

**Integrated Modeling of RMS Impacts:  
Hydrological Processes, and  
Water Resources Modeling**

Nile BDC Symposium on Modeling in the Blue Nile Basin  
Addis Ababa, 12 November 2012

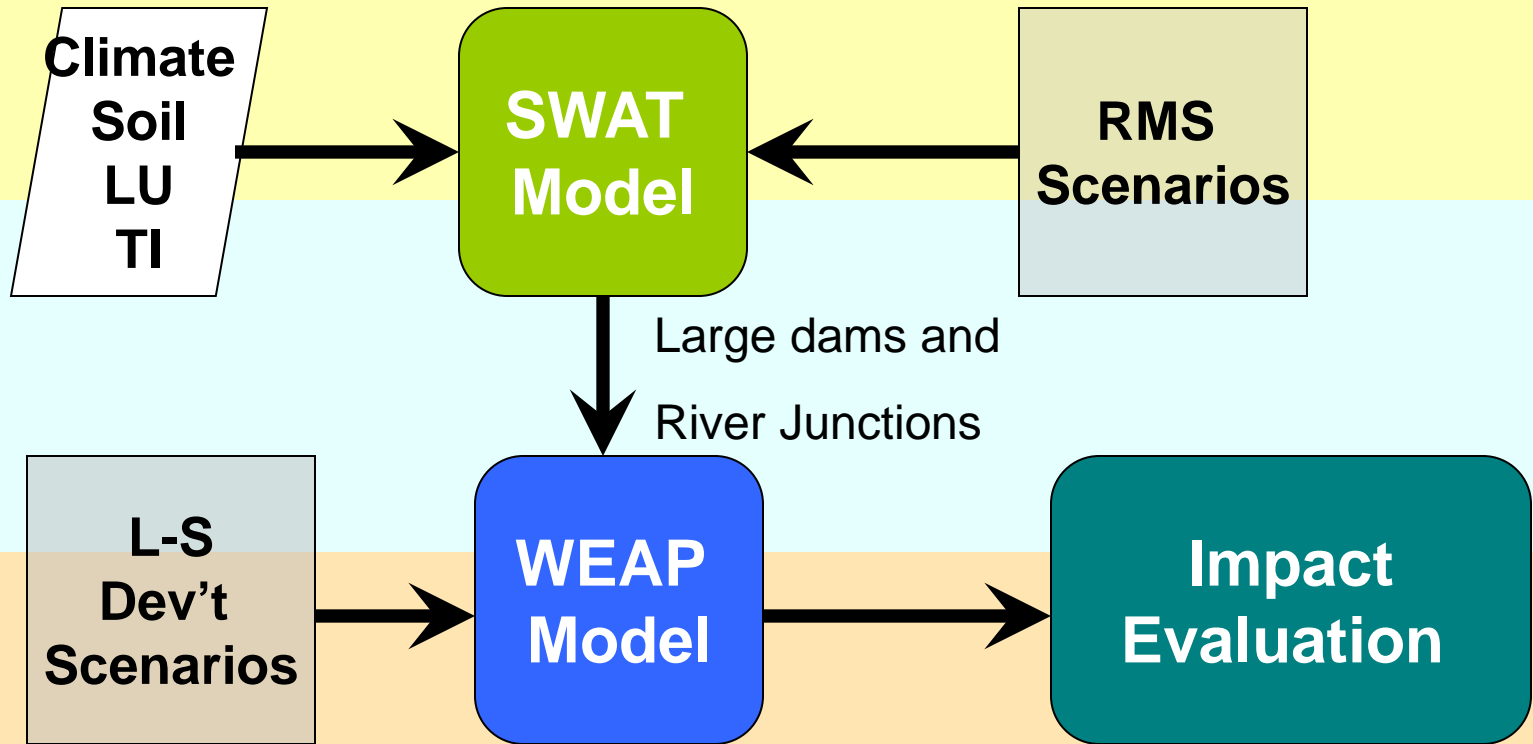
**Solomon Seyoum**  
**IWMI**

# Objectives

1. Assess integrated biophysical impacts of RMS practices and large-scale developments on water availability, sediment load (and groundwater recharge)
2. Devise mechanisms of incorporating RMS practices into basin IWRM planning
3. Investigate up- and out-scaling options of RMS practices using sustainability criteria of satisfying downstream requirements

