Govt. of Chhattisgarh

Manual on Design of Artificial Recharge Structures in Chhattisgarh

conceptualize & compiled by
Er O P Mishra & Er Akhlesh Verma

Water Resources DepartmentGovernment of Chhattisgarh
Sihawa Bhawan, Civil Line Raipur Chhattisgarh Pin – 492001

छत्तीसगढ़ में – पानी रोको अभियान
जलधारा धरातल से रसातल तक

WATER

How important is water as a commodity?

Water is a basic human right. Water is the essence of life. Without water human beings cannot live for more than a few days. Water plays a vital role in nearly every function of the body, protecting the immune system, the body's natural defenses and helping remove waste matter. water is essential for all living beings.

ARTIFICIAL RECHARGE

- ARTIFICIAL RECHARGE TO GROUND WATER IS A PROCESS BY WHICH THE GROUND WATER RESERVOIR IS AUGMENTED AT A RATE EXEEDING THAT UNDER NATURAL CONDITION OF REPLENISHMENT

Principle of artificial recharge – one which is running make it to walk, one which is walking make it to stop,& one which is stopped allow it to percolate it in to the ground.

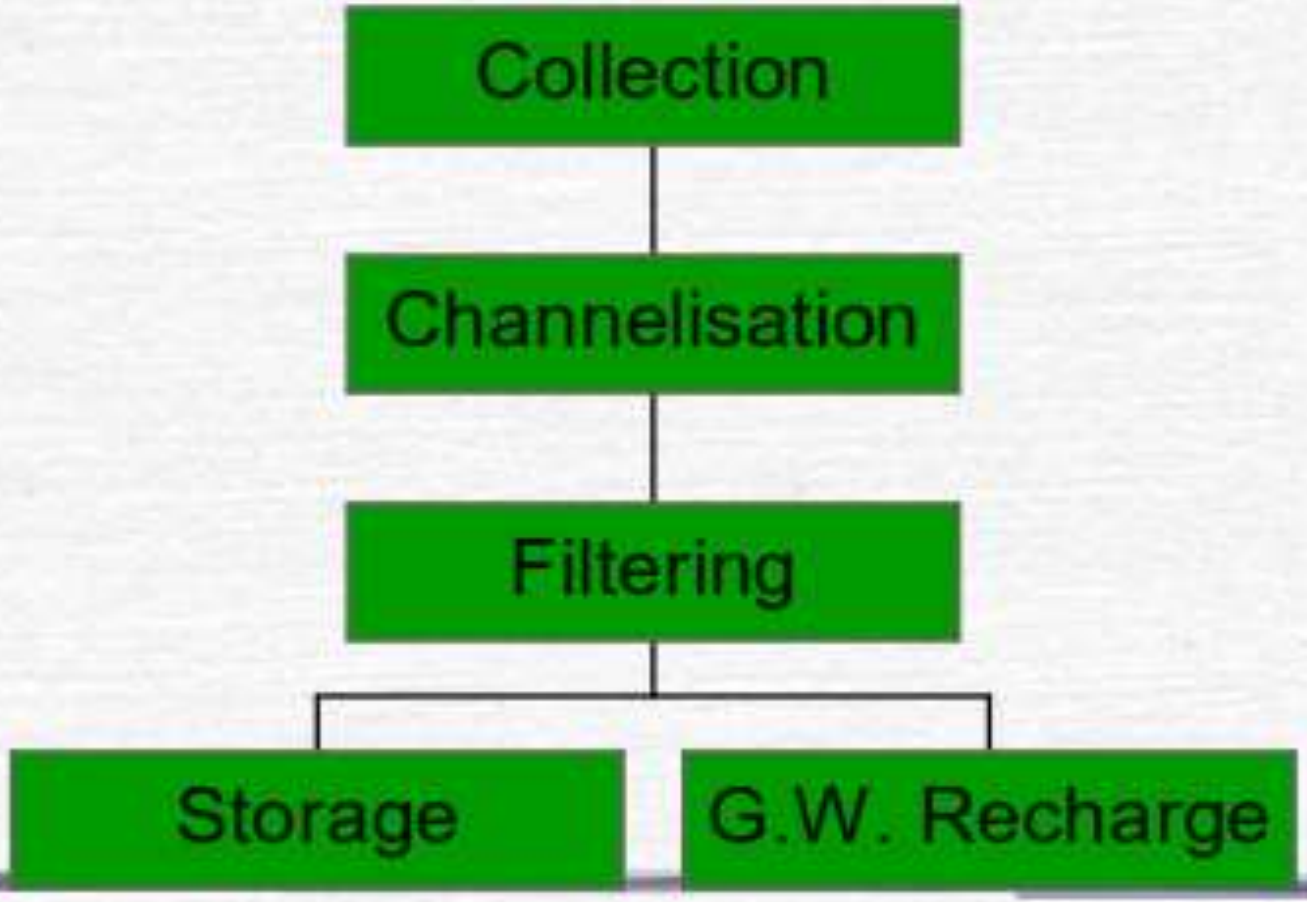
INFILTRATION

STORAGE

RUNOFF

Rainfall in India: 4000 bcm
Storage of India: 300 bcm
Infiltration: 10%(400 bcm)
Run off: 3300 bcm(>80%)

Various stages of rainwater Harvesting



What is rain water harvesting?

Rain Water Harvesting can be defined as the process of collecting and storing Rainwater in a scientific and controlled manner for future use. It is the principle of collecting and using precipitation from a catchment's surface.

Rain water would be the immediate resource to augment the existing water supply system by "catching water where ever it falls"

Water in India – Global Secnario

India is having good fresh water resources and favorably placed when compared to several other countries in the world. However due to the huge population the per capita availability of fresh water would soon make the country as a water stressed nation. India has a land area of 2.2% of global land area, supporting 17% of the world population. The present per capita annual fresh water available in the world is estimated as 6935 cubic meters per head per year. The corresponding figure in India is about 1700 cubic meters per head per year. Though India had fresh water resources of 5277 cubic meters per head per year in 1955, it got reduced to a level of about 1700 due to the increase in population during the past 59 years. According to the United Nations norms, any country having fresh water resources above 1700 cubic meters per head per year is classified as satisfactory. Any country less than 1700 is classified as water stressed. If it is less than 1000, it is classified as water scarce nation. Presently India is in the border of being declared as water stressed country. This can be avoided by controlling the population increase and artificial recharge of ground water.

India's Land Resource, Irrigation and Food Production

India has 2% of world's land, 4% of freshwater, 16% of population, and 10% of its cattle.

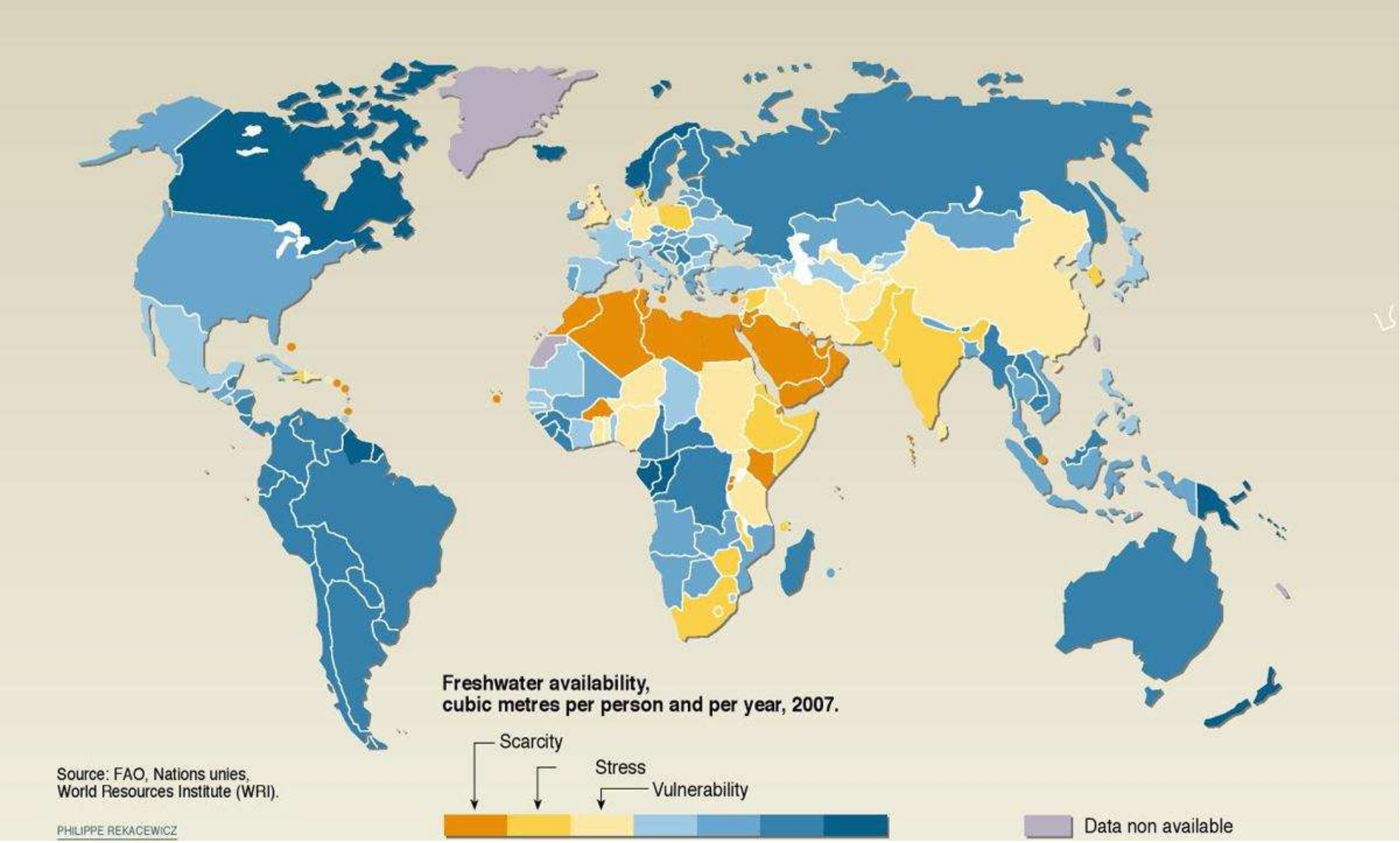
Geographical area = 329 Mha of which 47% (142 Mha) is cultivated, 23% forested, 7% under non-agri use, 23% waste.

Per capita availability of land 50 years ago was 0.9 ha, could be only 0. 14 ha in 2050.

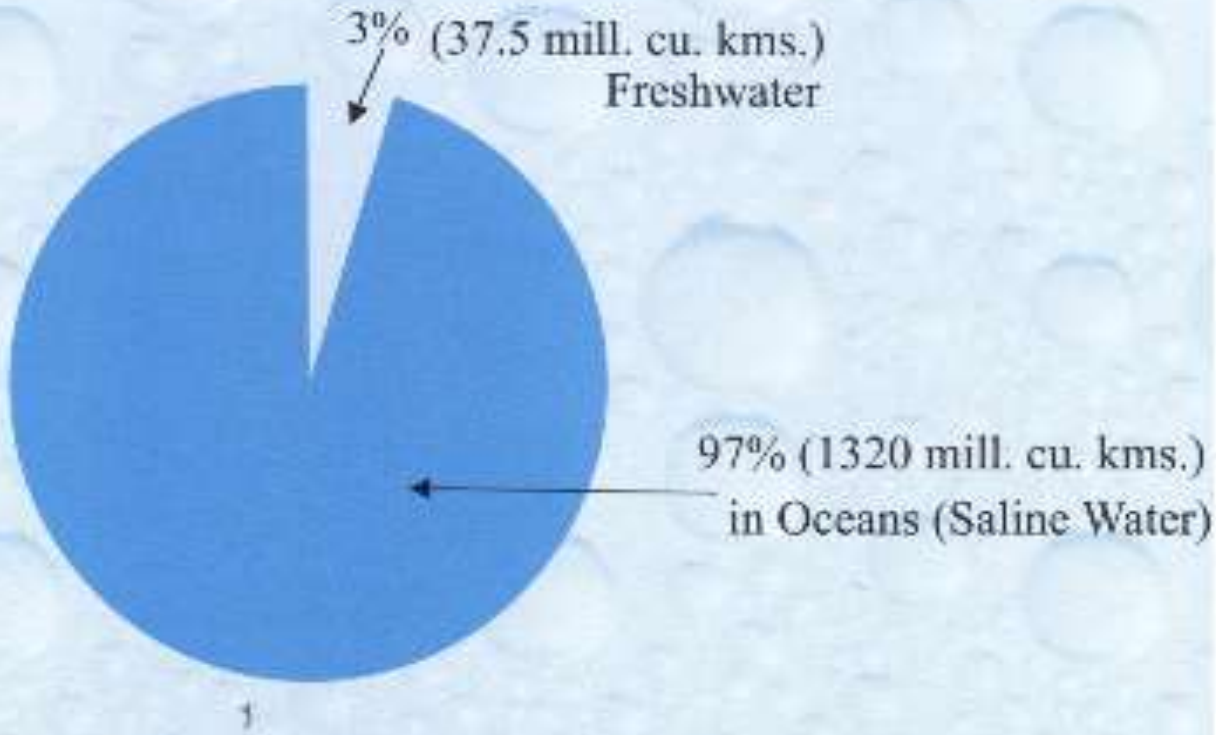
Out of cultivated area, 37% is irrigated which produces 55% food; 63% is rain-fed producing 45% of 200 M t of food.

In 50 years (ultimate), proportion could be 50:50 producing 75:25 of 500 M t of required food.

Fresh Water Availability

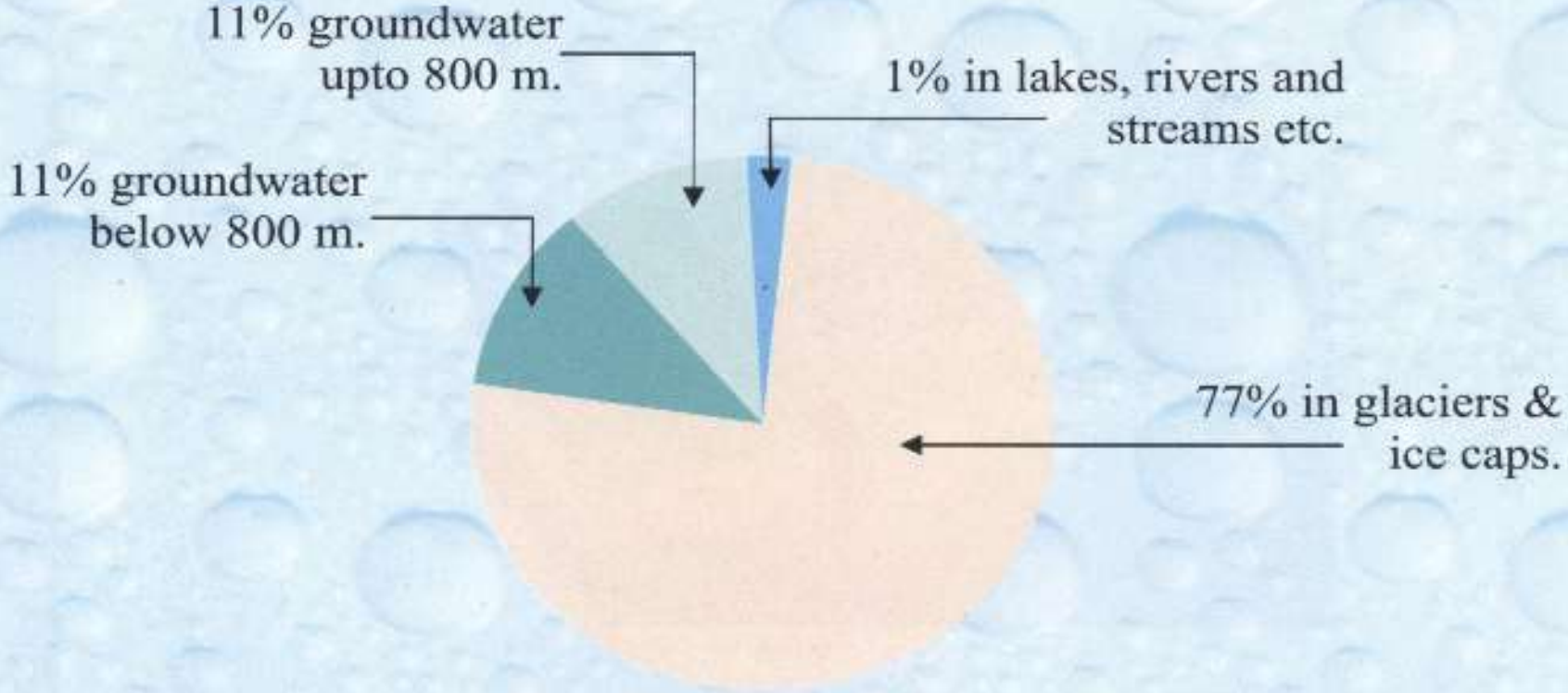


TOTAL WATER ON EARTH

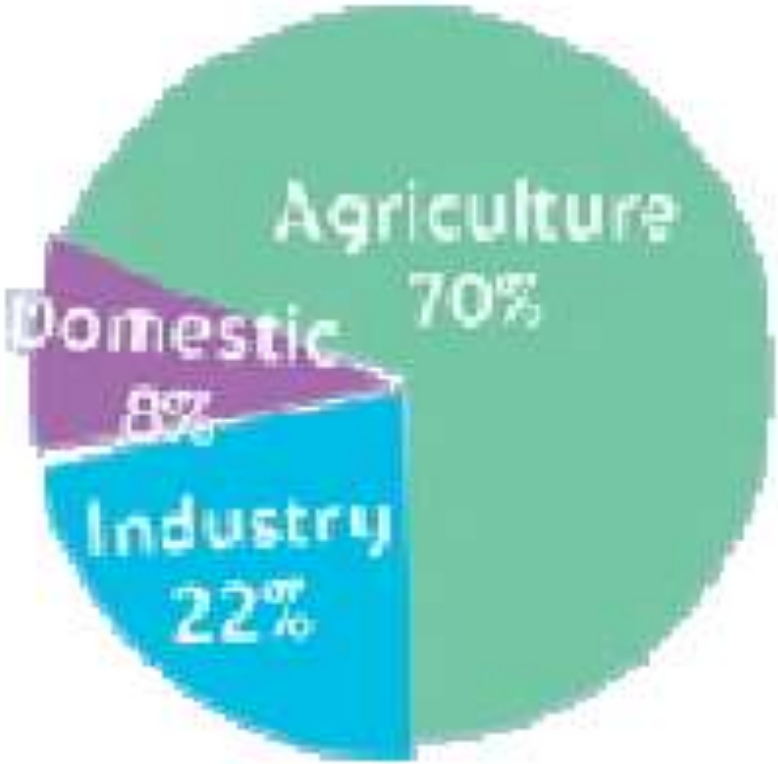


of the total water on earth only 3% constitutes freshwater.
Rest is saline water in the oceans.

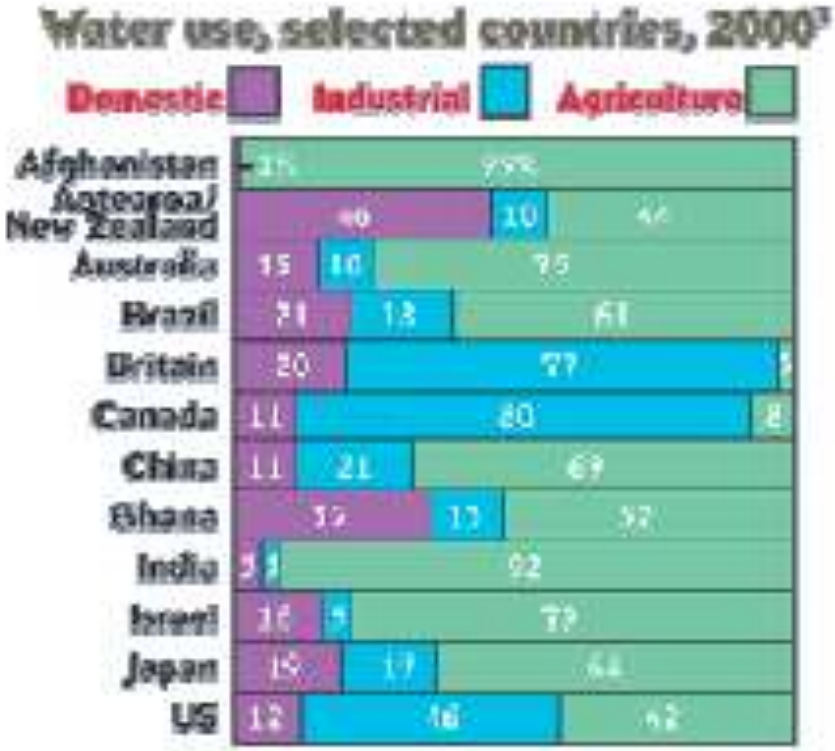
DISTRIBUTION OF FRESH WATER ON EARTH



- 11% of the total freshwater on earth is groundwater available upto a depth of 800m which can be extracted for use.
- Mindless extraction and over exploitation of very small quantity of this precious nature resource has caused a rapid depletion and deterioration in its quantity and quality both.



