Floods

A flood is usually caused by rain, heavy thunderstorms, and thawing of snow.

Its considered to be a temporary condition of two or more acres of dry land either:

- Overflowed with inland or tidal waters
- Rapid or runoff of surface waters
- Mudflows

Classification of flood

- Riverine floods
- Urban floods
- Ground failures, such as dam breaks
- Fluctuating lake levels
- Coastal flooding and erosion

Causes of flood

- Heavy Rains. The simplest explanation for **flooding** is heavy rains. ...
- Overflowing Rivers. ...
- Broken Dams. ...
- Urban Drainage Basins. ...
- Storm Surges and Tsunamis. ...
- Channels with Steep Sides. ...
- A Lack of Vegetation. ...
- Melting Snow and Ice.

- **I. Causes of Flooding:** usually caused by excess precipitation. Also caused by snow and glacier melts, ice dams, dam failures and landslides.

- In all cases water discharge exceeds stream capacity

- 1) Human causes:
- **Urbanization** - general term for development; increases runoff and decreases infiltration.
- **Channelization** - artificial channels; usually increase gradient by wall off flood plain.
- **Dams** - when they fail they release huge volumes of water very rapidly.
- **Destruction of vegetation** - allows soil to be removed and fill up channel; less volume to hold water.
- **Agriculture** - often results in previous problem and leaves fields unprotected.

•**Flood types:** two extremes. Most floods are a combination of the two, although one type may be dominant.

•**Upstream (upland)** - affects a small drainage basin along a tributary stream. Often caused by local intense rainfall or dam failure. Usually they are brief in duration (hours to days) but severe in intensity. Often referred to as a **flash flood**.

•**Downstream (lowland)** - affects large drainage basins along a main or trunk stream. Prolonged in duration (weeks or months) and regional in extent. Usually caused by prolonged precipitation and/or snowmelt.

Causes of Flooding: usually caused by excess precipitation. Also caused by snow and glacier melts, ice dams, dam failures and landslides.

In all cases water discharge exceeds stream capacity

1) Human causes:

Urbanization - general term for development; increases runoff and decreases infiltration.

Channelization - artificial channels; usually increase gradient by wall off flood plain.

Dams - when they fail they release huge volumes of water very rapidly.

Destruction of vegetation - allows soil to be removed and fill up channel; less volume to hold water.

Agriculture - often results in previous problem and leaves fields unprotected.

Causes of Flooding

- Effects of human development along streams:

1) Increased runoff - areas get paved and soil gets covered by impermeable materials. Water can't soak into the ground. Water has no place else to go other than into the local streams.

2) Increase discharge from storm servers and drained farm fields

3) Fill in channel and flood plain - floods become more severe.

4) Destruction of vegetation - more sediment load - less water capacity

5) More property to protect - now need to protect ourselves from the floods we helped create or have allowed ourselves to become affected by.

Flood flow determination

- formulae that take area of basin only in to consideration **($Q=CA^{n}$)**

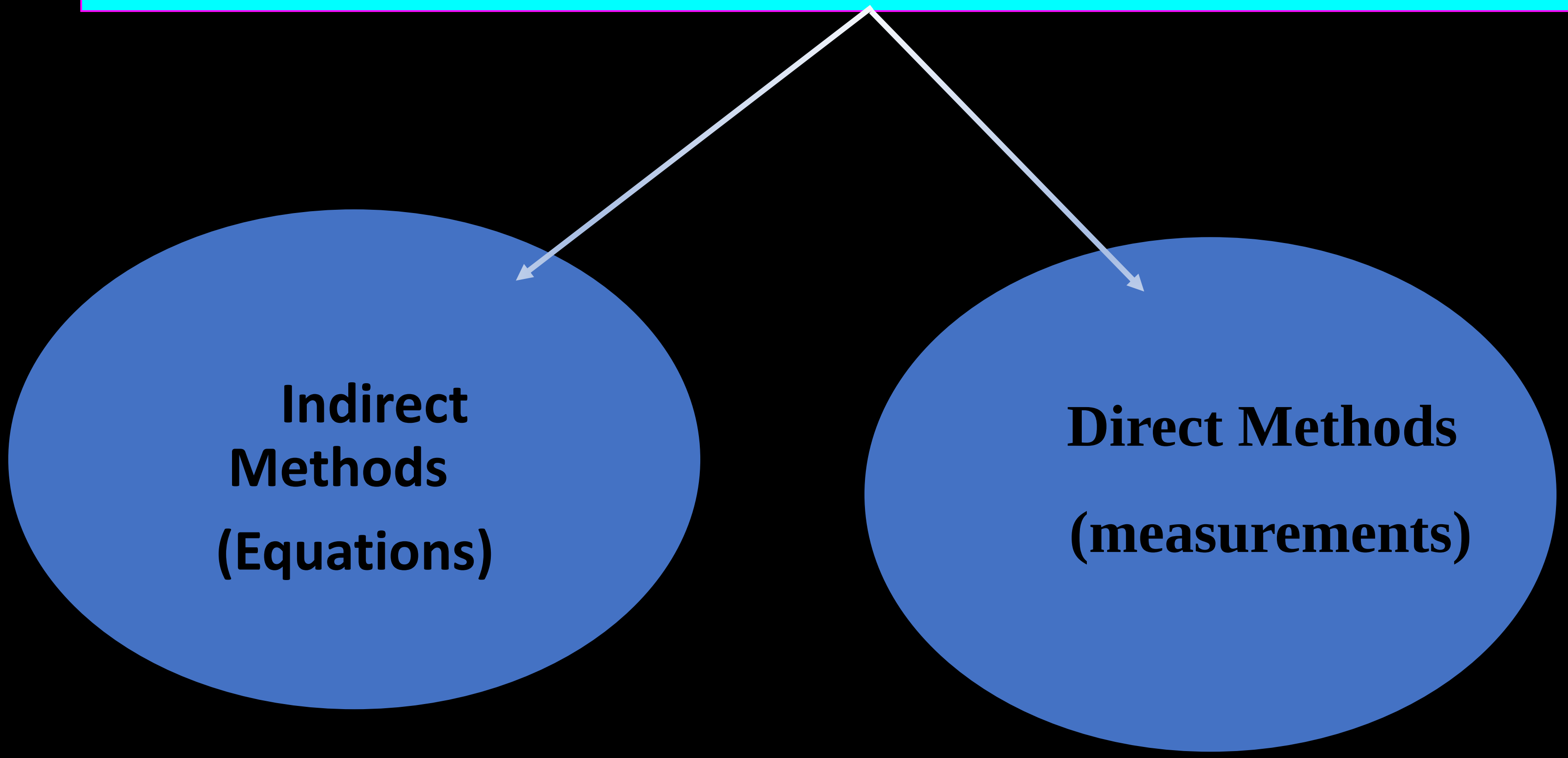
Q and A are flood peak and catchment area, C and n are empirical co-efficient.

