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International Commission on Irrigation and Drainage (ICID)



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Water Reuse and Recovery as a Strategic Resource for Agriculture: Experiences from around the World

2nd Indo Global Irrigation Summit

24-25 June 2026, New Delhi India

Water reuse and recovery as a strategic resource for agriculture: experiences from around the world

Marco Arcieri President ICID

2nd Indo-Global Irrigation Summit, 24-25 June 2026, New Delhi, India:



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The great challenges of agriculture

Global agriculture is facing unprecedented pressures, threatening both food and water security, as well as environmental sustainability.



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The great challenges of agriculture

Major challenges arise from the need to feed a growing population under alarmingly climate change scenarios, water and soil resources depletion, and socio-economic instability.



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Wastewater reuse in agriculture: from liability to resource

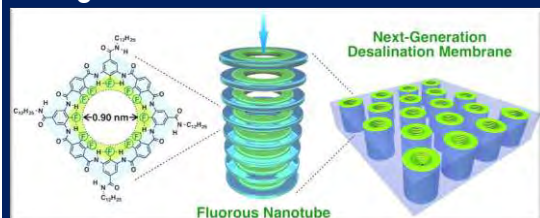
Wastewater reuse and sea water desalination have, in time, become increasingly suitable, sustainable solutions to global water scarcity, providing to be reliable alternatives to traditional water sources.



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Wastewater reuse in agriculture: from liability to resource

As of today, these technologies are transmuting from "last-resort" options into crucial components of global water security, driven by innovations in membrane and process technologies, the introduction of artificial intelligence (AI), and renewable, low cost energy integration.



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Wastewater reuse in agriculture: from liability to resource

Agricultural wastewater reuse plants treat water coming from municipal, industrial, or on-farm sources to irrigate crops and provide nutrients, reducing freshwater reliance.



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Wastewater reuse in agriculture: from liability to resource

These plants typically use secondary, tertiary, or advanced treatment to remove pathogens, ensuring compliance with strict safety guidelines for food and non-food crops.



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Wastewater reuse in agriculture: from liability to resource



Key benefits include increased drought resilience, reduced fertilizer demand, and sustainable nutrient management.



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Türkiye

Wastewater reuse in Türkiye



In Türkiye, water scarcity forced the Ministry of Environment to initiate an important project in 2017.



Water scarcity in Türkiye

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Türkiye

Wastewater reuse in Türkiye



The country faces the huge challenge of providing enough water to meet the growing needs of an increasing population.



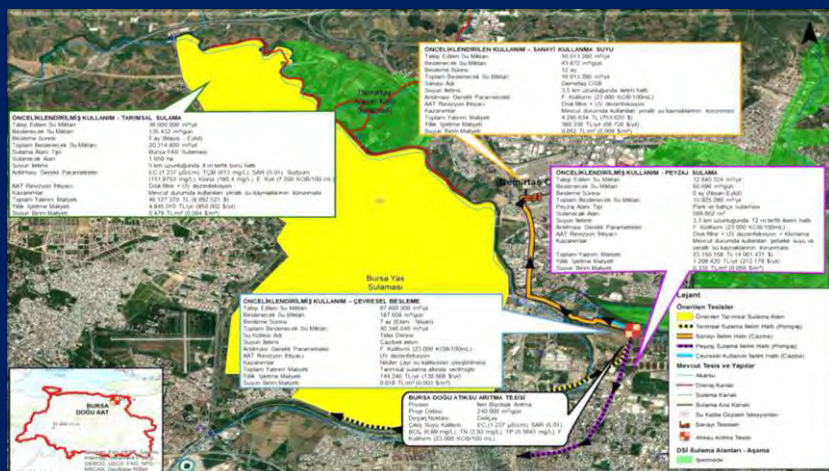
The Galata Tower & the Süleymaniye Mosque. İstanbul, Türkiye

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Wastewater reuse in Türkiye



But although there are 1,015 existing WWTPs, only 15 of them realize waste water reuse.



