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Enhancing water use efficiency through crop management practices

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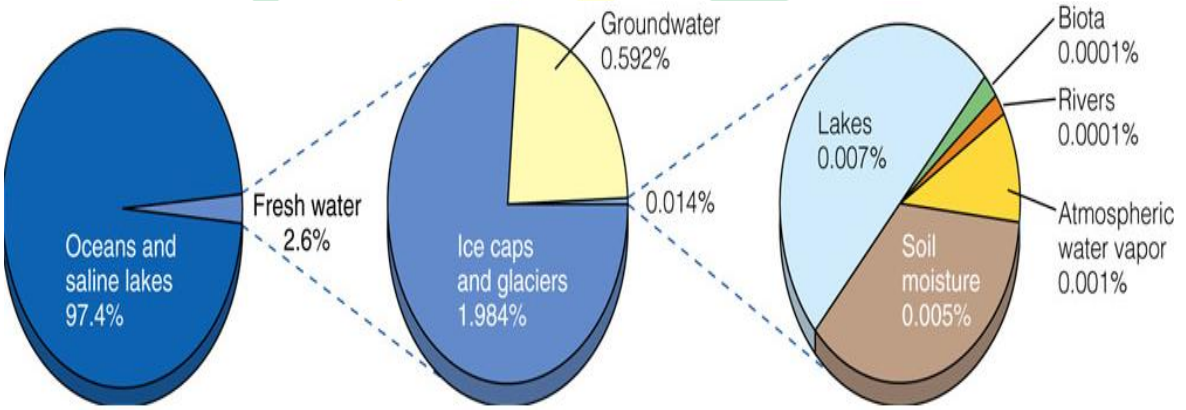
Introduction

We know that India is land of *Rishi* and *Krishi*. About 70 % of Indian population are engage in farming/agriculture community. Total geographical area of India is 328.7 M ha. Gross sown area in the country is 195 M ha. Irrigated area in India is 64.7 M ha. Agriculture is the biggest consumer of water. It uses around 70 % of all freshwater withdrawals worldwide. About 2.60 % of the total water available on the earth is fresh water, of which about 68.7 % lies frozen in polar region and 30.1 % is present as ground water. The rest is available in lakes, rivers, atmospheric moisture, soil *etc*. Water, a scare commodity in drylands is a key natural resource for stable agricultural production. In arid and semi-arid areas, it is considered as liquid gold for crop production. With a growing world population, agriculture will face more competition from industrial and domestic water users. Therefore agriculture sector will have to use water more efficiently.



All water **Fresh water** **Readily accessible fresh water**

Small fraction (0.014%) is readily available for human use

(Availability of water resources)

(Source: The Economist, May 2010)

❖ **Current situation: Rising water demand in India**

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Water (BCM)	2010	2025	2050
Irrigation	582.0	673.5	842.5
Domestic	62.5	75.5	136.5
Industrial	46.0	52.0	106.0
Power	19.5	42.0	95.0
Total	710	843	1180

(Source: MOWR, 2015)

- Estimated to increase 34 % in next 25 years
- Domestic/Industry demand growing faster than irrigation needs
- Water use efficiency is low *i.e.* 35 – 45%
- Against 50% - 60% in developed countries

Water scenario in Gujarat

- Geographical area is 196.12 lakh ha
- Net cultivated area is 98.01 lakh ha
- Under irrigation 38.27 lakh ha
- There is a wide annual variation in rainfall. Erratic rainfall affecting the crop productivity.
- Out of 248 talukas of the state, as many as 56 talukas are drought prone which suffer from drought or water scarcity condition at regular interval
- Drought, flood and cyclone raise after some interval badly affect agriculture of the state and also economy of the farmers

Need to improve the water use efficiency

- Population growth
- World demand for food, feed, fuel and fiber is increasing
- Irrigation water sources are declining
- Competition from other water users
- Shortage of water storage capacity
- Environmental & water quality degradation
- Production is being pushed into more arid environments

Concept of water use efficiency

Water use efficiency (WUE)can be defined as biomass produced per unit area per unit water evapo-transpired. The water utilization by the crop is generally described as water use efficiency (kg/ha-mm or q/ha-cm). It may be two types.

