Importance of Dry Season Recharge for Maintaining Environmental Underflow in Hard Rock Terrain in India

By

Dr Shrikant D. LIMAYE

Director, Ground Water Institute

Pune, INDIA

Project Leader,

UNESCO-IUGS-IGCP

Project no. 523: "GROWNET "

<limaye@vsnl.com>

PROBLEM

INDIA HAS 2.5% OF TOTAL GEOGRAPHICAL AREA OF THE WORLD AND ONLY 6% OF WORLD WATER RESOURCES,

BUT

IT IS SUPPORTING 16% HUMAN POPULATION AND 18% OF THE GLOBAL LIVESTOCK POPULATION.

67% of geographical area is occupied by Hard Rocks and 30% of Hard Rock area is in semi-arid zone.

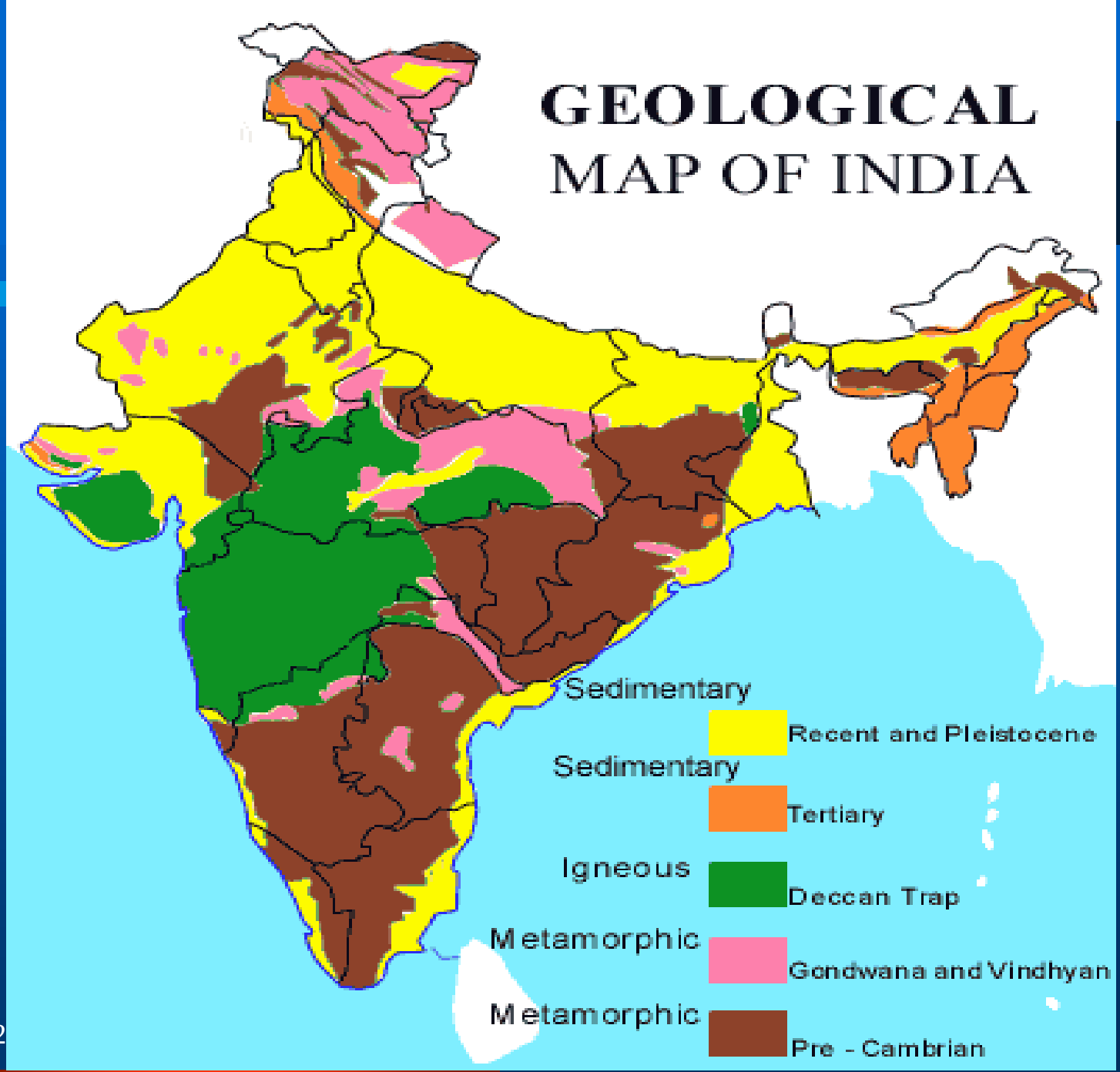
Proper management of surface water and ground water is therefore a prime necessity.

