

# HOW TO ADDRESS WATER SCARCITY IN THE AGRICULTURAL SECTOR THROUGH THE USE OF TECHNOLOGY



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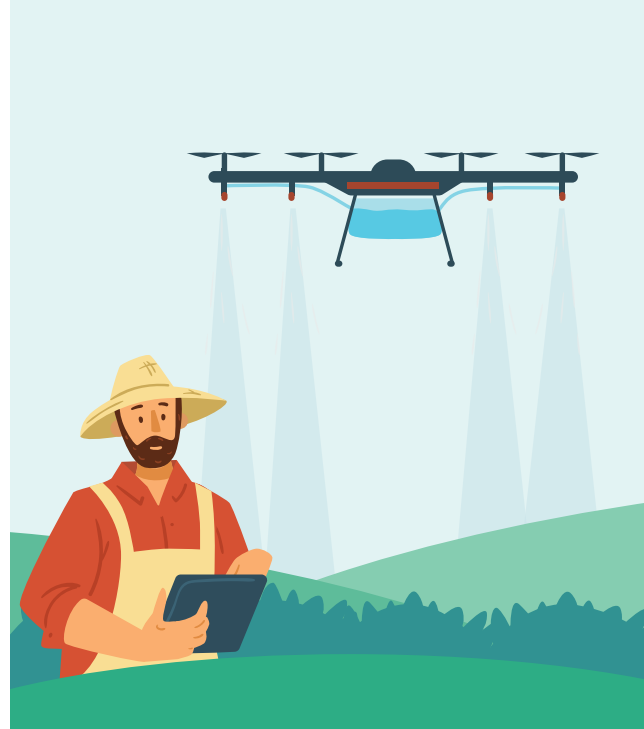


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## Towards resilient agriculture in the face of water scarcity



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# THE WATER CHALLENGE

## in modern agriculture

Water is a vital resource for agriculture, but its availability is under unprecedented pressure. As climate change alters weather patterns and demand for food increases with population growth, **water scarcity has become one of the greatest challenges facing agriculture.**

A recent report published in Forbes magazine highlights that soil degradation affects 33% of the planet's soil, increasing water demand and reducing the capacity to grow food, thus causing annual losses of nearly \$400 billion.

## TODAY'S GLOBAL WATER CRISIS

According to World Wildlife Fund (WWF) agriculture consumes 70% of the world's available freshwater, but about 60% of this resource is wasted due to inefficient irrigation systems, leakage and inappropriate choice of crops based on the environment.

The impact of this inefficiency is devastating, not only for agricultural production, but also for the environment. Agriculture as we know it cannot be sustained without radical changes in the way we manage this crucial resource.

This situation has forced farmers to reconsider their working methods, looking for more efficient ways to manage water and mitigate the impact of drought.

## THE ROLE OF TECHNOLOGY IN WATER MANAGEMENT

Today, technology is changing the rules of the game. Advances in precision agriculture are enabling farmers to make better use of every drop of water, leading to the development of resilient and resistant agriculture.

Through tools such as **IoT sensors, drones and GPS systems**, it is possible to monitor soil conditions in real time, determine exactly when and how much to irrigate, and detect leaks in irrigation systems.

This level of precision not only saves water, but also improves agricultural yields by ensuring that crops receive the exact amount of water they need to thrive.

In addition, innovations such as plastic covers that use state-of-the-art technology for their manufacture and drip irrigation systems have proven to be effective in reducing water waste. Products such as **Oasis SecondSky® covers, manufactured together with Armando Alvarez Group with advanced technology**, help maximize the efficiency of available resources in agriculture.



## Redefining agriculture in hot climates

Innovative solution to maximize efficiency in resource consumption in protected agriculture, increasing crop profitability.





# THE IMPORTANCE OF ACTING NOW

Inefficient water use not only jeopardizes global food security, but also directly affects the livelihoods of millions of farmers.

Without proper water management, agricultural systems in arid regions could collapse, leaving many communities at risk. However, technology offers practical and effective solutions to meet this challenge,

enabling farmers to continue farming sustainably.

We will then explore how technological innovations are transforming agriculture in arid areas and how farmers can apply these tools to cope with water scarcity, making agriculture more resilient to future climate challenges. ■

Similarly, **mulch plastic with Solar Shrink technology** minimizes the need for irrigation, contributing to a more rational use of water.



