

Modelling energy production by small hydro power plants in collective irrigation networks of Calabria (Southern Italy)

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The availability of geodetic heads and considerable water flows in collective irrigation networks suggests the possibility of recovery potential energy using small hydro power plants (SHPP) at sustainable costs. This is the case of many Water Users Associations (WUA) in Calabria (Southern Italy), where it could theoretically be possible to recovery electrical energy out of the irrigation season. However, very few Calabrian WUAs have currently built SHPP in their irrigation networks and thus in this region the potential energy is practically fully lost.

A previous study (Zema et al., 2016) proposed an original and simple model to site turbines and size their power output as well as to evaluate profits of SHPP in collective irrigation networks. Applying this model at regional scale, this paper estimates the theoretical energy production and the economic performances of SHPP installed in collective irrigation networks of Calabrian WUAs. In more detail, based on digital terrain models processed by GIS and few parameters of the water networks, for each SHPP the model provides: (i) the electrical power output; (iii) the optimal water discharge; (ii) costs, revenues and profits. Moreover, the map of the theoretical energy production by SHPP in collective irrigation networks of Calabria was drawn.

The total network length of the 103 water networks surveyed is equal to 414 km and the total geodetic head is 3157 m, of which 63% is lost due to hydraulic losses. Thus, a total power output of 19.4 MW could theoretically be installed. This would provide an annual energy production of 103 GWh, considering SHPPs in operation only out of the irrigation season. The single irrigation networks have a power output in the range 0.7 kW - 6.4 MW. However, the lowest SHPPs (that is, turbines with power output under 5 kW) have been neglected, because the annual profit is very low (on average less than 6%, Zema et al., 2016). On average each irrigation network provides an annual revenue from electrical energy sale of about 103000 €. Even though this revenue may appear quite low, it represents an important share of the annual WUA income.

For the entire region, the total revenues from recovery energy in collective irrigation networks through SHPPs have been estimated in about 12 million Euros; investment and operating costs have been evaluated by parametric equations and the total profit theoretically available for each WUA has been quantified.

This study has shown the economic opportunity of integrating SHPP in existing collecting irrigation networks of WUAs, in view of providing additional economic resources for users and enhancing the exploitation of a renewable energy source.

REFERENCE

Zema D.A., Nicotra A., Tamburino V., Zimbone S.M. 2016. A simple method to evaluate the technical and economic feasibility of micro hydro power plants in existing irrigation systems. *Renewable Energy* 85, 498-506. DOI: 10.1016/j.renene.2015.06.066.