J. Sci. Technol. Environ. Inform. 13(01): 840-849 | Hossain & Oliver et al. (2024)
EISSN: 2409-7632, Journal home: www.journalbinet.com
Crossref: https://doi.org/10.18801/jstei.130124.84

JSTEI ONLINE JOURNAL Journal of Science, Technology & Environment Informatics
Journal BiNET Scientific Publication

Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh

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Article received: 16.11.2023; Revised: 22.03.2024; First published online: 05 May, 2024

Article Information

Key Words:
Performance, Shallow Tube Well (STW), Groundwater and Irrigation

Access by Smart Phone

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ABSTRACT

This study evaluated the performance of shallow tube well (STW) irrigation system at Ghatail upazila in Tangail district of Bangladesh. Secondary data were collected from the office of upazila agriculture officer at Ghatail. Primary data were collected from the STWs owners through a questionnaire. The discharge and other parameters were directly measured for some selected STWs in the field. About 91.7% of the irrigated land of the upazila is irrigated by STW irrigation system. Remaining 7.98% and 0.32% are irrigated by deep tube well (DTW) and Low lift pump (LLP) irrigation systems, respectively. During 2013-2022, a limited increase in number of DTW, STW and LLP was found, which caused an insignificant overall increase of irrigated area of 0.74% only. However, LLP showed a higher overall increase in both units (20% for diesel engines and 66.67% for electric motors) and area coverage (41.38%). Average discharge and area coverage of the selected STWs were found to be 12.31 l/s and 3.32 ha per STW, respectively. The average area coverage of STW installed on low land was 3.97 ha/STW, while that of high land was 1.91 ha/STW. The electric motor powered STW showed higher area coverage (3.61 ha/STW) than the diesel engine powered STW (3.56 ha/STW). The average water use efficiency (WUE) was found to be 42.7% which was relatively very low. However, adopting appropriate resource conserving crop management practices and supervising low coverage and water use efficiency could significantly improve.

Citation: Hossain, S. M. I. and Oliver, M. M. H. (2024). Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh. Journal of Science, Technology and Environment Informatics, 13(01), 840-849. Crossref: https://doi.org/10.18801/jstei.130124.84

I. Introduction

Water is one of the significant inputs to Agriculture. In the dry season, crops are grown through irrigation. Therefore, irrigation plays an essential role in crop production that in turn ensures the food security of the country. Water for agriculture is becoming increasingly scarce worldwide (Rijsberman, 2006). Irrigation water is also scarce in Bangladesh. With the raising of river and canal beds due to increase in siltation, the surface water is getting diminished. In addition, surface water (river and canal water) is getting polluted by industrial effluents. For this reason, groundwater is becoming the primary source of irrigation water, which is also depleted rapidly and polluted by arsenic and other heavy metals. So, it is high time we think about the efficient use of irrigation water.

Rice production in Bangladesh is not fully irrigated. Broadcast Aman and Transplant Aman (T-Aman) rice are mainly grown with rainwater. However, Boro rice is fully grown with irrigation in the dry season. Through conjunctive use of groundwater and surface water, about 76% of the cultivable area of the country can be irrigated (WARPO, 2000), of which about 50% are presently under irrigation (MoA, 2020). Out of 50% of the present irrigated area (5587482 ha), about 73% is irrigated with groundwater irrigation systems using Deep tube wells (DTWs), Shallow tube well (STWs) and manually operated pumps (MOPs). The remaining area (27%) is irrigated with surface water irrigation system (MoA, 2020). The nominal discharges of DTW, LLP, STW, and MOP are 56, 28-42, 14-21 and 0.56 liters per second, respectively (Bhuiyan, 1984), which usually depend on the total hydraulic head, engine power, aquifer characteristics and other factors prevailing within the systems.

Rapid expansion of STW, DTW and LLP tremendously increased the Boro rice production in the country. During 1966-67, when the green revolution was initiated, Boro rice accounted for only nine percent (9%) of the rice production in the country. However, by 2008, it had contributed 60 percent to the total rice production in the country (Hossain, 2009). This is because of the rapid expansion of minor irrigation systems (DTW, STW, LLP) in the country. Among STW, DTW, LLP the number of STW is the highest (1357532) that covers about 2994466 ha (56% of irrigated area) during 2018-2019. Since STWs are owned and managed by individual farmers, some management problems might need to be identified.

