The relations between the variables may be formulated as follows:—

Consider a soil column of unit surface area and a depth extending through the root zone to the drainage region.

Let W_f = the weight of water in the column when the soil moisture is at field capacity, pounds per square foot;

W_a = the weight of water applied with each watering, pounds per square foot;

E = the evapotranspiration rate, pounds per square foot per week;

T = the irrigation time (period between waterings), weeks;

C_a = the salt concentration in the applied water;

C_T = the maximum permissible concentration in the soil water. The magnitude of C_T is fixed by the type of crop (degree of salt tolerance) and/or the limiting value of the sodium absorption ratio in the soil water for the particular soil being irrigated.

$\Delta = W_a/62.4T$ = the irrigation rate, feet per week;

R = the leaching ratio; the quantity of drainage water as a fraction of the amount of water applied.

After the soil has been irrigated for a period of time, the salt content in the soil will approach an equilibrium value with the increment of salt added during each cycle being balanced by the decrement of salt removed in drainage.

The amount of drainage water per cycle will be the excess of the water applied over that used consumptively. The leaching ratio therefore will be

$$R = (W_a - ET)/W_a \geq 0 \quad \text{.....(1)}$$

With each application the soil is saturated and drainage occurs until the soil moisture reaches a level corresponding to field capacity. With good soils this process occurs in a time interval that is small compared to the irrigation time. The consumptive use during the irrigation time will be the product of this time and the evapotranspiration rate. The water remaining in the soil at the end of the cycle, therefore, will be,

$$W_T = W_f - ET \geq 0 \quad \text{.....(2)}$$

If the system is managed so that the concentration of dissolved salts in the critical period at the end of the cycle has risen to the maximum permissible amount, the residual amount of salt remaining in the soil will be $W_T C_T$. When a salt balance is attained, the influx of salt will be balanced by the efflux to drainage. If it is assumed that the proportion of salt removed will be that of the drainage water to the total water after irrigation, then

$$W_a C_a = [(W_a - ET)/(W_a + W_T)]\,(W_T C_T + W_a C_a).$$