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NRM 370 WATERSHED MANAGEMENT Fall 1999 -- T,Th 9:45 a.m. NSB 201B + M 2-5 p.m O'Neill 359

Texts: Brooks, K.N., P.F. Ffolliott, H.M.Gregersen and J.L. Thames (1997) *Hydrology and the Management of Watersheds*. Second Edition, Iowa State U. Press, Ames, Iowa,392 p.

Anonymous (1983) *Alaska Watershed Management Handbook.* Alaska Dept. of Community & Regional Affairs/Ak. Dept. of Envrmtl. Consrv., Juneau, 62 pp. (will be on reserve in library).

Sept.02	Introduction, Hydrologic cycle-water budget .	Brooks: pp. xi-14
	Homework: Water units and solving problems	Handout + Brks 461-2
Sept.06	Labor Day – No Class	
07	The Watershed - Basin morphology - Open Systems.	Handout
09	Watershed Input - Solar Energy, Energy Exchange	Brooks: pp. 44-47
Sept.13	Field Trip -- Spinach Creek - Stream Gaging.	Handout
14	Energy Budget - Water Budget Interaction	Brooks: pp. 17-42
16	Watershed Input - Precipitation, Atmospheric Moisture	
Sept.20	Field Trip – Cache Creek / Fortune Creek	
21	Watershed Input (continued)/film	
23	Snow, Arctic hydrology	Brooks:pp.311-336
	Sept. 19 Last day for Student Initiated Withdrawals	
Sept.27	Lab: Watershed Morphology/description/ maps	Handout + Brks 201-8
28	Review	
30	**EXAM #1**	
Oct. 04	Lab: Lapse rates/precipitation problems	
05	Snowmelt	Brooks: pp.311-336
07	Soil Moisture	Handouts
Oct.11	Lab: Infiltration / soil hydrologic properties	Brooks: pp.69-78
12	Groundwater and Streamflow (Oct.15,Last Day to Apply: Fall Grad.)	Brooks: pp.93-110
14	Streamflow Production: some theories	Brooks:pp.78-92
Oct.18	Lab: Groundwater & Groundwater Quality - DRASTIC Index	
19	Evaporation and Transpiration	Brooks:pp.48-68
21	Vegetation and the Hydrologic Cycle	Brooks:pp.111-134
Oct.25	Lab: Local Water Budget calculations	Handout
26	Review	
28	**EXAM #2**	
Nov.01	Lab: Universal Soil Loss Equation	Brooks: pp.150-163
02	Streamflow: the hydrograph	
04	Channel dynamics	Brooks: pp.187-201
Nov.08	Discussion - "The Himalayan Dilemma"	Handout Reading
09	Erosion and sedimentation	Brooks: pp.137-150
11	Erosion - mass wasting/landslides	Brooks: pp. 165-186
Nov.15	Lab: Instream Flow Considerations/Fisheries	Handout
16	Water Quality - Temperature & Dissolved Oxygen	Brooks: pp. 209-234
18	Water Quality - Nutrients, Toxic Materials	
Nov.22	Planning and Appraisal/Watershed Analysis	Brooks:p.269-285:433-460
23	Watershed Management and Ecosystem Management	Brooks:pp.237-267
25	Thanksgiving Holiday	
Nov.29	Cumulative Impacts	Handouts
30	Economics of Watershed Management	Brooks:pp.287-307
Dec. 02	Riparian Zone Management - Ak.State Forest Practices Act	Handouts+Brks 337-364
Dec.06	Special topics / Discussion of Issues	
07	Open	
09	Review	
Dec.16	**Final Exam** 8:00-10:00 a.m.	

NRM 370 WATERSHED MANAGEMENT

Instructional Objectives

1. Develop appreciation and understanding of the linkage between the terrestrial and aquatic systems - between land and water.

2. Develop a working knowledge of hydrology.

   a. familiarization with terms and units of hydrology
   b. ability to calculate & understand the local water balance
   c. knowledge of major mechanisms of soil erosion (by water) and factors influencing non-point source water pollution.
   d. knowledge of what information is needed to solve watershed management problems and where to find it.