The total numbers of STWs, DTWs and LLPs operated during 2018-19 were 1357532, 37634 and 187188, respectively and the total area irrigated by these pumps were 2994466, 1076141, and 1248616 ha, respectively (MoA, 2020). Therefore, it can be estimated that about 76% (56% STWs & 20% DTWs) of the presently irrigated area is being irrigated using STWs, DTWs or alternatively, it can be said that 76% of the total irrigation water is supplied by STWs and DTWs which is groundwater. This groundwater is a scarce resource, and it is depleted every year. So use of groundwater should be very judicious. That means the withdrawal of groundwater by STWs & DTWs and their uses for irrigation purposes should be managed properly so that every drop of groundwater is used for crop production. Therefore, maximization of groundwater utilization and minimization of losses in the field should be the primary focus of the irrigation water management strategies.

Due to over-extraction or insufficient recharge the groundwater levels in some areas of the country fall beyond the suction limit of the centrifugal pump at the end of the Boro season. In these situations, water is withdrawn by placing STW in a pit below ground level which is termed as deep-set shallow tube well (DSSTW) or a very deep-set shallow tube well (VDSSTW). When groundwater depletes further, i.e. goes below 10.7 m (35 ft), it is not possible to use a STW (a suction mode tube well) in any form where only a submersible or vertical turbine (FMTW: force mode tube well) can be used to withdraw water. Presently in some areas of Rajshahi, Pabna and Tangail DSSTWs and VDSSTW are being used in Bangladesh. STWs in these forms are also being used in some other locations.

Coverage of STWs in Bangladesh was reported as 3.99 and 2.28 ha per STW during 1982-1990 and 2011-2012 respectively, where expected coverage is 5 ha per STW (Alam and Ghani, 2013). This indicates that almost all of the STWs are not being utilized to their full capacity. Since STWs irrigate about 65% of the Boro fields their under-utilization would cause an economic loss of the farmers. There may be many reasons behind under-utilization of STWs. The unavailability of sufficient land within the reach of the tube well, improper placement of the STWs in the field and low discharge of the pump may be some of the probable reasons which should be identified, evaluated and addressed properly. In addition, the water use efficiency, pumping plant efficiency and water losses in the distribution system should be identified and evaluated to improve the performance of STW irrigation system in the country.

Producing more crops with less water is the present policy of the Government of Bangladesh. Presently practiced flood irrigation method for Boro rice production using STWs needs 3000 to 5000 liters of water for one kilogram of rice, which is more than double the actual requirement (Anon, 2010). On the

EISSN: 2409-7632, Journal home: www.journalbinet.com
Crossref: https://doi.org/10.18801/jstei.130124.84

other hand, the average coverage of STW is almost 50% of the expected coverage. Since the major part of Boro rice field (about 65%) is irrigated by STWs irrigation system, the performance of STWs irrigation system should be evaluated to identify the problems and causes to improve their performance and reduce the farmers' economic losses. The objective of the study was to evaluate the performance of STW irrigation system in terms of discharge, coverage per STW and water use efficiency, and causes affecting the performance of STWs in Ghatail Upazila under Tangail district.

II. Materials and Methods

The data of different irrigation pumping units, such as deep tube well (DTW), shallow tube well (STW) and low lift pump (LLP), together with their area coverage from 2013-14 to 2021-22, were collected from the office of the upazila agriculture officer at Ghatail. The discharge of the STWs was measured in the field using V-notch. Other data like actual area irrigated, placement of the units and their performance etc. were collected from the farmers (STW owners) through questionnaires during 2021-22. The total number of STWs selected for discharge measurement and collection of other information was 19, of which 9 STWs were in high land and 10 STWs were in low land. The STWs were selected beside the road sites to have easy access to them. The data were analyzed using Microsoft Excel.

Ghatail upazila under Tangail district has an area of 450.71 sq km and located between 24^{o}23` and 24$^{o}$34` north latitudes and in between 89^{o}53` and 90$^{o}$95` east longitudes with a population of 371952. This upazila is the largest in Tangail district and occupies 13.35% of the total land area of the district. (Source: Bangladesh Burea of Statistics, Jun 18, 2021). It is bounded by Gopalpur and Madhupur upazila on the north, Kalihati and Sakhipur upazila on the South, Fulbaria and Bhaluka upazila on the east, Bhuapur and Gopalpur upazila on the west. It has 88.45 sq. km of forest land in the east. The total land area is 45171 hectares, of which 31686 ha is agricultural land. During 2021-22 Boro season, a sum of 21021 ha of agricultural land (about 66.34%) was irrigated by minor irrigation systems such as Deep tube wells (DTW), Shallow tube wells (STW) and Low lift pumps (LLP). Thus, it indicates there is still potential for irrigating agricultural land to boost agricultural products in the upazila.

