MAPPING OF NATURAL RESOURCES AND DEVELOPING STRATEGY FOR WATER RESOURCES MANAGEMENT IN SIKKIM

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Objectives

- ✓ To interact with local communities and assess their needs and preference for developing and managing land and water resources.
- ✓ To create digital resource map of South Sikkim district at 1:25000 scale.
- ✓ To quantify the water demand and availability status of the district and develop water resoiurces management model for the district.
- ✓ To develop content for capacity building in water resources management

TERRAIN CONDITIONS

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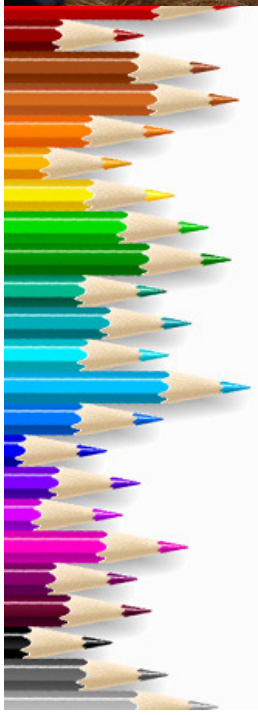
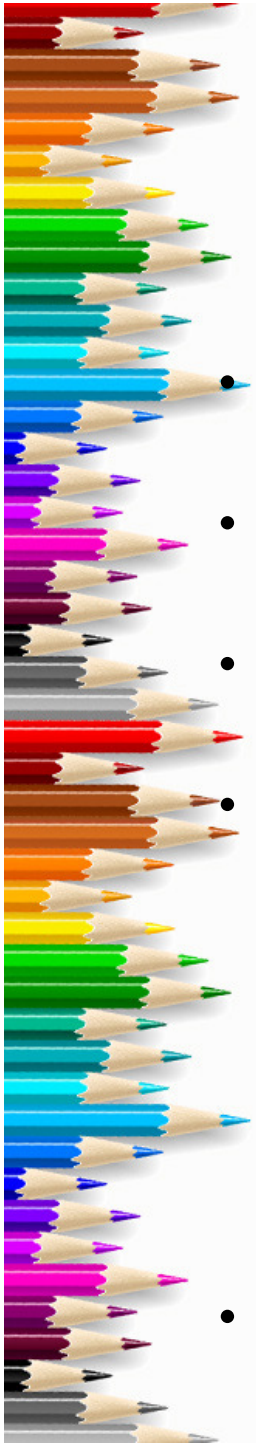


Achievements

- Recruitment staff:
  - Conducted selection process for manpower on 26.09.2014; 22.11.2014 and 15.01.2015.
  - Selected one Field Assistant
  - Selected one JRF in the last interview approval from university awaited.
- Purchase
  - Mapping and Purchase of imagery will be done in due course of time
  - Purchase of computer done
  - Purchase of other equipment awaited as the cost is higher than the sanctioned amount



Mapping

- Contacted Survey of India for toposheets of South Sikkim district at 1:25000 scale.
- Reply received vide email communication dated 03rd Dec, 2014 from SOI.
- South Sikkim district is spread in four toposheets and only three sheets at 1:50,000 scale available.
- Alternately maps can be created at 1:25,000 scale from data of TH01 satellite for terrain mapping and Rapid eye for resource mapping. The deliverables will be
  - Digital surface model
  - Topographic maps
  - LULC
  - Road layers
  - Spring maps
- Purchase can be made subject to reallocation of funds by DST.

Sl No	Product	Unit cost per sq km	Total Area (Sq Km)	Total cost	Cost in INR
1	5 m Rapid eye data	$ 1.3	800.00	$ 1040.00	67,600.00
2	5 m triplet stereo data	$ 3.0	800.00	$2400.00	1,56,000.00
3	Processing				1,56,000.00
	Total				3,79,600.00

If the sanctioned amount is re allocated the mapping can be achieved from the recent technologies. It will give a better output.
Readjustment can be done with equipment head .

Equipment Head

Sl No	Equipment	Base price	Env Cess (1%)	VAT	Total Price	Sanctioned amount	Difference
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(f-g)
1	AWS	1,70,000.00	1700.00	21,250.00	1,92,950.00	1,70,000.00	22,950.00
2	MP Kit with data logger	2,25,000.00	2,250.00	28,125.00	2,55,375.00	2,25,000.00	30,375.00
	Total				4,48,325.00	3,95,000.00	53,325.00

Data collection unit

- Selection of study area in South Sikkim
  - The smallest administrative unit in Sikkim is ward and cluster of wards form GPU.
  - Made visit to some GPU
  - Discussed with the locals regarding perception and problems.
- Status of water resources
  - Severe scarcity of water resources
  - Change in profession from Agriculture to others such as poultry and dairy.