# Framework

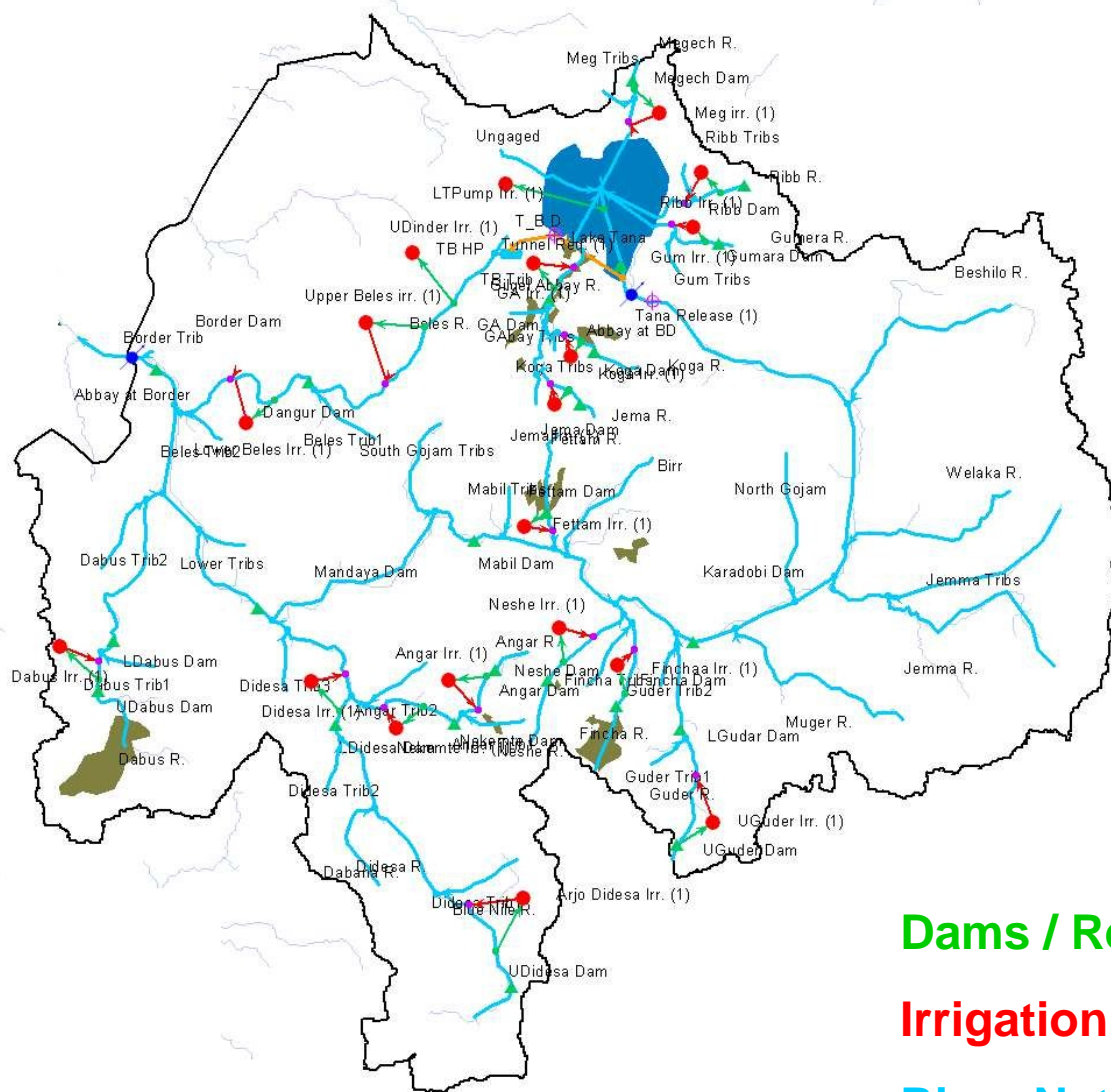
Abay Basin  
Sub-basins  
Watersheds



# WEAP Modeling

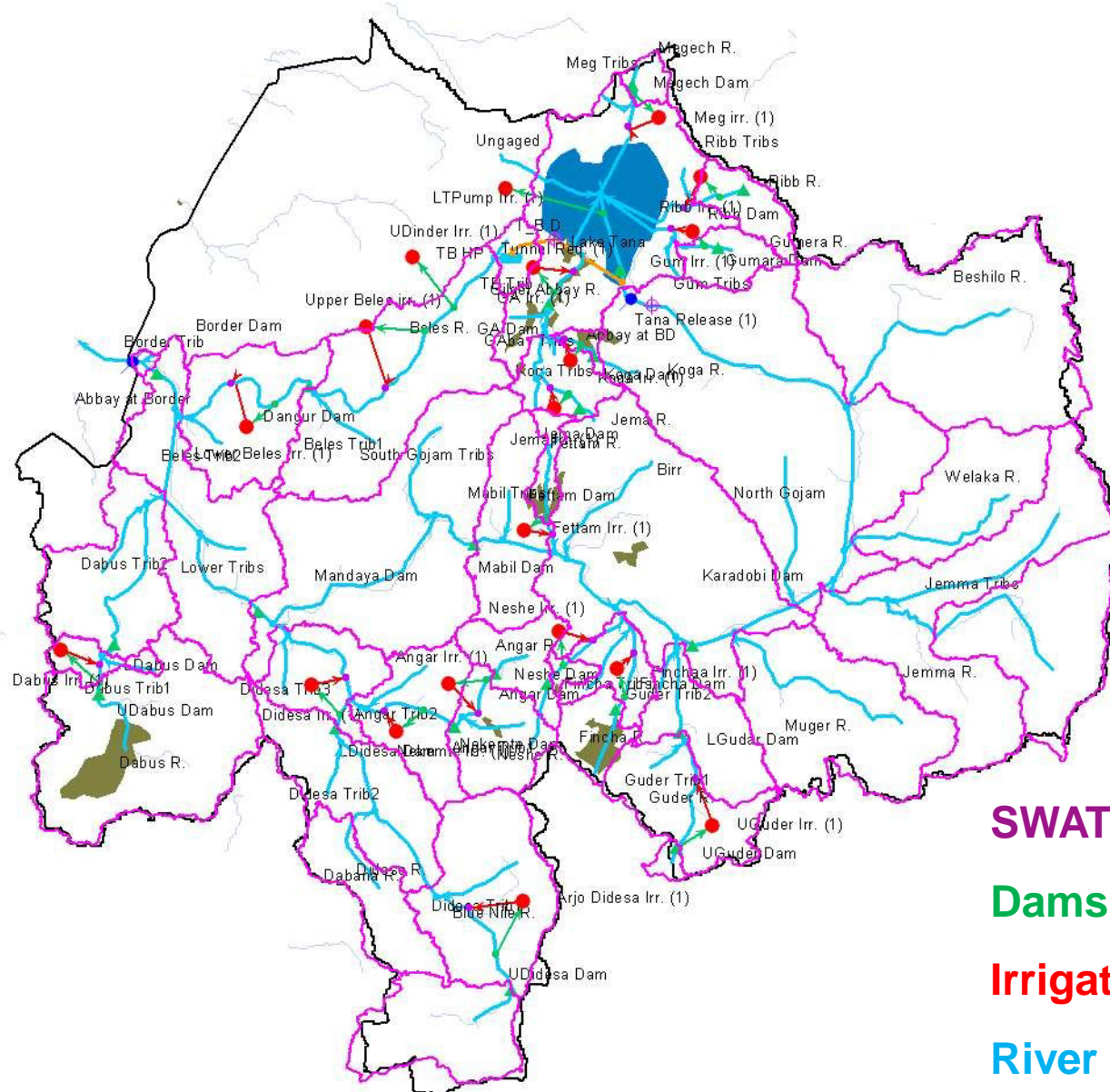
- Large-scale development interventions (practices):
  - Water control and storage infrastructures
  - Irrigation schemes
  - Hydropower plants
  - Environmental flows
- Improved schematization for SWAT-WEAP linkages
- SEI provided first feedback on the WEAP setup
- Scenario definition (development + RMS) ?

# WEAP Schematization



- Dams / Reservoirs
- Irrigation demands
- River Networks

# SWAT-WEAP Interface



**SWAT sub-catchments**

**Dams / Reservoirs**

**Irrigation demands**

**River Networks**

# SWAT Modeling

- SWAT initialized based on WEAP requirements and flow data availability
- Landuse, soil and climate data improved
- Variable sources area (VSA) concept implemented using TI
- GIS Tool developed for the Soil-TI derivation
- Calibration and RMS scenarios

