IMPACT OF LAND USE/COVER CHANGES ON STREAMFLOW:

THE CASE OF HARE RIVER WATERSHED, ETHIOPIA

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Presentation outline

1. Introduction
   - Study area
   - Objective

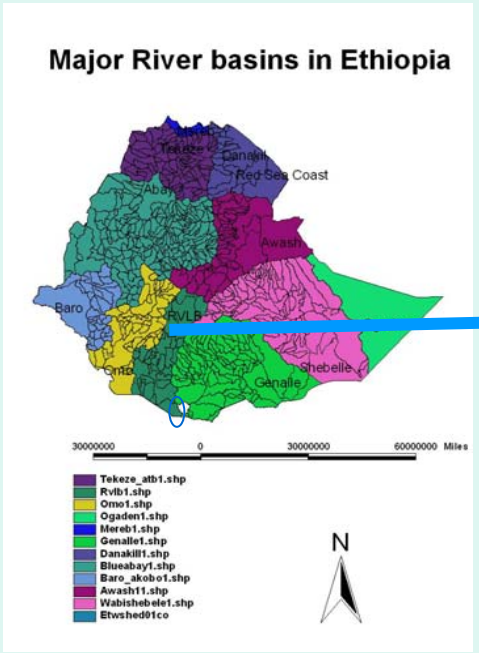
2. Methodology
   - Model setup
   - Existing watershed practices

3. Results
   - Land use dynamics
   - Model evaluation
   - Seasonal Streamflow variability
   - Downstream impacts

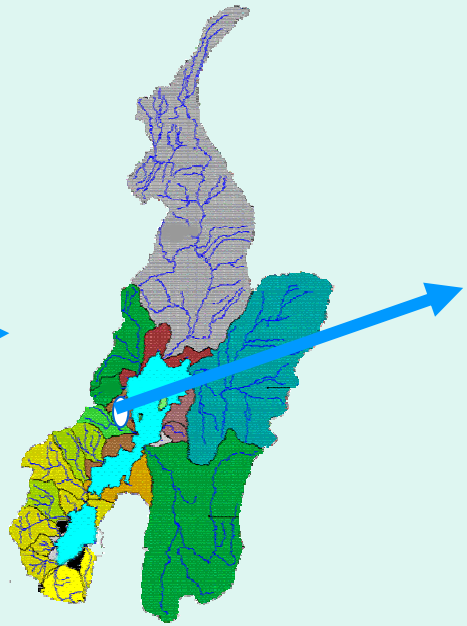
4. Conclusions

1. Introduction

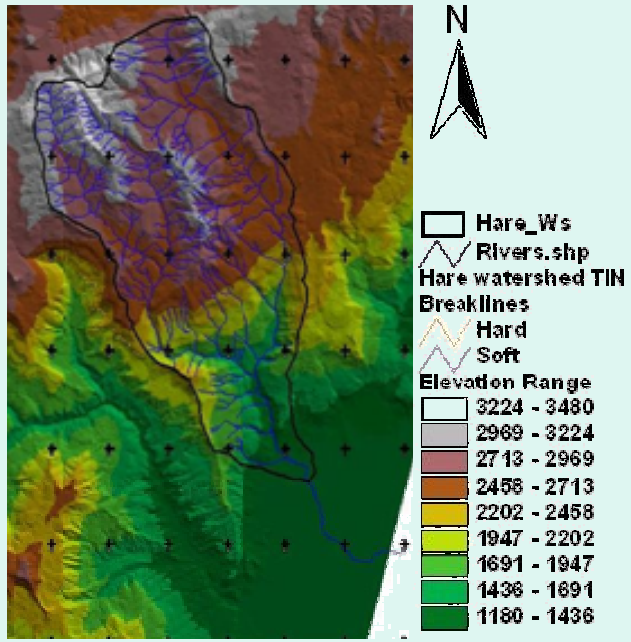
1.1 Study area



Abaya-Chamo Basin



Hare Watershed



1.2 Objectives of the study

- Examine the extent of past and present land use/cover dynamics and analyse their implications on streamflow at a watershed and sub-watershed levels

