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# Review of Water Saving Techniques for Sustainable Agriculture

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**ABSTRACT:** Water conservation in agriculture is a critical issue that affects not only the sustainability of food production but also the well-being of our planet. Agriculture accounts for 70% of the world's freshwater consumption, and as our population continues to grow, the demand for food will only increase, putting even more pressure on our limited water resources. Freshwater supply is limited — just 2.5% to put it in figures, and most of it is used up for agricultural activities. Groundwater depletion is a threat to global food security. Also, the outflow is much faster than the inflow; around 245 billion cubic meters of groundwater is consumed in India annually, and 90% goes to agriculture. The picture is way bleaker than it appears to the naked eye, and the government realizes it. Consumption is on the soil; with that, there will be more stress on agricultural land and freshwater. Hence, backed by technology in agriculture, farmers are now implementing advanced processes to conserve water, thereby making sustainable agriculture possible soon.

**KEYWORDS:** water conservation, agriculture, groundwater depletion, sustainable, farmers, freshwater supply

## I.INTRODUCTION

With innovative and sustainable practices, we can conserve water in agriculture and ensure a bright future for both food production and the environment. For instance, precision agriculture that uses sensors and smart technology can help farmers optimize water use, reducing waste and increasing efficiency.<sup>1</sup>

Another effective approach to water conservation in agriculture is the adoption of drought-resistant crops and the use of organic fertilizers and mulch, which help to reduce evaporation and retain moisture in the soil. In regions with limited water resources, farmers can also utilize rainwater harvesting and storage techniques to capture and store rainwater for use during dry spells.<sup>2</sup>

But water conservation in agriculture is not just about preserving resources for food production. It also has a far-reaching impact on the environment and human well-being. For example, conserving water in agriculture can help to reduce the stress on water systems, maintain healthy ecosystems, and preserve aquatic life.<sup>3</sup>

Before discussing the ways farmers are conserving water to promote agricultural sustainability, let us get acquainted with the existing issues first.

When it comes to agriculture, smallholder farmers suffer the most. Continued reliance on seasonal cycles has already ruined several harvests. With global climate change, calamities like floods and droughts are becoming more intense with every season. In fact, almost a third of all disaster losses are related to agricultural sectors. Some states like Andhra Pradesh, Orissa, Maharashtra, Rajasthan, and many more remain at the receiving end every year.<sup>4</sup>

This also hampers the overall economy of the agricultural sector. Farmers end up with around 20%-30% revenue losses each harvest. To improve this situation, the government made efforts to come up with irrigation canals. However, several glaring drawbacks are looming around here as well.<sup>5</sup>

Access to adequate water supply and know-how, like the use of technology in agriculture for effective water conservation, is still difficult for the majority of the farmers. Consequently, the harvest suffers immensely, and so does the GDP.<sup>6</sup>

And given the diversity of India, one unified plan does not solve the purpose.



That said, in the words of Ziglar, ‘One small positive thought can change your whole day.’ And thankfully, a lot is happening in terms of positive activities to fuel sustainable agriculture and the use of technology in agriculture for water conservation.<sup>7</sup>

With the infusion of several means of water conservation, farmers are now successfully executing better crop cycles.<sup>8</sup>

## II.DISCUSSION

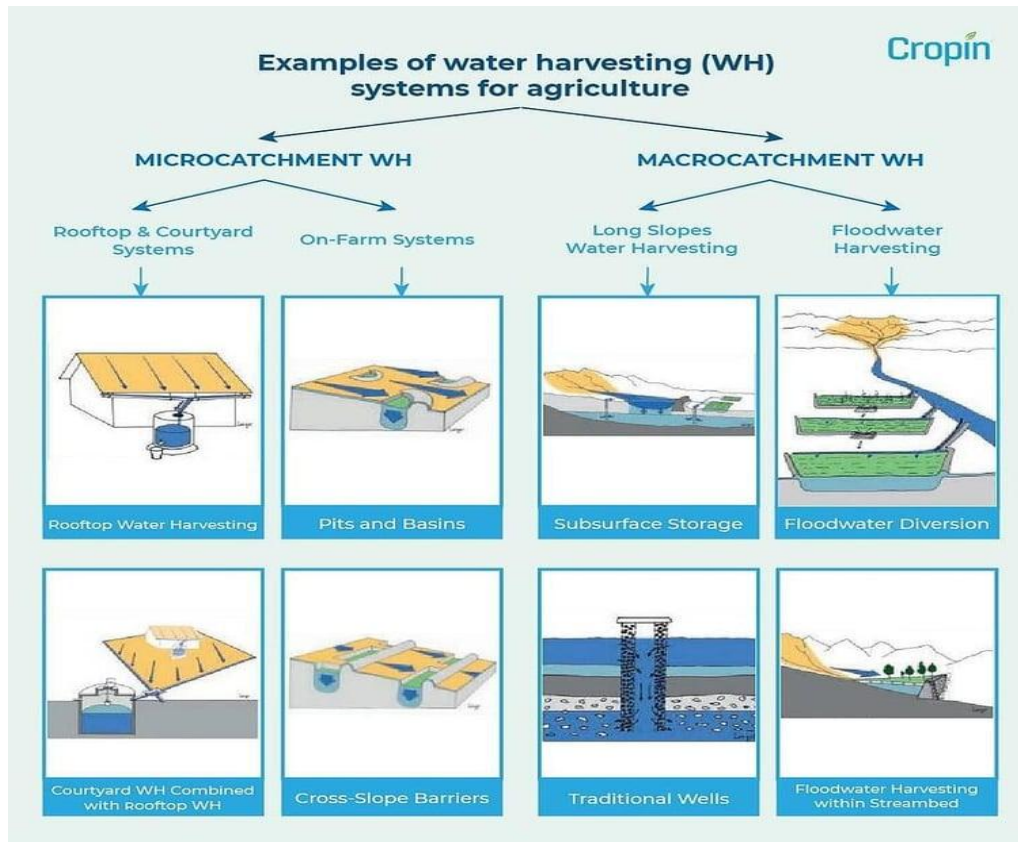
5 Water Conservation Methods that promote Sustainable Agriculture