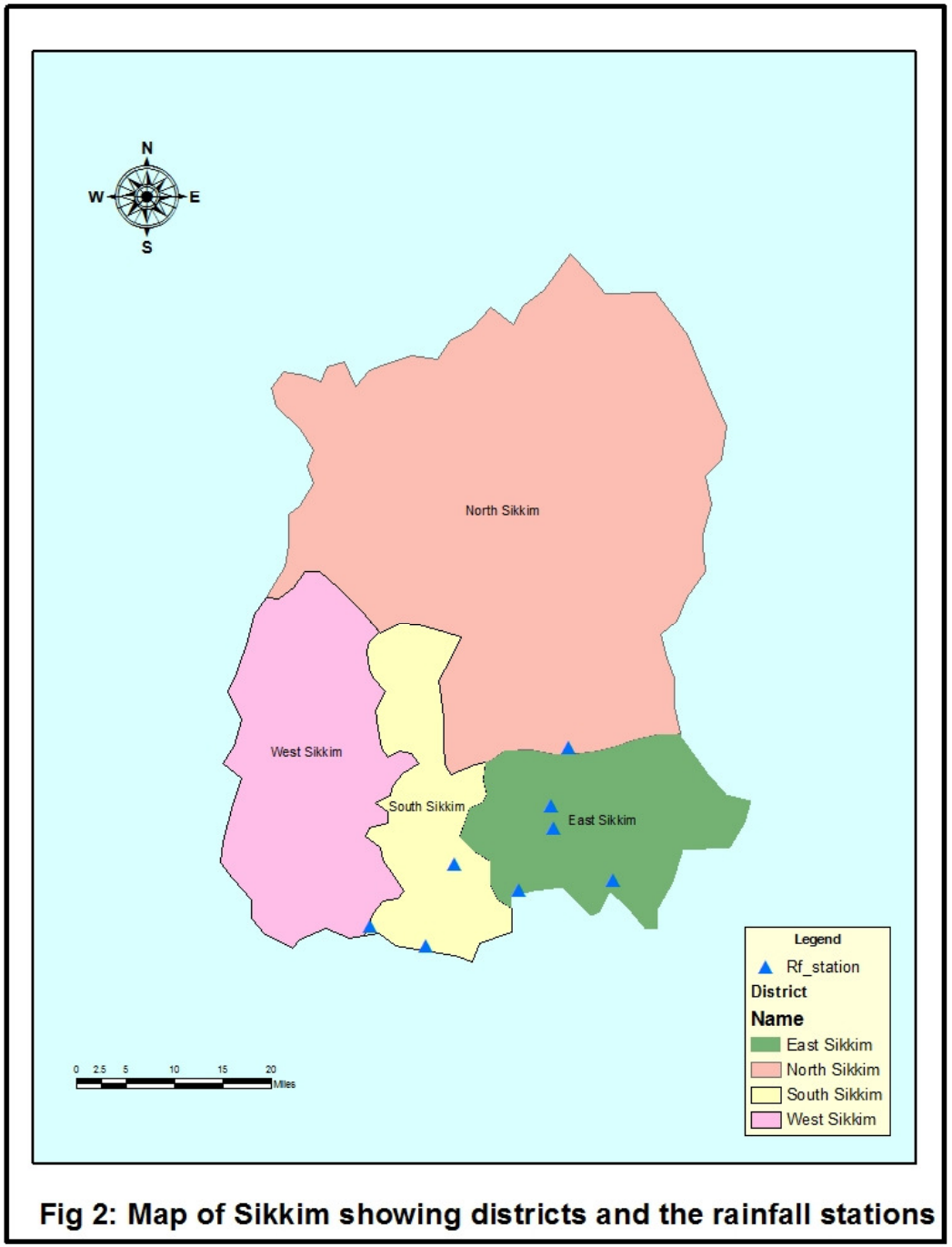


Fig 2: Map of Sikkim showing districts and the rainfall stations

Table : Percentage distribution of rainfall in the state in peak and lean season

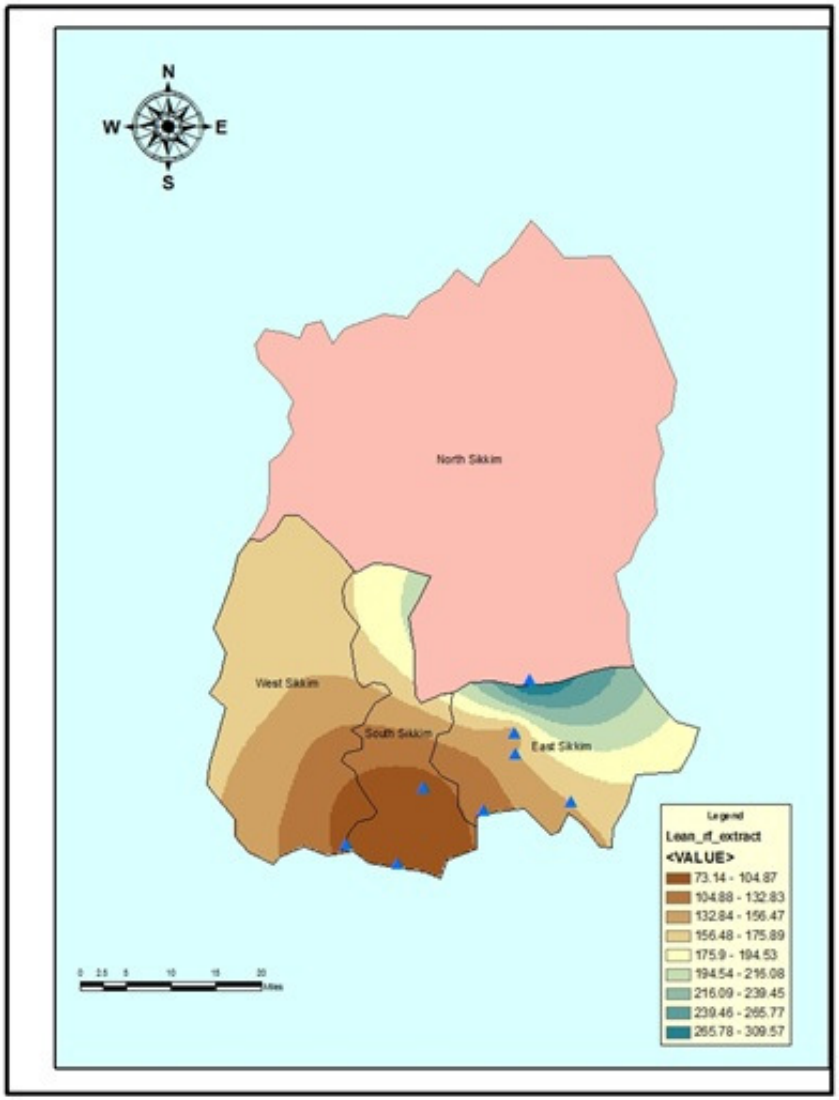
Sl No	Station	Average Rainfall during rainy