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Photovoltaic Pumps for Greenhouse Irrigation in China — A New Perspective?

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Abstract

Since the use of photovoltaic pumps (PVP) was first documented in the 1960s they have been applied for different application in agriculture and drinking water supply. Especially for the supply of drinking water for domestic animals in remote areas PVP have been a success story. Reliable and maintenance-free systems have been developed which guarantee water supply in dry areas where the sun is plentiful. But also drinking and household water for remote villages is often supplied by PVP.

In agriculture, however, the use of PVP was restricted mainly to very small field sizes and high value crops. The high demand for water and the comparatively low returns made the application of PVP in agriculture often uncompetitive. Generally, the size of the generator determines the price of the system. As its price increases linearly with the power output, while the marginal cost of fuel operated engines decreases with size, PVP are not competitive for larger pumping systems. Further, the high share of fixed cost in the total operation cost makes a year-round operation necessary. An institutional framework of subsidised fossil fuel for food production in many arid countries was an additional hindrance.

In China, however, economic growth and resource scarcity is changing the so-far established picture about the use of PVP for irrigation. Cheaper PV-modules and increasing prices for vegetables in suburban areas are reasons for the Chinese Academy of Agricultural Sciences to investigate on the use of PVP. Two PVP systems have been installed in greenhouses in the surrounding of Beijing. Radiation pumping performance and total water delivery are monitored, as well as agronomic parameters, such as system price and operation cost, vegetable yield, produce price and degree of utilisation.

In this paper, the experimental set-up is described with its technical details and implication for Chinese farmers. A cost comparison is done between the installed PVP and a comparable water pumping installation using fossil fuels.

Keywords: China, irrigation, pumps