The hard rock aquifers in Monsoon climate, as in India, have certain special features:

1) Surface water divide coincides with ground water divide.

i.e. Ground water flow does not take place under surface water divides.

A watershed is therefore, taken as ‘Unit of planning of ground water development’.


GEOLOGICAL
MAP OF INDIA
Sedimentary
Recent and Pleistocene
Sedimentary
Tertiary
Igneous
Deccan Trap
Metamorphic
Gondwana and Vindhyan
Metamorphic
Pre - Cambrian

2) The depth of ground water occurrence, in useful quantities, is usually limited to a hundred meters or so.

3) The saturated portion of the mantle of weathered rock, alluvium or laterite, overlying the hard fractured rock, often makes a significant contribution to the yield obtained from a dug well, a bore well or a dug-cum-bore well, either directly or through the fissure network within the hard rock..

Fig. 1

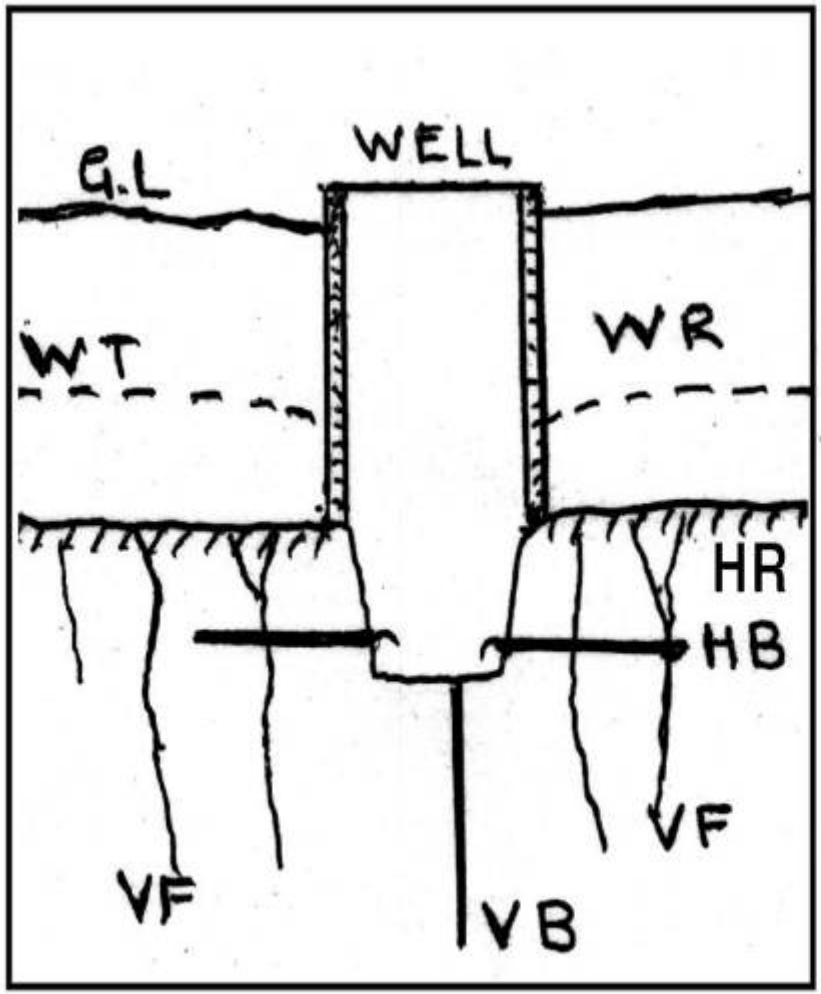


Fig. 2

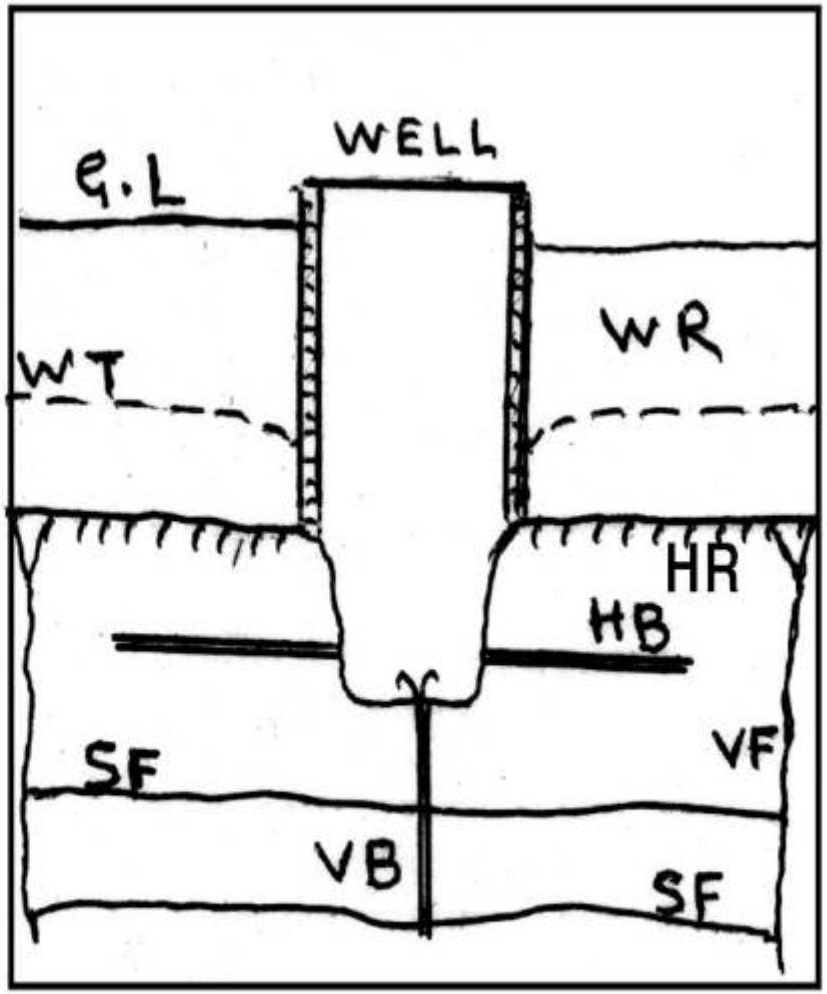


Fig. 1 & Fig. 2 : GL - Ground Level, HB. - Horizontal Bore, HR - Hard Rock SF - Sheet Fracture or joint, VB - Vertical Bore, VF - Vertical Fracture, WR - Weathered rock, WT - Water Table

4) Only a modest quantity of ground water, in the range of “one cu.m. up to 100 cu.m. or so” per day, is available at one spot. Drawdown in a pumping dug well or bore well is often almost equal to the total saturated thickness of the aquifer.

5) Ground water recharge from rainfall is available only during 3 to 4 months of Monsoon rains, (June to September).

This storage gets depleted in the post-Monsoon prolonged dry period of winter (October-January) and summer (February to May), due to pumpage from dug-wells / bore wells and due to dry-season underflow of ground water below the stream bed.