III. Results and Discussion

Existing irrigation system

There are 3 irrigation systems exist at Ghatail upazila. These are: Deep tube well (DTW), Shallow tube well (STW) and Low lift pump (LLP) as given in Table 01. There is no canal irrigation system in the upazila. River water is scarce during dry season. All the irrigation systems use two sources of power: Diesel engine and Electric motor. In case of shallow tubewell and low lift pumps the number of engine powered unit (well/pump) is greater than the number of electric motor operated units (well/pump) unlike deep tube well irrigation systems where number of diesel operated unit is less than the electric motor operated unit (Table 01).

Table 01. Number of different types of pumps used for irrigating fields at Ghatail upazila

Year	Deep tube well			Shallow tube well			Low lift pump		
	Diesel engine	Electric motor	Total	Diesel engine	Electric motor	Total	Diesel engine	Electric motor	Total
2013-14	6	85	91	4080	2381	6461	30	3	33
2014-15	6	85	91	4080	2385	6465	30	3	33
2015-16	7	88	95	4085	2387	6472	32	3	35
2016-17	7	91	98	4088	2391	6479	32	3	35
2017-18	7	98	105	4092	2395	6487	34	3	37
2018-19	8	106	114	4095	2401	6496	34	3	37
2019-20	8	113	121	4102	2417	6519	34	3	37
2020-21	8	123	131	4146	2436	6582	36	4	40
2021-22	8	123	131	4146	2440	6586	36	5	41

The land areas irrigated by different types of wells/pumps are given in Table 02. It is evident from Table 02 that maximum amount of land (91.70%) was irrigated by shallow tube well irrigation system followed by deep tube well irrigation system (7.98). The least land area (only 0.32%) was irrigated by low lift pump.

Table 02. Amount of land irrigated by different types of pumps during 2013-2022

Year	Area irrigated by DTW (ha)			Area irrigated by STW (ha)			Area irrigated by LLP(ha)			Grand total (ha)
	Diesel engine	Electric motor	Total (ha)	Diesel engine	Electric motor	Total (ha)	Diesel engine	Electric motor	Total (ha)	
2013-14	71	1575	1646	10491	8671	19162	50	8	58	20866
2014-15	71	1575	1646	10498	8678	19176	52	8	60	20882
2015-16	75	1577	1652	10502	8682	19184	52	9	61	20897
2016-17	80	1581	1661	10508	8685	19193	55	9	64	20918
2017-18	81	1585	1666	10519	8688	19207	57	9	66	20939
2018-19	87	1590	1677	10515	8691	19206	60	10	70	20953
2019-20	91	1594	1685	10520	8695	19215	62	10	72	20972
2020-21	96	1599	1695	10527	8699	19226	65	10	75	20996
2021-22	99	1605	1704	10530	8705	19235	70	12	82	21021
Average			1670			19200			67.56	20938
%			7.98			91.70			0.32	100
Overall increase(%)	39.44	1.90	3.52	0.37	0.39	0.38	40.00	50.00	41.38	0.74

Trend of increase/ Decrease of irrigating unit and land area

Yearly increases or decreases of different irrigating units (DTW, STW & LLP) together with land areas are given in Table 03, Table 04 and Table 05. The yearly increment of deep tube well units is almost negligible in diesel engine powered deep tube well. During 2013-14 the number of diesel engine powered deep tube wells was 6 while during 2021-22 it was 8. However, in the electric motor powered unit, there was a remarkable increase in the number of deep tube wells in the upazila. During 2013-14 the number of deep tube wells was 85 while it was 123 during 2021-22 which caused an increase of about 44.7% during 2013-22 based on 2013-14 (Table 03). With the increase of units of deep tube well there was also an increase in irrigated land area by 39.44% and 1.90% for diesel engines and electric motors, respectively, with an overall increase of 3.52% (Table 02).