# SWAT Sub-basins +

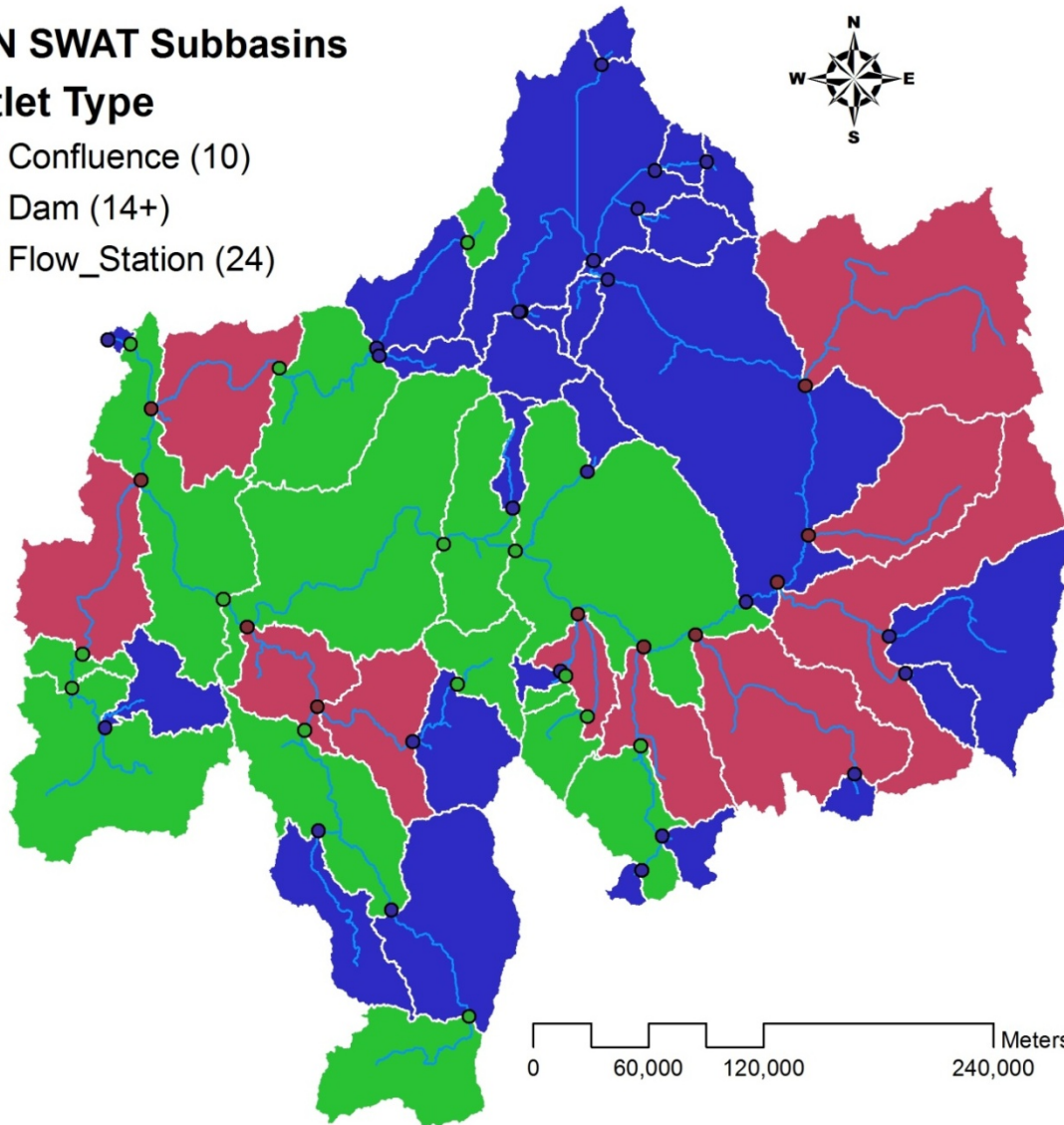
## UBN SWAT Subbasins

### Outlet Type

Confluence (10)

Dam (14+)

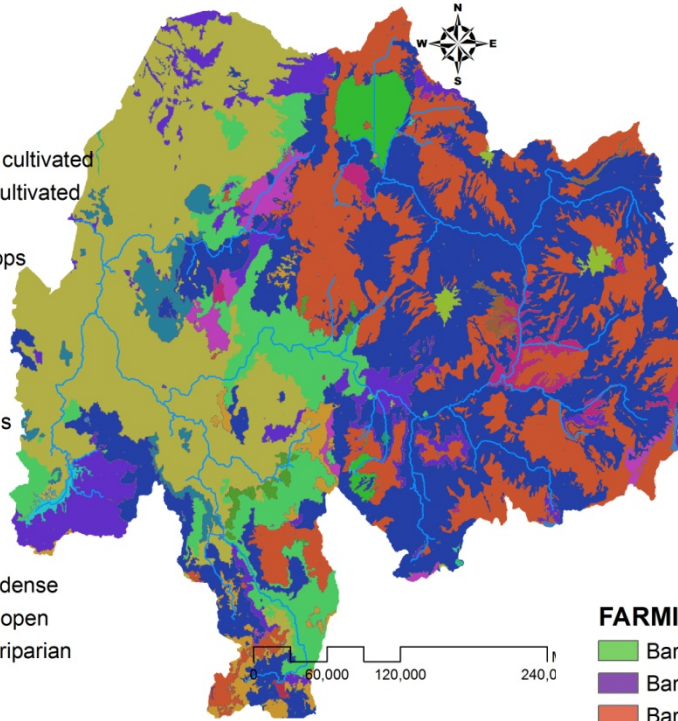
Flow\_Station (24)





## LAND COVER

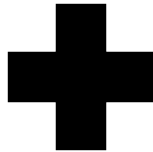
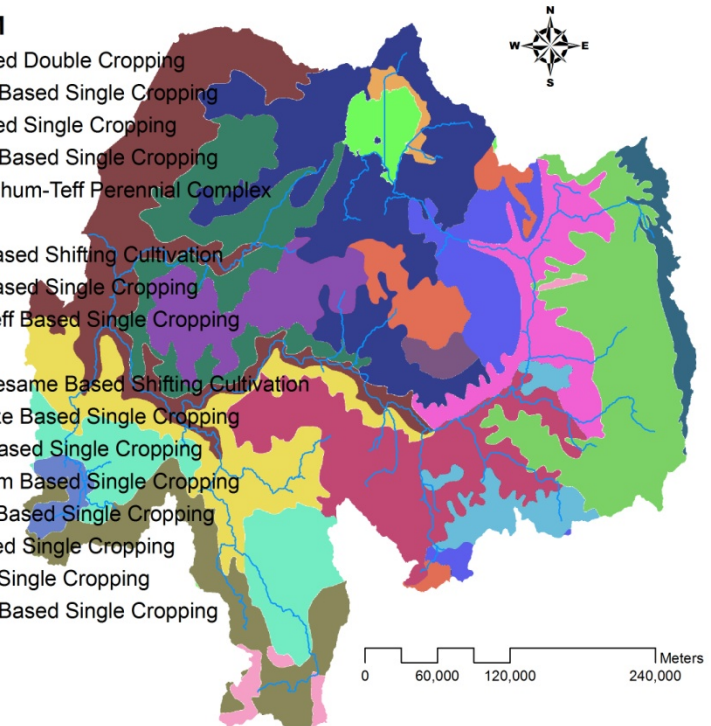
- A: Afro alpine
- B2: Bushland
- BA1: Bamboo
- C1: Dominantly cultivated
- C2: Moderatly cultivated
- C5: Irrigated
- C6: Perennial crops
- F2: Forest
- G1: Grassland
- H1: water body
- H2: Swamp
- P1.1: Plantations
- R: Rockland
- S1: Shrubland
- SF: State farm
- U: Urban
- WD: Woodland dense
- WO: Woodland open
- WR: Woodland riparian



