958 and 1988 the 1,375km (870 mile) Karakum Canal was constructed, dramatically increasing the amount of arable land which was devoted almost entirely to cotton production. Those two exports have continued to be the backbone of the Turkmen economy.

After the collapse of the USSR, the new Republic of Turkmenistan struggled to adapt without the structure provided by the other nations in the Soviet Union and the fact that cotton and natural gas made up the majority of its economy. In 2023, natural gas accounted for 68% of the country's exports (World Bank, 2024). Turkmenistan also lacks much of the critical infrastructure required for modernization and

diversification. It took until 1996 for a rail line to be constructed between Ashgabat (the capital of Turkmenistan) and Tehran (the capital of the Islamic Republic of Iran) despite them being only 659 kilometers or 409 miles apart.

The nation's heavy dependence on two products led to its suffering terrible economic shocks. When the price of hydrocarbons or cotton decreases, the entire Turkmen economy is in danger. Its economy contracted in the 1990s after gaining independence, in 2009 after the Great Recession, in 2014 after natural gas and oil prices fell, and in 2020 during the coronavirus pandemic (International Monetary Fund [IMF], 2025). The reason these global events were such a burden on the Turkmen economy was its heavy dependence on only a few exports, a problem that can be solved in conjunction with its food and water scarcity troubles.

The average Turkmen family has experienced hardships and restrictions unheard of in most of the world. The country operates under a system of "registration books," which work similarly to food stamps, allowing the government to more closely regulate the caloric intake of its citizens in a food scarce environment (Chung, 2020). Citizens often stand in lines for hours to get groceries and other essentials (Perrin, 2025). Forced labor in the cotton fields is not uncommon and Turkmen citizens who attempt to report injustices to the international press can be tortured and even killed (Perrin, 2025). Due to heavy sanctions, Turkmenistan is forced to sell cotton at well below market price so even those who are compensated for farming cotton struggle to survive.

Turkmenistan reportedly faces the highest food insecurity rate of any former Soviet country at 12.1%, much higher than any other nation in Central Asia or Europe (Progres, 2025). Geography and climate are large obstacles in the way of alleviating this food insecurity. Six percent of land is arable but only a fifth of a percent is home to permanent crops (Asian Development Bank, 2019). Because of this desert environment, water scarcity is the primary cause of food scarcity. An astounding 95% of Turkmenistan's surface water comes from rivers, 88% of which is the Amu Darya and Karakum Canal (Bakiyev, 2026). Although its population is increasing, both agricultural area and output have roughly stagnated over the last decade (Food and Agriculture Organization of the United Nations [FAO], 2026).

The Karakum Canal (also known as the Karakum-Lenin Canal) was part of the "Platinum Program" in Central Asia under the Soviet Union and it increased the amount of arable land by one million hectares (National Aeronautics and Space Administration [NASA], 2014). This was incredibly significant because it allowed the Turkmen, for the first time in their history, to make plant-based agriculture a sizable part of their society. A true engineering triumph, the Karakum Canal stretches on for over 1,300 kilometers or 800 miles (NASA, 2014). The canal is the only major successful infrastructure project targeting water scarcity issues in the nation's history.

The water resources of the country are strained far beyond a sustainable level. According to the Food and Agriculture Organization of the United Nations' AQUASTAT, Turkmenistan's water stress level is at 135%, far beyond what is sustainable; even if they cut off municipal and industrial water use entirely, they would still overdraw by 25% (2022). This unsustainable water use will only create more problems for the country as time goes on and irresponsibility compounds.

In order to fix their water woes, the government attempted to create an artificial lake out of the Karashor depression in the northern region of the country (Tukhbatullin, 2020). The "Golden Age Lake" was supported and propagandized by President Saparmurat Niyazov in 1999 and the first stage was completed in 2009 by his successor Gurbanguly Berdimuhamedov despite firm warnings against such a project from experts (Tukhbatullin, 2020). Today, the reservoir sits nearly empty. This spectacular failure is blamed almost unanimously on the government. All-powerful dictators and ignorance of well acknowledged scientific fact have supplanted the nation in the Soviet era.

