RAINWATER MANAGEMENT FOR CULTIVABLE LANDS

Practices

Artificial Recharge

- Artificial recharge to ground water is defined as the recharge that occurs when the natural pattern of recharge is deliberately modified to increase recharge (*ASCE:2001*).
- The process of recharge itself is not artificial. The same physical laws govern recharge, whether it occurs under *natural* or *artificial* conditions.
- What is artificial is the availability of water supply at a particular location and a particular time.

Advantages of Artificial Recharge

- Subsurface storage space is available free of cost and inundation is avoided
- Evaporation losses are negligible
- Quality improvement by infiltration through the permeable media
- Biological purity is very high
- It has no adverse social impacts such as displacement of population, loss of scarce agricultural land etc
- Temperature variations are minimum
- It is environment friendly, controls soil erosion and flood and provides sufficient soil moisture even during summer months
- Water stored underground is relatively immune to natural and man-made catastrophes
- It provides a natural distribution system between recharge and discharge points
- Results in energy saving due to reduction in suction and delivery head as a result of rise in water levels

Time of Concentration

It is defined as the time needed for water to flow from the most remote point in a watershed to the watershed outlet. It is a function of the topography, geology, and land use within the watershed.

Time of Concentration is normally determined by :

$$T_c = 0.01947 \quad L^{0.77} \quad S^{-0.385}$$

where, T_c = Time of concentration (min)

L = Maximum length of travel of water (m)

S = Slope of drainage basin = H ÷ L

H = Difference in elevation between the most remote point of the basin and its outlet (m)

L = Maximum length of travel (m)

Time of concentration increases with the increase in length of travel and decrease in the slope .

Increasing Time of Concentration

- Runoff generated during rainfall from the hills and forest above the village passes through rapidly to the stream or river below. Rain water hardly stays for an hour or half inside the village.
- Rainwater does not infiltrate(hardly 10%) due to such short stay. This because, water infiltrates @ 50 to 75 mm per hour compared to over the ground speed of 2km per hour. To infiltrate a shower into the ground the water must stay 10 to 20 hours inside the watershed.
- We need to have some mechanical measures to supplement the vegetative (cropping / plantation) measures to achieve this.
- Our crop fields have been bunded to achieve this. The height of the bunds are directly related to slope of land.

Management Technique

The aim is to increase the natural recharge of rainwater from 10% to 50% by proper management

Ridge to Valley Treatment

(1)Managing external runoff;

(2) Managing the rain falling inside the treated area;

(3) Preventing the loss of soil water through underground drainage from the treated area.

Managing External Runoff 1

- External runoff comes from the hills and/or jungle located above the treated area.
- Moderating role of the disappeared forest is sought in a mechanical measure called *Graded* Earthen Guide bund which is laid above the treated area covering reels and small gullies.
- Normally it runs along the border of cultivable area and village/reserve forest.
- Prevents the entry of runoff directly into the cultivable area arresting debris and rubbish.
- Protects the low lands from the wrath of flash floods and breaching of field bunds.

Managing External Runoff 2

- This bund is laid in a grade (1 : 200)so that it guides the runoff laterally in slow pace.
- The alignment of the bund will be such that the flow path will be as wide as possible to provide sufficient percolation area.
- Most of the water gets percolated and the balance, if any, is safely guided to nearby stream.
- This percolated water seeps laterally to low lands under the ground *and*
- On the way it provides root zone irrigation to crops on the lands below the bund.

Managing External Runoff 3

- Burrow pits should preferably located on the upstream side and discontinuous.
- This bund is not to retain water for very long as in case of reservoir bunds. Its purpose is to change the direction of flow of runoff.
- Stone pitching on the upstream side may be necessary to prevent scouring preferably at gully crossings.
- Deeper gullies can be converted into Water Harvesting Structurers.

Managing External Runoff 4

- This bund will be 1.5 meter high minimum at the ridges with stable cross section.
- If required, surplus escapes in the form of Loose Boulder Structures at ridge points may be provided at suitable (300metre) intervals to allow spilling of water in excess of 1 meter depth of flow.
- In case of sloping flow path beyond 0.5%, the longitudinal slope should be limited by providing Loose Boulder Spurs along the flow path, if necessary.

Managing the Treated Area (High Lands)

- Highlands to be bound with strong field bunds to conserve rainwater falling on individual plots.
- Excess water, if any, is guided laterally but not down below.
- This conserves enough moisture even if no external runoff water is available for the area.
- All the high lands of the village are developed to grow light duty crops and/or plant fruit trees.
- The treatment will facilitate conserve rainwater and reduce runoff to zero.

