International Research Conference presentation

On:

Application of GIS and Remote Sensing for Suggesting Best Land Use Scenario and Water Resources Management

(A Case Study of Muga Watershed, Abbay River Basin, Ethiopia)

By:

Girum Getachew

October, 2019

Jigjiga, Ethiopia

Presentation Outlines

- ❖ Introduction
  - ✓ Background
  - ✓ Statement of Problem
  - ✓ Objectives
- ❖ Description of the Study Area
- ❖ Methodology
- ❖ Results and Discussions
- ❖ Conclusions and Recommendations

Background

- Due to population growth, large areas in developing countries have gradually converted to agricultural land.
- Most land-uses such as forest, shrub and grass lands have come into direct competition with agriculture.
- Expansion of agricultural lands have adverse effects on pastoral lands and water resources.
- The land use changes to agriculture have impact on the water resources of the watershed.

Statement of problem

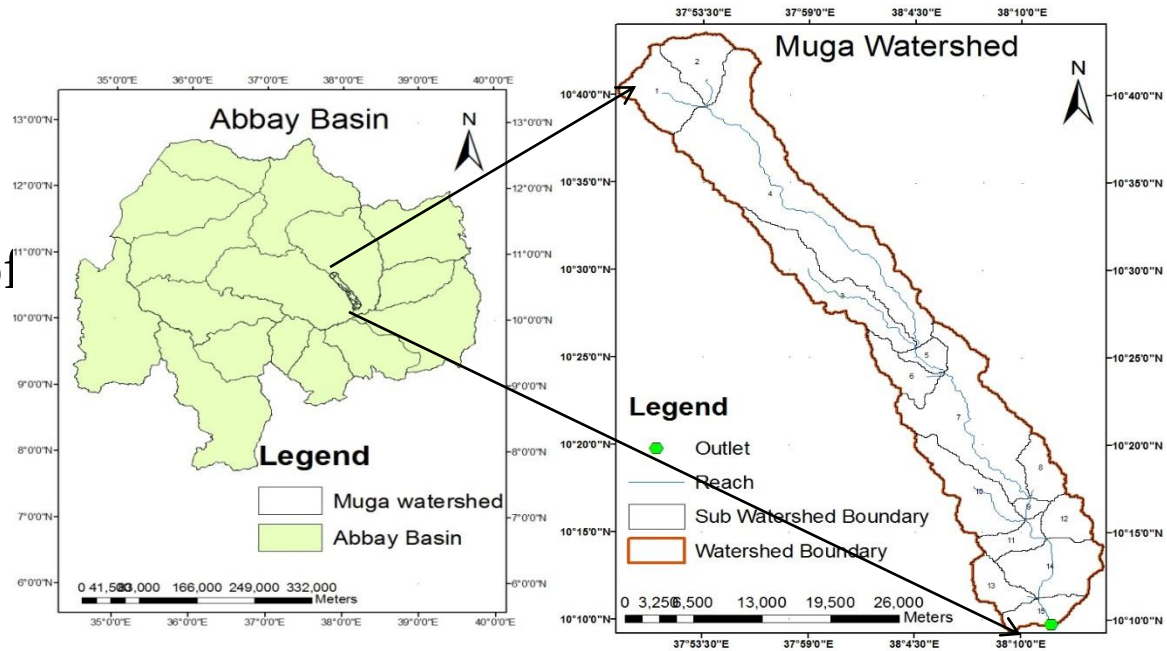
- Due to expansion intensive farming system, land use change affect the grazing lands as well as water resources.
- The effect of land use change on study area is not taken into consideration to perform urgent action.

Objectives of the study

- To investigate the impact of land use change responses on rangelands and water resources.
- To suggest best land use scenario for sustainable water resources management and range lands improvement.

Description of the Study Area

- It located10°6’30’’N to 10°43’30’’N and 37°49’00’’E to 38°16’30’’E.
- It covers an area of 641 km^2.
- has mean elevation of 2594 a.m.s.l.
- Mean annual Rainfall of 1445mm.
- Mini. and max. temp. of 5ºc and 25ºc respectively.
- Eutric Vertisols /clay soils/ are most common.