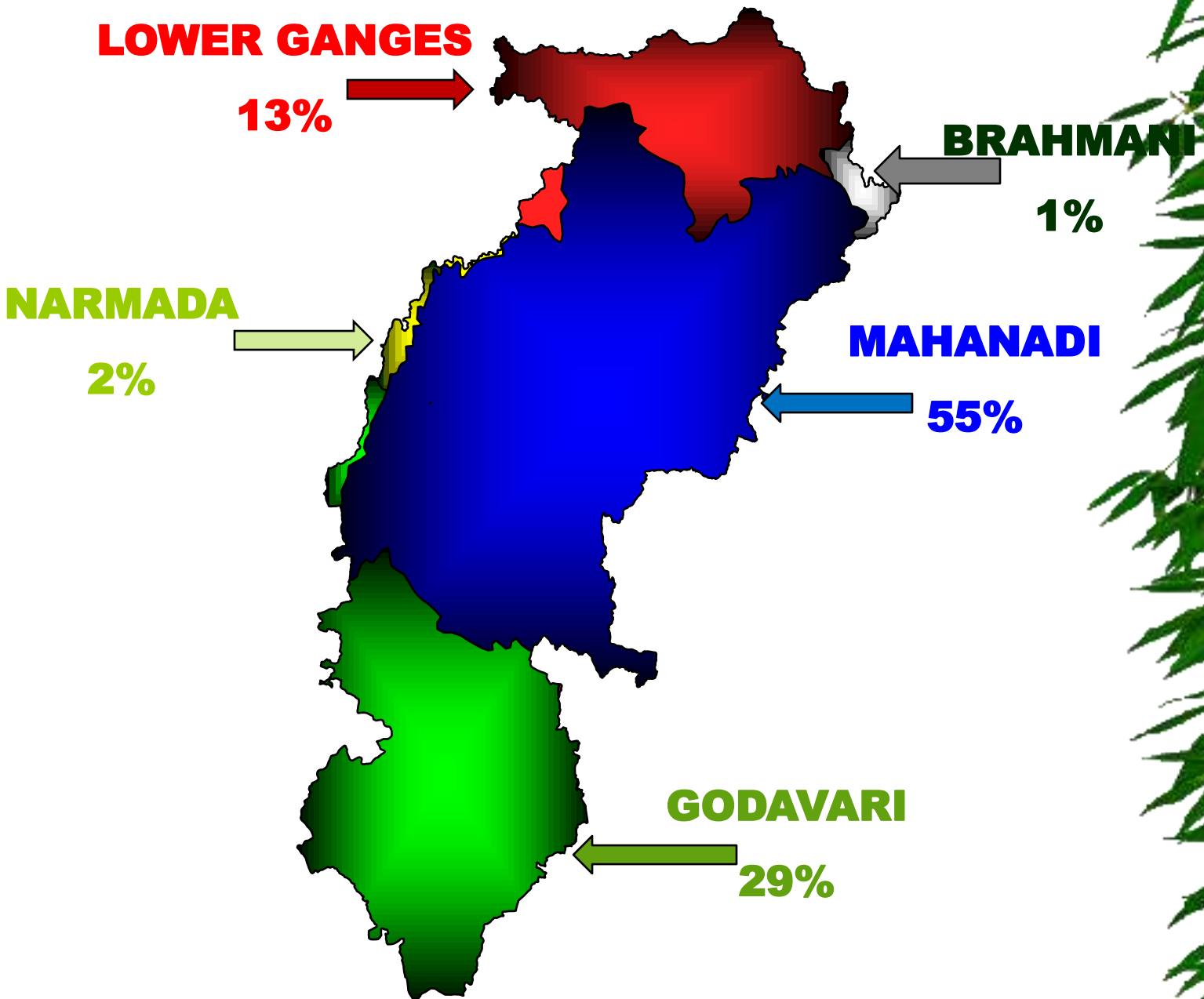
World water use[2]



CLASSIFICATION OF WATERSHEDS IN CHHATTISGARH

S.No.	Class	No.	Area(Ha)
1.	Region	3	250 lacs-10 crores
2.	Basin	5	30-250 Lacs
3.	Catchment	9	10-30 Lacs
4.	Sub Catchment	36	2-10 Lacs
5.	Watershed	170	50,000 to 2 Lacs
6.	Sub- Watersheds	665	10,000 to 50,000
7.	Milli-Watersheds	2,349	1,000 -10,000
8.	Micro-Watershed	17,623	500-1,000

BASIN MAP OF CHHATTISGARH

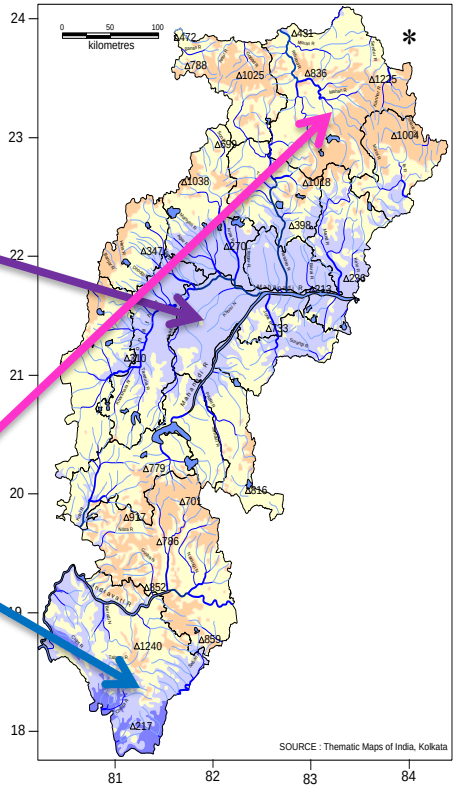


DRAINAGE MAP OF CHHATTISGARH

- Mahanadi & its tributaries like Seonath,Hasdeo, Mand, Arpa,etc.drains the central part.

- Tributary of Godavari like Indravati drains the Southern part.

- Tributaries of Ganges like Son, Gopad, Rihand etc. drains the northern part of state.

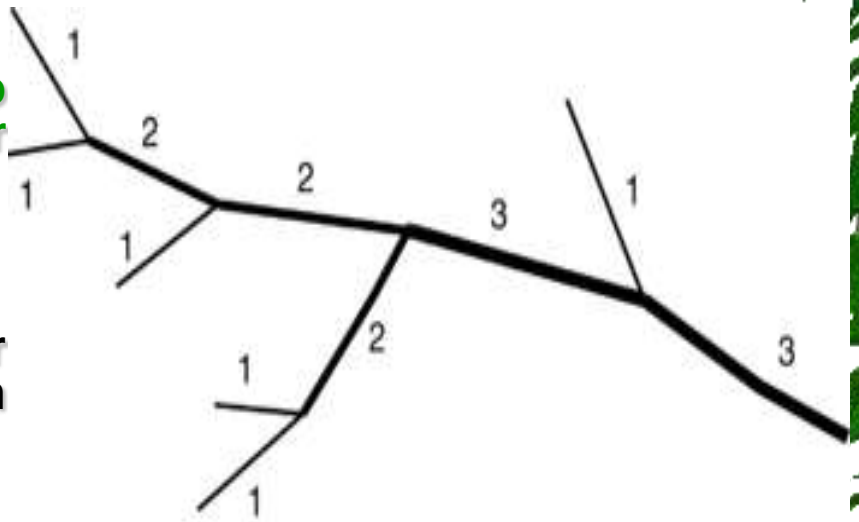


ORDER 0F STREAMS

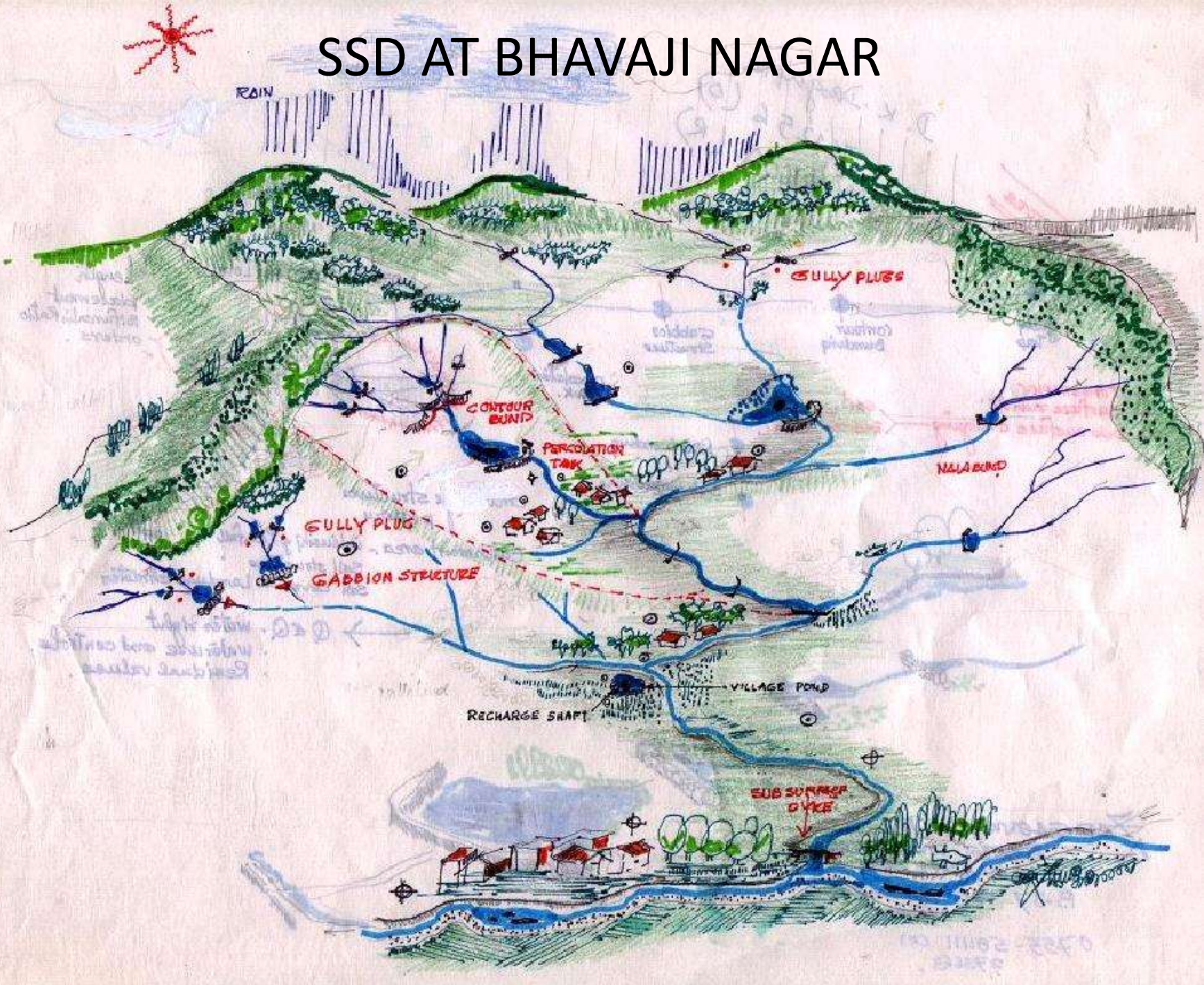
- **First Order Stream: A Stream Which does not have any other stream feeding in to it.**

- **Second Order Stream: When two first order streams join together they form second order stream.**

- **Third Order Stream:**
  When two Second order streams join together they form Third order stream



SSD AT BHAVAJI NAGAR



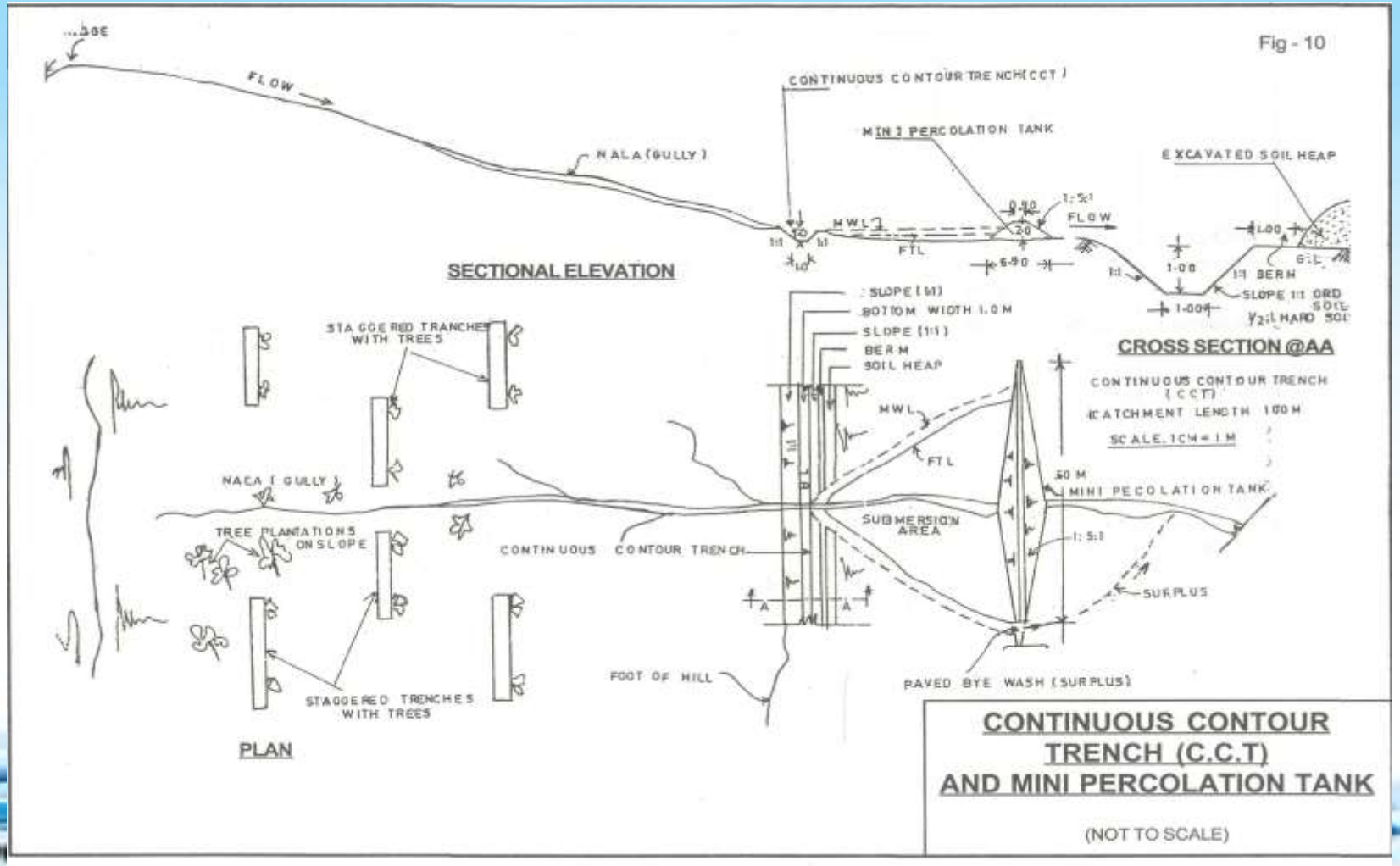


Fig - 10
FLOW
NALA (GULLY)
CONTINUOUS CONTOUR TRENCH (CCT)
MINI PERCOLATION TANK
EXCAVATED SOIL HEAP
MWL
FTL
FLOW
SECTIONAL ELEVATION
SLOPE (1:1)
BOTTOM WIDTH 1.0 M
SLOPE (1:1)
BERM
SOIL HEAP
1:1 BERM
SLOPE 1:1 ORD SOIL
HARD SOIL
CROSS SECTION @AA
CONTINUOUS CONTOUR TRENCH (CCT)
CATCHMENT LENGTH 100 M
SCALE 1CM = 1 M
STAGGERED TRANCHES WITH TREES
NACA (GULLY)
TREE PLANTATIONS ON SLOPE
CONTINUOUS CONTOUR TRENCH
SUBMERSION AREA
MINI PECOLATION TANK
SURPLUS
FOOT OF HILL
PAVED BYE WASH (SURPLUS)
STAGGERED TRENCHES WITH TREES
PLAN
CONTINUOUS CONTOUR TRENCH (C.C.T) AND MINI PERCOLATION TANK
(NOT TO SCALE)

•**Objectives of Check Dams :**

The purpose of check dam construction in minor irrigation sector may vary with type of dam, size of dam, location and requirement of government and local community. Considering the topography, width of water courses, possible detention or storage or diversion structures, broadly the purpose may be classifies into following two categories :

In upper part of stream, harvesting rain water and run off during monsoon to-

•Minimize peak run off volume and velocity in stream, reducing soil erosion,

•Create an impounding of water in up stream,

•Facilitate infiltration of water into sub surface and recharging ground water.

•Increase sub surface flow and increased months of availability of water in the stream.

•Promote gravity flow irrigation by diverting water into farmer's field either by underground PVC pipeline or diversion channels.

In middle or lower part of stream, harvesting stream flow and sub surface flow to -

•Harvest surface flow of stream going out of catchment and command area during monsoon and off monsoon period.

•Create impounding of water in upstream of dams for irrigation, domestic and other use.

•Site conditions for small Dams:

Following are the preferred site condition for small check dams in upper or middle or lower' part of the stream:

•A narrow, U - shaped, straight section in the stream.

•Availability of space for impounding water in upstream.

•Availability of minimum width of waterway of the stream.

•Prevalence of high firm embankment

•Site for spillway or diversion channel on either side of the dam in upper part of the stream (if required)

•Adequate Cultivable Command Area on either / both side of dam

•Minimum submergence of cultivable area

•Community accessing and using that section of the stream for their current uses

Considering the topography, rainfall pattern in the state, broad framework of AIBP and requirements of the state and local community, three structures namely (contour trench gully plug,gabians)Boulder Check dam, Earth dam and Masonry check dam are proposed to be constructed in upper, middle and lower parts of the stream respectively. The details of each structure have been dealt in subsequent pages

Boulder Check Dam

The boulder check dam is a small check dam made of boulders locally available and considered as a method for drainage line treatment. These are made in series on seasonal streams in ridge area of the stream. It arrests silt fully, water temporarily and allows water to flow at a decelerated velocity through and over the dam section.

5.1 Technical and Site Considerations:

i. Suitable in upper ridges, where the stream section has depth up to 3 meters and width up to 6 meters.

ii. Stream bed slope less than 20%,

iii. Availability of firm embankment on both the sides of the stream.

iv. Availability of boulders in the vicinity

v. Distance between two successive boulder check dam should be less than 50 meters, one series is effective for catchment area less than 50 hectares,(Distance depends on the slope of the stream

Functions of Boulder Check Dam:

Reduces the speed of run off during monsoon peak flow.

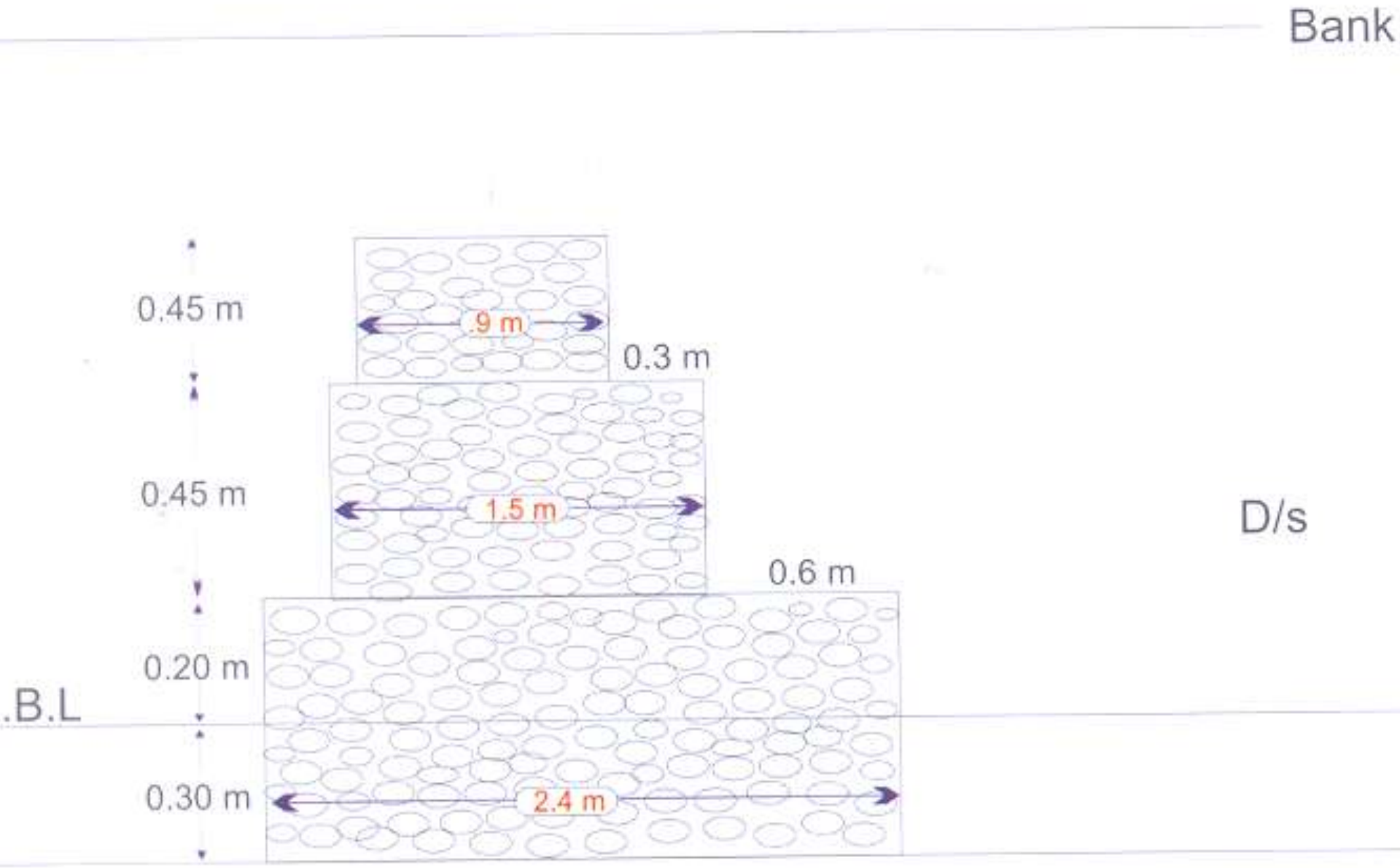
Checks soil erosion.