# THE WATER CRISIS

## in arid regions

The impact of climate change and the growing demand for food have exacerbated water scarcity around the world, but this problem is even more critical in arid regions.

These areas, characterized by low rainfall and high temperatures, face serious challenges to sustain agricultural production.

In this context, the new technologies that are increasingly being implemented in the field are proving to be an effective response to this problem.

## IMPACT OF CLIMATE CHANGE ON ARID ZONES

Climate change has altered rainfall patterns, making droughts more frequent and prolonged. Arid regions, which are already water-scarce, are particularly vulnerable.

According to data from the **Food and Agriculture Organization of the United Nations (FAO)**,

**more than 40% of the world's land area is classified as arid, and in these areas agriculture relies primarily on irrigation to sustain production.**

In countries such as India, China, Spain and Australia, the depletion of groundwater resources is alarming.



In India, for example, **overexploitation of groundwater has led to a critical decrease in the availability of this resource, affecting more than 600 million people.**

A major problem in arid regions is that agriculture is the most water-consuming activity, but much of this resource is wasted. Traditional irrigation methods, such as furrow irrigation or flood irrigation, are often inefficient and lead

to significant water losses.

**The consequence of this inefficient use is clear: rivers and lakes are drying up, and subway aquifers are rapidly diminishing.**

## SOIL EROSION AND ITS RELATIONSHIP TO THE GLOBAL WATER CRISIS

Lack of water is not the only challenge facing farmers in arid regions. Soil degradation is another problem, directly related to water use, which affects agricultural production.

Soil degradation affects agricultural land around the world, leading to a loss of fertility and a decrease in the soil's capacity to retain water. This, in turn, reduces crop yields and generates economic losses.

As mentioned earlier, unsustainable water use and soil degradation are closely linked. As soil degrades, it loses its capacity to absorb and retain water, which exacerbates the effects of drought and increases the need for irrigation.

This vicious circle makes farmers even more dependent on irrigation systems, which ultimately aggravates the water crisis.

## THE URGENT NEED FOR TECHNOLOGICAL SOLUTIONS

In this scenario, it is essential to adopt technological solutions that help optimize water use and improve soil health in arid regions.

Technology has the potential to transform agriculture in these areas, making it more resilient to extreme weather conditions and ensuring more efficient use of water resources.

In this regard, precision agriculture and smart irrigation systems are leading this transformation and offering hope to farmers working in the areas most affected by water scarcity. ■



# PRECISION AGRICULTURE AND KEY TECHNOLOGIES to optimize water use

Precision agriculture is revolutionizing the way farmers manage their crops, especially in arid regions where water scarcity is a constant challenge.

Using advanced technologies, such as **IoT sensors, drones and global positioning systems (GPS)**, farmers can monitor and fine-tune water use, ensuring that every drop counts. This not only reduces water waste, but also optimizes agricultural yields.

The following are the main technologies used for precision agriculture to optimize water use and its economic and environmental impact.

## SOIL AND WATER MONITORING WITH IOT SENSORS

One of the most promising technologies in precision agriculture is the use of IoT sensors, which allow real-time monitoring of soil and water conditions.

These sensors, placed in the field, measure soil moisture, temperature and nutrient levels, providing accurate data that farmers can use to adjust their irrigation practices.

