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A Simplified Mitigation Model of Chure Landslide: A Case Study of Setebhir Landslide, Makwanpur, Nepal

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Abstract

This research paper addresses the stability issues of the Setebhir landslide in Makwanpur District, a significant example of Chure region degradation. The study provides a site-specific analysis of the soil slope condition at Setebhir, with potential application for designing mitigation measures for other landslides in the Chure region. Using 2D-FEM-based software Rocscience Phase2, slope stability was assessed, and mitigation measures were proposed based on the computed Factor of Safety (FoS). Drainage measures increased the FoS from 0.81 to 1.00 (23.5% improvement) in Section 1 and from 0.74 to 1.00 (35.1% improvement) in Section 2. Vegetation measures raised the FoS from 1.00 to 1.16 (16%) in Section 1 and from 1.00 to 1.07 (7%) in Section 2. Slope modification provided the greatest improvement, increasing the FoS from 1.00 to 1.81 (81%) in Section 1 and from 1.00 to 1.73 (73%) in Section 2. Small-scale civil engineering structures and vegetative solutions were also suggested. The results were validated against existing literature, achieving a high correlation coefficient of 0.956. This study emphasizes the need for generalized, research-based guidelines to effectively mitigate landslides across the Chure region.

Keywords: *Landslide Slope Stability, Mitigation Measures, Setebhir Landslide, Chure Region, FEM Analysis, Safety Factor*

1. Introduction

Setebhir landslide is situated at the Makwanpur district of the Chure range and signifies the general features of the large scale landslides in the region. The Chure range hosts thousands of landslides of different scales and many of the landslide complexes. It is therefore imperative to take immediate action to prevent huge volumes of material from reaching the plains of the country. In this work, we examine the slope stability of Setebhir landslide under the prevailing soil and slope conditions and recommend appropriate measures for increasing the factor of safety (FOS) to stable levels. The numerical analysis in this work is carried out based on the current state of the literature in relation to Chure landslides (Pokharel, 2013; Thapa et al., 2023; Thapa et al., 2024; Zhu et al., 2026). Two dimensional finite element method (FEM) is employed for slope stability analysis and the development of the mitigation measures. There are several benefits associated with FEM over the limit equilibrium method (LEM), which include (Kong et al., 2025): 1) Non-restrictive assumptions concerning the geometry and location of the failure surface, 2) Non-restrictive assumptions concerning the inclination and location of interslice forces, 3) Simulating progressive failure, and 4) Accurate stress, strain and shear strength computations.

The results generated using the FEM indicate a strong relationship between the finite element method (FEM) and many limit equilibrium methods (LEM), and generate a good estimation of slope failure mechanism like progressive failure and overall shear failure. Moreover, FEM is efficient for analyzing the impact of the plants on the slope stability; thus, the application of FEM in bioengineering is suitable. Studies by Tiwari and Bhandary (2022-2024), Masi et al. (2021, 2022), Pisano and Cardile (2023), Nasiri et al. (2024), Lann et al. 92024), Kong et al. (2025), and Fernandez-Morocho et al. (2026) on applying FEM for estimating the impact of plants on slope stability were used for the current study. Table 1 presents the classification of failure modes of the slope by Xian et al. (2025). There are several failure mechanisms in the Setebhir landslide such as sliding, falling, and flowing. The Setebhir landslide is the representation of the large-scale landslides that occur in the Chure area. The similar landslide conditions prevail in the Chure hills, which indicates the importance of finding the sustainable stabilization methods. Thus, vegetation-based solution using the FEM, is the solution for solving shallow and deep slope failure problems.

Table 1: Modes of slope failures, according to Varnes (1978)

Failure Type	Characteristics
Collapse (CL)	• Collapsing material is residual soils and highly weathered or jointed rocks. Landslide slope prone to occur on steep slopes. The slope is mostly triggered by rainfall infiltration and the size is generally less than 1000 cum.
Rock Fall (RF)	• Rock fall is free fall or rolling down of hard rocks and boulders. It occur on a steep slope and cliff. Falls occur due to gravity and jointed failure and the size generally less than 5 cum.
Rock Mass Failure (RM)	• Materials are hard jointed rocks and the failure modes include wedge slide, plane slide and toppling. The size generally more than 5000 cum.
Landslide (LS)	• Materials may be soil, debris and or highly weathered rocks, which is marked by gentle and deformed topographic features. The landslide is mainly influenced by increased pore water pressure by infiltration. The size generally more than 5000 cum.
Debris Flow (DB)	• Debris flow is rapid flow of boulder, gravel, sand, silt and clay mixed with large quantity of water. It occurs in a contributory area that contains collapsible slopes.
Complex (C)	• Combination of two or more failure types as mentioned.

2.0 Study Area

The Setebhir landslide is located in Makawanpur District at Shripur Chhattiwan VP, at the origin of the Setebhir Khola, and is one of the most active landslides in the study area. It was initiated over 50 years ago and is situated in the mudstone and siltstone formations of the Lower Siwalik rocks. The landslide consists of five large scarps that extend downslope and converge into a single complex failure involving multiple types of mass movement. The toe of the landslide extends to both banks of the Setebhir Khola. The mudstones range from fresh to highly weathered. The flanks of the landslide are covered with residual and colluvial soils, with a thickness ranging from 2 to 8 meters. Gullies within the landslide area vary in width from 3 to 20 meters, with an average depth of approximately 20 meters. A site photograph of the Setebhir landslide is provided in Figure 1. The location is listed in Table 2, and detailed features are presented in Table 3.

Table 2: The location of the Setebhir landslide

Sample ID	Location	Co-ordinates	
		N	E
M2	Setebhir (toe of gully)	27°21'59.4"	85°13'57.0"
M3	Setebhir (downstream from main stream)	27°21'59.4"	85°13'57.0"
M4	Setebhir	27°21'59.4"	85°13'57.0"