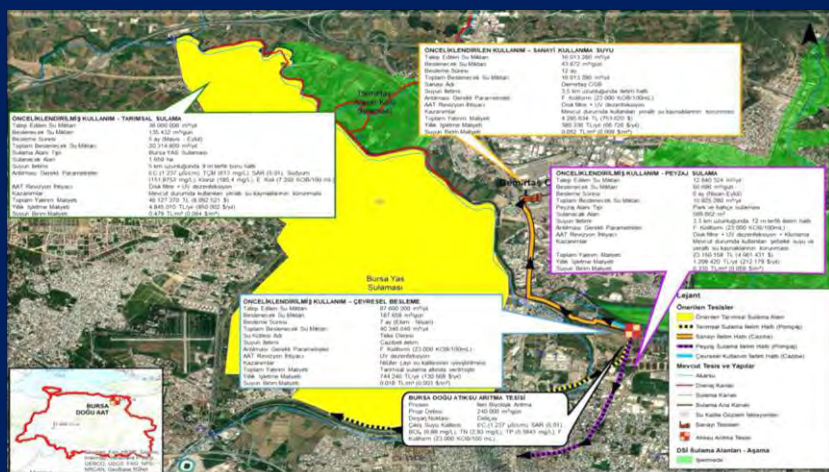
Waste Water reuse Plants in Türkiye

Wastewater reuse in Türkiye



But although there are 1,015 existing WWTPs, only 15 of them realize waste water reuse.

As of 2017, the total volume of wastewater treated and reused in Türkiye amounted to 29.6 million m³/year, accounting for 0.78% of the treated urban wastewater.



Waste Water reuse Plants in Türkiye

Wastewater recycling in Türkiye : the Atakoy Plant



Challenged with this perspective, the MoE has been developing projects to reuse water, setting the target of at least 5% of reused water for agricultural irrigation, groundwater supply and urban purposes.



Akhisar Wastewater Reuse Plant – Türkiye.



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Wastewater recycling in Türkiye : the Atakoy Plant



An excellent example is the Atakoy Reuse Plant in Istanbul, located in the southwest area of Istanbul, very close to the Atatürk International Airport.



Atakoy Wastewater Reuse Plant – Istanbul, Türkiye.



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Wastewater recycling in Türkiye : the Atakoy Plant



Rather than releasing into the nearby sea, the Atakoy Plant provides part of the wastewater an extra round of treatment, so it can be reused for purposes such as irrigation.



Atakoy Wastewater Reuse Plant – Istanbul, Türkiye.



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Wastewater recycling in Türkiye : the Atakoy Plant



It has adopted the latest innovations to recycle part of the wastewater it treats, by means of a technology, the so-called Membrane Bio-Reactor, also known as MBR.



Atakoy Wastewater Reuse Plant – Istanbul, Türkiye.



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Wastewater recycling in Türkiye : the Atakoy Plant



The conventional way of treating wastewater is to separate the sludge into solids and liquids, by what is called an activated sludge model.



Atakoy Wastewater Reuse Plant – Istanbul, Türkiye.

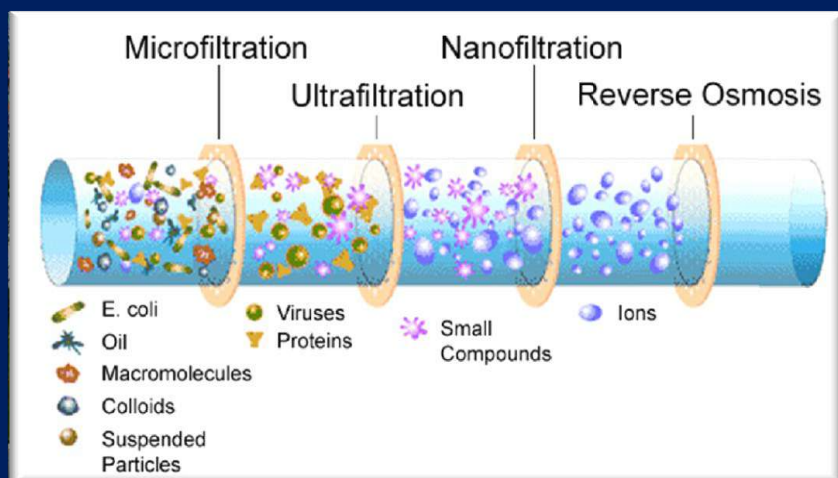


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Wastewater recycling in Türkiye : the Atakoy Plant



