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Turning Solarization of Agricultural Tubewells into a Social, Economic and Environmental Win-win in Balochistan

Once considered as a remedy to the Indus Basin's waterlogging and salinity problem, the indiscriminate growth of tubewells in Pakistan is one of the major concerns of agricultural energy and environmental policies today. Over the last 50 years, nearly one million of agricultural farms have installed tubewell inspired by its reliability, the possibility of conjunctive irrigation (in surface irrigation areas), and the provided installation and operation subsidies. In the case of the Balochistan province, policies promoted tubewell technology primarily to cope with water shortages in the arid climate, ensure food security and generate employment. Today about 90 percent of the tubewells in Pakistan are used for irrigation. The resulting groundwater overdraft in the Punjab and Balochistan provinces has depleted aquifers. This concern aggravates in purview of the looming threats of climate change and its possible impacts on hydrological regimes in the region.

Policy Concern: Irrigation and Energy Nexus in Balochistan

Balochistan province makes almost half of the country's land mass but houses less than one-tenth of its population. With its meager rainfalls, most part of the province lies outside the surface irrigation system and is subject to frequent draughts. This situation triggered the state and donor sponsored promotion of tubewells which has altered entire waterscape of the province. This certainly enhanced livelihood opportunities but at the cost of unaffordable subsidy burden, indiscriminate pumping and consequent depletion of aquifer.

Economics of groundwater promotion further problematizes the situation in Balochistan. Some 30,000 agricultural tubewells operate on electricity subsidy which make less than 4% of the total electricity connections in the province but consume more than 80% of its available electricity. Farmers pay a flat rate of PKR 4,000 per month (or just 9% of the actual bill) regardless of the size of the pumps and duration of their operations. The subsidy for the payment of 91% to the electricity bill too is untargeted as as half of the land area irrigated through electric tubewells belongs to just 15% of the farmers. In 2011, such subsidies equated to one-fifth of the province's developmental spending and has been currently estimated at Rs. 23 billion a year. Attempts to abolish this subsidy triggers mass farmer opposition leading to maintaining the statuesque.

Affordable solar-powered tubewells are considered as a way out to reduce the huge subsidy burden. About 900 MW electricity spared from solarization of tubewells would be more than sufficient to cover the entire power shortfall of Balochistan. However, the major drawback of this policy is the total loss of control over the operation of these standalone tubewells which may further deplete the already stressed ground water resources. Thus, a solution that is convincing to economists is perceived as a recipe to disaster to those concerned about environmental and natural resources sustainability.

> Solarizing 30000 grid-connected tube wells equipped with net-metering facility and HEIS can earn farmers additional incomes, help government get rid of electric subsidy, spare sufficient energy to cover QESCO existing power shortfall, generate additional power worth PKR 17 billion/year besides conserving the already stressed aquifer.

The Way Out

Technologies in concordance to farmers' needs

Any policymaking on the water and energy nexus in Balochistan needs to understand that despite the prime importance of irrigation for agriculture, its cost is not a major consideration in farmers' income equation due to distortions created by existing electricity subsidies. This is the reason why farmers are generally reluctant to adopt efficient irrigation technologies like drip system despite various incentives offered by the provincial and federal governments over the decades. One also has to unlearn the myth that Pakistani farmers are technology averse and adhere to traditions. If this was indeed the case, they, for instance, would not have adopted the modern pumps decades ago. They are very much open to adopt any technology that is in concordance to their needs.

Positive impact on disposable incomes

Solar operated pumps may be one of the technologies that farmers would welcome due to their affordability and the energy security that they offer. However, one cannot expect them to conserve water if it is not making any difference in their disposable incomes. The most recent example of such over-expectation is the Government of Punjab's on-going subsidized solar tubewell program that

is conditional to the adoption of High Efficiency Irrigation Systems - HEIS. Farmers continue to show lack of enthusiasm towards such programs as the conditional adoption of HEIS makes the entire package unworthy of consideration.

