https://doi.org/10.29321/MAJ.10.A03606

Ground Water Development with Particular Reference to Filter Point Tube Wells in Thanjavur District

by

R. SOMALINGAN *

Introduction: Efforts are being made to maximise the production of rice in Thanjavur District – the granery of South India – particularly after the introduction of Intensive Agricultural District Programme. The district gets a fairly assured supply of water during the cultivation season. But the Ground-water which is commonly understood as the water occurring in pores and interspaces of the geologic strata, has an important role in tiding over the water scarcity due to vagaries of monsoon and making better utilisation of the available surface sources of water. The ground water extracted through the filter point tube wells has been responsible in bringing about change in the pattern of agriculture in Thanjavur District. So it has become necessary to organise for a systematic development of the ground water in this district to achieve the goal of self sufficiency in food, as it holds full potentialities.

Historical Back-ground: Thanjavur district is served by the River Cauvery, through a net work of channels and the need for augumenting this supply was not felt in any appreciable extent in the old delta *i.e.*, excluding the ayacut under the Grand anicut canal. As such no attempt was made to tap the ground water upto the beginning of the last decade. A few dug wells available were used for irrigating small extents of garden land crops such as sugarcane. Such dug wells yield small quantity of water and mostly useful for domestic needs. The use of small size filter points of 1" to 1½" diameter was in existence for the past several decades, but to cater the domestic needs only. The first large size filter point tube well was sunk successfully by an enterprising farmer in Mayuram taluk, which was followed by a few others. Impressed by the utility of such filter point tube wells the Agricultural Department took steps for sinking more such wells. A scheme was sanctioned by the Government in 1951 for sinking 100 filter point tube wells in Thanjavur district. Actually the work was commenced in 1952 and this marked the beginning of organised development of ground water in Thanjavur district.

Origin and Occurence of Ground Water: Almost the entire ground may be considered as a part of the hydrologic cycle, including surface and atmospheric waters.

Ground water occurs in persueable geologic formations called Aquifer. The voids or interstices in rock or soil hold the ground water and act as conduits. The size, shape, irregularity and distribution of these voids govern the capacity to hold and transmit water, which in turn are characterised by the geologic formations.

* Assistant Agricultural Engineer (Crash Programme) Mayuram.

Thanjavur district forms an Alluvial plain, and the soil formation is by transportation. So the soil is not homogeneous. The main types of formations are clay, sand, silt and kankar. The sandy layers which form the aquifers are of large areal extent and may be considered as underground reservoirs. The water enters such a reservoir from natural recharge in this district. The volume of water removed or replaced annually represents only a small and negligible fraction of the storage capacity.

The unconfined aquifer generally found within 50′. Below ground level is suitable for sinking filter point tube wells. This aquifer is invariably divided into two or more layers by the presence of acquiclude *i.e.*, an impervious layer, mostly clay. But these aquiclude does not seem to extend throughout the area. Hence it can be assumed that these layers of sand as parts of one aquifer. It is interesting to note that these sandy layers are not present all over the area. There is wide variation from place to place and even within a same field. The presence and thickness of the aquiclude, is probably responsible for such wide variations. It is not uncommon to make several attempts before sinking one successful filter point tubewell in a farm or even within a field.

TABLE 1. *The results of attempts made for sinking filter point tube wells in Mayuram Division under Crash Programme from 1-4-65 to 31-3-1967*

Taluk	No. of attempts made	No. of wells sunk successfully	No. of failures	Percentage of success
Mayuram	1585	846	737	53.6
Sirkali	1306	714	592	54.7