- Main land uses: cultivated, grass, scarce shrub and forest lands
- Most LC types: moderately, dominantly cultivated & afro alpine
- Farming system: mixed farming

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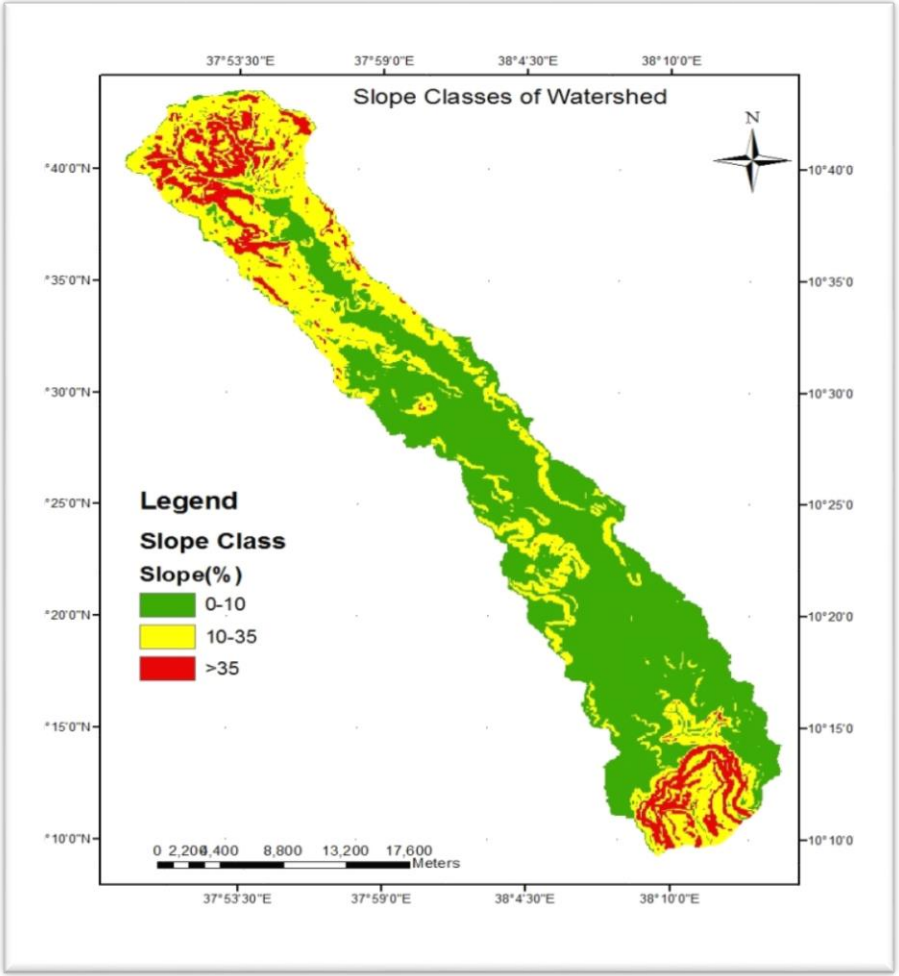
- Slope

