

SOIL CONSERVATION IN TEA LANDS AFFECTED BY WATER-INDUCED EROSION

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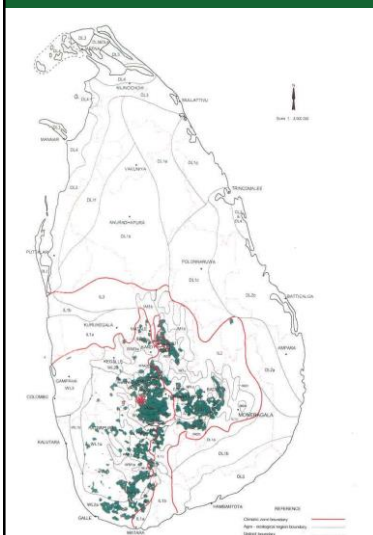
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Introduction



Challenges of tea industry

Declining of production

Low land productivity
Increasing cost of production
Price competition

Declining of production

Lack of tea replanting and infilling
Soil degradation

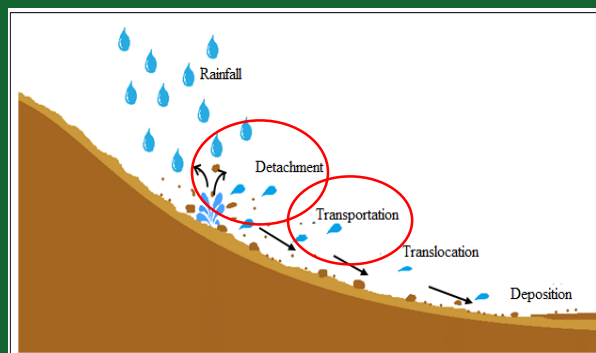
- Soil erosion
- Soil compaction
- Nutrient depletion

Poor practices of GAPs
Adverse climatic conditions

Introduction...

Soil Erosion

“Soil erosion is the natural process in which the topsoil of a field is carried away by physical sources such as water and wind.”



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Introduction....

Soil and Water Conservation

“Soil and water conservation are those activities at the local level which maintain or enhance the productive capacity of the land”

• Types of conservation measures

- ❖ Agronomic measures
- ❖ Structural measures
- ❖ Biological measures



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Introduction....
Agronomic Measures



Contour planting



Mulching



Mixed cropping/ Inter cropping



Application of organic matter



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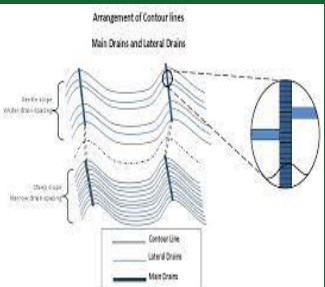
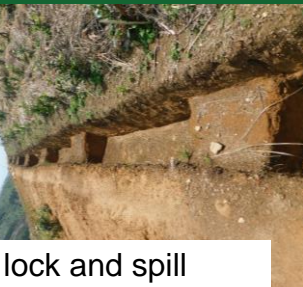
Introduction....
Structural Measures



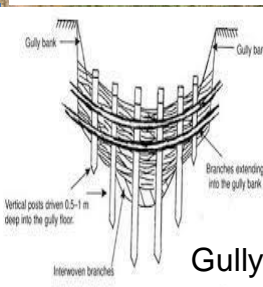
Leader drain



Lateral drains with lock and spill



Stone terrace



Gully control structures



Terrace planting



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Introduction....

Biological Measures



Slopping Agricultural Land Technology (SALT)



Cover crops



Hedge row



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Introduction....

Estimated Soil Erosion in Tea Lands in Different Regions

Region	Status of tea land	Soil erosion	References
Uva	Seedling tea (slope 20-30%)	25.52(t/ha/yr)	Dharmasena <i>et. al.</i> , (2011)
	VP tea (slope 20-30%)	3.41(t/ha/yr)	
Mid	Seedling tea (without SCP- slope 30-40%)	20.0 (mt/ha)	Krishnaraja, 1985
	VP tea (contour planting)	0.36 (mt/ha)	
Up	Bare land (Un - mulch clean weeded)	40.0 (t/ha) (Month of April, 1969)	Manipura <i>et. al.</i> , 1969
	Tea land (Mulched)	0.07 (t/ha) (Month of April, 1969)	
	VP (Clean weeded)	53.0 (t/ha/yr)	Mapa , 2003