season (mm)	%	Avg rainfall during non rainy season (mm)	%
1	Melli	1455	95.4	70	4.5
2	Temi	1197	93	91.2	7
3	SIRD_Karfacter	1490.5	94	93.0	6

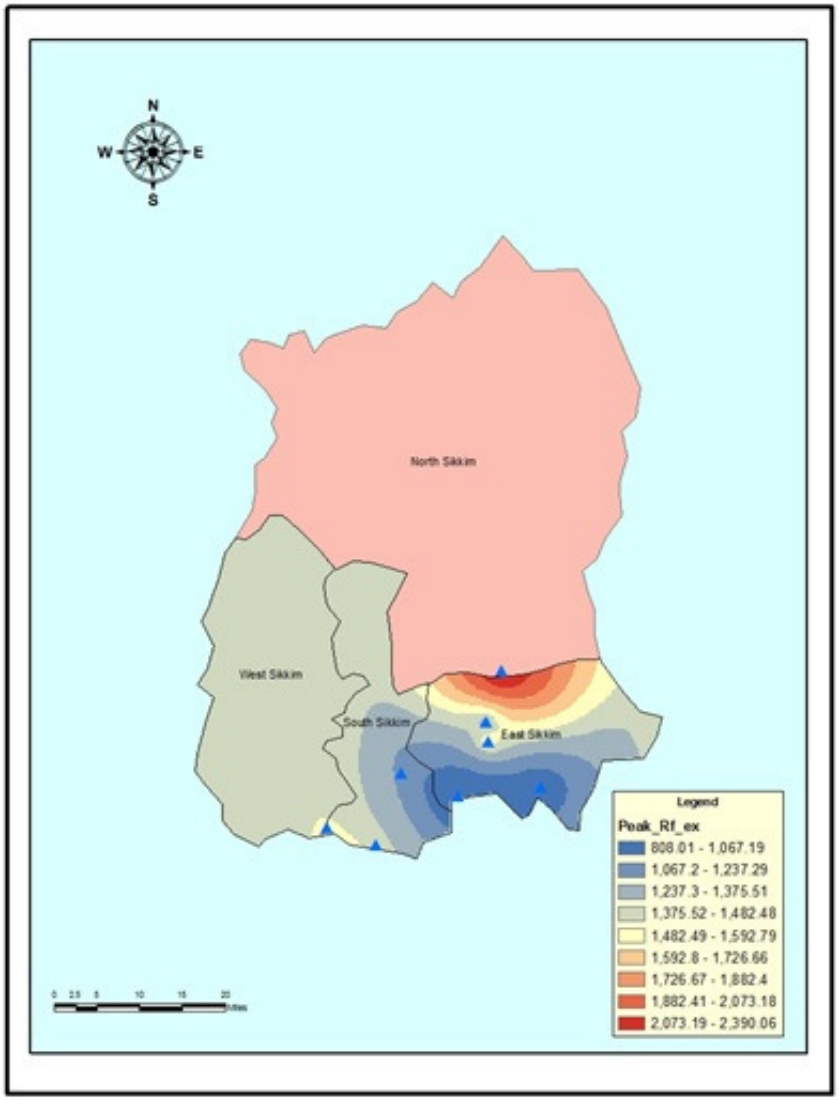
Table : Station wise distribution of rainy days in each rainfall observation station in South Sikkim