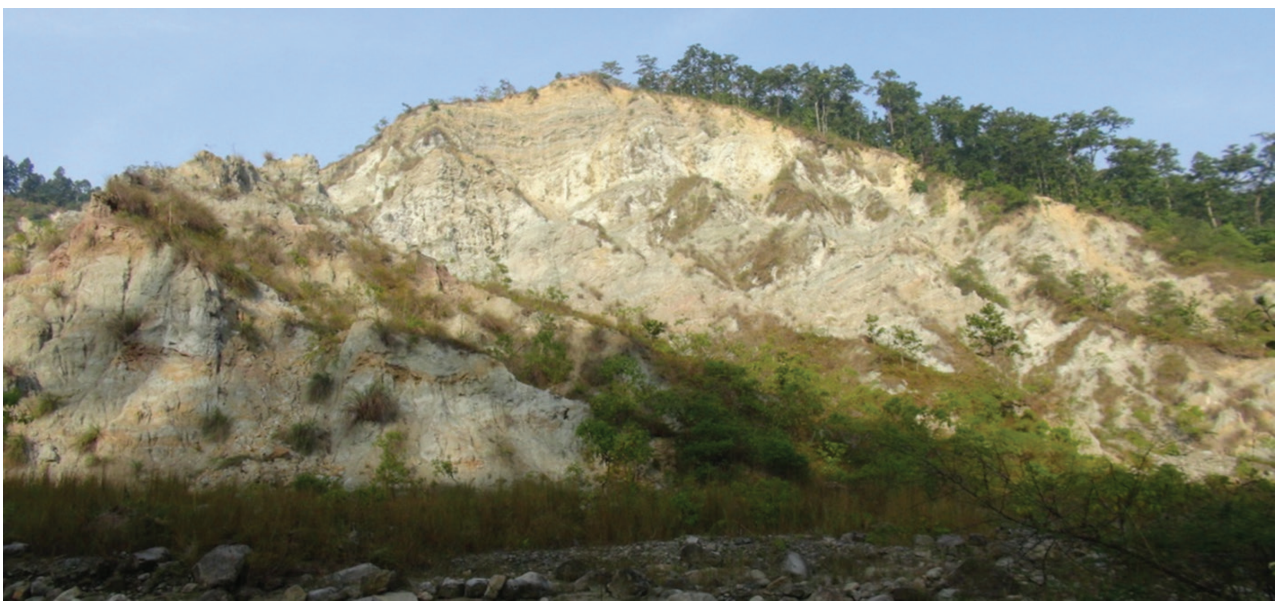

Figure 1: Setibhir Landslide in Makwanpur District, Chure region

Table 3: Description of the Setibhir Landslide (CDES, 2016)

Description	Details
Type	Landslide
Co-ordinates	27 22' 02.57" N, 85 14'16.73"E
Length(m)	400 m
Breadth (m)	280 m
Slope Curvature	Concave, Diverging
Direction and Inclination of undisturbed slope	NW, NE, SW and SE
Land use	Barren slope and unused
Infrastructure	Not present
Rate of movement	Few meters per year
Activity	Active
Types of Landslide	Initially gully erosion and mud flow, now complex
Stratigraphy	Lower Siwalik
Types of soil	Clayey sand and silt-clay mixtures
Types of rock	Mudstone and siltstone
Max Thickness of weathered	2-3m
Direction of dip, Dip amount	NE,33°
Discontinuities Spacing	Few cm to meter
Presence of Water	Water follows from gullies, all over the year
Causes of Landslide	Steep slope, weak rock, swelling nature of clay, spheroidal weathering of mudstone and toe cutting by Setibhir khola.
Damages/ Risks	Debris deposits in cultivation

2.1 Mitigating Measures

Based on Genevois et al. (2022) various methods are suggested in order to stabilize the Setebhir landside slope which are outlined in Table 4. These methods are thought to be appropriate to the site condition and will certainly make the slope more stable. These methods have been divided into four types including: slope geometry modification, drainage, retaining structure and internal slope reinforcement. The purpose of slope geometry modification is the reshaping of the slope so as to minimize driving forces. Drainage method tries to decrease pore water pressure using drainage system. Retaining structures like walls and gabions offer lateral support against movement of slope masses.

Table 4: Possible mitigation measures suggested according to Genevois et al. (2022)

S. No.	Types of Mitigation measures	Mitigation details
1	Modification of Geometry	(i) Removing material and substituting with light weight material (ii) Adding material to maintain stability
2	Drainage	(i) Surface Drain (ii) Sub- surface drain (iii) Vegetation (iv) Drainage galleries
3	Retaining Structures	(i) Gabion walls
4	Internal slope reinforcement	(i) Vegetation

3.0 Materials and Methods

The contour map of the landslide site was produced using AutoCAD Civil 3D and ArcGIS. The FEM based software, RocScience Phase2, was utilized in analyzing the stability of the slope and suggesting appropriate methods for mitigation. The Mohr-Coulomb criterion for failure was considered along with the strength reduction technique proposed by Murgia et al. (2022). This technique is considering strength of materials either in terms of Mohr-Coulomb or Hoek-Brown model. The material models provided in the software for analysis of rock and soil are Mohr-Coulomb, Generalized Hoek-Brown, and Cam-Clay.

3.1 Material model

Failure criterion adopted for the soil model in this work is Mohr Coulomb Failure Criterion. Parameters used in the model include friction angle, cohesion, dilation angle, Young's modulus, Poisson's ratio, and specific gravity. Elasticity modulus may be computed using the procedure suggested by Masi et al. (2021). Results of laboratory testing conducted on soil samples from Section 1 and Section 2 of the Setebhir Landslide are summarized in Table 5.

Table 5: Summary of laboratory investigation of soil sample taken from section-1 and 2 from Setebhir landslide

S. No.	Parameters	Setebhir	
		Sec-1	**Sec-2**
1	Cohesion, c (kN/m2)	8.5	8
2	Friction angle, φ (degrees)	31	30
3	Specific Gravity, G	2.140	2.253
4	Liquid Limit, LL (%)	35.50	32.50
5	Plastic Limit, PL (%)	18.37	21.14

After calculating the shear strength parameters, the frictional angle of different section is calculated from the method describe in Roadside geo-technical Problems, a handbook published by the Department of Road

(DOR, GoN, 2007). The process of calculating the friction angle is according to the Table 6. With this method, the corrected parameters are presented in Table 7.

Table 6: Friction angle without correction obtained from Road side Geotechnical (DOR, GoN, 2007)

Friction Angle without correction				
Landslide	**Setebhir**	**Section**	**2**	
Grain size range	**Fraction weight (%)**	**Dividers**	**Parameters**	**Quotient (deg.)**
<0.002 mm	11	7	A	1.57
0.002-0.01 mm	16	5	B	3.20
0.01-0.2 mm	32	3	C	10.67
0.2-60 mm	41	2.5	D1	16.40
>60 mm	0	2.5	D2	0.00
Total	100		Sum	31.84
Landslide	Setibhir	Section	1	
Grain size range	Fraction weight (%)	Dividers	Parameters	Quotient (deg.)
<0.002 mm	18	7	A	2.57
0.002-0.01 mm	14	5	B	2.80
0.01-0.2 mm	26	3	C	8.67
0.2-60 mm	42	2.5	D1	16.80
>60 mm	0	2.5	D2	0.00
Total	100		Sum	30.84

Formula: $\varphi 0=A+B+C+D$

Where, $\varphi 0$ = friction angle without correction

A=1/7 x [fraction weight (%) of grains < 0.002 mm]

B=1/5 x [fraction weight (%) of grains between 0.002 mm and 0.01 mm]

C=1/3 x [fraction weight (%) of grains between 0.01 mm and 0.2 mm]

D=1/2.5 x [fraction weight (%) of grains between 0.2 mm and 60 mm+fraction weight of grains > 60 mm]

Table 7: Corrected friction angle from Roadside Geotechnical Handbook (DoR, GoN, 2007)

Property	Criteria	Setebhir	
		Sec-1	**Sec-2**
Grain shape	+ 1° for sharp angular grains ± 0° for medium angular grains - 3° for rounded grains	1	1
Distribution curve	- 3° for poor gradation (or uniform size) ± 0° for medium gradation + 6° for well distributed grain sizes	0	0
Compactness of soil	- 6° for loose layer of soil ± 0° for medium loose layer of soil + 6° for compact layer of soil	0	0
Corrected effective friction angle		31.84	32.84

Corrections: φ effective = $\varphi 0+\varphi 1+\varphi 2+\varphi 3$

Where, φ1=correction of grain shape, φ2=correction for form of distribution curve and φ3=correction for compactness of soil.