Managing the Treated Area (Gullies)

- Gullies are controlled by earthen bunds above the gully (horseshoe shape) to prevent runoff entering into it.
- Larger wider gullies are bunded downstream to convert them into WHSs.
- Surplus water, if any, released over flatter lands to facilitate infiltration.
- Deep Gullies / Ravines may need one Sub - Surface Dyke to conserve moisture inside the gully.

Managing the treated area (Medium Lands)

- Mediums lands usually have steep slope.
- Normally, they are thoroughly bunded with high bunds and do not need further treatment.
- If required, Loose Boulder Surpluses may be provided to handle the excess runoff to side plot but never to plot below.
- Crops in medium land get irrigation from the rainwater conserved there.
- Underground flow of in-filtered water of highlands draining down to lowlands provide root zone irrigation

Managing the treated area (Low Lands)

- Low lands are flatter and never fall short of moisture.
- Their problem of breaching field bunds is tackled by the work done in the highlands.
- Shallow dug wells can be dug in low lands to pump out water to

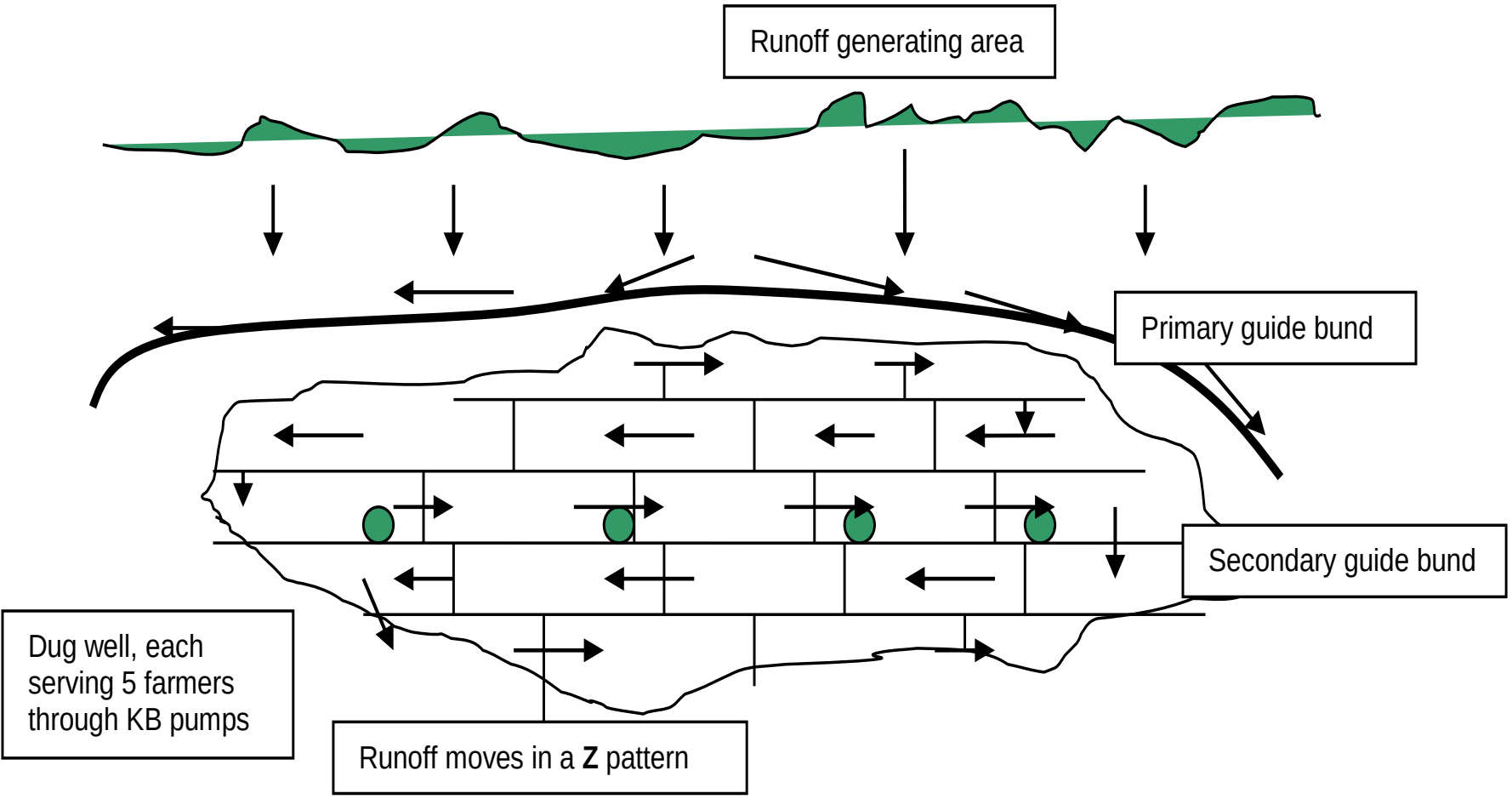
(i) grow summer vegetable in adjoining medium land and

(ii) free low land of water logging to grow legumes instead of summer paddy.

