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WATER-SAVING TECHNOLOGY FOR CULTIVATED FIELDS

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ABSTRACT

The flood irrigation method is primarily used in Indian agriculture and has a very low water use efficiency due to significant transportation and distribution losses. Water-saving strategies such as the renovation of bunds, laser levelling, adjustment of dates of sowing, and use of efficient varieties, mulching and drip irrigation etc., to improve the water use efficiency. Compared to the traditional surface technique of irrigation, which has a water use efficiency of just 35–40%, the drip method of irrigation, which we'll discuss above, may prove to be an effective approach for conserving water and enhancing water use efficiency.

INTRODUCTION

The foundation of Indian agriculture has increasingly become groundwater. Security of both the environment and the water supply. Nearly 62 per cent of groundwater is used for agriculture, 85% of rural water supply, and 50% of urban water supply. However, the country's ever-growing thirst for water has forced groundwater extraction in some areas to exceed annual replenishment. Adverse environmental effects include diminishing groundwater levels, de-saturation of aquifers, and deterioration of water quality. This decrease in water level is especially pronounced in the northern states of Punjab, Haryana, and Uttar Pradesh, where widespread acceptance of paddy-wheat monoculture has increased farmers' dependence on irrigation water supplies. In Punjab alone, where over 15 lakh tube wells are contributing to more than 70% of the irrigated area and endangering the state ground reserves, Despite numerous attempts at crop diversification, Punjab's paddy area has grown to 31.49 lakh hectares, making paddy agriculture eventually the primary factor in excessive groundwater consumption. In Punjab, out of 150 assessment units (blocks), 117 units (78%) have been labelled as "Overexploited," 6 units (4%), "Critical," 10, "Semi-Critical," and 17 units (11.33%) as "Safe" (National compilation on groundwater resources of India, 2020). As a result, Punjab, formerly known as the "Land of Five Rivers (Punj-aab)," is today India's most "overexploited" state due to the dire state of its groundwater resources.

Additionally, rising water from lower depths demands more energy, which has increased agricultural costs. This worrying situation necessitates effective water management measures to stop the

indiscriminate use of valuable groundwater supplies. Here are a few effective water management strategies and practical options for crops:

1) Irrigation channels should be repaired and cleaned

Before planting crops this season, irrigation channel maintenance should be done. The loss of irrigation water during transportation can be minimized by using an underground pipeline system. Create smaller field areas by dividing larger ones. This saves water due to uniform irrigation water application and shorter irrigation times.

2) Land levelling with a laser

To use water wisely, precision land levelling is the first stage, and a laser land leveller is one such tool that could encourage effective water use. In an agricultural field, laser levelling is a laser-guided precision levelling technology used to achieve very fine levelling with the specified grade. With laser levelling, a laser transmitter unit continuously emits a 360° rotating beam parallel to the necessary field plane. A laser receiver (also known as a receiving unit) installed on a mast on the scraper unit picks up this beam. A two-way hydraulic control valve automatically changes the scraper level in accordance with the converted cut and fill level adjustments from the signal received. Before employing the laser land leveller, the field is prepared by cultivating and planking. The efficient use of various agricultural inputs, including fertilizers, insecticides, and herbicides, is improved by laser levelling and saving water, electricity, and time. Additionally, this causes the crop to mature uniformly, improving the crop's quality and yield. An additional 5–10% yield advantage saves around 15–25% of irrigation water.

3) Prevent rice from being transplanted too soon

For better grain quality, water conservation, and a reduction in the growth of stem borers, Punjab should limit rice transplanting to a timely schedule (Jun 20 to Jul 5). This is because the warmth and evaporation are higher during the early stages of transplanting, increasing the crop's need for water. Conversely, seedlings moved after Jun 20 require fewer irrigations because the monsoon typically arrives at the end of June or relative humidity rises, lowering the warmth and evaporation rate. Therefore, delaying transplanting from June 15 to July 5 will result in significantly higher apparent and total water productivity and saving of irrigation water of 23.6 cm.

4) Variety of short duration

Grow short-duration PR varieties in accordance with the Ludhiana-based Punjab Agricultural University's advice. These short-duration cultivars, PR 126, PR 130, PR 127, PR 129, PR 121, and PR 128, mature after transplanting in 93, 105, 107, 108, 110, and 111 days, respectively, and stay on the

field for a shorter period, requiring fewer irrigations. These short-duration types not only conserve irrigation water but also leave the field early, making it simple to manage the straw for the timely seeding of wheat crops. Avoid growing non-PR kinds since they have a longer maturation period and need 15–25% more water than PR varieties.

5) Alternately wetting and drying

After transplanting, only leave the water constantly standing for two weeks to allow the seedlings to establish themselves properly. Irrigation is used two days after the ponded water has soaked into the soil following two weeks of continual submersion. The field is consequently alternately flooded and unflooded. However, caution should be made to prevent the field from developing fissures. Therefore, farmers can readily use alternate wetting and drying (AWD) in their fields to reduce the need for irrigation water. This method has demonstrated irrigation water savings of 15% to 25% without affecting crop output. On the other hand, continuous submersion does not increase yields; rather, it wastes irrigation water and may lead to an increase in the prevalence of pests and diseases.