After the long trials, the friction angle which gives the factor of safety 1 are obtained and their results are tabulated according to the Table 8.

Table 8: SRF value on different landslide section at different friction angle

φ value	Setebhir		
	sec-1		**sec-2**
29			0.89
30			0.91
31	0.85		0.93
32	0.88		0.98
33	0.91		1.00
34	0.94		
35	0.98		
36	1.00		
	Setibhir		
Final value of φ	sec-1	sec-2	
	36	33	

After getting the friction angle from back analysis, the result of back analysis and laboratory data are compared. The data obtained from both ways are tabulated below. While comparing the result we found that the result of BA technique is more satisfactory and reliable which is because the soil sample collected from the site is from the slip mass not from the exact failure surface. The comparison of laboratory and BA technique is shown in Table 9.

The soil material model is prepared as per the Unified Soil Classification System (USCS). The failure criterion of the soil model used in the study is assumed as Mohr-Coulomb criterion and the model consists of following parameters such as friction angle, cohesion, dilation angle (= phi-300), young's modulus (= 105kN/m2), poisson's ratio (= 0.3) and unit weight.

Table 9: Result Comparison of laboratory and BA Technique

S. No.	Methods	Parameters	Setebhir	
			Sec-1	**Sec-2**
1	Laboratory	Cohesion, c (kN/m2)	8.5	8
		Friction angle, φ degrees	31	30
2	Back analysis	Cohesion, c (kN/m2)	8.5	8
		Friction angle, φ degrees	36	33

3.2 Numerical Model

Slope geometry, profile and sections the best representative for the landslide zone are extracted from the field observation and contours available. AutoCAD Civil3D and Arc GIS programs are employed to prepare the contour map of landslide area from which the profiles of different longitudinal sections are prepared. The Rocscience *Phase 2* program is a powerful 2D FEM program for soil and rock applications (*RS2* = Rock and Soil 2-dimensional analysis program).

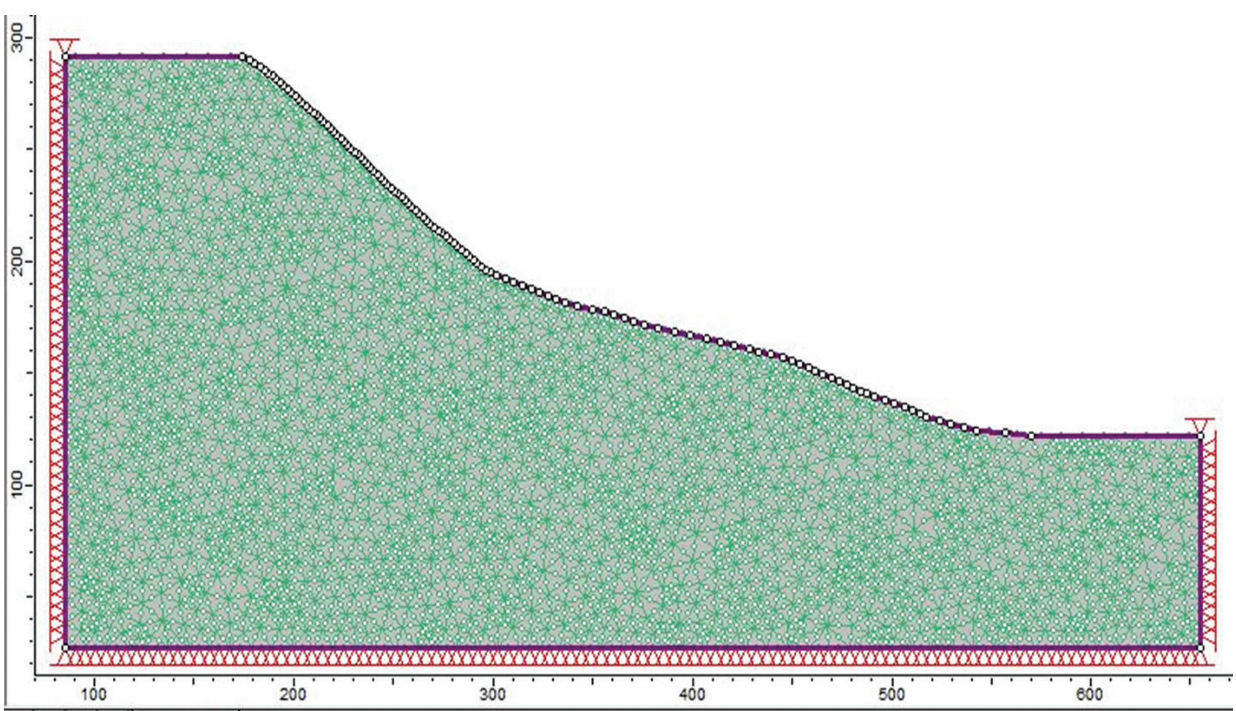

Figure 2: Model of landslide profile on Rocscience Phase2 program

Figure 2 shows the model of the landslide profile of section-1 in a normal soil slope condition in the Rocscience Phase2 program. Similarly, Figure 3 shows the graph of SRF vs Maximum displacement of Setebhir landslide at section-1. Similarly, Figure 4 shows the graph of SRF vs Maximum displacement of Setebhir landslide at section-2. Regarding soil-bioengineering following literatures are employed to prepare the model and to explore the root-reinforcement effect. They are Coppin and Rechard (1990), Morgan and Rickson (1995), Gray and Sotir (1996) and Morgan (1996).