Sl No	Station	Average no. of rainy days in each months											
		Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	Melli	3	4	3	15	13	21	28	24	25	3	7	1
2	Temi	5	4	10		12	30	25	17		11	5	1
3	SIRD_Karfacter	4	4	5	11	17	21	27	21	16	8	8	1

Table : Rainfall characterization for different stations in South Sikkim during winter

Station	Number of rainfall days with rainfall quantity (mm)								Total
	≤2	3-5	6-8	9-11	12-15	16-20	21-30	>30	days
Melli	6	6	1	0	1	0	0	0	14
Temi	15	7	6	2	2	1	1	0	32
SIRD_karfacter	12	6	3	1	1	1	0	0	22

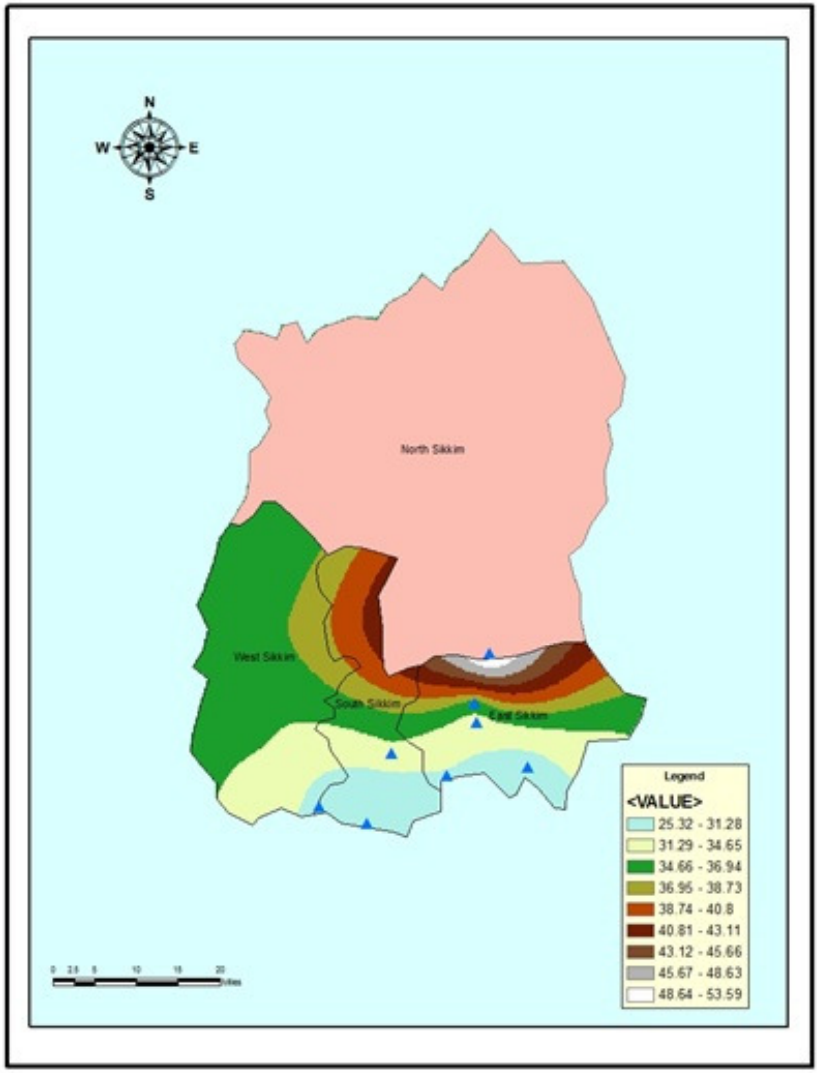




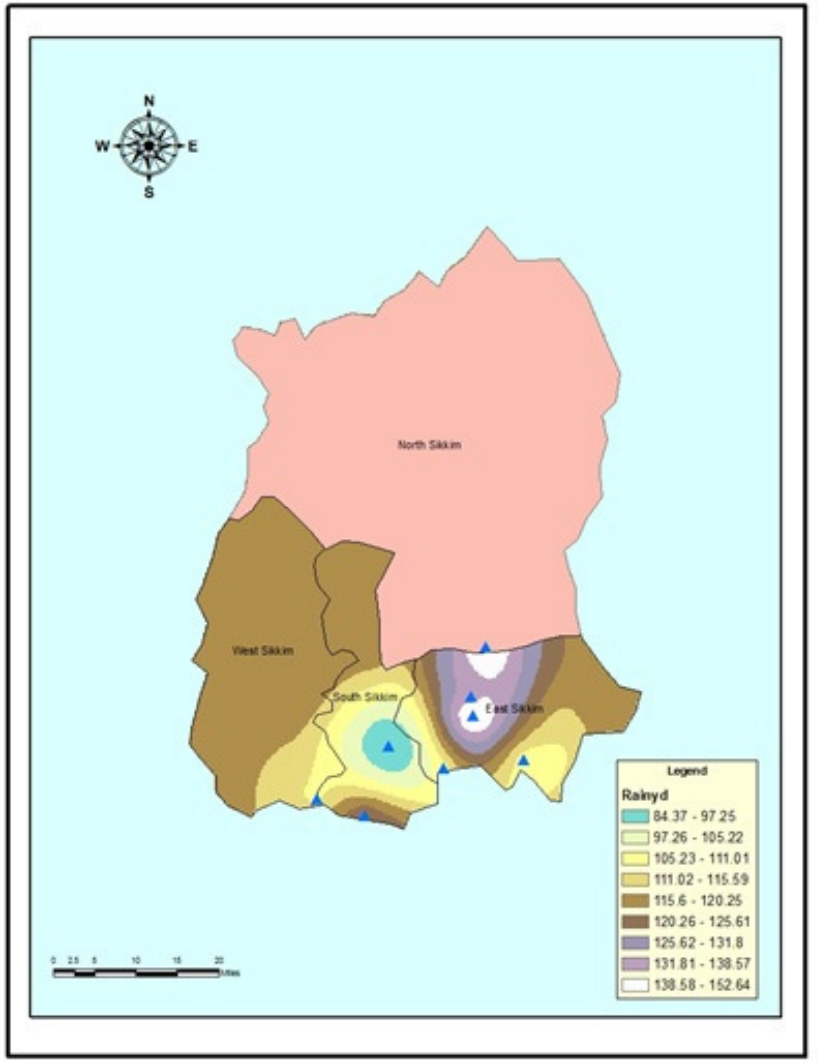
Non- Rainy season

Rainy season

Fig 3: Spatial rainfall distribution during non rainy and rainy season



Non- Rainy season



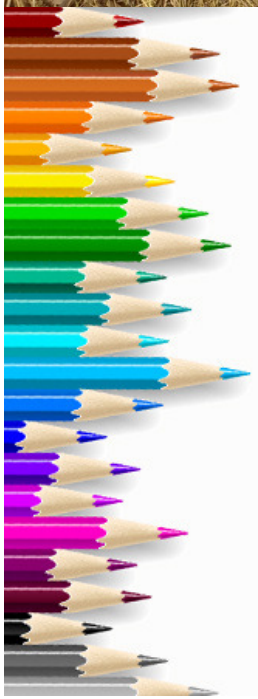
Rainy season

Fig 4: Distribution of rainy days during non rainy and rainy season

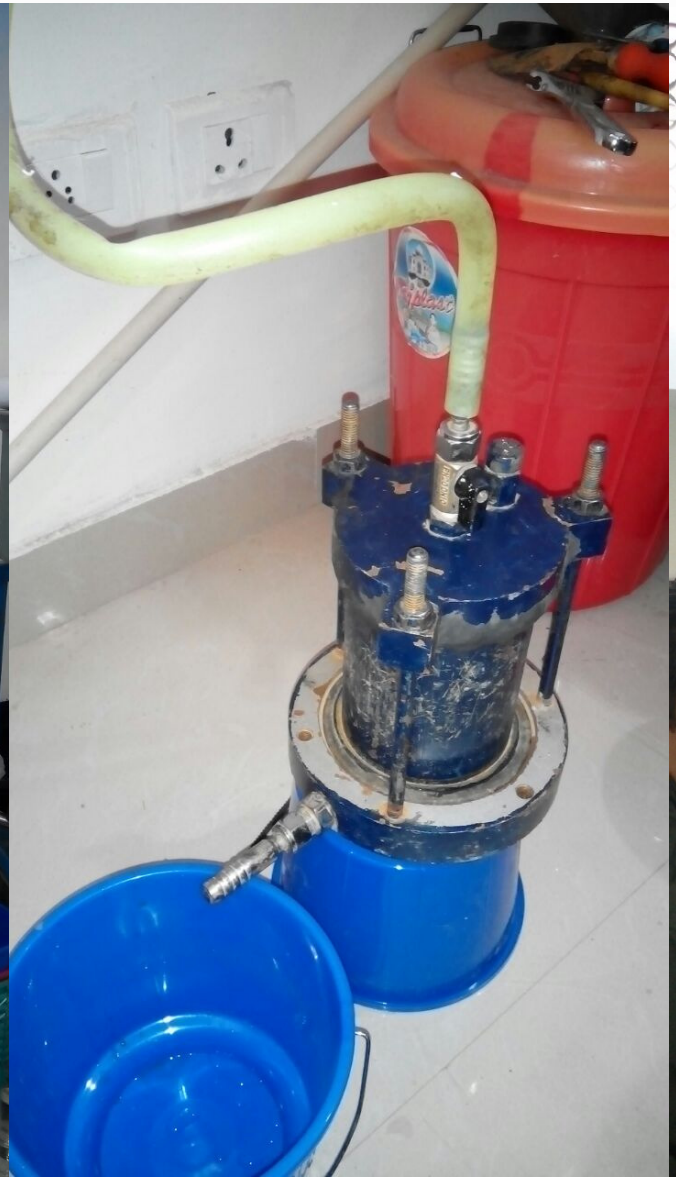
Soil Analysis

- Soil samples have been collected from different elevations of the district for analysis.