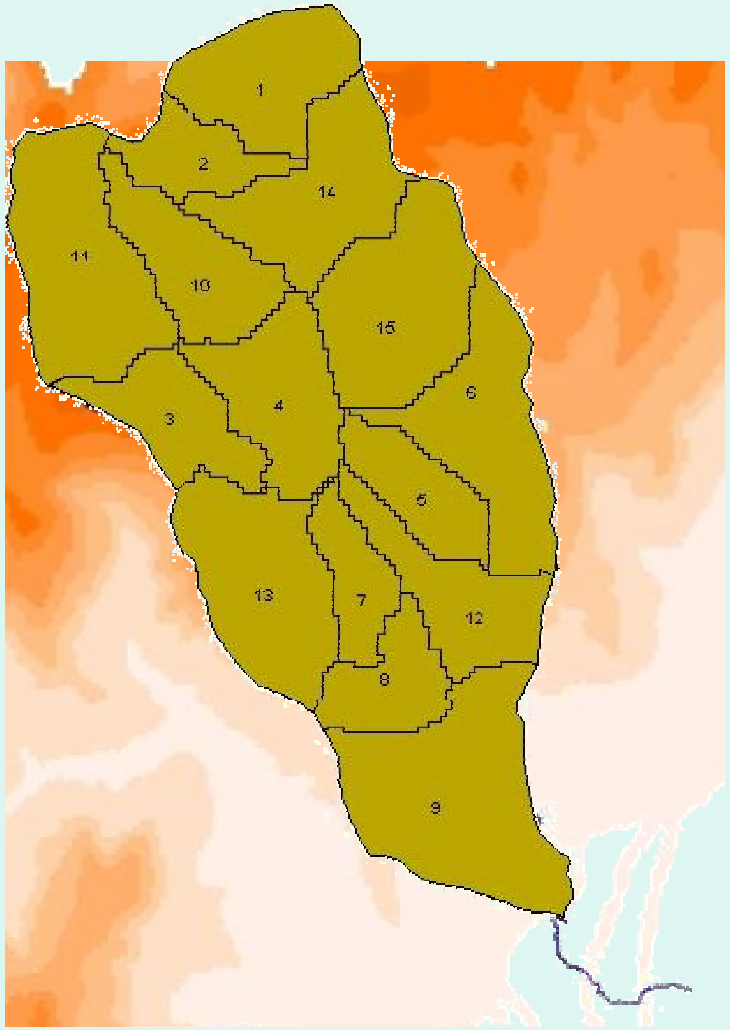
- Analyse the seasonal streamflow variability and understand the upstream-downstream linkages with respect to irrigation water use

2. Methodology

2.1) Model setup

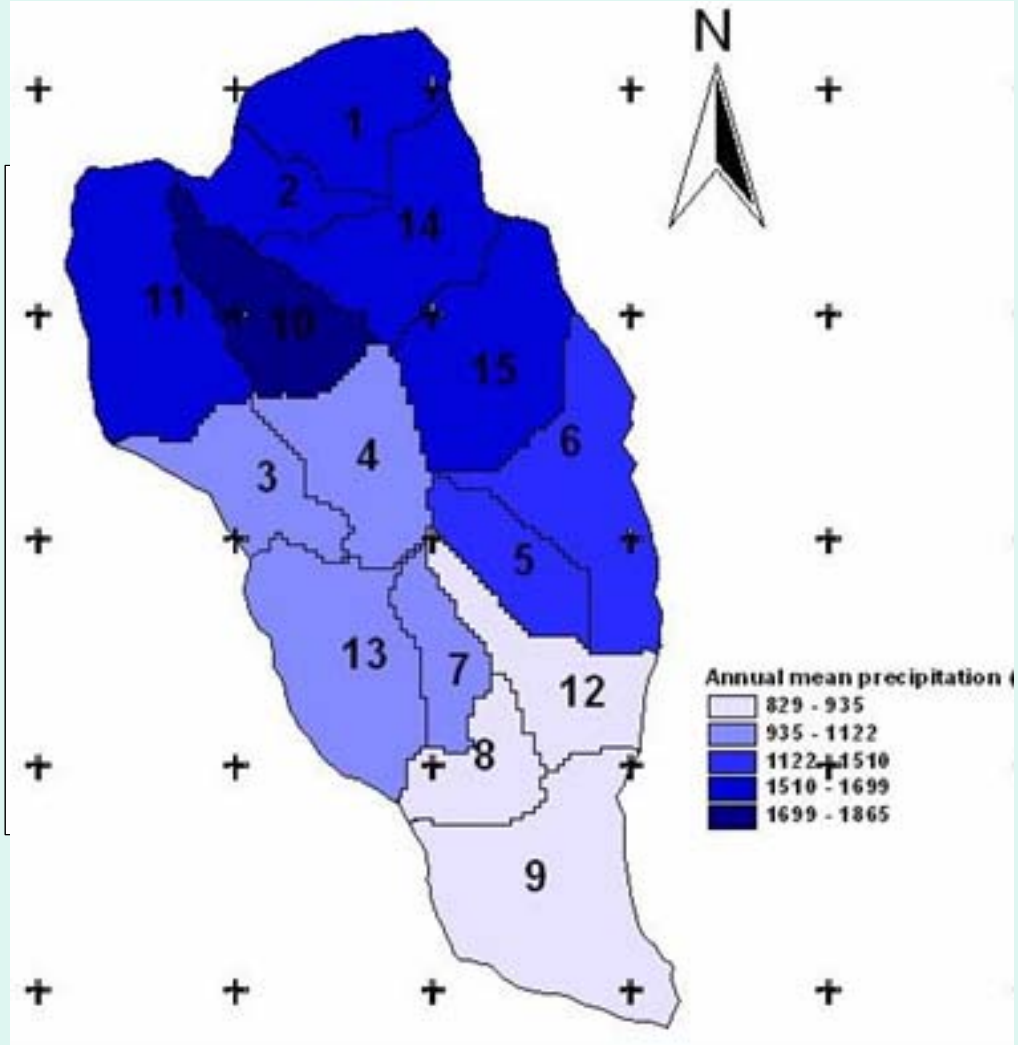
I) DEM and stream network

- A DEM was derived from digital contour lines
- A stream network was digitized from top map
- 15 sub-watersheds and 92 HRUs were created