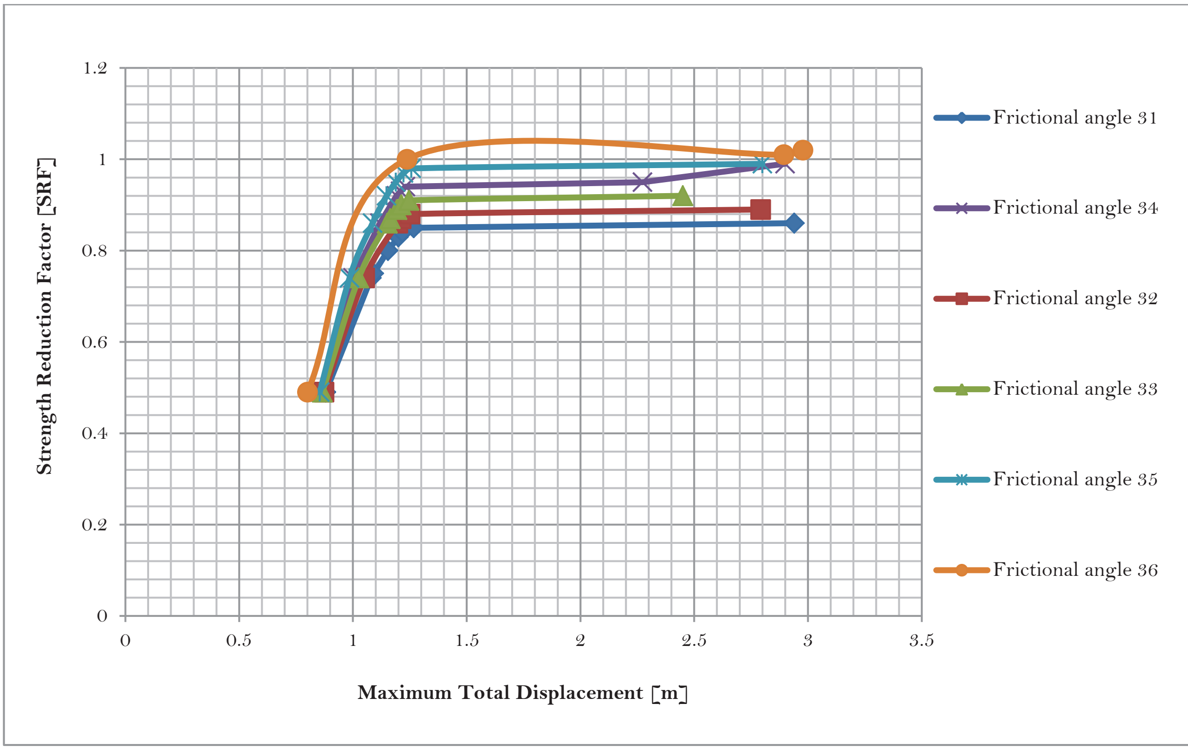

Figure 3: Graph of SRF vs Maximum displacement of Setibhir landslide at section-1 from back analysis technique

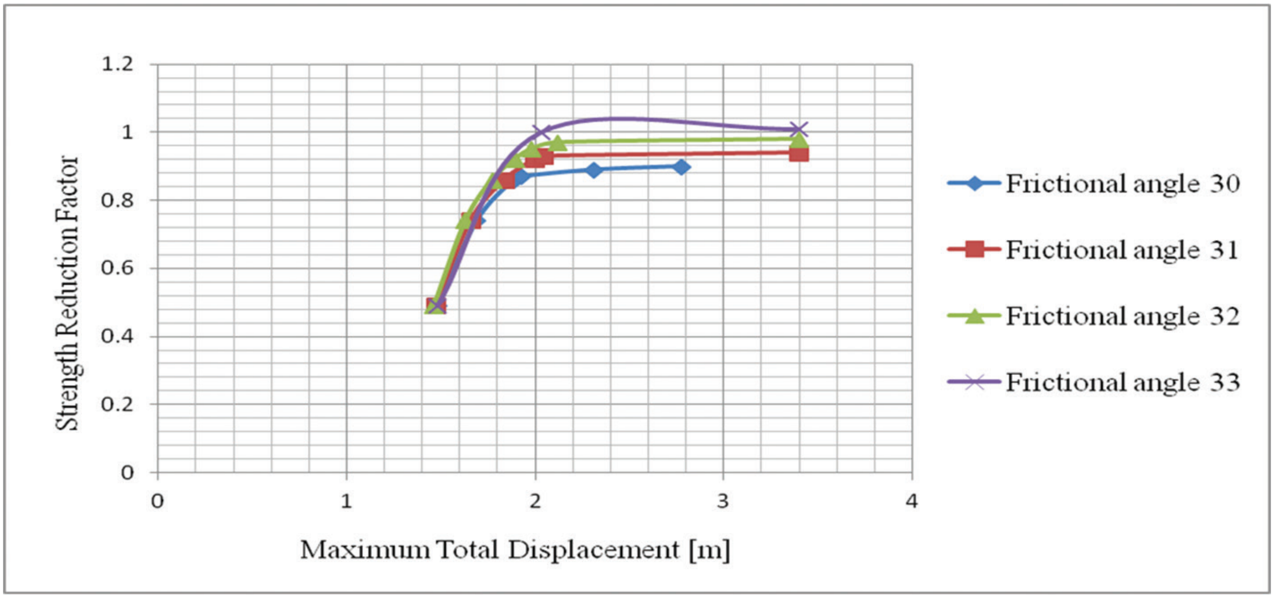

Figure 4: Graph of SRF vs Maximum displacement of Setebhir landslide at section-2 from back analysis technique

4. Results and discussion

Stability analysis considering variations in the groundwater table (GWT) was carried out as summarized in Table 13. The objective of this analysis is to determine the factor of safety (FoS) for different landslide sections in the Chure region under varying GWT conditions. By performing stability analysis on two sections of the Setebhir landslide with reduced GWT levels, the resulting variation in the strength reduction factor (SRF) values is presented in Table 10.

Table 10: SRF and Deformation values at different GWT position

S. No.	GWT position	Setebhir	
		Sec-1	Sec-2
1	Dry condition	1.00	1.00
2	Saturated condition	0.27	0.36
3	WT 5m down	0.51	0.54
4	WT 10m down	0.69	0.64
5	WT 12m down	0.70	0.69
6	WT 15m down	0.81	0.74
7	Dry condition	5.94	5.23
8	Saturated condition	7.32	5.67
9	WT 5m down	7.09	5.63
10	WT 10m down	6.95	5.46
11	WT 12m down	6.72	5.39
12	WT 15m down	6.67	5.32

Figure 5 and 6 show the SRF vs Displacement plot of Setebhir landslide section-1 and 2 with GWT variation. Figure 7 shows an increase in SRF with bioengineering at section-2 of Setebhir landslide.

