Gravity Irrigation- infrastructures design and siphon

Submission date 30/09/2024 at 23:00

Exercise 1- Basic elements of irrigation system

We propose to irrigate a surface area of 800 ha by rotation, with 16 hours of irrigation per day (between 6:00 and 22:00), every day of the month. The scheme is given in figure 1.

1. Knowing that the net water need, Bn, requirement for the peak month (June) is 144 mm, that the handling flow rate is 30 l/s, that the overall efficiency E is 60%, and the plot efficiency e is 80%, that the retention capacity and the temporary wilting point are 0.27 and 0.195 cm^3/cm^3 respectively, and that the root depth of the crops selected is 80 cm, calculate the following quantities (per ha where needed):
   (a) effective peak demand B_p in both mm and in m^3/ha at the head of the network,
   (b) effective peak demand B_{par} at plot level both mm and in m^3/ha,
   (c) specific peak flow rate q_p in l/(s ha) at network head,
   (d) specific peak flow q_{par} in l/(s ha) at plot level,
   (e) the mean flow rate in peak period Q_p in both l/s and m^3/s at the head of the network,
   (f) the fictitious continuous flow rate q in l/(s ha) for the peak month at the head of the network,
   (g) maximum net irrigation dose D_n in mm,
   (h) maximum gross irrigation dose D_b in mm,
   (i) minimum number of irrigation doses n,
   (j) Net effective irrigation dose D_n in mm,
   (k) Gross effective irrigation dose D_b in mm,
   (l) time t' required to water 1 ha,
   (m) maximum surface area S' in ha of a district,
   (n) rotation R in hours and days,
   (o) water turn over T in hours and days,
   (p) duration of irrigation (in hours) for each of the plots of the district shown in Figure 1
   (q) Draw up a watering schedule for a round of watering starting on 1 June for the neighbourhood shown in figure 1.

Exercise 2- weir sizing

1. A trapezoidal concrete channel (Manning-Strickler roughness coefficient $K = 65\,m^{1/3}/s$) with a slope $I = 10\,cm/km$, a base width of 0.4 m, and side slopes of 2/3 must carry a maximum flow rate of 94 l/s. A weir is installed so that the water level upstream of the structure does not vary by more than 11 cm.

   Calculate and design the weir so that there is no rise in the water line at the location of the structure.

2. What happens if we want to limit the variation in the water level to 8 cm?

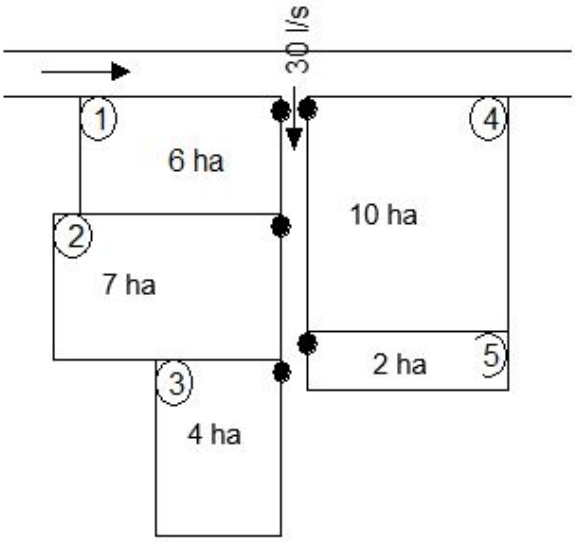

Figure 1: Scheme of the irrigation surface area (district) with 5 plots (or parcels)