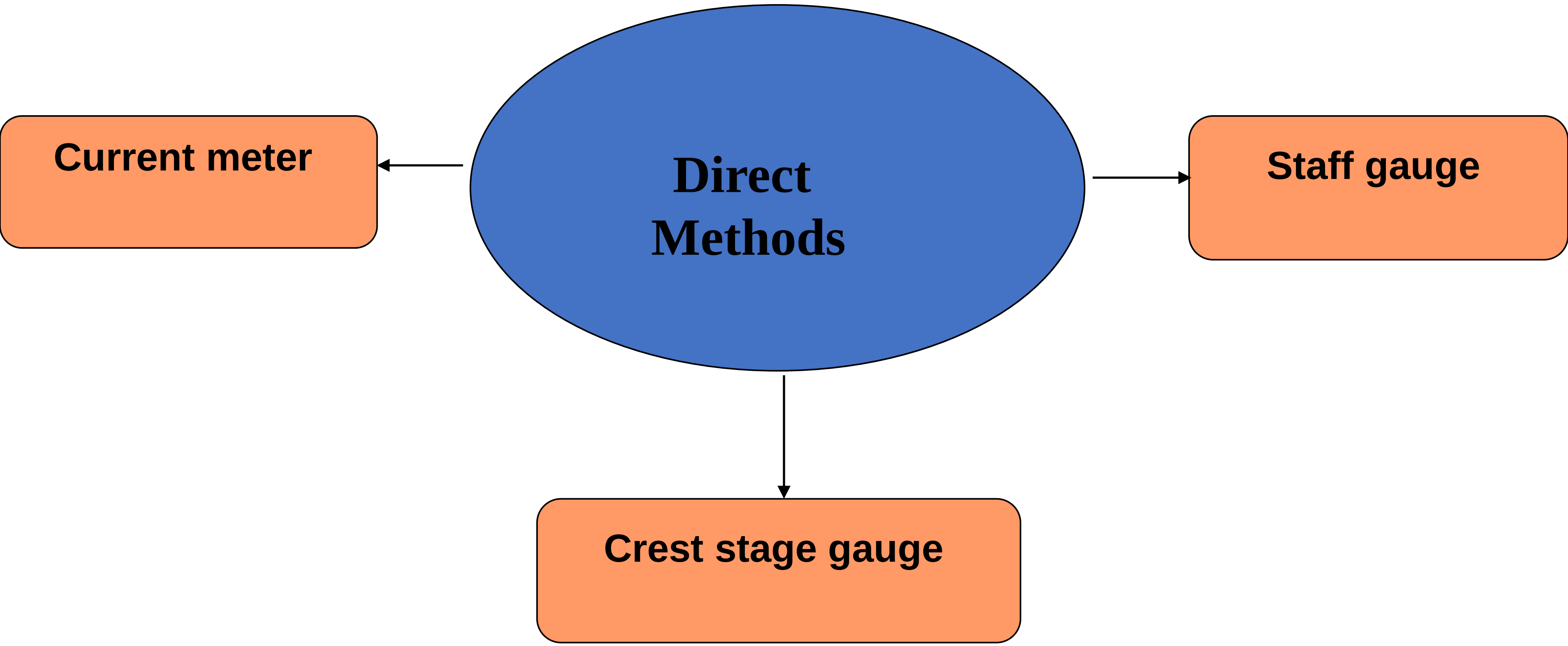
- formulae that take one or more basin parameter apart from area and also rainfall characteristics in to consideration (Craig, Lillie, Rhind formula)
- formulae that take recurrence interval (fullers,Hortson, Pettis formula)