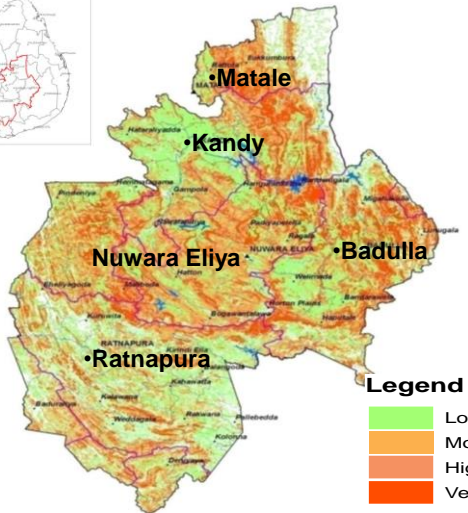
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Introduction....



Extraordinary Gazette No 1550 / 9 : 2008 May 22



Declared Soil Conservation Areas

It occupies 16 % of the total land area in the country

It mainly covers considerable areas of Kandy, Nuwara Eliya, Badulla, Kegalla, Ratnapura and Matale districts

Source: Munasinghe, 2002

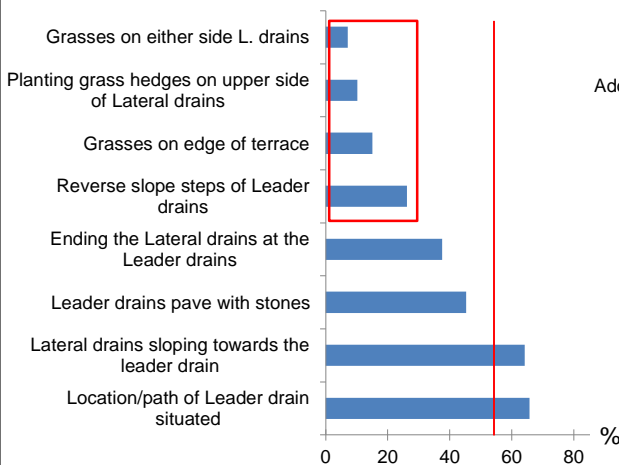


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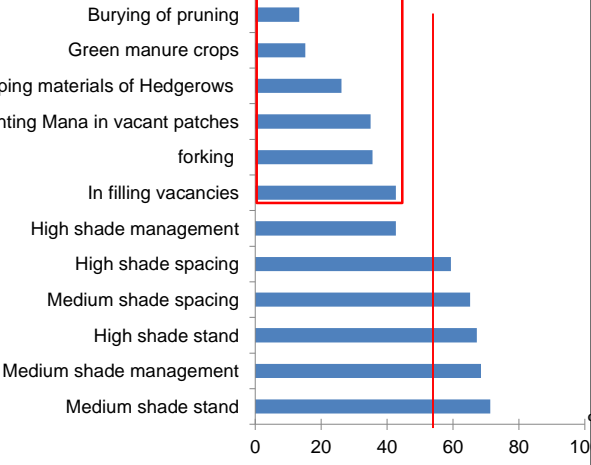
Introduction....

Adoption Level of Soil Conservation Practices in Mature Tea

Structural Practices



Agronomic Practices



Rajasinghe, et al., 2015



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General Objective

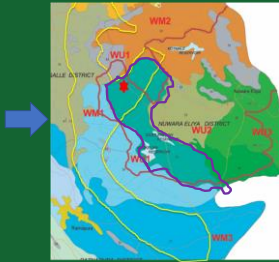
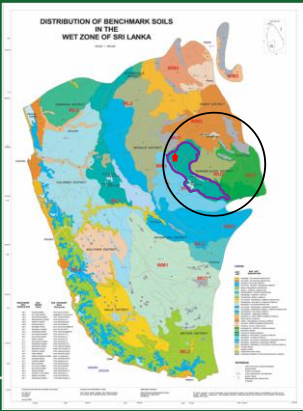
“To quantify reduction of soil erosion and nutrient losses, derived from soil conservation practices by field method and to come up the recommendation”