✓0-10% = 357.58km²

✓10-35% = 220.77km²

✓Above 35% = 62.65km²



Methodology

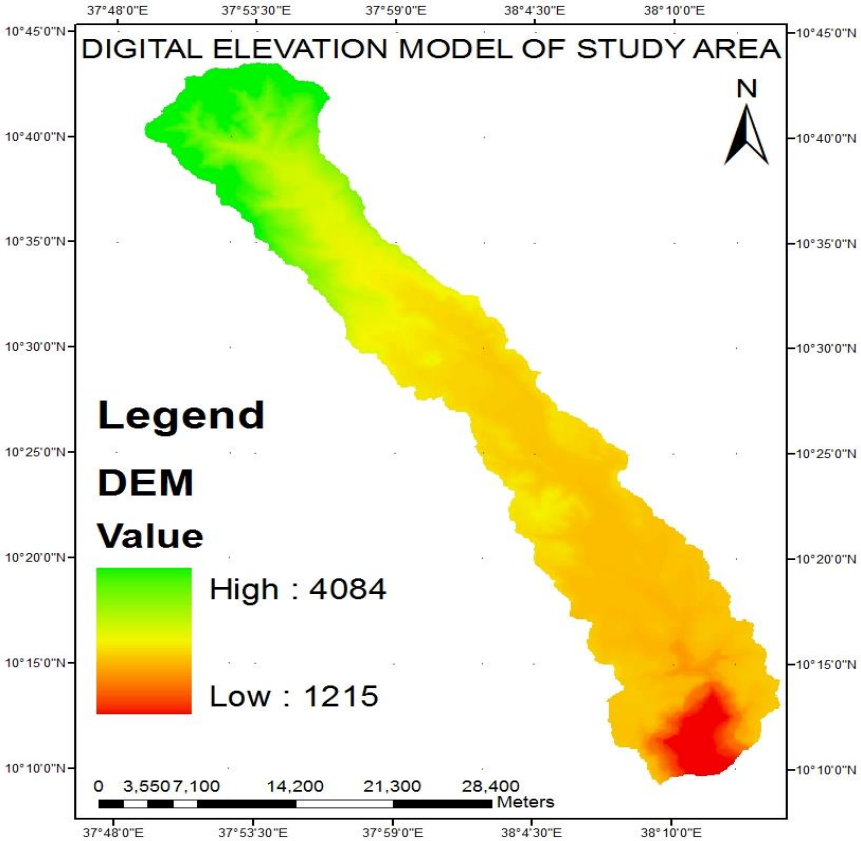
Software Used

- Arc GIS 9.3
- SWAT
- ERDAS IMAGINE
- WHAT base flow separator

Data Collection and Analysis

Data Collection

- DEM is one of spatial input to delineate the watershed.
- DEM was obtained from MoWIE with 30x30 m resolution and
- projected using Arc GIS 9.3 software package.



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Land use data

- 1986 and 2009 satellite images were taken from USGS/GLOVIS for classification process.

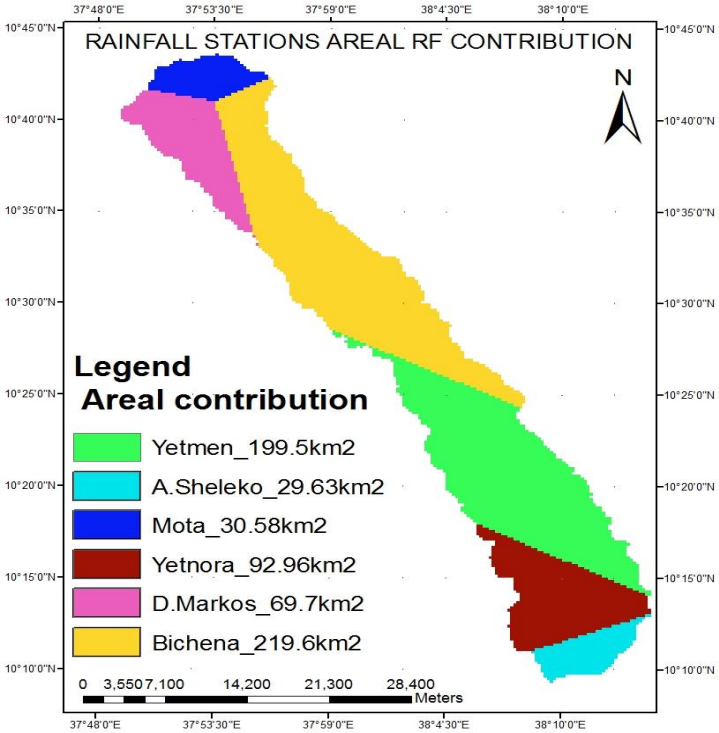
Soil data

- Soil data was taken from MoWIE.