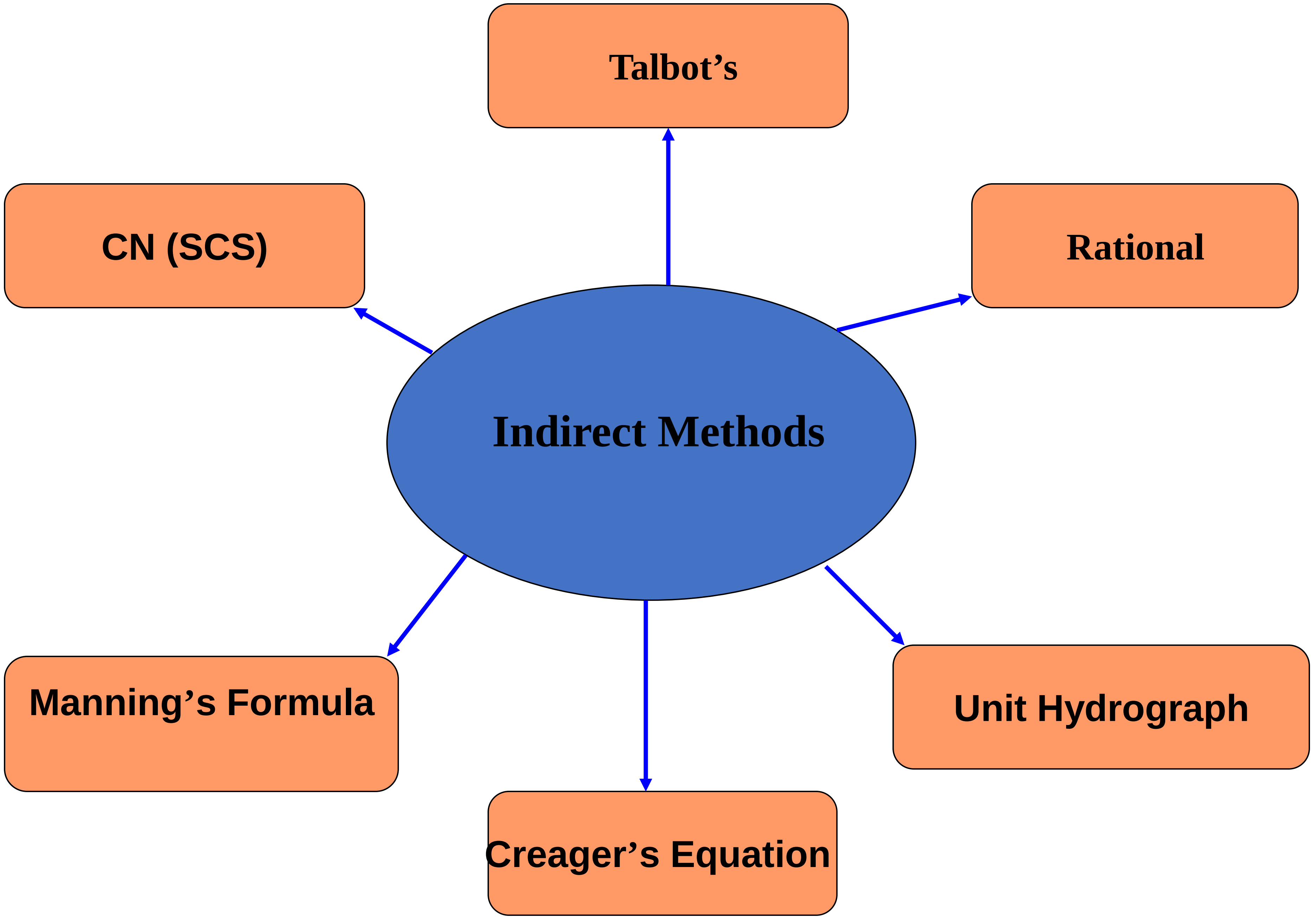
Urban development and flooding

- Urbanization can have a great effect on hydrologic processes, such as surface-runoff patterns.
- roads and buildings have replaced most of the watershed surface. When that one inch of rainfall occurs, it can't infiltrate these impervious surfaces and will runoff directly into the stream, and very quickly, tool. The result is a very quick and short-lived urban flood, rather than a gradual rise and fall in the river
- The rural stream rose much slower and reached a lower peak, meaning it may not have flooded at all

Method of Flood Estimation




Direct Methods
Current meter
Staff gauge
Crest stage gauge


Talbot's
CN (SCS)
Rational
Indirect Methods
Manning's Formula
Unit Hydrograph
Creager's Equation

Estimation of Design Flood

- *Rational Method*

- The rational method uses existing rainfall data and land use in estimating peak runoff from small drainage areas that are less than 15 km^2.

$$Q = 0.278CiA$$

Estimation of Design Flood

- *Rational Method*

Runoff Coefficients for the Rational Method

Type Of Drainage Area	Runoff Coefficient, C
Steep, bare rock	0.90
Rock, steep but wooded	0.80
Plateaus lightly covered, ordinary ground bare	0.70
Densely built up areas of cities with metal led roads & paths	0.70-0.90
Residential areas not densely built up, with metal led roads	0.50-0.70
Residential areas not densely built up, with unmetalled roads	0.20-0.50
Clayey soils, stiff and bare	0.60
Clayey soils lightly covered	0.50
Loam, lightly cultivated or covered	0.40
Loam, lightly, largely cultivated	0.30
Suburbs with gardens, lawns and macadamized roads	0.30
Sandy soil, light growth	0.20

Runoff coefficients for use in the rational method

Character of surface	Return Period (years)						
	2	5	10	25	50	100	500
Developed							
Asphaltic	0.73	0.77	0.81	0.86	0.90	0.95	1.00
Concrete/roof	0.75	0.80	0.83	0.88	0.92	0.97	1.00
Grass areas (lawns, parks, etc.)							
Poor condition (grass cover less than 50% of the area)							
Flat, 0–2%	0.32	0.34	0.37	0.40	0.44	0.47	0.58
Average, 2–7%	0.37	0.40	0.43	0.46	0.49	0.53	0.61
Steep, over 7%	0.40	0.43	0.45	0.49	0.52	0.55	0.62
Fair condition (grass cover on 50% to 75% of the area)							
Flat, 0–2%	0.25	0.28	0.30	0.34	0.37	0.41	0.53
Average, 2–7%	0.33	0.36	0.38	0.42	0.45	0.49	0.58
Steep, over 7%	0.37	0.40	0.42	0.46	0.49	0.53	0.60
Good condition (grass cover larger than 75% of the area)							
Flat, 0–2%	0.21	0.23	0.25	0.29	0.32	0.36	0.49
Average, 2–7%	0.29	0.32	0.35	0.39	0.42	0.46	0.56
Steep, over 7%	0.34	0.37	0.40	0.44	0.47	0.51	0.58
Undeveloped							
Cultivated Land							
Flat, 0–2%	0.31	0.34	0.36	0.40	0.43	0.47	0.57
Average, 2–7%	0.35	0.38	0.41	0.44	0.48	0.51	0.60
Steep, over 7%	0.39	0.42	0.44	0.48	0.51	0.54	0.61
Pasture/Range							
Flat, 0–2%	0.25	0.28	0.30	0.34	0.37	0.41	0.53
Average, 2–7%	0.33	0.36	0.38	0.42	0.45	0.49	0.58
Steep, over 7%	0.37	0.40	0.42	0.46	0.49	0.53	0.60
Forest/Woodlands							
Flat, 0–2%	0.22	0.25	0.28	0.31	0.35	0.39	0.48
Average, 2–7%	0.31	0.34	0.36	0.40	0.43	0.47	0.56
Steep, over 7%	0.35	0.39	0.41	0.45	0.48	0.52	0.58

Note: The values in the table are the standards used by the City of Austin, Texas. Used with permission.