### 1. Rainwater Harvesting

With this simple yet effective technique, farmers can store excess rainwater for further usage. Hence, farmers can not only ensure water adequacy throughout the yield but also effectively recharge groundwater levels to deal with rapid depletion.<sup>9</sup>

The method is practiced in drought-prone regions of the country where rainfall is aplenty to aid groundwater recharge.

A few states like Rajasthan, Kerala, Tamil Nadu, and several others have benefited from this method, and many more states are adopting this water conservation technique on a large scale.







## 2. Irrigation Scheduling

The use of technology in agriculture has been highly potent and fruitful when it comes to water conservation. AgTech leaders, like Cropin, have come up with practical solutions to prevent excess water usage. For example, one can schedule irrigation plans based on the local weather conditions and forecasts for the week.<sup>10</sup>

With the availability of accurate weather predictions, SmartFarm can trigger alerts to farmers to prepare them for unexpected or delayed rainfall. Based on these alerts, they can schedule irrigation at the right time and prevent excessive irrigation, too, thus saving the already low groundwater level.

## 3. Region-based Produce

Advancements in seed technologies have resulted in resilient crop varieties that produce high yields despite tough growing conditions. In addition, crop advisories that are tailored for crop variety and the agro-climatic zone further enhance agricultural productivity.

Cropin's farm management software allows farming companies to configure advisories and a package of best practices based on recommendations from agronomists. These advisories and reminders for scheduled farm activities can be shared with extension agents as alerts and notifications, who can pass them on to the farmers they are working with.<sup>11</sup>

This method has turned out to be highly fruitful in drought-prone regions like Rajasthan, where, with drought-tolerant crops, there has been a significant boost in yield. The alerts sent to the field officers via the SmartFarm application enable the farmers to take necessary precautions to avoid damage to the produce. This digital intervention increased the use of technology in agriculture in the region, along with taking a step towards increased revenue for the farmers.

## 4. Organic Farming

Organic farming improves yield besides reducing the use of fertilizers. According to a Rodale Institute survey, organically-grown corn produced 31% more output during droughts than conventionally-produced corn.

Additionally, this method helps recycle water and reduces the chances of chemical fertilizers polluting the groundwater. The same Rodale Institute survey found that organic fields can charge groundwater levels by up to 20%!<sup>12</sup>

Processes like eutrophication are also on the decline with the increased adoption of organic farming and reduced dependence on chemical fertilizers. This also helps preserve freshwater ecosystems, thereby making agricultural development sustainable.

## 5. Use of AgTech Solutions

In recent times, the use of agricultural technology to aid sustainable development has become prevalent. With the adoption of precision agriculture and the introduction of products like Cropin Grow (SmartFarm), farmers and organizations get alerts of a possible agri-adversity in advance and have been able to conserve water better and boosted produce significantly. Monitoring all farming practices, from pre-sowing to harvest, with the farm management software also promotes better water management.<sup>13</sup>



At Cropin, we build solutions that analyze pixel-level data derived from satellite imagery, IoT, and field intelligence and deliver actionable insights that boost resource efficiency and crop productivity.

Several brands have partnered with Cropin to realize their targets for sustainable agriculture. With such small but incredibly crucial steps, several lives have already been impacted for the better.<sup>14</sup>

### Implications

Sustainability-minded farmers are looking ahead and using an arsenal of methods to conserve water. Here are just a few.

