Uniformity and Efficiency

Low uniformity always results in low efficiency of the irrigation.

Efficiency Definitions

1. The effectiveness of an irrigation system in delivering water to a crop
2. The effectiveness of irrigation in increasing crop yields.

Some water losses are expected and accepted in proper irrigation system design, installation, and management.

Reservoir Storage Efficiency ($E_s$).

Reservoir storage efficiency is the ratio of the volume of irrigation water available from an irrigation reservoir to the volume of water delivered to the reservoir. This ratio is normally less than 1.0 because of seepage, evaporation, and transpiration losses.

Water Conveyance Efficiency ($E_c$).

Water conveyance efficiency is the ratio of the volume of water delivered for irrigation to the volume of water placed in the conveyance system. This ratio is normally less than 1.0 for open channel conveyance systems, but it may be approximately 1.0 for pipeline conveyance systems.
Irrigation Application Efficiency ($E_a$)

Irrigation application efficiency is the ratio of the volume of irrigation water stored in the root zone and available for crop use (evapotranspiration) to the volume delivered from the irrigation system. This ratio is always less than 1.0 because of losses due to evaporation, wind drift, deep percolation, lateral seepage (interflow) and runoff which may occur during irrigation.

Overall (irrigation system, project or farm) Irrigation Efficiency ($E_o$).

Overall irrigation efficiency is calculated by multiplying the efficiencies of the components. For a system which includes reservoir storage, water conveyance, and water application, the overall irrigation efficiency is defined as:

$$E_o = E_r E_f E_a$$

Effective Irrigation Efficiency ($E_e$).

Effective irrigation efficiency is the overall irrigation efficiency corrected for water which (1) is reused, or (2) is restored to the water source without a reduction in water quality.

Effective Irrigation Efficiency

The effective irrigation efficiency is defined as:

$$E_e = E_o (1 - FR) + FR$$

where $FR$ is the fraction of the water lost that is recovered.
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Potential Uniformity Impact
Water Use Efficiency

The water use efficiency WUE is defined as:

\[ E_u = \frac{Y - Y_o}{V_i} \]

where:
- \( E_u \) = water use efficiency,
- \( Y \) = yield under irrigation,
- \( Y_o \) = yield without irrigation,
- \( V_i \) = irrigation amount.

Yield and Efficiency versus Applied Water

- From research conducted in Texas, Florida and other parts of the Southeast on various forage and grain crops yield can be related to ET through a relationship similar to:

\[ Y = Y_o \frac{(ET - E_u)}{1 + (ET - E_u)} \]

- While ET (through most typical production levels) is linearly correlated with applied water, such as:

\[ ET = \alpha I + ET_u \]