Discharge measurement by slope area method

- **Introduction**
  - Area-slope method is an indirect method which determines an approximate estimate of discharge in the streams and is used when measurement of discharge by accurate method like the area velocity method is not possible.
- The cross section survey will be taken up to 200 m horizontal beyond the highest flood level in both left and right side

Principles of the slope area methods

- The slope-area method is a function of
- Slope,
- Channel dimensions and
- Channel roughness
- Therefore field data are required for estimation of peak discharge. These data include determining the elevation and location of high water marks along the stream, measurement of channel cross section and wetted perimeter by surveying, tape and compass, or GPS.

Selection of Site

- The river reach should be fairly straight having stable bed and banks and uniform cross-section over a length of at least five times the width of the channel. In any case, the length should not be less than about 300m.
- The slope should be such that surface drop is as large as possible but not less than a minimum of 15 cm. in the length of the reach will be selected.

Measurement of slope

- Gauges should be installed at least in three cross-sections, on either bank of the river. If three cross-sections are chosen two should be at the ends of selected reach and one at the centre. The alignment of each cross-section should be normal to the general direction of flow.
- Flood marks on the banks will be used for estimation of the slope.

Computation of discharge by slope area methods (Mannings Fourmula)

- Peak flood will be estimated by the slope-area method, using these factors in one of the variations of the Chezy equation. The simplest of the several variations is the Manning equation which, although developed for conditions uniform flow in open channels, will give an adequate estimate of the non-uniform flow which is usual in natural channels. The Manning equation states that:

$$Q=(AR^{2/3}S^{1/2})/n$$

where, Q = discharge ($m^3\ s^{-1}$)

A = cross-sectional area (m^2)

R = hydraulic radius (m) and = A/P

P = wetted perimeter (m)

S = slope of gradient of the stream bed

n = roughness coefficient

Introduction of Current meter

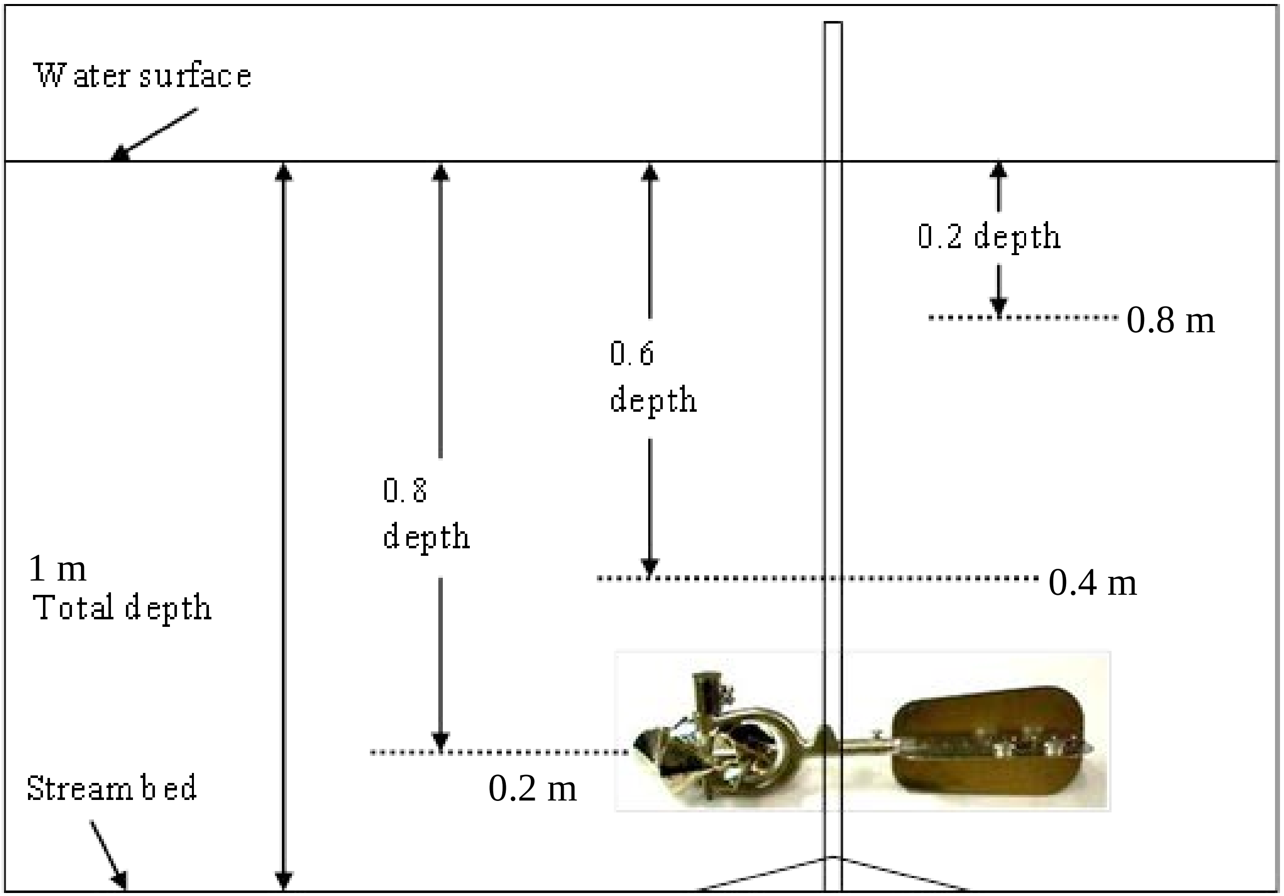
- A current meter is an instrument used to measure the velocity of flowing water. The principle of operation is based on the proportionality between the velocity of the water and the resulting angular velocity of the meter rotor. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined

Current meter methods

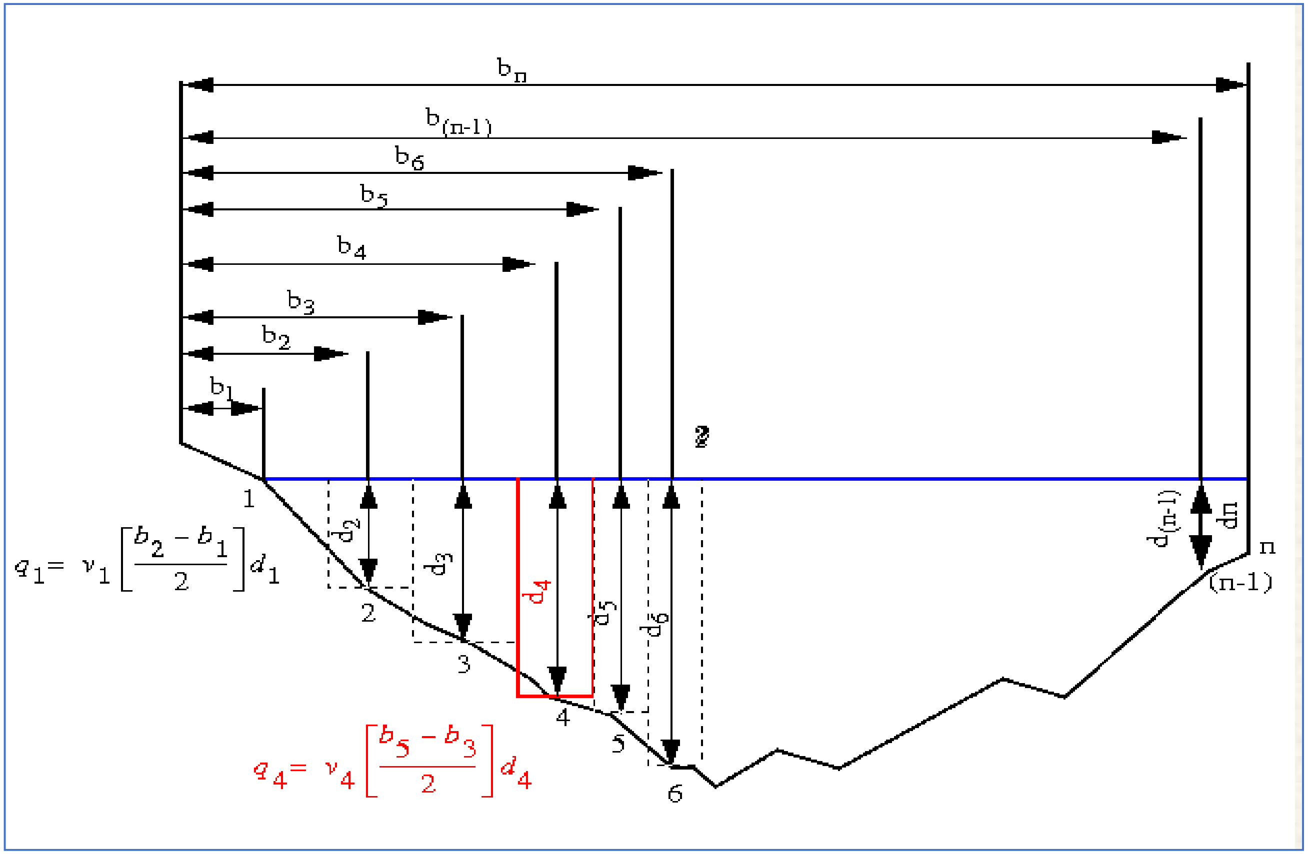
- The one (0.6D) and two point (0.2D & 0.8D) methods are adequate for most routine fieldwork. The former is used for depths less than 1.0 m and the latter for depths greater than a 1.0m, but for the latter also the 0.6D method will be used.

Current-meter measurements by wading are preferred

Observation of velocities at 0.2, 0.6 and 0.8 depths



Computation of discharge by mid section method



1,2,3….n is the Observation vertical

$b_1, b_2, b_{3,}$…..b_n is the Distance from initial point to observation vertical

d_1, d_2, d_3,…..d_n is the Depth of water observation vertical and

Dashed lines is the Boundaries of subsections.

Computation of discharge by mid section method

- Discharge can be computed by following formula

$$Q = A * V$$

- Where, Q is discharge, A is area and V is average velocity

FACTORS AFFECTING OF FLOOD

- Effect of the basin characteristics
- Drainage Area - Watershed Area
- Slope
- Roughness
- Drainage Density
- Channel Length
- Antecedent Moisture
- Other Factors