Preventing the loss of soil-water from the treated area

- In the hilly areas the recharged (naturally and artificially) water drains out rapidly through streams after the rain stops due to high slope.
- Subsurface dykes/Groundwater dams are built across streams at tactical locations to conserve soil water even after rains.
- They allow normal flood discharge to flow without any restriction.

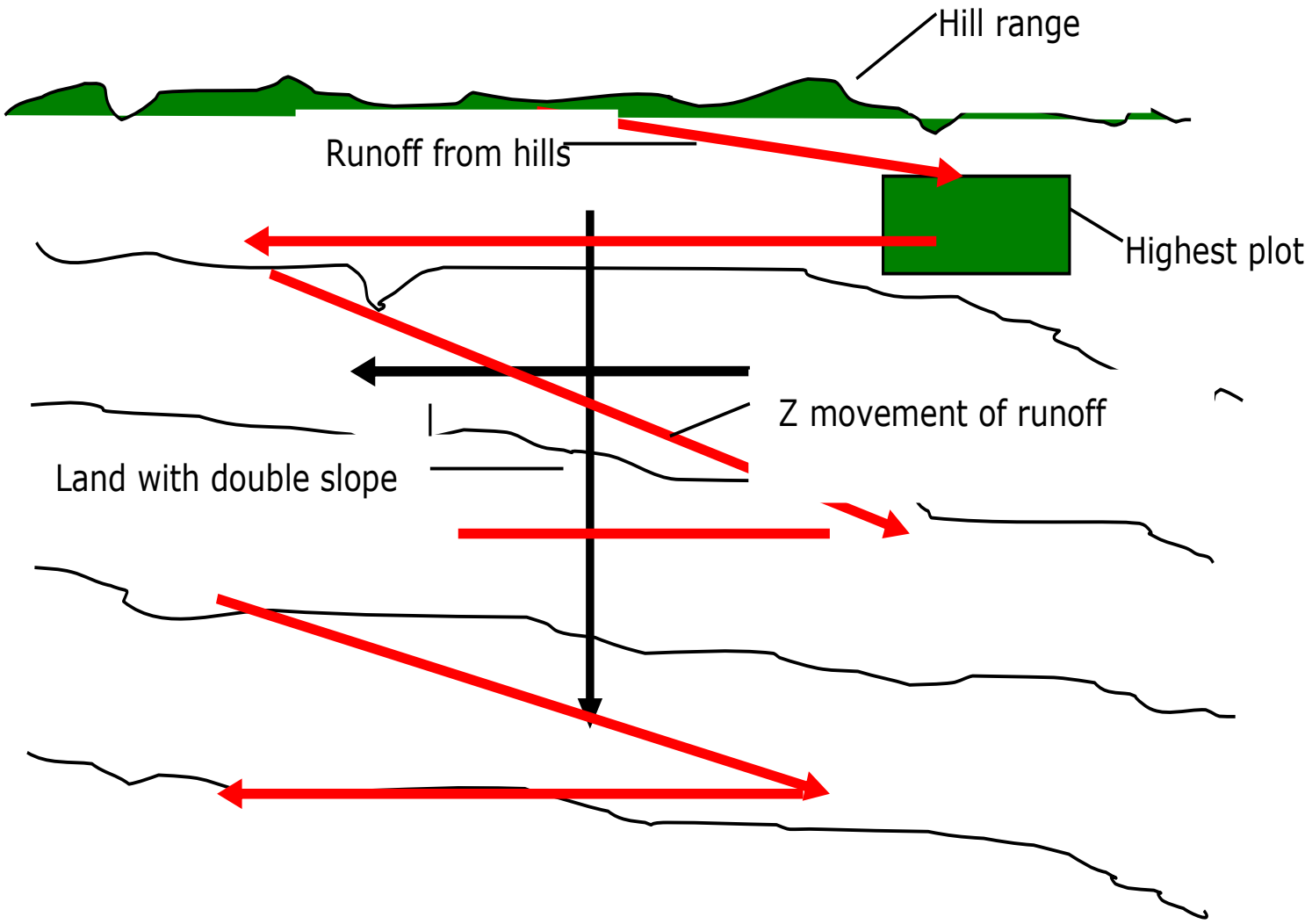
General Project Design



Relatively flat valley with / without a spring

- Here the terrain is relatively flat with a double slope. Down ward slope is steeper. Lateral slope is milder.
- A runoff collection bund is to be created and led via the highest plot of the area. There after the entire runoff is to be led via plots in a Z path.
- The field bunds are to be strengthened to contain the run off.
- Here, if the generated runoff in the hills is too high only part of it could be tapped. Rest could be bye-passed to the nearest stream.