# Landuse Map for SWAT

## FARMING SYSTEM

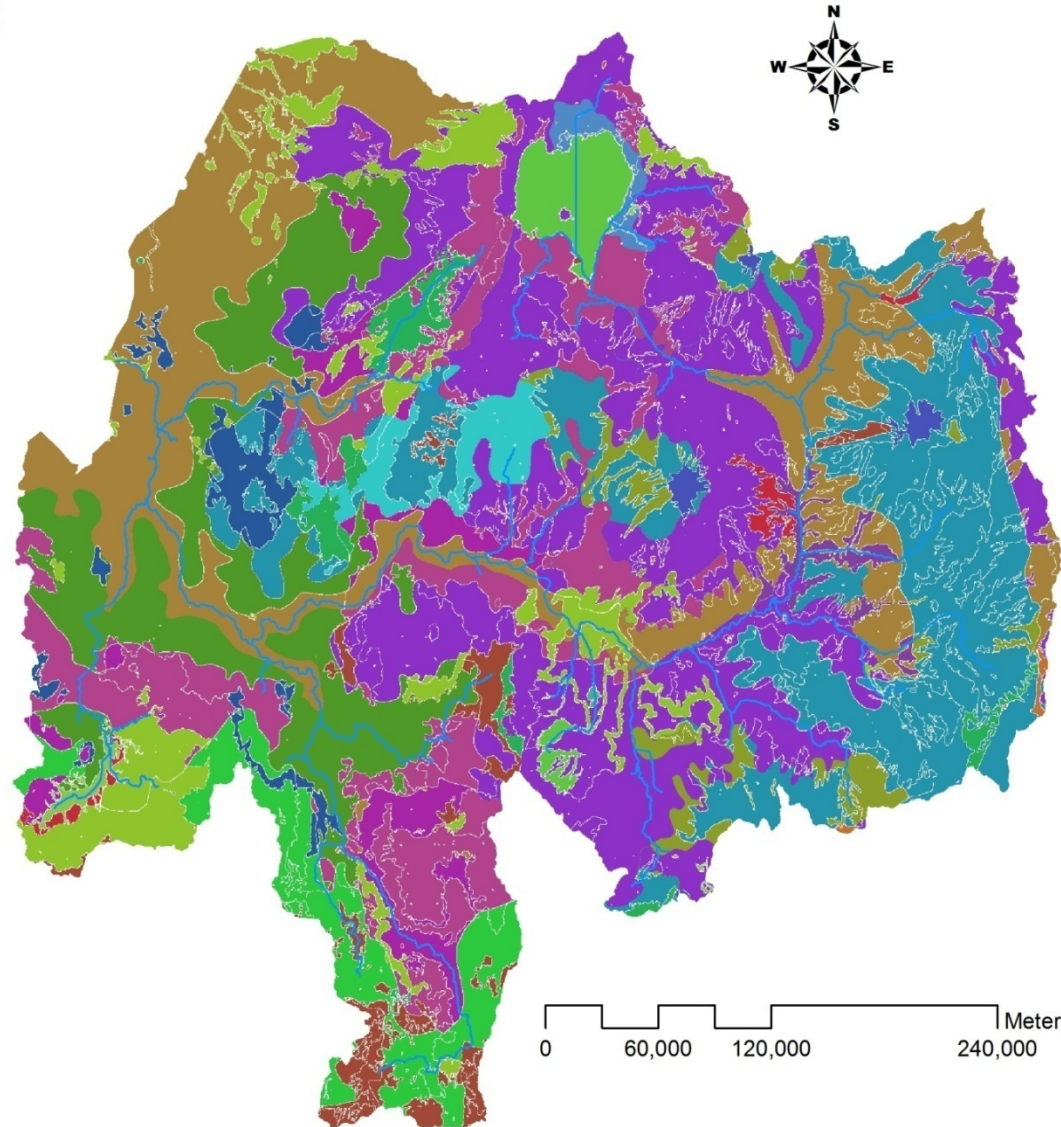
- Barely-Wheat Based Double Cropping
- Barley-Teff-Potato Based Single Cropping
- Barley-Wheat Based Single Cropping
- Barley-Wheat-Teff Based Single Cropping
- Coffee-Maize-Sorghum-Teff Perennial Complex
- Forest
- Maize-Sorghum Based Shifting Cultivation
- Maize-Sorghum Based Single Cropping
- Maize-Sorghum-Teff Based Single Cropping
- Not Suitable
- Sorghum-Maize-Sesame Based Shifting Cultivation
- Sorghum-Teff-Maize Based Single Cropping
- Teff-Maize-Millet Based Single Cropping
- Teff-Maize-Sorghum Based Single Cropping
- Teff-Maize-Wheat Based Single Cropping
- Teff-Sorghum Based Single Cropping
- Teff-Wheat Based Single Cropping
- Teff-Wheat-Barley Based Single Cropping
- Water Body



# UBN SWAT Landuse Map

## LANDUSE SWAT\_CODE

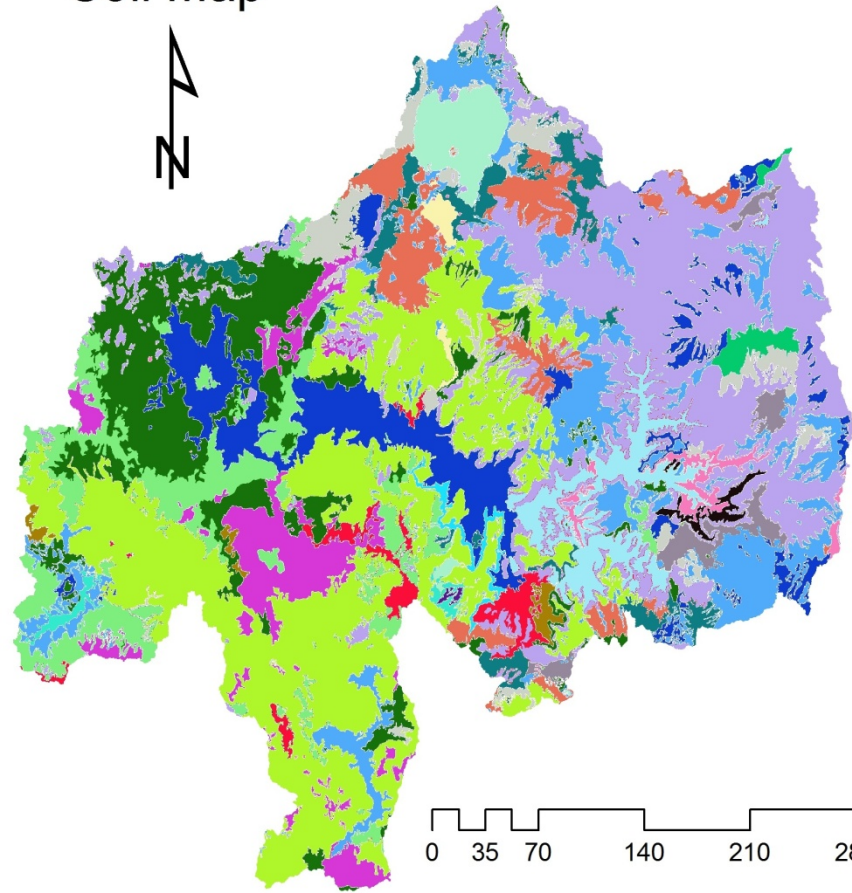
	AGRC
	AGRL
	BARL
	BARR
	COFF
	CORN
	CRIR
	CRWO
	FODN
	FOEB
	FOEN
	FRSE
	FRST
	GRAS
	GRSG
	PINE
	PMIL
	POTA
	RNGB
	SHRB
	SWHT
	TEFF
	URBN
	WATR
	WETL



