ENVS 435: Watershed Management

3 Credits

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Unit 1: Introduction - Watershed Concepts

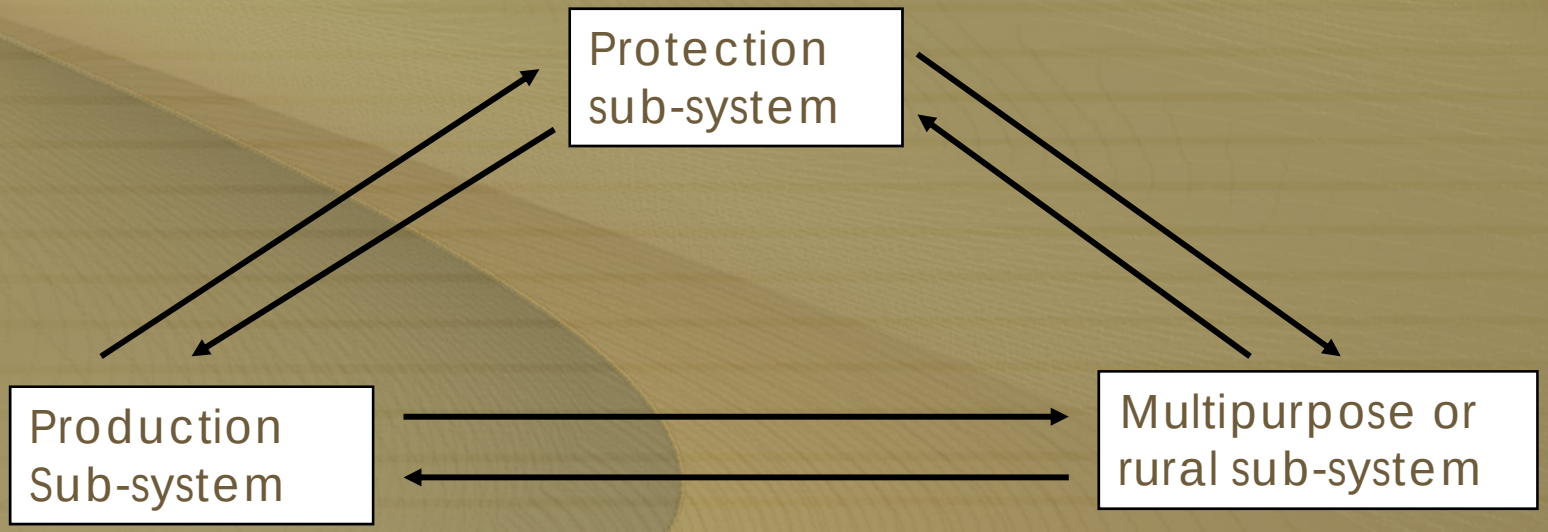
- Definitions of watershed
  - "The elevated line separating the head streams which are tributaries of different river systems of basins". (Moore's Dictionary of Geography, 4th Ed.)
  - "An area drained by a river" – synonymous with the terms catchment or basin. (Cassell et al., 1982)
  - Segments which make up landscape patterns such as a mature river valley, which are eroded by a river system. (Backett & Webster, 1962; Gregory & Brown, 1966)

Definition of Watershed continued

- "Topographic, hydraulic and hydrologic units within a basin" (Horton, 1945)
- Strahler (1964) and Lee (1964) define watershed as:
  - A limited, convenient and usually clearly defined and unambiguous topographic unit, available in a nested hierarchy of sizes on the basis of stream ordering, and,
  - An open physical system in terms of inputs of precipitation and solar radiation, and outputs of discharge, evaporation and reradiation.
- As a development unit, Gibbs (1986) defined it as: "a readily defined, functional unit established by a relationship between physical and cultural influences".