Table 03. Annual rate of increment of deep tube wells and area during 2013-2022

Year	Diesel engine			Electric motor			Land increased (%)
	No. of pump	Yearly increment	Percent increment	No. of pump	Yearly increment	Percent increment	
2013-14	6			85			
2014-15	6	0	0.00	85	0	0.00	0.00
2015-16	7	1	16.67	88	3	3.53	0.36
2016-17	7	0	0.00	91	3	3.41	0.54
2017-18	7	0	0.00	98	7	7.69	0.30
2018-19	8	1	14.29	106	8	8.16	0.66
2019-20	8	0	0.00	113	7	6.60	0.48
2020-21	8	0	0.00	123	10	8.85	0.59
2021-22	8	0	0.00	123	0	0.00	0.53
Overall			33.33			44.7	3.52

In case of shallow tube wells, there was an insignificant increase of both diesel engine powered and electric motor powered units which was about 1.61 and 2.48% respectively based on 2013-14 (Table 04). Consequently, there was an insignificant increase in land area also. The land area increase was 0.37, 0.39% for diesel and electric motor powered units, respectively with an overall increase of 0.38% based on 2013-22 (Table 02). In case of low lift pumps, there was an increase of only 6 units (20%) of diesel engine operated pumps and only 2 (66.67%) units of electric motor operated pumps (Table 05). This increase in the number of units of deep tube wells caused an increase in irrigated land area also. The increase in land area due to diesel engines and electric motor operated low lift pumps were 40 and 50% respectively (Table 05) with an overall increase of 41.38% (Table 02).

Table 04. Annual rate of increment of shallow tube wells (STWs) and area during 2013-2022

Year	Diesel engine			Electric motor			Land increased (%)
	No. of pump	Yearly increment	Percent increment	No. of pump	Yearly increment	Percent increment	
2013-14	4080			2381			
2014-15	4080	0	0.00	2385	4	0.17	0.07
2015-16	4085	5	0.12	2387	2	0.08	0.04
2016-17	4088	3	0.07	2391	4	0.17	0.05
2017-18	4092	4	0.10	2395	4	0.17	0.07
2018-19	4095	3	0.07	2401	6	0.25	-0.01
2019-20	4102	7	0.17	2417	16	0.67	0.05
2020-21	4146	44	1.07	2436	19	0.79	0.06
2021-22	4146	0	0.00	2440	4	0.16	0.05
Overall			1.61			2.48	0.38

Table 05. Annual rate of increment of low lift pumps (LLPs) and area during 2013-2022

Year	Diesel engine			Electric motor			Land increased (%)
	No. of Pump	Yearly increment	Percent increment	No. of Pump	Yearly increment	Percent increment	
2013-14	30			3			
2014-15	30	0	0.00	3	0	0.00	3.45
2015-16	32	2	6.67	3	0	0.00	1.67
2016-17	32	0	0.00	3	0	0.00	4.92
2017-18	34	2	6.25	3	0	0.00	3.13
2018-19	34	0	0.00	3	0	0.00	6.06
2019-20	34	0	0.00	3	0	0.00	2.86
2020-21	36	2	5.88	4	1	33.33	4.17
2021-22	36	0	0.00	5	1	25.00	9.33
Overall			20.00			66.67	41.38

Area coverage of STW

The average coverage of STWs in Ghatail upazila, as shown in Table 06, was found to be 2.95 ha per STW during 2013-2022. However, the maximum coverage was 2.97 ha per STW in 2014-2015 and minimum was 2.92 ha per STW in 2021-2022. The recommended coverage of STW in Bangladesh is 5 ha per STW (Alam and Ghani, 2013). So in comparison to the recommended coverage of STW in Bangladesh, the actual coverage in Ghatail upazila was very low, almost half of the recommended coverage.

Table 06. Area irrigated by each shallow tube well (ha/STW) during 2013-2022.

Year	Diesel engine (ha)	Diesel engine (ha/STW)	Electric motor (ha)	Electric motor (ha/STW)	Total land (ha)	Average of both Diesel and electric motor (ha/STW)
2013-14	10491	2.57	8671	3.64	19162	2.97
2014-15	10498	2.57	8678	3.64	19176	2.97
2015-16	10502	2.57	8682	6.64	19184	2.96
2016-17	10508	2.57	8685	3.63	19193	2.96
2017-18	10519	2.57	8688	3.63	19207	2.96
2018-19	10515	2.57	8691	3.62	19206	2.96
2019-20	10520	2.56	8695	3.60	19215	2.95
2020-21	10527	2.54	8699	3.57	19226	2.92
2021-22	10530	2.54	8705	3.57	19235	2.92
Average		2.56		3.61		2.95

However, the value was very close to the average coverage of STWs in Bangladesh as reported as 3.99 and 2.28 ha per STW during 1982-1990 and 2011-2012 respectively (Alam and Ghani, 2013). The average land area coverage by STWs operated by electric motor was 3.61 ha with a maximum of 3.64 ha from 2013-14 to 2015-16 and a minimum of 3.57 ha from 2021-22. The average coverage of land area by STWs operated by Diesel engine was 2.56 ha with a maximum of 2.57 ha during 2013-14 to 2018-19 and a minimum of 2.54 ha during 2021-22. It is evident from Table 6 that the average area covered by Electric motor operated STWs was higher than that of Diesel engine operated STWs. It is important to note that both Electric motor operated and the Diesel engine operated STWs showed a decreasing trend of land coverage during the mentioned period (Table 06).