With MBR, a further step is taking place with the adoption of membranes characterized by very tiny pores, enabling a second round of filtering for the liquids. In this way, the water comes out cleaner.



Atakoy Wastewater Reuse Plant – Istanbul, Türkiye.



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Wastewater recycling in Türkiye : the Atakoy Plant



Recently put into operation, the Atakoy plant can treat 20,000 m³ per day of wastewater to be recycled. At a later stage, its capacity will increase by another 10,000 m³, for a total amount of 30,000 m³.



Atakoy Wastewater reuse Plant - Aeration Tanks II Stage



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Wastewater recycling in Türkiye : the Atakoy Plant



The importance of the plant: its capacity will be 10% of the combined 5.8 million cubic meters of waste water treated every day by all of the plants in the province.



Atakoy Wastewater reuse Plant - Aeration Tanks II Stage



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Egypt



Wastewater reuse in Egypt



The country of Egypt is leading significant efforts to cope with climate change in order to ensure food security, trying to move agriculture away from the overcrowded Nile Valley.

The Delta of the Nile River–Egypt

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Egypt



Wastewater reuse in Egypt



The NEW DELTA PROJECT is a land reclamation initiative developed in the Western Desert, designed to transform the over 9,240 square kilometers of this sterile area into productive farmland.

New Delta Artificial River–Egypt

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Wastewater reuse in Egypt



In order to achieve these goals, Egypt is investing heavily in wastewater treatment plants to mitigate water scarcity, focusing on the reuse of treated water for agricultural development and expand irrigation.



Wastewater Reuse Plant in Egypt.



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Wastewater reuse in Egypt



As a matter of fact, today Egypt is the leading country in the world in terms of new, massive irrigation wastewater reuse projects.



Wastewater Reuse Plant in Egypt.



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Wastewater reuse in Egypt



Most significant plants are:

- El Hamam (2021): today the largest wastewater treatment plant in the world, it treats 7.5 million m³/day.



El Hamam Wastewater Reuse Plant–Egypt.



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Wastewater reuse in Egypt



Most significant plants are:

- El Hamam (2021): today the largest wastewater treatment plant in the world, it treats 7.5 million m³/day.
- Bahr Al-Baqar (2019): it treats about 5.6 million m³/day, producing water for agricultural, industrial, and domestic uses.



Bahr Al-Baqar Wastewater Reuse Plant-Egypt.



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Wastewater reuse in Egypt: the El Hamam plant



The El Hamam Water Treatment Plant, located in the Marsa Matruh area, is the largest in the world, carrying the highest sludge treatment capacity globally.



El Hamam Wastewater Reuse Plant – Marsa Matruh, Egypt.



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Wastewater reuse in Egypt: the El Hamam plant



The plant has a production capacity of 7.5 million m³/day using agricultural drainage water, serving more than 900,000 ha in the western Delta region. Water is transported through a 120 kilometer long canal.



El Hamam Wastewater Reuse Plant – Marsa Matruh, Egypt.



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Wastewater reuse in Egypt: the El Hamam plant



Spanning over an area of 320,000 m², the plant operates with a capacity of 86.8 m³/second, ensuring a capability in sludge treatment of 670.01 kg/s.



El Hamam Wastewater Reuse Plant – Marsa Matruh, Egypt.



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Wastewater reuse in Egypt: the El Hamam plant



The plant is expected to provide irrigation for about 485,000 hectares of land west of the Nile Delta and circa 917,000 hectares in the western region.