Introducing net-metering

Fortunately, there government has already announced net-metering policy for its three phased domestic and commercial consumers. If a net-metering facility is added to the offer, farmers may be more responsive towards the package. The conceptual sketch of this policy is as follows: Most parts of Pakistan receive a mean daily solar insolation of 19.0 MJ/m^2 for more than 300 days that is sufficient to produce 175,800 GWh electricity per year. Whereas, a solar tubewell is supposed to operate for about 125 days annually. Provision of the net-metering facility to the solar-operated tubewells in Balochistan means that for the remaining days farmers can sell excess energy to the national grid. Even on days when tubewell will be operational, the farmer will have a choice to either consume a unit of solar energy for over-irrigation or to sell it to the grid, and the economic theory suggests that they would do the latter. Thus, raising the opportunity cost of wasting energy on pumping excess water would compel them to adopt HEIS. This is where using less water will become financially attractive to them and would have positive impact on aquifers and sustainability of agricultural livelihoods.

Putting it in monitory terms, a mere 1 KW of solar system can earn an additional income of PKR 10,000 to 15,000 after fulfilling all the yearly irrigation needs of one acre farm without paying a single rupee to the utility company. Given the fact that land is abundant in the province, supporting solar power establishment somewhat larger than the farmers irrigation needs will have long term poverty alleviation and subsequent social benefits as well. Thus, if solar system to run a 50 HP tube well is supported, an estimated cost to cover 30,000 tube wells would be about 200 billion PKR. The payback period would be nearly 8.5 years just through the elimination of subsidy (i.e., ~23 billion a year implying that farmer would not face any financial constraints in adopting this package). Furthermore, the energy supplied by these solar tube wells to national grid through net-metering during non-irrigation time would be worth nearly 17 billion PKR annually. This implies even a much quicker payback of this seemingly huge investments. Certainly, there can be various other options to finance this transition such as farmer-government participation.

Although generally the Distribution Companies (DISCOs) in Pakistan are not very enthused towards promoting net-metering, Quetta Electric Supply Company (QESCO) may proactively facilitate this transition due to at least three reasons: Firstly, they will get rid of the difficulty to recover outstanding agricultural electricity bills (which is already lowest in Pakistan) and revenue shortfall created by electric subsidies. Secondly, electricity saved from the solarized-net-metered tubewells will be more than they need to correct their existing power shortfall. And lastly, the energy injected by agricultural farms would help QESCO in decreasing its reliance on power purchased through Pakistan Electric Power Company (PEPCO).

Applicability to other areas of Pakistan

Though this policy brief focuses on Balochistan due to subsidized electricity supplied to agricultural tube wells there, potentially the proposal given here is applicable to any area where tube wells are operated on the electricity supplied by the national grid or where farm has grid access. However, government has to ensure that net-metering is available to anyone interested with extraordinary convenience so that more and more farmers are motivated. A one-window operation in each DISCO charged with the mission may simplify the process that is currently very tedious. The concept elaborated in this policy brief may directly feed in the draft Alternate and Renewable Energy Policy 2019 to make it obligatory on DISCOs.

This policy brief is based on following research studies conducted at PIDE:

Memon, J. A., Alizai, M. Q., Hussain, A., (2019) Who will think outside the sink? Farmers' willingness to invest in technologies for groundwater sustainability in Pakistan, *Environment, Development and Sustainability* – Springer

Memon, J.A., Hussain, A (2019). Consumer Co-ownership in Renewables in Pakistan. In: Jens Lowitzsch (ed.). Energy Transition – Financing consumer (co-)ownership in renewables – 18 country studies and a comparative analysis Palgrave Macmillan.

Lowitzsch, J., Memon, J. Al., Mishra, S. N. (Under Review) Harnessing the Potential of Consumer (Co-)Ownership in Renewables in the Asian Energy Transition: A Comparative Study of Pakistan and India

Memon, J. A., Jogezai, G., Hussain, A., Alizai, M. Q., Baloch, M. A., (2017) Rehabilitating Traditional Irrigation Systems: Assessing Popular Support for Karez Rehabilitation in Balochistan, Pakistan. *Human Ecology,* 45 (2), 151–159 – Springer.

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