6) Direct seeding of rice (DSR)

In comparison to puddled transplanted rice, direct seeding of rice (tar-water conditions) in medium to heavy textured soil also aids in saving 15 to 20% irrigation water. Apply the first irrigation using DSR technology about 21 days after sowing. After that, depending on the soil type and rainfall, apply irrigation every 5-7 days.

7) Diversity of crops

It attempts to replace the water-guzzling paddy grown on more than 85% of Punjab's cropland with less water-intensive crops and is seen as a successful solution to address the province's agri-water issues. To conserve groundwater, the state aims to convert 1.2 million ha of paddy (out of a total of 3 million ha) to alternative crops (maize, sugarcane, oilseeds and pulses, vegetable crops, and fruit plantations). The literature also points to several advantages of crop diversity, including groundwater preservation, soil regeneration through the growth of nitrogen-fixing plants, increased productivity, resource usage efficiency, ecological benefits, job creation, and sustainable agriculture.

8) Planting in the Ridge/Bed

Paddy can be transplanted on ridges (60 cm) or beds (67.5 cm) on heavy textured soils to conserve irrigation water. With a plant to plant distance of 9 cm on beds and 10 cm on ridges, irrigate the furrows before planting seedlings in the middle of the slopes (on both sides). Apply water regularly for the first 15 days after transplanting. After the ponded water has soaked into the soil for two days, start applying irrigation in furrows. Every effort should be made to prevent furrow cracking in the field.

Similar to this, two rows of wheat can be sown 20 cm apart in a bed that is 37.5 cm broad, with a 30 cm wide furrow between the two beds. For effective water and fertilizer use, reduced weed emergence, and other benefits, beds can also be used to plant other crops, including gobhi sarson, soybean, maize, cotton, moong, mash, mentha, chickpea, etc.

9) Drip irrigation

The process of drip irrigation, also known as trickling irrigation, involves pouring water onto the soil extremely slowly from a network of pipes made of small-diameter plastic and equipped with emitters or drippers. In contrast to surface irrigation, which includes watering the entire soil profile, water is supplied close to the plants so that just the portion of the soil where the roots develop is moist. Unlike other approaches, drip irrigation uses water applications more frequently (typically every 1-3 days), resulting in a more hospitable moisture level in the soil where plants thrive. The emitters release water and nutrients into the soil, which are then carried by capillary action and gravity into the root zone of the plants. By doing this, the plant's loss of moisture and nutrients is nearly immediately replaced, preventing it from ever experiencing water stress and improving quality, high yield, and optimum growth. Drip irrigation can conserve between 26 and 46% of irrigation water in the crops potato, chilli, onion, wheat, spring maize, pea, brinjal, turmeric cotton, mentha, gobhi sarson, and kinnow.

10) Mulching

The soil or ground is covered to create more favourable conditions for plant growth, development, and effective agricultural production. Mulching conserves soil water by lowering soil evaporation and

controlling soil temperature, reducing the need for irrigation during crop cultivation periods. By blocking sunlight from penetrating the soil's top layer, mulch decreases weeds' germination. Mulch also lessens rain's kinetic energy and pauses its effect, preventing runoff and giving the soil more time to absorb the rain. Additional moisture encourages plant root growth, which further contributes to soil stabilization. Using polythene sheets or crop waste, such as paddy straw, sugarcane garbage, etc., mulching can be done. Punjab generates a significant amount of paddy straw, which is easily used as a mulch for field crops, helping to address the state's serious residue-burning issue.

S. No.	Crops	Paddy straw mulch (q/acre)
1	Maize	30
2	Sugarcane	20-25
3	Mentha	24
4	Turmeric	36

Dynamic groundwater resources of India and Punjab (Year: 2020)

Parameter	India	Punjab
Total Annual Ground Water Recharge (BCM*)	436.15	22.80
Annual Extractable Ground Water Resources (BCM)	397.62	20.59
Annual Ground Water Extraction (BCM)	244.92	33.85
Stage of Ground Water Extraction (%)	61.60	164.4

Source: Central Ground Water Board, Government of India (* billion cubic meter)

CONCLUSION

The flood irrigation method is primarily used in Indian agriculture and has a very low water use efficiency due to significant transportation and distribution losses. Water-saving strategies such as the renovation of bunds, laser levelling, adjustment of dates of sowing, and use of efficient varieties, mulching and drip irrigation etc., to improve the water use efficiency. Compared to the traditional surface technique of irrigation, which has a water use efficiency of just 35–40%, the drip method of irrigation, which we'll discuss above, may prove to be an effective approach for conserving water and enhancing water use efficiency.