

GROUNDWATER RESOURCES

You might have noticed that when it does not rain for several months after the rainy season, streams and tanks dry up; yet we continue to get water from wells. You may also have noticed that in some years when there is insufficient rainfall even the wells dry up within a few months. The wells are recharged once there is rain again. You may have wondered, from where does water come into the wells? Water is found at great depth in some wells and nearer the surface in others. The water of some wells is sweet while that of others is salty or brackish. Come let us find out why this is so.

MALWA PLATEAU AND NARMADA VALLEY

Arlavda is a village on the Malwa Plateau. This village has been facing a severe water shortage in the last few years. A large well called 'Gangajalia' used to supply water to the entire village. It was considered a very reliable well and its water was supplied even to nearby towns. However, this well too went dry in the summer of 1993. Now people had to travel long distances to faraway wells to fetch drinking water. Arlavda is not the only village facing this problem – this has become a common problem in the villages of the region.

You read about Kotgaon in the Narmada valley in class 6. Here there is no dearth of water. Water is usually available at a depth of 15 to 20 feet. Why is there such a stark difference between Arlavda and Kotgaon? Why is it that while one village has no water shortage another village has to face such acute shortage?

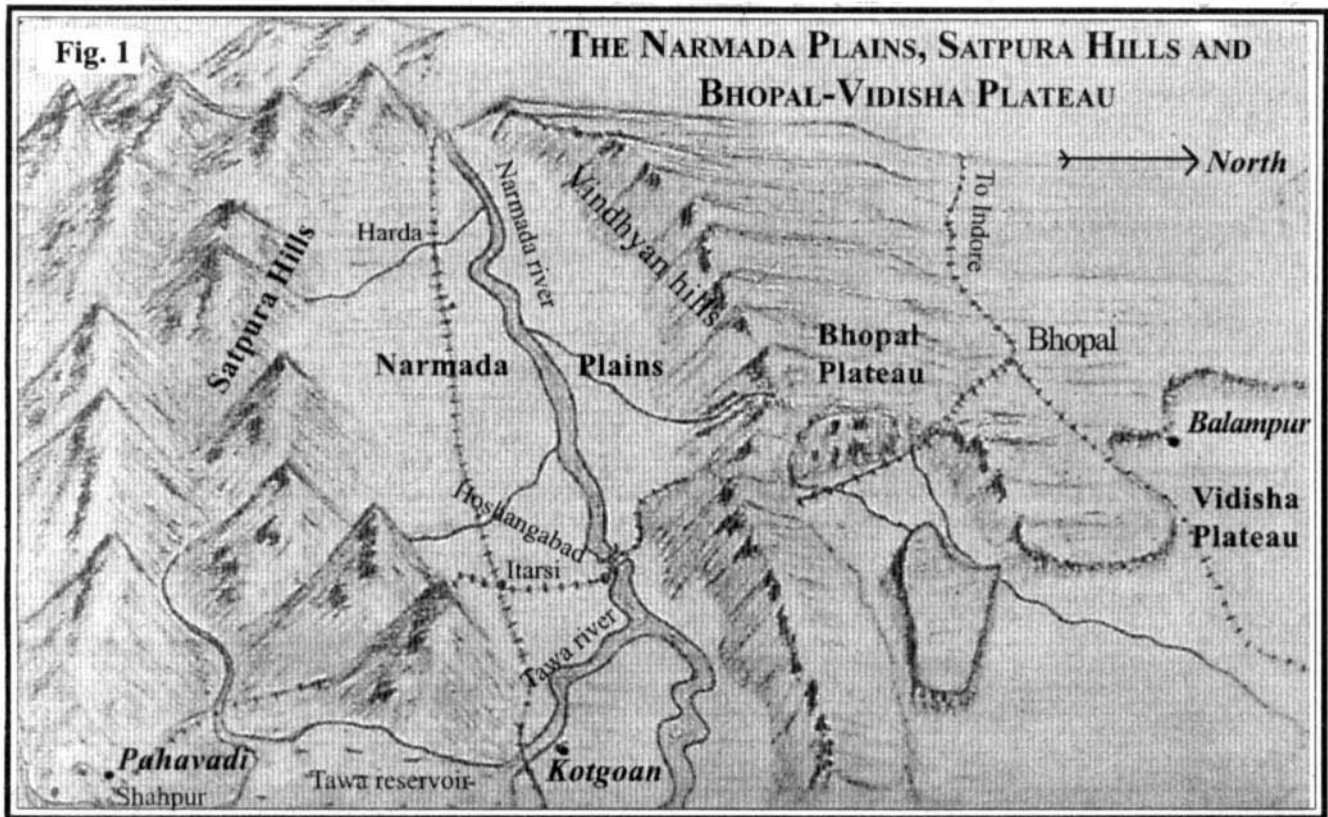
GROUNDWATER

From where do wells get their water? How does water get deep into the ground? Rainwater not only flows down the streams or rivers but it also slowly percolates into the soil. This water accumulates in the ground in the gaps between rocks, pebbles, sand, etc. It also accumulates in porous rocks or in the cracks in the rocks. This is the *groundwater* which we reach through wells.

Pervious and Impervious Rocks

Rocks which have cracks or pores (minute holes) in them, and can contain water are called '*pervious rocks*'.

Some rocks are very hard and do not have pores or cracks in them. Water cannot enter into them. Ground water usually accumulates *above* such rocks because the water cannot go underneath them. These are called '*impervious rocks*'.



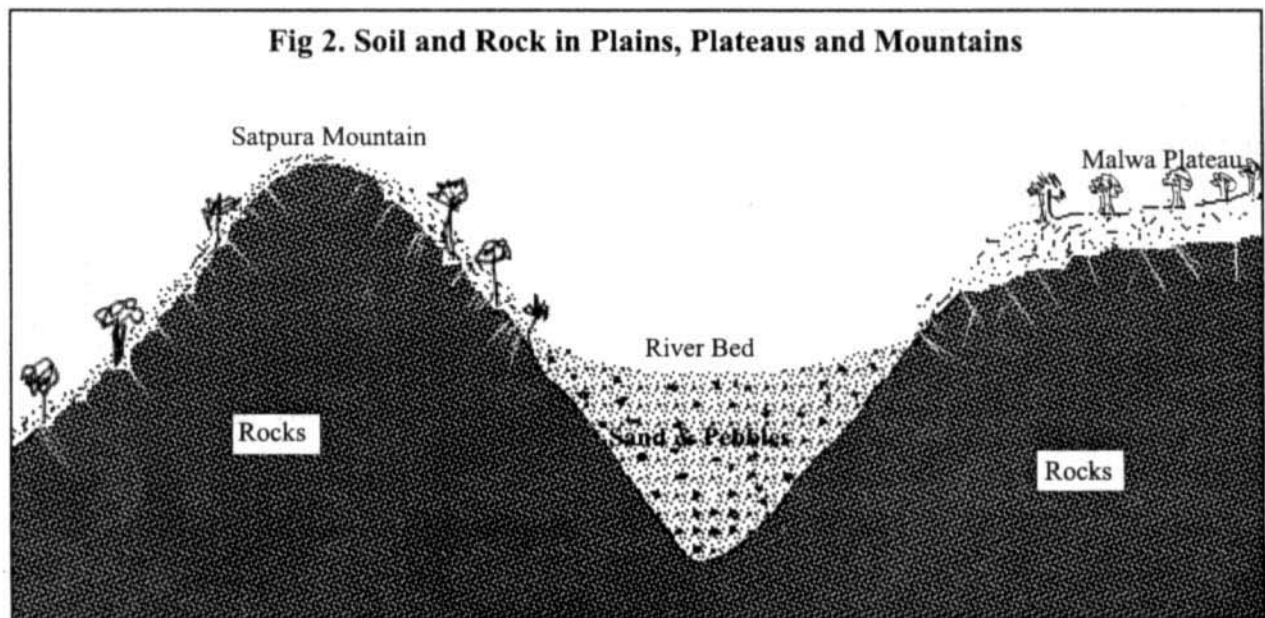
The arrangement of rocks and soil under the ground is not uniform everywhere. Let us see how this affects groundwater.

Abundance of Groundwater in Valleys

In Kotgaon, the village in the Narmada valley, it was easy to dig wells and the farmers

were able to irrigate their fields even in hot summer months. Why do the river valleys and plains have so much groundwater?