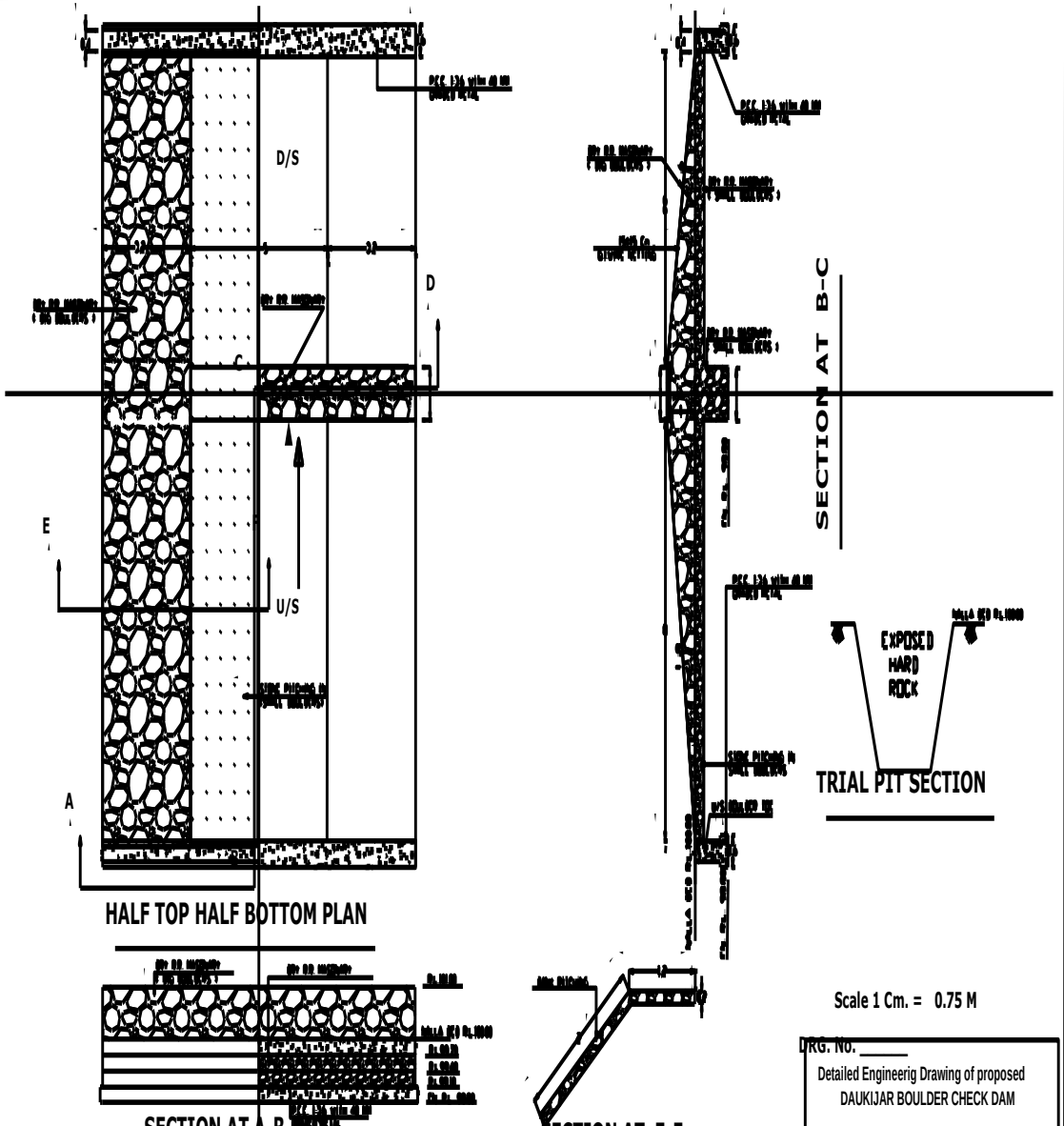
Checks silt of flowing water and reduces siltation in the downstream reservoirs.

Rejuvenates water flow, increases duration of surface flow in the stream and thereby prolonging the recharging time in downstream wells and other water bodies

1. Design and Layout:

The boulder check dam, being the harvesting structure, it's height above the gully is generally kept between 1.2 to 2.5 meters. The length of the check dam shall be equal to the water ways plus 0.50 meter on both sides, embedded in the embankment. The depth of foundation below the stream bed is provided between 0.30 to 0.75 meters. The top width is kept 0.6 to 0.9 The slope in downstream is kept more gradual so as to minimize the impact of water which flows over the dam. The height of dam embedded in the embankment is always more than the height of dam in the middle of the stream, so as to provide a gradual slope which facilitates safe flow of water over the dam without damaging the embankments. Additionally on downstream side sufficient (1.5 times of the height of the fall) length and width of stone apron needs to be provided to prevent scour. An illustrative sample section is presented as following


Bank
0.45 m
.9 m
0.3 m
0.45 m
1.5 m
D/s
0.6 m
0.20 m
.B.L
0.30 m
2.4 m



Scale 1 Cm. = 0.75 M

DRG. No. _____

Detailed Engineerig Drawing of proposed
DAUKIJAR BOULDER CHECK DAM

Draft report submitted to PHED, Chhatisgarh
DPR on "Artificial Recharge of Groundwater and Rainwater Harvesting in Watersheds ofChhatisgarh"

Nature Environmental Education And Research Associates
B-3 Aurobindo Enclave, Pachpedi Naka, Raipur , (C.G.)
Ph.- 0771-2412072 , 98271-68881

ALL DIMENSIONS IN METER

BOLDER CHECK

The distance between two successive check dams shall be governed by the gradient /slope of the stream. If the slope is flat, the distance would be more and vice versa. The maximum water stored by one boulder check may reach up to toe of the upper boulder check dam. Any distance lower than this, would be uneconomical. Since the boulder check dam is small structure, allows water to flow through and above it; if designed as per above mentioned dimension and specifications, check for safety against sliding, overturning is not generally required. In order to provide further safety, the surface of the dam may be anchored in the foundation and embankments with the help of wire mess.

1.Construction procedures:

•Layout (foundation, height, top width, upstream! downstream slopes, apron) of the boulder check dam as per dimensions and specification provisioned in design.

•Excavate the foundation, embedded into both the embankments

•Built the profile of the boulder check as per layout with the following precautions:

•Avoid using round stones strictly, use angular stone in the construction so that they develop grip among each other.

•Small stone weighing less than a kg should not be used, as they wash away easily.

•Larger boulders placed on outer side of the profile.

•Check for the embedding of the section into the embankments.

•The check dam should be raised in horizontal layers, care must be taken for maintaining the downstream and upstream slopes as per design.

•Keep the embankment higher than that of middle section of the boulder check dam, If the section is leveled, water will cut through the embankments and the check dam will collapse. The construction of the boulder check dam shall complete before the onset on monsoon.

•Provide anchorage with wire mess and suitable pitching for water cushion in downstream.

•Small maintenance may be required after the monsoon and farmers shall encourage doing/to do it.

.

6. Masonry Check Dam

Big Masonry check dams such as anicuts are being built across various streams by departments in the state. More such work is expected to be taken up in the coming future by Water Resources department. **In** Chhattisgarh context, such dams broadly, are envisaged to fulfill the following objectives:

•Harvest water flowing through the stream, which are going out of catchment and command area during monsoon and off monsoon period.

•Create impounding of water in the upstream of dam, to be used for irrigation, domestic, animal and other purposes.

•Facilitate infiltration of water into sub surface strata and recharging of ground water.

•Increased months of availability of water in the streams.

•Promote Gravity Flow Irrigation and Community Managed micro lift irrigation system for enhancing cropping intensity and crop productivity.

To fulfill the above objectives; planning, design, implementation and monitoring procedures are in place for the series of check dam in the department. However, the department has identified few dimensions in the design of check dam such as site considerations, length and height of weir, protection work in downstream, provision of gravity flow irrigation or community managed micro lift irrigation system, etc., which requires to be fine tuned over the prevailing design and practices. Accordingly, these are emphasized in the subsequent sections

cont

Site Selection:

Following are the preferred general site condition for check dams to be constructed in upper, middle or lower part of the stream:

•Availability of adequate catchment area, at the axis of check dam.

•Availability of straight and narrow firm bank of stream; any curve or meandering portion of stream shall be avoided.

Prevalence of high firm foundation condition at axis of proposed dam, rocky or hard strata makes the designed section of dam economical.

Availability of space for impounding water in upstream.

Fetch generally be more than 300 meters; i e river slope l: 150 or should have good storage - perennial sub surface flow.

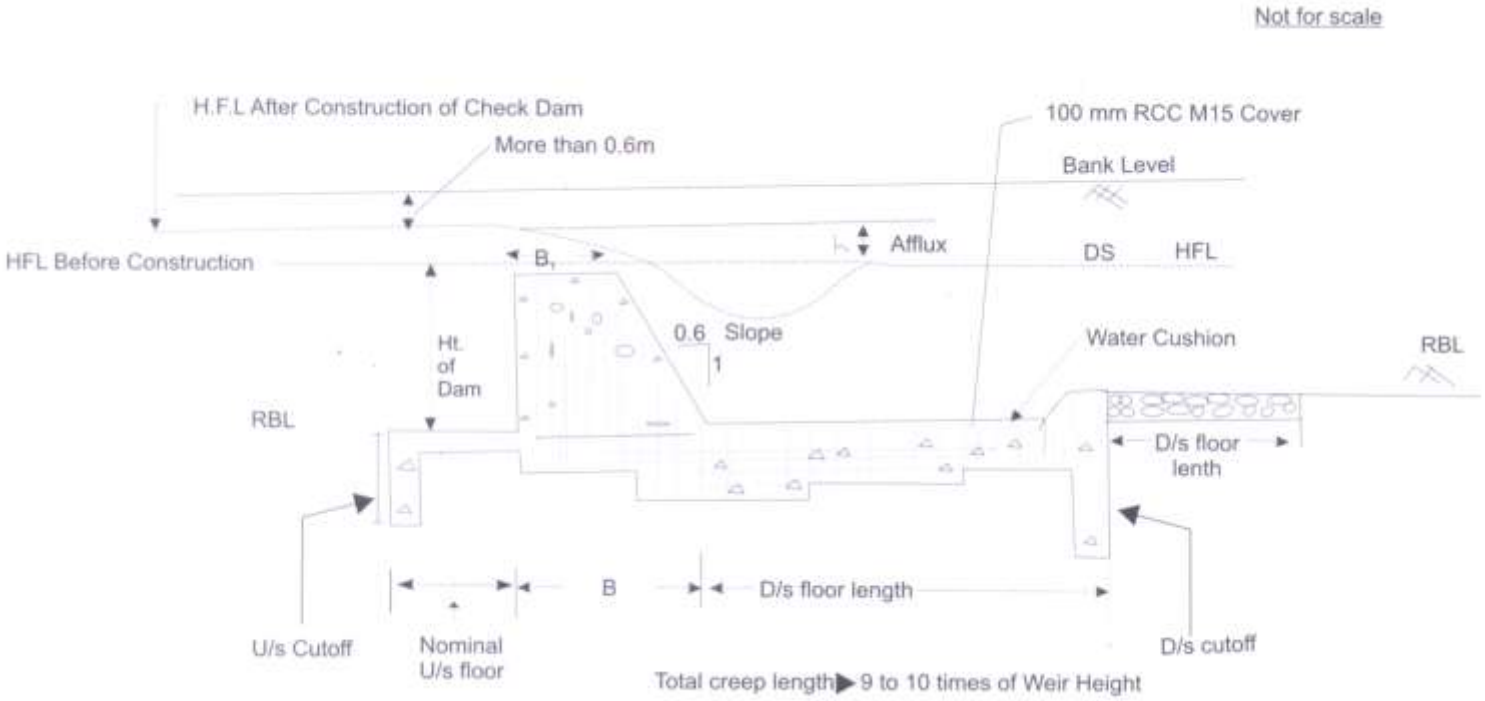
High flood level (HFL) should not inundate private /cultivable land; flatter upstream or below adjunction of 2-3 tributaries provides such sections in general,

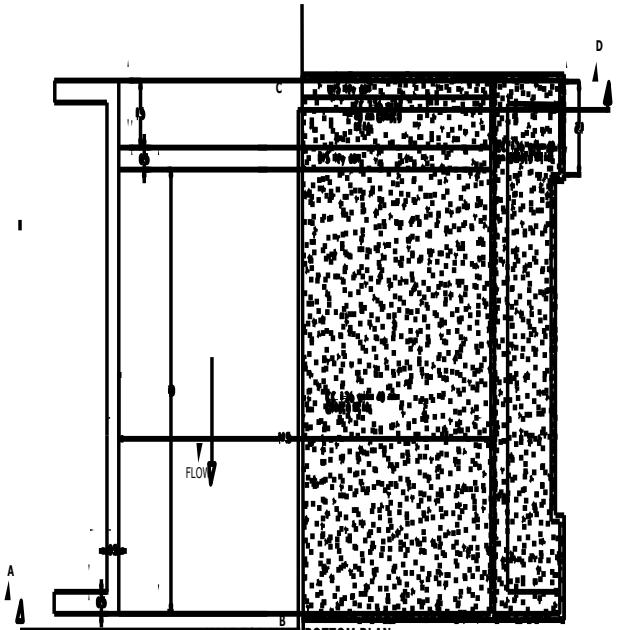
Adequate Cultivable Command Area should be available on either / both side of dam.

Community accessing and using that section of the stream for their current uses.

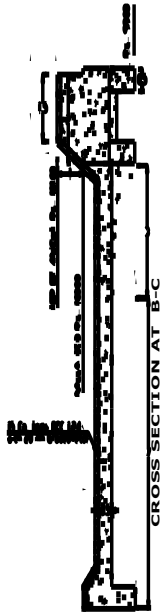
Submergence of forest land, cultivable area, displacement should be negligible.

The sample section of check dam is presented below:

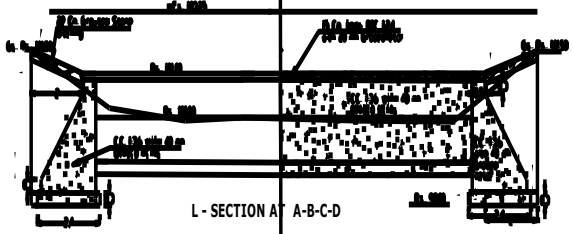




HALF TOP HALF BOTTOM PLAN



TRIAL PIT DETAILS



L - SECTION AT A-B-C-D

Scale 1 Cm. = 0.75 M

DRG. No. _____

Detailed Engineerig Drawing of proposed
CHHINCH Check Dam

Draft report submitted to PHED, Chhatisgarh
DPR on "Artificial Recharge of Groundwater and
Rainwater Harvesting in Watersheds ofChhatisgarh"

Naturo Enviromental Education And Research Associates
B-3 Aurobindo Enclave, Pachpedi Naka, Raipur , (C.G.)
Ph. - 0771-2412072 , 98271-68881

ALL DIMENSIONS IN METER

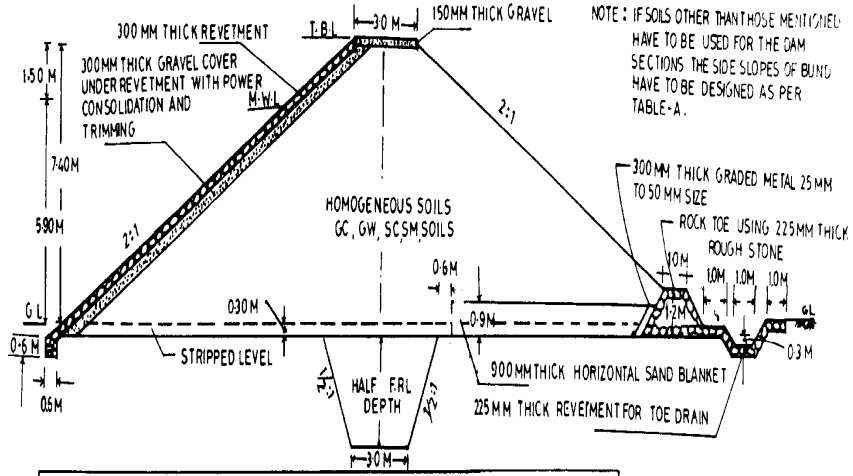
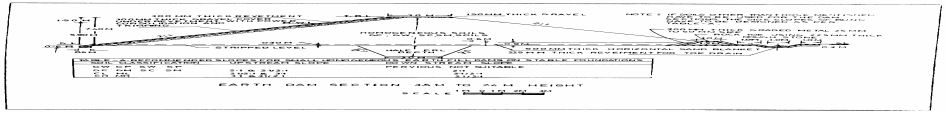


TABLE-A-RECOMMENDED SLOPES FOR SMALL HOMOGENEOUS EARTH FILL DAMS ON STABLE FOUNDATIONS		
SOIL CLASSIFICATION	UPSTREAM SLOPE	DOWN STREAM SLOPE
GW GP SW SP		PERVIOUS NOT SUITABLE
GC GM SC SM	2:1 & 2 1/2:1	2:1
CL ML	2 1/2:1 & 3:1	2 1/2:1
CH MH	3:1 & 3 1/2:1	2 1/2:1

EARTH DAM SECTION 3.5 M TO 7.4 M HEIGHT

SCALE 1M 0 1M 2M 3M



Small Earth Dam

The small earthen dams are the most common storage structure across the drainage lines It is easy to construct and its sizes are usually governed by the availability of impounding area in the upstream. Based on the type of material used and method of construction, earth dam may be classified into Homogeneous Embankment Type or Zoned Embankment Type or Diaphragm / Core wall Type Embankments. Site condition plays a critical role for designing the structure for harvesting maximum volume of water. Chhattisgarh terrain offers great opportunity for the constructions of small earthen dam (Diaphragm or core wall type embankment type) in series as water harvesting structure in the stream at suitable sites. Such dam would harvest rain water and runoff water in the reservoir and allows excess water to flow through spillway/diversion channels. The structure would facilitate promotion of irrigation through gravity.