Coverage of the selected (Tested) STWs

Out of 19 selected shallow tube wells 13 were normal STW in the low land area where groundwater level existed within 6-7.5m (20-25ft) from ground surface while 6 were deep set STW (DSSTW) in the high land area in the eastern part of the upazila where groundwater level is more than 10-12m (35 to 40ft) deep from the ground surface. Among all 19 STWs/DSSTWs, 10 STWs were powered by electric motors of 5 to 7.5 hp, whereas other 9 STWs were powered by diesel engines of 12 to 16 hp. The coverage of the selected STWs was calculated from the collected data provided by the farmers during test. The coverage of land area by STWs/DSSTWs ranged from 1.34 ha to 6.01 ha where the coverage of less than 5.0 ha area was found for 99% of STWs and only 7% of STWs covered more than 5.0 ha. Thus, the average coverage was 3.32 ha per STW (Table 07).

Table 07. Area coverage by selected STWs at Ghatail Upazila

Sl. No.	Types of prime mover	Type of land	Type of Tube well	Discharge (l/s)	Area coverage (ha/STW)
	Diesel engine/ Electric motor	Low land/High land	STW/DSSTW		
1	Electric Motor	Low land	STW	12.72	3.34
2	Electric Motor	Low land	STW	19.52	5.34
3	Electric Motor	Low land	STW	12.22	3.74
4	Electric Motor	Low land	STW	11.67	2.94
5	Diesel Engine	Low land	STW	14.52	3.74
6	Electric Motor	Low land	STW	14.28	4.68
7	Electric Motor	Low land	STW	20.79	6.01
8	Electric Motor	Low land	STW	19.04	3.07
9	Diesel Engine	Low land	STW	9.04	1.34
10	Electric Motor	Low land	STW	9.52	4.01
11	Diesel Engine	Low land	STW	12.69	4.68
12	Electric Motor	Low land	STW	12.69	4.01
13	Electric Motor	Low land	STW	12.61	4.68
14	Diesel Engine	High land	DSSTW	10.61	2.40
15	Diesel Engine	High land	DSSTW	9.52	1.87
16	Diesel Engine	High land	DSSTW	9.52	2.40
17	Diesel Engine	High land	DSSTW	7.62	1.60
18	Diesel Engine	High land	DSSTW	7.62	1.60
19	Diesel Engine	High land	DSSTW	7.61	1.60
Ave				12.31	3.32

The discharge of the tested tube wells ranged from 7.61 to 20.79 l/s with an average of 12.31 l/s (Table 7). The coverage is usually proportional to the discharge of STW/DSSTW. However, there was found no positive correlation between discharge and coverage. Because there were some other factors such as suitability and availability of land along with soil types and desire of the farmers also influenced the coverage of land by each STW/DSSTW.

Frequency distribution of STWs with their coverage of land per STW

Figure 01 shows the frequency distribution of STWs against their area coverage. It is evident from Figure 01 that 17 STWs (about 90% of the STWs) had area coverage of less than 5.0 ha whereas about 26 % of STWs had a capacity of only 1 to 2 ha per STW. Only 11% of the selected STWs had area coverage higher than 5.0 ha, the recommended capacity of an STW (Alam and Ghani, 2013).

