Water Resources Engineering and Management

(CIVIL-466, A.Y. 2024-2025)

5 ETCS, Master course

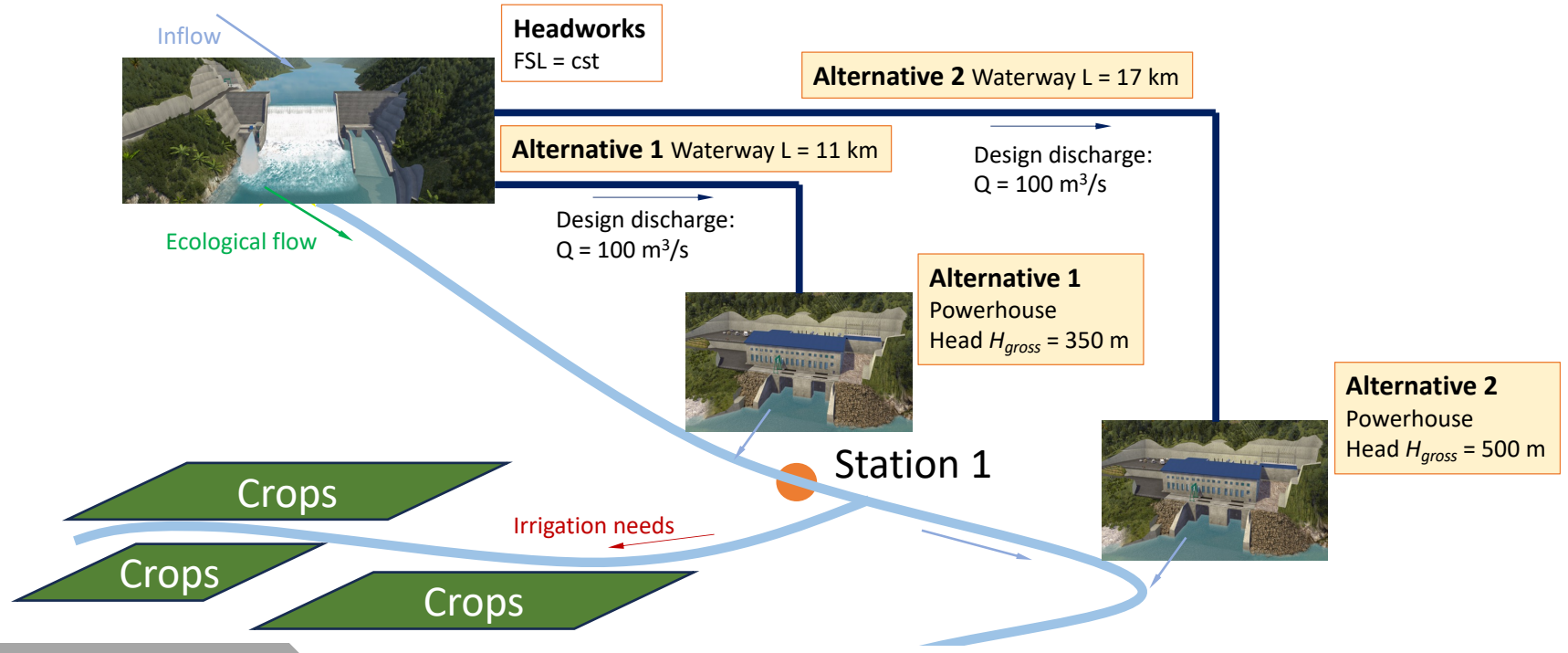
P. Perona, M. Leite-Ribeiro and M. Bieri

Junjia Kang, Giulio Calvani

Practical Work : Case study hydropower optimal water allocation and financial study

Project description

To the purposes of analyzing the two project alternatives, we must now determine the irrigation needs of the crop cultures towards which a fraction of river discharge is being withdrawn to.
The cultures are rice growing in a predominant sandy soil, which need to be constantly submersed with recirculating water following a gravity irrigation scheme. Rice takes approximately 120 day to grow to maturity with crop coefficients assigned per each growing month. Assume that three growth cycles per year are feasible using the same crop coefficients due to the relatively constant climatic conditions of the region. For the sake of simplicity, the reference evapotranspiration and the amount of water required by the crop as per the above conditions can be comuted starting from the temperature vs water requirement ratio. This does not account for the contributing role of rainfalls though.



Available data and description

Total (gravity) irrigation efficiency for sandy soil (see slides L 4.3 and take average value)

Mean monthly temperatures [°C]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
24.72	24.88	25.71	26.68	27.02	26.47	25.94	25.92	25.9	25.83	25.65	25.21

Water req. to T ratio* [mm °C/day]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.81	5.04	4.62	6.85	6.17	6.59	6.78	8.36	6.96	4.82	4.50	7.03

Crop coefficient, Kc

Jan, May, Sep	Feb, Jun, Oct	Mar, Jul, Nov	Apr, Aug, Dec
0.7	1.1	1.1	0.5

Mean cumulated monthly rainfall [mm/month]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
137	96	93	97	189	248	291	310	281	280	230	207

Total irrigated surface, S [ha]: 370

Number of days per month: 30

*This ratio does not only calculate ET_0, but also the amount of water needed to maintain a constant water depth to submerge the crop and guarrantee a continous recirculation for avoiding anoxic conditions. It does not include the role of rainfall.

Project tasks (Week10 – 28/04/2025)

PLATEFORME DE CONSTRUCTIONS HYDRAULIQUES

Your tasks today:

- Use the provided meteorological data to calculate the gross water need and the monthly value of continous fictitious flow that should be derived to the irrigation perimeter. To the purpose:

1) use the provided monthly mean temperature and related ratio to the reference evapotranspiration ET_0 to obtain ET_0;

2) Calculate the irrigation net water need using the mass balance equation and assuming that the reserve is zero each month and that effective precipitation is equal to falling rain amount (no interception nor losses);

3) Use the irrigation efficiency for gravity irrigation in a sandy soil (check L4.3) to obtain the gross water need;

4) Calculate the continous fictitious flowrate to irrigate the total assigned surface S; express the fictitious continuoum flowrate in m^3/s; this is the flow that is constantly provided each day of the month

5) Seek for a proportional relationship between the monthly mean river discharges that you calculated in Project Week 1 and the continous fictitious flowrate for irrigation needs. These proportions will be used later for successive project phases