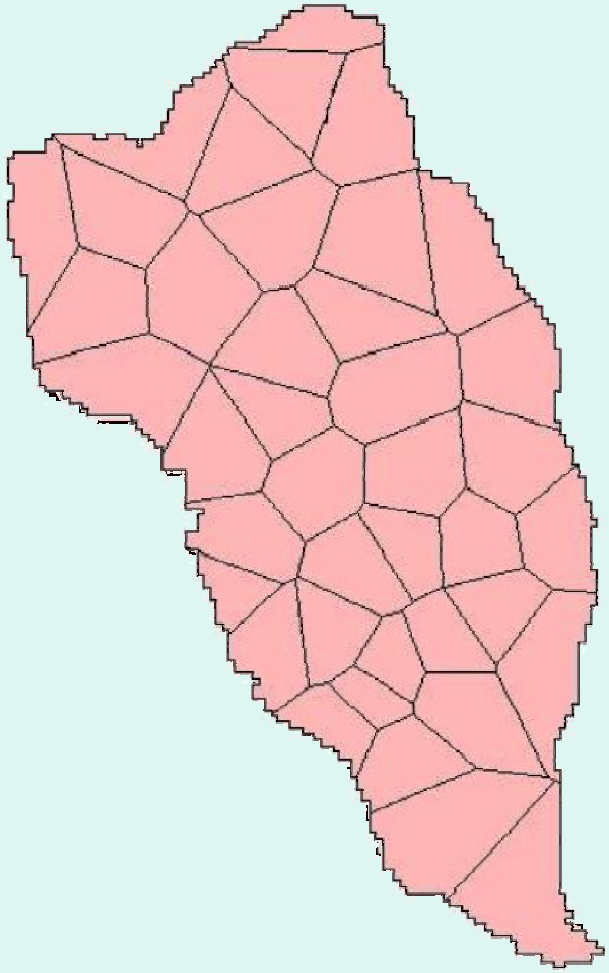
II) Meteorological Data

- To establish elevation-rainfall relation, 15 weather stations,
- Elevation bands were developed in SWAT to account for orographic effect of PCP