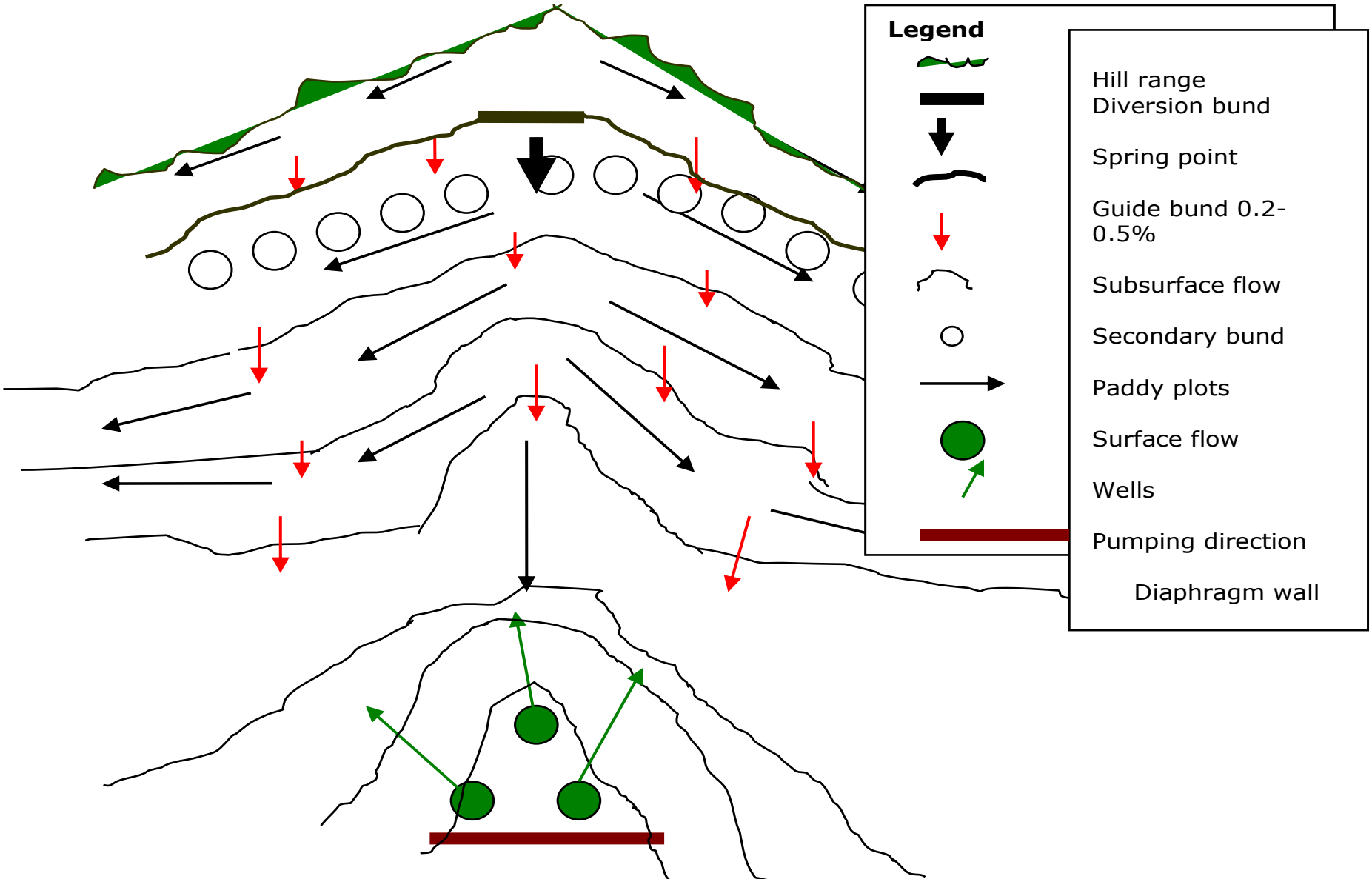
Relatively flat valley with/without a spring



Sunken valley with / without a spring

- The treatment starts with the first plot located at the highest elevation at the foothills. The lower bund of the plot is strengthened to serve as a diversion bund.
- The entire run off is divided in to two halves and made to pass along the highest cultivated strip of land on either side.
- For that matter the appropriate bunds are to be selected and strengthened so as to be able to contain the runoff.
- The entire run off passes along the side flanks so that the paddy lands lying in the valley are not flooded to avoid breach in field bunds.
- It facilitates maximising infiltration to saturate the subsoil from top to bottom.

Sunken valley with / without a spring



Wrap-up

- Terrains are rarely pure.
- They are usually a mix.
- Designs are to be developed depending on the topography keeping the principles deliberated so far.