TABLE 2. *The variations in the formations within a same field*

Village	Field No.	Serial No. of attempts	Depth B.G.L.	Soil strata bored	Results
Kokkur	90/1	44/65/66-67	0′-30′	Clay	Failure
(Kuttalam Block		45/65/66-67	0′-30′	Clay	Failure
		46/65/66-67	0′-40′	Clay	Failure
		47/65/66-67	0′- 9′	Clay	
			9′-20′	Fine sand	
			20′-42′	Coarse sand	Successful
Thenpathi	234	31/18/67-68	0′- 4′	Clay	
(Sirkali Block)			4′-26′	Fine sand	
			26′-38′	Clay	Failure
		32/18/67-68	0′- 9′	Clay	
			9′-15′	Fine sand	
			15′-42′	Clay	Failure
		33/18/67-68	0′- 4′	Clay	
			4′-18′	Sand	
			18′-32′	Coarse sand	Successful

So far no consolidated formations have been met with even up to 750′ B.G.L. Several layers of sand with thickness extending upto 60′ to 100′ which are generally confined aquifers are found below 200′. But tube wells tapping in these zones are very few. With the availability of hydraulic rotary drills such deep wells are likely to increase in number during the years to come.

TABLE 3. *The representative well logs of a filter point tube-wells and deep wells*

Village	Field Number	Depth	Soil strata bored	Remarks
Illupur (Senbanar koil block)	249/5	0′-8′	Clay	4″ Filter point tube well
		8′-22′	Sand	
		22′-29′	Clay	
		29 -44′	Sand	
Perumangalam (Sirkali Block)	101	0′-30′	Clay	4″ tube well sunk with hand boring set
		30′-50′	Clay mixed with sand	
		50′-97′	Red clay with Kankar	
		97′-110′	Kankar	
		110′-141′	Sand	
		141′-	Clay	
Kumarakudi (Coleroon Block)		0′-10′	Black clay	8″ tube well sunk with hydraulic rotary drill
		10′-57′	Sand	
		57′-88′	Black clay with Kankar	
		88′-154′	Yellow clay	
		154′-164′	Sand	
		164′-171′	Yellow clay	
		171′-181′	Sand	
		181′-205′	Yellow clay	
		205′-298′	Grey sand	
		298′-330′	Yellow clay	
		350′-384′	Coarse grey sand	
		384′-	Clay	

Sirkali, Mayuram, Kumbakonam, Papanasam, parts of Thanjavur, Nannilam and Nagapattinam taluks lying on either sides of Cauvery have got good potentialities for sinking filter point tube wells as well as regular tube wells of about 100′ to 200′ in depth. Mannargudi and Thiruthuraipoondi taluks are mostly suitable for sinking tube wells within a depth of about 150 to 250 feet.

The formations in Pattukkottai, Orathanad parts of Thanjavur and Arantangi have scope for sinking tube wells, but require more investigation. The formations in this area are different from the rest of the district.

In parts of Sirkali and Mayuram Taluks a layer of carbaraceous clay black in colour, plastic in texture and mixed with partially decomposed wood is found to occur. A combustible gas, presumably Methane, escapes from this zone. The escaping gas makes the suction side of the centrifugal pump air bound rendering it ineffective. If tube wells are sunk in such areas, the farmers are advised to use a self priming pump to overcome this trouble. This layer is found in depths ranging from 20′ to 100′ B. G. L.

Surface and sub-surface investigations for ground water: Sub-surface investigations are more useful and reliable than surface investigations. Until recently no attempts have been made to carry out investigations on a scientific basis. The work in progress by the United Nation's Development Project in Cauvery Delta may give some useful results in due course. Till then, compiling the informations available with the Agricultural department and other agencies about the several thousands of tube-wells already completed may help in locating potential areas fairly and accurately.

The usual method of Dowsing or water divining is most unreliable and does not give good results in this district.

Types of Wells: (i) *Open Wells:* Sunk wells, the only type of open wells possible in the unconsolidated formations present in the old delta region are not suitable for developing ground water for irrigation. Invariably they develop cracks and collapse while pumping due to caving. It may be possible to sink open wells in Pattukkottai and Orathanad taluks, but the yield is generally meagre.