El Hamam Wastewater Reuse Plant – Marsa Matruh, Egypt.



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Spain



Wastewater reuse in Spain

Spain is the leading European country for waste water reuse in the Mediterranean area. More than 2/3 of its recycled water is today used for agriculture...



Wastewater Reuse Plant in Almeria, Spain.

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Spain



Wastewater reuse in Spain

...Whilst more than 30% of irrigation in the country is provided by water coming from waste reuse and seawater desalination plants.



Seawater Desalination Plant of Torrevieja (Alicante), Spain.

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The most important ones are

- El Prat de Llobregat Wastewater Treatment Plant (**Barcelona**)

Wastewater reuse in Spain



El Prat de Llobregat Wastewater Reuse Plant. Barcelona, Spain.



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The most important ones are

- El Prat de Llobregat Wastewater Treatment Plant (**Barcelona**)
- The Pinedo Wastewater Treatment Plant (**Valencia**)

Wastewater reuse in Spain



Pinedo Wastewater Reuse Plant – Valencia, Spain.



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- El Prat de Llobregat Wastewater Treatment Plant (**Barcelona**)
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- Rincón de León Wastewater Treatment Plant (**Alicante**)

Wastewater reuse in Spain



Rincón de León Wastewater Reuse Plant. Alicante, Spain.



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- **Tarragona** Industrial Complex (AITASA) Project.

Wastewater reuse in Spain



Tarragona Wastewater Reuse Plant. Tarragona, Spain.



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- **Tarragona** Industrial Complex (AITASA) Project.
- Adeje-Arona Wastewater Treatment Plant (**Tenerife**).

Wastewater reuse in Spain



Adeje-Arona Wastewater Reuse Plant. Tenerife, Spain.



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Wastewater reuse in Spain: the El Prat de Llobregat Plant

One of the most important in the world is the El Prat de Llobregat plant (Barcelona), which includes a Water Regeneration Reuse Plant that can produce up to 50,000,000 m³ per year.



El Prat de Llobregat Wastewater Reuse Plant. Barcelona, Spain.



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Wastewater reuse in Spain: the El Prat de Llobregat Plant

It uses now consolidated technologies like *reverse osmosis*, but also a very advanced and innovative ultraviolet disinfection process for treatment, which allows for agricultural and industrial uses of the water.



El Prat de Llobregat Wastewater Reuse Plant. Barcelona, Spain.



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Wastewater reuse in Spain: the El Prat de Llobregat Plant

It treats approximately 420,000 m³ per day, being specialized in advanced water reuse for agricultural and industrial uses, as well as for environmental needs.



El Prat de Llobregat Wastewater Reuse Plant. Barcelona, Spain.



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Wastewater reuse in Spain: the El Prat de Llobregat Plant

The reclamation plant has a peak flow capacity of $3.5 \text{ m}^3/\text{s}$ and a design flow of $12,500 \text{ m}^3/\text{h}$, with around $0.75 \text{ m}^3/\text{s}$ specifically assigned for irrigation of agricultural cash crops.



El Prat de Llobregat Wastewater Reuse Plant. Barcelona, Spain.



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Wastewater reuse in Spain: the El Prat de Llobregat Plant

The plant is expected to provide irrigation to an area ranging between 3,000 and 4,000 hectares of land, depending on the agro-ecological specific conditions, the crop water requirements and the efficiency of the irrigation system.



El Prat de Llobregat Wastewater Reuse Plant. Barcelona, Spain.



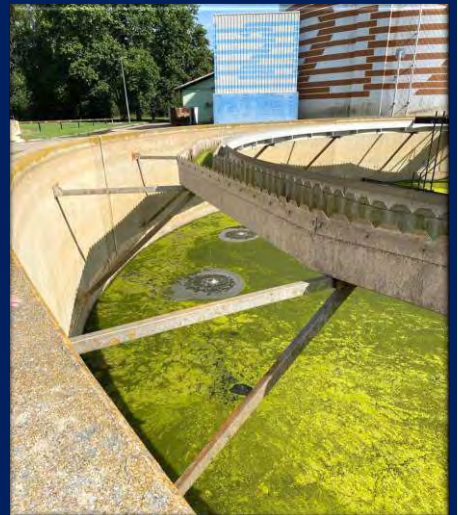
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The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.