In hard-rock regions, especially in semi-arid zones, the stream-flow stops within a few weeks from the Monsoon rains. Afterwards, the streamside ecosystem of phreatophytic trees and irrigated farms totally depends upon the UNDERFLOW of ground water in the sand, alluvium, and weathered rock below the stream-bed & near the stream bank.

This vulnerable ecosystem in the central valley portion by the streamside, comprising trees, bushes, nesting birds, grazing animals, irrigated farms, fruit trees, and tiny villages is the only greenery & life in an otherwise dry and barren post-Monsoon landscape.

Protection and Augmentation of the underflow below the stream-bed is therefore, a prime necessity for sustainability of this ecosystem and for survival of the people and cattle within the ecosystem..

Quantitative aspect for underflow:

1 liter of water is required to grow food grains which supply ONE food calorie.

Daily 3,000-5,000 lit of water/capita.

Dry season underflow should support a part of this requirement PLUS 70 lit/capita for domestic use.

AIM:

To increase recharge/rainfall ratio in the Watershed so as to augment underflow

BY:

(A) Undertaking activities during the Monsoon (rainy) season and

(B) Storing runoff during rains for the post-Monsoon recharge in dry season.

ACTIONS spread all over the watershed:

Soil and water conservation techniques like hill-slope trenching, contour bunding of farms, excavation of farm ponds, constructing small stream bunds, etc. to check velocity of runoff and promote recharge during the Monsoon rains.

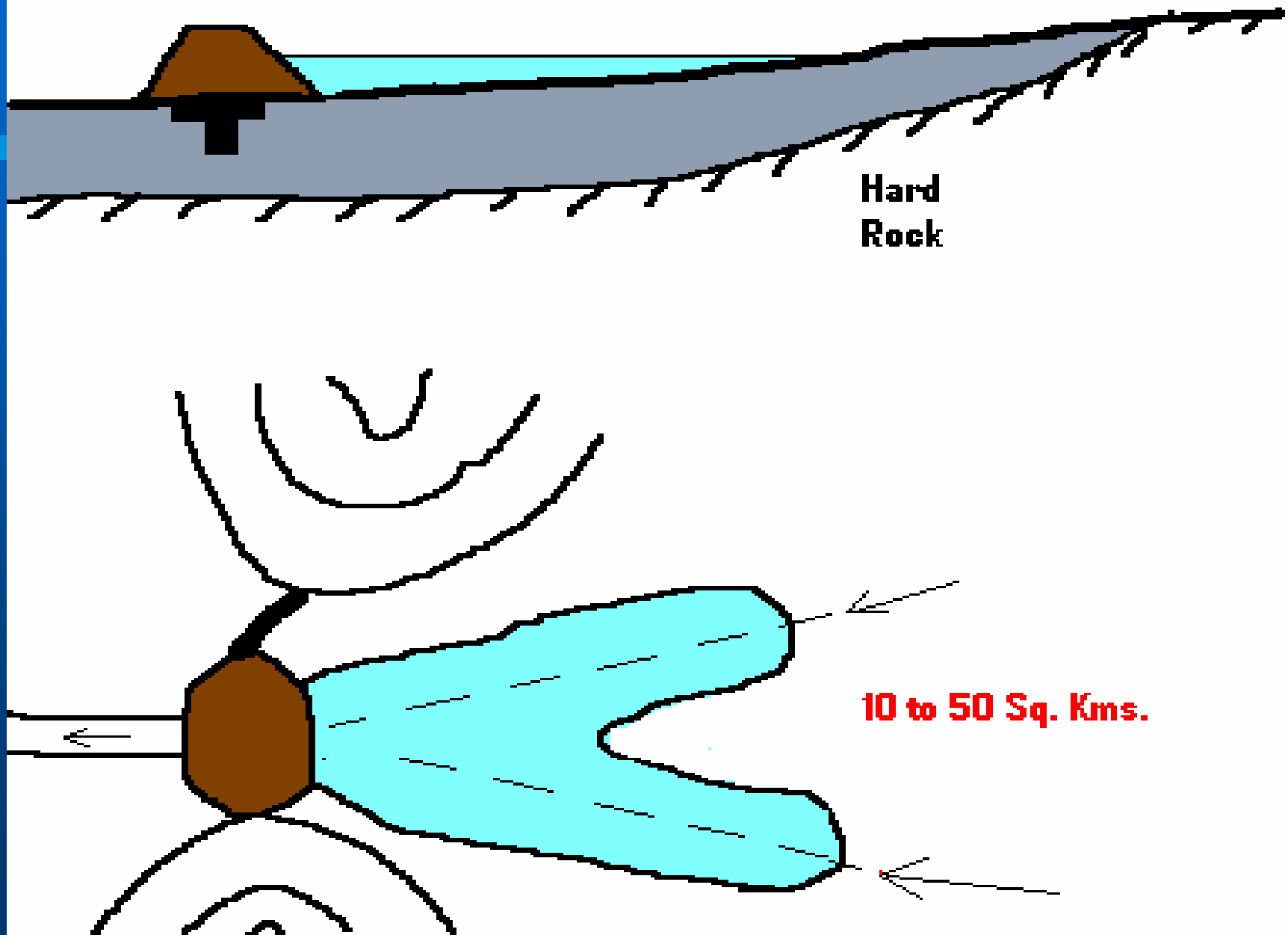
But there is a limit to recharge augmentation during the Monsoons.