Site considerations:

i. Availability of a narrow gorge with a pan shaped valley in upstream, so that a small dam can store large volume of water,

ii. A junction of two tributaries or depressions, with a fill of sufficiently low permeability with favorable geology[14]

iii. The catchment area adequate enough to fill the reservoir in about 2-3 heavy rains. The capacity should not be too small to be silted up with sediments very soon,

iv. Availability of natural site for spillway,

v. Higher elevation of impounding reservoir than that of the neighboring agriculture field so that irrigation may be provided with gravity flow,

vi. Adequate Cultivable Command Area on either / both side of dam,

•Access of local community to the site for easy supervision and maintenance purpose

Submergence of forest land, cultivable area and displacement should be minimum and avoid interference of important communication structures like railway, NH and other important structure, etc

Design Considerations:

i. Upstream face should be properly protected against wave action and downstream face against rain and other external actions of human and animal,

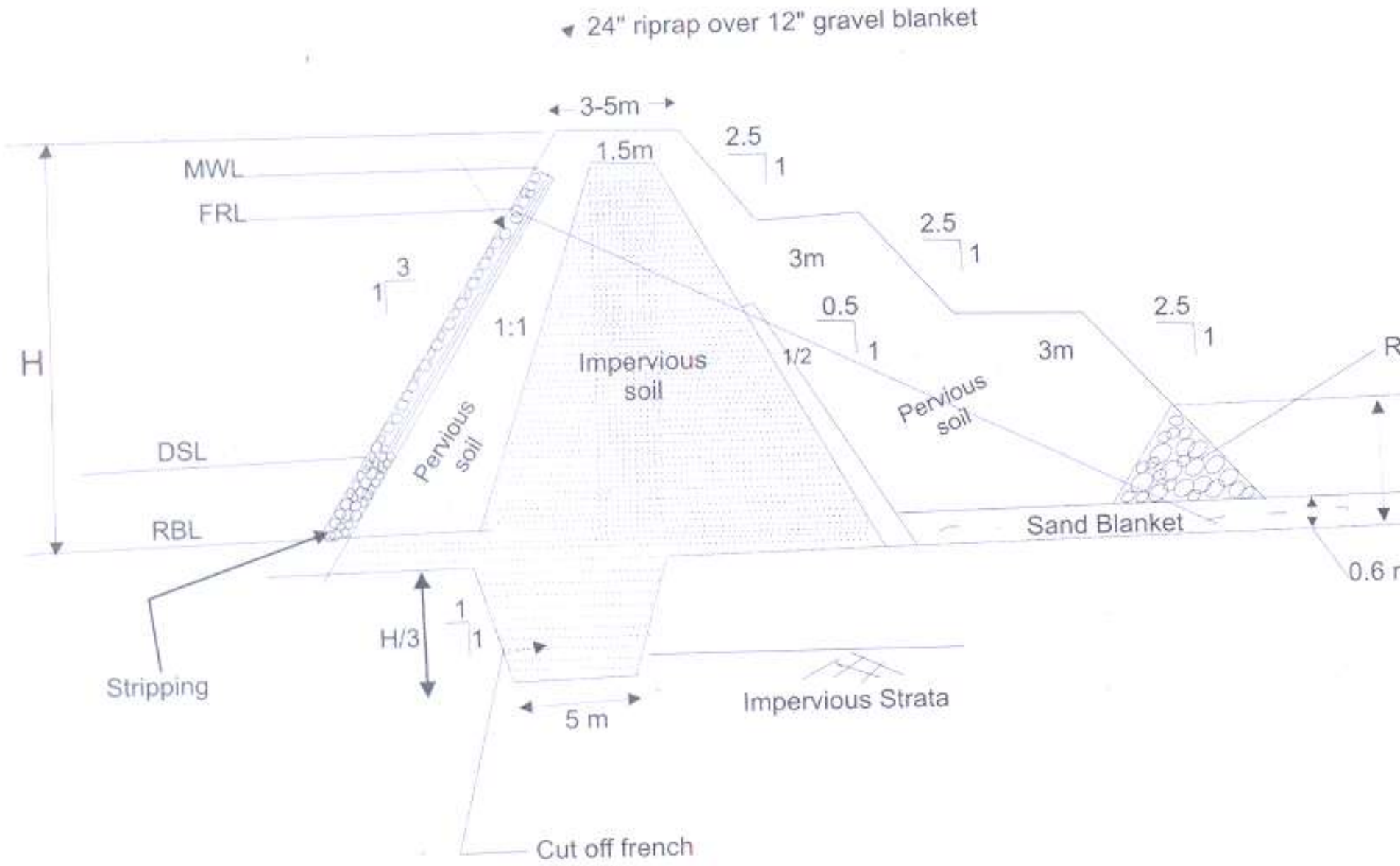
ii. The slopes should be stable in worst condition of loading i.e. sudden draw down or steady seepage during full reservoir level,

iii. The dam shall be drained out properly with the provision of sand filter and rock toe

iv. The seepage line shall be well within the downstream face of the dam, so that no sloughing of the toe happens,

v. The borrow pits shall be in upstream to increase the reservoir capacity, the lowest level of reservoir / borrow pits shall not be lower than bottom level of core wall,

Incorporation of suggestions of local community would address many of the site and design considerations for small earth dam.



Typical Section of a small Earth dam

ANGIOPLASTY

IN

WATER CONSERVATION

ABSTRACT

1/3 of the total area of shirpur taluka is covered by tapi Alluvium and 2/3 portion is covered by deccan Basalt. In Tapi Alluvium and as well as in Deccan Basalt multiaquifer system occurs. In Basalt alternate layers of weathered basalt and hard massive basalt are observed. In the same manner in tapi alluvium alternate layers of yellow silt, sand and boulders can be noticed. The effective porosity of sand bed in Tapi Alluvium is about 30%.

Due to overexploitation of ground water resources, ground water levels declined and all the dug wells in the Tapi Alluvium in Shirpur Taluka dried in 1990. Even after heavy rainfall the wells are dry. There is very little lateral and vertical percolation through the yellow silt.

In Basalt area there is severe scarcity after December for drinking water as well as for Irrigation. Only Kharip crop was possible.

Drying of wells and tube wells in alluvial area and insufficient availability of water after December in the deccan Basalt area were the main problem of the Shirpur Taluka. To change the whole scenario and make available perennial water to this rain fed area was the main object of the project.

cont

14 small steams in the project area were widened up to 20 to 30 meters and deepened up to 10 to 15 meters from its origin in the Basalt and Alluvial area. In this manner the impervious layer of yellow soil in alluvium and hard massive trap in Basalt were removed and 65 cement plugs of appropriate dimension without gates and waste weir were constructed. Hence this project is named as Angioplasty in Water Conservation.

Also surplus water of dams was injected into 59 dry dug wells directly with proper filtration, Due to this water levels both in Alluvium and Basalt area risen to a great extent. In basalt area over dry bore wells of 150 meters in depth attained water level at a depth of 6 meters below ground level, and in Alluvial area at a depth of 20 meters bgl.

This project of Angioplasty in Water Conservation if adopted in the whole of Maharashtra 2nd and even 3rd crop will be possible in all the villages in Non-Command and Rain fed area and there will not be drinking water problem and total eradication of tankers will be possible.

INTRODUCDTION

Shirpur taluka has a geographical area of 837.39 sq.km. It has a cultivable area of 653.77 sq.km. Out of the cultivable total area under Irrigation is about 84.61 (12.94%)

The tahsil Shirpur in Dhule district falling in Tapi alluvial basin is mainly underlain by alluvial formation with basaltic lava flows in hilly tract but give rise to perennial and seasonal springs.

The contact of the basaltic lava flows with alluvial mountain front deposit is demarcated by a major fault. The alluvial deposits are further subdivided into.

- **Talus and Scree deposits bordering the Satpura foot hills and**
- **Alluvium consisting of sand clays gravel.**

MISBEHAVIOR OF RAINFALL IN SHIRPUR TALIKA DURING 2005 TO 2009

Year	Total Rainfall	No. of Rainy Days	No. of Days of 20 mm Rainfall	Total Rainfall During These Days	% With Total Rainfall
2006	533	41	10	338	63
2006	996	41	15	795	80
2007	854	27	13	724	85
2008	621	37	13	402	65
2009	803	32	14	639	80
Total	3806	178	65	2899	373
AV	7612	356	13	5798	746

DISCHARGE FROM 100 METER DEEP TUBEWELL HAVING 10 HP SUBMERCIBLE PUMP IN SHIRPUR TALUKA

The occurrence and distribution of rainfall in the Shirpur taluka is highly erratic. The annual normal rainfall is 617 mm received over 36 days but 75% of the average rainfall occurs within 13 days. Surface water resources in the Taluka are unevenly distributed. This resources is also not assured as it depends on rainfall. Irrigation project in the taluka cover only small area in south eastern part of the taluka. As a result of this, the use of groundwater for irrigation, drinking water and Industrial purposes has increased many folds. In entire taluka intensive development of ground water has lead to critical salutations resulting in manifestations of problems like declining groundwater levels, shortage of water supply, etc.

45 METERS DEEP DRY DUGWELL IN SHIRPUR TALUKA SINCE 1990 TILL TODAY

Dying of wells and tube wells in alluvial area and insufficient availability of water after December in the Deccan Basalt area were the main problem of the Shirpur Taluka. To change the whole scenario and make available perennial water to this rain fed area was the main object of the project.

Artificial recharge of filtered water

- **METHODS**

ARTIFICIAL RECHARGE OF GROUNDWATER BY DIRECT INJECTION

ARTIFICIAL RECHARGE OF GROUND WATER AT THE RATE OF 70000 L.P.H.

In this method the surplus water of reservoir is collected in the setting tank through the conduits. This water is then filtered and poured into the dry dug wells. Due to high percolation of underlying alluvial formation, the water is constantly recharged in to the ground, resulting into the rise of water table.

THE ANGIOPLASTY IN WATER CONSERVATION

The Alluvial basins have alternate layers of yellow silt and sand with effective porosity of 30% The Deccan Basalt consists of pervious and Impervious layers. The effective porosity of the aquifer in the Deccan Basalt is 2.5% In this method the yellow Impervious soil in alluvial formations and impervious layer in Deccan Basalt is completely removed with the help of machinery and the streams are deepened up to 10 to 15 meters and widened up to 15 to 30 meters right from its origin.

STORAGE OF WATER IN CEMENT BUNDS. DEPTH OF WATER COLUMN IS 10 M.

.

The cement check dams without gates are constructed at a distance interval of about 500 meters with the study of geological and technical feasibility. This helps to arrest rain water, adds to the pressure to the underneath layers. This increases the percolation rate and even reduces the danger of floods.

STORAGE OF WATER IN CEMENT BUNDS. DEPTH OF WATER COLUMN IS 8 M.

•WORK COMPLETED IN SHIRPUR TALUKA

Since 2004 in Shirpur taluka Tech. Based water conservation is under progress. Project area is about 100 sq.km. in which 65 cement bunds have been constructed on 14 small streams. This whole area is rain fed and non command. There are no gates and waste weir to these bunds. Minimum storage capacity of the bund is 10 T.C.M. and maximum is 150 T.C.M. Artificial recharge projects are completed on 59 dry dug wells. To recharge the deeper aquifers in the Alluvial area of Tapi Basin, surplus water of dams at the rate of 70000 L.P.H. is artificially poured by gravity in to the dry dug wells. 25 villages in the taluka have been benefited

•**RESULTS:**

•Water level in Basalt area which has depleted up to 150 meters has risen by 140 meters Now water level is about 10 meter b.g.l. Water level in Alluvial area which has depleted up to 150 meters has risen by 110 meters. Now water level is about 40 meter b.g.l.

•Now water remains in the stream up to March. Previously streams used to dry in November.

•Drinking water problem solved. Forever.

•Irrigation area increased. Now farmers are taking double crop in this rain fed and non-command area. Average per capacity income increased at least by one lakh Rs. /Ha.

•Energy consumption decreased. Due to reduction in suction length , low HP pumps have been installed to draw water.

•Fisheries started in many villages resulting in to rise in annual income of the farmer.

Once upon a time, a drought prone area has now become a paradise with pristine landscape and brooks and streams filled to the brim with sparking water. Today Shirpur radiates in glory of its success and sets up an ideal modal for the drought prone areas all over India.

- **CONCLUSIONS:**

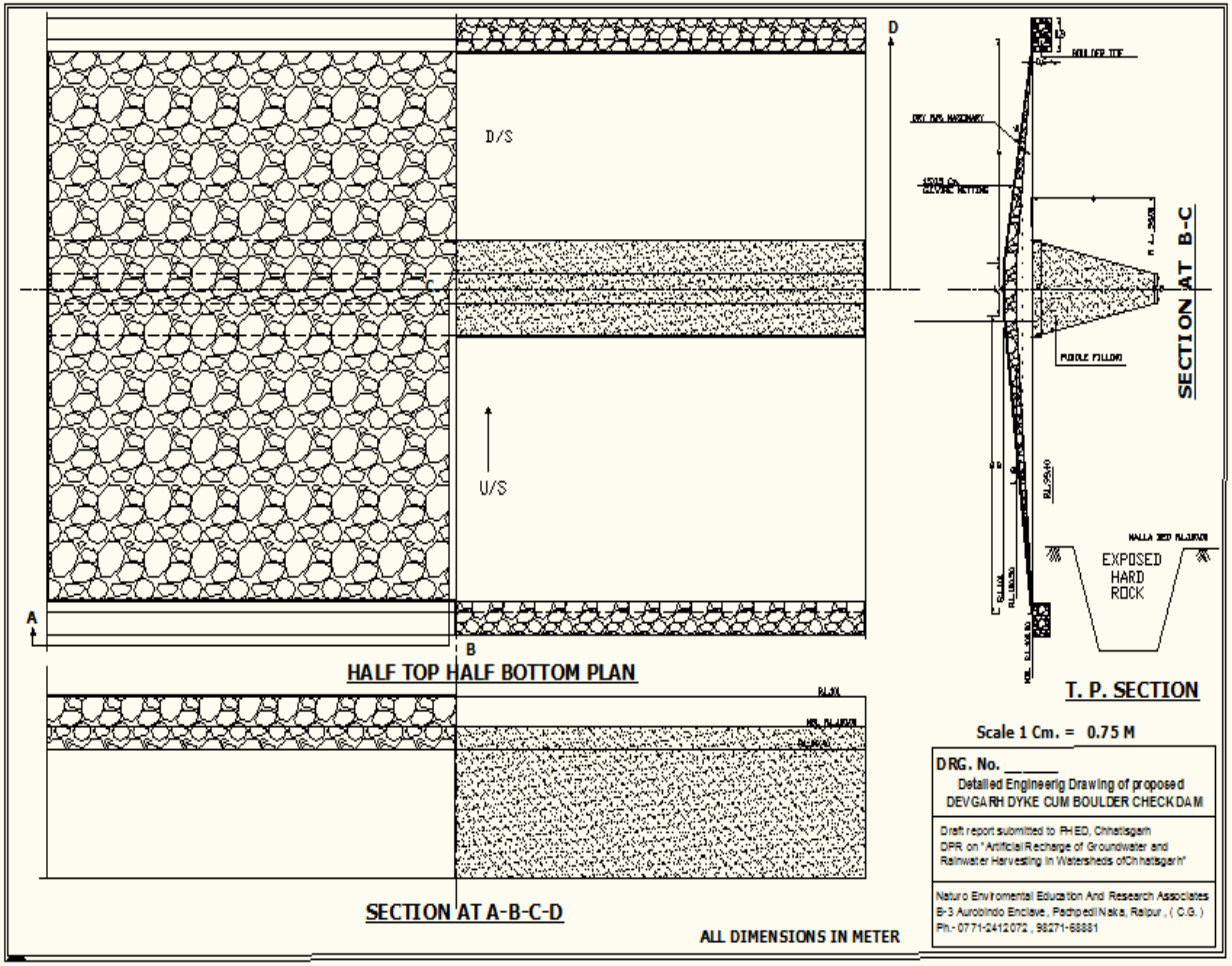
Such type of projects with the Angioplasty in Water Conservation if carried out on all small streams in all the mini and micro watersheds of the entire states there will not be tanker fed village and for all villages in rain fed and non command areas, water will be available for second crop also. Total eradication of flood and scarcity is possible maximum within 10 years.

- **FUTURE WORK:**

There are total 150 villages in Shirpur taluka. As on today 25 villages got the benefit of the above programme. Remaining 125 villages will be completed in all respected within 10 years.

SUB SURFACE DAM / DYKE

SUB SURFACE DAM



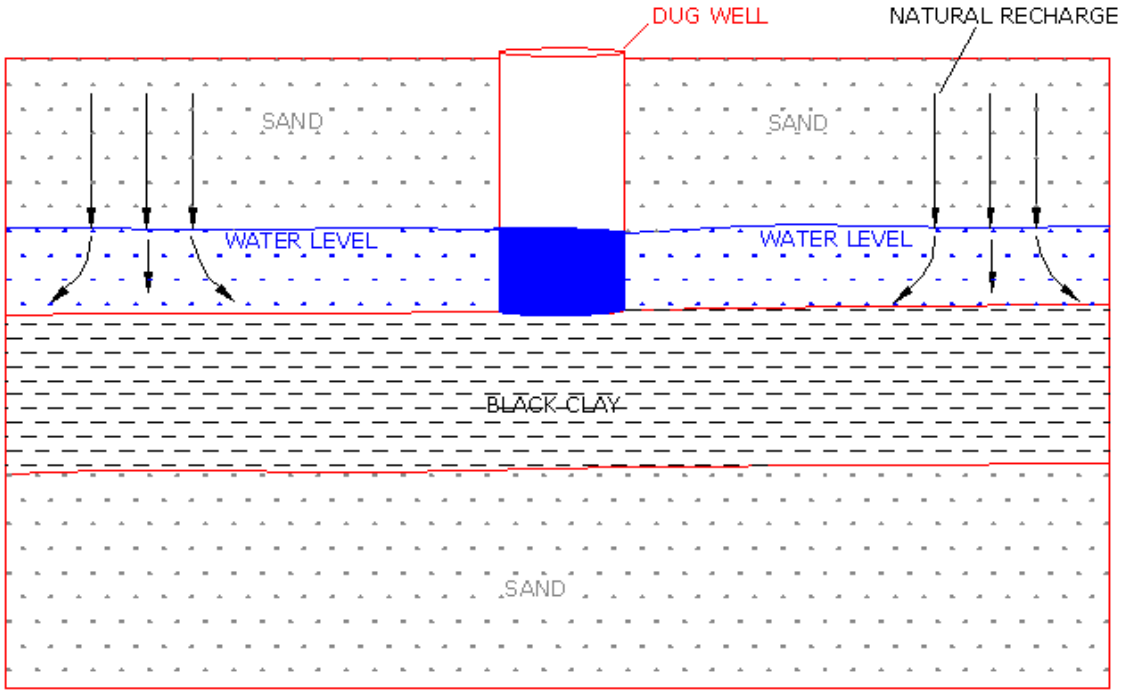
SUB SURFACE DAM

SUB SURFACE BARRAGE CONSTRUCTED TO CHECK SUB SURFACE WATER FLOW (BASE FLOW)

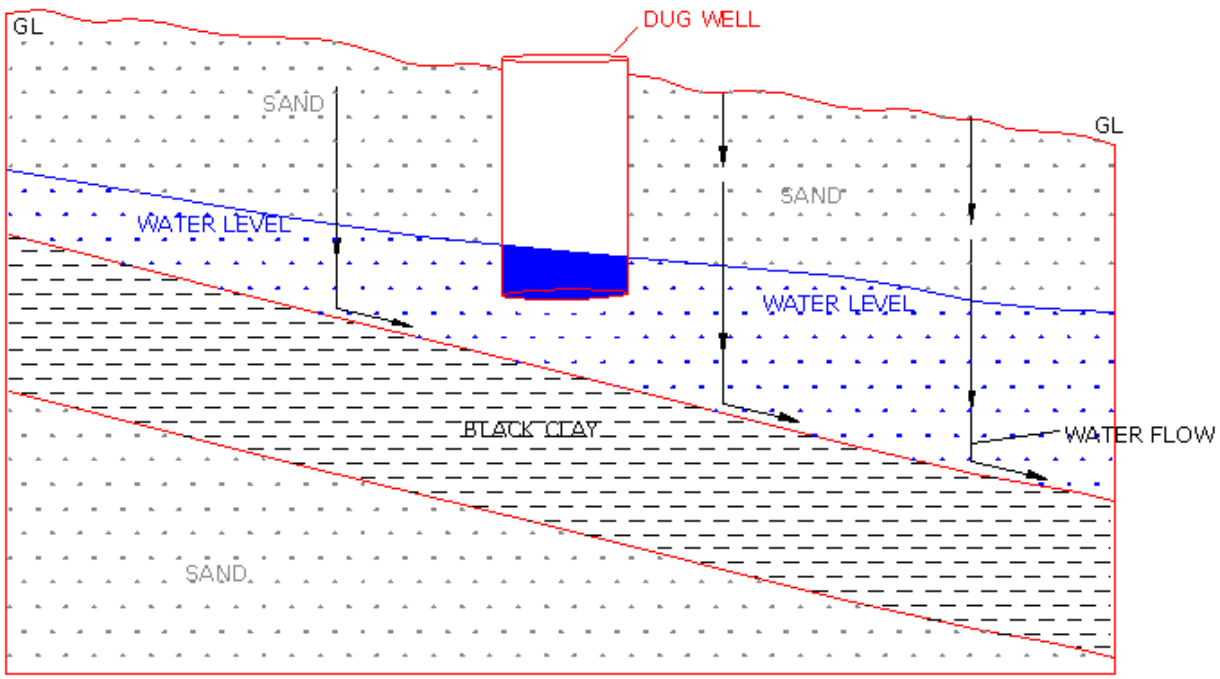
Concept and principle of a subsurface dam

- **A subsurface dam is a system to store groundwater by a “cut-off wall” (dam body) set up across a groundwater channel.**

VERTICAL INFILTRATION



SUB SURFACE FLOW



It is similar to a "surface dam" in its function of water storage by a dam body, but is different in the following areas:

1) **A system to store groundwater**

In contrast with a surface dam that stores surface water (river water), a subsurface dam stores groundwater. In general, it stores shallow ground water because a subsurface dam to store deep groundwater needs huge-scale construction.

(2) Storage in geological strata

Groundwater is stored in geological strata.