Look at figure 1 which shows the Satpura hills, the Narmada valley and the Malwa plateau. You can see that rainwater from the surrounding hills collects in the valley. While



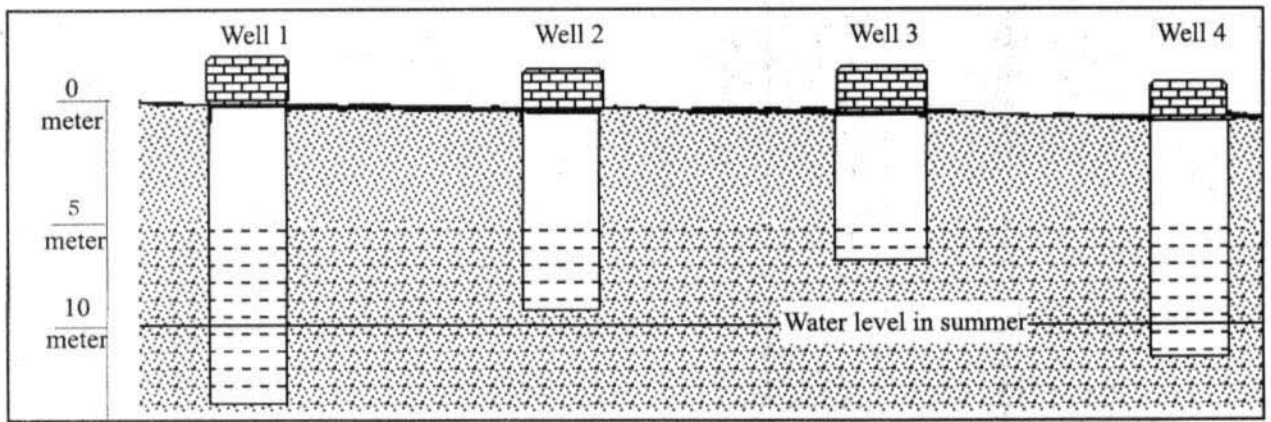


Fig 3 Water Level in the Wells

most of this water flows down the Narmada some of it also percolates into the ground to join the groundwater.

Figure 2 shows the internal structure of the same region. Hard and impervious rocks are not found near the surface in the valleys. Such rocks lie under a large accumulation of sand, silt and pebbles. People who dig bore wells tell us that they do not reach hard rock even at a depth of a thousand feet in the Narmada valley. Rainwater percolates very easily among sand, silt and pebbles. This water accumulates in the gaps between sand particles or pebbles in the ground. It is this which explains the abundance of ground water in the plains and river valleys.

- *Can you explain how the surrounding hills help in increasing groundwater in the river valleys?*
- *How do the sand, silt and pebbles help in increasing the groundwater?*
- *What would happen if the impervious rock in the river valley was nearer to the surface?*

Groundwater in Hills and Plateaus

You may remember that villages like Pahawadi on the hills and Balampur on the plateau are less fortunate with groundwater. You can see in figure 2 that the hard impervious rock is very near the surface of the land on hills and plateaus and the layer of soil is very thin.

Some water accumulates in the cracks among the rocks but this is very little compared to the amount of water that collects in the valleys. This is why the people of hills and plateaus face a groundwater problem.

- *Can you explain the difference in the availability of groundwater in the valleys and hills and plateaus?*

Water Table

Look at the wells in figure 3 carefully. The water level is the same in all these wells. This is the water level in the wells after the rains. You can see that in all these wells water is available at the depth of five meters. This means that if you were to dig a new well in the same region you would strike water at the same depth. This is the level of groundwater, which is also called the 'water table'.

You know that in summer the water level falls and you have to reach deeper and deeper to get to the water. The water table in summer is shown by a continuous line in figure 3.