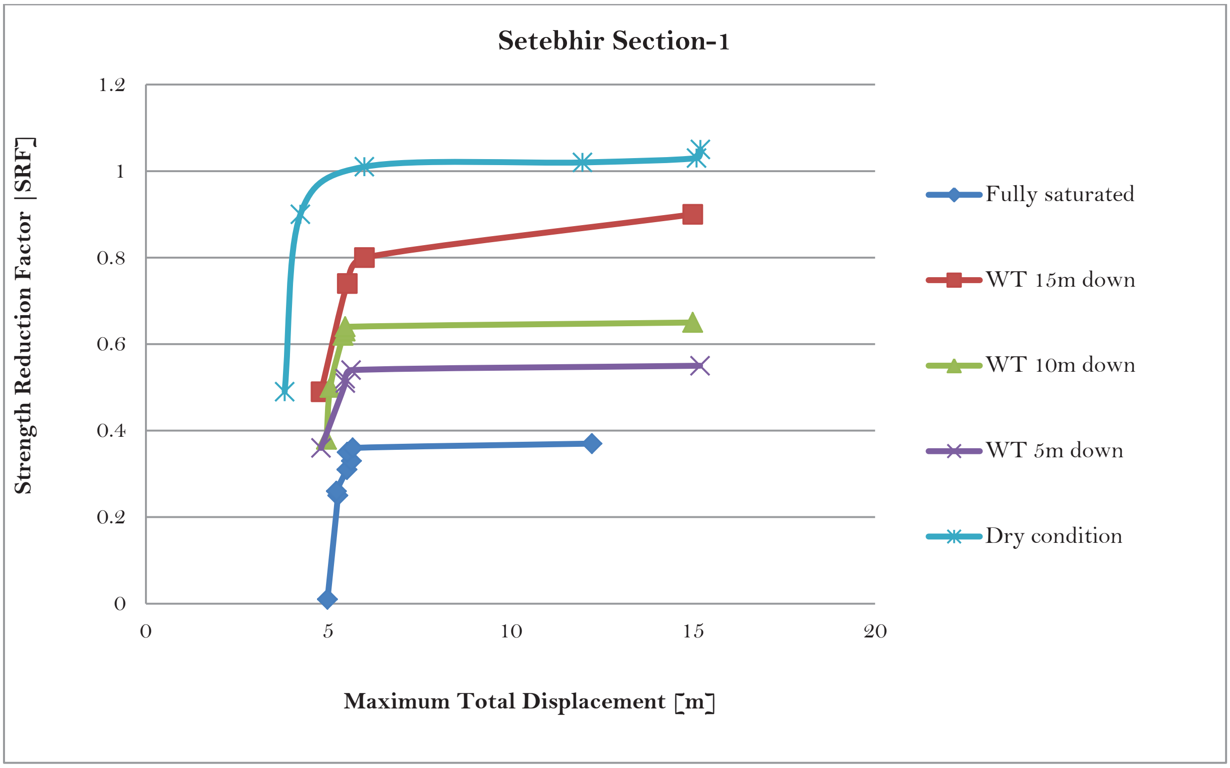

Figure 5: SRF vs Displacement plot of Setibhir landslide section-1 with GWT variation

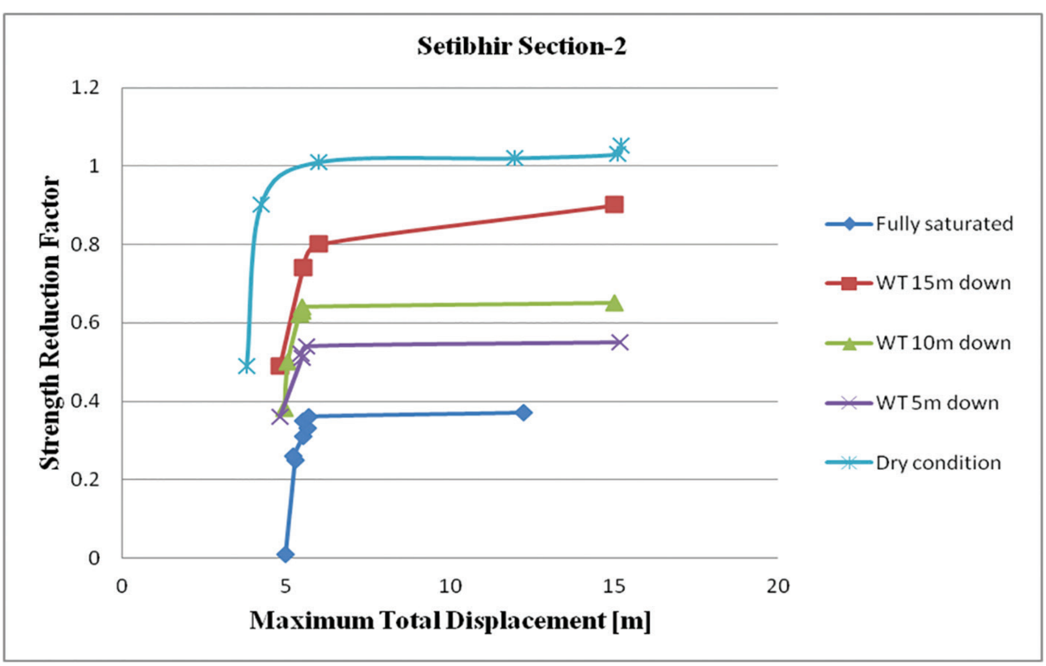

Figure 6: SRF vs Displacement plot at section-2 of Setebhir landslide with GWT variation

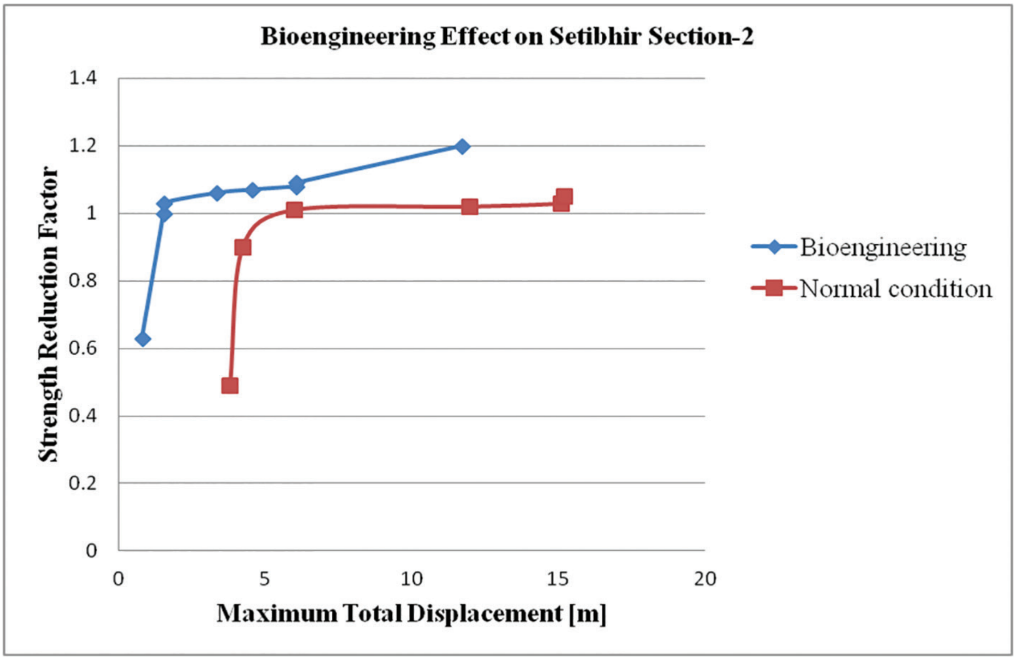

Figure 7: Increase in SRF with bioengineering at section-2 of Setebhir landslide

4.1 Verification of work with Literatures

We verify the model with back calculation with the literature "Road Side Geo-Technical Problems: A Practical Guide to their Solutions" which is published by the Department of Roads which is shown on table below (DOR, GoN, 2007). Table 11 shows the computational results from Back analysis and Roadside Geo-technical Problems (DOR, GoN, 2007).

