Watershed is a geo-hydrological unit governed by the topography of the terrain from where rain/runoff water drained through a particular point.
Watershed as Planning Tool

- Watershed constitutes natural spatial frame of hydrologic units for harnessing and utilizing water, soil and forest resources in a sustainable manner within its natural eco-system.

- Delineation and codification of watershed of a country allows recognizing each hydrologic unit with unique ‘National Code’ that provides a vital platform to synergize all developmental programmes related to natural resources management, rural livelihoods etc., avoiding duplication of interventions of various line departments and ministries.
WATERSHED DELINNATION

Watershed to Sub-watershed Delineation

Sub-watershed to Micro-watershed Delineation

Codification

1st digit: Region
2nd digit: Basin
3rd digit: Catchment
4th digit: Sub Catchment
5th digit: Watershed
6th digit: Sub Watershed
7th digit: Micro Watershed
Shape of a typical watershed
WATERSHED: IMPORTANT PARAMETERS

- Topography
- Soil & geology
- Meteorology
- Land use & crop cover
- Water bodies
- Institution

Planning, Designing and Implementation
WATERSHED: IMPORTANT PARAMETERS

- **TOPOGRAPHY**: Slope, drainage lines, depressions, catchments for structures etc facilitates decision making for structural locations and agronomic measures.

- **SOIL & GEOLOGY**: Estimation of soil loss, infiltration & ground water recharge, type of intervention.

- **METEOROLOGY**: Quantification of available water & runoff, identification of agro-climatic zone, water requirement etc.

- **CROPS & LAND USE**: Selection plants, sustainable farming, crop diversification and allied activities.

- **WATER BODIES**: To estimate available storage capacity and supplementary requirement.

- **INSTITUTION**: To plan, design, execute, monitor and maintain through people’s participation.
WATER BALANCE

Precipitation

ET

Land Surface

Infiltration

Overland flow & inter flow

Stream Channel

Water Body

Base flow

Soil

Aquifer

discharge
SCS method for prediction of runoff

\[ R_s = \frac{[P - 0.2S_{max}]^2}{[P + 0.8S_{max}]} \]

\[ S_{max} = \frac{2540}{CN} - 25.4 \]

- **\( R_s \)**: Storm Runoff
- **\( S_{max} \)**: Maximum Retention Capacity

\[ R_t = \frac{A_1R_{s1} + A_2R_{s2} + A_3R_{s3} \ldots}{A_1 + A_2 + A_3 \ldots} \]