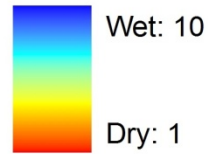
0 60,000 120,000 240,000 Meters

# Soil Map for SWAT

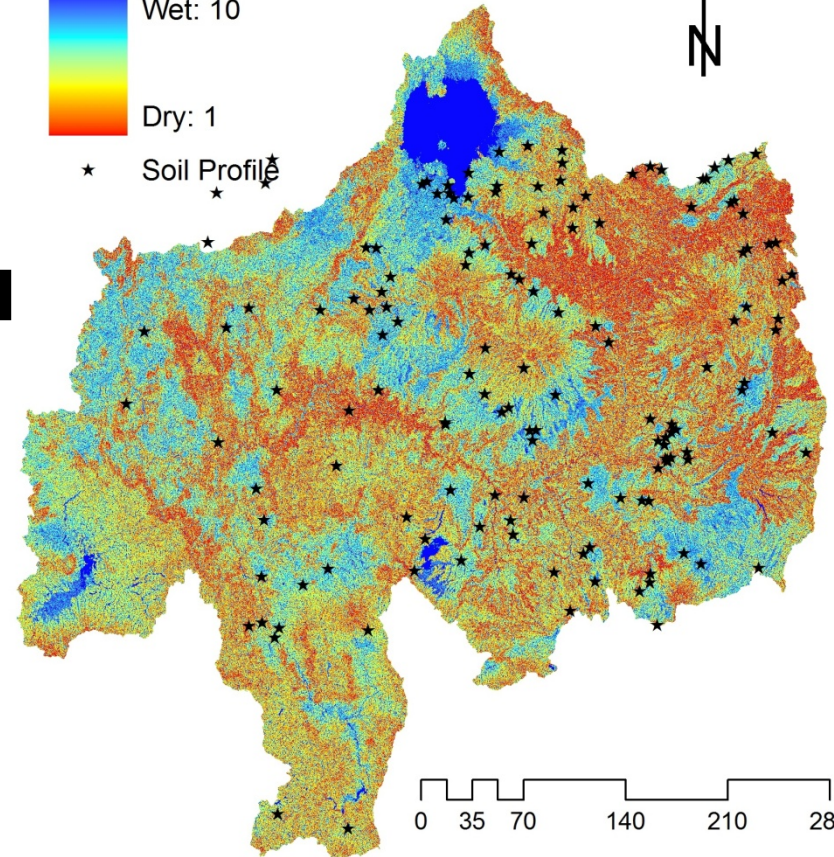
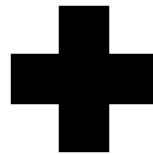
Soil Map