#### 1. Drip Irrigation

Drip irrigation systems deliver water directly to a plant's roots, reducing the evaporation that happens with spray watering systems. Timers can be used to schedule watering for the cooler parts of the day, further reducing water loss. Devoto Gardens, Glashoff Farms, and Twin Girls Farm are a few of the Ferry Plaza Farmers Market farms that irrigate their crops with drip irrigation lines. Properly installed drip irrigation can save up to 80 percent more water than conventional irrigation, and can even contribute to increased crop yields.<sup>15</sup>

#### 2. Capturing and Storing Water

Many farms rely on municipal water or wells (groundwater), while some have built their own ponds to capture and store rainfall for use throughout the year. Properly managed ponds can also create habitat for local wildlife. Marin Roots Farm relies on two ponds for all of their water needs, helping to minimize their impact on the surrounding watershed.<sup>16</sup>



### 3. Irrigation Scheduling

Smart water management is not just about how water is delivered but also when, how often, and how much. To avoid under- or overwatering their crops, farmers carefully monitor the weather forecast, as well as soil and plant moisture, and adapt their irrigation schedule to the current conditions. Tory Farms, which uses flood irrigation in their orchards, waters at night to slow down evaporation, allowing water to seep down into the soil and replenish the water table.<sup>17</sup>

### 4. Drought-Tolerant Crops

Growing crops that are appropriate to the region's climate is another way that farmers are getting more crop per drop. Crop species that are native to arid regions are naturally drought-tolerant, while other crop varieties have been selected over time for their low water needs. Olives, Armenian cucumbers, tepary beans, and orach are a few of the more drought-tolerant crops you can find in the Ferry Plaza Farmers Market.<sup>18</sup>

### 5. Dry Farming

California dry farmers don't irrigate, relying on soil moisture to produce their crops during the dry season. Special tilling practices and careful attention to microclimates are essential. Dry farming tends to enhance flavors, but produces lower yields than irrigated crops. Dirty Girl Produce is known for their dry-farmed Early Girl tomatoes. Wine grapes, olives, potatoes, and apple trees can also be successfully dry farmed in California.<sup>19</sup>

### 6. Rotational Grazing

Rotational grazing is a process in which livestock are moved between fields to help promote pasture regrowth. Good grazing management increases the fields' water absorption and decreases water runoff, making pastures more drought-resistant. Increased soil organic matter and better forage cover are also water-saving benefits of rotational grazing. Bodega & Yerba Santa Goat Cheese and Marin Sun Farms, among others, practice rotational grazing to keep their pastures and animals healthy.<sup>20</sup>

### 7. Compost and Mulch

Compost, or decomposed organic matter used as fertilizer, has been found to improve soil structure, increasing its water-holding capacity. Mulch is a material spread on top of the soil to conserve moisture. Mulch made from organic materials such as straw or wood chips will break down into compost, further increasing the soil's ability to retain water. Compost and mulch help Allstar Organics, Tierra Vegetables, and many other Ferry Plaza Farmers Market farms retain more water in the soil during the dry season. Farmers may also use black plastic mulch as a soil cover to suppress weeds and reduce evaporation.<sup>21</sup>

### 8. Cover Crops

Planted to protect soil that would otherwise go bare, cover crops reduce weeds, increase soil fertility and organic matter, and help prevent erosion and compaction. This allows water to more easily penetrate the soil and improves its water-holding capacity. A 2012 survey of 750 farmers conducted by North Central Sustainable Agriculture Research and Education found that fields planted with cover crops were 11 to 14 percent more productive than conventional fields during years of drought. Woodleaf Farm uses perennial grass and clover in their peach orchards, and at Frog Hollow Farm, organic fruit farmer Al Courchesne swears by his use of cover crops for building healthy soil.<sup>22</sup>



#### 9. Conservation Tillage

The Dust Bowl of the 1930s was created by a perfect storm of deep plowing and loss of perennial grasses followed by extreme drought and wind erosion. Conservation tillage uses specialized plows or other implements that partially till the soil but leave at least 30 percent of vegetative crop residue on the surface. Like the use of cover crops, such practices help increase water absorption and reduce evaporation, erosion, and compaction. Date grower Flying Disc Ranch makes the most of their water use in the Coachella desert by using a mix of mulch, compost, and cover crop with no tillage.

#### 10. Going Organic

In a 30-year farm systems trial, the Rodale Institute found that corn grown in organic fields had 30 percent greater yields than conventional fields in years of drought. In addition to keeping many of the more toxic pesticides out of our waterways, organic methods help retain soil moisture. Healthy soil that is rich in organic matter and microbial life serves as a sponge that delivers moisture to plants. The trial also found that organic fields can recharge groundwater supplies up to 20 percent.<sup>23</sup>

### III. CONCLUSIONS

Agriculture not only consumes 70% of global freshwater and 90% of global groundwater but also causes a lot of environmental problems, such as drying up of rivers, groundwater depletion and pollution. Thus, water conservation is considered a necessary requirement if we are to feed the booming global population by supporting sustainable agriculture. Generally, increasing water supply (e.g. interbasin water transfer, artificial precipitation) and enhancing water use efficiency via water-saving technologies (e.g. dripping irrigation, mulching, deficit irrigation, and water-saving cultivars) are the main ways to solve water resources shortage in agriculture. In practice, water use efficiency in different scales is measured to help people to realize the importance of the process of water consumption and to enhance water productivity<sup>24</sup>. Water transfer and other human actions also aim to sustain the water demand of human society. However, overuse of water resources is still threatening human lives in most countries globally, and we need to employ water-saving technologies, increase reuse of water continually, and also mind the risks from agricultural intensification (irrigation and fertilization) and climate change on food production.<sup>25</sup>

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