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Comparison of Operational Cost between Deep Tubewell Irrigation and Borewell Irrigation System in Parasan, Kanchanpur District, Nepal

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Abstract

The study was conducted in order to know the cost operation analysis between deep tube well irrigation system and former bore well irrigation system during the period of 2016-2018 in Prasasn, Punarbash Municipality, Kanchnapur, Nepal. Questionnaire survey and field verification of Punarbash area were conducted and the crops like Oryza sativa (Paddy), Saccharum officinarum (Sugar cane), Brassica nigra (Mustard), Triticum aestivum (Wheat) were chosen for the analysis with reference to water requirement per hour. It was found that the lowest pumping hours for one hector was through deep tube well irrigation system with oryza sativa (13 hrs), Saccharum officinarum (39 hrs), Brassica nigra (6.5 hrs), Triticum aestivum (26 hrs). The study concluded that deep tube well irrigation was almost three fold economical than the bore well irrigation to operate where bore well irrigation is a primary source of water for irrigating crops.

Keywords: Borewell Irrigation; Deep Tubewell Irrigation; Total Irrigation Hour; and Total Operation Cost.

1. Introduction

In general irrigation is defined as an art of applying water artificially to the field in accordance to the crop requirement throughout the cropping period for the full fledge nourishment of the plant for better yield ability [1]. The need of food is inevitable till the cycle of life exist on the planet. Scientists have developed various techniques of irrigation weather it is surface or ground.

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The trend of conjunctive use of water is a big issue. In these days for year round irrigation which will utilized ground water for dry seasons and surface irrigation for remaining seasons. The use of groundwater as a water source for irrigation is increasing day by day. The cause behind this is: surface water supplies are becoming fully utilized and increasing in value which has made the pumping of groundwater an attractive alternatives [2]. Worldwide it is a common goal to achieve higher yield for a unit of water applied and consequently government in all countries are interested in more economic return from the irrigation systems they have applied. It is obvious that water used in surface irrigation is considerably higher than ground water. Thus, the study is focused on the comparison of operational cost between Deep Tube Well System (DTS) and Bore Well Irrigation System (BWIS) both using ground water while there are many factors to consider before deciding on an appropriate groundwater pumping system. The implementation of a ground water pumping system by farmers mainly depends on its financial viability [2]. There are so many obstacles for tapping ground water. One of them is the mobilization of water resources and its associated costs. The cost of setting up a pumping system can vary significantly between farms depending on the pumping system, hydrological conditions, groundwater quality, location to electrical power, disposal options and so on [2]. The cost becomes prohibitive, especially when groundwater is used for irrigation purpose. The fact is that the deeper the well or borehole, higher will be the capital, operation and maintenance costs [3]. However, Deep Tube well (DTW) projects are profitable than the others from the viewpoints of participating farmers [4]. In general, heavy duty deep tubewell are used almost exclusively in most developed countries for trapping ground water for irrigation throughout the world [5]. Farmers are usually interested in the lesser operating hour for water extraction and consequently, increase in Irrigation Efficiency for crops. However, the main objective of this study is to compare the operation cost for water pumping between Deep Tubewell Irrigation system and Borewell Irrigation System.

2. Material and Methods

2.1 Study Area

Parasan is a small town area of Punarbash Municipality, which lies in Kanchanpur district Sudoorpaschhim Province of Nepal with bounding coordinates of maximum 28°36'17.0444", 080°29'24.9433"and minimum 28°36'12.8062", 080°28'43.7332" (Figure 1). The ground water irrigation system, serves 498.7 ha areas as gross commanded area but the study was limited to gross command area of 60 ha having cultivable command area of 40 ha (www.googleearth.com).

Data collection technique at preliminary design stage was through farmer's demand form at Ground Water Irrigation Development Division, Kailali, which is responsible for overall construction and monitoring of Ground Water Irrigation System in Sudoorpaschhim Province, Nepal. Office provided the basic information for further design, then Focused Group Discussion (FGD) and direct observation method were conducted and it helped to know the problems regarding the existing irrigation facilities in the study area.