In other words, a subsurface dam is a system that conserve ground water in the upstream side of it

(3) NECESSITY FOR WATER-PUMPING FACILITIES

The reserved groundwater level is lower than the ground surface because the dam is constructed under ground. Therefore, for using the reserved water, water-pumping facilities is needed

Requirements for a subsurface dam site

- (1) Presence of shallow groundwater with high fluidity
- 2) Presence of a porous layer (aquifer) for water storage
- 3) Presence of the surrounding basement rock with low permeability

Requirements for a subsurface dam site

- **(4) Presence of a gorge of basement rock with low permeability**

To construct a subsurface dam effectively, it is desirable to set up the dam at a bottleneck point, where basement rock with low permeability make a gorge with a vast aquifer upstream, as in the case of a surface dam.

CONSTRUCTION

AFTER THE TRENCH WAS EXCAVATED DOWN TO THE BASEMENT, THE WEATHERED PORTION WAS CHISELD OUT USING HAMMER DRILLER AND COMPRESSED AIR SO THAT FRESH OUTCROP WAS OBTAINED

CONSTRUCTION

REMOOVED THE MUCK AND SURFACE THOROUGHLY WASHED AND CHISELD TO MAKE IT EVEN

CONSTRUCTION

AFTER THIS CEMENT GROUT WAS PORED OVER THE SURFACE AND A LAYER OF CONCRETE OF 1:1:5.3 WAS PUT OVER THIS AND THE CONCRETE SURFACE MADE EVEN . OVER THIS A PLATFORM OF ONE LAYER BRICK OF 75 CM WIDTH WAS CONSTRUCTED WITH CEMENT MORTAR

SSD

CONSTRUCTION

ABOVE THIS A LAYER OF BRICK WITH WIDTH OF 60 CM WAS CONSTRUCTED

ABOVE THIS A WALL OF 35 CM THICKNESS CONSTRUCTED USING CEMENT MORTAR

Sub surface dam at Bavaji Nagar, Palghat

CONSTRUCTION

TO COMPLETE CONSTRUCTION,THE TRENCH WAS BACKFILLED WITH THE EXVAVATED MATERIALS AND LEVELLED TO THE ORIGINAL POSITION

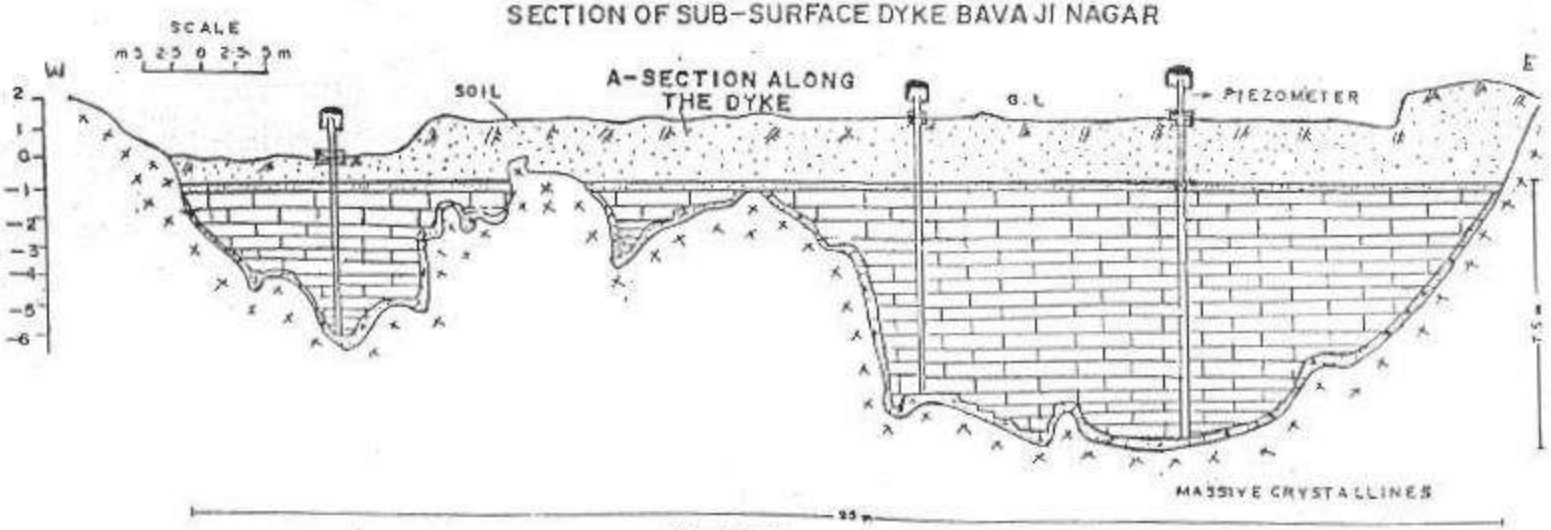
NO LAND LOSS FOR FARMER

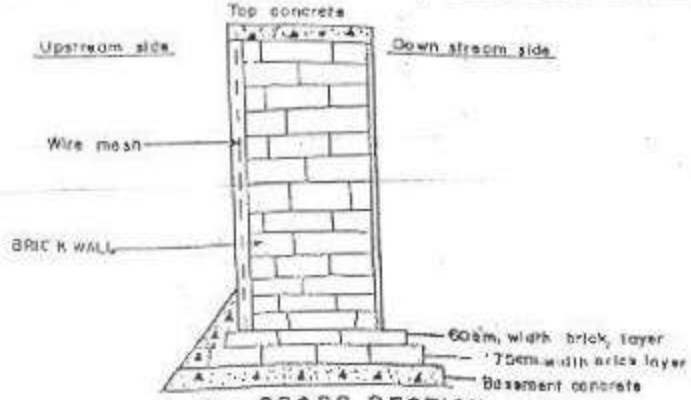
THE PZ KEPT 50 cm AGL AND PROVIDED A WELL CAP

SSD BHAVAJI NAGAR

SSD

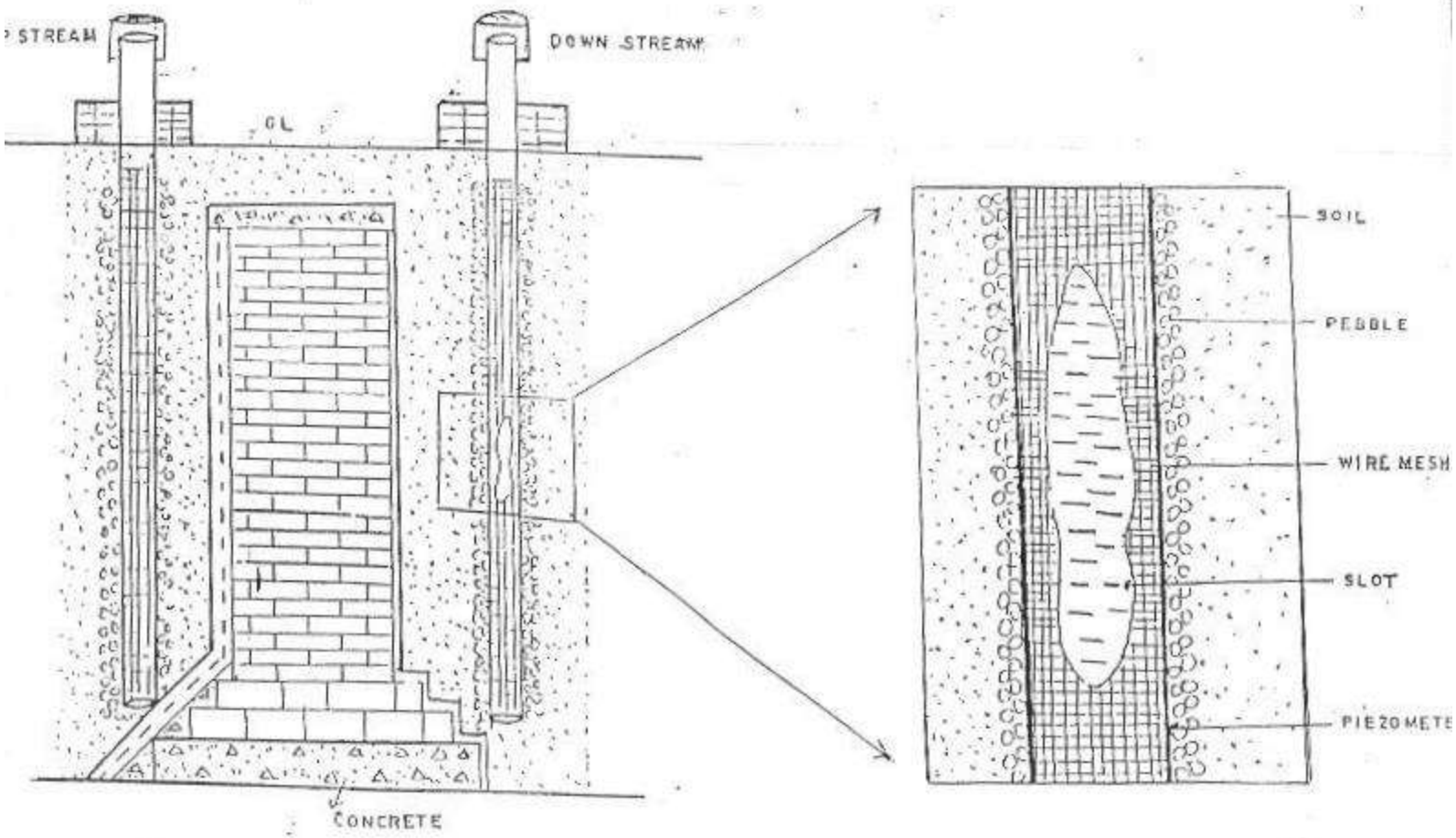
SECTION OF SUB-SURFACE DYKE BAVAJI NAGAR





B- CROSS SECTION

CROSS SECTION OF PIEZOMETER



COMPLETION

COMPLETED BY 1ST WEEK OF JUNE 1998

Plan view of the Piezometers constructed in the up stream and down stream portion of the sub surface dyke at Bavaji Nagar, Palakkad district

PERFORMANCE EVALUTION AND IMPACT ASSESSMENT

THE VISUAL POSITIVE IMPACT IS RECOGNIZED FROM THE GREENERY OF THE AREA AFTER THE CONSTRUCTION OF THE SSD.

IMPACT ON GROUND WATER LEVEL

DOWN STREAM SIDE---8 IRRIGATION DUG WELLS WERE FIXED AS KEY WELL TO MONITOE THE IMPACT OF THE SSD OVER GROUND WATER LEVEL

BEFORE CONSTRUCTION OF SSD			
SLNo	TOTAL DEPTH(Mbgl)	DWL APRIL 1998(Mbgl)	DWL JUNE 1998(Mbgl)
1	6.35	6.05	4.68
2	7.15	6.18	5.08
3	6.59	6.10	5.08
4	7.25	6.90	5.58
5	9.15	8.8	7.48
6	11.6	11.20	9.08
7	11.47	11.00	9.58
8	8.75	8.75(DRY)	8.75(DRY)
9	10.95	10.95(DRY)	9.15
10	9.50	9.20	8.15
PZ	8.4	NOT INSTALLED	4.55

AFTER CONSTRUCTION OF SSD			
SLNo	TOTAL DEPTH(Mbgl)	DWL APRIL 1998(Mbgl)BEFORE	DWL APRIL1999 AFTER
1	6.35	6.05	4.00
2	7.15	6.18	4.50
3	6.59	6.10	4.80
4	7.25	6.90	5.60
5	9.15	8.80	6..48
6	11.6	11.20	7.00
7	11.47	11.00	6.50
8	8.75	8.75(DRY)	6.00
9	10.95	10.95(DRY)	7.20
10	9.50	9.20	740
PZ	8.4	NOT INSTALLED	2.25

UPSTREAM AFTER CONSTRUCTION			
SL NO	TOTAL DEPTH OF MONITORING DUG WELL(MBGL)	DWL(AUG 1998) MBGL	DWL AUG1997
1	6.35	1.30	NOT AVAILABLE
2	7.15	1.35	
3	6.59	1.64	
4	7.25	1.42	
5	9.15	1.80	
6	11.60	2.20	
7	11.47	2.15	
8	8.75	2.10	
9	10.95	2.50	
10	9.50	2.70	
PZ3	8.40	1.10	

UPSTREAM AFTER CONSTRUCTION			
SL NO	TOTAL DEPTH OF MONITORING DUG WELL(MBGL)	DWL(AUG 1998) MBGL	DWL AUG1997
1	6.35	1.30	NOT AVAILABLE
2	7.15	1.35	
3	6.59	1.64	
4	7.25	1.42	
5	9.15	1.80	
6	11.60	2.20	
7	11.47	2.15	
8	8.75	2.10	
9	10.95	2.50	
10	9.50	2.70	
PZ3	8.40	1.10	

SURPLUS WATER

THERE IS RISE IN WATER LEVEL INSPITE OF ADDITIONAL WITHDRAWAL OF GROUND WATER

ADVANTAGES OF A SUBSURFACE DAM

- COMPARED WITH A SURFACE DAM, A SUBSURFACE DAM HAS THE FOLLOWING ADVANTAGES:
- (1) A water storage system without land submergence OR LOSS OF LAND
- A subsurface dam does not submerge land area in contrast with a surface dam because it stores water under ground. Therefore, it does not seriously damage the environment, (flora & fauna) nor
- does it cause social problems such as the forced migration of the local people.

(2) PREVENTION OF EVAPORATION OF RESERVED WATER

- **A subsurface dam does not lose reserved water by evaporation because water is stored underground and there is very little evaporation, in contrast with a surface dam that often loses a significant amount of reserved water due to evaporation in the dry season in arid or semi-arid areas.**

(3) CLEAN, SAFE WATER

- **Reserved water using a subsurface dam is of fairly good quality because it is stored under ground, and it can be used like ordinary well water, in contrast with reserved water using a surface dam that tends to proliferate parasites, anopheles that transmit malaria, and germs.**

(4) A STABLE, SECURE DAM

- **In general, a subsurface dam is more stable than a surface dam from the viewpoint of dynamics because it is buried under ground, and thus does not need maintenance. Even if it breaks, there is no damage to the downstream area because the breakage occurs under ground.**

CHECKING SEAWATER INTRUSION

Sub surface dams are useful in checking sea water intrusion and inland salinity ingress

DISADVANTAGES OF A SUBSURFACE DAM

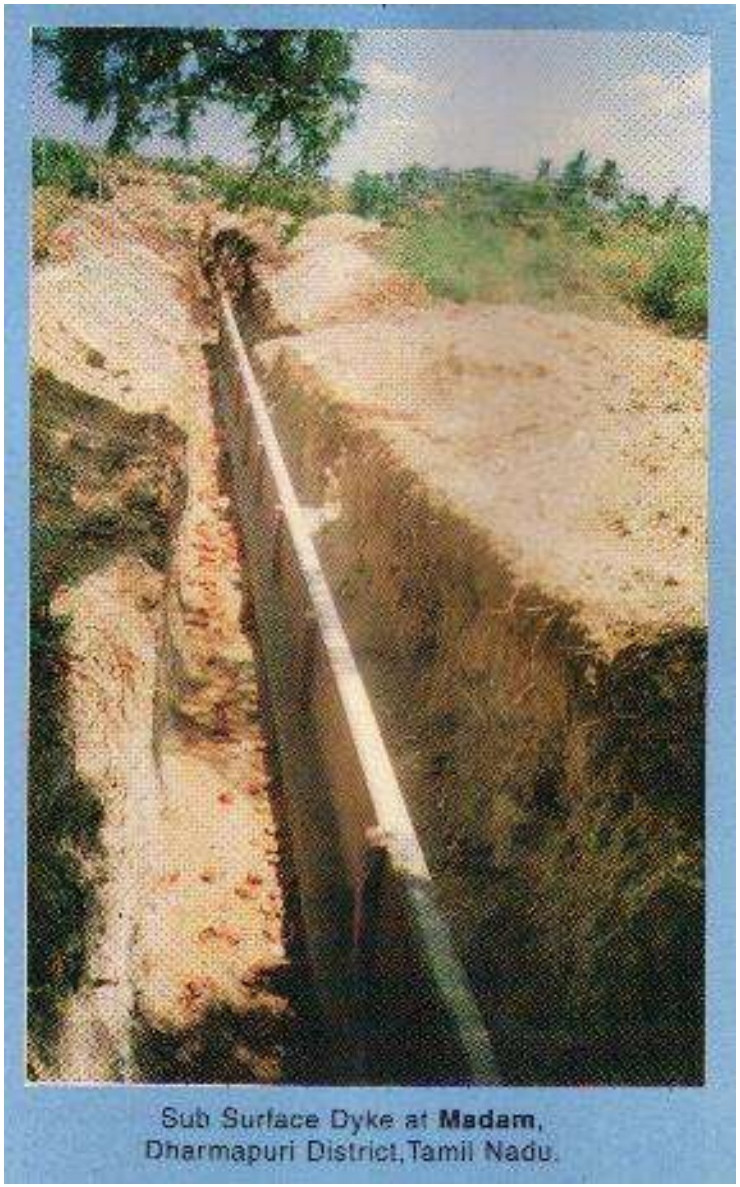
- (1) Difficulties in site selection
- Low effectiveness of water storage

In case of a subsurface dam, water is stored in the pores of geological strata. Therefore, thevolume of reserved water is determined by the volume of those pores (effective porosity), and reaches only 10 to 30% of the volume of the reservoir layer.

(4) Salinization in reservoir area

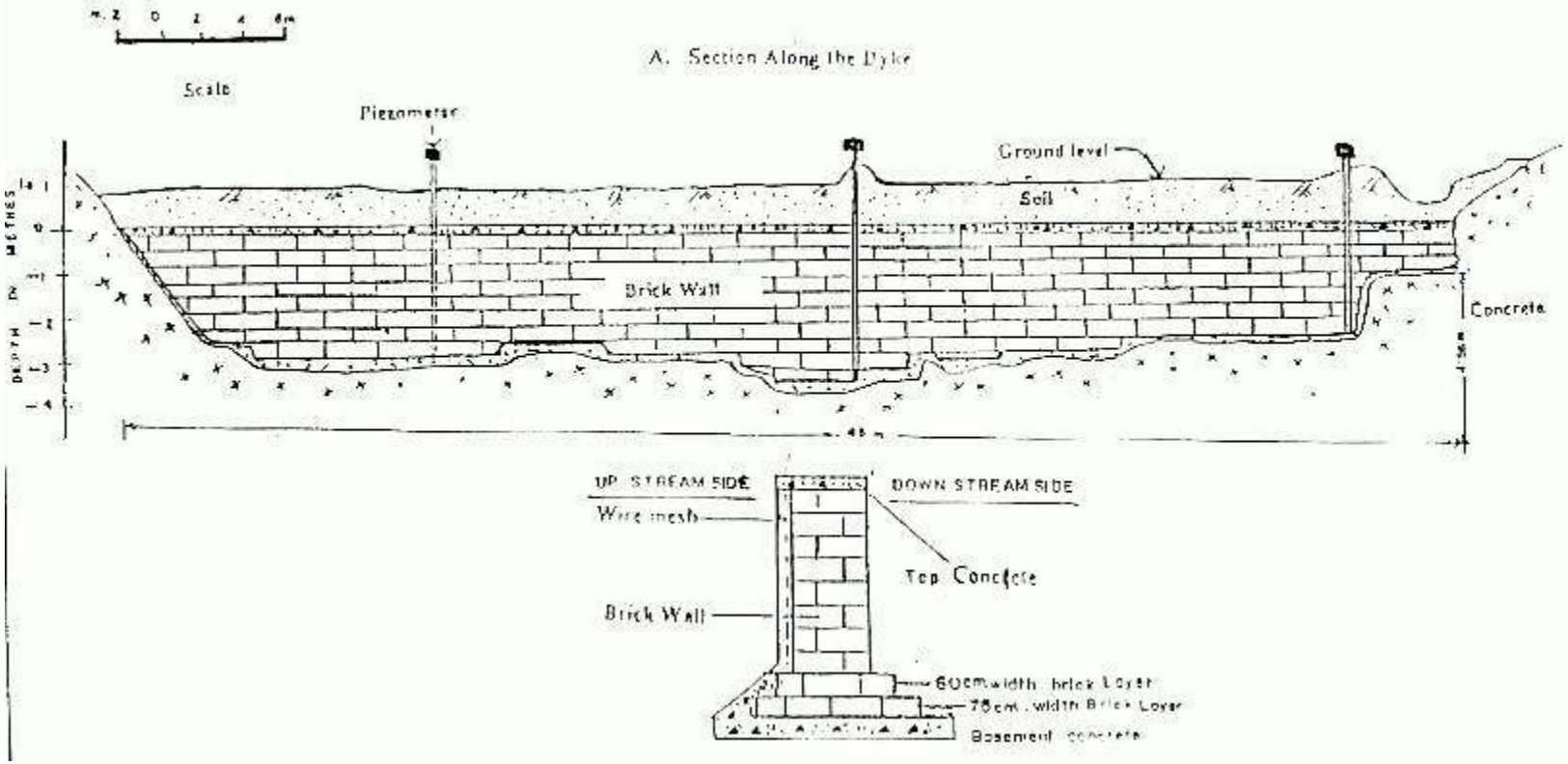
- **The subsurface dam is likely to cause accumulation of salt on the ground surface in thereservoir area due to the rise of reserved groundwater to the surface by evaporation.**

  However, this phenomenon occurs only when the highest groundwater level is close to the ground surface. It is thus possible to avoid this problem by setting the highest level of reserved groundwater at a sufficient depth below the ground surface. In this project, the highest level of reserved groundwater (the depth of the crest of the dam)was thus set at 1 m below the ground surface.



