



Land-Water Linkages in Rural Watersheds Electronic Workshop 18 September – 27 October 2000

Case Study 3

Impact of small dams on surface hydrology. Case of the Yvel watershed, France

C. Cudennec, Ecole Nationale Supérieure Agronomique de Rennes, France
M. Sarraza, Aquascop, France
email: cudennec@agrorennes.educagri.fr

PROBLEMATICS

Under the pressure of the food industry, many farms of the administrative county of Morbihan (Brittany, France) have developed vegetable crops (peas, beans, spinach...) for their high added value. The land area dedicated to these crops reached 15072 ha in the year 1993 (Sagot et al., 1994). In order to obtain strong yields and then to honour contracts signed with industrial societies, irrigation has been widely developed for these crops. Since 1989, 500 to 600 ha / year are equipped for irrigation with financial support from the state, the region and the county. The official purpose of this financing program is to irrigate 50% of the fields cultivated for industrial vegetable crops.

The water quantity used for this irrigation has been estimated to 6 millions m³ in 1999. The need coincide with the period of low level in streams. Thus there is a strong competition with drinking water and ecological minimum standards. Moreover groundwater is very rare and few usable. So the solution is building upstream dams to store winter flows and to use this resource in summer. In order to help local public authorities to renew their strategy, we now need a quantification of this evolution impact.

THE YVEL PILOTE watershed

The Yvel watershed (Figure 1) (Lambert coordinates of the outlet: 248979 / 1043554) is 302 km² wide. It is located in a strong upstream dams development region because its geological substratum is mainly made of schist with very few groundwater, because its rainfall is a bit weaker than the surrounding average, and because the vegetable crops industry is well implemented and much demanding. For all these reasons, this watershed is particularly vulnerable. Moreover this watershed presents also a territorial policy problematics: the downstream area is located in the Morbihan county whereas the upstream area owns to the two neighbour counties of Côtes d'Armor and Ille et Vilaine which don't so much finance irrigation development. This structural difference is confirmed by the actual localization of dams, mostly in the downstream area of the watershed (Figure 1).

UPSTREAM DAMS IMPLEMENTATION SCENARIOS

We propose a conceptual tool based on a 'geomorphological unit hydrograph' modelling (Cudennec, 2000 ; Cudennec *et al.*, 2000).

It allows to explicitly take dams into account in the modelling and thus can be used for *a priori* impact studies. It can also be used in a semi-distributed perspective, where the geographical splitting is determined from variabilities and not from gauging stations constraints. These two points led us to study different scenarios (Sarraza, 1997). Particularly we have studied the one corresponding to the preferential zone presented on Figure 1. Figure 2 presents the example of the August 10, 1994 event used as a typical project event. It shows simulated hydrograph corresponding to the cases of 100 – 300 et 500 eventual future upstream dams. These simulations show how the beginning of the hydrograph is alleviated because of the modification of the downstream watershed part. Consequently this shows a strong modification of the whole hydrograph shape.

Generally speaking, the *in situ* observation and the modelling led us to identify three main points. Firstly, upstream dams don't have any impact when reservoirs are full. The lamination is very local and doesn't have any influence at the watershed scale. Secondly the consequence of a spatially homogeneous implementation scheme is an affine alleviation of hydrograph, the affinity ratio being equal to the captation area ratio. The consequence is the same for low level

flows. Thirdly the hypothesis of an implementation localized in certain zones can be studied through modelling, with a precision sufficient enough to give relevant informations to decision makers.

BIBLIOGRAPHY

Cudennec, C. 2000. *Description mathématique de l'organisation du réseau hydrographique et modélisation hydrologique*. PhD dissertation, ENSAR, 198 p. + annexes.

Cudennec C., Sarraza M., Duchesne J, 2000. *Quantification de l'impact de la multiplication des retenues collinaires sur la ressource en eau*. British Hydrological Society Occasional Paper, 11, 21-27.

Sagot, F., Hubaud, M.O. et Daniel, F. 1994. *Etude des caractéristiques des retenues collinaires pour l'irrigation dans le Morbihan*. Observatoire Départemental de l'Environnement du Morbihan.

Sarraza, M. 1997. *Impact de la multiplication des retenues collinaires sur la ressource en eau ; cas du bassin versant de l'Yvel*. Msc dissertation, ENSAR - Observatoire Départemental de l'Environnement du Morbihan.