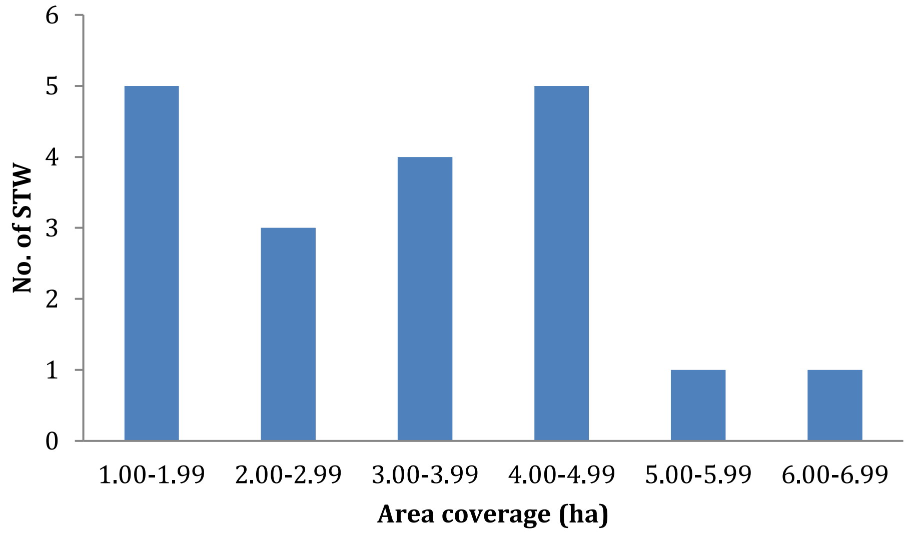


Figure 01. Frequency distribution of STWs against their area coverage

Area coverage of Electric motor (EM) and Diesel engine (DE) powered STWs in low and high land

From Figure 02 it is evident that out of 19 tested STWs the average capacity (coverage) of 10 EM in low land was equal to 4.18 ha/STW whereas average capacity of 10 EM and 3 DE in low land was equal to 3.97 ha/STW and capacity of 3DE in law land was equal to 3.25 ha/STW. However, the average capacity of all the STW/DSSTW in low land and high land was equal to 3.32 and that of 6 DE DSSTW in high land was equal to 1.91 ha per DSSTW which was comparatively very low.

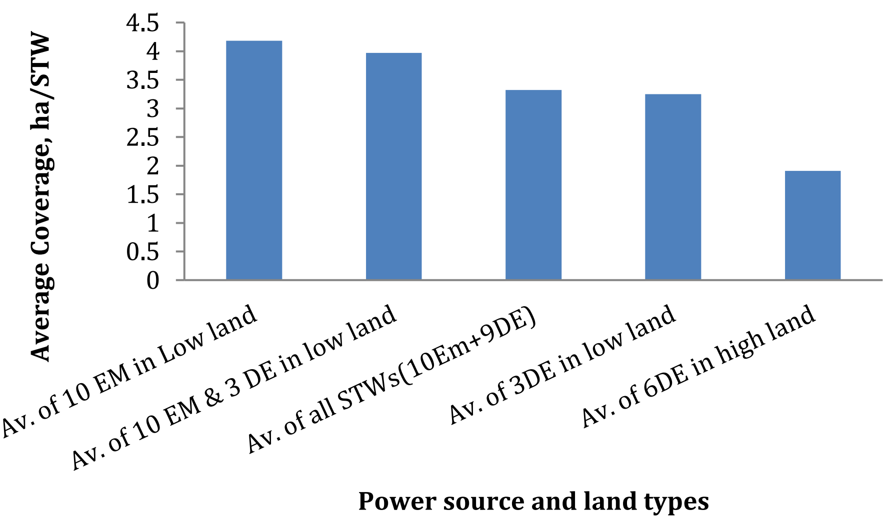


Figure 02. Average area coverage of Electric Motor (EM) and Diesel Engine (DE) powered STWs

Distance of furthest irrigated land from STWs

It is evident from the observation in the field that almost all the STWs are installed within the land to be irrigated. That is the first land to be irrigated at zero distance from the STW. The distance of the furthest land that was irrigated by the selected STW is shown in Figure 03. It is evident from Figure 03 that the distance of the furthest land irrigated by a specific STW varied from STW to STW. The furthest land in 63% cases is within 300m from the STW. For these STWs, the conveyance loss may be expected to be less as it depends on the distance of the land to be irrigated. Thus, 37% of STWs that irrigated land more than 500m distance would cause higher conveyance loss of irrigation water. Therefore, conveyance loss directly influences the area coverage of STWs and also water use efficiency of STWs.

