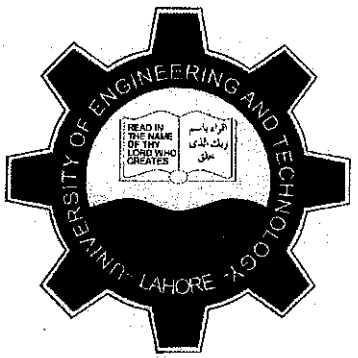
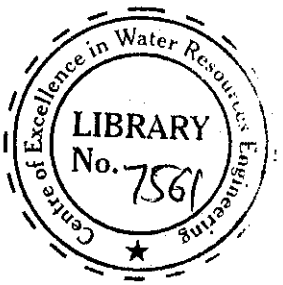
EFFICIENT DESIGN OF TUBEWELL BY ENERGY AND HYDRAULIC APPROACH





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ABSTRACT

Pakistan is an agricultural country, where major sources of irrigation are canal water, groundwater and rainfall. In Punjab, the canal system is a major source for irrigation but unfortunately, this system has very limited potential to meet the crop water requirements and the remaining crop water needs are met from groundwater sources through nearly (1.2 million) tubewells (Hassan et al., 2014). At present in agriculture sector; irrigation tubewells and farm tractors are large consumers of energy, so it is need of hour to make the most efficient use of available water and energy resources.

In this study, aquifer was initially analyzed by considering the recharging parameters like rainfall, river flows and canals passing through the area. Rainfall trends of (1980-2018) indicated that maximum rainfall occurs during the month of July (209.52 mm) and minimum rainfall observed was (5.72 mm) in the month of November in Lahore. Discharge data of river Ravi (1991-2018) at Shahdra showed that minimum flow observed was (569 cumec) in 2005 and maximum flow in 1995 was (4,740 cumec). The results showed that there is a continuous decrease in rainfall as well as it is found that discharge of river Ravi is also decreasing. Groundwater level maps were drawn using GIS software for year (2000-2018), which indicates that the average decline in water table depth was 1.4 meter per year.

The average seasonal crop water requirements (CWR) were estimated for the major crops in Lahore i.e. wheat and rice, their CWR's were simulated as 206 mm/dec and 667.5 mm/dec respectively. It was concluded that surface water contribution to CWR from rainfall and canal water source was 37% and remaining 63% area has to be irrigated by groundwater extraction.

Tubewell of capacity 50.9 m^3/hr and 76.5 m^3/hr discharges were designed for available groundwater level of 11 m. All the calculations were performed by considering different parameters of tubewell design i.e statistical equations, pump curves and site-specific information. For discharge of 50.9 m^3/hr a polyvinyl chloride (PVC) material screen was selected with an open area lies between 10-15%. The length of screen was computed as 15.3 m with a flow entrance velocity 0.030 m/sec. Total drawdown is an accumulation of aquifer and well losses which was calculated as 2.14 m. Power requirements were estimated with an ample of pump curves against discharge of 50.9 m^3/hr and total head of 18.3 m. A comparison was made between different pumps to select the efficient one such that it should not be oversized or undersized pump. In comparison, it was observed that these pumps have different efficiency as varying from 81%, 78 %, 34 % and 65 % respectively. The results indicate that the selected pump model with 2900 RPM gives better performance/efficiency as compared to other three pumps with less power consumption. It was recommended that by replacing existing inefficient pump with a new pump can save energy up to 30 % to 40 %.

Efficiency of existing engines and pumps was less, due to local manufacturing without patent design approved by the qualified engineers. Due to less consideration paid towards the usage of energy and water extraction, these impacts have been diagnosed long after their occurrence. To save significant amount of fuel and to improve water discharge, there is a dire need to replace conventional engines and pumps with efficient alternatives.