- *Which of the wells in figure 3 are likely to go dry in summer? Which of the wells will continue to have water?*

Figure 3 showed wells on a level ground. Now we shall look at a situation where the land surface is uneven and undulating. Look at figure 4. You can see two houses on either side of a river. One of them belongs to Lakshmi

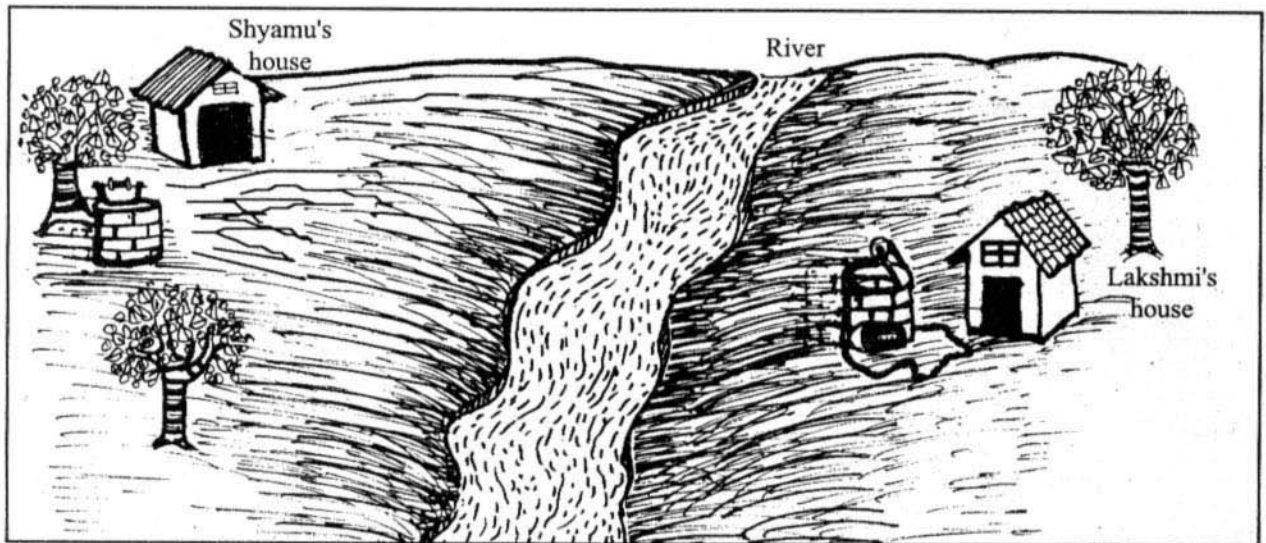


Fig. 4

and the other to Shyamu. Both the houses have a well adjoining them. Even though both the houses are at the same distance from the river, Shyamu had to dig deeper to get to the water in his well whereas Lakshmi did not have to dig so deep. Shyamu was surprised by this. What could be the reason for this difference? Let us look at figure 5, which shows the internal structure of the area.

- *Can you explain to Shyamu why he had to dig deeper than Lakshmi to reach the water table?*
- *You can see that the water table in both the places is the same. But Shyamu's house is situated at a higher ground than Lakshmi's. Had their houses been on the same level then they would have struck water at the same depth. Do you agree with this answer?*

Percolation of water

Figures 3 and 5 showed wells on the plains where ground water is found mainly in sand and gravel deposits underground. Water percolates easily through sand and mud. The larger the grains of sand or soil the faster is the rate of percolation. That is why water percolates faster into sand whose grains are big, and slower into clay, which has very fine particles.

Groundwater is also found in plateaus and hills where the soil/sand cover is thin and there are underground rocks. How does water enter the rocks? Let us study the wells of Balampur, which is situated on a plateau.

In Balampur the underlying rocks are made of red sandstone which is hard and does not absorb water. However, these sandstone rocks have cracks in them and water collects in these cracks after percolating down from the