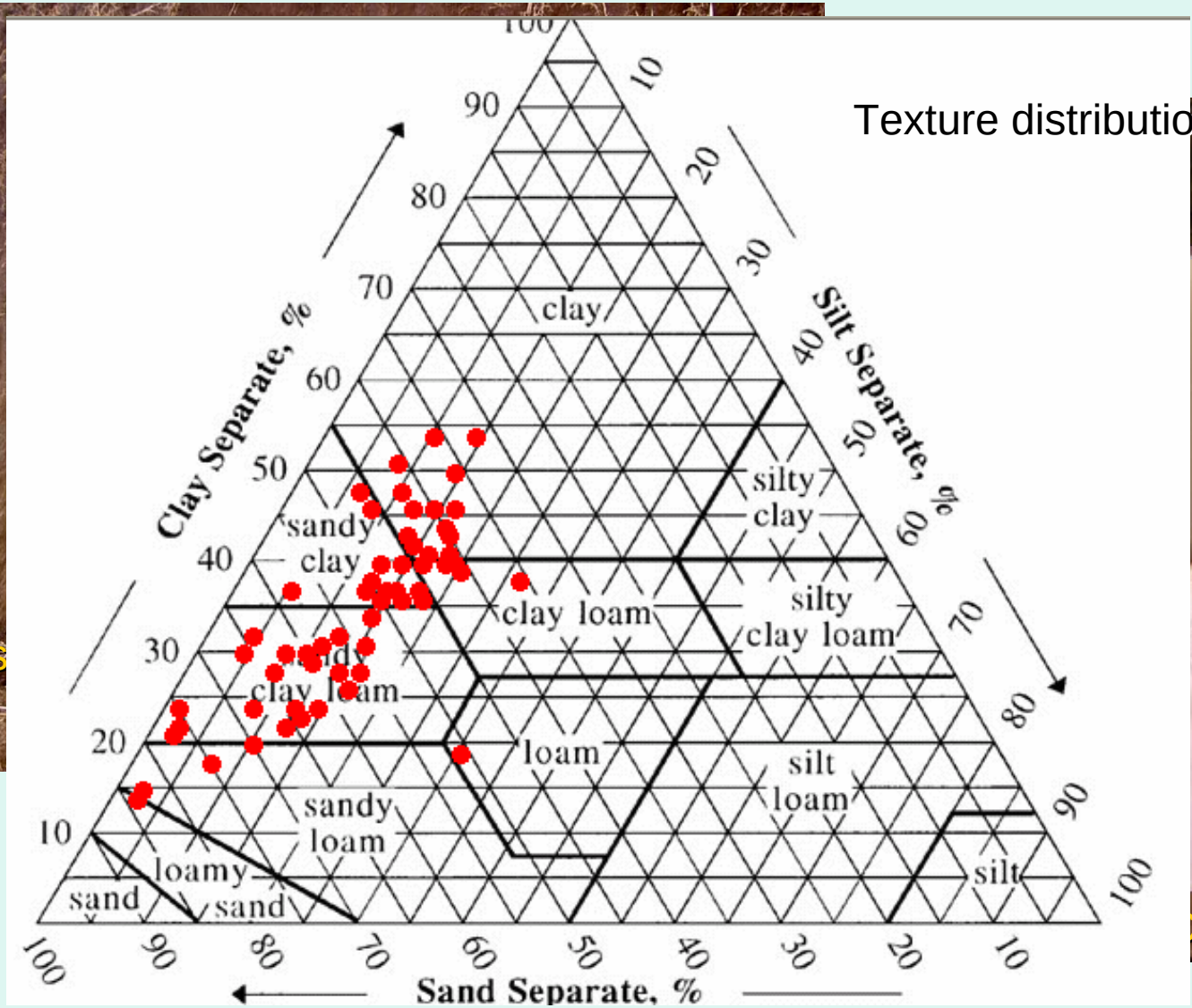
III) Soil data

- Sample locations identified (random sampling)
- Sample were taken to determine physical & chemical parameters
- Soil polygons were developed for the point location samples



Soil sampling and analysis

Texture distribution



IV) Land use/cover mapping

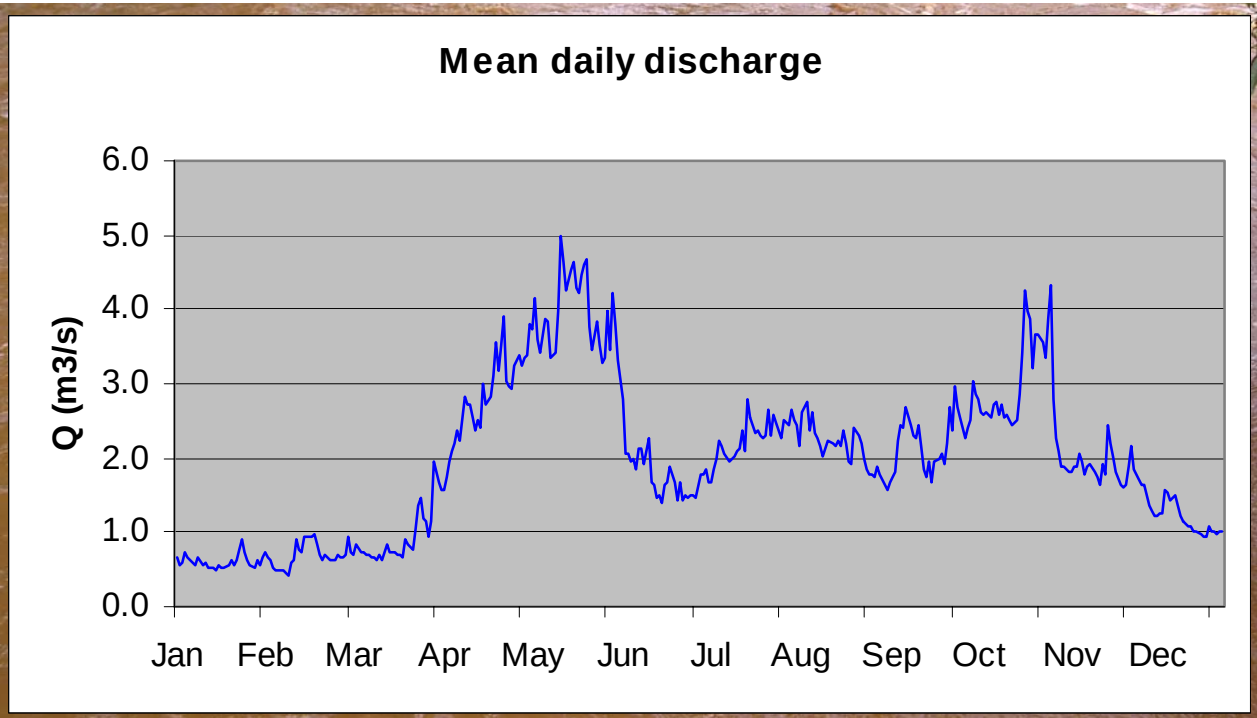
- Spatial databases were developed using aerial photographs (1967 &1975), satellite image (2004) and intensive on field land use mapping (2005)

- Hybrid of automated classification (supervised classification based on maximum livelihood approach) and visual interpretation (based on tone, texture, proximity) was adopted