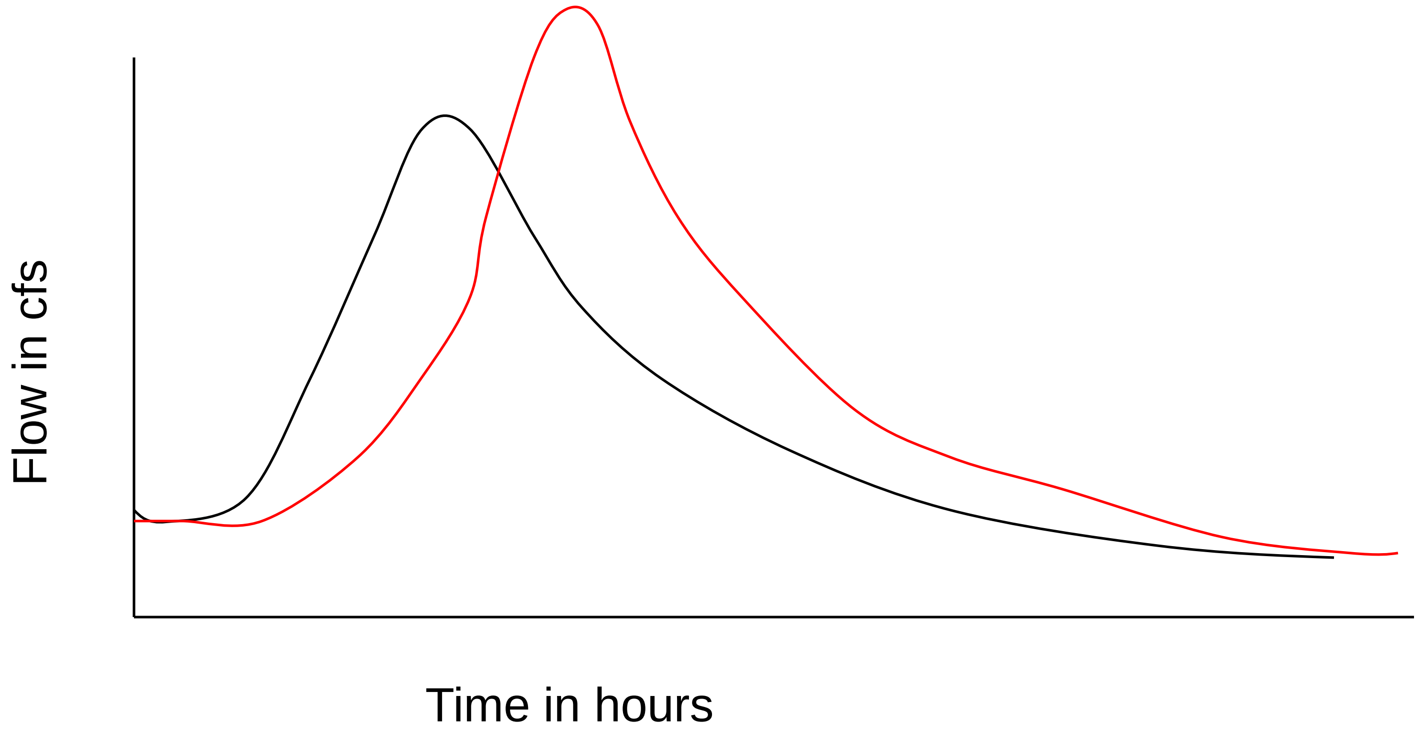
EFFECT OF BASIN CHARACTERISTICS

- In addition to the spatial and temporal characteristics of rainfall, the physical features of the watershed also control the shape of the runoff hydrograph.
- •Factors affecting the hydrograph include: drainage area, slope, roughness, storage, drainage density, channel length, and antecedent moisture conditions.

EFFECT OF BASIN CHARACTERISTICS

- Features that facilitate runoff removal produce high peaks and short hydrographs. Features that delay runoff removal produce low peaks and long hydrographs.

BASIN EFFECTS



Roughness

- Roughness affects the velocity of overland flow and stream flow. A rough channel will cause smaller peaks than a smooth channel.
- For a given discharge, stage levels (water surface elevations) in a stream are higher for rough channels.