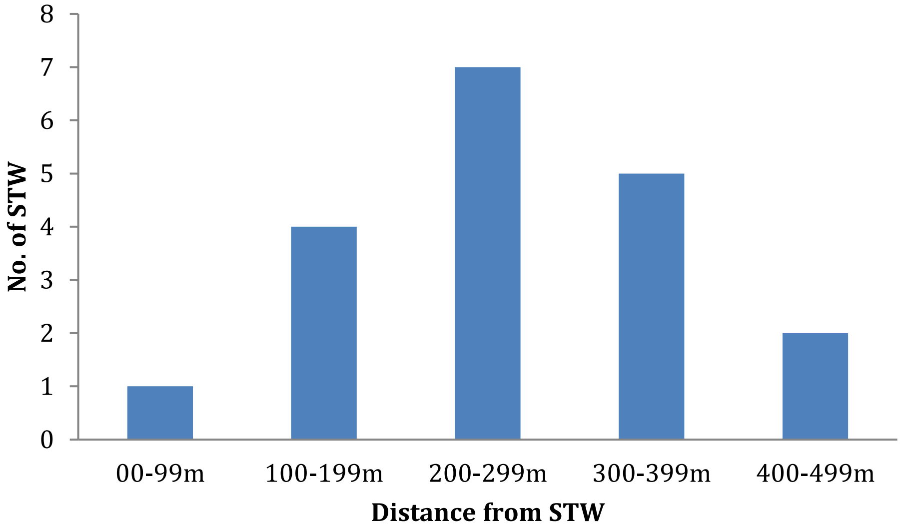


Figure 03. Frequency of STWs against distance of furthest irrigated land from STWS

Water use efficiency

The average water use efficiency (WUE) of STWs used for irrigating rice fields was 42.7%, while the highest and the lowest were 68.9% and 25.6%, respectively, without considering the losses of irrigation water through seepage and deep percolation. This average WUE (42.7%) is low compared to the average WUE (62.5%) found by Hossain and Angeles, 2003. However, WUE can be improved through adoption of resource conserving crop management practices such as alternate wetting and drying (AWD), direct-seeded rice and bed planting (MoA, 2020). Since the water use efficiency is the ratio of ET_{crop} to total water withdrawn from the underground, it depends on the total water withdrawn and area irrigated and the type of crops. For the same amount of water withdrawn, the WUE is higher for the crop with higher ET_{crop} and lower for the crop with lesser ET_{crop}. Hence, from the viewpoint of improving WUE, the main technique that should be adopted is to supply optimum amount of water based on the needs of the crops. A possible way of achieving this goal is to train the farmers on different techniques for using water efficiently in irrigating upland and low-land crop fields.

Table 08. Water use efficiency of the selected STWs at Ghatail upazila

Sl. No.	Pump use (hr/day)	Average discharge (l/s)	GW withdrawal in season (mm)	Total ETcrop* (mm)	WUE without percolation and seepage loss (%)
1	11	12.72	1659	691	45.8
2	13	19.52	1882	691	36.7
3	10	12.22	1294	691	53.4
4	8	11.67	1415	691	48.8
5	10	14.52	1537	691	44.9
6	11	14.28	1329	691	52.0
7	11	20.79	1507	691	45.9
8	11	19.04	2702	691	25.6
9	7	9.04	1870	691	37.0
10	13	9.52	1222	691	56.5
11	13	12.69	1396	691	49.5
12	8	12.69	1003	691	68.9
13	14	12.61	1494	691	46.3
14	13	10.61	2276	691	30.4
15	10	9.52	2016	691	34.3
16	12	9.52	1885	691	36.7
17	12	7.62	2263	691	30.5
18	12	7.62	2263	691	30.5
19	10	7.61	1883	691	36.7
Ave	11.05	12.31	1731	691	42.7

*From climate adjusted model estimated CWR (Islam, 2021)

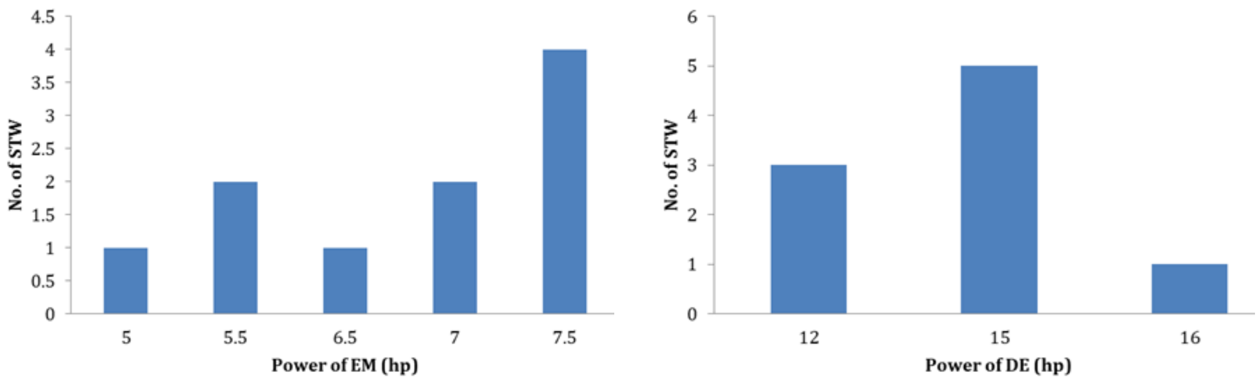
J. Sci. Technol. Environ. Inform. 13(01): 840-849 | Hossain & Oliver et al. (2024)
EISSN: 2409-7632, Journal home: www.journalbinet.com
Crossref: https://doi.org/10.18801/jstei.130124.84