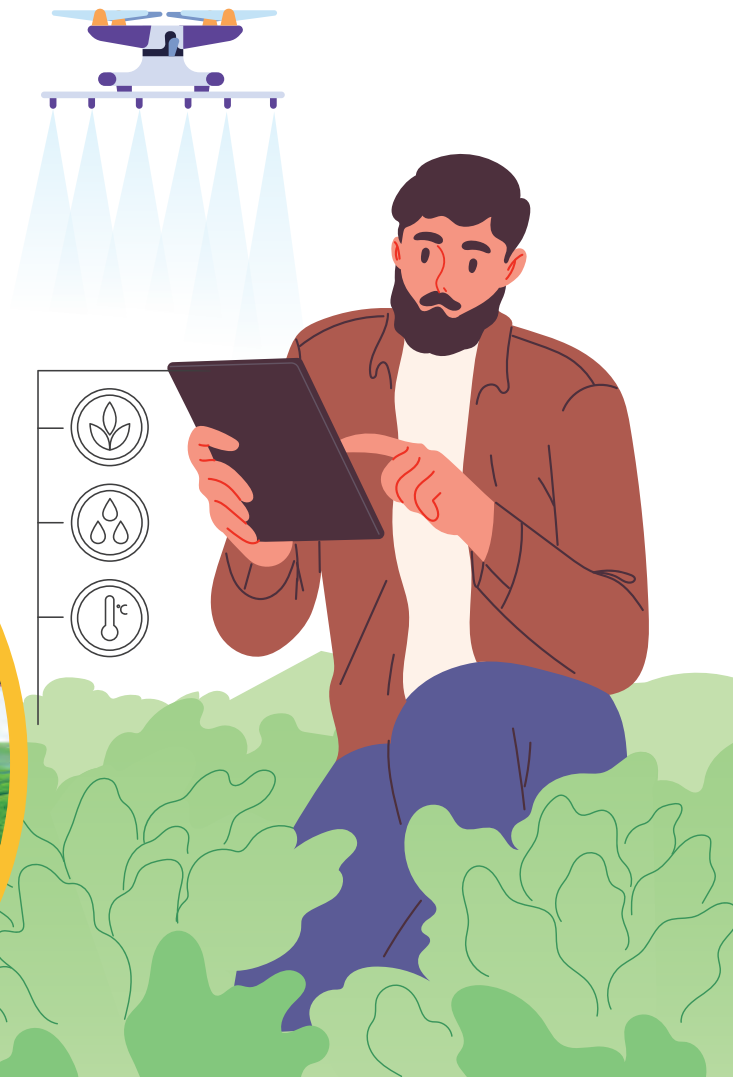
According to a **report published in Mordor Intelligence**, the global agricultural sensors market is expected to grow at a rate of 13.2% annually, reaching \$2.9 billion by 2025.

This growth is driven in large part by the need to manage water more efficiently in arid areas. Sensors allow farmers to identify exactly when and how much to irrigate, avoiding both overwatering and extreme soil dryness.





One example of how IoT sensors are transforming water management is the irrigation project in California, where the installation of these devices has reduced water use by 30%, maintaining or even improving crop yields.



## USE OF DRONES AND GPS AND SIG SYSTEMS TO MONITOR CROPS

Drones also play a key role in precision agriculture. Equipped with high-resolution cameras and multispectral sensors, drones can fly over fields and provide a detailed view of crop condition.

Through the analysis of aerial imagery, farmers can detect areas of water stress in real time, allowing them to make informed irrigation decisions.

GPS systems, on the other hand, allow precise mapping of crop areas, which facilitates specific and localized water and fertilizer application.

In addition, geographic information systems (GIS) enable the collection, analysis and visualization of spatial data, assisting in decision-making processes.

According to an **IAgric study**, the use of drones and GPS in agriculture has reduced water consumption by up to 20% on many farms by applying irrigation only where it is needed.

## IRRIGATION OPTIMIZATION WITH STATE-OF-THE-ART PLASTIC COVERS

State-of-the-art plastic covers are gaining popularity as an effective solution for water retention in the soil.

As previously mentioned, products such as **Oasis SecondSky®** covers, manufactured by **Armando Alvarez Group**, help to maximize the efficiency of resource use in agriculture, increasing crop profitability. These covers also improve soil temperature, favoring crop growth.

Another example mentioned at the beginning of this eBook is **mulch plastic with Solar Shrink technology**, which reduces evaporation and optimizes water consumption. **It is estimated that the use of this type of plastic can reduce crop water consumption by up to 50%, especially in dry climates.**

## SMART IRRIGATION AND DATA ANALYSIS

Smart irrigation systems represent another crucial advance for water optimization in agriculture. **These systems integrate moisture sensors with data analysis software**, enabling irrigation automation based on the specific needs of the soil and crops.

Techniques such as drip irrigation, which delivers water directly to the roots, have proven to be very effective in reducing water wastage.

In this regard, combining plastic mulch with drip irrigation is a highly effective system for reducing water loss by preventing evaporation from the surface and directing water to plant roots.

In China, studies show that combining the use of plastic mulch with drip irrigation has increased crop water productivity by 18% for corn and reduced overall water consumption by up to 68%.





# EXAMPLES OF COUNTRIES EMPLOYING THE USE OF THESE TECHNOLOGIES

Some prominent countries that have implemented precision agriculture by using these technologies to optimize water use are:



**China**

Thanks to significant investments in agricultural water management, **China** has widely adopted precision agriculture in arid areas, such as in the Xinjiang region. In the northwest regions, **subsoil drip irrigation combined with the use of mulching reduced water requirement by more than 50%** while maintaining and increasing yields of crops such as wheat and corn.