3. Develop ability to interpret land-use activities in terms of hydrologic processes -- Deduce or predict the nature and relative seriousness of impacts of land-use on hydrologic systems.

4. Develop appreciation of multidiciplinary nature of watershed management
   a. role of science & technology
   b. role of economics
   c. role of politics & law
   d. role of people

NRM 370 GRADING POLICY

The grade received in this course will be based upon performance on exams, homework assignments and lab/field sessions. The following percentages will apply:

Exams (including final)	80 %
Homework	10 %
Lab/Field work & attendence	10 %

The instructor reserves the right to modify the final grade in consideration of notable progress demonstrated by an individual, or unforeseen and extenuating circumstances. In such cases, extra credit assignments and/or makeup work may be used at the discretion of the instructor.

NRM 370 Overview Notes **WATERSHED MANAGEMENT NOTES**

A. Watershed management versus water management
Watershed management is the management of <u>all the resources</u> of the watershed in such a was as to : maintain, promote, or restore <u>desirable</u> water quantity,quality, and timing.

B. Watershed management and planning must start with a :
1. recognition of need and specification of objectives
2. consideration of technical alternatives
3. involvement of people

C. Watershed management founded on the science of hydrology - hydrologic cycle as it interacts with the land.

D. Watershed as a fundamental unit of study - Landscape Level Management
1. Sloping land the sheds water
2. area of the landscape that drains or sheds water to a common point or outlet.
3. watersheds separated by divides/boundaries - hierarchical in organization ie., watersheds within watersheds within watersheds ....
4. watershed as an ecological unit and a management planning unit.
-logical unit for implimenting "Ecosystem Management"
-integrates vertical & lateral perspectives & processes

E. Water Budget Equation - basic concept of hydrology and watershed management

$$P = SF + ET + \Delta S$$

$$SF = P - ET - \Delta S$$

(Streamflow (SF) = Precipitation (P) - Evapotranspiration (ET) - Change in Storage (ΔS)

F. Cannot separate the stream from the land that nourishes it! "The land gives birth to the stream." - Failure to recognize and appreciate this point has resulted in much land degradation and many water quality problems. --
Much of watershed management deals with or has focused on erosion and sedimentation. --"Land use hydrology".

Issues & Concerns Related to Watershed Management:
*Deforestation - Land Use Conversion
*Timber harvest effects on fish
*Stream & Lake Acidification
*Forest Health
*Climate Change
*Non-Point Source Pollution
*Wetlands: definitions & values
*Riparian Zones and Buffer Strips
* Erosion & Sedimentation
*Land Degradation
*Groundwater Contamination
*Biodiversity
*Ecosystem fragmentation
*Wildlife habitat
* others ....

G. It is more a matter of "how you do it" rather than "what you do".

H. Sensitivity: the degree to which a given land system (soil, water, vegetation) undergoes changes due to natural forces, following human interference.
Resilience: a property of a natural system that allows it to absorb and utilize (or even benefit from) change; the ability of land to reproduce or restore its capability after interference, (and the measure of need for human effort toward that end).

I. Complexity, Uncertainty, and Wickedness!

A. Complexity: "It all depends"
on Science .....Hypothesis Falsification
on Perspective......"What you see is what you get"
on Objective......social, economic, ...

B. Uncertainty: Change, Surprise, Chaos:

"Abandon the siren of certainty,
Embrace the whims of the gods.
With luck events uncertain
Will turn out based on the odds."

Ask: "What do you want the facts to be?"

C. Wickedness: (malignant, perverse, tricky, emotional, irrational.....)
"The uncompromising pursuit of whatever name is given to the supposedly highest ideal --be it security, patriotism, peace, freedom, happiness or whatever -- is an ultra-solution, a force which, to paraphrase Goethe, always seeks the good and always creates evil." --Paul Watzlawick, Ultra-Solutions, p.40.

NRM 370 Intro. to Watershed Management

Early Understanding of the Hydrologic Cycle:

"All rivers run into the sea, yet the sea is not full: Unto the place from which the rivers come thither they return again."

