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**A small self-powered
pump irrigation scheme
in the Bengawan Solo Basin**

by

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Acknowledgement

The scheme was designed and implemented by Experimental Station for Rivers (Balai Sungai), Solo, under Ministry of Public Works.

Summary

The Colo micro-hydro-powered pump irrigation scheme is located on Bengawan Solo, Central Java, 13 km downstream of the Wonogiri Dam and Reservoir. The scheme supplies water to an otherwise rainfed paddy area of 30-40 ha with an elevation above the river level, so that gravity flow from the weir is not possible.

The scheme is regarded as practical, inexpensive and highly beneficial.

The feasibility of the scheme is related to the following circumstances:

- Availability of a suitable reliable flow with a reasonable pressure height; and
- a nearby area suited for cultivation (and irrigation) with a ground level that cannot be reached by gravity flow, but not too far above that level.

The feasibility of similar schemes at other locations depends on the actual design conditions, as well as the additional value generated by the irrigated cultivation.

Location map



1 Introduction

Self-powered lift irrigation has been practised in Asia (and Egypt) since ancient times (by water wheels powered by the flow).¹

The present note presents a case of a new approach to an old concept: A small, self-powered pump irrigation scheme, powered by the flow in Bengawan Solo (Solo River) (Central Java), lifting water to adjacent paddy fields, using today's turbine and pump technology, but by-passing the need of electricity - the pumps are connected directly to the turbines.

Since its commissioning in early 2008, the scheme has proven itself practical, feasible and highly useful.

2 Background and rationale

Since 1983, the Colo Weir has served large command areas on the left and right banks of Bengawan Solo, by 22 km and 64 km feeder canals, respectively. A small area has been left out, however, because its ground level is above the river level and therefore beyond gravity irrigation. This area is located some 2 km upstream of the weir (and 6-8 m above the mean river level). In principle, it is supplied by the rainfed Krisak reservoir, but this reservoir has deteriorated due to siltation and structural deficiencies.

The Colo Weir



Location: Upper Bengawan Solo Basin, Central Java, 13 km downstream of the Wonogiri Reservoir

Built: 1980-83

Command area (left and right bank): 23,200 ha

In-stream storage capacity: 1.2 mio. m³

Source: *PJT1 website*

The flow past the Colo Weir is regulated by the upstream Wonogiri Dam and Reservoir (with its live storage capacity of some 0.4 km³). A steady throughflow past the weir is aimed at for the sake of flow maintenance in the downstream parts of the basin.

A small, low-cost, self-powered pump irrigation scheme was devised and successfully implemented to supplement the rainfall supply to the command area of the Krisak reservoir.

¹ Lift irrigation = irrigation that requires lifting of the water to a level above the river;
pump irrigation = lift irrigation where the lifting is done by pumping

3 Description of the scheme

The scheme has the following components:

- An intake (on the left bank distribution canal);
- an intake culvert, leading to ...
- two turbines, each of which is connected by a belt to one of ...
- two centrifugal pumps;
- a drainage culvert from the turbine;
- a pressure main from the pump to ...
- a tower tank; and
- a main distribution culvert from the tank to the command area.

