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TUBEWELL UTILIZATION, WATER REQUIREMENT AND DISTRIBUTION

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Tubewell Utilization
Water Requirement and Distribution

1. In row crop irrigation, as for corn and beets, where no time losses occur and efficiency is at 100 per cent then a 1 cusec supply of water will irrigate 84 acres of land, based upon four-inch irrigation every two weeks. The flow rate would be 5.3 g.p.m. per acre and an efficiency of water use no one has demonstrated. This water-application efficiency would not be desirable or practical. Where irrigation efficiency is at 60 per cent then only 50 acres can be irrigated by a 1 cusec flow of water. This is a flow rate of 9 g.p.m. per acre and many irrigators have reached this efficiency. Irrigation efficiency of 75 per cent should be a reasonable target for an irrigation group to attain. That is, 25 per cent of the water pumped is lost through deep seepage in the distribution system and in the fields, plus seepage losses around the levees. At 75 per cent irrigation efficiency, 1 cusec of supply should irrigate 61 acres of land, giving a flow rate of 7.1 g.p.m. per acre. In East Pakistan where 1 cusec is irrigating only about 20 acres we get an irrigation efficiency of about 24 per cent and a flow rate of 22.5 g.p.m. per acre. This very low efficiency certainly needs improvement. At one time in East Pakistan a 1-cusec flow of water was irrigating 33 acres, about 40 per cent efficiency or about 13.7 g.p.m. per acre.

2. The World Bank in its report about low-lift pumping in East Pakistan stated that a reasonable target for the 2-cusec pump (900 g.p.m.) was an 80-acre area. This is 40 acres per cusec of flow and a flow rate of 11.2 g.p.m. per acre. However, in the economic analysis the Bank used a very conservative target of 70 acres per 2-cusec pump or a flow rate of 12.8 g.p.m. per acre. This efficiency was to be reached by the 4th irrigation season. They proposed the following pattern of yearly acreage increases:

1st year = 50 A. per 2 cusec pump (25 A. per cusec)

2nd year = 60 A. per 2 cusec pump (30 A. per cusec)

3rd year = 65 A. per 2 cusec pump (32.5 A. per cusec)

4th year = 70 A. per 2 cusec pump (35 A. per cusec)

They also stated that each 2-cusec pump should theoretically irrigate 100 acres of paddy. The delta in the Bank study was set at 30 acre inches of water per crop but to be on the safe side they used 48-acre inches for boro crops. If the area to be irrigated is 70 acres, it will require 1,680 hours of pumping with a 2-cusec pump to provide 48 acre inches in 150 days. A 2-cusec pump can provide 2 acre inches of water per hour. If the paddy season is a 150-day period it will require that the pump operate 11 hours, 15 minutes per day, seven days per week in order to supply the necessary 48 acre inches of water in 1,680 hours of pumping time.

3. These air-cooled pumping engines are designed and built for continuous operation. With good service, full lubrication, adjusted for proper engine speed of 1,500 R.P.M. and with good-quality, clean fuel these engines can operate 3,600 hours in a 150-day period. The proper speed of engine operation is very important for it regulates the air flow that cools the engine. Most East Pakistan Agricultural Development Corporation pump drivers, for reasons known only to themselves, have tampered with the engine governors so that most engines are operating below recommended minimum speeds. This reduction in speed interferes with air volume and proper cooling of the engine so overheating occurs. Overheating reduces the lubrication value of the motor oil, causes rapid wear of the piston and rings and causes burn out of the cylinder head valves. These diesel engines can operate safely up to speeds of 2,500 R.P.M. but when used on a 2-cusec pump that has been built to operate at 1,500 R.P.M. and requiring only 12.5 Hp there is little justification for applying 26 Hp which this engine will develop when operated at 2500 RPM. When the engine is operated at 1,500 R.P.M. it is developing 16 Hp and more than adequate power to operate the pump. Faster speeds only increase the rate of fuel consumption and produce unused power.

4. Engineers at the International Rice Research Institute use a value of water use for rice at 0.68c.m. per day which in 150 days adds up to 51 acre inches of water per season. European engineers commonly use a figure of 1 liter per second per hectare for irrigation supply which is 0.864 c.m. per day and adds up to 50 acre inches for a 150-day growing season.

5. If we use a delta of 4? acre inches and plan to irrigate 70 acres with a 2-c sec pump, how will we program the pumping hours? In a 150-day season it will require 1,630 hours of pumping or 11 hours 15 minutes each day. However, on a 6-day week the pump must run 13 hours 10 minutes daily. At 11 hours 15 minutes operation, 22½ acres can be covered with one inch of water or 10 acres with 2.25 inches of water. In seven days then, we could apply 2.25 inches of water to each of the seven plots of 10 acres each. The water loss from these plots is continuous and in 6 days they will have lost about 2 inches of water. Before resupply of the plot has started the soil should be saturated, or it should have 1-inch depth of water left from the last flooding, so the new level, after applying 2.25 inches of water, should give a total depth of 3.25 inches of standing water. Many soils in East Pakistan are so permeable that a 3-inch flooding will not remain on the soil more than 10 hours but such flooding should last

144 hours to satisfy a 7-day irrigation scheme. Highly permeable soils are not suitable for rice growing.