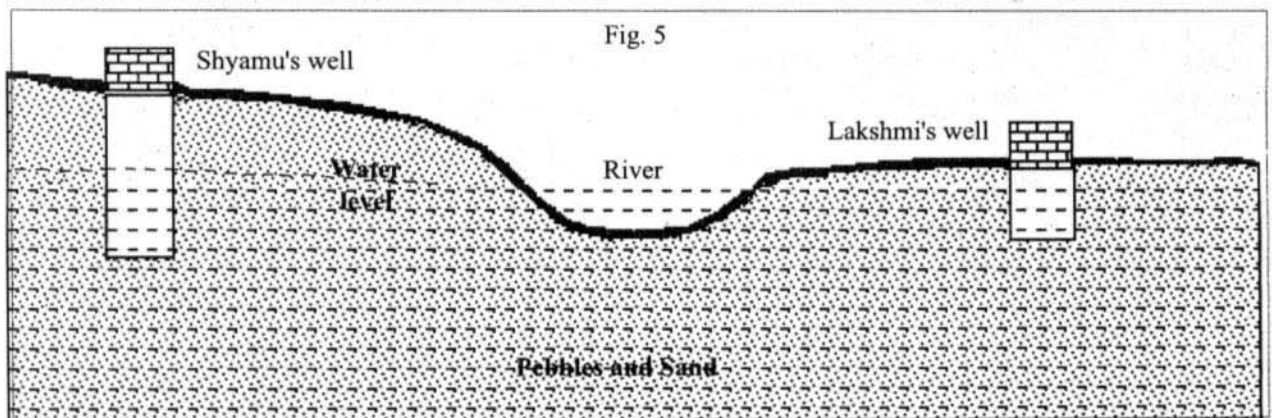


Fig. 5

topsoil. When wells are dug here, it is necessary to reach these cracks to strike water. Water springs forth from the water bearing cracks. This point is illustrated in figure 6 which shows the internal structure of a plateau region, just as you can see the insides of a cake when you take out a slice from the cake. On the top is a layer of soil. Beneath this layer are red sandstone rocks which have joints and cracks between them. Groundwater collects among these joints and cracks. In this figure water has been shown in dark black. These cracks are mutually connected. As a result water from one crack flows into another and more and more water collects in the lower reaches of the rock. The roots of the trees, which grow in these parts draw moisture from these cracks.

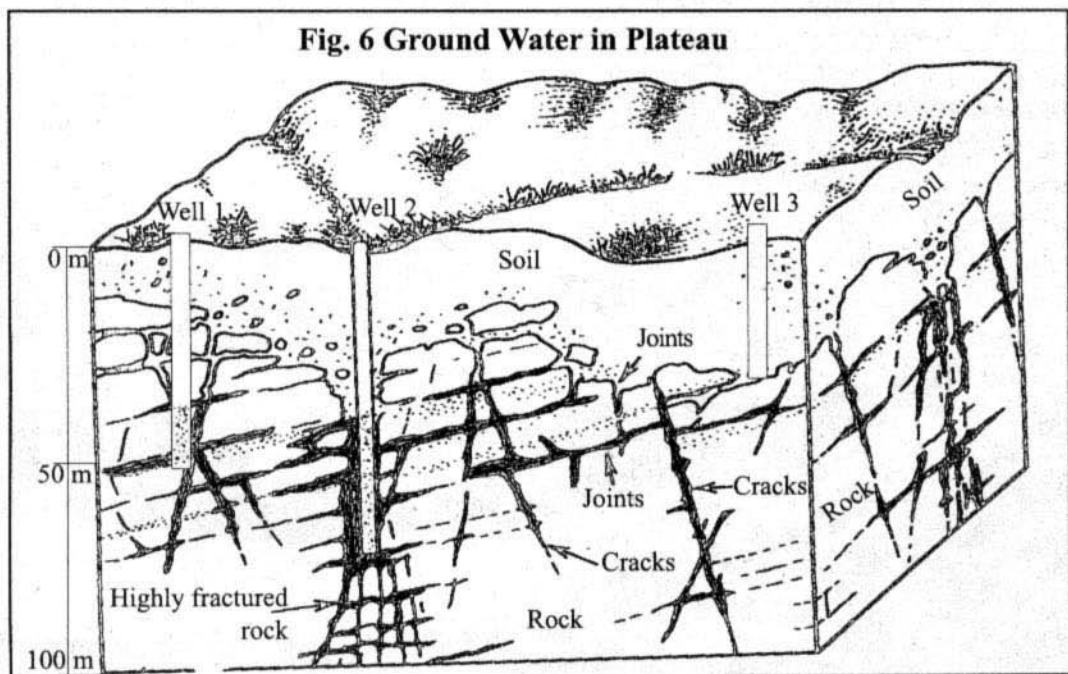
Not all plateaus have sandstone rocks under the soil. Things are a little different in the Malwa plateau near Indore or Dewas. Let us visit a village in this region to see how groundwater is obtained here.