  - The texture classification
  - Hydraulic conductivity and
  - Efforts will be made to construct a soil moisture retention curves of selected soil sample

Soil sample collection



Soil Hydraulic conductivity analysis



PRA exercise

- A PRA exercise was conducted in some GPU.
- A participatory resource map was created during the exercise.
- A village schedule questionnaire survey is prepared for base line survey.
- The problems and prospects were discussed for developing strategy for water resources management.

Table : Perception of water stress on temporal scale (in %)

Availability categorization	Months				
	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-Sept
Normal	64.58	4.17	4.17	27.08	54.17
Surplus	10.42	0.00	0.00	20.83	33.33
Stressful	10.42	33.33	39.58	39.58	8.33
Very scarce	14.58	62.5	56.25	33.33	4.17

Table : Average water requirement in different activities of a family

Activities	Average number of buckets	Average volume of water demand (lit)	Percentage of water demand
Cooking	3	60	15
washing	5	100	25
Bathing	4	80	20
Toilet	4	80	20
Cleaning	4	80	20
Total		400	

Table : Priority demand of water for various domestic activities

Domestic activities	Priority (%)				
	1st	2nd	3rd	4th	5th
Cooking	18.75	8.33	8.33	4.17	60.416
Washing	31.25	20.83	22.91	12.5	12.5
Bathing	10.42	33.33	22.91	25.0	8.33
Toilet	31.25	14.58	33.33	18.75	2.08
Cleaning	8.33	20.83	14.58	37.5	18.57

- **Estimation of rain water harvesting potential**

- The rain water harvesting potential was estimated by the method suggested by Farreny et al., (2011) and is shown in equation 1.

$$RWH\ potential = P \times A \times RC \qquad (1)$$

- Where RWH is the rain water harvesting potential (in L/year) of a roof, P is the local precipitation (P, in mm/year), A the catchment area (in m^2) and the runoff coefficient (RC, non-dimensional). The values of runoff coefficient for different types of roofs are given by Farreny et al., (2011).

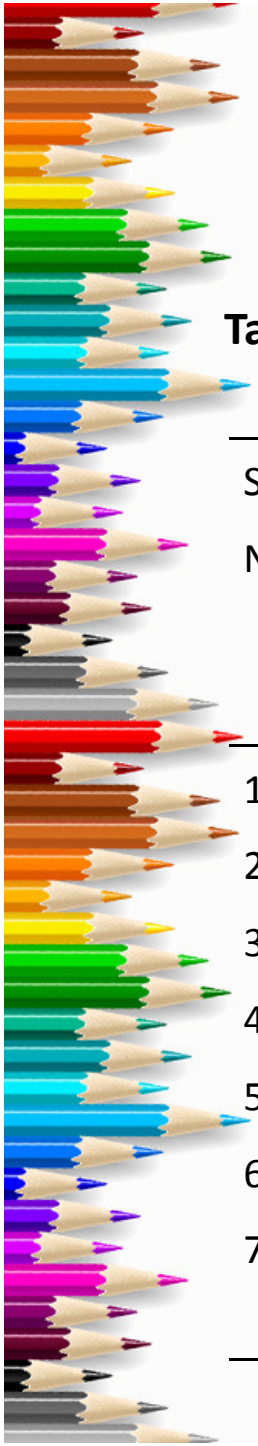


Table : Effective harvestable water volumes under different types of rainfall events