Materials and Method

Description of Study Location

Location	Kenilworth Estate (WM1a)
Elevation	580-600m amsl
Geographical coordinates	6° 59' N Latitude 80° 29' E Longitude
Annual Rainfall (mm)	5970.2
Average Temperature (°C)	22.6
Average Humidity (%)	94.4
Soil Group	Red Yellow Pozolic
Soil Series	Maskeliya
Tea Cultivar	TRI 2023 (1992)
Slope Level	Low – 20% -30% High – 60% -72%
Plot Size	High –21m ² to 37m ² Low – 22m ² to 38m ²
Time Period	Oct' 2020 – Nov' 2021



Materials and Method....



Experiment layout in high slope (60% -72%)

Experiment layout in low slope (20% -30%)



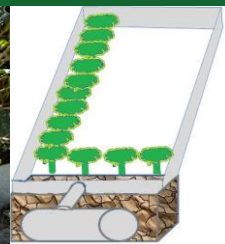
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Treatments

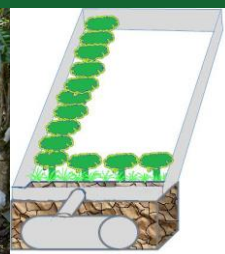
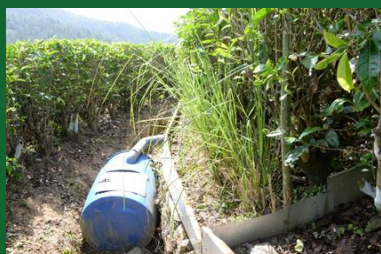
1. Stone Terrace (T)

Terrace was built up to the height of the soil surface and its width was 45 cm. (The upper face of terrace and soil surface are almost in same level)



2. Stone Terrace with Vetiver grass (TV)

Vetiver grasses were planted closer to the inner edge of the stone terrace



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Treatments....

3. Terrace Wall (TW)

Terrace wall / stone bund was built similar to the stone terrace where the height of the terrace wall is 30 cm above the soil surface

**4. Bare land (B)**

Plots were without tea and conservation measures



Treatments....

5. Tea (TO)

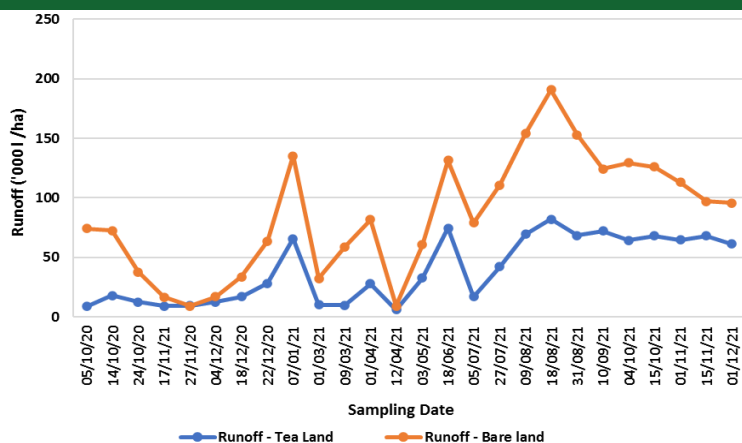
Tea field without any soil conservation measures



Findings

Runoff

Tea land (without conservation measures) has shown significantly lower runoff compared to the bare land. It was 116% reduction.



Average annual runoff

Bare land - 3,169.3 ('000 l/ha/yr)

Tea land - 1,463.4 ('000 l/ha/yr)

(no-conservation measures)

High slope - Bare land - 4,178.1 ('000 l/ha/yr)

Tea land - 1,681.8 ('000 l/ha/yr)

Low slope - Bare land - 2,160.5 ('000 l/ha/yr)

- Tea land - 1,245.0 ('000 l/ha/yr)



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Runoff....

Terrace with Vetiver grass, Terrace wall and Terrace have shown significantly lower runoff compared with tea in high slope and runoff reduction was 80%, 68% and 55% respectively.