WELLS IN THE MALWA PLATEAU

If you dig a well in Malwa you will find a layer of *murram* beneath the layer of black soil (see figure 7). This layer of *murram* is of varying thickness - it is deep in some places and shallow in others. *Murram* absorbs a lot of water. When the *murram* is full of water, the water percolates beneath this layer to enter the next layer of soft rocks. There is a layer of soft greenish rocks beneath the *murram*. These are porous rocks and they too absorb a lot of water. Under these soft rocks you will find a layer of hard black rocks. These may contain some cracks on the upper side but there are no such cracks at the bottom. These are impervious rocks - rocks which do not allow water to percolate into them. Since water cannot enter them, it collects above them. They, in fact, act like the bottom of a vessel above which any

Look at figure 6 carefully and answer the following questions:

- **In which well are you likely to get more water, in well 1 or well 2?**
- **Why is well 3 dry?**
- **In what way would well 2 benefit from its greater depth?**



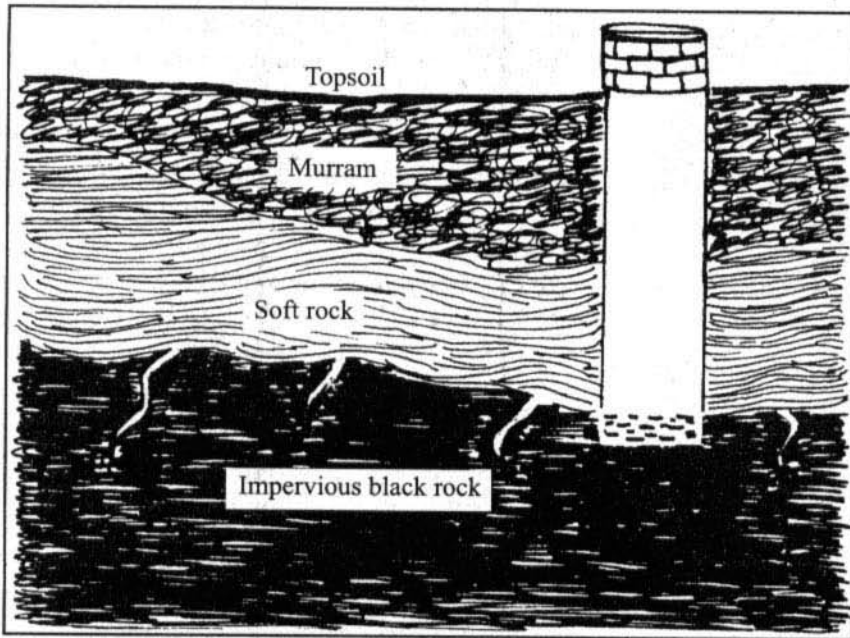


Fig 7. The underground structure in Malwa plateau

liquid can be stored. When digging wells people take care to dig till they reach these rocks so that they can get the maximum amount of water.

Interestingly, even within the Malwa plateau the internal structure varies from place to place. It is not necessary that you find the structure as described in figure 7 in all the villages. The depth of the different kinds of rocks may vary and in some places you may not find a rocky layer at all.

Tubewells

You may have seen people digging bore-wells, also called tube wells. These are drilled deep, cutting into several layers of soils and rocks, both pervious and impervious. That is why digging tube wells is very expensive. However, tube wells give plenty of water.

Look carefully at figure 8. Identify the black impervious rock layers. Water cannot enter into them or percolate into them. However,

there are water-bearing soft rocks beneath these hard rocks. That is why the tube well has been dug across the impervious layer into the lower water-bearing layer.

- *Study figure 8 and answer these questions:*
- *Of the five layers shown in the figure into which layers can rain water enter?*
- *Which of the layers contain impervious rocks?*
- *How does water enter layer D even*