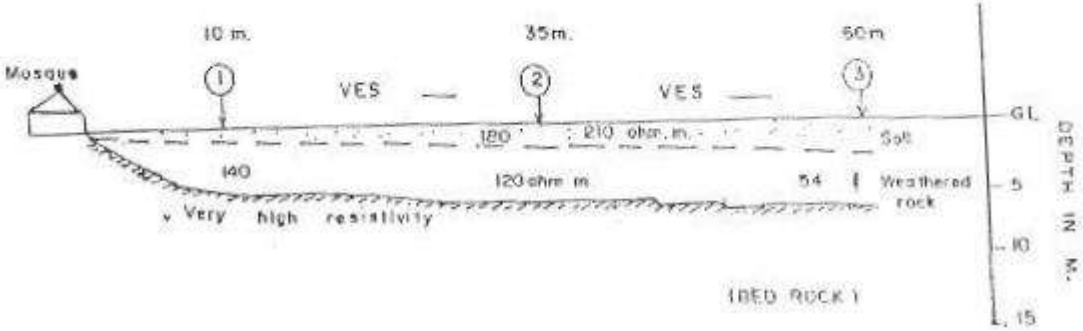
Sub Surface Dyke at **Madam**,
Dharmapuri District, Tamil Nadu.

Fig 3 SECTION OF THE SUB-SURFACE DYKE, ALANALLUR



GEOELECTRICAL SECTION OF ALANALLUR SITE

BEDROCK PROFILE KUMMANCHIRA Mannarghat taluk, Palghat Dt.



POTHENCODE ASRAM

POLYTHENE SHEET

CLAY PACK

REDUCE COST

ROAD TO WATER PROSPERITY

4 R's

- **Reap** (Rain water)
- **Recharge** (Ground water)
- **Regulate** (water use)
- **Reuse** (water)

ENHANCED RECHARGE

- **The term artificial recharge refers to transfer of surface water to the aquifer by human interference. The natural process of recharging the aquifers is accelerated through percolation of stored or flowing surface water otherwise not percolating to the aquifers.**

ARTIFICIAL RECHARGE

- **ARTIFICIAL RECHARGE TO GROUND WATER IS A PROCESS BY WHICH THE GROUND WATER RESERVOIR IS AUGMENTED AT A RATE EXEEDING THAT UNDER NATURAL CONDITION OF REPLENISHMENT**

CONCLUSION

THE SUBSURFACE DAMS ARE ONE OF THE BEST WATER CONSERVATION STRUCTURE FOR KERALA CONDITIONS AND IT CAN BE CONSTRUCTED COST EFFECTIVELY BY REPLACING THE CONCRETE WALL BY POLYTHENE SHEETS FOLLOWED BY CLAY FILLING

RUNOFF

RAIN WATER HARVESTING

are

Rainwater – at all places

- **Three methods**
  - Roof top RWH
  - Runoff RWH (landscapes, parks, storm water drains, roads, etc.)
  - Natural storage and collection through lakes and tanks

How much water do I use ?

Consumption range :

from 50 to 300 liters per person per day

Use	Litres/person
Drinking	3
Cooking	4
Bathing	20
Flushing	40
Washing-clothes	25
Washing Utensils	20
Gardening	23
Total	*135*

Why harvest rainwater?

Water is one of the most common substances on our earth. But urban areas face a shortage of water and require an alternate source to bridge the gap between demand and supply. Rainwater would be the immediate resource to augment the existing water supply systems by "catching water wherever it falls".

Surface water is inadequate to meet our demand and we have to depend on ground water. Due to rapid urbanization, infiltration of rain water into the sub-soil has decreased drastically and recharging of ground water has diminished. The benefits of rainwater harvesting can include:

Relief of strain on other water supply

Ability to build or farm in areas with no other water supply

Cleaner water

Increased independence and water security

Lower water supply cost

Reduced flood flows

Reduced topsoil loss

Improved plant growth

Advantages of Rain Water Harvesting

RWH makes ecological and financial sense not to waste a pure natural resource available in large quantity.

RWH encourages water conservation and self-dependence.

RWH is being recognized that people from various sectors have to become partners in the solution process and not remain simply as institutional beneficiaries (CSR).

Capturing rain water in-situ and augmenting water supply at a marginal cost

Replenishing ground water through recharge of rain water by using the soil column.

Reducing pollution and contamination

Reducing the water bill for the exchequer

Providing clean and safe water

Least capital investment with maximum benefits at house hold as well as city levels

The demerits of RWH

It is dependent on the monsoons and intensity of rainfall

It depends on intensive participation form the house level to the city level

It is only a supplementary source and cannot replace the existing supply system completely

DID YOU KNOW

UNITED STATES
NORTHERN CHINA
IRAN MEXICO
INDIA PAKISTAN

Due to over-pumping, the groundwater in several countries is almost gone.

Let us join hands and take the responsibility to erase the this CRY. BY SAVING RAIN WATER

Our water sources
are under pressure.

**It's been said,
we're going to
run out of water
before we run out of oil.**

0 1 2
WATER

FORMS OF RAIN WATER HARVESTING

Roof tops
- Flat roof
- Sloping Roof
- Temporary collection facility

Water storage Devices
- Overhead Tank
- Surface Tank
- Underground Sump

Ground water recharge
- Infiltration Gallery
- Rainwater Soak Pit
- Trench Method
- Basin Method
- Recharge through Bore well/Open well

Rainwater Harvesting in Lakes and Tanks
- Check dams
- Desilting and Deepening
- Subsurface Dykes

Groundwater Recharge Methods

- *Surface GW Recharge*
- *Soak Pit*
- *Trenches*
- *Barrel System of Infiltration Gallery*
- *Infiltration Gallery*
- *Check Bunds*
- *Recharge through Open well / Bore well*
- *Lakes or Water bodies*

Recharge pits can be created around or near the bore well / open well by using layers of Sand, Pebble, Boulders and Aggregates through which water is made to infiltrate to the ground for increasing the yield of bore well / open well.

The making of a recharge pit : locality

If the pit aims to recharge a borewell, it should be built as close to it as possible.
Ideally it should be in the valley of the surface layout.

Borewell and recharge pit

Excavation

The excavation should reach porous soil / weathered rock / fracture.

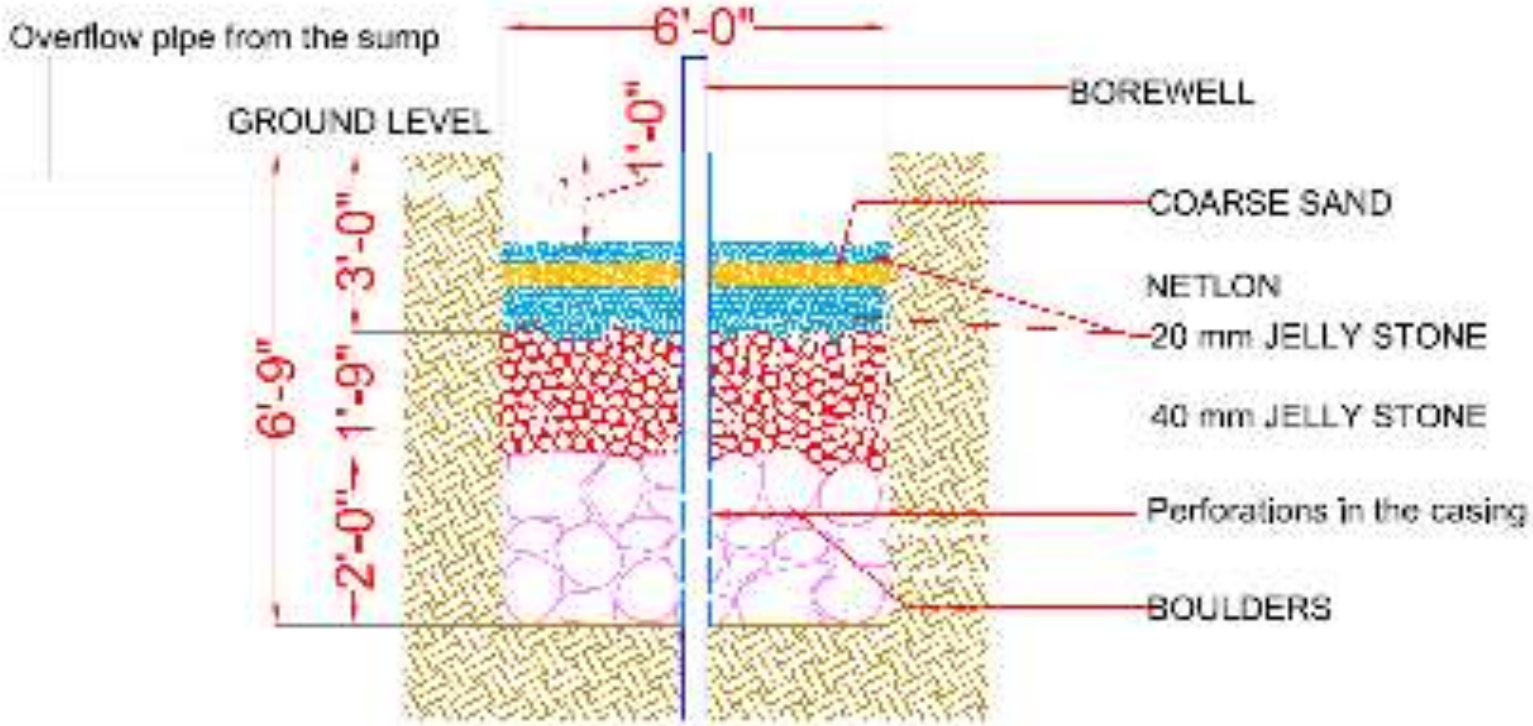
Digging the pit

Filling of the pit

Backfilling. Round hard material.

Finished recharge pit

Recharge pit around bore wells



Ground water recharge through road side drains

Ground water recharge through road side drains

Recharge wells details

Covers : grilled or perforated RCC

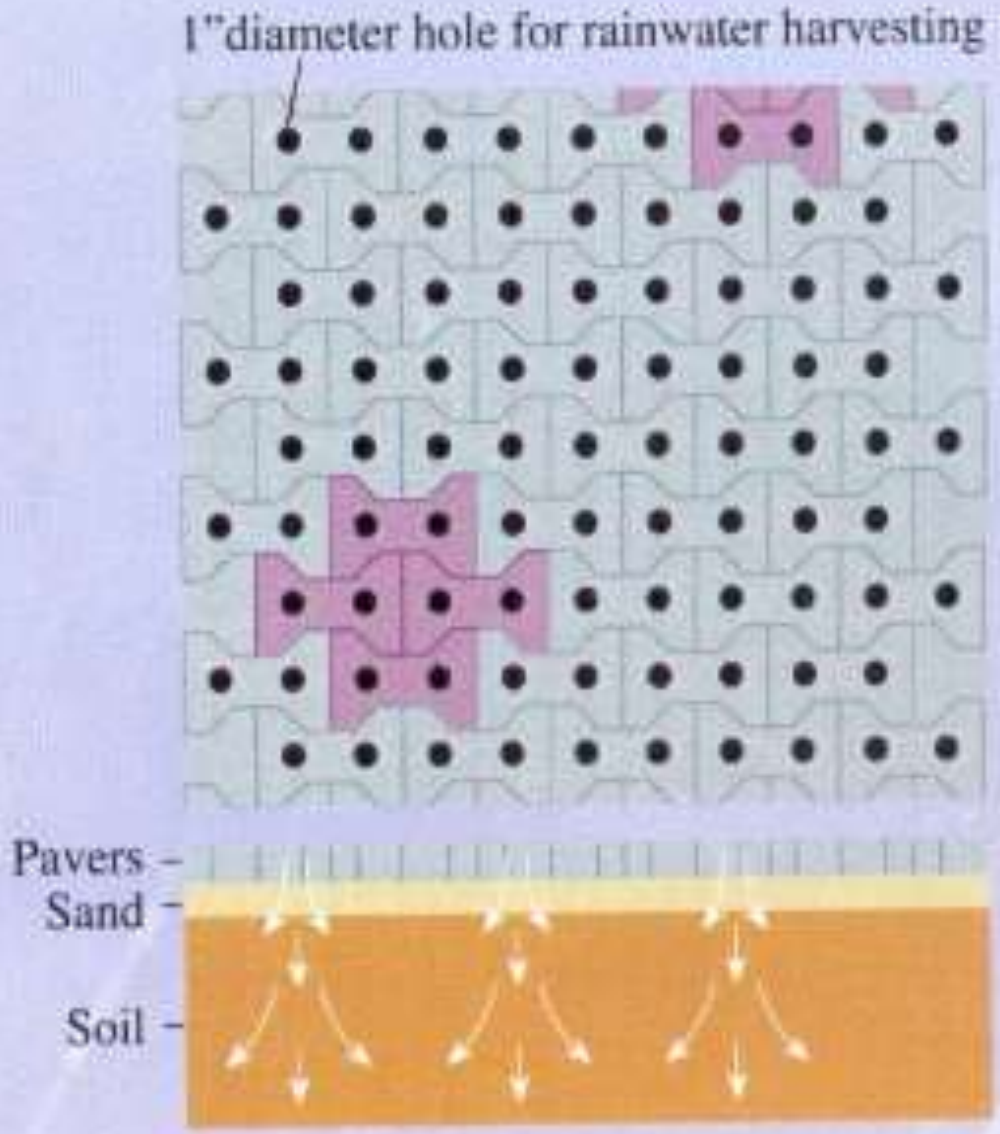
Silt and leaves trap in a stormwater drain

Procedure ….. continued

Locate recharge well in the channel or off the channel

Make arrangements to remove silt and leaves before water enters recharge well

Monitor the rate of recharge and decide on the number of recharge wells necessary for the catchment



Pavers with holes for ground water recharge

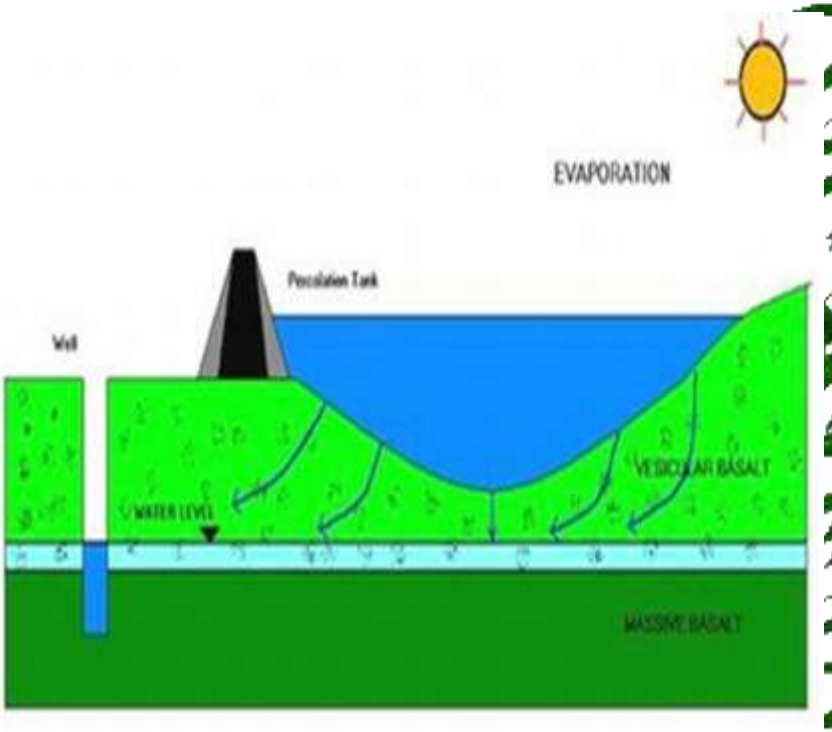
STRAGARD CONTOUR TRENCHS

PERCOLATION TANKS

- Function

To augment the ground water recharge

- Salient features
- Shallow depression created at lower portions in a natural or diverted stream course
- Preferable under gentle sloping stream where narrow valley exists
- Located in soils of permeable nature
- Adaptable where 20-30 ground water wells for irrigation exist with in the zone of influence about 800 – 900m
- Minimum capacity may be around 5000 m3 for the sack of economy
- Also act as silt detention reservoir



ROOF TOP RAIN WATER HARVESTING

AND

FILTER DESIGN

ROOF TOP RAIN WATER HARVESTING AND FILTER DESIGN

RTRWH

ROOF TOP RAIN WATER HARVESTING

- What is Roof Top Rain Water Harvesting ?
- Where and why it is required ?
- Whether it is really effective in augmenting the ground water storage ?
- Is not there a possibility of contamination of ground water through this ?

RTRWH

Storage Tanks

RTRWH

PLANNING A ROOF TOP RAIN WATER HARVESTING PROJECT

- ❖Study of layout plan of building and calculation of roof area.

- ❖Collection of rainfall, surface and sub surface geological, hydrogeological information of the area.

- ❖Calculations of Rain water to be harvested from the roof / to be available for recharge.

- ❖ Selection of feasible recharge structure, its type ,number and pinpointing.

- ❖ Preparation of roof top (catchment) and design of piping's

- ❖Selection of suitable filter (design , size and dimensions).

RTRWH

If the project is for a remote tribal village ,under community participation program, The planning is to be done in terms of its:-

- **Technical Suitability : involves study of factors that influences the need and reliability of RRHS.**

1. Existing Water Source: water availability , Quality & accessibility.
2. Roof catchment: Type, slope shape & size,15-20 m2 required.
3. Rainfall – amount & distribution, to confirm dependability of RHS.
4. Space – For 10,000 ltr capacity tank 3×3m area required.

- **Economic Viability : High cost may not be affordable to villagers**

1. Bring down the cost by using local material like bamboos.
2. Contribution can be raised in terms of labour & material to meet a part of investment.
3. Let the user meet a sizable portion of cost of RHS

- **Social Acceptance :**

1. Acceptance of Roof water as drinking water:
   Colour, odour & taste are criterion, for people, in choosing source of drinking water.
2. Willingness of Household to participate in planning,

RTRWH

Calculations involved in Rooftop Rainwater Harvesting

Annual collection of rainwater through rooftop	
Area of the roof top(Length x Width)	100 sq.m
Average annual Rainfall at Raipur	1200 mm or 1.2 m
Precipitation on 100 sq. m. roof	100 x1.2 or 120 m^3
Maximum annual collection of water (@ 80% efficiency)	96m^3
Average annual consumption per head at Raipur (Taking 120 lt. PCPD)	0.12 x 365 = 43.8 m^3
Average annual draft per family at Raipur (Taking 5 members per family)	43.8 x 5 = 219 m^3

Therefore saving by recharge (96m^3) is about 44 % of annual draft of per abstraction structure.

OR

Water requirement for about 160 days for a family of 5 members.

RUN OFF CO-EFFICIENT

The entire volume of the rain falling on the roof cannot be harvested. A part of it is lost due to evaporation, seepage etc.

Available Run off = Rainfall * Area * Runoff-Coefficient

Run off coefficient is defined as the actual percentage of rainwater that can be harvested from any catchmant.

Catchments	Runoff Coefficient
Roof top	0.75 - 0.95
Paved area	0.50 - 0.85
Bare ground	0.10 - 0.20
Green area	0.05 - 0.10

RTRWH

AVAILABILITY OF HARVESTED WATER THROUGH ROOF TOP RAINWATER HARVESTING

Rainfall (mm)	600	700	800	1000	1200	1400	1600
Roof area (sq m)	Harvested water from roof top (cu m)						
20	9.6	11.2	12.8	16	19.2	22.4	25.6
30	14.4	16.8	19.2	24	28.8	33.6	38.4
40	19.2	22.4	25.6	32	38.4	44.8	51.2
50	24	28	32	40	48	56	64
60	28.8	33.6	38.4	48	57.6	67.2	76.8
70	33.6	39.2	44.8	56	67.2	78.4	89.6
80	38.4	44.8	51.2	64	76.8	89.6	102.4
90	43.2	50.4	57.6	72	86.4	100.8	115.2
100	48	56	64	80	96	112	128
150	72	84	96	120	144	168	192
200	96	112	128	160	192	224	256
250	120	140	160	200	240	280	320
300	144	168	192	240	288	336	384
400	192	224	256	320	384	448	512
500	240	280	320	400	480	560	640
1000	480	560	640	800	960	1120	1280
2000	960	1120	1280	1600	1920	2240	2560
3000	1440	1680	1920	2400	2880	3360	3840

HARVESTING FROM SLOPING ROOFS

Rain Water falling on the roof moves down towards edges of roof and is channelized through gutters & drain pipe to the storage tank or recharge structure.

Gutters are placed along both the edges of sloping roofs.

Slope of roof should not be more than 30 degree.