**Israel**

**A pioneer in the use of smart irrigation systems**, farmers in this country **integrate soil moisture sensors and automated irrigation systems that have been shown to increase water use efficiency by more than 30%** in various crops. This has made Israel a world leader in water-saving technologies, particularly in arid and semi-arid regions.



**USA**

In California vineyards and orchards, **precision irrigation technologies have led to water savings of up to 25%**, ensuring sustainable production in the midst of prolonged droughts.



**Spain**

**Spain uses precision irrigation in its extensive agricultural regions**, especially in regions such as Andalusia, where water conservation is essential for olive and citrus production.

# KEY BENEFITS OF PRECISION AGRICULTURE

As a summary, the main benefits of using these technologies include:

## Increased efficiency

Precision technologies optimize the use of resources such as water, seeds and fertilizers, reducing waste and cost.

## Improved yields

Data-driven management practices can lead to higher crop yields and better quality products.

## Sustainability

By minimizing inputs and maximizing outputs, precision farming promotes sustainable agricultural practices.

## Reduced environmental impact

Targeted application of inputs reduces the risk of runoff and environmental contamination.

## Improved resilience

Improved monitoring and predictive capabilities help farmers adapt to changing environmental conditions and mitigate risks.

# CHALLENGES AND FUTURE DIRECTIONS

Some of the challenges to overcome in the near future to apply precision agriculture and key technologies to optimize water use are:

## Data integration

Integrating data from various sources remains a challenge, requiring standardized protocols and interoperability.

## High costs

The initial investment in precision farming technologies can be prohibitive for small-scale farmers.

## The skills gap

Effective use of these technologies often requires training and technical expertise, which may be lacking in some regions.

## Data Privacy

Managing and protecting the large amounts of data generated by precision farming systems is crucial.

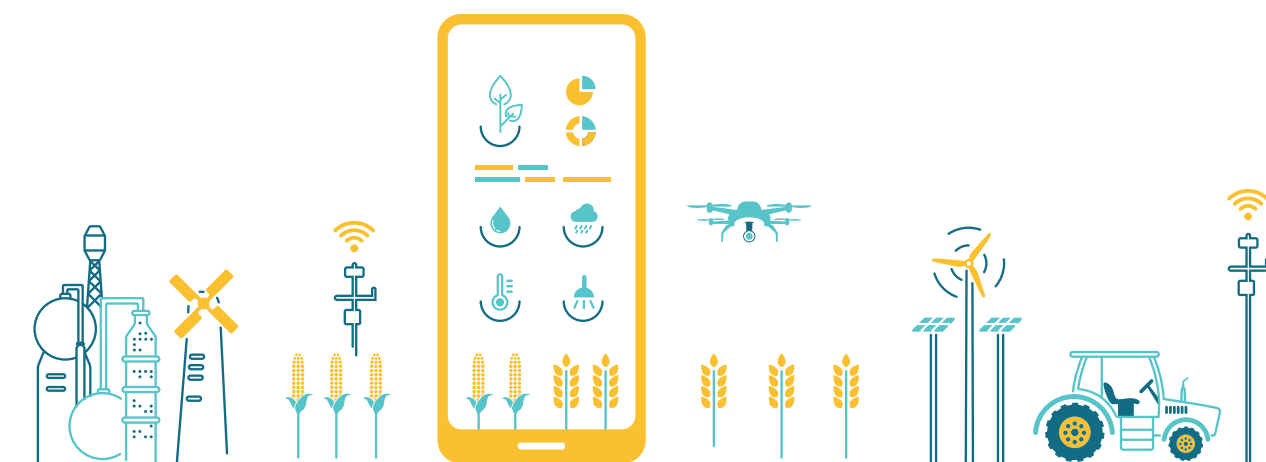




The future success of precision agriculture lies in further advances in AI and IoT systems, which will lead to smarter, more efficient and sustainable farming practices globally.

As can be seen, although there are challenges to overcome in the short and medium term, the long-term benefits of implementing these innovative technological solutions in terms of precision agriculture are substantial and very promising.