Turkmenistan's economy was revolutionized by the first canal, but major expansions or another canal would be impractical, if not infeasible. The first canal was one of the biggest projects of a country larger than the United States and China combined. The modern day equivalent of building the Karkum Canal would be to divert part of the Mississippi River to run from St. Louis to Santa Fe. The lack of financial resources coupled with economic instability make major infrastructure projects in Turkmenistan unattainable.

Besides increasing arable land, the only other way to increase yield is to make the land already devoted to agriculture more efficient. Turkmenistan increasingly suffers from excess salt in its water which can lead to physiological and biochemical abnormalities in plants seen in increased reactive oxygen species or RMS buildup (Ahmed, 2024). Not far away, the small nation of Israel was in crisis due to the same problem of salinization. The government urged citizens to conserve water whenever possible, but as desalinization technology grew more powerful and affordable the country invested in five desalination plants which brought their water recycling rate up to 90%, making it one of the most sustainable countries in the world when it comes to water usage (Ferris, 2023). Such methods are still expensive and the vast majority of such plants reside in wealthy nations such as Israel, Saudi Arabia, and the United Arab Emirates; the only two desalination plants in Central Asia are in Kazakhstan (Ferris, 2023). Unfortunately, this technology remains out of reach for many countries, including Turkmenistan.

Creating a combination of solutions could increase Turkmenistan's crop production by over 50% in 10-20 years. By incorporating drip irrigation, worker education, and data driven adjustments, Turkmenistan could alleviate its struggles with food and water scarcity. When applied properly, these techniques have the potential to transform the country and are much more financially and politically feasible than other solutions.

Over the past two thousand years, drip irrigation technologies and techniques have seen continual improvements. Such systems work by delivering water directly to a crop, improving production areas prone to drought. Covered pipes deliver water straight to plant roots, reducing waste (Kloosterman, 2024). The costs associated with drip irrigation prove low when considering return on investment. Utilizing inexpensive plastics and the forces of gravity cuts down on initial setup and energy costs. The current practices employed in Turkmenistan, though antiquated, may be upgraded affordably.

The United Nations Development Programme and the State Committee of Water Management of Turkmenistan carried out joint research in Geokdepe analyzing the impact of drip irrigation on various crops (2020). They found that effective irrigation can bolster cotton yield from two tons per hectare to six tons per hectare and found similar results using wheat and corn all while using less energy (UNDP, 2020). Such a solution is crucial for the longevity and quality of ordinary Trukmen. It would free up labor and ease the hunger crisis. While the results of this study were widely broadcast, no significant changes have been reported.

Many farmers lack the appropriate education required to work efficiently. By creating mass education campaigns, the government would be able to reduce waste at a relatively insignificant cost while also creating a more capable workforce. Currently, members of "peasant associations" are assigned land but lack the knowledge to mitigate erosion and water waste.

Turkmenistan's centralized economy provides an advantage many of their neighbors lack. By collecting and thoroughly analyzing harvest data, they can pinpoint where water flows and understand what techniques and minerals prove best for farming. This simple step would require some effort but pay off tremendously in the long run, creating a dynamic agricultural system out of one that remained largely stagnant for decades.

The current dictatorship in the country of Turkmenistan serves as a major hindrance. Its complete control of markets, land distribution, and agriculture coupled with repression of innovation and denial of citizens' rights has led to many poor policy decisions. By allowing farmers and companies more autonomy and making room for innovation, Turkmenistan could see vast quality of life improvements that would not require complete regime change.

After practical implementation of these solutions, the economy can recover further by shrinking water subsidies. Water subsidies, though currently necessary for farmers, disincentivise conservation. After the agricultural sector has made significant gains, the Turkmen government's best course of action includes making individual farmers pay for water usage while also receiving more compensation for crops produced.

Coordinated efforts toward what arable land currently exists in Turkmenistan could have life changing consequences for its citizens. Through water conservation, drip irrigation, education, and careful data collection and analysis, they could become one of the wealthiest countries in Central Asia. More importantly, Turkmen families would never again stand in lines for hours hoping for food.

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