There were borewell for extracting water and was old fashioned that rely on diesel pump to extract water. Data were collected from questionnaire survey and results were drawn from the analysis of collected data from the field.

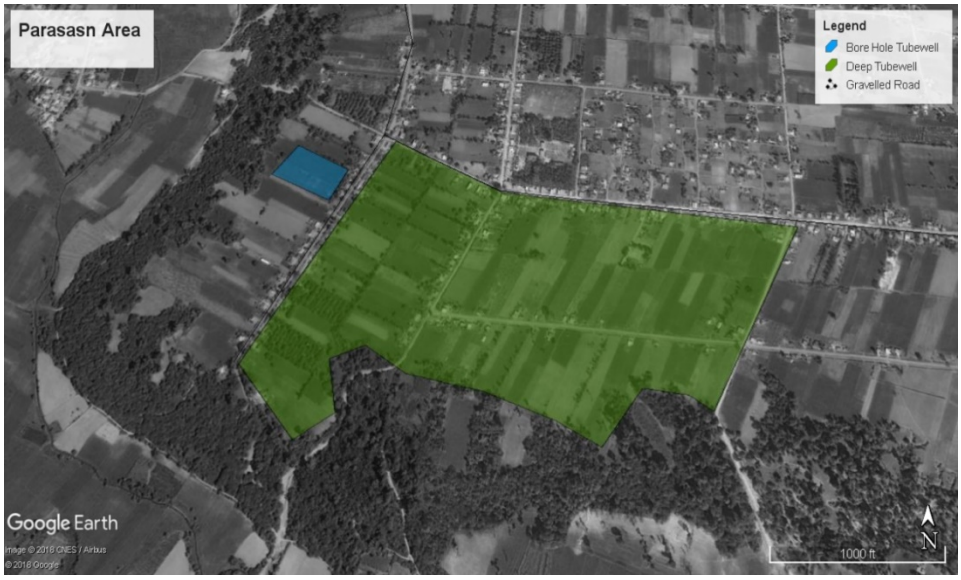

Figure 1: Study area

3. Results and Discussion

3.1 Bore Well Irrigation System

Questionnaire Survey showed that cropping calendar is not changed from last 12 years. They are growing what they were doing before 12 years. The market rate was changed from no valve to some good money but the operation cost remains the big question. They require 102 hours of operating diesel engine from cultivating of Oryza sativa (paddy) to till harvesting. For Saccharum officinarum, 207 hours of water pumping through diesel engine is required. Among all the crops, Brassica nigra required minimum of 48 hours of water pumping whereas Triticum aestivum required 211 hours of operation of diesel engine for better yield of crops in 1 ha of irrigable filed.

3.1.1 Deep Tube well Irrigation System

After successful implementation and test run of system, system was handover to Water User's Association (WUA) for operation and maintenance. They followed the same cropping calendar and operate the system to irrigate 40 ha of filed. From questionnaire survey it was found that it required 520 hours of operating 25 hp of electric pump for Oryza sativa (Paddy) from transplanting to harvesting and for Saccharum officinarum, 1560 hours of water pumping through same pump of 25hp. Among all the crops, here Brassica nigra required minimum of 260 hours of water pumping, whereas Triticum aestivum required 1040 hours of operation of pump for better yield of crops in 40 ha of irrigable filed.

3.1.2 Comparison of Bore Well Irrigation and Deep Tube Well Irrigation systems

After the calculation of all field data, an overall result was obtained. The result and comparison is presented in the table (Table 1).