TI Class

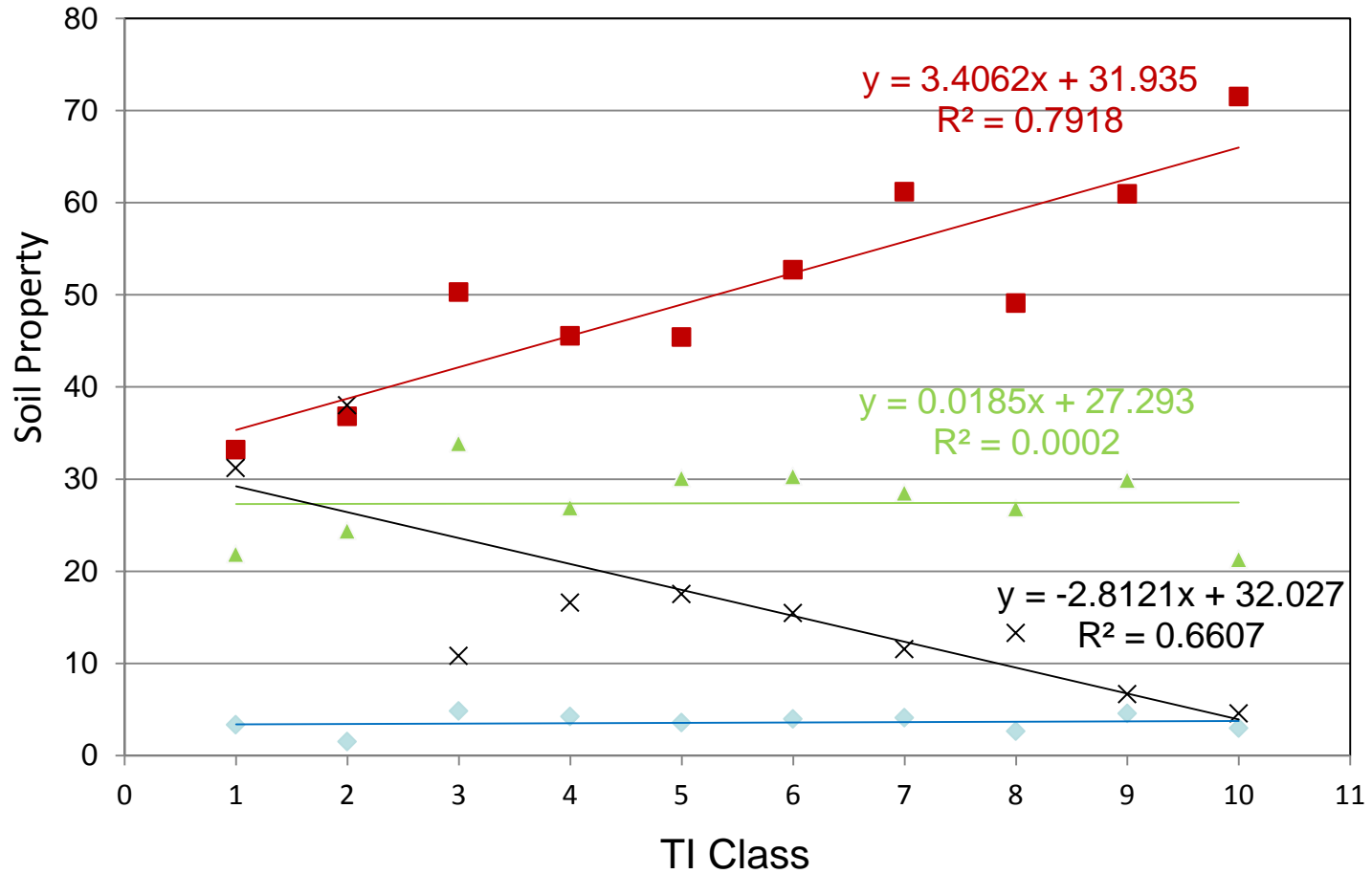


★ Soil Profile

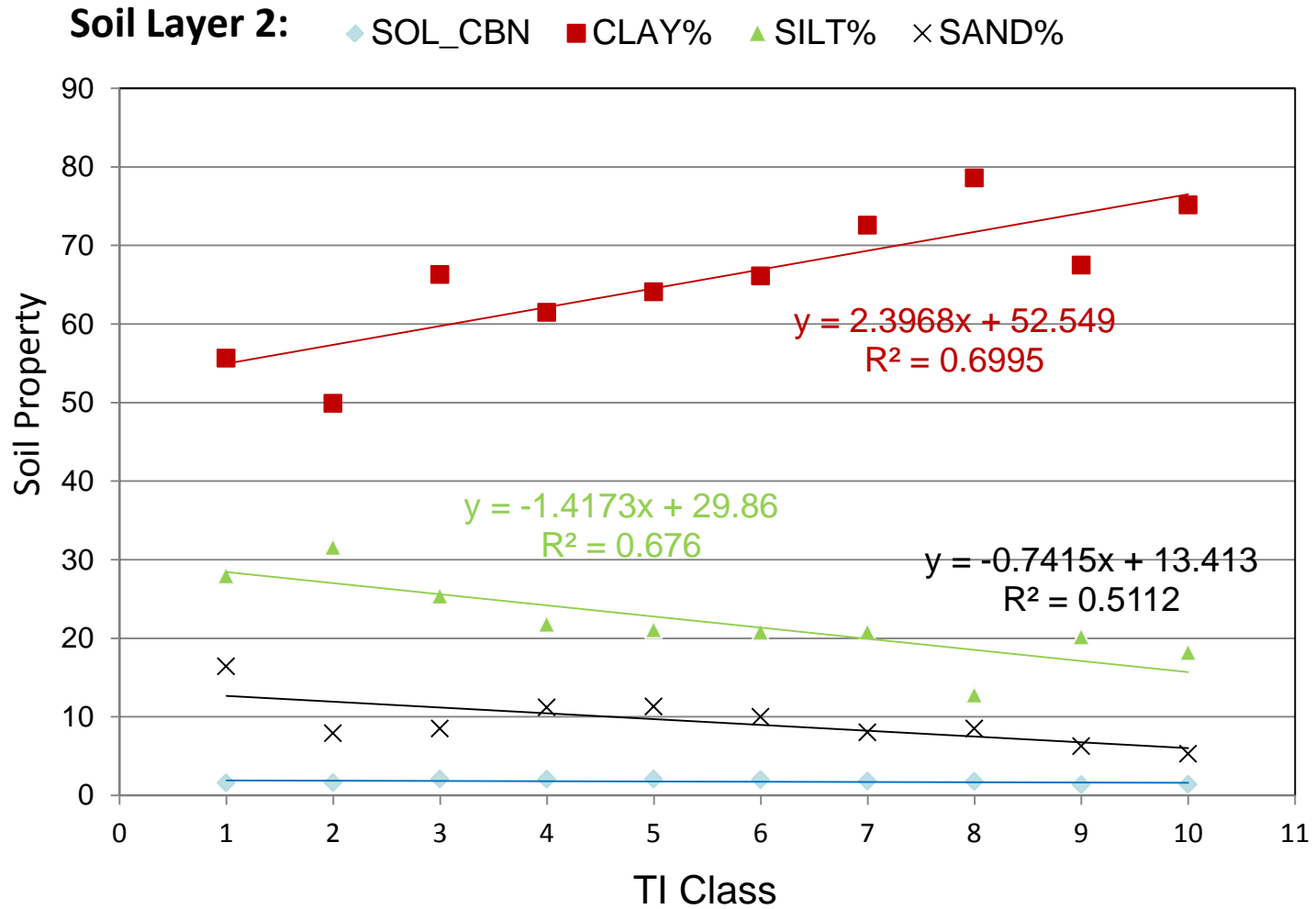


# Soil-Topography Dynamics (1)

Soil Layer 1:    ◆ SOL\_CBN    ■ CLAY%    ▲ SILT%    × SAND%

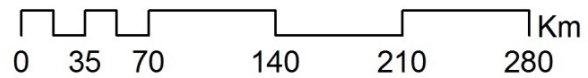
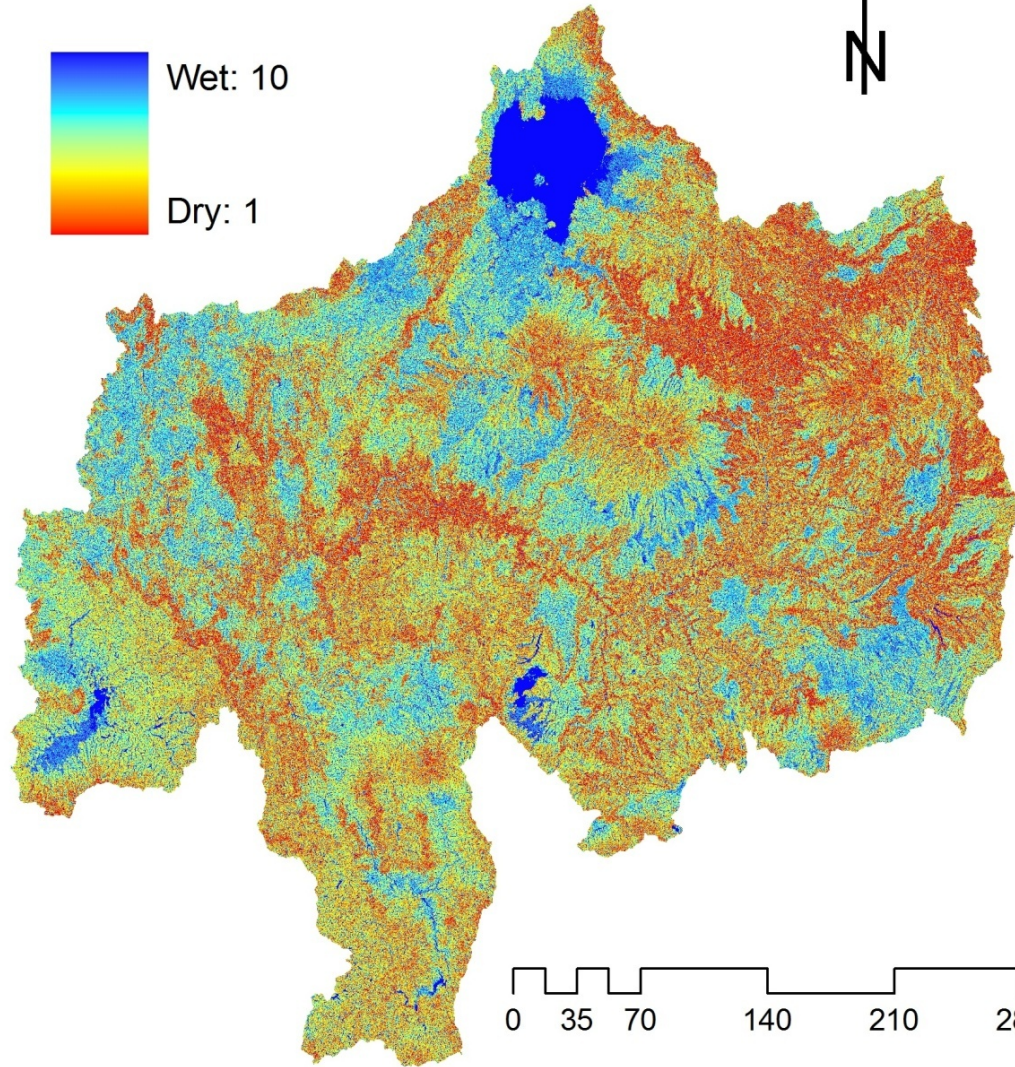
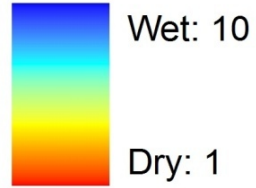