Hydro-meteorological data

- Hydrological data was obtained from MoWIE.
- Meteorological data from NMA.
- Six meteorological stations were taken for this study.

✓ Theissen polygon method was used to know their contribution.

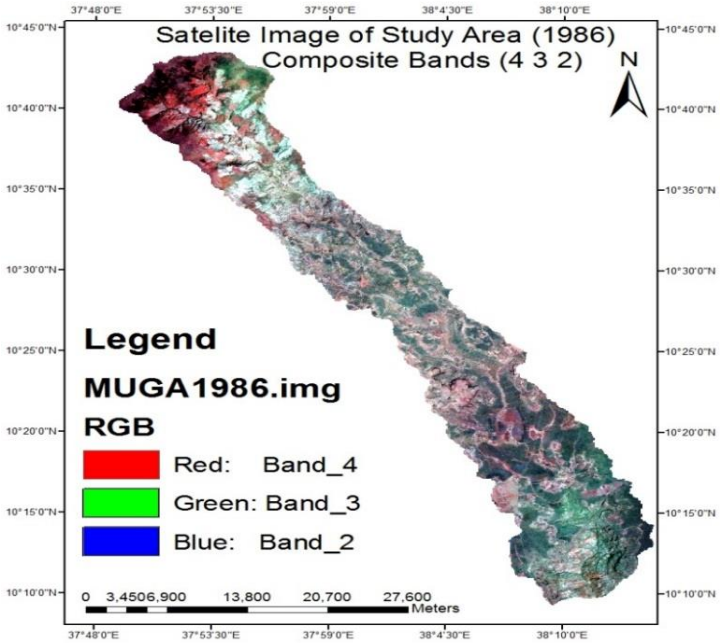


Data Analysis

Image Processing

The image data files were taken from USGS/GLOVIS website.

- 1986 image from TM sensor
- 2009 image from ETM+ sensor
- Both land sat images was layer stacked for classification.