(A) Crop water use efficiency: CWUE = Y/CU

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where, CWUE = Crop water use efficiency (kg/ha-mm)
Y = Marketable yield of crop (kg/ha)
CU = Consumptive use of water (mm)

(B) Field water use efficiency: **FWUE = Y/ Water requirement**

where, FWUE = Field water use efficiency (kg/ha-mm)
Y = Crop yield (kg/ha)

❖ **Crop management practices for improving water use efficiency**

1. **Choice of crops and varieties**

It should be done based on availability of water, under rainfed crops. WUE of different crop varies differently because of many reasons, like C_4 plants are more water efficient as compared to C_3 plants as they lack photorespiration and have various adaptive mechanisms to water scarcity condition, apart from this climate, soil and crop characteristics are also responsible for variation in water use efficiency.

2. **Time of sowing**

It is non-monitory input which is not only ensures the higher yields but also optimum utilization of the applied inputs. One of the main reasons for choosing the optimum dates for sowing is to ensure good germination by placing the seed in optimum moisture zone. In early sowing, provides longer productive phase, results in higher seed yield. In delayed sowing, decreased WUE and reduced seed yield with proportionate consumptive use of water in timely sowing/early sowing.

3. **Methods of planting/sowing**

Planting methods/sowing has direct effect on yield, solar energy interception, soil water evaporation and an indirect effect on WUE. Broad bed and furrows (BBF) are formed for rainy season crops. For some crop like maize, vegetable etc. the field has to be laid out into ridges and furrow. Planting crop on raised beds is an improved practice for increasing water use efficiency.

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4. Spacing

Two type – Inter row and Intra row. Establishment of optimum plant population by maintaining proper row spacing is one of the important factors to secure a better translocation of photosynthates, which render better yield of crop. Spacing and orientation of rows effect on WUE and crop yield.

5. Intercropping

Growing more than one crop simultaneously in the same land area in rows of definite proportion and pattern. Provide opportunity to diversify cropping system. Make possible to optimum utilization of land, water and other resources more effectively. They provides a cover against the failure of one crop particularly under the rain fed situations. An increase yield will be increase WUE.

A few examples of suitable intercropping systems are-

- ✓ Maize and pigeon pea
- ✓ Pearl millet and mothbean

6. Fertilizer

Fertilizer use can also have a very marked effect on crop yield and water use efficiency. Use of nitrogen, phosphorus and combination of chemical fertilizer with organic manure or chemical fertilizer with bio fertilizer have shown to increase growth and development of plant in rainfed and irrigated areas.

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7. Irrigation

Irrigation scheduling is the process of determining when to irrigate and how much water to apply in limited water supply. Application of water at critical stages of crop. Proper scheduling of irrigation leads to save water, energy, higher crop yield, efficient use of inputs and lower production costs. When a limited quantity of water is available and their aim to produce maximum yield per unit of water.



8. Weed management

Weed competes with crops for soil moisture, nutrient and light. In general, for producing equal amount of dry mater weed transpire more water than field crop.Consumptive use of *Chenopodium album* is 550 mm against 479 mm for wheat crop. Weed also hosts some pests and diseases and that affect the crops.



9. Moisture conservation practices

Widely adopted in water-limited area. In this, practices include tillage, ridge and furrow and rain water management. Tillage affects the WUE by modifying the hydrological properties of the soil and influencing root growth of plant.



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10. Mulching

Type of mulch:

- Straw
- Saw dust
- Plastic film

Benefits of use of mulches:

- Conserve soil moisture
- Control weeds
- Moderate soil temperature

Mulching influences WUE of crops by affecting the hydrothermal regime of soil, which may enhance root and shoot growth, besides it helps in reducing the evaporation (E) component of the evapo-transpiration.



11. Antitranspirants

Antitranspirants are the materials or chemicals that decrease the water loss from plant leaves by reducing the size and number of stomata. Nearly 99% of the water absorbed by the plant is lost in transpiration.

There are four types of Antitranspirants:-

- Stomatal closing type: Atrazine, PMA
- Film forming type: Ethyl alcohol, mobileaf
- Leaf reflectant type: kaoline
- Growth retardants: Cycocoel (CCC)

Conclusion

From the foregoing discussion it can be concluded that adoption of various agronomic/management practices such as growing of hybrid/improved varieties than local varieties; timely sowing of the crop; sowing of crop on trench/ raised bed method; sowing of crop at optimum inter and intra row spacing; raising crops under intercropping system than sole cropping; application of optimum dose of fertilizers at proper time; irrigating crop by drip method than surface irrigation method; timely control of weeds by different methods; use of mulch and spraying of anti transpirants on crop foliage in different crops resulted in substantially increment of water use efficiency due to remarkable increase in yield of different crops.

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