In this regard, it is crucial that governments support both small and large farmers in this transformation process. ■



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# ADVANCED IRRIGATION SYSTEMS

## for efficient water management

In arid regions, where water scarcity is critical, the implementation of advanced irrigation systems is key to ensure agricultural sustainability. These systems, combined with digital technologies, enable a more efficient use of water, maximizing its availability for crops and minimizing waste.

Among the most effective methods are drip irrigation, automated irrigation systems, polyirrigation through the use of polytubes and advanced distribution systems.

Below, we explore how these technologies are transforming agriculture in water-scarce areas.

## DRIP IRRIGATION: DIRECT WATER OPTIMIZATION

As mentioned earlier, **drip irrigation is one of the most efficient systems for water distribution in agriculture.** This method delivers water directly to plant roots through a network of tubes and drippers, minimizing evaporation and waste through runoff.





According to a report by the **Food and Agriculture Organization of the United Nations (FAO)**, drip irrigation can increase water use efficiency by up to 95%, compared to other traditional methods such as flood irrigation, which barely achieves 50% efficiency.

**In Israel**, a pioneer in the use of advanced irrigation technologies, **75% of agricultural land is now drip irrigated**. This system has enabled Israel to reduce agricultural water consumption by more than 25%, while increasing productivity by 12%.

## AUTOMATED IRRIGATION SYSTEMS AND DATA ANALYSIS

**Automated irrigation systems** are an evolution of traditional irrigation, **integrating sensors and data analysis to automatically adjust irrigation based on soil conditions, climate and crop needs**.

These systems use software that **analyzes real-time data from moisture sensors and weather stations** and optimizes irrigation based on field specific variables.

A report by **Allied Market Research** predicts that the global smart irrigation market will reach \$5.57 billion by 2030, growing at a compound annual growth rate of 13.9% from 2021 to 2030, due to the increasing demand for water-efficient solutions. This growth is driven by the need to address water scarcity and reduce the environmental impact of agriculture.

**A practical example of the impact of automated systems is the use of irrigation software managed by smartphones.** In Australia, farmers have adopted these tools to remotely monitor and control their irrigation systems, resulting in water savings of up to 30%.

## POLYIRRIGATION THROUGH POLYTUBES AND ADVANCED DISTRIBUTION SYSTEMS

**Polyirrigation is irrigation that is done through furrows or ditches that are dug in the soil surface and are usually located between the rows of crops in a field.**





**Polyirrigation represents a low-cost, low-tech solution to improve crop production, conserve resources and simplify irrigation management.** It can be used in conjunction with other more sophisticated field monitoring systems discussed above to further optimize water consumption in crops such as sugarcane, cotton or corn.

Polyirrigation can be done by leveling fields to take advantage of gravity and let flow water; also by flooding crops at predetermined times; or through flexible polyethylene pipes, known as polytubes.

**Polytubes**, used in low-pressure irrigation systems and manufactured mainly from polyethylene, **are flexible and durable pipes whose purpose is to transport water by gravity in an efficient manner from storage sources to irrigation systems.** They can be manufactured in different thicknesses and diameters, allowing a uniform and controlled distribution of water over large areas of land.

According to data from the Food and Agriculture Organization of the United Nations (FAO), the implementation of distribution systems such as polytubes has reduced water losses in agriculture by 25% in arid regions.

In Spain, for example, the use of polytubes has been a key factor in the modernization of the irrigation system in areas such as Andalusia, where rainfall is limited.

A recent study published by the Junta de Andalucía revealed that the implementation of these systems has improved irrigation efficiency by 40%, allowing farmers to save large amounts of water and reduce operating costs.



## BENEFITS FOR THE CROP

- **Uniform distribution of water and nutrients:** when applied directly to the root zone, polytubes help plants absorb water and nutrients more effectively, which increases yields and improves crop quality..
- **Applicable to all types of soil:** polytubes can be used in all types of soil. Its design allows it to be adapted to the different conditions and characteristics of each crop field. In addition, it produces less soil erosion compared to other types of irrigation.
- **Reduction of diseases:** by not wetting the leaves, the proliferation of fungi and moisture-related diseases is reduced. This implies less use of chemical products in the crop..
- **Fast crop irrigation:** it is excellent for fast and efficient irrigation of the crop, allowing a uniform distribution of water in the root area of the plants, which maximizes absorption in less time.