- post-classification comparison method

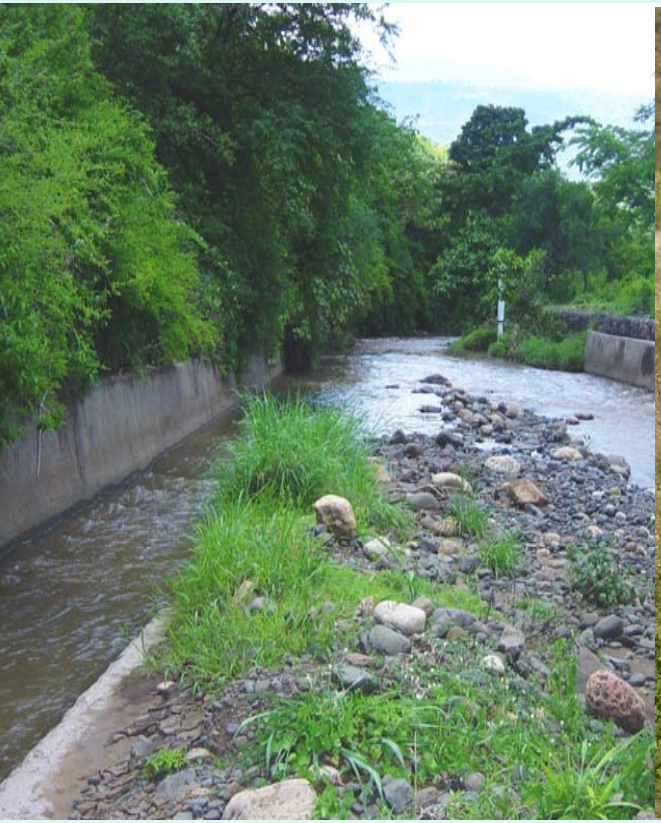
V) Streamflow data

- Observed daily streamflow (1980 – 2005) at the outlet of the watershed



2.2) Existing watershed practices
a) Downstream practices

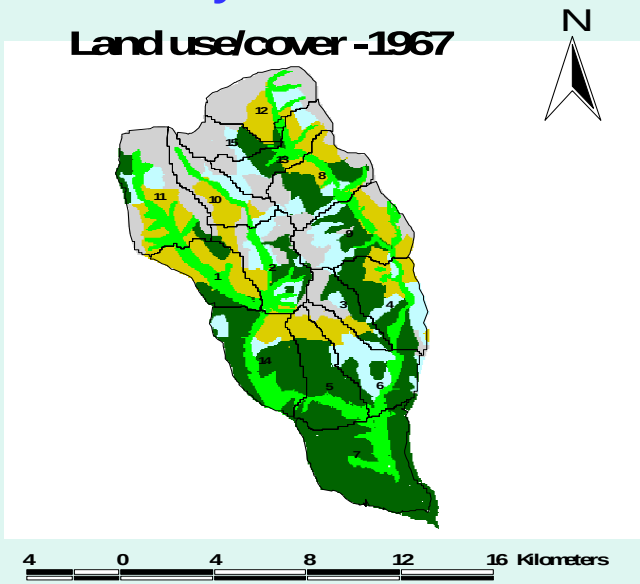
- 3 diversions to irrigate 2224 ha (depend on daily streamflow)