Table 11: Result from Back analysis and Roadside Geo-technical Problems (DOR, GoN, 2007)

S. No.	Frictional angle	Setebhir	
		Sec-1	Sec-2
1	Back Analysis	36	33
2	Roadside Geo-technical Problems	31.84	32.84

4.2 Mitigation models

As there are various mitigation measures available to control the landslide slope failure. Among them, we have selected following mitigating measures. They are: 1) Drainage Management, 2) Internal Slope Reinforcement and 3) Modification of Slope Geometry.

4.2.1 Drainage Management

This section enlightens how GWT reduction effort increases the safety factor. By employing drainage galleries, safety factor can be achieved to that extent. Surface and sub-surface drain can reduce GWT up to 3-4m according to Table 12.

Table 12: GWT depth to obtain SRF value 1 in different landslide

S. No.	GWT position	Setebhir	
		Sec-1	Sec-2
1	WT 15m down	0.81	0.74
2	WT 16m down		
3	WT 17m down		
4	WT 18m down		
5	WT 20m down	0.92	
6	WT 23m down	0.98	
7	WT 24m down	1	0.9
8	WT 26m down		0.94
9	WT 28m down		1

4.2.2 Internal Slope Reinforcement

The effect of vegetation can be implemented to enhance internal slope reinforcement. Root reinforcement effects are considered. The grasses, shrubs and trees are respectively employed in the top, middle and bottom of the landslide slopes. The depth of the root zone effect of grass, shrubs and trees is respectively taken as 0.5m, 2m 4m. The vegetative effect is applied on five sections of three landslides at normal condition and respective increase on the factor of safety is noted which is tabulated below. Table 13 shows the computational results of SRF vs Deformation at normal soil condition and with vegetation. The corresponding plots of computational results is shown in Figure 8.

Table 13: SRF vs Deformation at normal soil condition and with vegetation

S. No.	Conditions	Value	Setebhir	
			Sec-1	Sec-2
1	Normal condition	SRF	1.00	1.00
		Deformation	5.94	5.23
2	Vegetation	SRF	1.16	1.07
		Deformation	2.76	4.54

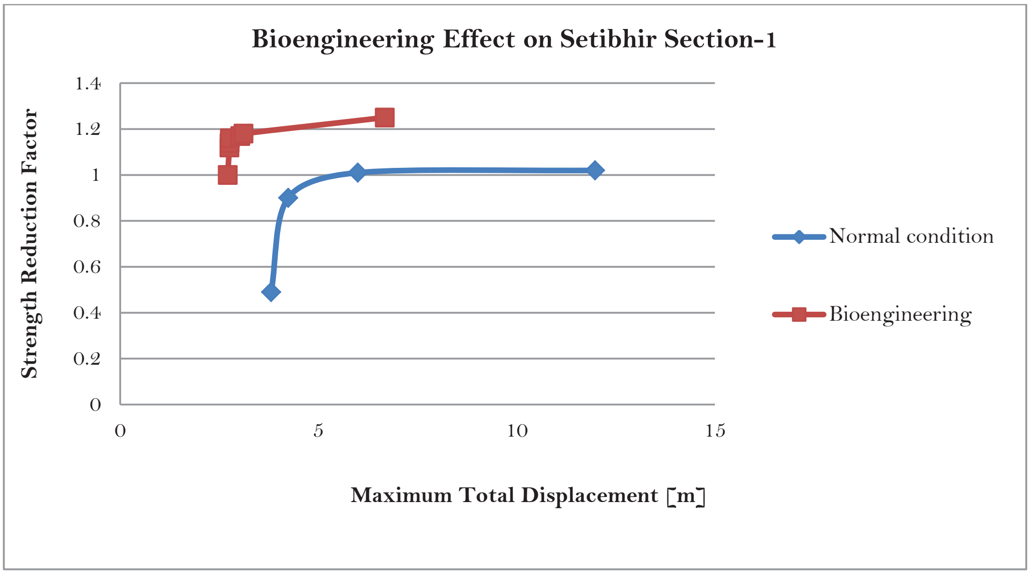

Figure 8: Increase in SRF with bioengineering in Setebhir section-1

4.2.3 Modification of Slope Geometry

The slope profiles of two sections of Setebhir landslide is modified with simple cut and fill approach. The benching is provided at certain interval one after slope. Then the slope is imported in the Rocscience Phase2 program and respective factor of safety or SRF are computed accordingly as per Table 14. The corresponding computational results are shown in Figure 9. The effect of slope modification on the Setibhir landslide sections seems to be more effective as compared to the other landslide sections.

Table 14: SRF vs Deformation with slope modification

S. No.	Conditions	Value	Setebhir Sec-1	Setebhir Sec-2
1	Normal condition	SRF	1.00	1.00
		Deformation	5.94	5.23
		SRF	1.81	1.73
2	Slope modification	Deformation	4.83	5.05