Sloping roof may be of any material. (Asbestos, G.I., Concrete and Tiles)

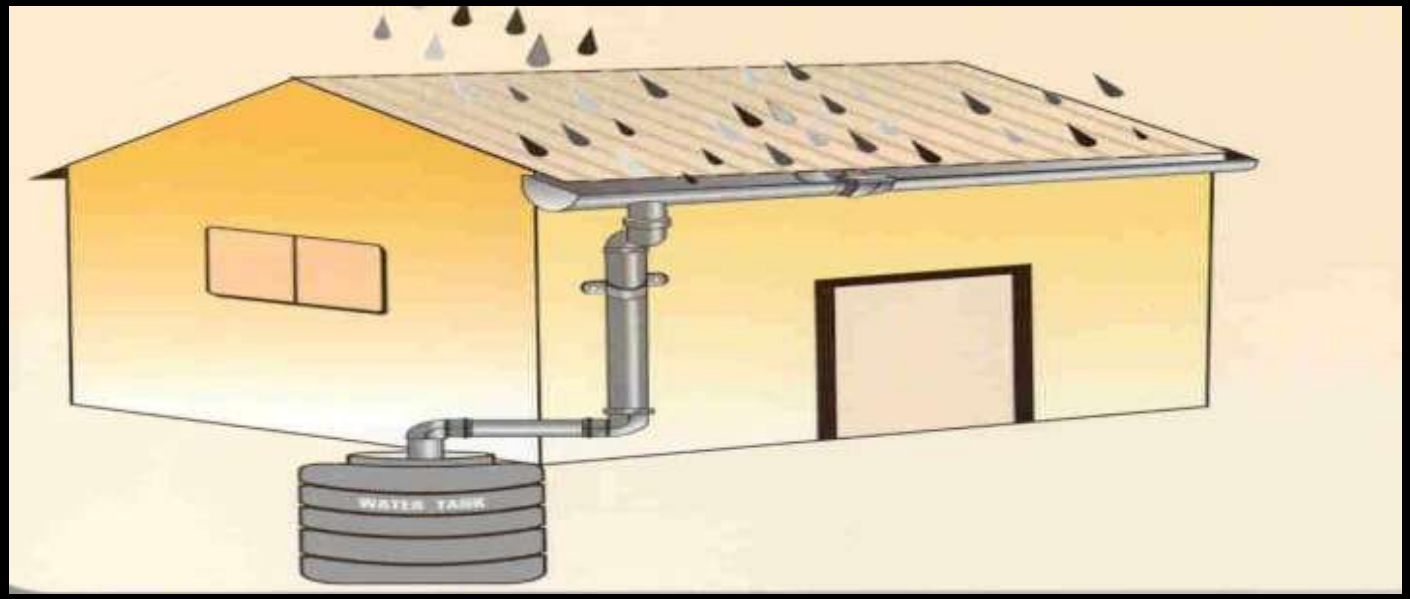
1. SEMI-CIRCULAR GUTTERS

2. RECTANGULAR GUTTERS

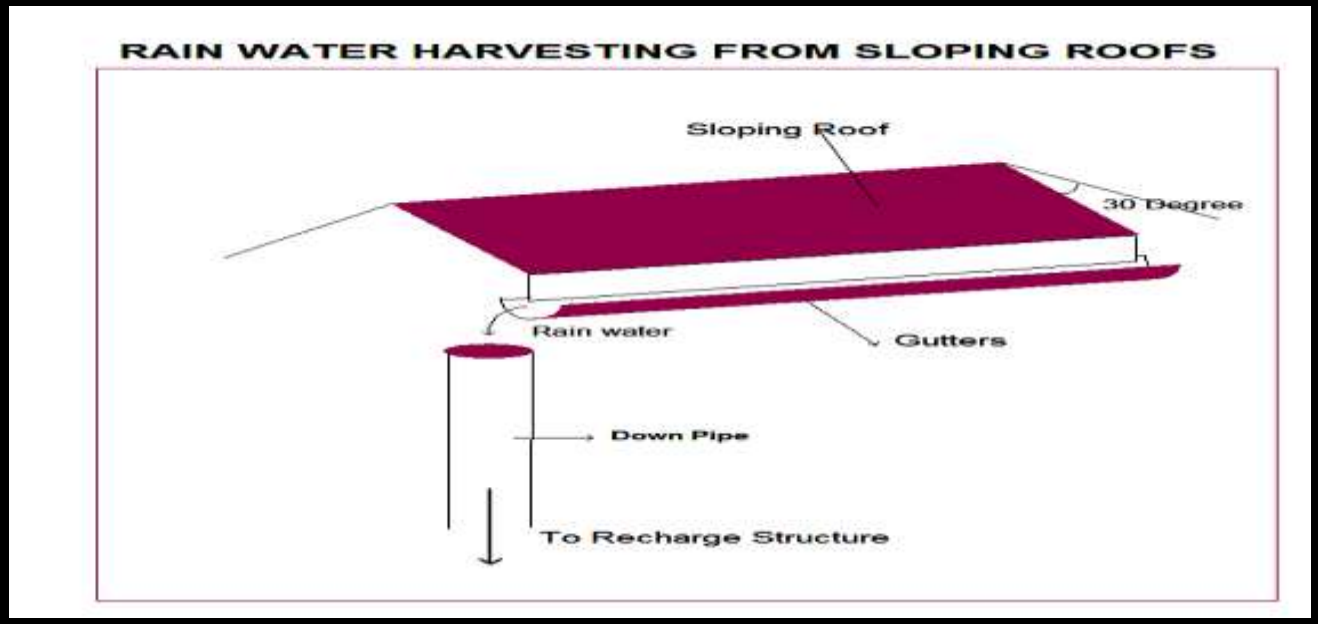
Gutters may be of GI,PVC or Split bamboos.

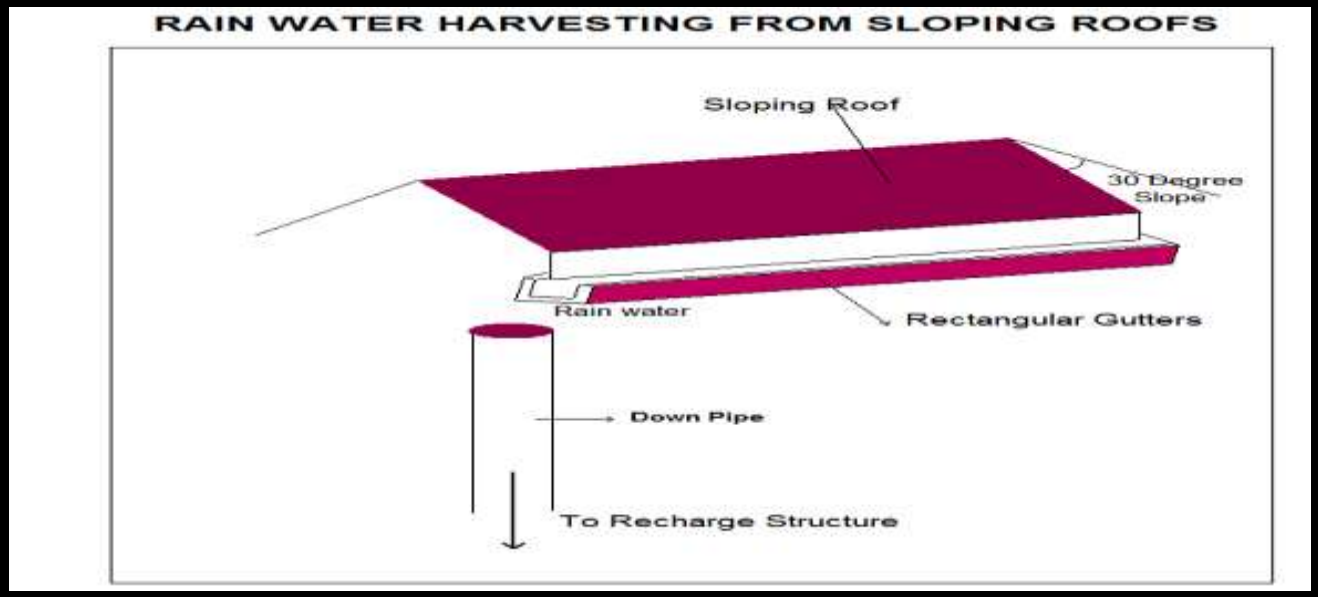
RTRWH

HARVESTING FROM SLOPING ROOFS



RTRWH


RAIN WATER HARVESTING FROM SLOPING ROOFS
Sloping Roof
30 Degree
Rain water
Gutters
Down Pipe
To Recharge Structure

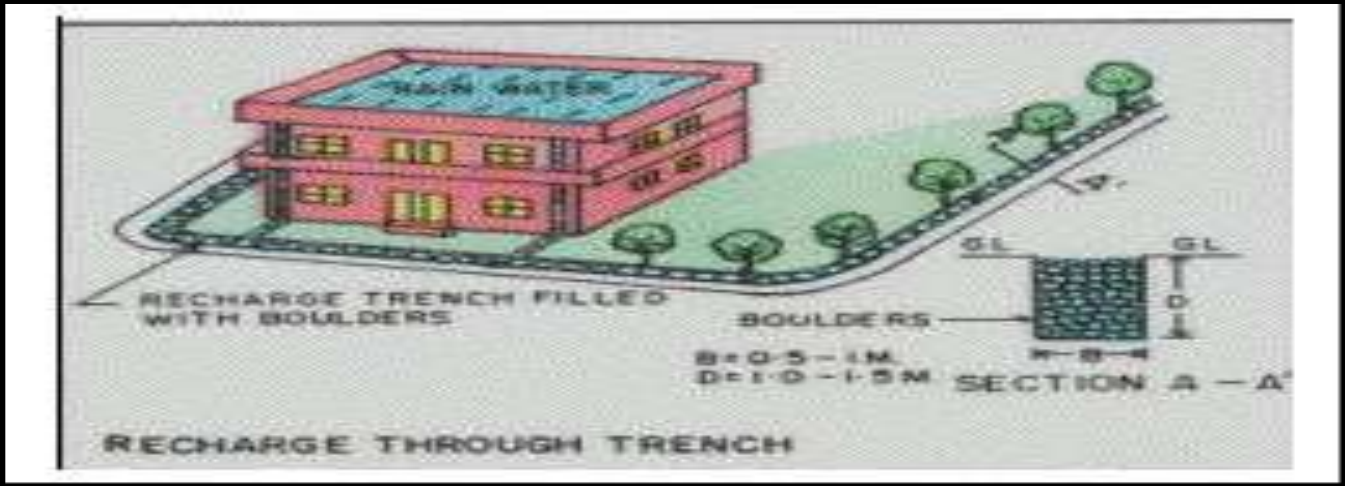

RAIN WATER HARVESTING FROM SLOPING ROOFS
Sloping Roof
30 Degree
Slope
Rain water
Rectangular Gutters
Down Pipe
To Recharge Structure

RTRWH

TYPES OF RECHARGE STRUCTURES USED IN RTRWH

- Areas where permeable rocks are exposed at shallow depth.
- For building having roof area of 100sq.m , for recharging shallow aquifers
- 1-2m wide,2-3 m deep and 2-3m long pit ,back filled with boulders (5-20cm),gravel(5-10mm.size)and Coarse sand(1.5-2mm.size) in the order of increasing grain size.
- A mesh should be provided at roof to prevent entry of solid waste /leaf debris into recharge pit.
- Settling pit or desilting chamber should be provided to prevent the entry of finer particles into the recharge pit.
- Clogging of filter media reduces the rate of filtration.Top layer of filter media should be cleaned periodically.
- By pass arrangements for diverting the flow of first 2-3 shower should be provided.

RTRWH

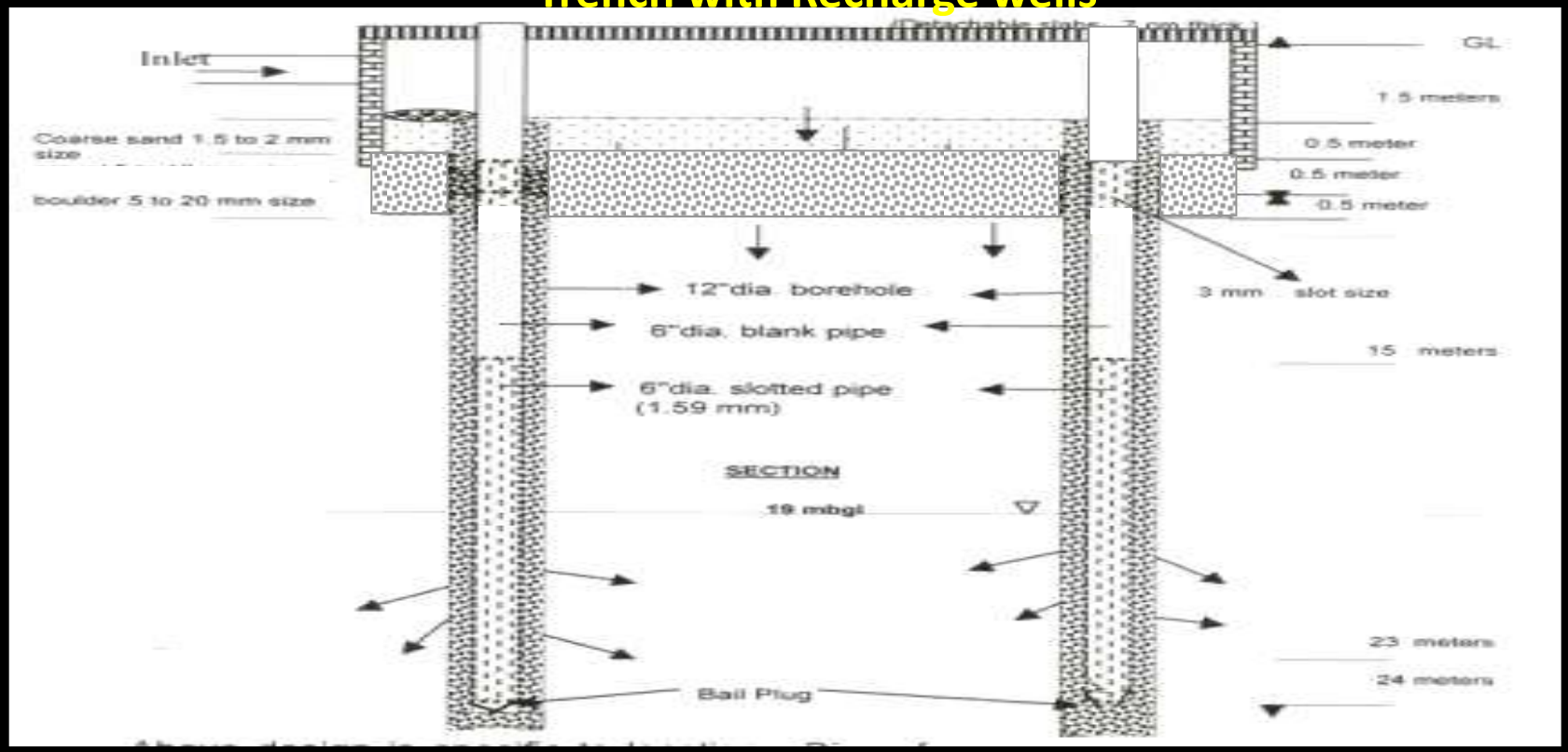


Recharge through trenches

- Suitable for building having roof area of 200 – 300 sq.m and where permeable rocks are at shallow depth.
- Trench may be 0.5 - 1m.wide ,1 - 1.5m deep and 10 - 20m long depending upon the roof area.
- Trench is backfilled with filter media of recommended size, in the order of increasing grain size.
- A mesh should be provided at roof to prevent entry of solid waste /leaf debris into recharge trench.
- Settling pit or desilting chamber should be provided to arrest the flow of finer particles before it enters into the trench.
- Clogging of filter media reduces the rate of filtration.Top layer of filter media should be cleaned periodically.

RTRWH

Trench with Recharge wells



- Suitable where top layer is impervious and permeable strata lies at shallow depth(within 20 m).
- Where roof area is big and large quantity of roof water is available within a short period of heavy rain fall.
- Lateral trench of 1.5 to 3m. in width and 10-30m length & 3m.depthi s constructed with the shallow recharge well in the centre.
- The trench is back filled with boulders, gravels and coarse

RTRWH

Trench with recharge well

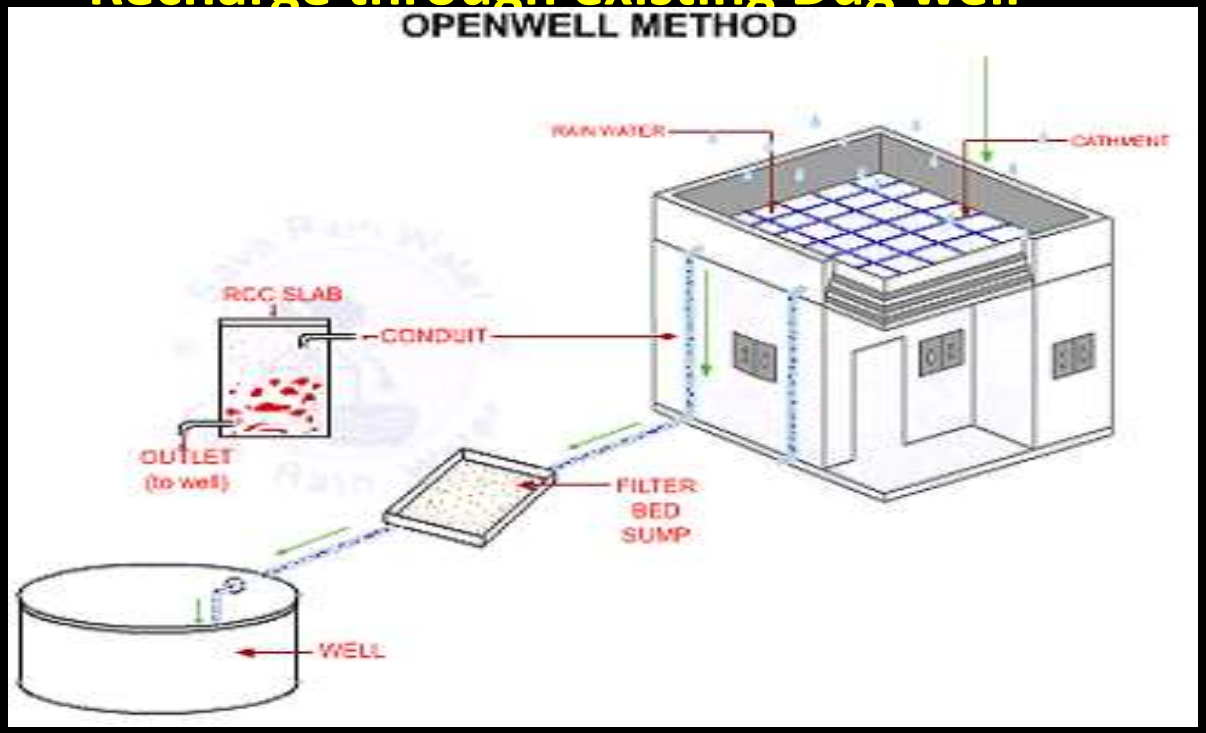
- If the aquifer is available at greater depth(>20m.) a shallow shaft of 2m dia and 3-5m depth is constructed.

- Inside shaft a recharge well of 100-300mm dia is constructed for recharging the available water to deeper aquifers.

- At the bottom of the shaft a filter media is provided to avoid choking of recharge well.