Among the polytube solutions available on the market is

**Reywat**



## WATER AND ENERGY SAVINGS

- **Lower water consumption:** this system uses less water than sprinkler or flood irrigation, since it applies the resource in the right place and in precise quantities, which allows an average savings of 25% compared to other systems.
- **Energy savings:** by using less water, the energy required for pumping and distribution is also decreased, reducing operating costs and environmental impact.
- **Less evaporation and runoff losses:** by directing water directly to the ground, polytubes reduce evaporation and prevent it from being lost to surface drainage.

## EASE OF USE, INSTALLATION AND MAINTENANCE

- **Adaptable installation:** irrigation through polytubes is a versatile system that can be adapted to different types of crops and soil. Pipes and irrigators are easily and flexibly installed.
- **Simple maintenance:** once installed, system maintenance is relatively simple. It consists of checking these flexible tubes to prevent blockages and ensure proper operation.

# COATED CANALS AND SMART IRRIGATION SYSTEMS

Traditional irrigation canals are subject to significant water losses due to evaporation and filtration into the soil. To mitigate this problem, **thanks to the use of technology, it has been possible to develop coated canals lined with impermeable materials, which make it possible to drastically reduce water leakage.**

In this sense, the use of geomembranes in the construction of irrigation canals has made it possible to significantly reduce losses due to filtration.

**In Spain, for example, the use of geomembranes has helped conserve up to 40% more water in agricultural areas in the southeast, one of the driest areas of the country.**

This type of technology is essential to ensure water availability in drought-prone areas and to achieve an efficient distribution of this resource. This technology, combined with smart irrigation systems, which control and adjust the amount of water needed for crops in real time, has proven to be a highly efficient solution.

According to data from the U.S. Environmental Protection Agency (EPA), **coated canals and automated irrigation systems have led to a 35% improvement in water use efficiency compared to traditional systems.**

Furthermore, in areas with extreme weather conditions, such as the southwestern United States, this combination of technologies has been instrumental in ensuring continued agricultural production, even during periods of severe drought.



# KEY BENEFITS OF ADVANCED IRRIGATION SYSTEMS

To summarize, the following highlights the five main key benefits of advanced irrigation systems for efficient water management:



## 1 **Reduction of water wastage:**

It is estimated that on average they can reduce water wastage by up to 40% compared to traditional methods. This is because they apply water directly to the root zone of the plants, avoiding evaporation and runoff losses.

## 2 **Improved agricultural productivity:**

by delivering water more precisely and efficiently, advanced irrigation systems can increase agricultural productivity by 20-30% by enabling farmers to better control the water needs of their crops.

## 3 **Energy savings:**

Automated irrigation systems allow significant energy savings by using more efficient pumps and valves adjusted to crop conditions. The European

Commission estimates that advanced irrigation systems can reduce energy consumption by up to 30% by reducing overexploitation of water resources.

## 4 **Reduced water pollution:**

Efficient irrigation not only saves water, but also minimizes leaching of fertilizers and pesticides into the soil and groundwater, reducing pollution.

## 5 **Adaptation to climate change:**

Advanced irrigation systems also allow farmers to better adapt to changing climatic conditions. According to the World Meteorological Organization (WMO), technologies that optimize water use help mitigate the effects of drought and enable farmers to maintain productivity under water stress conditions.

As can be seen, the use of advanced irrigation systems is not only an efficient solution for water management, but also

contributes to a more sustainable and profitable agriculture in the current context of climate change and resource scarcity. ■





# WASTEWATER REUSE AND DESALINATION TECHNOLOGIES in agriculture

Reuse of treated wastewater and desalination are two advanced technological solutions that farmers around the world are turning to in the face of the growing challenge of water scarcity.

These technologies are playing a crucial role in regions where access to freshwater is limited, allowing farmers to use alternative resources in an efficient and sustainable manner.

## REUSE OF TREATED WASTEWATER IN AGRICULTURE

The use of treated wastewater in agriculture has gained popularity as a viable solution to address water scarcity. This process involves treating urban or industrial wastewater for safe reuse in crop irrigation.



**The World Bank analyzes this use of treated wastewater in the agricultural world as a practice to alleviate pressure on freshwater resources.**

In countries such as Spain, the reuse of treated water has been a key response to drought. It is estimated that, thanks to these technologies, **Spanish farmers reuse up to 500 million cubic meters of water annually**, which has contributed significantly to maintaining agricultural production in arid areas. A notable example of success is the **Region of Murcia**, where through advanced treatment systems it has achieved **98% of wastewater reuse in agriculture**.