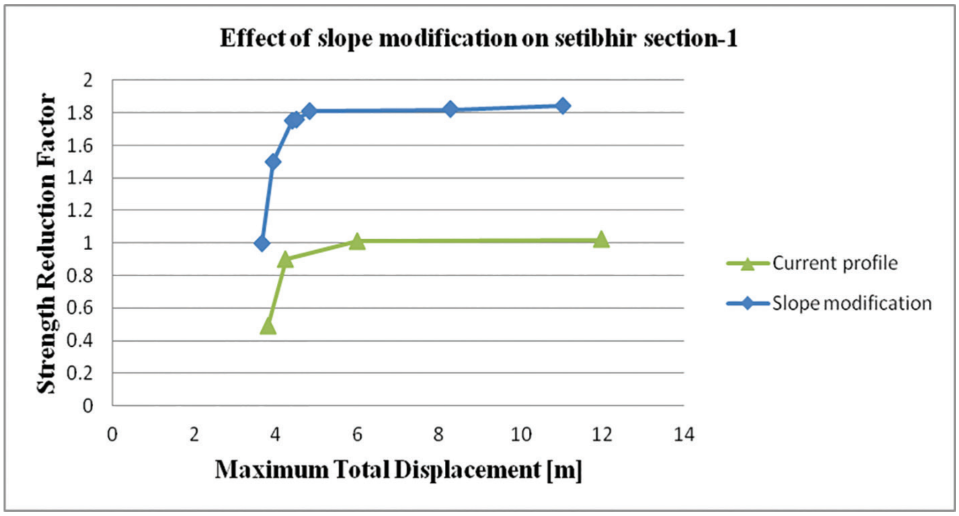

Figure 9: Effect of slope modification in Setebhir section-1

4.2.4 Implementation of landslide mitigation measures

Based on previous analyses, the Setebhir landslide slope should be mitigated using a combination of measures, including modification of slope geometry, bioengineering applications, surface and subsurface drainage, check dams, and retaining structures. For rock slopes, the use of rock barriers and catchment trenches is proposed. In the context of bioengineering, plant selection is based on the drought factor, which considers relative hotness and dryness. The selection process follows the guidelines provided in the Roadside Bioengineering Handbook published by the Department of Roads (DoR, GoN, 2002). Using these guidelines, several plant species have been identified as suitable for implementation at the Setebhir landslide site. Possible small legumes and grasses include Amliso, Babiyo, Dhonde, Kans, Khar, Kush, Narkat, and Nigalo. Suitable shrubs and small trees include Areri, Bayer, Bhujetro, Dhanyero, Kanda Phul, Keraukosh, Simali, and Tilka. Mai Bans is considered an appropriate large clumping bamboo species, while recommended large trees include Bakaino, Chilaune, Kalosiris, Khanyu, Khayer, Lankuri, and Painyu. Figure 10 presents typical Mitigation Model-1 for Section 2 of the Setebhir landslide, incorporating a retaining wall, check dam, and both surface and subsurface drainage systems. The computational results for this mitigation model are shown in Figures 11 and 12. Similar work is done for other models.

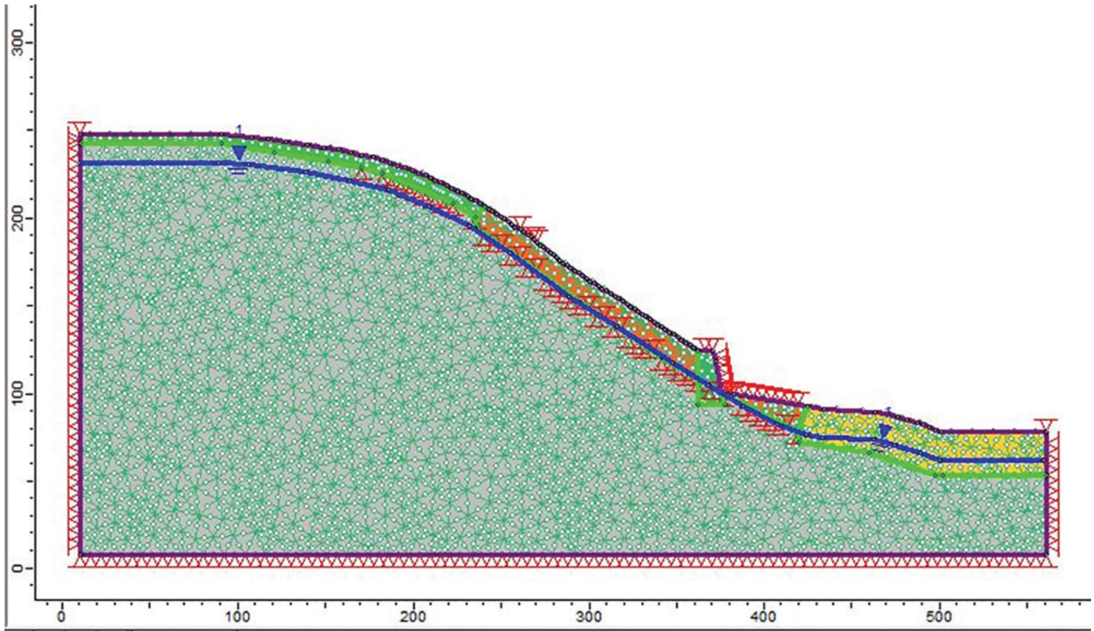

Figure 10: Mitigation model-1 at Slope section-2

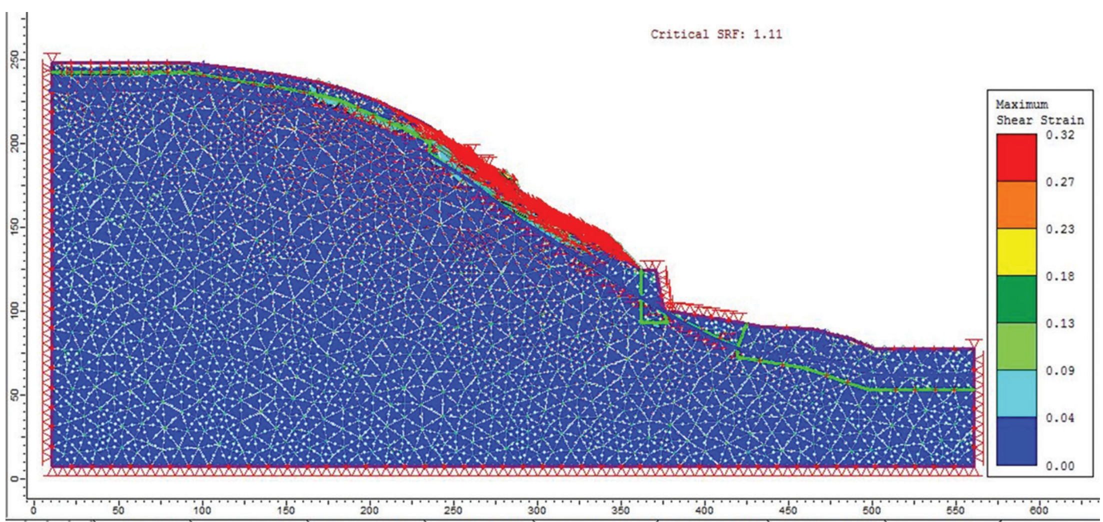

Figure 11: Maximum shear strain vs displacement at mitigation model-1 of section-2