Table 1: Comparison of Borewell Irrigation System and Deep Tube Well Irrigation System

S.N.	Parameter	Borewell Irrigation System	Deep Tubewell Irrigation System
1	Command Area	1 ha	40 ha
2	Crops	Oryza sativa (Paddy)	
		Saccharum officinarum (Sugarcane)	
		Brassica nigra (Mustard)	
		Triticum aestivum (Wheat)	
3	Irrigation hours for Crops from plantation to harvest	Hours	Hours
A	Oryza sativa (Paddy)	102	520
B	Saccharum officinarum (Sugarcane)	207	1560
C	Brassica nigra (Mustard)	48	260
D	Triticum aestivum (Wheat)	211	1040
4	Operation Cost of Irrigation hours	in Nepalese Rupee	in Nepalese Rupee
A	Oryza sativa (Paddy)	7650	77584
B	Saccharum officinarum (Sugarcane)	15525	232752
C	Brassica nigra (Mustard)	3600	38792
D	Triticum aestivum (Wheat)	15825	155168
5	Total Cost of Operation in a year	42600	504296
6	Total Cost of Operation in a year per hectare	42600	12607.4
7	Saving Per hectare Through Deep Tubewell Irrigation system Over Borewell Irrigation System	3.00	

From Table 1, for Borewell Irrigation System, the rate of diesel was taken NRs. 75/liter which consumes 1 liter diesel in an hour. Thus, Oryza sativa required 102 hours of pumping which equals 102 Hours*NRS75/Liter/Hour= NRs. 7650.00. Similarly, Saccharum officinarum required 207 hours of pumping which equals NRS.15,525.00 of diesel, Brassica nigra required 48 hours of pumping which equals NRs.3,600.00 of diesel and finally for Triticum aestivum 211 hours of pumping which costs 15,825.00. The total cost of operation of diesel engine throughout years was NRs. 42,600.00. This amount of NRs 42,600.00 can operate to irrigate 1 ha of field for different crops.

Similarly, from Table 1, for Deep Tubewell Irrigation System, the rate of agricultural electricity meter and water man was taken NRs 8/unit kWhr of electricity and an 25 hp submersible pump consumes 25 hp*0.746Kw= 18.65 unit of electricity in an hour. Thus, Oryza sativa required 520 hours of pumping which equals 520 Hours*NRs 8/unit*18.65 unit/Hour= NRs. 77,584.00. Similarly, Saccharum officinarum required 1,560 hours of

pumping which equals NRs. 2, 32,752.00 of electricity bill, and Brassica nigra required 260 hours of pumping which equals NRs.38, 792.00 of electricity and finally for Triticum aestivum 1040 hours of pumping required electricity of amount NRs. 1, 55,168.00. The total cost of operation of 25hp submersible pump throughout years was NRs. 5, 04,269.00 to irrigate 40 ha of field for same crops as in Bore well Irrigation system.