Slope	Conservation Practices	Runoff ('000 l/ha/yr)	Runoff Reduction %	
High ^b	Terrace	753.5 c	82	55
	Terrace with Vetiver grass	332.9 c	92	80
	Terrace wall	535.7 c	87	68
	Tea (No conservation)	1681.8 b	60	*
Low ^a	Terrace	1029.9 b	52	17
	Terrace with Vetiver grass	1181.7 b	45	5
	Terrace wall	1238.5 b	43	0.5
	Tea (No conservation)	1245.0 b	42	*



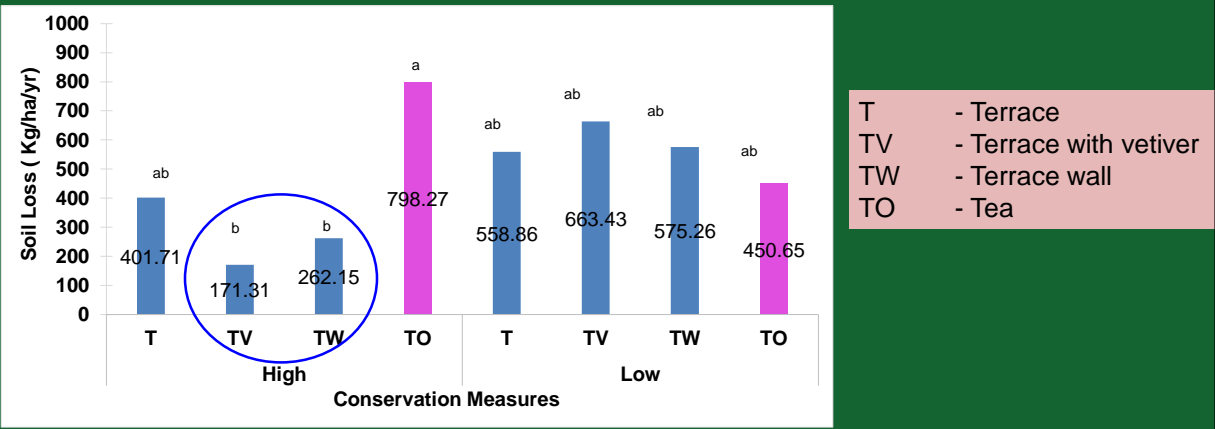
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Soil Loss

There were significantly low soil loss in Terrace with vetiver grass and Terrace wall than the tea in high slope .

Soil loss reduction of TV and TW was 78% and 67% respectively.

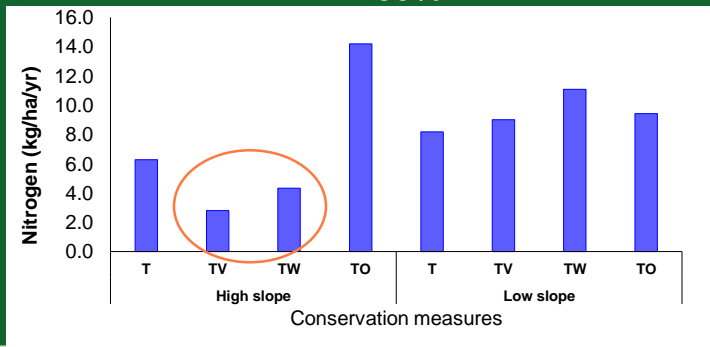


Nutrient Loss

Nitrogen

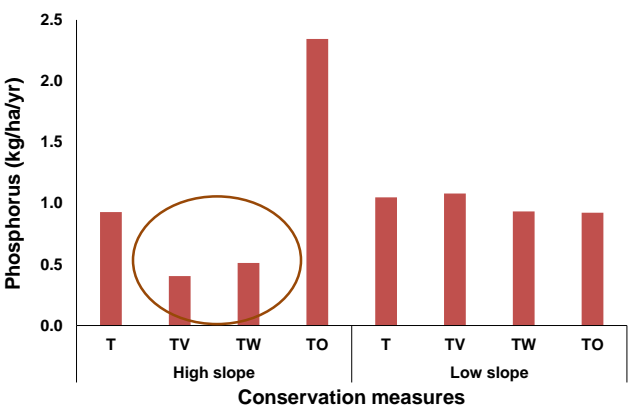
Terrace with vetiver grass, terrace wall and terrace have shown low amount of nutrient removal by runoff than tea only in high slope.