Figure 1: Scheme layout

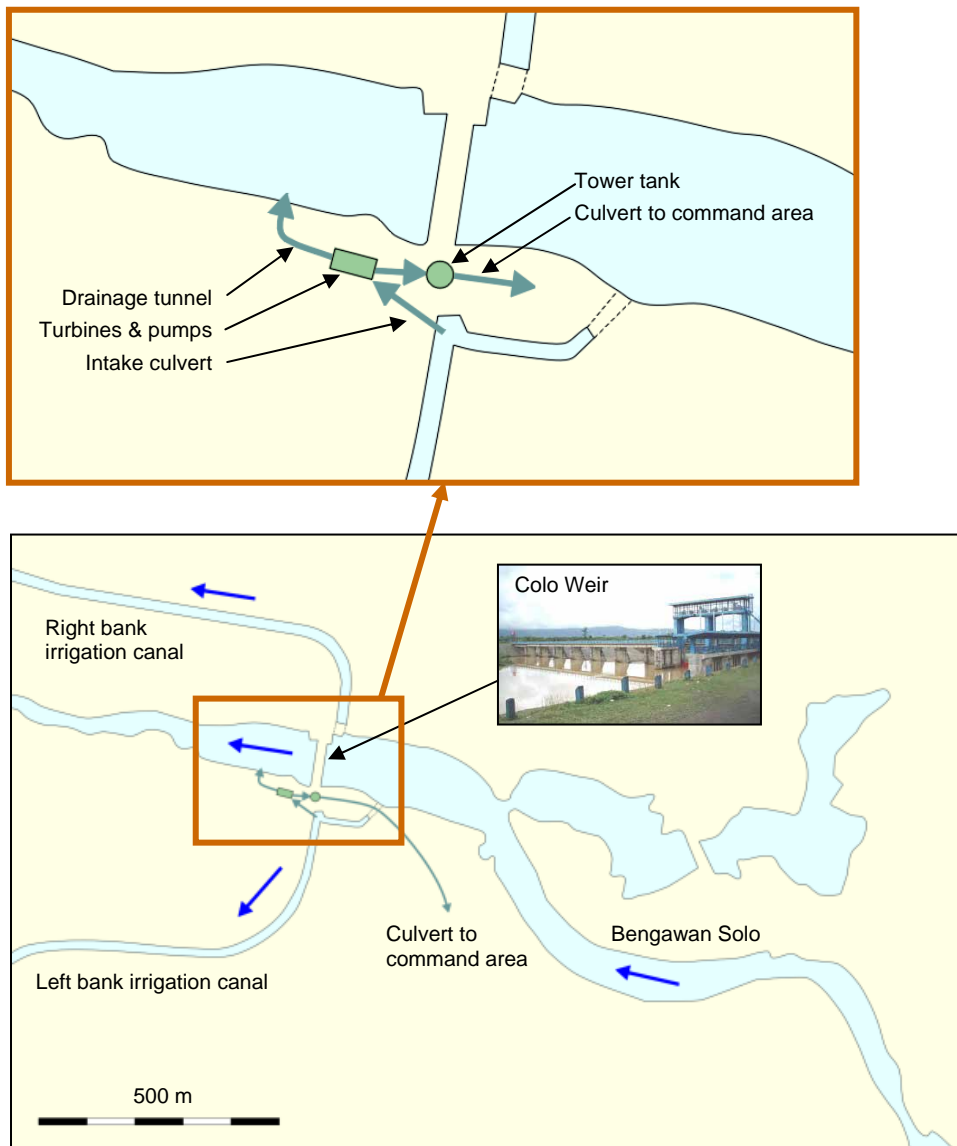


Figure 2: System outline

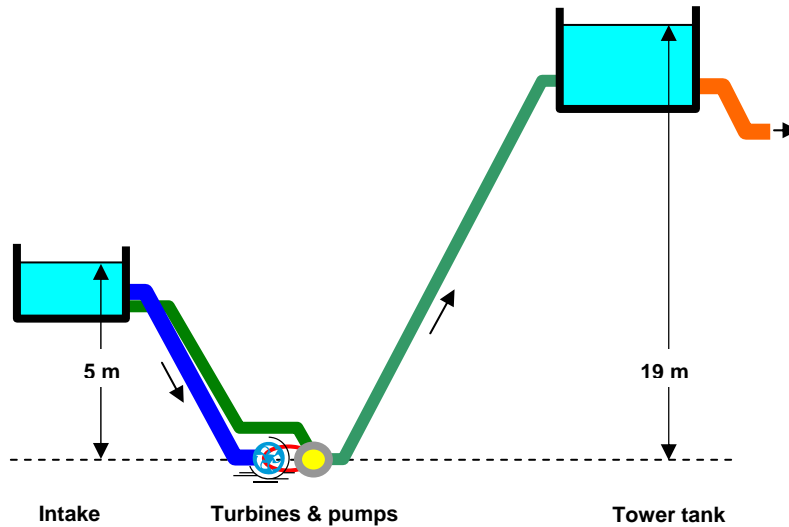


Figure 3: Turbine (right) and pump (left), connected by a belt



Table 1: Scheme specifications and key data

Turbines	6.7-8.4 Hp (5.0-6.2 kW), at 200 l/s with a pressure head of 4-5 m
Pumps	13-29 l/s with a pressure head of 18-24 m, at 6.4-10.1 Hp (4.8-7.5 kW)
Distribution culvert	900 m, head loss 2 m, with 3 control structures for sediment flushing
Completion date	Feb 2008
Construction costs	700 mio. IDR (70,000 USD); including 20 percent for excavation. Each turbine cost 50 mio. IDR (5,000 USD) Each pump cost 2.5 mio. IDR (250 USD)
Command area	30-40 ha of paddy fields

4 Evaluation

The Colo scheme was built by inexpensive (and expectedly durable) standard components. The scheme produces no electricity and requires no energy or fuel other than the hydropower it generates by itself (and which would otherwise have been wasted).

The turbine and the pump are located below ground level, and a positive pressure is maintained throughout. Hereby, the system becomes robust in terms of operation and maintenance, because air entrainment and cavitation are prevented.

Routine maintenance includes greasing, leakage inspection and packing, sediment flushing, and replacement of some parts. Consumables are readily available.

The general feasibility of the scheme is related to the following circumstances:

- Availability of a suitable reliable flow with a reasonable pressure height - in this case around 200 l/s with a pressure height of around 4 m;
- a nearby area suited for cultivation (and irrigation) with a ground level that cannot be reached by gravity flow, but not too far above that level. In this case, the area is some 1 km away and is elevated around 6-8 m above the (mean) surface of the river.

The feasibility of similar schemes at other locations depends on the actual design conditions, as well as the additional value generated by the irrigated cultivation.

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