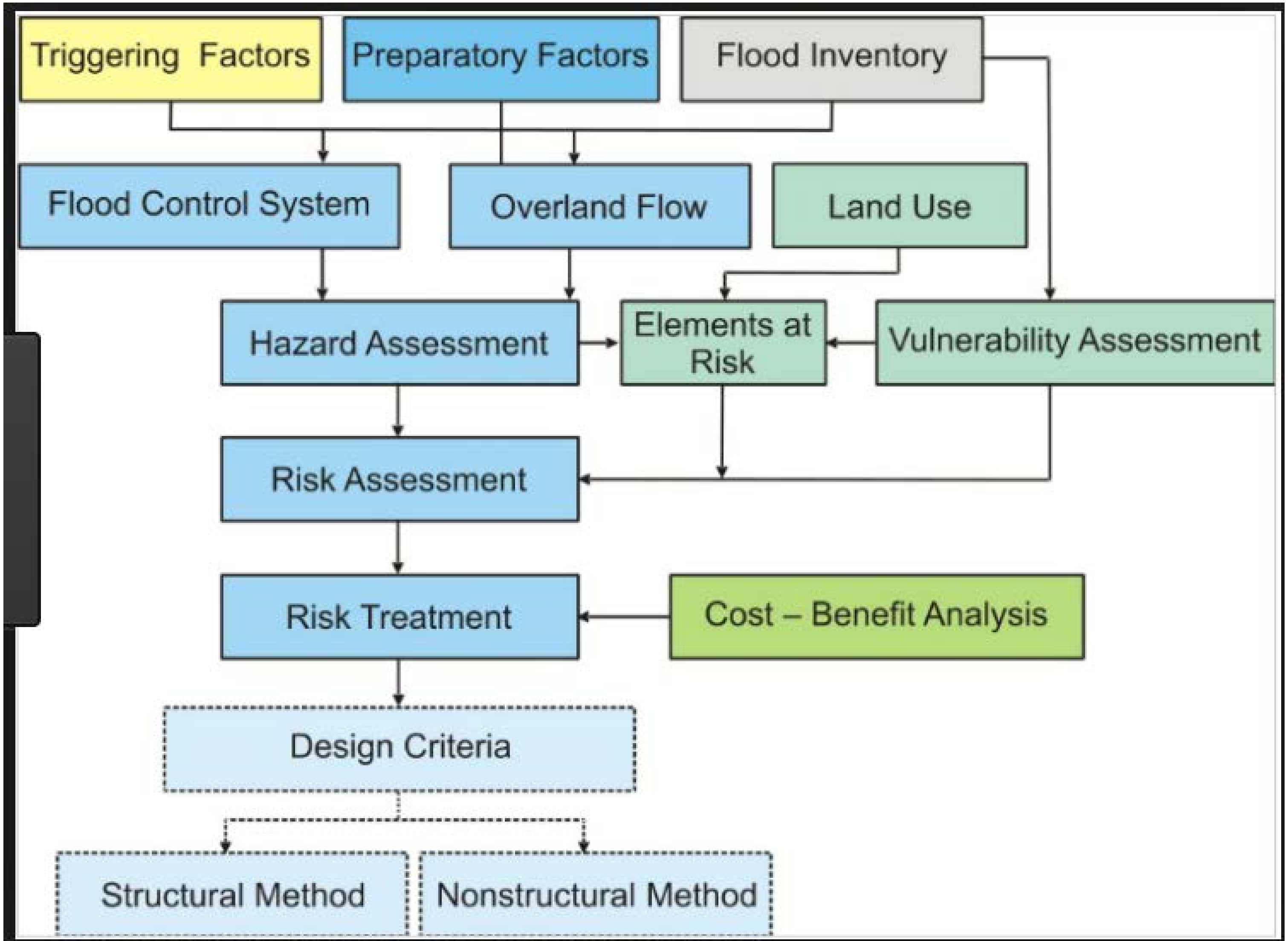
Channel Length

- The effective length of a channel depends on flow magnitude. Large flows overtop the banks and fill the floodplain whose length is usually shorter than that of the meandering streambed.
- A long drainage channel usually indicates a long runoff removal time. Therefore, longer channels cause a response to rainfall slower than for shorter channels.

Channel Length

- Long channels also cause more attenuation of peaks due to storage and hydraulic roughness. Consequently, long channels cause low peaks and hydrographs of long duration.

Triggring Factors Flood



What is agricultural biodiversity?

It includes all components of biological diversity of ***relevance to food and agriculture:***

the variety and variability of

plants, animals and micro-organisms

at genetic, species and ecosystem level

which are necessary to sustain

key functions *in the agro-ecosystem,*

its structures and processes.

Local knowledge and cultural diversity can be considered an essential part of agrobiodiversity as it is the human activity of agriculture which conserves this biodiversity.

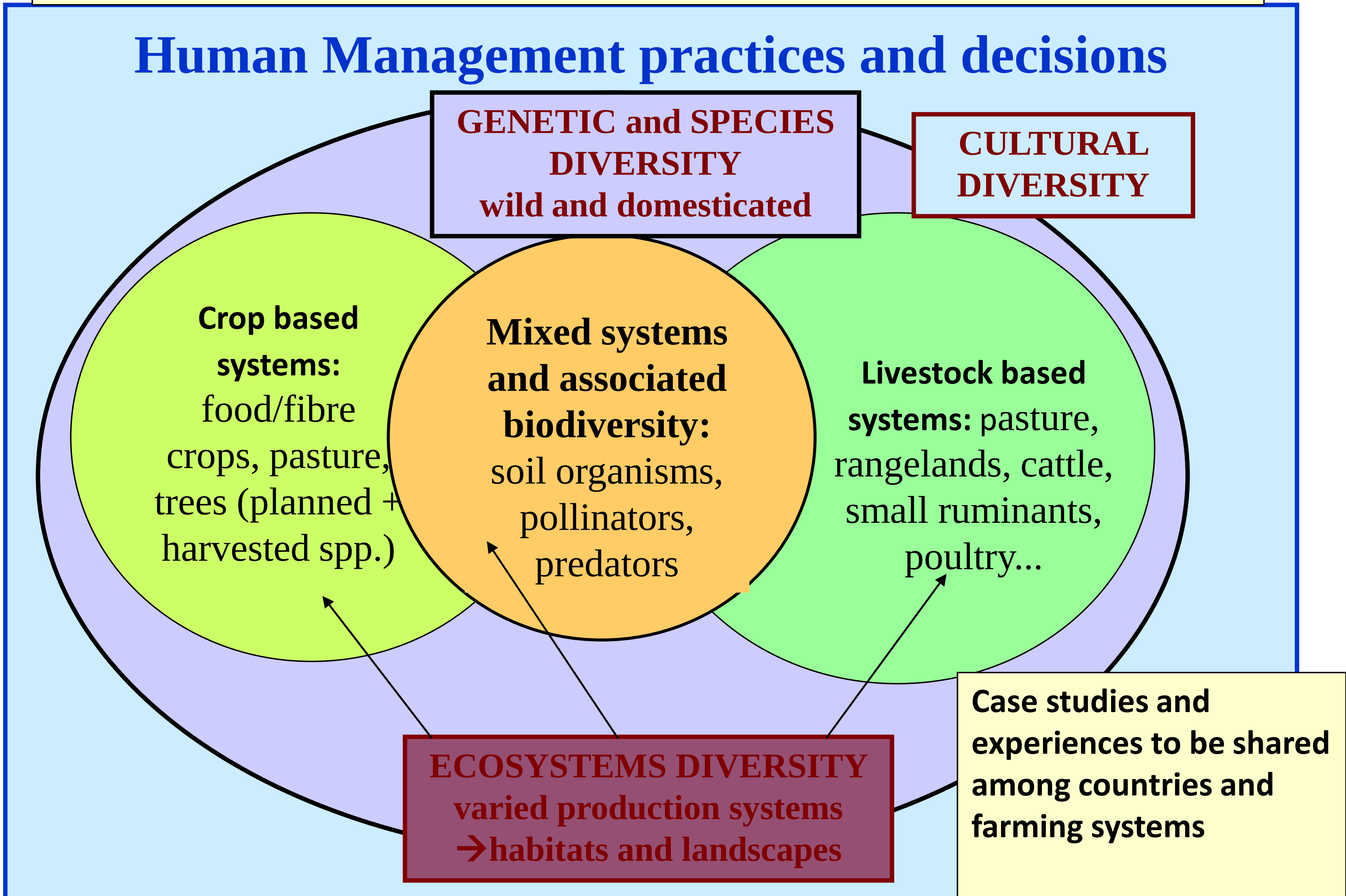
Importance (value) of biodiversity in agricultural ecosystems