- Nitrogen saving
- TV - 80 %
 - TW – 69%



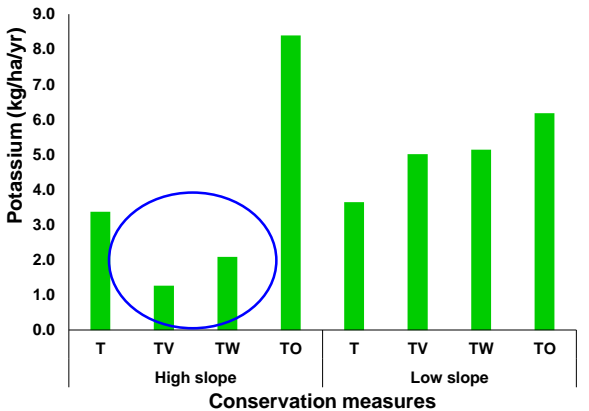
Phosphorus

Phosphorus saving - TV - 83 %
- TW - 78%
- T - 60%



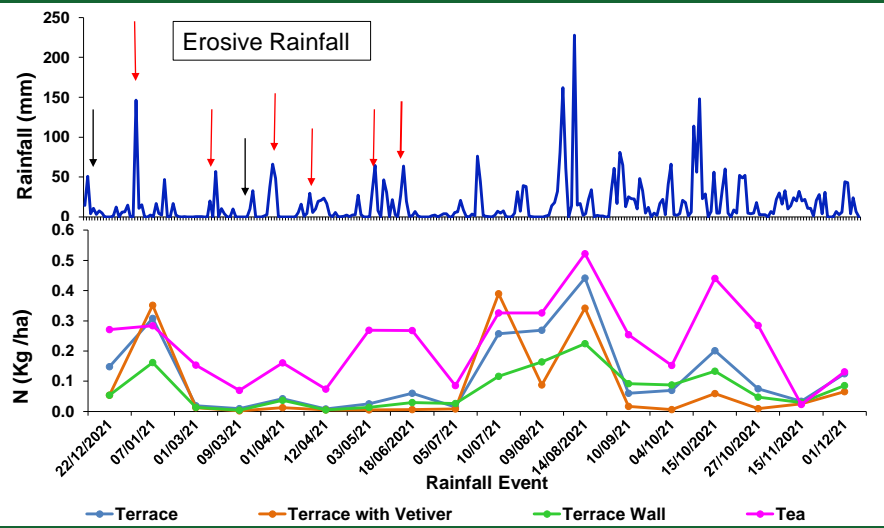
Potassium

Potassium saving - TV - 86 %
- TW - 77%
- T - 63%



Effect of Rainfall on Nutrient Losses

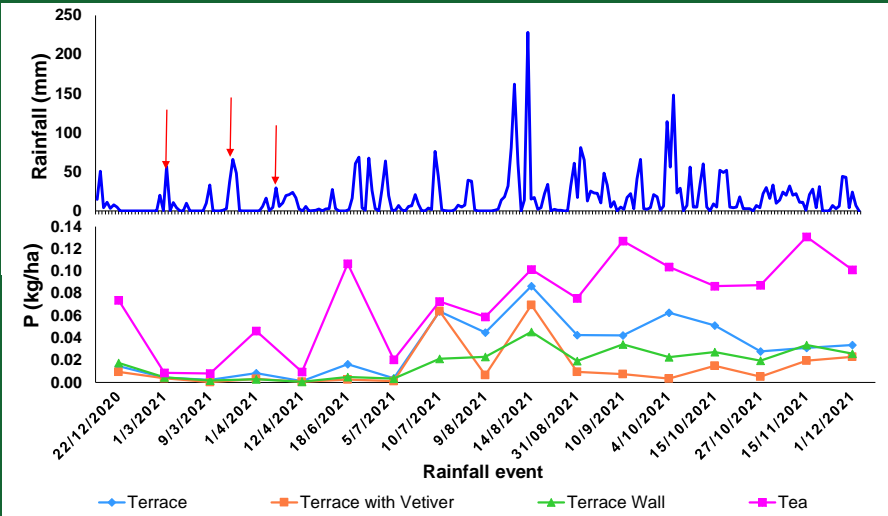
Nitrogen



- Higher nitrogen loss during
 - South - west monsoon and
 - Second inter-monsoon
- Lower nitrogen loss in soil conservation practices

Effect of Rainfall on Nutrient Losses.....