RTRWH

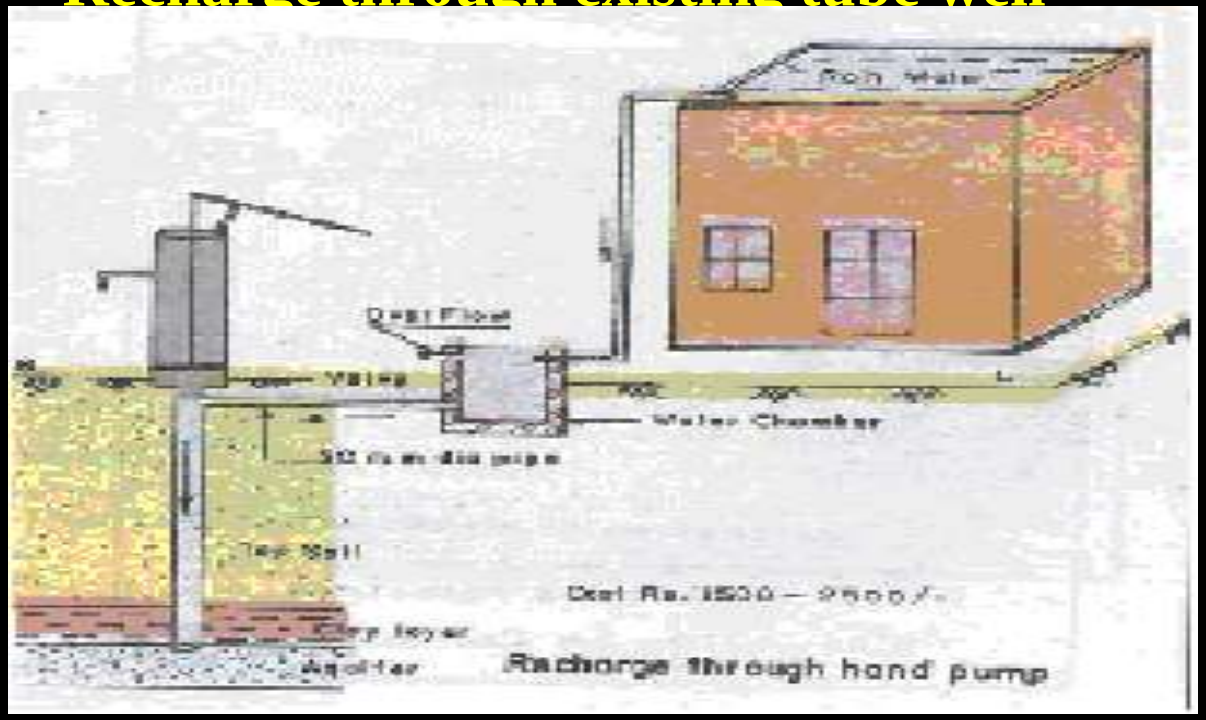
Recharge through existing Dug well



- This method is used where Shallow dug well aquifer is dry.
- Water collected on roof top is brought down through PVC pipes.
- Water is passed through the settling tanks and filter media .
- Filtered water is poured in to the dug well

RTRWH

Recharge through existing tube well



- This is used when shallow aquifer is dry and deeper aquifer to be Recharged.
- Roof water is brought down at G.L by using pvc fittings.
- Water is passed through PVC filter before entering into recharge structure.
- Desilting tank is constructed before Filter.
- A gentle slope of 1:15 may be maintained between desilting chamber and filter
- water from tube well should be used after chlorination

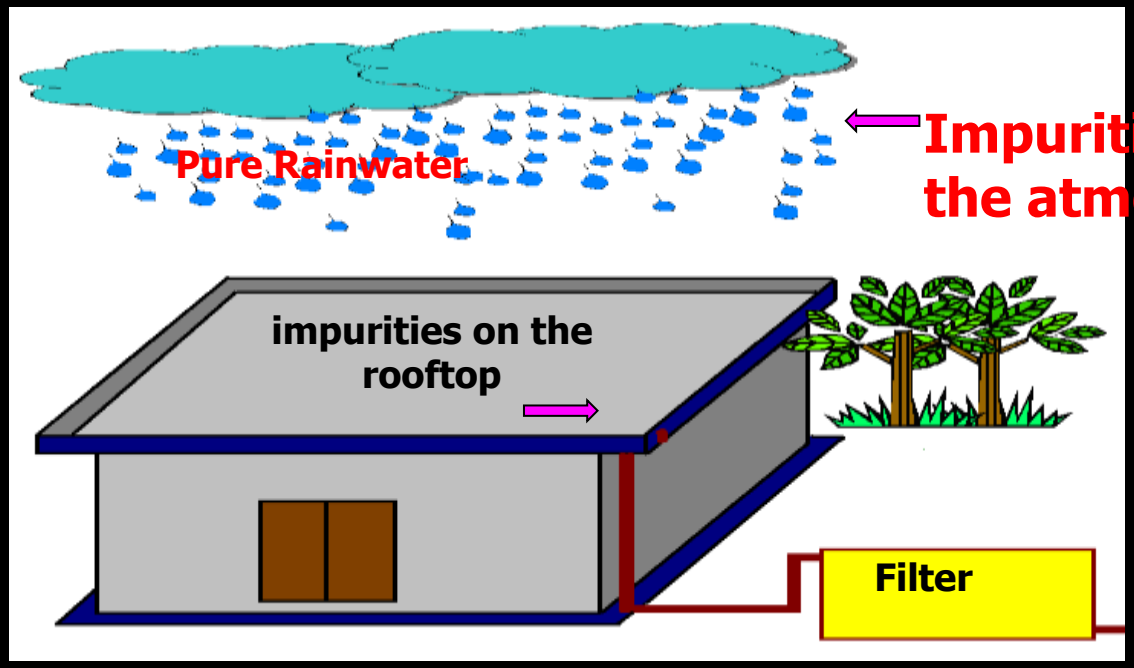
RTRWH

FILTERS

- Why do I require a Filter.
- What is a Filter.
- Where should I place the Filter.
- What are the different types of Filters.
- How big my Filter should be.

RTRWH

Why Filters ?

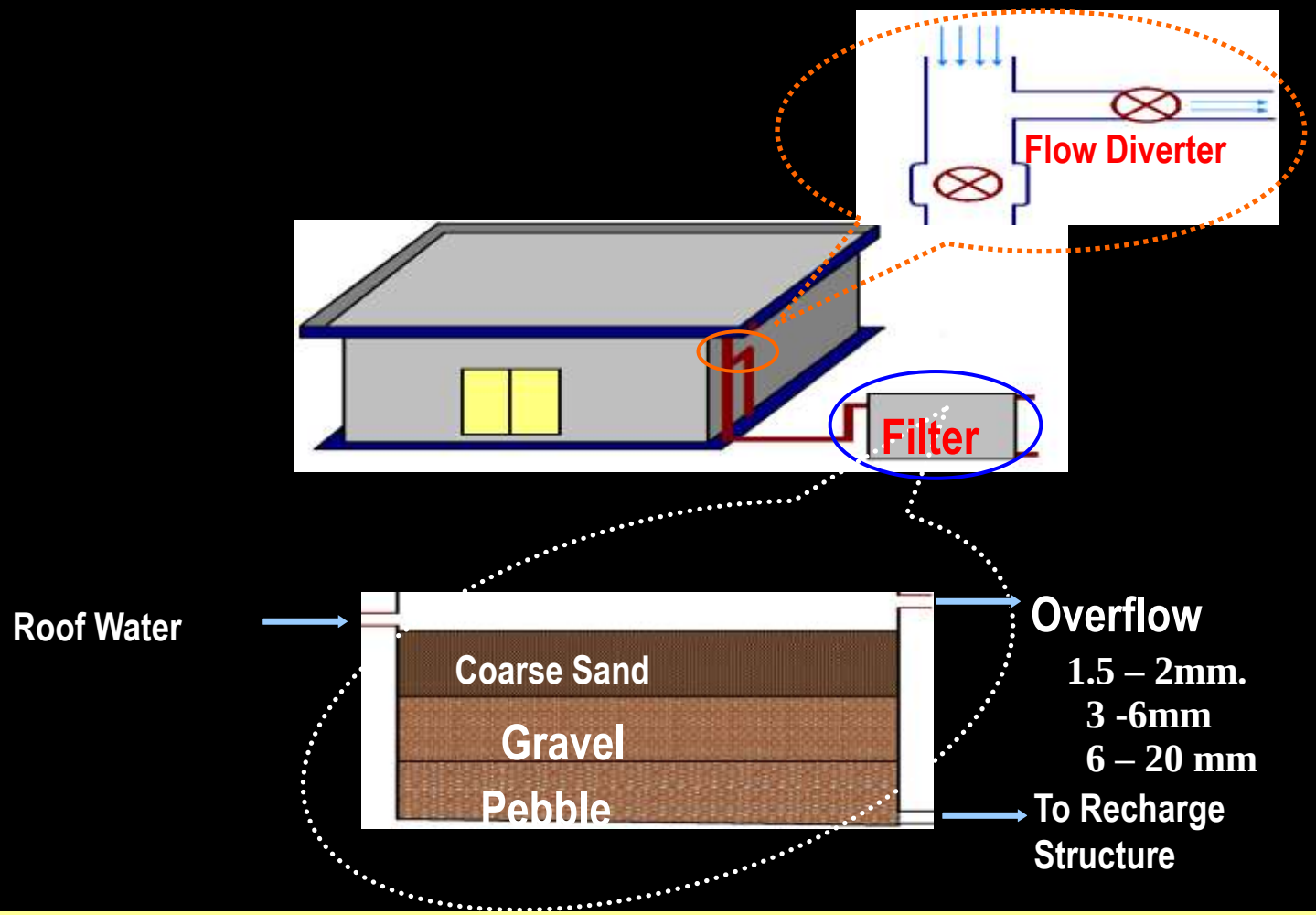


Basic concept of using filter is to remove the suspended particles from rain water and make it suitable for recharge.

Suspended particles in water if allowed to go into the well may reduce the life of the well.

Roof washing and flushing.

WHAT IS A FILTER ?



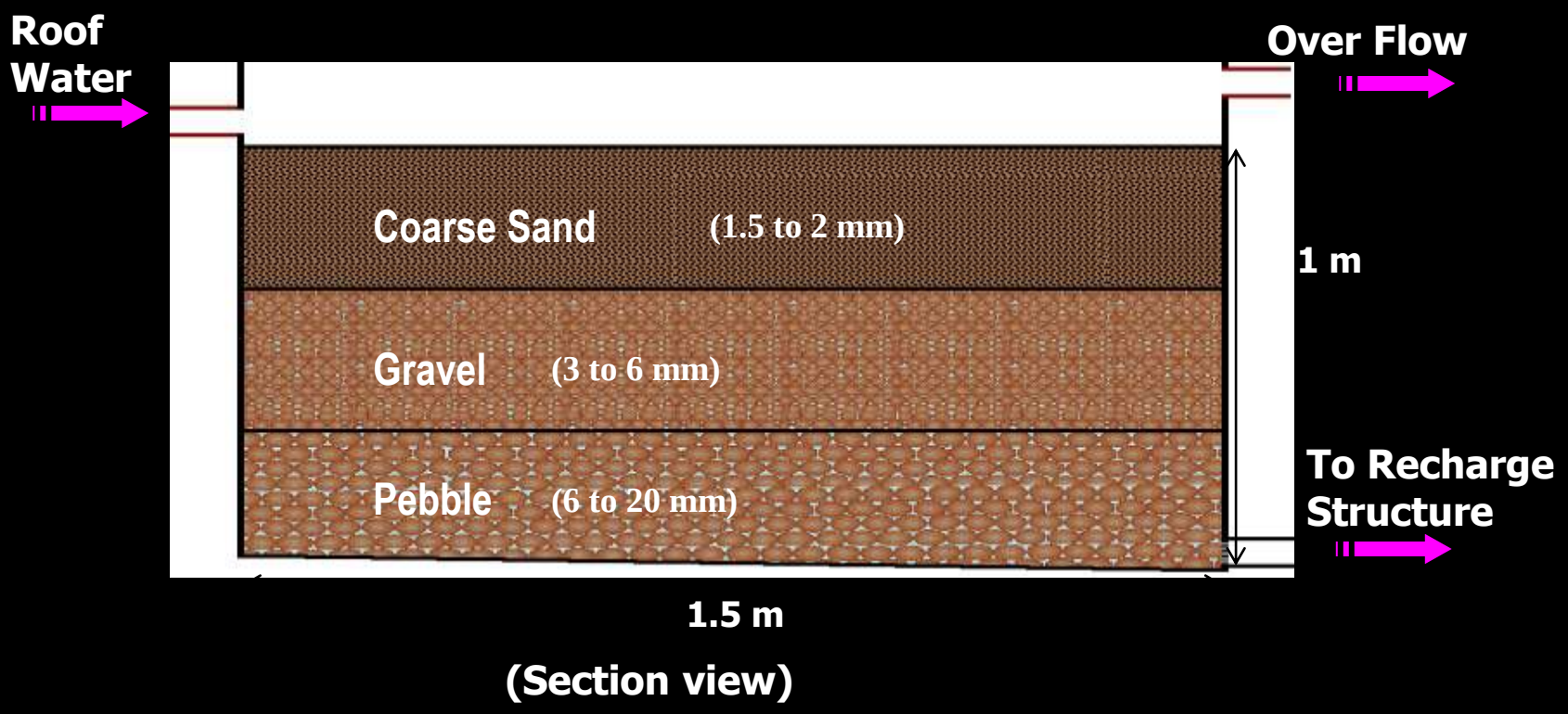
Filter is a columnar structure filled up with different layers of well rounded & well sorted corrosion free granular material of increasing grain size.

Placement of the Filter

- The filter should be placed near to the recharge structure.
- The Filter can be placed above ground level or below ground level.
- The underground filter should not be placed close to a source of contamination, such as a septic tank and open drains.
- The filter can be placed horizontally or vertically .

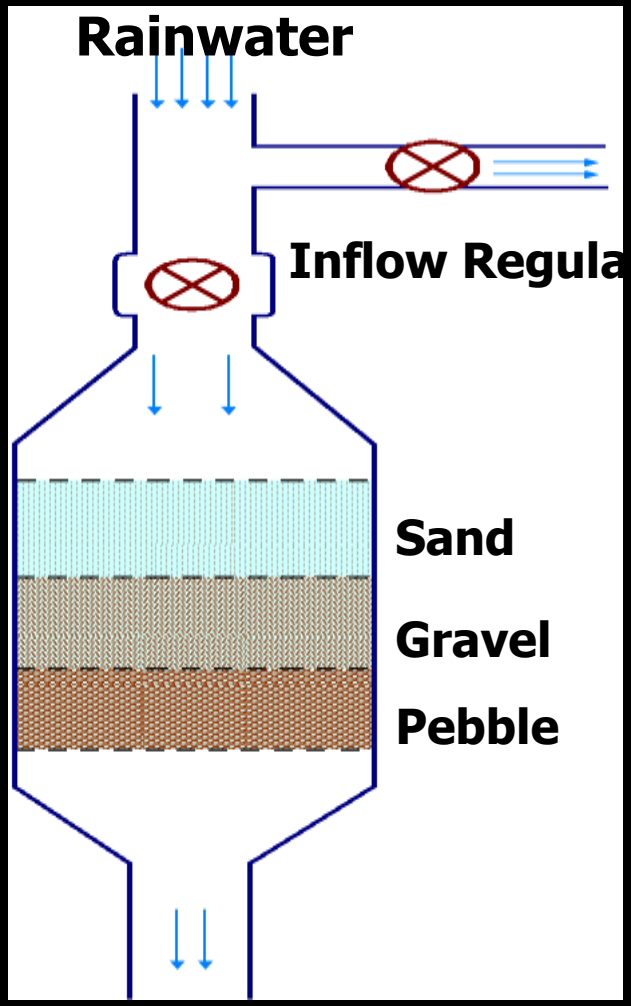
Types of filter and selection criteria

Filter Design



RTRWH

FILTER DESIGN



To Recharge Structure

Filter Design

Why prefer sand as filter media?

- **Sand is cheap and easily available natural material**

- **It is corrosion free & long lasting if its origin is quartzitic.**

- It forms a highly permeable and porous media(if well rounded & well sorted).

- The sand layer acts as a **'Slow Sand Filter'** improving water quality in different ways:

Filter Design

Why prefer sand as filter media?

By mechanical Straining:

Remove suspended particles, which are too large to pass through pore spaces.

Sedimentation:

Finer suspended material gets deposited on surface of sand grains.

Adsorption:

Suspended particles retained in the sticky gelatin coating formed by deposited bacteria and organic matter on sand grains.

Bio-Chemical Activity:

By the action of micro-organism, organic matter will be converted in to mineral constituents which ultimately gets dissolved in water.

Filter Design

Why prefer sand as filter media?

Bacterial Activity: Raw water contains some Bacteria and Pathogens. Most of them gets filtered while passing through sand media through mechanical straining, deposition and adsorption. Even if some of them passes through the sand media, the sub-surface is an unhealthy place for them and can't survive longer.

" Thus the water coming out of filter is free from suspended particles and bacteria and Pathogens"

DIMENSION OF THE FILTER

Dimension of the filter depends upon the following factors.

- **Area of catchment**
- **Intensity of rainfall**
- **Filtration capacity**
- **Intake capacity of the aquifer**

DIMENSION OF THE FILTER

The dimension of the filter can be estimated using the Darcy law as follows:

$$Q = K A h/L$$

$$A = QL/Kh$$

Where

Q = rate of inflow of water

A = Cross sectional area of the filter

h = Head

K = Hydraulic conductivity

L = Length of the filter column

(sand column)

Sample calculation

Catchment Area

= 100 m^2

Average Daily Rainfall in Raipur City

= 20mm/hr or 0.02m/hr

Volume of Rainfall

= Catchment*Rain Fall

= 100sq.m *0.02m/hr

= 2 Cu.m/hr.

= 2000 ltrs/hr

= Volume of Rainfall Harvested @80% efficiency

=1600 ltrs /hr $\simeq$ 0.5 lps = 0.5 x 10^{-3} m^3/sec

Q = 0.5 x 10^{-3} m^3/sec (rate of inflow into the filter).

K = 45 m /day (Hydraulic conductivity for C.Sand)

h = 2 m (Head Difference)

L = 0.5 m (Thickness of sand Layer)

Using the equation $A = QL/Kh$

$A = 0.24\ m^2$

For a circular filter ,Diameter = 0.55 m

For a square filter, dimension = 0.5 m x 0.5 m

MAINTENANCE OF FILTER

To maintain longer efficiency & good performance of filter its maintenance is must.

Upper layer of filter material should be cleaned / changed periodically.

Underground filter should be properly Lined/Sealed and covered from top.

All the chambers of filter may be separated by PVC / rust proof material screens.

All the openings of the filter should be properly sealed.

Presence of settling tank ,increases the efficiency & life of filter.

Provision of screen to retain the debris should be on roof itself.

POINTS TO PONDER

The roof should be kept clean by regular washing & flushing.

If the water is being used for drinking, it has to be chlorinated/boiled after abstraction.

A rainwater system must include installation of an overflow pipe, which empties into a non-flooding area.

All the openings into the filter should be screened/covered.

Filters should be accessible for cleaning.

The first rain should not be allowed to enter the filter.

The filter should be cleaned periodically.

Ensure that the entire process is Hygienic, Because There is no remedy for aquifers once polluted.

(AR/RWH) = to make running water towalk,walkingwater to stop stopped water to percolate

जलम जीवन आधारम
जहाँ का पानी वहीँ

जायन्ते लियानते अस्मिन इति जलम

If you fail to plan ,you plan to fail
what ever emerges from god almighty it merges in him.

Jalam is a God gift so we must take it as a Prasad.

Water is one of the five life sustaining element of nature.

Water is a sacred (liquid gold)that is why people take dip in kumbh.

Demand of water is growing by 2.4%per year .
Cup =conservation+utilization+preservation

Crop	water consumption per/kg in liter
rice	1900 Lt
wheat	1400 Lt
cotton	530 Lt
tea	7000 Lt
coffee	10000 Lt

Velocity of water to be filtered should not be more than 0.3M/sec.
Water is essential for life growth & health since water is life & we are working for water/life. i. e we are water /life givers that is why we are great engineer
Life is a echo, if you are good to others you are best to yourself .
Do the thing ,the thing you cannot do .
Doing right thing ,things doing right .

God has given you one mouth and two ears so listen twice than what you speak .wastage of water

one drop /sec in	one day	=5.2 litres
	one week	=36.4 litres
	one year	=1891 liters’

Points to be noted—

1. Till 1970's open well were used everywhere .wastage of water started with the introduction of electric pumps for lifting water. The Government has some unscientific Plan such as deepening the existing bore wells, drilling more number of tube wells, supplying water by tankers etc. are responsible for water crises. Now the time has come to pay the prices of our mistakes over the decades.

Average rainfall of Karnataka is 1135 mm, if so where does this water go !

The answer is quite simple it goes in to the sea without recharging the ground storage due to deep hard rock.

Ground water storage is like a bank account if you will fill it in rainy season you can withdraw in summer. However irresponsible behavior resulted in to empty water account. Hence we are responsible for its recharge.

Runoff erodes the fertile soil surface hence the term soil & water conservation is in use. Leftover eroded hard soil of this kind is not suitable for crops. On the other hand the silt accumulates in the tank, river basin and dams, this result in the dead storage.15-20 T soil eroded per hectare every year every session.

Check Dam- A check dam or small structure of this type is useful for rainwater harvest at the bottom of the hill. No cement is used here, collected water percolates deep & recharge the ground water storage. A canal may draw excess water for the other storage structure or directly for irrigation.

Trenches & bunds- plough the land across the slope. Make trenches & bund of this size, if the slope is steep

Even though the rain water is pure as distilled water, it may get polluted with the dust & set of dissolved gases in the atmosphere, hence filtering is essential, it is very difficult to remove these dissolved gases, so we have process of first rain water seperator.first 1-2mm rain is diverted through the separator.

The 2.5’x2.5’x2.5’size filter is sufficient for roof of 30’x40’

Let us choose a separate storage tank for rain water & municipal supply. Let the light not entre the sump to avoid algae. Use a small motor or hand pump to lift.

Ground Water-

Surface of the earth is covered with the soil, below that is the weathered zone, the next layer is fractures zone, and the central core of the earth is a massive rock zone. Even these rock zones have cracks. The percolated rain water is stored in all these layers. This store itself is called underground storage. Recharging with rainwater can bring down the salinity of such bore well water & hence it improves the yield as well as the quality of water.

Recharging is better option than drilling one more bore well. It is cheaper & permanent solution of the water problems. If the polluted runoff water enters the bore well, will spoil the quality of water .Hence the perfect filtering system is important. If it is a drinking water bore well put a layer of charcoal, this is a good filtering material, which will remove the bed odor of water. This is not necessary for irrigation bore well. In case of drinking water bore wells only roof water is fed. At least now we must start serious efforts towards harvesting .No life can exist in this planet without water. Better late than never. Let us join hand for this noble cause.

Thank You