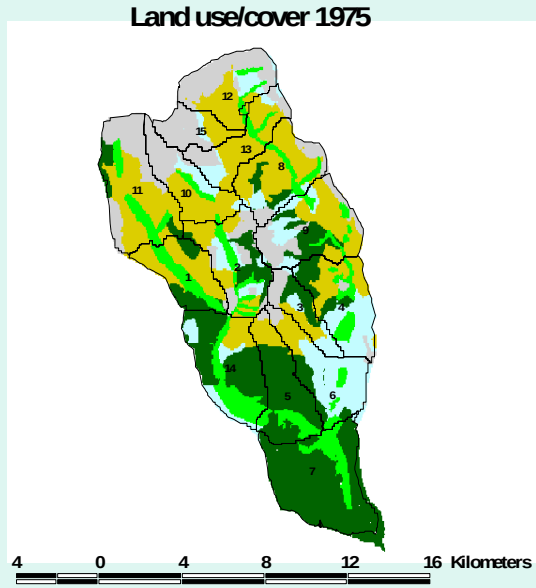


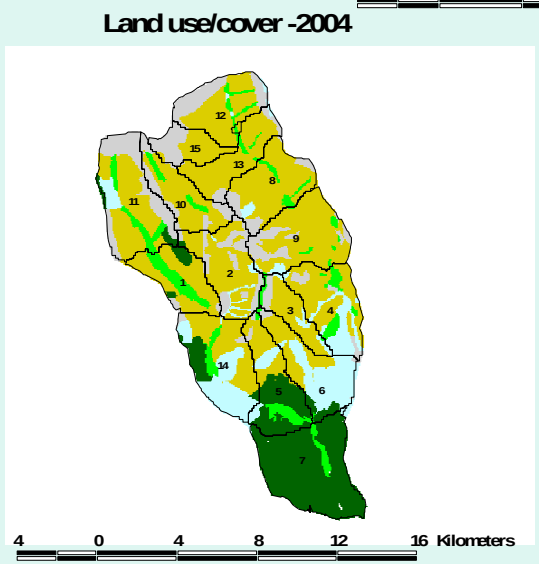
b) Upstream practices

3. Results

3.1 Land use dynamics







Legend

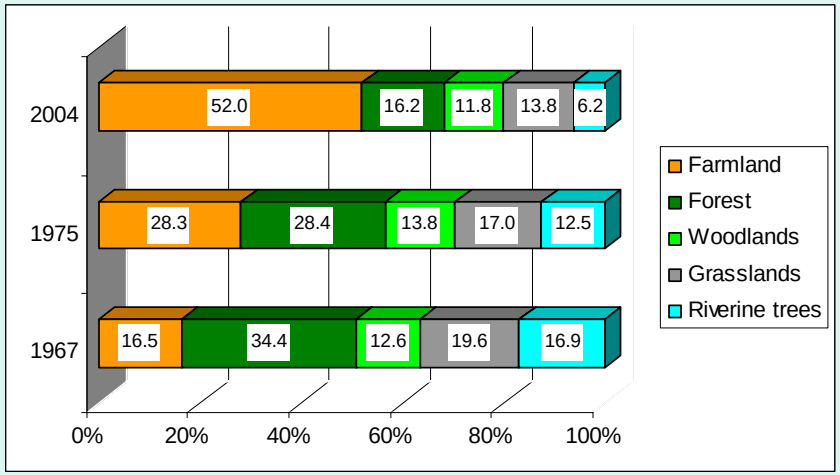
- Subbasins

Land use/cover

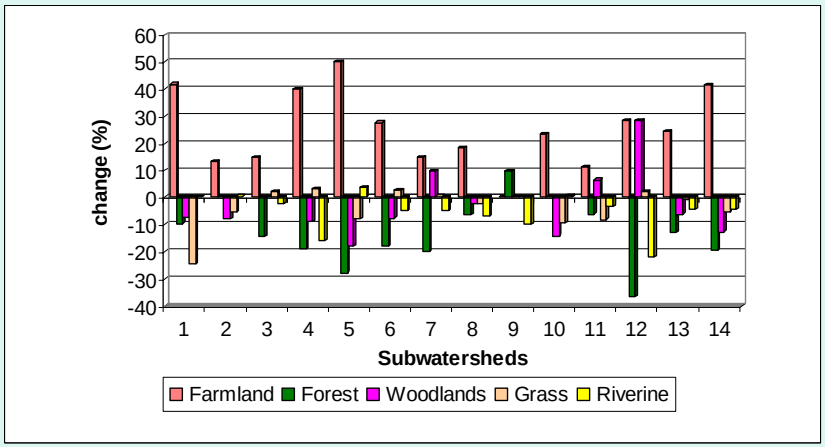
- Farmlands and settlement
- Grazing/pasture land
- Wood/Bush land
- Forest land
- Riverine tree/Bamboo