In agricultural systems biodiversity is important

1. for the production of food, fibre, fuel, fodder...(goods)
2. to conserve the ecological foundations to sustain life (life support function)
3. to allow adaptation to changing situations
4. and to sustain rural peoples' livelihoods (sustainable agriculture – food security, income, employment,...)

Specificity: it has been developed through human intervention over generations and it requires human management to sustain it.

Agricultural Biodiversity is complex



Need to address all components of agrobiodiversity

- Habitat diversity (mosaic of land uses varies with soil and terrain, hedges, borders, trees in the landscape; farm type)

- Inter-species diversity (plant, animal and microbial)

- Inter-species diversity (very important for agrobiodiversity) genetic resources, unique traits –resistance to drought, cold, disease, etc, rooting, aspect, taste, storage, etc.

- Harvested species and Associated species (pollinators, beneficial/harmful predators, soil organisms – health/ disease,…)

- **as well as** Cultural diversity (type of farmer and farm; regulations; common property resources/ownership)

- and to understand implication of agrobiodiversity on **ecosystem functions/processes and the services provided**

  (see adapted Table by J. Paruel, Environmental controls and effect of land use on ecosystem functioning in temperate Argentina)

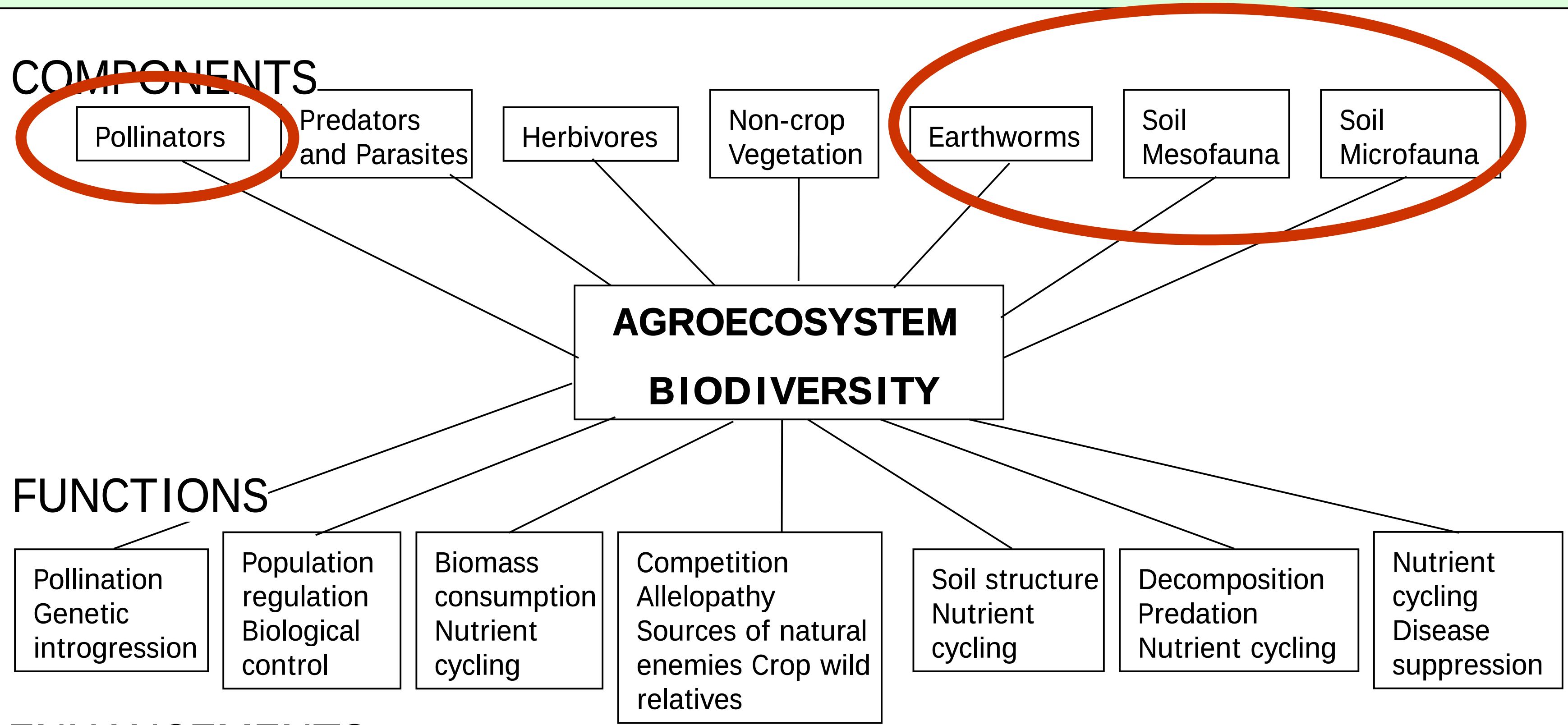
Farmers managing …

Farmers managing genes

Farmers managing species

Farmers managing ecosystems

Managing Agro-ecosystem biodiversity



ENHANCEMENTS

Intercropping **RotationsNo-Tillage** **Green manures** **Windbreaks**

Agroforestry **Cover crops** **Composting** **OM inputs**

From Altieri, M.A. Biodiversity and pest management Agro-ecosystems, Haworth Press, New York, 1994)