(ii) *Tube Wells:* There is good scope for sinking filter point or deep tube wells as stated earlier. They are generally successful and give adequate water. The filter point tube well is nothing but a shallow tube well with a well filter at the bottom, sunk in unconsolidated aquifer. Cavity wells which are otherwise tube-wells without a strainer are also successful in certain parts where the permeability of the aquifer is very poor.

Types of Well Filters: As the tube wells are constructed in unconsolidated formations in this district, a well filter is essential at the bottom except in a cavity well. The following are several types of filters used in this district: (i) *Metal Filter Point:* A standard pipe of convenient length usually 6′ 0″ in length with holes of 1/2″ to 5/8″ in diameter all over is covered with a brass or copper wire mesh of suitable gauge and over which a brass perforated sheet is provided. The lower end is either seated or a conical drive point and the top end is threaded. This type of filter is not being used at present as it gets damaged due to corrosion and is comparatively costlier.

(ii) *Slotted Pipes:* Standard pipes are used as strainers after cutting slots either horizontally or vertically. The slot openings are generally 1/16" to 1/4" in width and 2" to 4" in length. A horizontal opening gives a better performance than a vertical opening in unconsolidated formations.

(iii) *Metal Screens:* Screens made of pressed metal sheets with lonvered openings are also useful but they are also affected by corrosion.

(iv) *Coir Filters:* This is the cheapest and efficient type of filter and is commonly used for filter point tube wells in this district. A suitable shell is fabricated with mild steel strips having a bit of standard pipe usually of about 9" in length on either side as a base. The bottom is sealed and the top end is threaded. The shell is wound with coir rope (made of coconut fibre) of about 3/8" size in two layers. The average life of a coir filter is about 10 to 15 years, if they are not disturbed while in service.

Construction of Tube Wells: A hole at least 50% longer in diameter than the proposed well is made with hand or power operated tools as the case may be. Work lining pipes are inserted in the holes to arrest collapsing or caving of the wall. When the hole is completed to a desired depth duly penetrating the aquifer, the samples of formations in aquifer and quality of water are studied. If it is decided to instal the well a well screen of suitable length and type is connected to a string of tubes of required length and inserted into the hole. The lining pipes are then pulled out leaving this string of tubes and filter in position. The loose material in the aquifer fixes the well and keeps it in position. The annular space if any left uncovered is filled up with good coarse sand or clay as the case may be.

If a gravel packed well is required the annular space between the lining pipe and the well is gradually filled up with selected size of gravel before the lining pipes are removed. When the lining pipe is removed the gravel settles down and covers the sides of the filter. Gravel packing increases specific capacity of the well. In aquifer containing large proportion of fine sand, gravel packing is a necessity to avoid sand - pumping. The thickness of gravel packing depends upon the type of formation and method of drilling, but a minimum thickness of 3" is necessary to be effective. Generally the gravel used should be about 1/4" in size. No gravel packing is given for coir filters but it is essential where slotted pipes are used.

If a hydraulic Rotary drill is used no lining pipes are required. The circulating drilling mud (Bentonite) forms a lining on the wall of the well which prevents caving. When desired depth is drilled tubes with required length of screen (Slotted pipe) are inserted into the hole. The well is washed and gravel packing is also given through the annular space. Then the well is developed.

Developing the Well: The completed well should be developed to increase its specific capacity, prevent sanding and obtain maximum economic life. By this process the finer materials are removed from the formations surrounding the filter. To accomplish proper development the openings of the filter should be such as to allow 50 to 60% of the grains in the surrounding area into the well leaving the coarse grains around. The finer grains allowed into the well is bailed out during the process of developing. The importance of Development cannot be underestimated. Failure to develop the well properly is a major cause for well failures. Of the several methods of development of wells pumping, surging and by injection of compressed air are the common methods adopted in this district.

The filter point tube wells which are shallow do not require elaborate developing. But still they are being developed with the help of a hand operated pitcher pump with beneficial results. Due to its reciprocating motion the finer grains are brought out thereby the sand bridging and clogging are eliminated.