Operation, maintenance and priming

Most of the STWs (about 71%) were operated and maintained by the STW owners themselves and about 29% of the STWs were operated and maintained by the hired labour. Most of the STW owners (about 98%) were literate of which 83% were class five to SSC pass and about 12% of STW owners had HSC to higher education. Hundred percent of the STW was found non-self-priming. That means all the pumps were not self-priming. Instead, there is a hand pump with each STW which was used for priming the pump before starting it.

Prime mover

The prime movers used for providing power to the selected 19 shallow tube wells were Electric Motors and Diesel Engine. Out of 19 selected STWs, 10 STWs (53%) were operated by electric motors, and 9 STWs (47%) were operated by diesel engines. The average coverage of STWs operated by electricity was 2.61 per STW, which was slightly higher than the diesel engine operated STW (2.44 ha per STW). Horsepower of electric motors ranged from 5 to 7.5 hp (3.73 to 5.60 kW). while the horsepower of diesel engines ranged from 12 to 16 hp (8.95 to 11.94 kW) as shown in Figure 04 (a & b).



(a) Power of electric motor (EM) (b) Power of diesel engine (DE)

Figure 04. Power of Electric motor and Diesel engine

Reasons for Low Coverage

Upon discussion with the STW owners during survey it was revealed that there were two main reasons for the low coverage per STW i.e. There was no more suitable land for irrigation around the STW and they had to share the available land with other nearby STWs owners. About 11 farmers (STW owners) reported that there was no more land around the target STW which could be brought for irrigation under the STW. On the other hand, eight farmers reported that they had to share the land of the area with other STW installed nearby. In few cases, the recommended distance between two STWs was not maintained properly. It is evident from Table 07 that many of the STWs (about 37%) were operated for 10 hours or less than 10 hours per day for irrigation, with an average of 12.31 hours. That is, by increasing the operating hours per day, the coverage of irrigated areas per STW could be increased substantially provided that there were available lands for irrigation. However, all the STW owners reported that they were happy with the performance of their STWs.

IV. Conclusion

The major part of the Boro rice field (91.7%) is irrigated by STWs at Ghatail upazila. The remaining 8.3% of land is irrigated by deep tube well (DTW) and Low lift pump (LLP) irrigation system. As measured in the field, the average discharge of the STWs was 12.31 l/s, which was lower than the recommended discharge (14 l/s) of STWs in Bangladesh. Similarly, the average area coverage of STW was found to be 3.32 ha/STW which was also lower than the recommended area coverage (5.0 ha/STW) by STW in Bangladesh. The average water use efficiency was calculated as 42.7% which was also very low. Among the various factors of low coverage of STW, two factors are 1. Unavailability of suitable land and 2. Sharing of land with other nearby STWs could be considered the major one. Thus proper placement of STWs in the field with appropriate management practices may increase the area coverage and water use efficiency of STWs in the upazila.

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HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jstei.130124.84

MLA

Hossain, S. M. I. and Oliver, M. M. H. "Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh". Journal of Science, Technology and Environment Informatics 13(01) (2024): 840-849.

APA

Hossain, S. M. I. and Oliver, M. M. H. (2024). Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh. *Journal of Science, Technology and Environment Informatics*, 13(01), 840-849.

Chicago

Hossain, S. M. I. and Oliver, M. M. H. "Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh" Journal of Science, Technology and Environment Informatics 13(01) (2024): 840-849.

Harvard

Hossain, S. M. I. and Oliver, M. M. H. 2024. Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh. Journal of Science, Technology and Environment Informatics, 13(01), pp. 840-849.

Vancouver

Hossain, SMI and Oliver, MMH. Performance of shallow tube well irrigation system at Ghatail upazila in Bangladesh. Journal of Science, Technology and Environment Informatics. 2024 May, 13(01): 840-849.