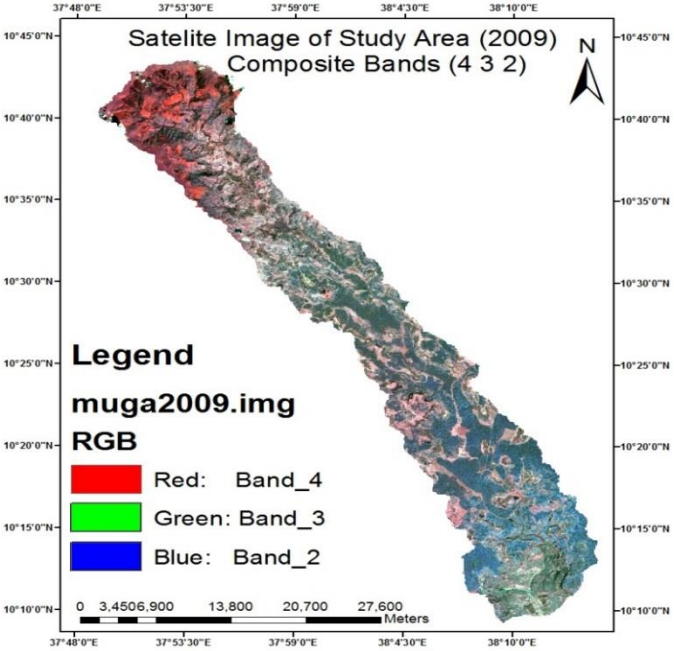


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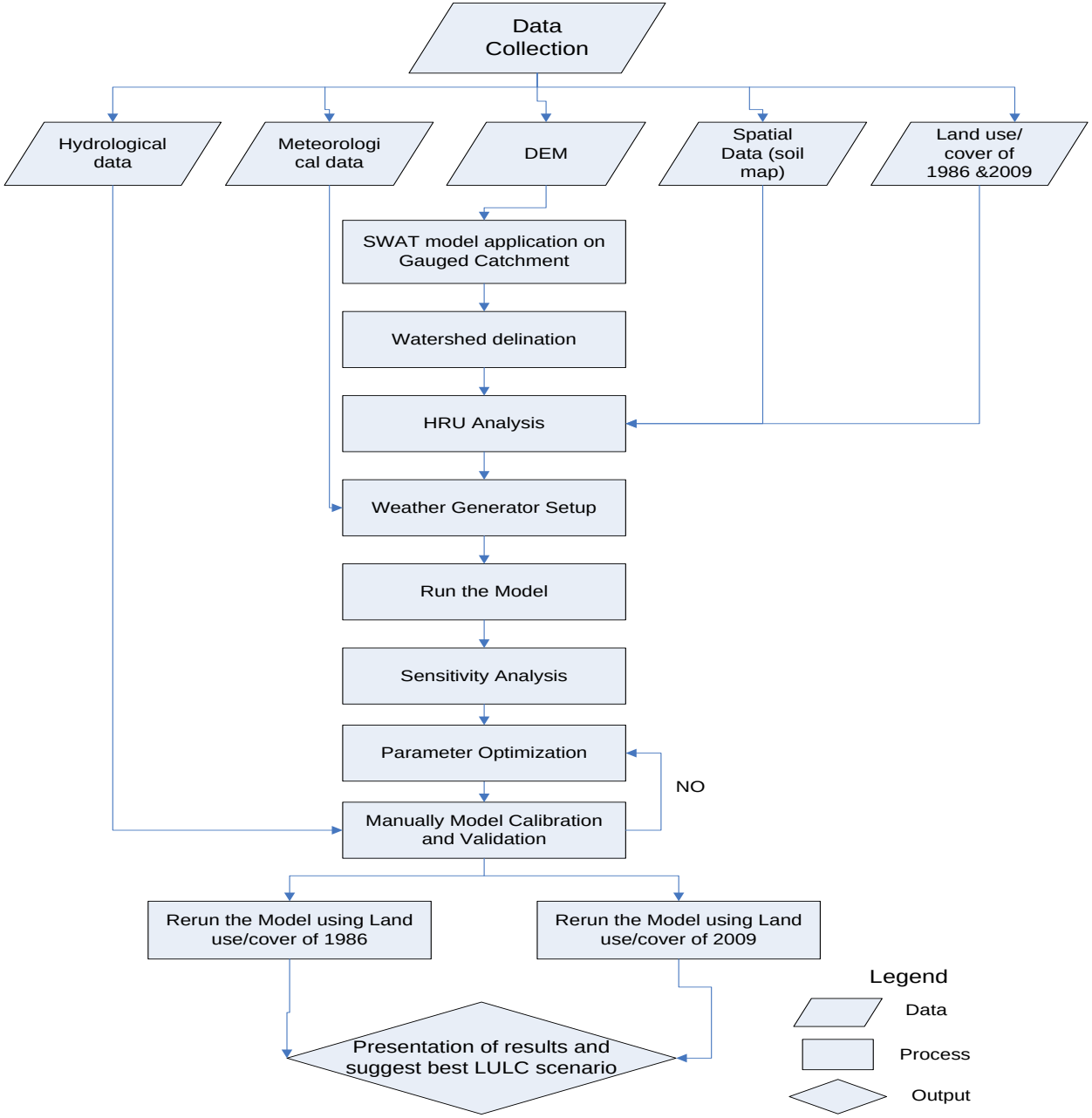
Image Classification

- In this study supervised classification was used to prepare land use data.
- After the signatures prepared , for each land use 6-7 GCPs were taken.
- Each class was examined, assigned a name and merge a number of classes in to a single category.
- Then the land use was classified.