# Soil-Topography Dynamics (2)



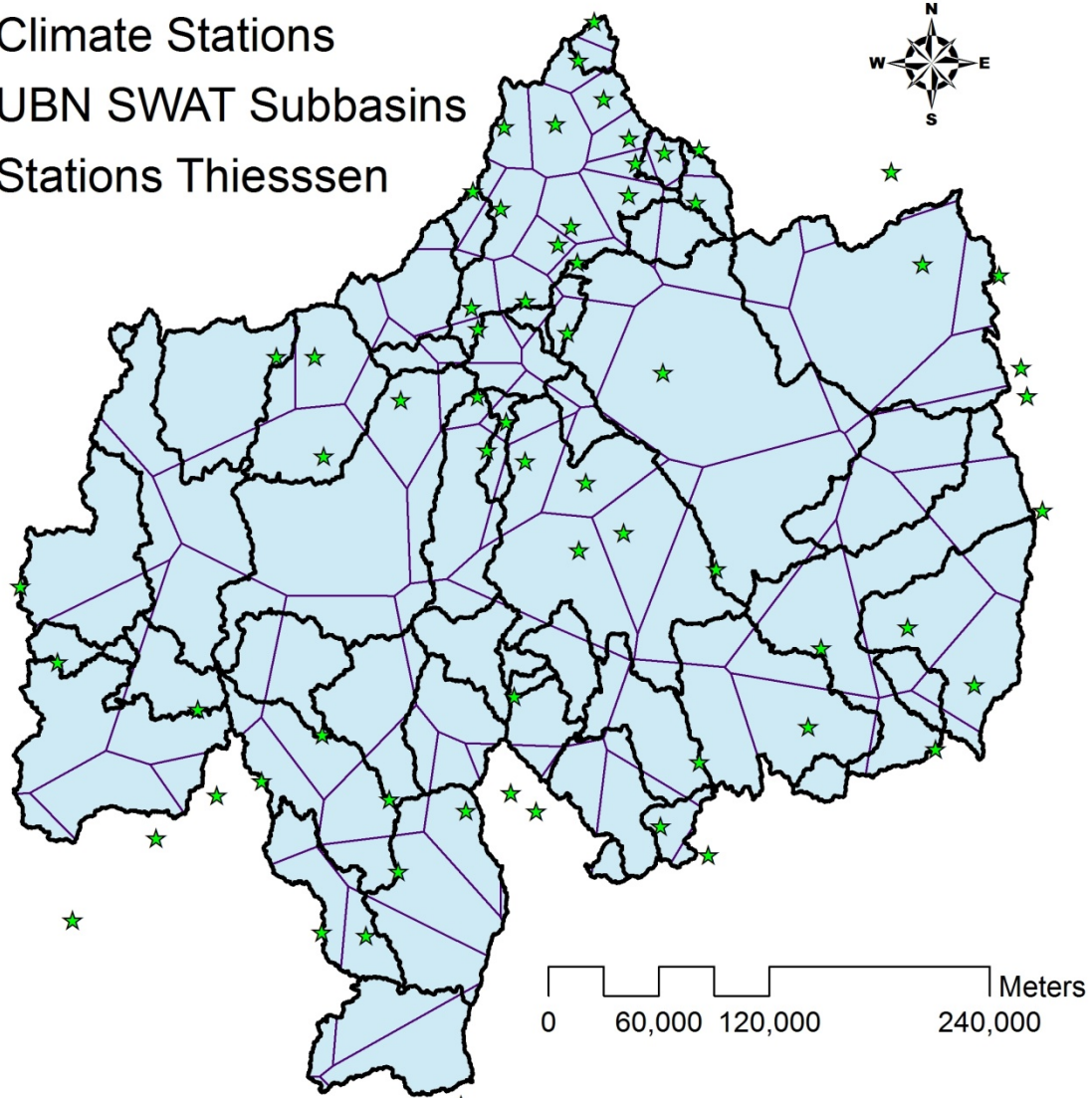
# Topography-Soil Map

TI Class

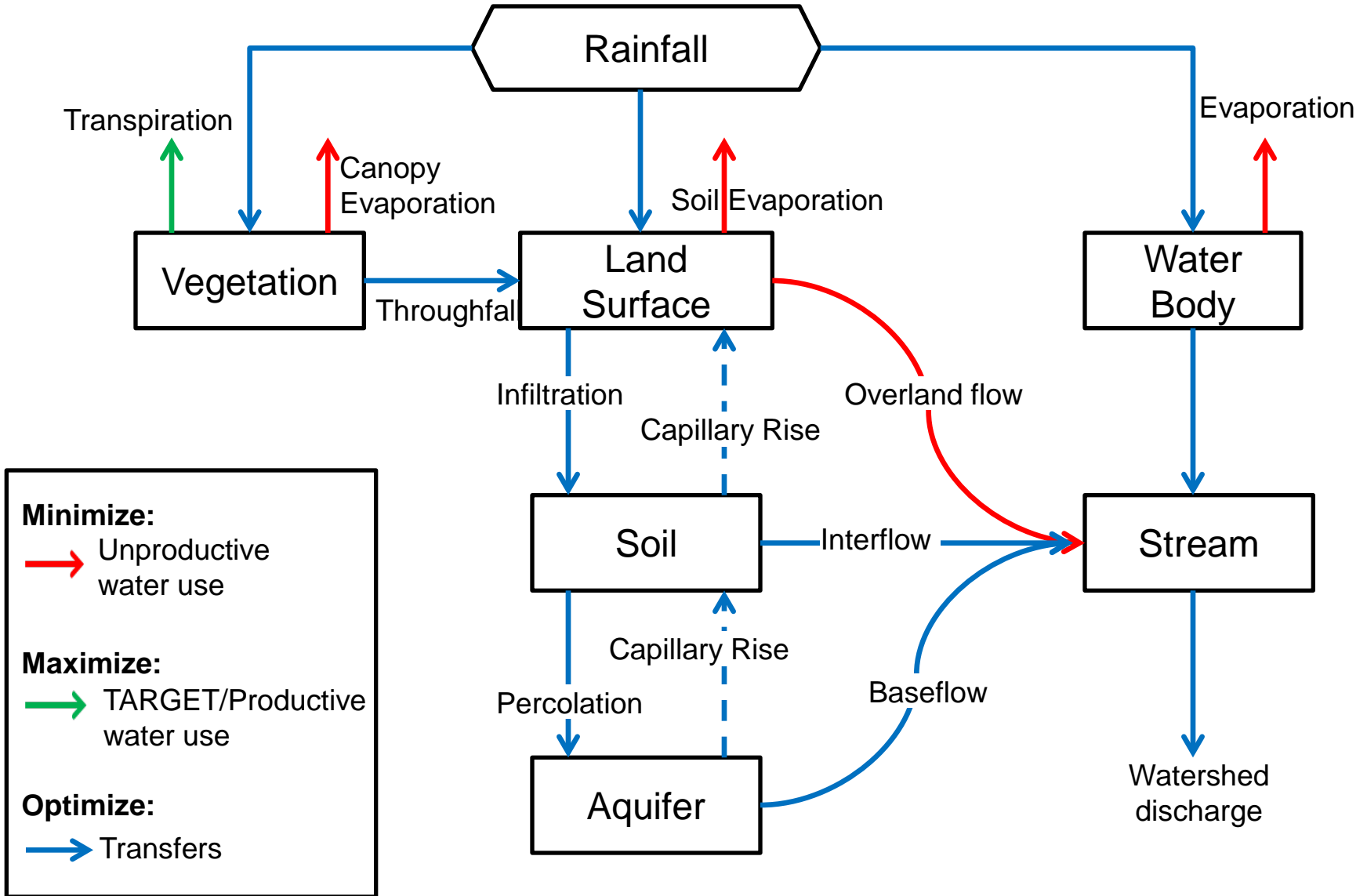


# Climate Data

- ★ Climate Stations
- ▭ UBN SWAT Subbasins
- ▭ Stations Thiessen



# RMS Impacts on Runoff Processes





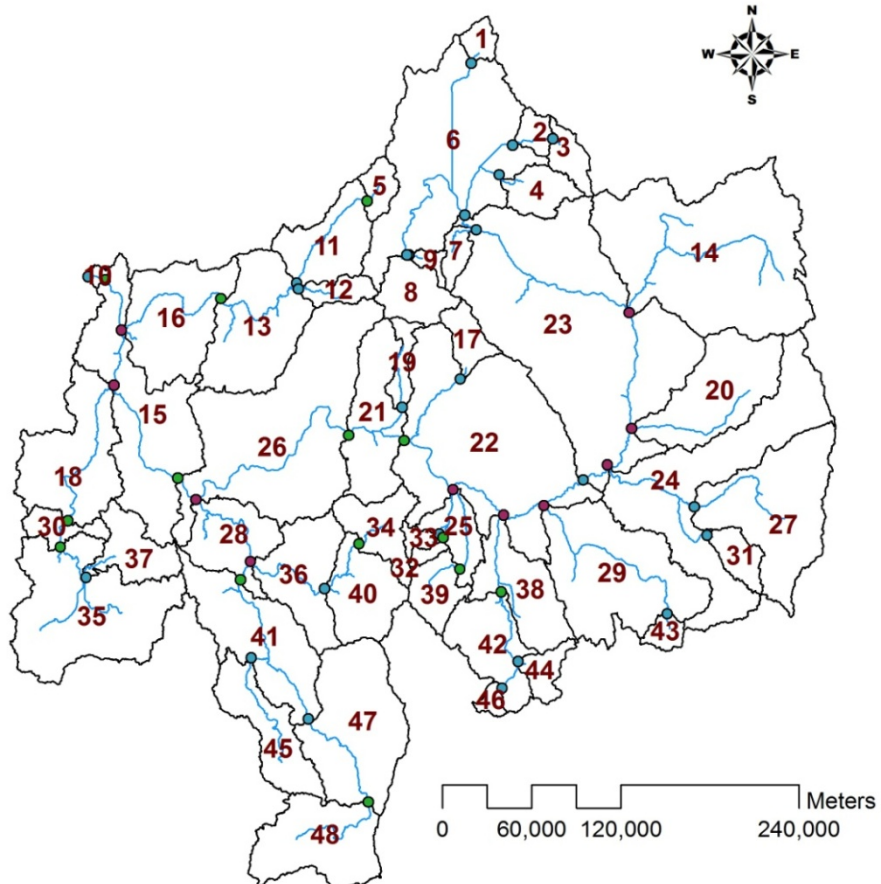
# SWAT Scheduled Management Operations

Code	Practice	Operation
1	Terracing	Simulates a terrace to the HRU
2	Tile drainage	Simulates a tile to the HRU
3	Contouring	Simulates a contour to the HRU
4	Filter strip	Simulates a vegetative filter strip to the HRU
5	Strip cropping	Simulates strip cropping to the HRU
6	fire	Simulates fire to the HRU
7	Grassed waterway	Simulates grassed waterways to the HRU
8	Plant parameter	Updates crop parameters to the HRU

# SWAT Management Operations

	mgt												
	mon	day	HU	op	mgt1i	mgt2i	mgt3i	mgt4	mgt5	mgt6	mgt7	mgt8	mgt9
plant/begin growing season	*	*	*	1	PLANT_ID		CURYR_MAT	HEAT_UNITS	LAI_INIT	BIO_INIT	HI_TARG	BIO_TARG	CNOP
irrigate	*	*	*	2				IRR_AMT					
fertilizer application	*	*	*	3	FERT_ID			FRT_KG	FRT_SURFACE				
pesticide application	*	*	*	4	PEST_ID			PST_KG					
harvest/kill operation	*	*	*	5				CNOP					
tillage operation	*	*	*	6	TILL_ID			CNOP					
harvest operation	*	*	*	7				HARVEFF	HI_OVR				
kill/end growing season	*	*	*	8									
grazing	*	*	*	9	GRZ_DAYS	MANURE_ID		BIO_EAT	BIO_TRMP	MANURE_KG			
auto irrigation	*	*	*	10	WSTRS_ID			AUTO_WSTRS					
auto fertilization	*	*	*	11	AFERT_ID			AUTO_NSTRS	AUTO_NAPP	AUTO_NYR	AUTO_EFF	AFRT_SURFACE	
sweep operation	*	*		12				SWEEPEFF	FR_CURB				
release/impound	*	*		13	IMP_TRIG								
continuous fertilization	*	*	*	14	FERT_DAYS	CFRT_ID	IFRT_FREQ	CFRT_KG					