Sl No	Rainfall amount (mm)	Average number of days	Average depth of rain received (mm)	Volume of effective harvestable water (m^3)	Practicable collectable water considering the losses
1	3-5	5.5	22	2.05	1.53
2	6-8	3.25	22.75	2.12	1.59
3	9-11	1.5	15	1.40	1.05
4	12-15	1.375	18.56	1.73	1.29
5	16-20	1.625	29.25	2.72	2.04
6	21-30	0.75	18.75	1.74	1.31
7	>30	0.625	18.75	1.74	1.31
			145.06	13.49	10.12

Table : Estimated harvesting potential for rural household of Sikkim in lean period

Sl No	Months	Quantity (m^3)	Effective volume in m^3 (after considering loss)
1	October	4.86	3.64
2	November	2.02	1.52
3	December	0.15	0.11
4	January	0.77	0.58
5	February	1.80	1.35
6	March	3.74	2.81
	Total	13.35	10.01

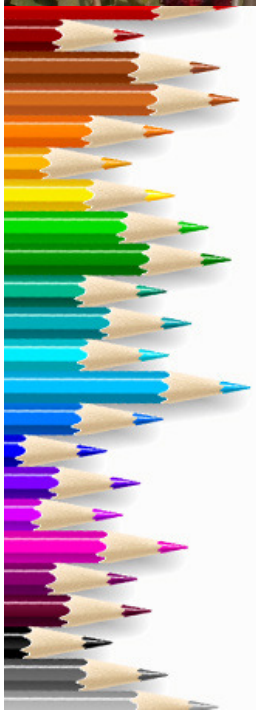
Table : Period for which harvested water can be used under different scenario

Sl No	Scenario	Daily Demand (lit)	Tank of 5 m^3	Tank of 10 m^3
1	All demand	400.00	12.50	25.00
2	Cooking, Washing, Bathing and toilet	320.00	15.63	31.25
3	Washing, Bathing and toilet	260.00	19.23	38.46
4	Washing and toilet	180.00	27.78	55.56