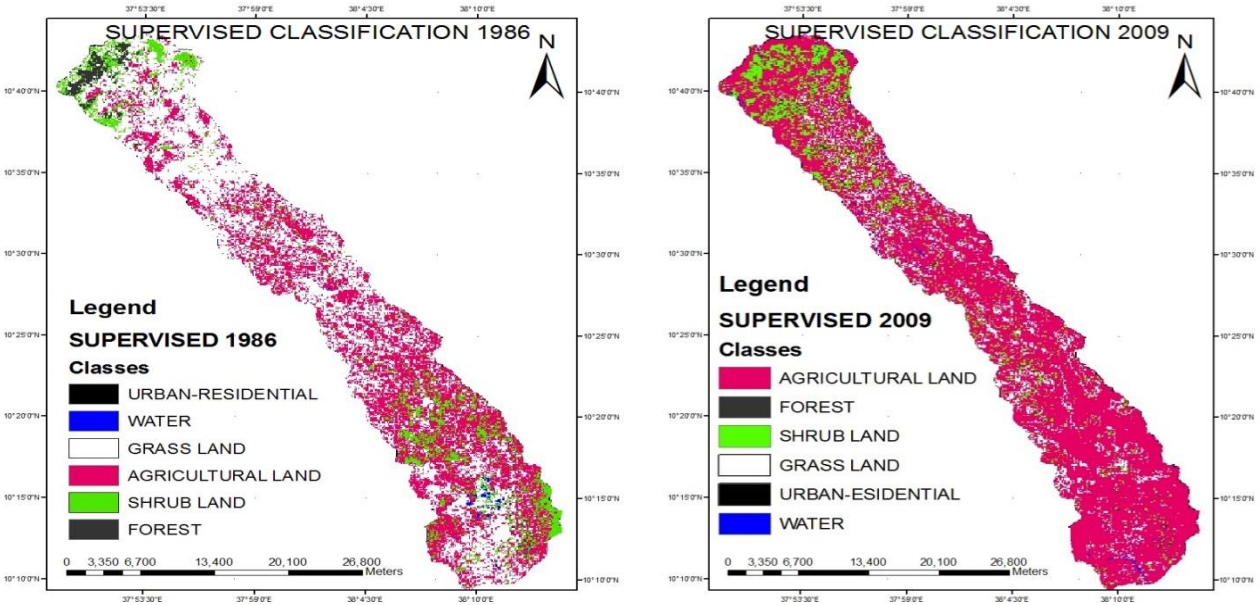
Methodology Summary



Result and Discussion

Land use change analysis

- ✓ After through step by step processing and land use detection the map showing six (cultivated, water, grass land, shrub land, urban and forest) classes of land use were created unifying these classes for the 1986 and 2009



(a) ***(b)***

Land use map of year (a) 1986 and (b) 2009

Land use….

- ✓ During this study periods (1986 – 2009); there had been a significant land use change where the agricultural land had been increased from 40.01% to 76.47%, while grass lands were decreased from 46.23% to 10.99%. Hence, pastoral lands affected by the land use change and was forage deficiency for livestock.

Land use classes	1986		2009		Land use change from 1986 to 2009	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Agricultural land	**25704.6**	**40.1**	**49018.3**	**76.47**	**+23313.7**	**+36.37**
Grassland	**29634.0**	**46.23**	**7044.7**	**10.99**	**22589.3**	**-35.24**
Shrub land	**6903.7**	**10.77**	**6833.2**	**10.66**	**-70.5**	**-0.11**
Forest	**1230.7**	**1.92**	**448.7**	**0.7**	**-782.0**	**-1.22**
Water	**339.8**	**0.53**	**262.8**	**0.41**	**-77.9**	**-0.12**
Urban	**288.5**	**0.45**	**493.6**	**0.77**	**+205.1**	**+0.32**

Hydrological impacts due to land use changes

- The mean annually surface flow, lateral flow and ground water flow for 1986 and 2009 have changed due to land use variability. Groundwater flow was decreased and deficiency of water happened in dry seasons.