Ecclesiastes (1:7)

Early Misconceptions of the Hydrologic Cycle:

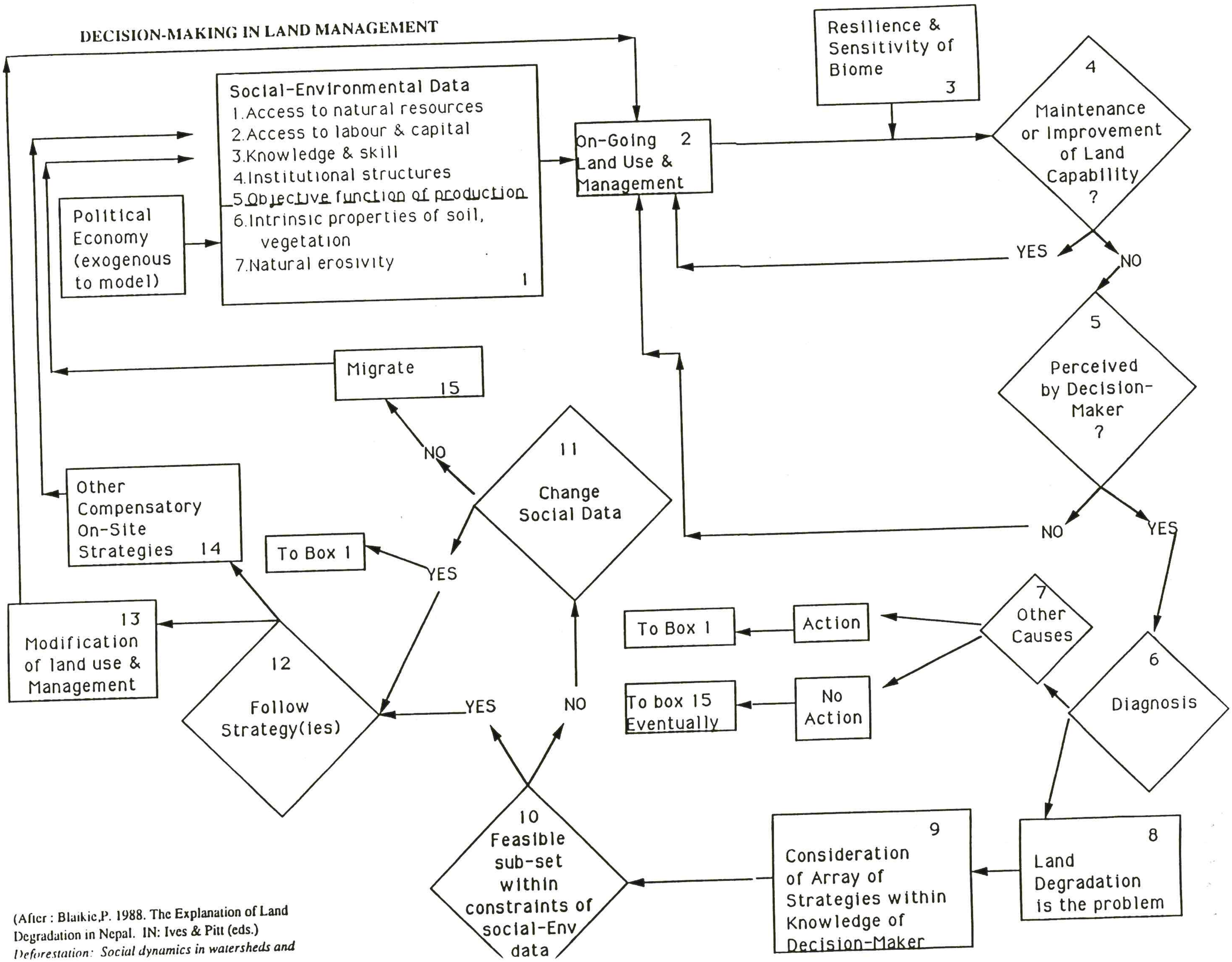
"Furthermore, that sea, rivers, fountains always stream over with new moisture and that waters well up without ceasing, it needs no words to prove: the great flow of waters from all sides clearly shows it. But then the water on the surface is always taken off, and thus it is that on the whole there is no overflow, partly because the seas are lessened by the strong winds sweeping over them and by the ethereal sun decomposing them with his rays; partly because the water is diffused below the surface over all lands, for the salt is strained off and the matter of liquid streams back again to the source and all meets together at the riverheads, and then flows over the lands in a fresh current, where a channel once scooped out has carried down the waters with liquid foot."