# SWAT Calibration



000470129.ops	8/22/2012 17:15	OPS File
000470129.sep	8/22/2012 11:29	SEP File
000470129.sol	8/22/2012 11:01	SOL File
000480000.pnd	8/22/2012 11:29	Pond Model Input
000480000.rte	8/22/2012 11:02	RTE File
000480000.sub	8/22/2012 11:29	SUB File
000480000.swq	8/22/2012 11:29	SWQ File
000480000.wgn	8/22/2012 11:01	WGN File
000480000.wus	8/22/2012 11:03	WUS File
000480001.chm	8/22/2012 11:29	Compiled HTML ...
000480001.gw	8/22/2012 11:03	GW File
000480001.hru	8/22/2012 11:02	HRU File
000480001.mgt	8/22/2012 11:28	MGT File

GRID CODE	Outlet	UBN Subbasins	Watershed Subbasins
1	Megech_nr_Azezo_Stn	1	1
3	UpRibb_on_DebreTaborRoad_Stn	3	3
4	Gumara_nr_BahirDar_Stn	4	4
7	Andassa_nr_BahirDar_Stn	7	1
8	GilgelAbbay_nr_Merawi_Stn	8	6
9	Koga_at_Merawi_Stn	9	7
12	GilgelBeles_nr_Mandura_Stn	12	1
17	Birr_nr_Jiga_Stn	17	1
19	LowerFettam_at_Galebed_Stn	19	1
31	Robi_Gumero_nr_Lemi_Stn	31	1
33	Neshi_nr_Shambu	33	1
37	Aleltu_at_Nedjo_Stn	37	1
43	Mugher_nr_Chancho_Stn	43	1
44	Debis_at_Guder_Stn	44	2
46	Bello_nr_Guder_Stn	46	3
2	Ribb_nr_AddisZemen_Stn	2	2
11	MainBeles_at_Bridge_Stn	11 5	2 1
40	Angar_nr_Nekemte_Stn	40 34	2 1
47	Didesa_nr_Arjo_Stn	47 48	1 2
6	Abbay_at_BhirDar_Stn	6	5
23	Abbay_nr_Kessie_Stn	23 14 20 27 24	23 14 20 27 24
10	Abbay_at_SudanBorder_Stn	10 13 15 16 18 21 22 25 26 28 29 30 32 35 36 38 39 41 42 45	10 13 15 16 18 21 22 25 26 28 29 30 32 35 36 38 39 41 42 45

# Outlook

- Finalize SWAT Calibration and SWAT-WEAP interactions for baseline scenarios
- Develop scenarios of RMS practices and large-scale developments
- Implement RMS Scenarios in SWAT and large-scale development scenarios in WEAP
- Evaluate RMS impacts using WEAP and SWAT outputs