	Mean annually flow (mm)		
	1986	2009	Change from 1986 to 2009
SURQ	**351.73**	**375.69**	**23.96**
LATQ	**96.85**	**91.47**	**-5.38**
GWQ	**384.07**	**360.41**	**-23.66**

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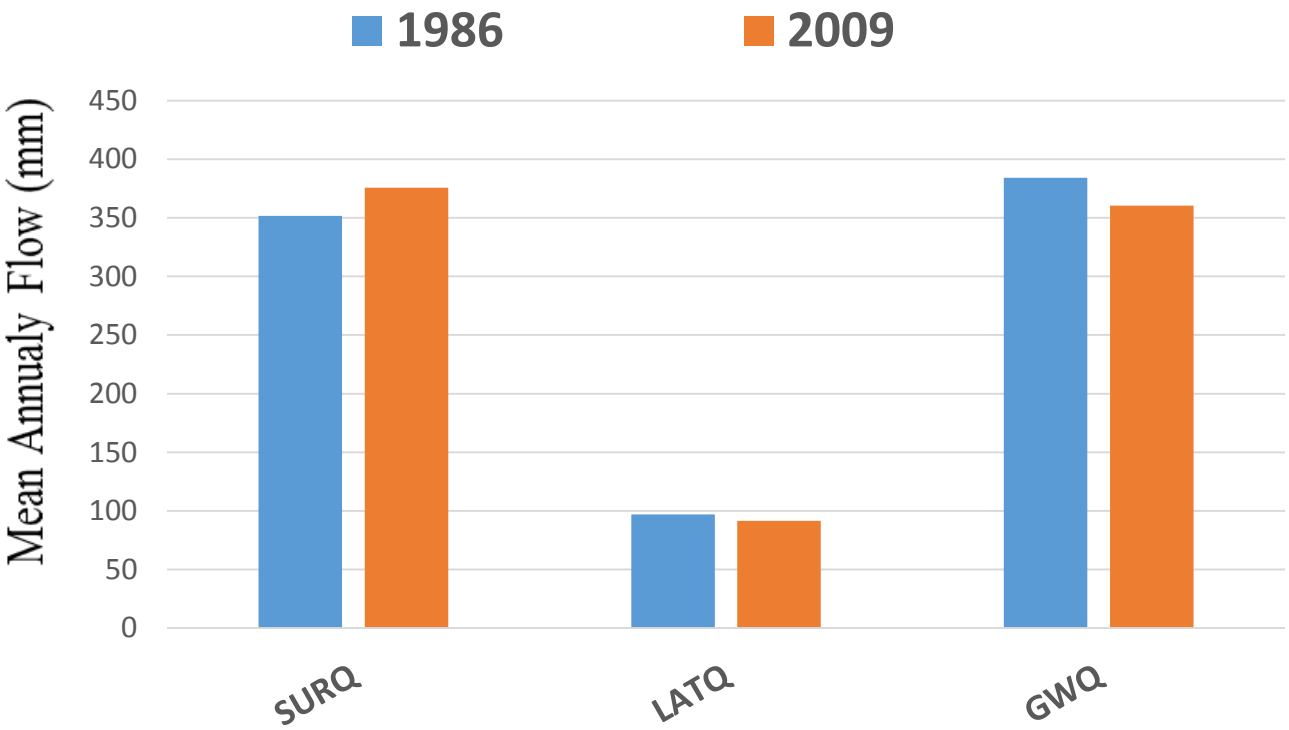
- Mean annually surface runoff, lateral and groundwater flow variability (1986 and 2009)



Change in the Seasonal Stream Flows

	Mean monthly flow (cms)		
	1986	2009	Change from 1986 to 2009
Wet seasons	254.24	257.96	3.74
Dry seasons	8.05	5.05	-3