…Cont'd

- Farmlands increased mostly associated with a decrease in forest cover

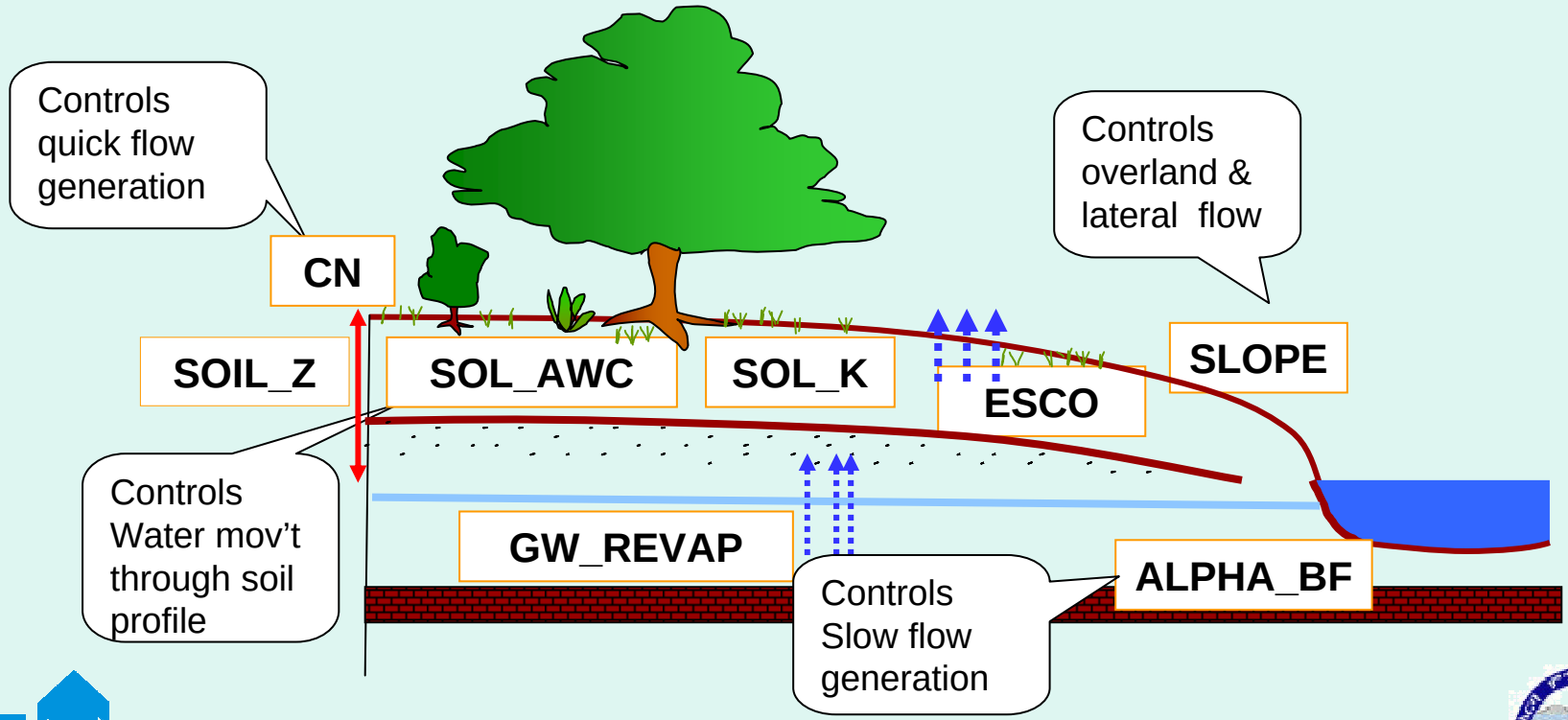


- Sub-watersheds adjacent to villages more affected



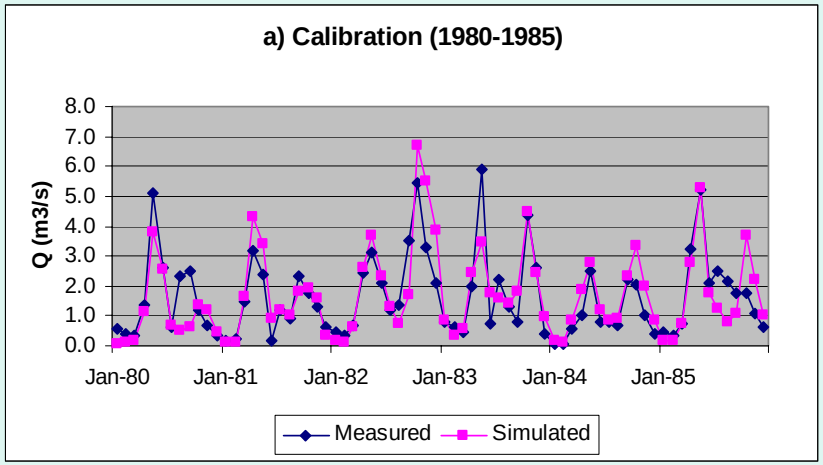
I) Sensitivity Analysis (SA)

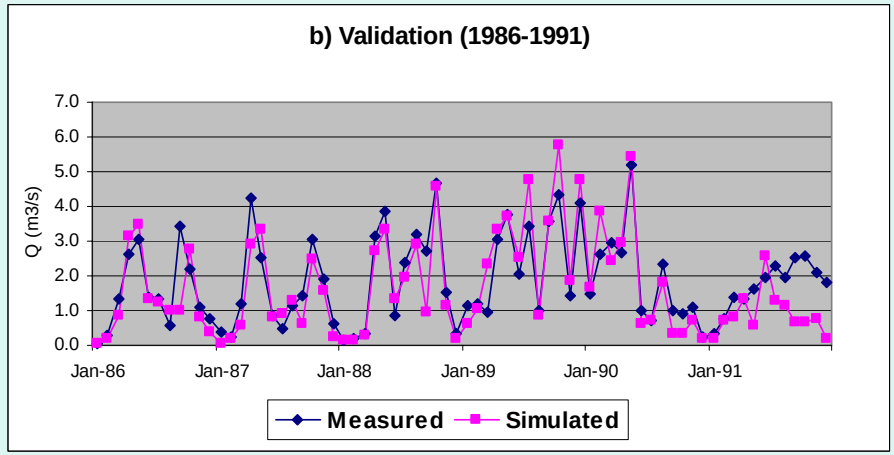
- 8 most crucial parameters
  - Curve number (CN), Soil Available Water Capacity (SOL_AWC), Soil depth (SOL_Z), Soil Evaporation Compensation factor (ESCO), Saturated hydraulic conductivity (SOL_K), Slope (SLOPE), Groundwater "revap" coefficient (GW_REVAP) and Groundwater recession factor (ALPHA_BF)