### Curve Number (CN) for different land use

<table>
<thead>
<tr>
<th>LAND USE OR COVER</th>
<th>TREATMENT OR PRACTICE</th>
<th>HYDROLOGIC CONDITION</th>
<th>HYDROLOGIC SOIL GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow</td>
<td>Straight row</td>
<td>Poor</td>
<td>A 77 B 86 C 91 D 94</td>
</tr>
<tr>
<td>Row crops</td>
<td>Straight row</td>
<td>Poor</td>
<td>A 72 B 81 C 88 D 91</td>
</tr>
<tr>
<td>Contoured</td>
<td>Straight row</td>
<td>Good</td>
<td>A 67 B 78 C 85 D 89</td>
</tr>
<tr>
<td>Contoured</td>
<td>Contoured</td>
<td>Poor</td>
<td>A 70 B 79 C 84 D 88</td>
</tr>
<tr>
<td>Contoured</td>
<td>Contoured and terraced</td>
<td>Poor</td>
<td>A 65 B 75 C 82 D 86</td>
</tr>
<tr>
<td>Contoured</td>
<td>Contoured and terraced</td>
<td>Poor</td>
<td>A 66 B 74 C 80 D 82</td>
</tr>
<tr>
<td>Small grain</td>
<td>Straight row</td>
<td>Poor</td>
<td>A 65 B 76 C 84 D 88</td>
</tr>
<tr>
<td>Close-seeded legumes or rotation meadow</td>
<td>Straight row</td>
<td>Good</td>
<td>A 63 B 75 C 83 D 87</td>
</tr>
<tr>
<td>Close-seeded legumes or rotation meadow</td>
<td>Contoured</td>
<td>Poor</td>
<td>A 63 B 74 C 82 D 85</td>
</tr>
<tr>
<td>Close-seeded legumes or rotation meadow</td>
<td>Contoured and terraced</td>
<td>Poor</td>
<td>A 61 B 73 C 79 D 82</td>
</tr>
<tr>
<td>Pasture or range</td>
<td></td>
<td>Good</td>
<td>A 59 B 70 C 78 D 81</td>
</tr>
<tr>
<td>Meadow (permanent)</td>
<td></td>
<td>Poor</td>
<td>A 66 B 77 C 85 D 89</td>
</tr>
<tr>
<td>Woodlands (farm woodlots)</td>
<td></td>
<td>Good</td>
<td>A 58 B 72 C 81 D 85</td>
</tr>
<tr>
<td>Farmsteads</td>
<td></td>
<td>Poor</td>
<td>A 64 B 75 C 83 D 85</td>
</tr>
<tr>
<td>Roads, dirt</td>
<td></td>
<td>Good</td>
<td>A 55 B 69 C 78 D 83</td>
</tr>
<tr>
<td>Roads, hard-surface</td>
<td></td>
<td>Poor</td>
<td>A 63 B 73 C 80 D 83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 51 B 67 C 76 D 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor</td>
<td>A 68 B 79 C 86 D 89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 49 B 69 C 79 D 84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor</td>
<td>A 39 B 61 C 74 D 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 47 B 67 C 81 D 88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor</td>
<td>A 25 B 59 C 75 D 83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 6 B 35 C 70 D 79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 30 B 58 C 71 D 78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor</td>
<td>A 45 B 66 C 77 D 83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fair</td>
<td>A 36 B 60 C 73 D 79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 25 B 55 C 70 D 77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor</td>
<td>A 59 B 74 C 82 D 86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fair</td>
<td>A 72 B 82 C 87 D 89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>A 74 B 84 C 90 D 92</td>
</tr>
</tbody>
</table>
Demand and Availability of Water

Rainfall (mm) vs. WR (mm)

- Excess
- Shortage

January to December

Graph showing the relationship between rainfall (mm) and water resources (WR, mm) over the year, indicating periods of excess and shortage.
Illustrative Watershed Interventions

**Arable**
- Field/Contour/Graded Bunding, Vegetative barriers
- Contour farming, strip cropping, mulching, tillage, residue management
- Bench/Zingg terracing, Land Leveling
- Farm ponds, diversions, safe disposals, grassed water way

**Non Arable**
- Contour/staggered trenching
- Stone/retaining walls, Orchard terracing
- Plantation: Horticulture, Forestry, Silvi Pasture
- Water harvesting structures

**Drainage Lines**
- Gully stabilization measures
- Gabion structures, stream bank protection
- Percolation tanks, sub-surface dykes
- Check dams
Illustrative Planning of activities

- Check dams
- High value crops
- Afforestation
- Horticulture

**LEGEND**
1. Contour trenching
2. Contour stone wall
3. Contour bunds
4. Check dams or gully plugging
5. Farm ponds
6. Percolation ponds
7. Wells
8. Irrigation tanks
9. In situ moisture conservation measures
Watershed Management: Processes

- Topographic & benchmark survey
- Participatory Planning & decision making
- Multi disciplinary implementing agency
- Research & scientific backstop
- Integrated & conservation farming
- Water management
- Livelihood support system
- Capacity building
- Monitoring
Strengths of Ministry of Agriculture

- **Survey**: Soil & Land Use Survey of India
- **Research**: Indian Council of Agricultural Research
- **Multi Disciplinary Teams**: Subject matter Divisions and Departments at National level, Subject matter directorates under Agril depts in States
- **Schemes on Integrated farming & agriculture production systems for leveraging natural resources developed**
- **Schemes for Water management like NMMI**
- **Livelihood through livestock & fishery based activities**
- **Strong extension Institutions**: ATMA, KVKs, ICAR Trg. Centers, MANAGE
Watershed Based Interventions: Expected Outcome

- Sustainable deployment of Land Resources
- Water availability
- Food Security
- Livelihood
- Sustainable Agriculture