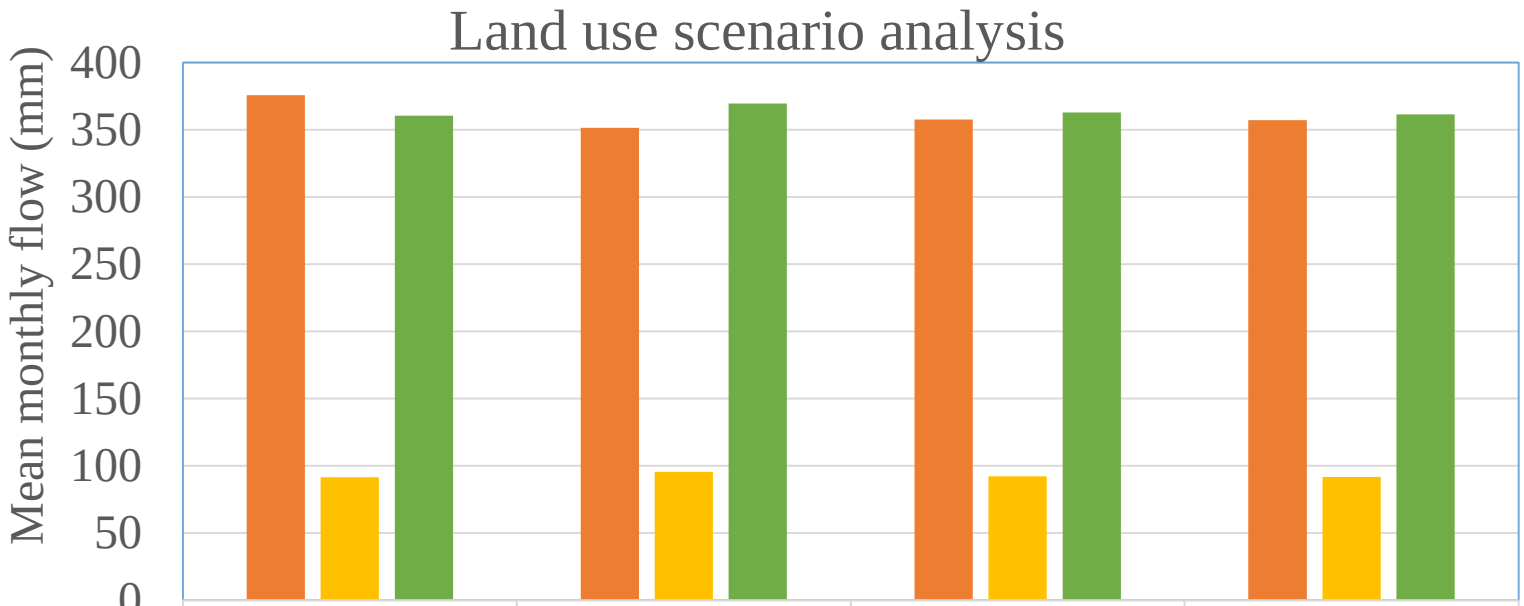
Wet seasons: June, July, August
Dry seasons: January, February, March

Affected areas

- ✓Water scarcity
- ✓Irrigation activities (Food security)
- ✓Forage dev’t (Livestock dev’t)

LU scenario analysis

- The intension of making these scenarios is improving water resources management.



	2009 land use	Scenario 1	Scenario 2	Scenario 3
SURQ	375.69	351.36	357.69	357.08
LATQ	91.47	95.57	92.07	91.7
GWQ	360.41	369.6	362.79	361.38

Scenario1: agricultural lands to forest scenario

Scenario2: grass lands to forest scenario

Scenario3: shrub lands to forest scenario

Cont…

- From the above scenarios discussed scenario 1, covering 5% of cultivated land with forest was the best scenario as compared to others.
- Hence, these scenarios were not only improve water resources, also it enhances grazing lands for recover accessibility of pastoralism.
- Hence, with management of land use and water resources, forage and water for livestock has been improved for ensure food security.

Conclusions

- Results obtained shows that grass, shrub and forest lands were declined while agricultural land was expanded over the study period.
- Mean annually surface runoff increased while groundwater flow and lateral flow were decreased.
- Scenario1 (agricultural land to forest scenario) was best scenario to address water resource degradation problem and improving accessibility of pastoral lands for livestock.

Recommendations

- The best land use scenario should be performed by afforest high sloppy areas.
- Areas which are managed should be covered with forages to improve range lands lands.

THANK YOU ALL