Recharge to ground water during post-Monsoon winter season (October-January) is what the Ecosystem demands.

Construction of Percolation Tanks is the preferred solution:

1. Catchment area : 10 to 50 sq kms for storing Monsoon runoff.
2. Size: Usually 50 m to 150 m long and about 6 to 8 m in height.
3. In a drought year, it can provide employment for 1,000 to 1,500 villagers for 6 to 8 months.

A Typical Percolation Tank



Reservoir Efficiency (R.E) = Stored Runoff / Available Runoff (About 70 to 80 %)

Percolation Efficiency (P.E) = Water Recharged / Stored Runoff (About 35 to 50%)

Overall Efficiency = R.E x P.E

A typical Percolation Tank costs between US$ 50,000 to 100,000 and can employ up to 500 people for 4 to 6 months.

BEFORE

Villagers engaged in watershed work

9/6/2007

Continuous Contour Trench

AFTER Plantation

CONCLUSIONS:

* In hard rock regions in India, especially in semi-arid zones, the environmental flow is NOT the surface water flowing in a stream, because the flow of surface water in the stream exists only for a few days in a year.

The streamside ecosystem, therefore depends on the ***UNDERFLOW.***

* Sustainability of the Streamside Ecosystem comprising trees, bushes, nesting birds, grazing animals, irrigated farms, fruit trees, and tiny villages is related to augmentation of underflow, which in turn depends upon the augmentation of recharge, especially the dry season recharge, to ground water body within the watershed.