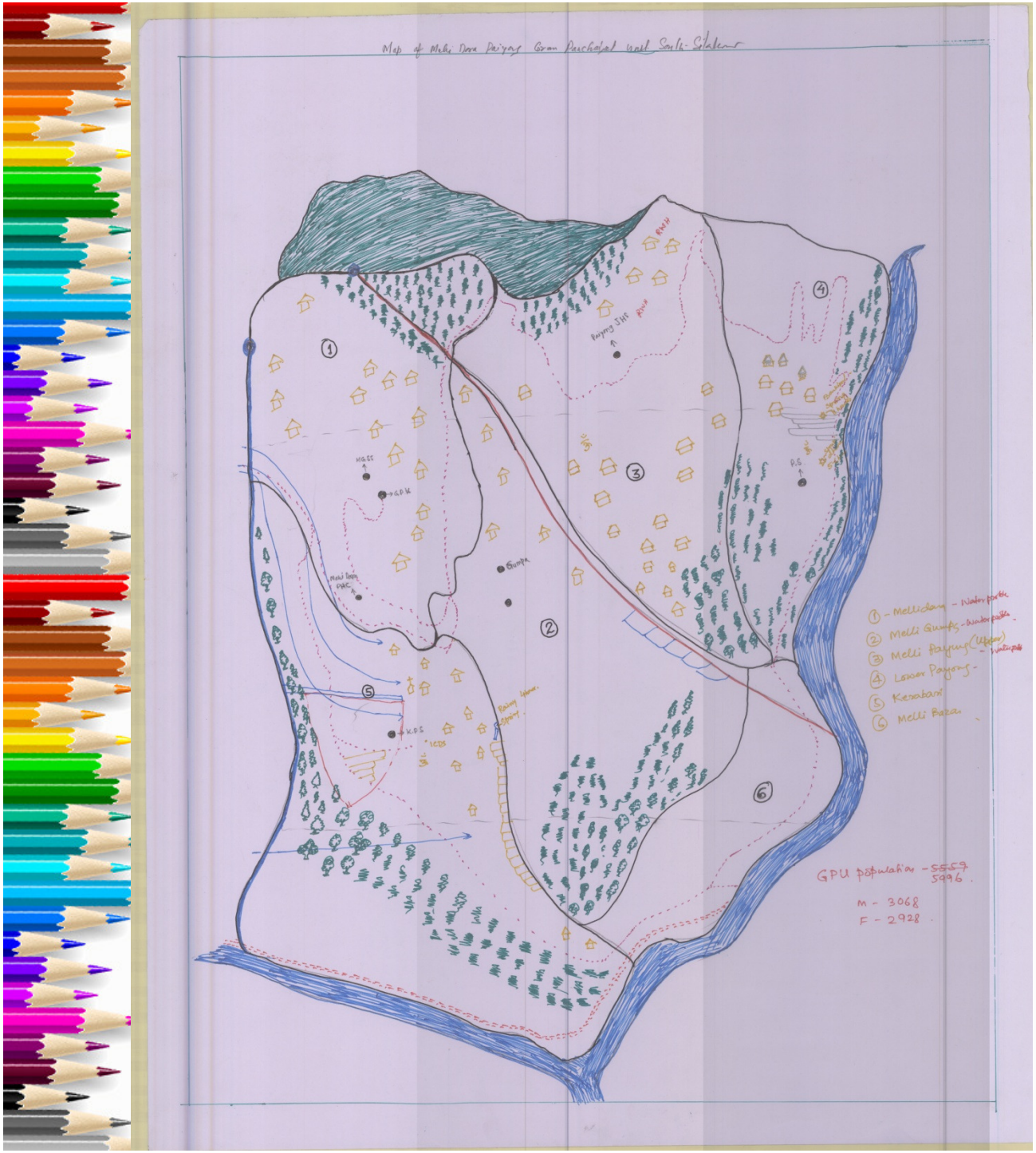
Content building

- A meeting will be organized with various state government department and stake holders and efforts will be made to develop content for water resources mapping.

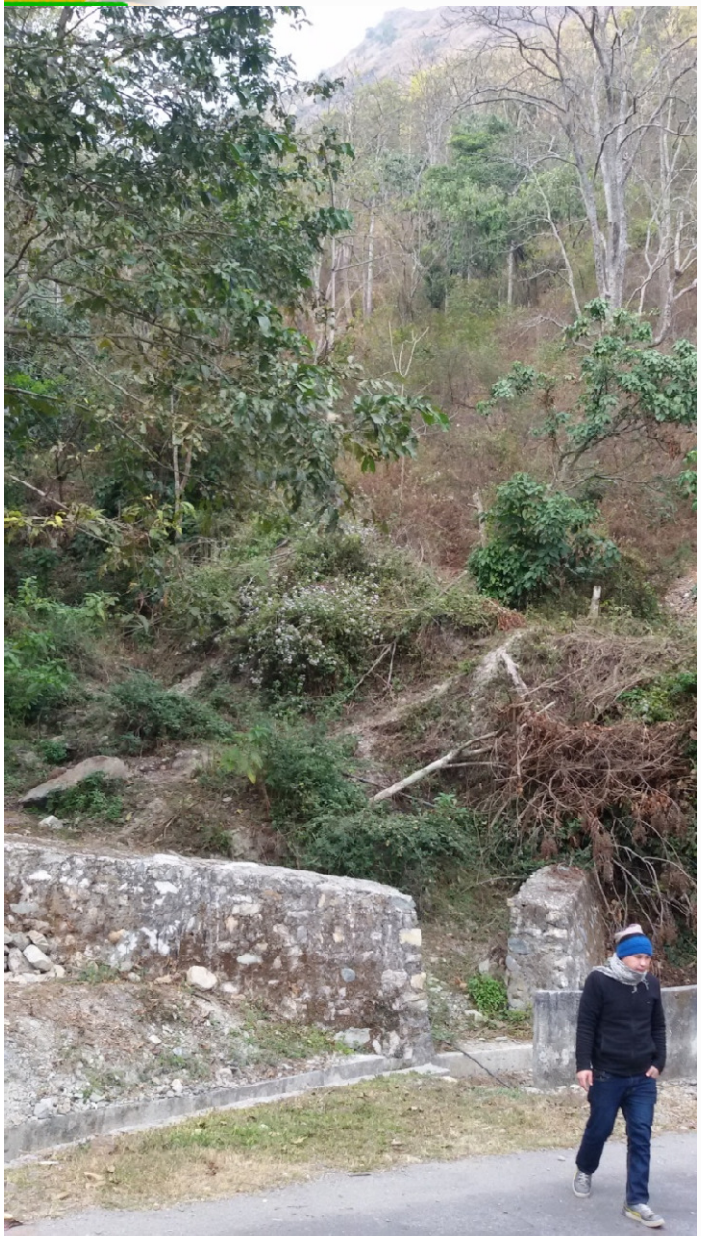
View of PRA exercise



PRA Map



WATER SOURCE



THANKS