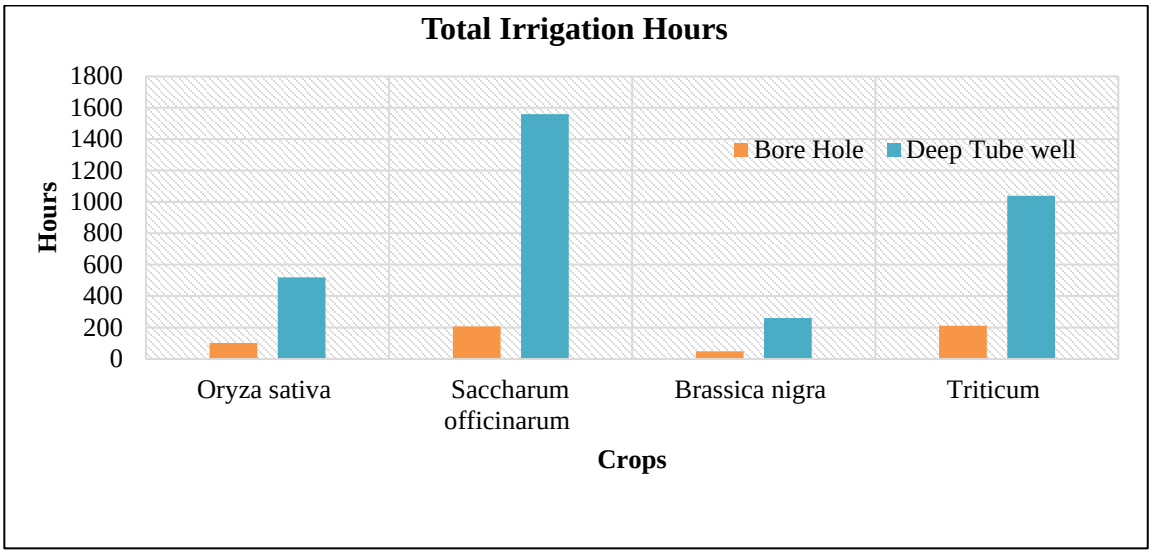

Figure 2: Total Irrigation Hours for Borewell and Deep Tubewell irrigation systems

This bar chart compares the total Irrigation hours per year between Borewell and Deep tubewell Irrigation system. Total Irrigation hours for bore well system is 568 hours for 1 ha of field and for deep tube well Irrigation system is 3380 hours for 40 ha of field.

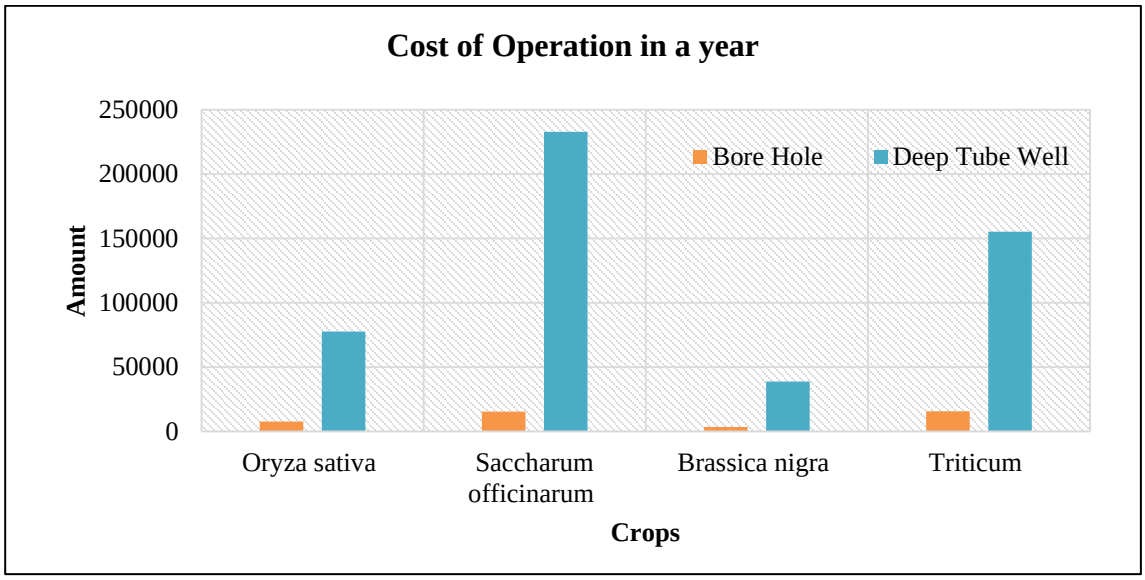

Figure 3: Total Cost of Operation for Borewell and Deep Tubewell irrigation systems

This Figure 3 compares the total cost of operation per year between Borewell and Deep tubewell Irrigation system. Total operation cost for Borewell system is NRs. 42,600.00 for 1 ha of field and for Deep Tubewell Irrigation system is NRs. 5, 04,296.00 for 40 ha of field.