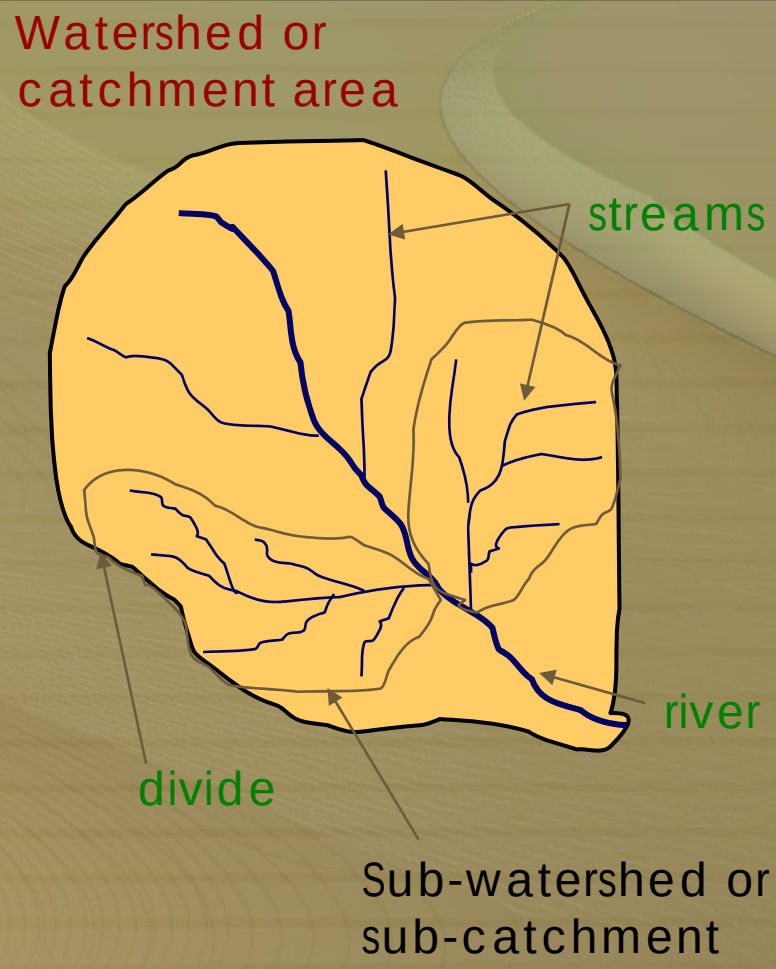
Watershed as an ecosystem

- Paembonan (1985) defines watershed as an "ecosystem" in itself, consisting of production, protection, and multipurpose subsystems.



Meaning of watershed and catchment

- According to British usage:
  - Catchment is the area from which runoff occurs, and,
  - watershed is the boundary of a catchment.
- According to American usage:
  - Watershed is the total area catching the runoff, and,
  - Divide (or drainage divide) is the boundary between two watersheds.
- Catchment is also called a Drainage Basin

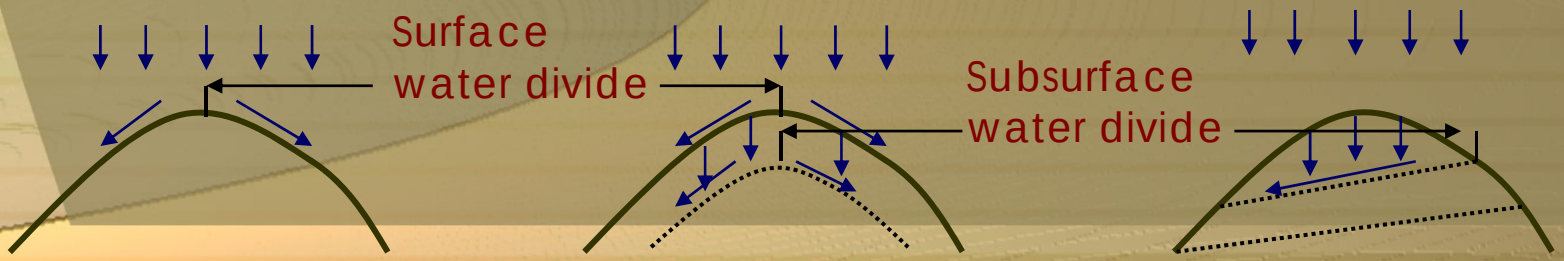


What then is a watershed?

- It is the area bounded by a drainage divide and draining all the water incident upon it through a common outlet (stream or river), or to a common point/place (lake, pond).
- Or simply, all the land within the confines of a drainage divide.
- Watershed, catchment, drainage area, river basin, drainage basin, are all terms used interchangeably.
- BUT generally:
  - Watershed, catchment and drainage area are used for small streams and rivers, while,
  - Drainage basin and river basin are used for large river systems with numerous sub-watersheds or sub-catchments nested within it.

Meaning of a “divide”

- A “divide” or “drainage divide” is the line drawn through the highest elevated points within a watershed.
- It forms the limits of a single watershed and the boundary between two or more watersheds.
- A water divide is categorised into:
  - Surface water divide – highest elevation line between basins (watersheds) that defines the perimeter and sheds water into adjacent basins, and,
  - Subsurface water divide – which refers to faults, folds, tilted geologic strata (rock layers), etc., that cause sub-surface flow to move in one direction or the other.