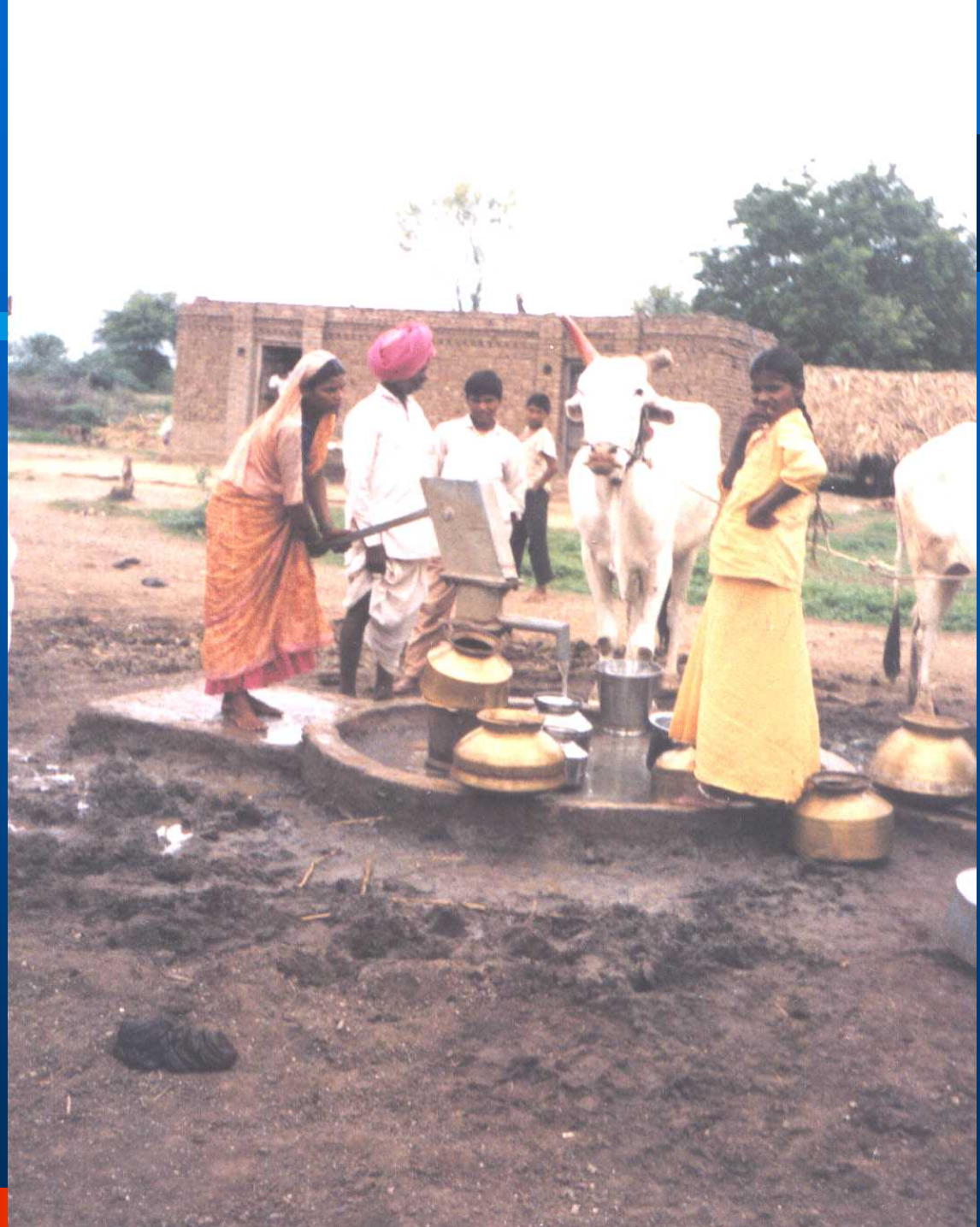
*Small water storages or percolation tanks created in the mini-watersheds by constructing bunds across streams and gullies, store runoff water during the Monsoon season and cause recharge to ground water during the next few months of dry season.

* However, by February or March the tank should be dry, so that the water body is not exposed to high rates of evaporation in summer months.

* Whatever quantity percolates from the Tank between October and March is available as underflow on downstream side of the tank even in summer months.

* Treatment of catchment area is necessary for reducing the silt-load coming into a Percolation Tank.

* However, accumulation of silt takes place slowly and de-silting of the bed of percolation tank is necessary from time to time, for maintaining its reservoir efficiency and percolation efficiency. A well maintained percolation tank increases underflow and even in summer season, scarcity of drinking water is not felt in the valley.



"GROWNET: Ground Water Network for best practices in ground water management in low-income countries" is a project sponsored by UNESCO & IUGS
as IGCP Project no. 523.
I am the Project Leader of this Project.

Please visit our website:

www.igcp-grownet.org

GROWNET recognizes construction of Percolation Tanks as one of the 'best practices' in augmentation of recharge to ground water.

THANK YOU

Visit our Website: www.igcp-grownet.org

A Request:

Due to my impaired hearing,

I request that any Question on this presentation be kindly written on Paper and given to the Session's Chair.

THANKS.