Lucretius (c.94-c.55 B.C.)
On The Nature Of Things

"The intention of the Artificer of nature must have been to unite earth and water in a mutual embrace, earth opening her bosom and water penetrating her entire frame by means of a network of veins radiating within and without, above and below, the water bursting out even at the tops of the mountain ridges, to which it is driven and squeezed out by the weight of the earth, and spouts out like a jet of water from a pipe, and is so far from being in danger of falling down that it leaps upward to all the loftiest elevations. This theory shows clearly why the seas do not increase in bulk with the daily accession of so many rivers. The consequence is that the earth at every point of the globe is encircled and engirdled by sea flowing round it, and this does not need theoretical investigation, but has already been ascertained by experience."

Pliny the Elder (23-79 A.D.)
Natural History

DECISION-MAKING IN LAND MANAGEMENT



(After: Blaikie,P. 1988. The Explanation of Land Degradation in Nepal. IN: Ives & Pitt (eds.) *Deforestation: Social dynamics in watersheds and*

Water Units and Measurements

(Satterlund, D.R. 1972. *Wildland Watershed Management*. Ronald Press, NY.)

Volume

One acre-foot:	43,560 cubic feet
	1233.5 cubic meters
	325,851 U.S. gallons
One acre-inch:	0.0833 acre foot
One cubic foot:	0.0283 cubic meters
	7.4805 U.S. gallons
U.S. gallon:	0.1337 cubic foot
	3.7853 liters

Weight

One acre-inch:	113.256 tons at 4°C
One cubic foot:	62.4 lbs at 4°C
U.S. gallon:	8.34 lbs at 4°C
One pound:	0.4536 kilogram

Flowing water

one cubic foot per second (cfs):	0.0283 cubic meters per second
one cfs:	1.9835 acre-feet per day (2)
one cfs:	0.9917 acre-inches per hour (1)
one cfs:	723.98 acre-feet per 365-day year
one cfs:	725.96 acre-feet per 366-day year
one cfs:	38.4 to 50 miner's inch (variable)
	448.80 gal per min (≈450)
one cubic foot per second per square mile (csm):	1.0413 inches depth per 28-day month
one csm:	1.0785 inches depth per 29-day month
one csm:	1.1157 inches depth per 30-day month
one csm:	1.1529 inches depth per 31-day month
one csm:	13.574 inches depth per 365-day year
one csm:	13.612 inches depth per 366-day year
one inch depth per hour:	645.33 csm
one inch depth per day:	26.889 csm
one inch:	2.54 centimeters

640 acres/mi^2
43560 ft^2/acre

NRM 370
Homework Problems

Due: Thur. 9-9-99

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1. A watershed received 50 cm. of precipitation during one year. Streamflow was 26 cm. and evapotranspiration was 20 cm.. Set up the proper equation and solve for change in storage in centimeters. Was it a gain or a loss?

2. Six inches of rain fell on a watershed 16.5 acres in size. How many acre-feet of water fell on the watershed? How many cubic meters?

3. Convert 1.0 inches per hour of runoff from 1.0 acre to cubic feet per second(cfs), and to gallons per minute (gpm).

4. Determine the volume of water that could be added to a reservoir in acre-feet in one day from a stream with an average flow rate of 1 cfs.

5. Determine the time (hours) required to fill a 10 acre-ft. reservoir if the average streamflow into the reservoir was 2 cfs.

6. A cabin has the dimensions of 20 ft. by 25 ft. The annual precipitation is approximately 12 inches. Allowing for 2 inches of evaporative loss, how many gallons of water could be obtained from collecting and storing the precipitation as it ran off the roof?

7. Average families use approximately 100 gallons of water per day. How many inches of water would this be for a year (365 days) if withdrawn from the following areas:

   0.5 acre
   1.0 acre
   5.0 acres
   10.0 acres

   How might this relate to planning and zoning in residential areas, ie. minimum lots size, etc.?