Watershed Management policies and principles in Nepal

- The primary responsibility and authority for the management and development of watersheds in Nepal lies with the Dep. Of Soil Conservation and Watershed Management (DSCWM) within HMG Ministry of Forest and Soil Conservation.
- The policy of the Nepalese government has been to give overall responsibility to manage and conserve watersheds and their resources (water, land, forests, biodiversity, etc.) to the DSCWM, although watersheds are complex, dynamic entities falling into several sectors of development:
  - Agriculture
  - Forestry
  - Water resources
  - Biodiversity (flora & fauna), etc.

DSCWM's watershed management strategy

- The basic strategy of DSCWM in watershed management and conservation is as follows:
  - Break down major river basins across Nepal in to sub-watersheds of a few to 25 sq. km.
  - Identify and select priority sub-watersheds for development planning and conservation activities according to level of need and status of degradation.
  - Collect sufficient biophysical and socioeconomic information for integrated watershed management planning.
  - Prepare a sub-watershed management plan for each priority sub-watershed in order to minimize natural and human-induced hazards and to conserve valuable resources (soil, water, biodiversity, socio-cultural aspects).
  - Implement various integrated watershed mgmt. activities in the selected priority sub-watershed.

Policy Framework for Watershed Management in Nepal

- HMG Nepal has, as a major policy focus, the protection and conservation of natural resources, as well as, its proper and beneficial utilization.
  - Water resource use, protection and management
  - Proper and scientific use and management of land
  - Maintenance and preservation of ecological balance
  - Conservation & preservation of biological diversity
- National Council for Conserv. of Natural Resources
- These have been highlighted in the National Conservation Strategy (NCS) and in numerous 5-year plans (6^{th} through 10^{th}).
- The main legal reference to watershed management is the "*Soil Conservation and Watershed Management act*" of **1982**.

Policy framework continued . . .

- The SCWM Act (1982) is supported by other policies and Acts:
  - National parks & wildlife conser. Act (NPCWA) – 1973
  - Soil and water conservation act (SWCA) – 1982
  - Water resources act – 1992
  - Electricity Act – 1992
  - Prospective Land Use Plan (1986)
  - The APP (1995)
  - The Forest Act (1993)
  - Nepal Environmental Policy and Action Plan (1993)
- In recent years other related policy and legal measures are being formulated:
  - National EIA guidelines with regard to industry, projects, various development sectors; protected areas & forests
  - Environmental Protection Act (1997)
  - Action plan for conservation of biological diversity (1995-2000)

Concept of Watershed Management and its consideration in project planning

- Watershed management (WSM) is the process of guiding and organizing the use of land & other resource in a watershed to provide desired goods and services without adversely affecting the environment or ecological balance.
- It involves multiple resource types & requires understanding of the relationships among land use, soil, water, flora, fauna and human communities.
- Also important are linkages between upland and downstream areas & their interdependence.
- NOTE: Economic, social & political forces that shape development work within socio-political boundaries, while the forces of nature affecting land & water resources respect only natural (watershed) boundaries.

Watershed management projects

- These involve actions aimed at "production [of goods & services] with protection [of the natural resource base]"
- The overall objective of WSM is to achieve the most appropriate use of land, water and other resources so that economic and social development within a watershed can be attained on a sustainable basis.
- Any WSM project must have the following basic components:
  1. A definable set of inputs (land, materials, people)
  2. A definable set of outputs (goods or services)
  3. A definable set of activities or processes (technical and/or institutional) to transform inputs into outputs.

Project planning in watershed management

- Major objectives in WSM project planning:
  - Restoration of degraded lands (land use categories)
  - Protection or prevention of watershed degradation
  - Mitigate, to an acceptable level, effects of land use practices (designed to produce needed goods & services)
- Broad categories of linkages among watershed practices and benefits in upstream & downstream areas (regarded as environmental changes):
  - Stabilization of soil and steep slopes
  - Improvement stream flow pattern and/or water yield
  - Maintenance and improvement of water quality
  - Maintenance & enhancement of biodiversity (natural & agricultural)

Project planning in WSM, continued

- Planners should therefore consider the following realities in WSM projects:
  - Dynamic and complex interaction of water with land, vegetation and other resources as influenced by climate & topography
  - Interaction and impacts between natural resources and people
  - Implications of these interactions and socio-political boundaries
  - Concepts of sustainable and equitable resource use within and across ecological and national (political) boundaries
  - Existence of externalities (unanticipated or undesired side-effects)
  - Need for environmentally/ecologically sound management

Summary

- A Watershed is the area within a drainage divide for which all water falling upon is drained through a common stream or to a common point.
- Watersheds are natural bio-geophysical units that are important in terms of ecologically sound mgmt.
- Human society and rural communities are also integral components of many watersheds.
- The development of a watershed management plan needs to integrate **biophysical, socio-cultural and politico-economic factors** to ensure that the plan/project will be **technically sound, socially acceptable, economically feasible, and environmentally friendly**.