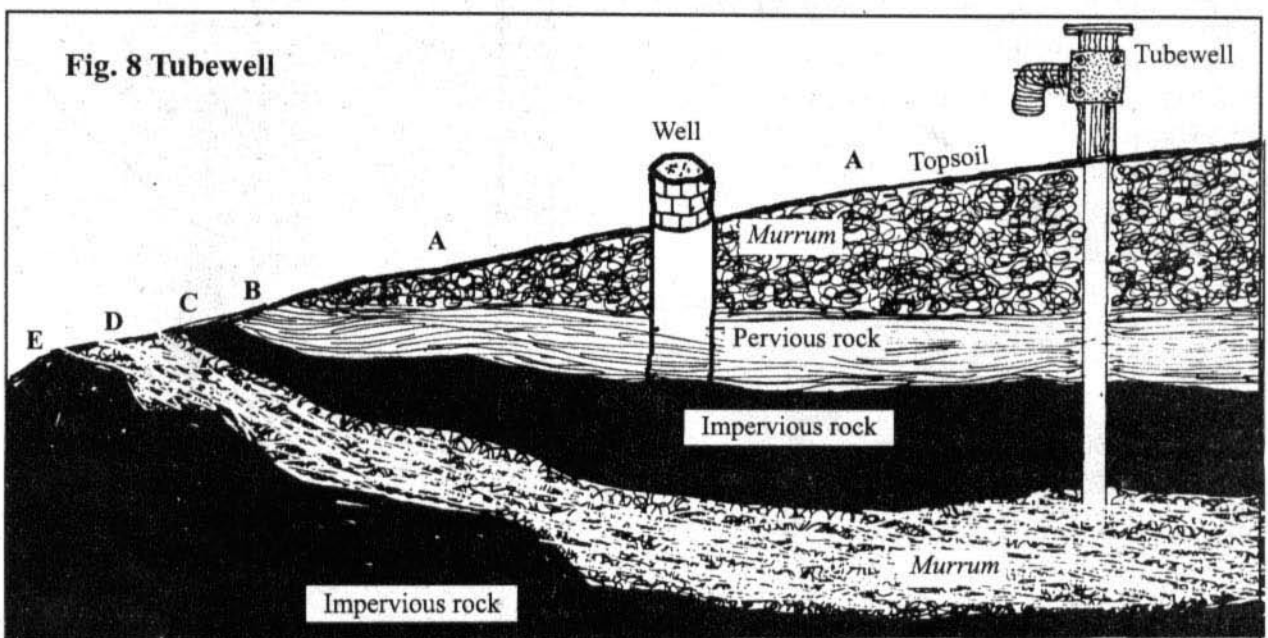


Fig. 8 Tubewell

though it lies under an impervious rock layer?

- *Looking at this picture, can you explain why the tubewell is likely to have more water than the well?*

RECHARGING GROUNDWATER

In our part of the country it rains only for about three to four months. For the rest of the year we are dependent upon groundwater. Rivers, wells and ponds all get their water from these groundwater sources. Can we help to increase groundwater?

You may have noticed that water flows swiftly on naked ground which has no cover of trees or grasses, as there is nothing to stop the flow. Then water quickly flows into streams and into rivers. However if the flow of the rainwater were to be checked by vegetation or *bunds*, then there is a greater possibility of the water percolating into the soil to join the groundwater. That is why vegetation like trees and grasses and *bunds* are used to enhance groundwater. Over the last few years great efforts have been undertaken to 'harvest' rainwater through these means. These measures are usually taken around a stream or river. Hence such efforts are called 'watershed development projects'. Under these projects trees and grasses are planted on the hill slopes from where a stream starts and small *bunds* are built across small *nullahs* and streams to stop the flow of water. Small check dams are also built across streams to store water for a longer time. All this helps to increase or 'recharge' groundwater.

- *Are there any watershed development projects in your area? Try to visit the site and study how it is done. Try to draw a sketch-map of the project area.*

Depletion of Groundwater

If we draw more water from the ground than the water that percolates down, the total

amount of groundwater will decrease over time. Finally there may be little groundwater left for us. This is what has been happening during the last few years. We have been drawing enormous amounts of water through tube wells and pumps to run factories, provide water to cities and irrigate the fields. However the amount of water that percolates into the soil has declined due to cutting down of forests. As a result the groundwater has been decreasing steadily. That is why wells have to be dug deeper and deeper to reach this water.

The problem cannot be solved if one or two persons reduce the amount of water they are pumping out of the ground. This is because all groundwater in a region is connected and the water keeps flowing underground. If too much water is extracted from the ground then all the wells of a region will be affected at the same time. It is therefore necessary that all people in a region come to an understanding about regulating the use of ground water.