6. In row crop irrigation, the scheme of water application is usually four inches every 12 to 15 days but in rice growing the idea is to keep standing water on the soil most of the time, especially during the rice heading and grain development periods of growth. A period of 90 days during flowering and grain formation must have enough water on the soils to maintain flooded conditions. A flow rate of 12.85 g.p.m. per acre would be provided if we use 2 cusec of flow on 70 acres of area. This is near the lower limit of what is considered good soils and water management. A more ideal range would be flow rates of 8 to 10 g.p.m. and these rates are more normal for economical use of water. At 8 g.p.m. of flow it should cover 112 acres of area, not 70 acres, and at 10 g.p.m. of flow it should be possible to cover 90 acres of area.

7. If we have a tubewell that is being pumped and the discharge is 1.5 cusec (675 g.p.m.) and this rate of flow is used to irrigate 50 acres of Boro we are using water at the rate of 13.5 g.p.m. per acre. A more satisfactory rate would be 11.25 g.p.m. in which case we could add 10 more acres to give a total of 60 acres in the service area.

8. The first rule for [illegible] is that the area to be irrigated is a compact block of crop as near to the well as possible, with no unirrigated land in the block. If the soils are suitable for rice growing without excessive water losses and 60 per cent of the farmers wish to grow rice, then all of them must grow rice. The rice should be all one variety so that the crop on the different plots can mature at one time. This will avoid prolonged pumping seasons of limited pumping where 10 or 20 per cent of the crop matures late because the seed used was of a variety that required 175 days growing period while the major acreage matured in 130 days.

9. The second rule for efficient water use is to know how much water expressed as a flow rate will be required to maintain flooded conditions. This rate should be somewhere near 8 or 10 g.p.m. per acre and if it drops to 15 g.p.m. per acre the soils are so permeable that water management will be difficult if 60 acres of rice are to be covered. There will be enough leaching deep into the soil profile to make fertility management difficult for even the most experienced farmers. At 15 g.p.m. per acre flow it would require 21,600 g.p. day per acre which gives about 0.75 acre inch per day as the permeability rate. A permeability rate of 0.75 acre inches per day would, for a 60- acre area, during

150-day growing season would require 3,375 hours of pumping with a 2-cusec pump, or 22.2 hours of pumping every day. At that rate a total of 112 acre inches of water would be provided to grow about the same crop as 48 acre inches should have grown if the soils were really suitable for flooded type of rice production. If we pumped 1,680 hours to apply 48 acre inches of water to 70 acres of area the pumping cost would be, at Rs.4.5 per hour, Rs.7,560 or Rs. 108 per acre. However, if it required 3,375 hours of pumping to grow rice on 60 acres of permeable soil it would cost Rs. 253 per acre for pumping. Farmers will certainly complain about such high costs and the pump group most likely could not collect the Rs.15,187 to cover the cost of pumping for the season.

10. The third rule would be to divide the irrigation area (70 A.) into about 4 tracks of 18 acres each so that with a 2-cusec pump at full discharge working 9 hours per day we could supply one acre inch of water to replace that has been lost by evaporation, transpiration and seepage. The necessary canals and control gates must be installed so that a 4th day rotation of water application can be effectively handled.

11. The fourth rule is do not allow water to enter fields where it is not needed. This means a daily inspection of the canals to see that the water is going to the scheduled location and not being lost through open

canal gates, rat holes through the canals or by over-topping of canals that are too small or need cleaning. The irrigation system does not stop at the pump discharge pipe. Both the pump driver and the Union Agricultural Assistant should see to it that the water is being properly distributed. The conventional method of irrigation in most Asian countries has been to allow the water to flow from field to field without the benefit of canals and controlled distribution. The result has been over-irrigation of lands near the pump and under-irrigation of the more distant land tracts. Usually the crops fare very poor on the more distant lands as they got started late and ran out of water before maturity as the crops near the pump had matured and the pump was shut down. The canal system for rotational irrigation system will increase crop yields, in addition to which the area to be irrigated can be increased by 20 to 50 per cent over the flooding, field to field method.

12. The fifth rule is to have the water in the field at the proper time and in sufficient quantities. The irrigation scheme must be based upon the driest season so as to have capacity enough even if during more rainy seasons some of the pumping capacity is not used. Rains of less than 1/2 inch depth of water are usually not enough water to cause the pump to be shut down. Rice

is very easily damaged by failure of water supply during the flowering stage and grain development period. After the crop has been planted, fields should never be allowed to dry so that the soils start to develop cracks.

13. The sixth rule - inspect the levees between fields and around the parameter of the area to see that excessive water escape is not occuring. The farmer must be instructed to repair holes and breaks in levees and to keep them high enough to prevent overtopping.

14. The seventh rule is to encourage each farmer to level his land properly so that he gets uniform depth of water on his soil. High spots in the field require more water in the field than necessary and increase seepage losses. Usually, these high spots are dry most of the time so the crop does poorly.

15. The eighth rule - encourage the farmer to keep the weeds out of his fields for weeds use as much water as crops and they compete with the crop for sunlight and soil fertility.

16. The ninth rule - keep the engine and pump clean at all times. There should be enough oil and fuel on hand for several days' operation. If repairs are needed, the mechanics should be notified as quickly as possible. If the repairs will take several days, a substitute pump or engine should be arranged for.

This paper attempts to point out the difference between pumping water and irrigation where the water is under control at all times and the farmer is getting full value out of his pumping cost.

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