The deep wells are developed by surging or by injecting compressed air and the latter method is found to be very effective.

Testing the Well: After the well is developed the tests are conducted with centrifugal pump to estimate the yield. The static level of water is taken and the pump is worked at a maximum rate till the level stabilised. The depth of water is also taken when the level is stabilised but while the pump is still working. The difference in depths is the Draw down. The Discharge Draw down ratio is an estimate of the Specific capacity of the well.

Well-Hydraulics: The well filter or the slotted pipe should be placed opposite the most permeable aquifer. The well should penetrate the entire aquifer or the saturated thickness of the aquifer in confined and unconfined aquifers respectively. If the well does not penetrate the entire thickness of aquifer or that thickness is not covered by well filter it is called a partially penetrating well. Such partially penetrating well yields comparatively less water than a fully penetrating well for a given draw down.

To determine the size of wells several factors, such as the economics, the actual needs and the characteristics of the aquifer are to be taken into consideration. Merely by increasing the diameter of the well the yield cannot be increased when other factors are constant. It has been estimated by experts that by increasing the diameter from 6" to 12", the increase in discharge is only 10% keeping the other factors constant. But by doubling the diameter the intake area is doubled, the entrance velocity is reduced to half and the fractional loss to a third. So the well loss, if taken into consideration, the effect of increasing the well diameter is significant. The well loss may be neglected for relatively low pumping rates. Considering the above factors the normal size of the wells is 4″ and increased to 6″ wherever needed. Under the conditions prevailing in most parts of Thanjavur District a 4″ well is found to be economical and advantageous to an ordinary farmer.

Multiple wells: Where one well in an unconfined aquifer does not supply adequate water another well is sunk at about 15′ away. Both the wells are coupled to a common header and connected to a single pump. Such multiple wells give fairly satisfactory results.

Fluctuations in Ground Water Level: The ground water level indicates the elevation of the atmospheric pressure of the aquifer. The ground water level will vary due to the changes in storage, resulting from difference between supply and drawal of water. If the draft exceeds the recharge due to excessive pumping, a downward trend in ground water may occur. The magnitude of the fluctuation depends upon the quantities of water recharges and discharged. The seasonal pattern of fluctuations need not cause any anxiety. This pattern is evident in Thanjavur district. The ground water level shows a gradual decline from March and again recouped during June-July. The normal ground water level is about 5′ 0″ and the lowest during summer is about 12′ 0″ in Mayuram division. It is observed that the discharge of the wells also decline corresponding to the lowering of the ground water level and again comes to normal when the water level rises. The aquifers to get recharged to the maximum in this district with the seasonal rainfall and through the influent streams and channels. The utilisations of ground water is very little during the main cultivation season.

Several thousands of filter point tube wells have been sunk in recent years under the Crash Programme in the unconfined aquifers. More numbers will be sunk in coming years. When all these wells are commissioned it may have a bearing on the ground water level. So it is necessary to have a systematic study of the fluctuations in ground water level so as to take remedial measures if needed. To provide maximum development of ground water

TABLE 5. *The distribution of filter point tube wells in Mayuram Division as on 31—8—1967*

Name of Block	No. of villages	No. of villages where filter points are sunk	Number of wells sunk in the block
Mayuram	58	56	351
Sembanarkoil	61	58	290
Kuttalam	51	40	231
Sirkali	38	36	489
Kollidam	41	33	194
Total	249	223	1555

resources in Thanjavur, a Basin wide planning and development is required. To maintain the resources indefinitely a hydrological equilibrium must exist between all waters entering and leaving the basin.

Conjunctive Use : To get maximum water development the conjunctive utilisation of surface and ground water is essential. Surface storage supplies most of the requirements while ground water reserves can be used for dry periods. An optimum rate of surface water is also transferred to ground water storage.