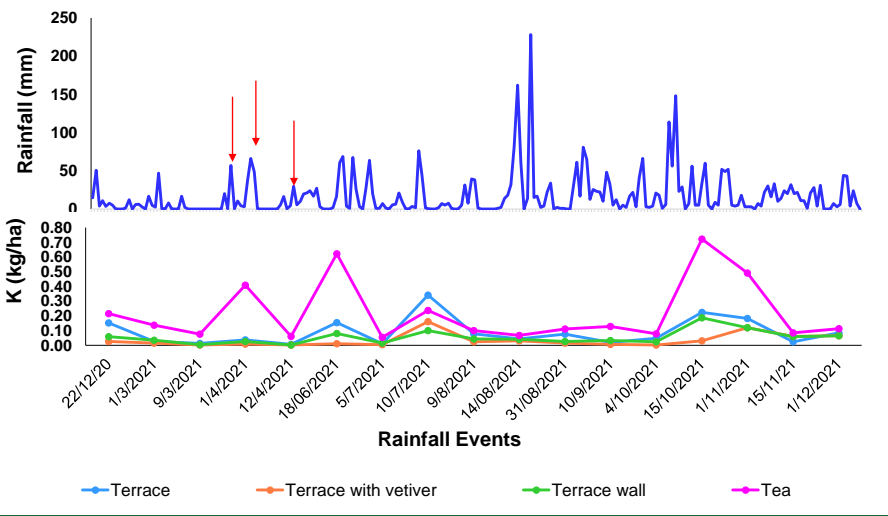
Phosphorus



- Higher phosphorus loss during
- South - west monsoon and
- Second inter-monsoon

Effect of Rainfall on Nutrient Losses.....

Potassium



- Higher potassium loss during
- South - west monsoon and
- Second inter-monsoon

Estimated Nutrient loss in Tea lands

Region	Tea land	N (kg/ha/yr)	P (kg/ha/yr)	K (kg/ha/yr)
Mid	Terrace	6.29	0.93	3.37
	Terrace with vetiver grass	2.81	0.40	1.27
	Terrace wall	4.33	0.51	2.09
	Tea (without conservation)	14.19	2.34	8.39

- Tea lands with soil conservation practises show lower nutrient loss
- Nutrient loss higher than previous studies

Region	Status of tea land	Nutrients (kg/ha/yr)				References
		N	P	K	OM	
Uva	Seedling tea (20 % - 30%)	29.34	2.1	182.4	319.0	Dharmasena <i>et. al.</i> (2011)
	VP tea (20 % -30%)	4.8	0.92	13.6	60.0	
Mid country	Seedling tea (with out SCP)	66.7	16.7	33.3	400	
	VP tea (with SCP)	0.4	0.1	0.2	2.4	



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Values of Nutrient Loss and Saving in Rupees

Value of Nutrient Loss

Soil Conservation Measures	Value of Nutrients (Rs.)			
	N	P	K	Total value
Terrace	5334	80	3858	9271
Terrace with vetiver grass	2385	35	1453	3872
Terrace wall	3673	44	2386	6103
Tea (without conservation)	12030	180.00	9598	21808

Value of Nutrient Saving

Soil Conservation Measures	Value of Nutrients (Rs.)			
	N	P	K	Total value
Terrace	6696	100	5741	12537
Terrace with vetiver grass	9645	145	8146	17936
Terrace wall	8357	136	7212	15705
Tea (without conservation)	*	*	*	*



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What shall we do for combating soil erosion?



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Recommendation

- 1.) Planting of tea should be done at recommended spacing and maintenance of tea land without vacancies



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Recommendation....

- 2.) It is highly recommended to use soil conservation measures, especially in high slope.

The most appropriate conservation measures for high slope are terrace with vetiver grass and terrace wall to reduce runoff, soil loss and nutrient depletion.



- 3.) It is important to apply fertilizers at correct time to reduce nutrient wash off by rainfall.



Acknowledgement

Authors sincere thanks to Tea Research Board, Consultative Committee on Research, Management and the staff of TRI, UPLB and SLCARP for guiding, encouraging, helping and giving opportunity to successfully complete research





Thank you