It is managed under the jurisdiction of the **Canal de Isabel II**, the public entity responsible for the integral water cycle in the Community of Madrid.

The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.



The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.

Wastewater reuse in Spain: the EDAR Viveros de la Villa in Madrid.

It has an authorized water treatment capacity of about 200,000 m³ per day, consistently handling average daily flows of 100,000 m³, its maximum water flow being 2.63 m³/second or 9,468 m³ per hour.



The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.



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Wastewater reuse in Spain: the EDAR Viveros de la Villa in Madrid.

It processes urban wastewater for roughly 700,000 residents (with a design capacity of over one million equivalent inhabitants) to protect the Manzanares River.



The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.



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Wastewater reuse in Spain: the EDAR Viveros de la Villa in Madrid.

Contains complementary facilities that transform treated wastewater into high-quality reclaimed water for the city's network, primarily used for watering urban parks and green spaces.



The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.



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Wastewater reuse in Spain: the EDAR Viveros de la Villa in Madrid.

It employs anaerobic digestion and sludge dehydration by means of centrifuges. It also utilizes high-efficiency cogeneration systems (like MWM gas gensets) that convert biogas produced during the treatment process into electrical energy.



The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.



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Wastewater reuse in Spain: the EDAR Viveros de la Villa in Madrid.

It features cutting-edge sanitization processes consisting of textile mesh microfiltration, use of ozonation, hydrogen peroxide treating, and ultraviolet (UV) lamp disinfection to eliminate microcontaminants and pathogens.



The EDAR Villa Wastewater and Regeneration Plant. Madrid, Spain.



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PROs and CONs of Wastewater Reuse for food security

PROs

- **Reliable Water Supply:** provides a constant, climate-resilient source of water, reducing vulnerability to droughts and erratic weather.



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PROs and CONs of Wastewater Reuse for food security

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- **Nutrient Enrichment:** treated wastewater is often rich in nitrogen and phosphorus, reducing the need for synthetic fertilizers.
- **Freshwater Conservation:** relieves pressure on depleting freshwater aquifers and rivers, preserving them for municipal and drinking purposes.



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PROs and CONs of Wastewater Reuse for food security

CONs

- Salinity buildup: high levels of dissolved salts in wastewater can accumulate over time, degrading the structure.



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PROs and CONs of Wastewater Reuse for food security

CONs

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PROs and CONs of Wastewater Reuse for food security

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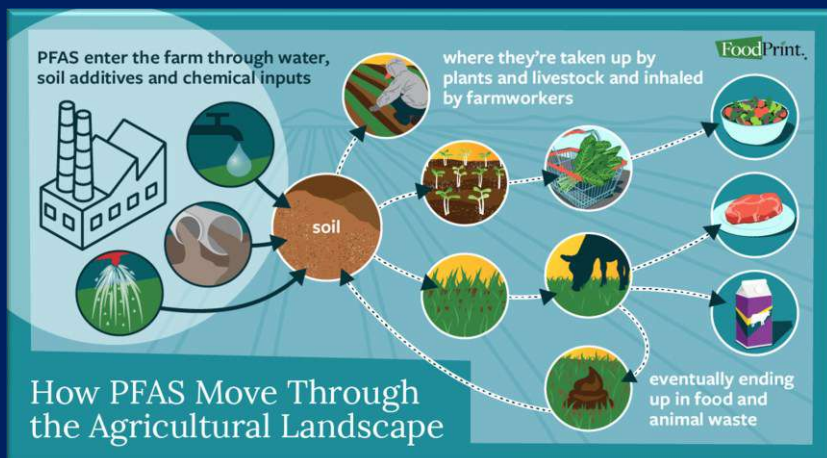
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- Costs: making and maintaining advanced treatment plants, filtration systems, and separate pipeline networks require massive capital investment.