II) Calibration and validation

Index	1975 land use/cover map				2004 land use/cover map			
	Calibration (1980-85)		Validation (1986-91)		Calibration (1992-97)		Validation (1998-04)	
	Daily	Mon.	Daily	Mon.	Daily	Mon.	Daily	Mon.
Coef. dete(R^2)	0.63	0.72	0.52	0. 55	0.71	0.85	0.62	0.71
N-S coeff. (E)	0.52	0.63	0.43	0.45	0.62	0.82	0.58	0.67



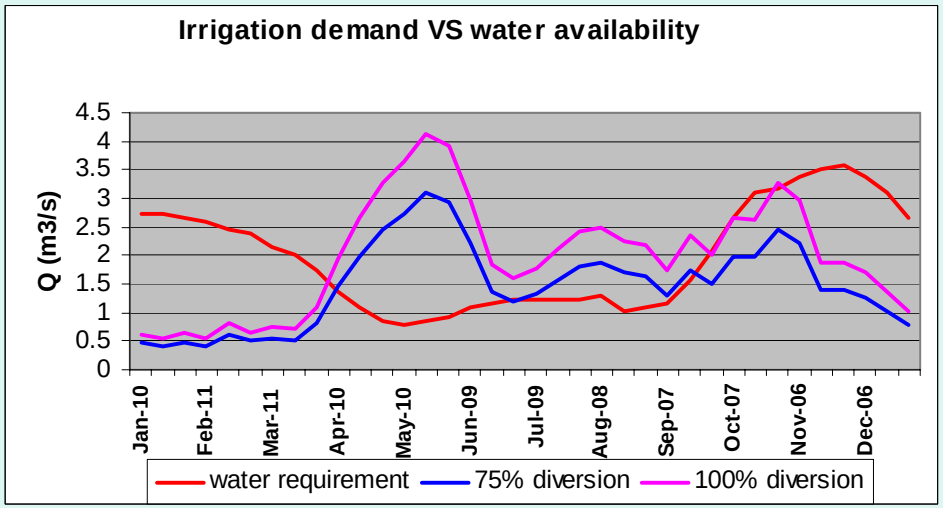


3.3 Seasonal streamflow variability (1992-2004)

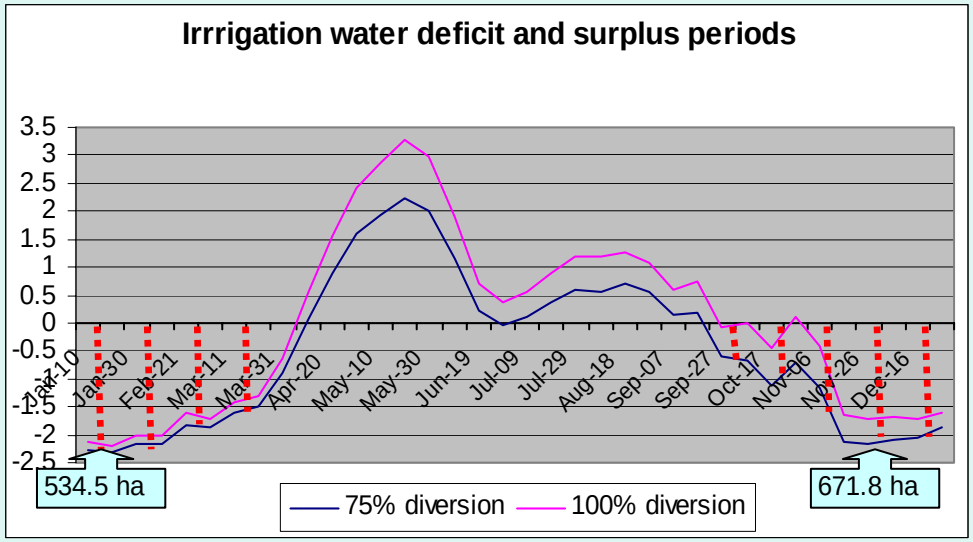
sub-watersheds	Farmland & settlement class change (%)	Mean monthly flow change (%)	
		Wet season (Mar.-May)	Dry season (Nov.-Feb.)
11	+ 5.1	+ 7.1	- 13.8
13	+ 12.8	+ 8.1	- 26.9
4	+ 18.2	+ 11.6	- 31.8
2	+ 18.8	+ 13.3	- 39.6
15	+ 18.9	+ 11,7	- 43,3
Entire WS	**+ 10.4**	**+ 12.5**	**-30.5**

3.4 Downstream impacts on irrigation project

- Irrigation water demand at the intakes was computed



- Water deficit & surplus periods for irrigation were determined



4. Conclusions

- Hare watershed had experienced land use/cover dynamics during the past four decades

- Model performance assessment verified that the model simulation results are dependable and SWAT can be utilized in similar watersheds

- Simulation results illustrated that land use/cover dynamics has had significant impacts on streamflow

  - *at present Hare River only satisfies 15.75% of downstream* irrigation water *demand*


Thank you for your attention