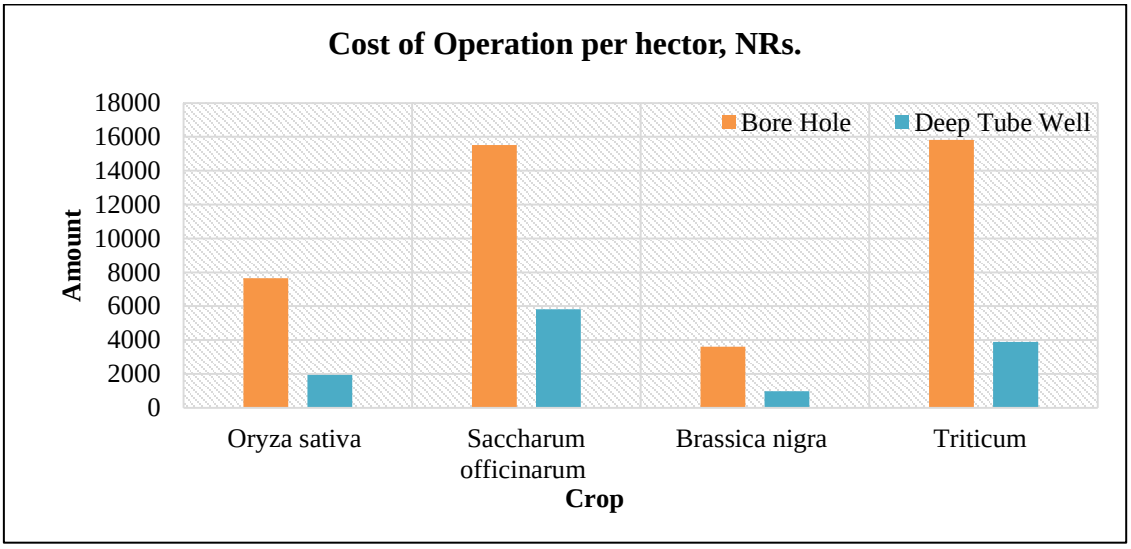

Figure 4: Total Cost of Operation for Borewell and Deep Tubewell irrigation systems

From figure 4, it is clear that operation cost of deep tubewell is less than that of borewell irrigation system and is three times economical to Borewell irrigation system if compared in a hectare.

According to Government policy for a deep tubewell project, 40 ha of land is mandatory to be arranged by farmers. Farmers should form a user's association and register it officially in government office with all necessary data demand form and little money to share for their project implementation. They will received certificate of registered Water User's Association from Department of Irrigation, Nepal which should be renewed each year. Government finally approved budget for implementation of deep tubewell with overall system under Sambridha Terai Madesh Sinchai Bishesh Karyakaram (Government Project for Implementation) that will require another 2 years for construction. First year Tubewell will be constructed and next year Pump house, Distribution system, electrification, and Pumping system.

As per Public Procurement Regulation, 2064 of Nepal, contract was awarded and construction of deep tubewell was completed in a month with design discharge of 28 liter per second from overall 100m of well depth.

Next year, 2017, Water User's Association was awarded for construction of Pump house, Distribution system, electrification, and Pump on their own. They completed construction work of overall system in 4 months and connected their system with grid of electricity and started extracting water. The distribution system was 1918 meter long PVC pipe of pressure class 2.5kgf/cm2 with 16 outlets for irrigating while each could irrigate 2.5 ha and also a submersible pump of 25 Hp was installed along with transformer of 50 kva.

After implementation and successful test run of system, the system was hand over to Water User's Association for operation and maintenance of project. Major maintenance will be carried out by Ground Water Irrigation

Development Division, Kailali. They initiated their irrigation system with cultivation of Sugarcane, followed by Wheat and then Paddy.

4. Conclusions

For assessing operating cost analysis of deep tube well irrigation system and bore well irrigation system, the study found out that the operation cost of the deep tubewell irrigation system is three times economical than borewell irrigation system. This study does not consider the yield and return from cultivation as both being same for both system per hectare. Hence, this study concludes that three times saving in operation cost of deep tubewell irrigation system to borewell irrigation system.

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