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PROs and CONs of Wastewater Reuse for food security

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- Emerging contaminants: conventional treatment may not remove all micropollutants like pharmaceuticals, heavy metals, or PFAS, which can accumulate in the food chain over the long term.



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World Bank has warned 'Global food security'...



But how have we reached this point?

- Traditional freshwater sources (like rivers and aquifers) are running dry due to over-extraction.



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But how have we reached this point?

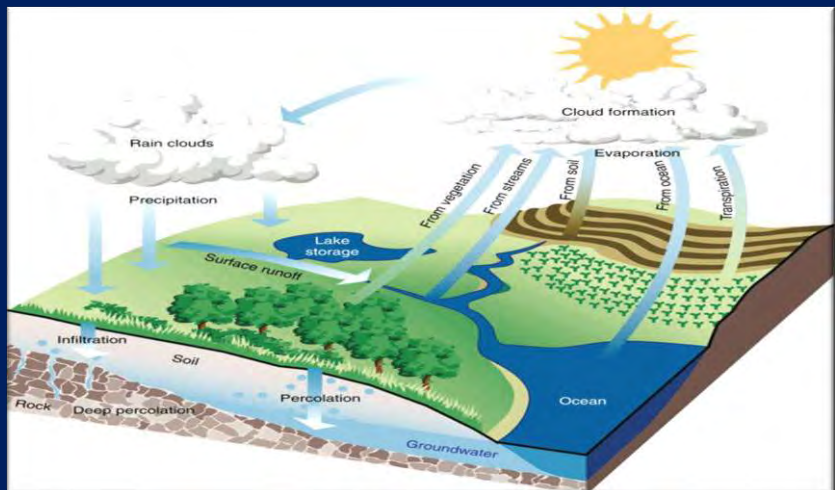
- Traditional freshwater sources (like rivers and aquifers) are running dry due to over-extraction.
- We need to take the load off nature: reusing water and desalinating seawater can reduce pressure on vulnerable underground aquifers, allowing natural river ecosystems to recover.



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- But we also need to rebalance the water cycle, moving from "drain and pave" to "retain and regenerate" models.

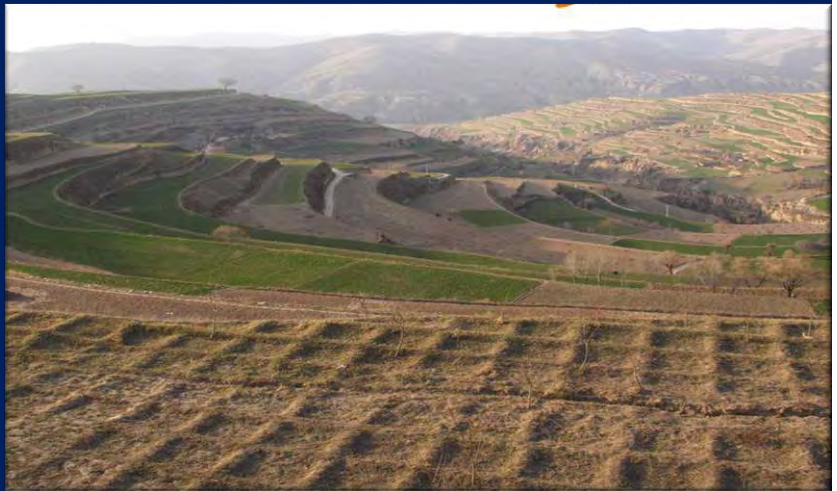


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1. Rain Water Harvesting



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1. Rain Water Harvesting

2. Nature Based Solutions



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1. Rain Water Harvesting
2. Nature Based Solutions
3. Planting vegetation to rehydrate the atmosphere



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