In Thanjavur district the concept of conjunctive use is important to get a steady and sustained improvement in cropping pattern. The main source of supply of water is Cauvery with its storage reservoir at Mettur. The short duration first crop *(Kuruvai)* generally gets damaged at the time of harvest due to the prevailing North East Monsoon. To avert this damage, the cropping has to be advanced to have the harvest before the onset of North East Monsoon. The Mettur Reservoir may be opened in the middle of June if the storage positions permits. The strain like ADT 27 with a duration of 105 days if sown after the receipt of water during the last week of June, will come to harvest, during October when the monsoon is likely to set in. So to advance the crop, nurseries can be raised with filter point tube wells before the Mettur Reservoir is opened and the planting taken up after the receipt of water in the channels. By this the harvesting can be advanced by 3 weeks to save the crop from damages. This will facilitate the planting of second crop *(Thaladi)* also without difficulty. These tube wells will be useful to save the second crop during February – March when the scarcity of water is generally felt. The successive years of delayed monsoon, and consequent poor storage in Mettur Reservoir, the increased area under double cropping and the ambitious programme of third cropping have made the utilisation of ground water indispensible. Ground water development with conjunctive use of surface water may help in achieving the following benefits.

1. Availability of water when it is required.
2. Control of water table resulting in solving drainage as well as flood problems.
3. Greater water conservation.
4. Increased productions.

Quality of Ground Water : The quality of ground water is generally good and suitable for irrigation. The electric conductivity of most of the samples collected from the filter point tube wells is between the range of 0.2 to 0.9 milli Mhos/cm at 25° C. As the "Bay of Bengal" forms the eastern boundary of this district, the coastal aquifers are intruded with sea water. This intrusion is noticed in a 5 to 10 miles belt along the eastern coast. But even here the unconfined aquifer upto a depth of about 25' to 30' is free from contamination in most places.

The coastal aquifers always come in contact with the sea. Under natural conditions fresh water is discharged into the sea. But with over pumping the seaward flow of ground water may be decreased or even reversed, causing sea water intrusion into the aquifer. It has been established that the sea-water is is found up to a depth of forty time the height of fresh water above sea level. This distribution is attributed to a hydrostatic equilibrium existing between two fluids of different densities. So it will not be possible to get water fit for irrigation at a reasonable depth in such intruded areas.

Economics of Tube-Wells: The initial investment for sinking 4" tube-well including the cost of pumping set is relatively low in this district. A 4" tube well will supply about 200 to 300 gallons per minutue. Under the existing conditions this water can cover an area of about 5 to 10 acres depending upon the soil, season and crop. On an average the cost of lifting water to irrigate one crop of paddy works out to Rs. 40-00 to 60-00 per acre provided with the electric motor.

1.	Cost of sinking (including materials) of one 4" filter point tube well ...	Rs.	450.00
2.	Cost of sinking (including materials) of one tube well to a depth of 150' ...	Rs.	2000.00
3.	Cost of pumping plant consisting 5 HP Electric motor with 4" × 3" centrifugal pump and accessories...	Rs.	2500.00

Summary: There is a large storage of ground water in Thanjavur District, both under confined and unconfined conditions. The filter point tube wells and tube wells may be sunk successfully. The aquifers will get recharged through the influent streams and channels with the fairly sufficient rainfall. With the concept of conjunctive use of both surface and ground water the problem of over draft may not occur. The ground water development will render sustained increase in area under double cropping, stabilise the irrigation potentials and result in maximising the production. By controlling the water table the problems of drainage and flood may be solved to certain extent.

The saline water intruded coastal aquifers should be demarcated to arrest the further extension of contamination.

A basin-wide investigation and programme for systematic Development is needed for proper utilisation of ground water indefinitely. There is evidence of changing pattern of agriculture and awareness among the farmers. There is vast scope to increase the crop production to solve the food problem permanently and for the general economic uplift of the community at large.

REFERENCES

Todd, D. K. 1959. *Ground water Hydrology*. John Willey & Sons., Inc., London.

Tolman, C. F. 1937. *Ground water*. Mc. Graw - Hill Book Company Inc., New York.