Depletion of ground water has become a major problem in Malwa plateau. Increasingly wells are going dry and people have to dig deeper and deeper tube wells. As such, providing even drinking water to the villages and towns is becoming very difficult these days. This problem is not unique to Malwa as it is also being faced across the country.

- *Do you think it is permissible for any farmer or factory owner to pump out as much water as he pleases from his tube well? What will be the consequences of such action?*
- *What steps do you think need to be taken to address this problem?*

Excess of Groundwater

So far we have been reading about shortage of groundwater. Excessive ground water also poses problems in many regions. In Hoshangabad district a dam has been built across the river Tawa. The dammed water is taken to villages through canals. Due to seepage

from these canals and over-irrigation, the level of groundwater has risen in several villages. In these villages we can scoop out water from the wells with just our hands! Due to the rise of groundwater level agricultural land has become marshy and uncultivable. Excess groundwater also causes many other problems like salination of soil, contamination of drinking water, etc.

• *Find out more about these problems with the help of your teacher.*

Why is Water from a Well Pure?

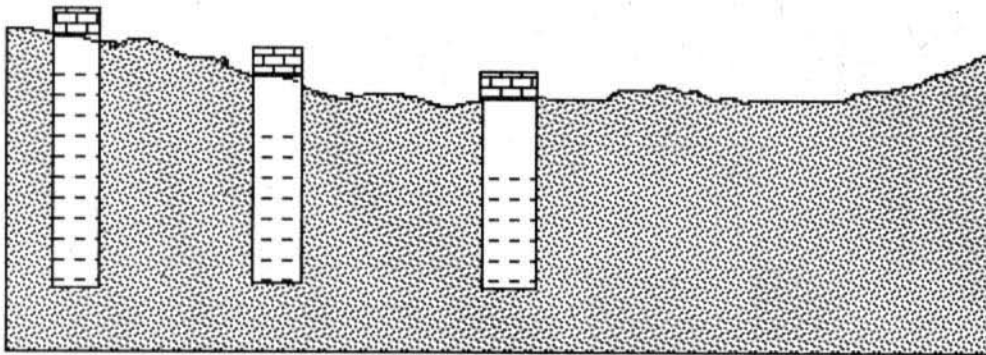
Even when water is available from tanks and rivers, people prefer to drink well water. Do you know the reason? A lot of dirt and decomposing matter mixes with the river and tank water. On the other hand, when water percolates through the ground it passes through sand and mud which act as very fine filters, purifying the water in the process. That is why well water is pure.

EXERCISES

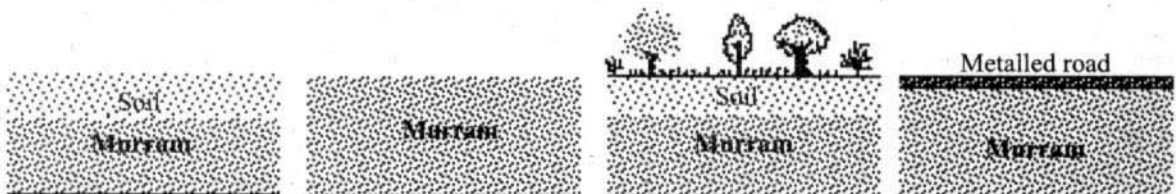
1. Correct the incorrect sentences:

- i. Water flows from the plains to the plateau.
- ii. There is a thick deposit of sand and gravel in the plains.
- iii. According to figure. 3 the summer water level is below 5 meters from the ground.
- iv. It is easy to dig wells in Balampur.

2. The wells shown in this figure are situated on the plains of the Narmada. But there seems to be a mistake in the figure. Can you correct it?



3. Write eight sentences about the Narmada valley on the basis of figure 1 and 2.
4. Discuss the difference between digging a well in the Narmada valley and in the Malwa Plateau.
5. In several places in the Malwa plateau water is to be found beneath a layer of black impervious rock. How is this possible - explain in your own words.
6. In which of these places do you expect maximum percolation to take place?



7. When the owners of some wells in Pipalakhedi started using high-powered motors to draw water from the wells, the owners of the other wells noticed that their wells were drying up. Discuss the possible solutions to this problem.
8. In areas where there is shortage of groundwater, should there be any restriction on digging tube wells?