A review of the solar pumping networks in Kutapalong, Bangladesh

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Introduction

Cox's Bazar District in Bangladesh hosts the largest refugee camp in the world. The majority of the 700,000 Rohingya refugees who fled violence and persecution in Myanmar in 2017 settled in Kutapalong 'Megacamp'. The water table in this area is high, and initially several thousand tubewells were drilled and equipped with handpump, and this resolved the immediate issue of providing a sufficient quantity of water to the refugees. However, the use of shallow groundwater in a congested area, in close proximity to thousands of latrines, prompted concern for the water quality and a decision by the WASH sector to provide chlorinated piped water to ensure water quality. From March - May 2018 Oxfam, with UNHCR funding, created a water network masterplan on behalf of the WASH sector. The masterplan delineated the Megacamp into more than 100 distinct distribution zones, based on topography and sized mostly to allow for one solar powered borehole to supply the whole zone. Key criteria for the design were simplicity and low-cost of operation. Application of solar pumping at this scale in a humanitarian context is unprecedented. In November 2019, the authors were commissioned by UNHCR to undertake a technical review of performance of completed networks.

Methodology

The authors undertook a review of 17 out of an estimated 30 networks that had been completed and were operational at that time. Each of the 21 functioning boreholes for 17 water networks within the UNHCR camps in Kutapalong was technically appraised on site. Meetings with key stakeholders, agencies, and engineers responsible for construction and operation of systems were held to obtain information on costs, technical details of boreholes, pumps, network design details, water levels and production. For the majority of pumps, it was possible to download performance data captured and stored on the pump controller which includes water production since time of installation. Data loggers were placed in several tanks and a limited number of focus group discussions held with a very small sample of users to get an indication of the user's experience of the networks, and whether they are meeting people's needs.

Findings

Overall, the solar pumping systems are performing relatively well but below their potential. Water quantities supplied varies significantly between networks with some providing greater than 30 litres per person per day (l/p/d) and others less than 10 l/p/d litre and is influenced by both supply and demand factors. Supply-side factors limiting production include shading of solar panels, maintenance operations interrupting supply, and operator error. For most under-performing networks demand-side factors are the more significant limiting factor. This is predominantly due to inaccessibility or inappropriate siting of tapstands. People in the camp have an expectation that water will be available close to their shelters and given the large number of handpumps on tubewells in the camp, if the tapstands are not close to their shelter then they will use a handpump instead. A secondary demand-side reason for low demand is that some

networks restrict opening hours, and in some cases missing peak demands which is early morning and evening. This highlights the importance of engaging with users to understand their needs.
Data from pump controllers and dataloggers dropped into storage tanks enabled a "water balance" analysis. This highlighted the contrasting performance of the best and worst performing systems. Whilst the best performing systems allow users unrestricted access to water, data showed that poor operational decisions in the worst performing systems, resulting from a lack of understanding between supply, demand and storage and directly leading to reduced production of water. This resulted in unnecessary water rationing, underperformance of solar pumping systems and a misleading impression of the capacity of PV systems.
A key concern for all solar pumping systems is whether they will give year-round performance. During the monsoon season (June-Aug) there are times when the irradiation is low, and networks are unable to provide the desired volumetric target standard of water. However, analysis of the worst month shows that the number of days this occurs on a well-functioning network is limited and anecdotal evidence from the community indicates that this is not problematic, because handpumps on tubewells provide an acceptable alternative source of supply.
Some of the existing networks have diesel generators as backups to compensate for periods of low irradiation. Findings from this study shows that these do not necessarily lead to a more reliable supply as they are not operationalised during times of need or used effectively.
Optimal performance is achieved when solar pumping systems run automatically with minimal manual input.

Conclusions

Solar pumping at this scale in a humanitarian context is unprecedented. Assuming the roll out of the masterplan continues, water supplied through PV powered pumps can become the primary source of water for the estimated 700,000 refugees hosted in Kutapalong "Megacamp". This demonstrates how far the technology has come in the last decade. The study has identified several significant factors that need to be understood and addressed to improve performance and realise this goal. Optimising output from a solar PV system is not just about individual or collective elements of the design such as pump, solar array, water storage capacity or number and location of tapstands. Of equal importance is understanding community behaviour and habits; and then ensuring operational decisions do not inadvertently undermine performance potential. Better use and analysis of data which is already being routinely captured by solar pumping systems can help in understanding and optimising performance.

References

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