In the United States, wastewater reuse is also on the rise, especially in **California**, where chronic drought has forced farmers to seek alternative solutions. In 2021,

more than 600 million cubic meters of treated wastewater was reused, allowing farmers to continue farming in extreme drought conditions.

**Use of geomembrane-covered ponds as a wastewater reuse technology**


One of the most effective technologies to carry out wastewater reuse is the use of geomembrane-covered ponds that **facilitate wastewater treatment, in aspects such as UV filtration and disinfection**.

These allow wastewater to be safely treated for reuse in crop irrigation, while avoiding infiltration losses and ensuring that the water remains available for treatment and subsequent use.



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On the other hand, **geomembranes prevent wastewater from filtration into the ground and contaminating subway aquifers.**

Although the installation of these geomembrane reservoirs involves an initial cost, the long-term benefits such as reduced dependence on fresh water and the ability to reuse a previously wasted resource are worth the investment.

## DESALINATION: TRANSFORMING SEAWATER INTO IRRIGATION WATER

Another innovative technology that is gaining ground is desalination. **This process converts seawater into drinking water or water suitable for irrigation by removing salts and minerals.**

Although desalination has historically been expensive due to high energy costs, recent technological advances have significantly reduced costs and improved efficiency.

**Since the 1960s, the cost to desalinate**

**water has been reduced by 96%, from unit costs of approximately US\$10/m<sup>3</sup> in the 1960s to less than US\$0.5/m<sup>3</sup> in 2020.**

According to the International Desalination Association (IDA), there are **more than 20,000 desalination plants worldwide, producing approximately 95 million cubic meters of water per day, and much of this water is for agricultural use.**

Countries such as Israel and Saudi Arabia have led the way in adopting this technology for agriculture.

In Israel, where more than 80% of the water used in agriculture comes from desalination plants, it has been shown that agriculture in coastal and semi-arid areas can be sustainable in the long term.

The case of Saudi Arabia is also significant, as the country has invested heavily in desalination plants for agriculture. Currently, **Saudi Arabia is responsible for**





**22% of the world's desalination capacity**, with a daily production of water that allows irrigation of large areas of desert crops.

**Although cost remains a challenge, technological innovation is moving toward more affordable and energy-efficient solutions.**

## ECONOMIC AND ENVIRONMENTAL IMPACT OF DESALINATION AND WATER REUSE

Despite the benefits of wastewater reuse and desalination, both processes present both economic and environmental challenges. Wastewater treatment and the construction of desalination plants require significant upfront investments and ongoing maintenance.

However, **the costs of not implementing these technologies in water-scarce areas would be much higher, as the collapse of agricultural production would severely affect food security.**

There is also an environmental concern associated with the management of desalination by-products, such as brine, which can have a negative impact on marine ecosystems if not handled properly.

However, many modern plants are implementing more sustainable solutions, such as the use of renewable energy and

the correct disposal of by-products.

In terms of positive economic impact, a report by the **World Resources Institute (WRI)**, estimates that every dollar invested in water reuse can generate between two and four dollars in agricultural benefits, due to improved productivity and reduced costs related to water scarcity. This demonstrates that, in the long term, investment in these technologies can be highly profitable.

Treated wastewater reuse and desalination are emerging as crucial solutions to address growing water scarcity in agriculture. Both technologies are enabling farmers in arid areas to access previously inaccessible water resources, while advances in efficiency and sustainability continue to reduce costs and environmental impact.

**As climate change exacerbates water challenges, these innovations will become essential components of resilient and sustainable agriculture.■**



# TOWARDS RESILIENT AGRICULTURE in the face of water scarcity

Agriculture faces a crucial challenge:  
***to ensure sustainable food production in a  
context of increasing water scarcity.***

Arid and semi-arid regions, which  
represent approximately 40% of the  
planet's land surface, are particularly  
affected by this problem.

In this context, technology has emerged  
as a key ally to address the lack of water,  
promoting a more efficient and resilient  
agriculture.

In the previous pages we have explored  
the main technological solutions that are  
revolutionizing the agricultural sector.  
These solutions demonstrate that it is  
possible to address water scarcity and  
build a more resilient agriculture.

Adopting these innovations not only  
allows farmers to increase water use  
efficiency, but also to reduce operating  
costs and ensure long-term sustainability  
in a context of climate change and  
limited water resources. ■