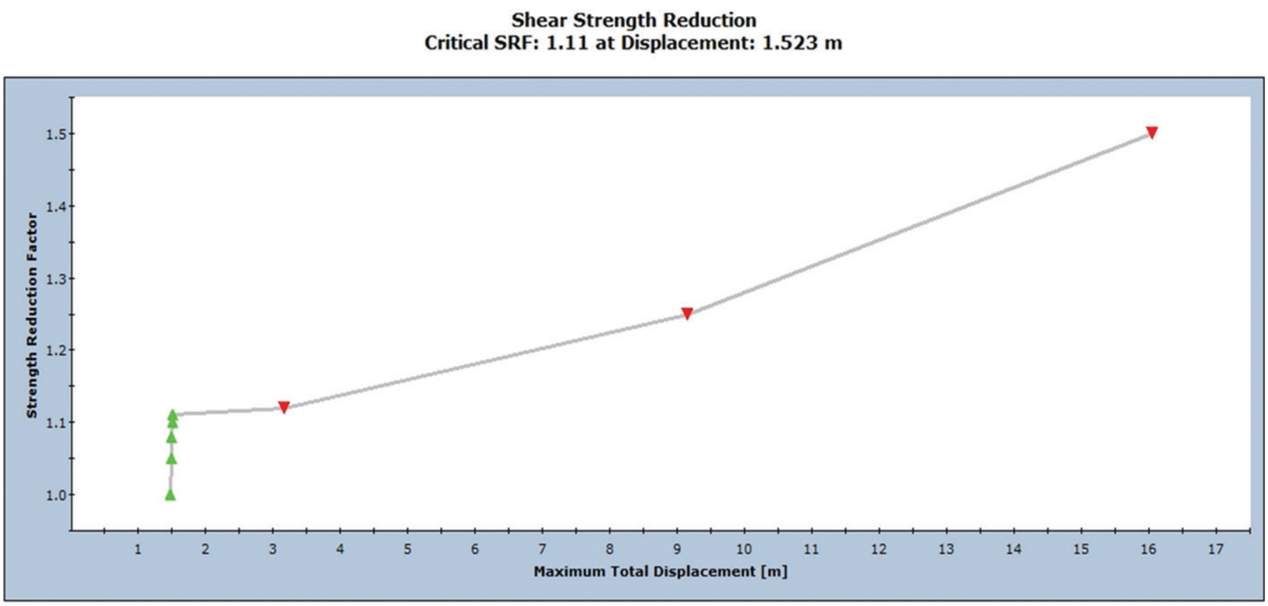

Figure 12: SRF vs displacement at mitigation model-1 of slope section-2

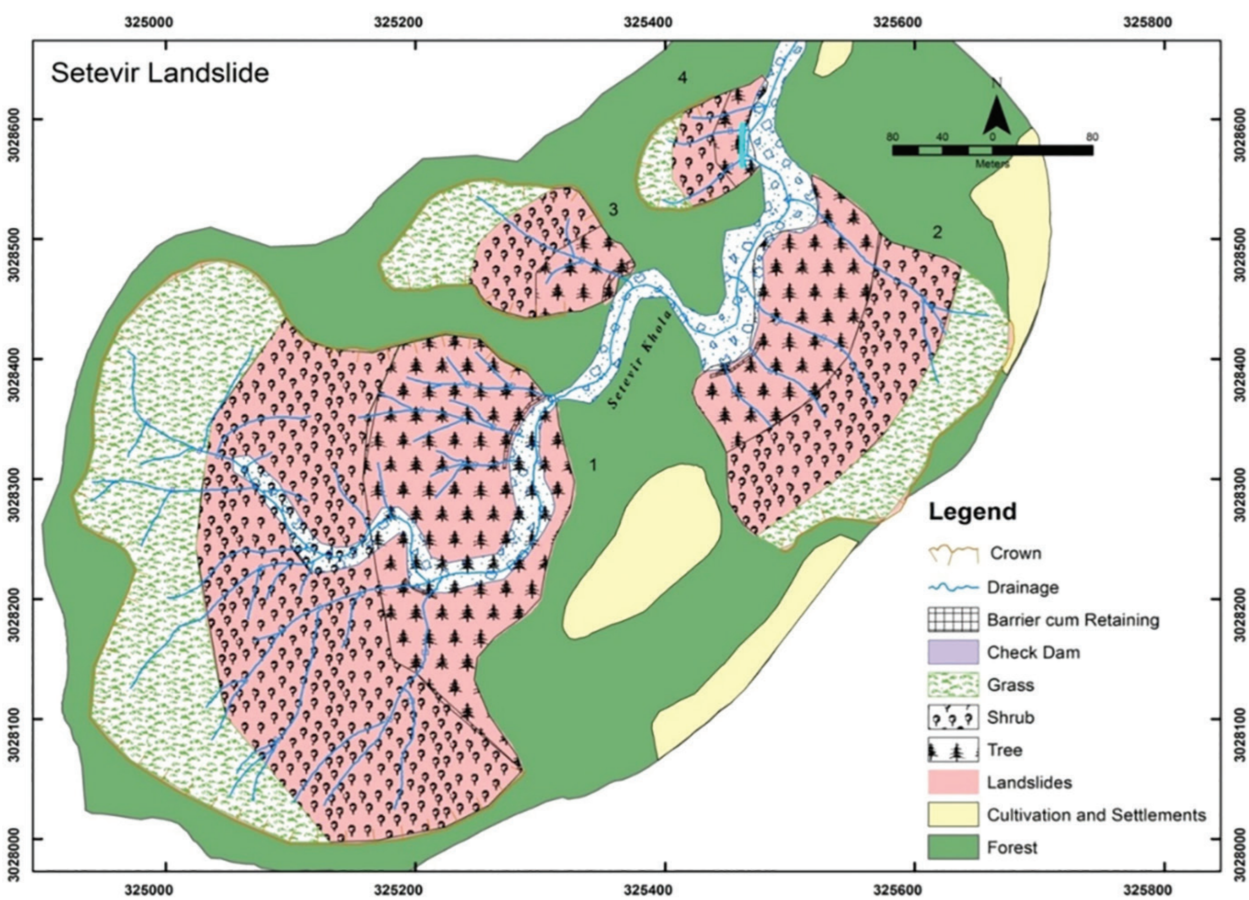

Figure 13: Mitigation measures in GIS sketch

Figure 13. shows the mitigation model of Setebhir landslide in GIS sketch. Similarly, Figure 14. shows the same mitigation measures in field photographs. It shows the mitigation measures such as vegetative structures, surface and sub-surface drain and check Dam.

With the implementation of the proposed mitigation model, significant improvements in slope stability were observed in both sections of the Setebhir landslide. In Section 1, the application of drainage measures increased the Factor of Safety (FoS) from 0.81 to 1.00, representing a 23.5% improvement. In Section 2, the FoS increased from 0.74 to 1.00, indicating a 35.1% enhancement. When vegetation was introduced, the FoS rose from 1.00 to 1.16 in Section 1 and from 1.00 to 1.07 in Section 2, corresponding to increases of 16% and 7%, respectively. Slope modification proved to be the most effective intervention, increasing the FoS from 1.00 to 1.81 in Section 1 (an 81% increase) and from 1.00 to 1.73 in Section 2 (a 73% increase). Among the adopted measures, slope modification provided the highest improvement in stability, making it the most effective mitigation approach for the Setebhir landslide site under the current geological and geotechnical conditions. However, achieving the necessary groundwater table reduction—approximately 24 meters in Section 1 and 28 meters in Section 2—is not feasible using conventional subsurface drainage systems such as French drains. Such a reduction would require more advanced interventions like drainage wells, pumping stations, or drainage tunnels, which may not be practical or economically viable for this specific landslide project.

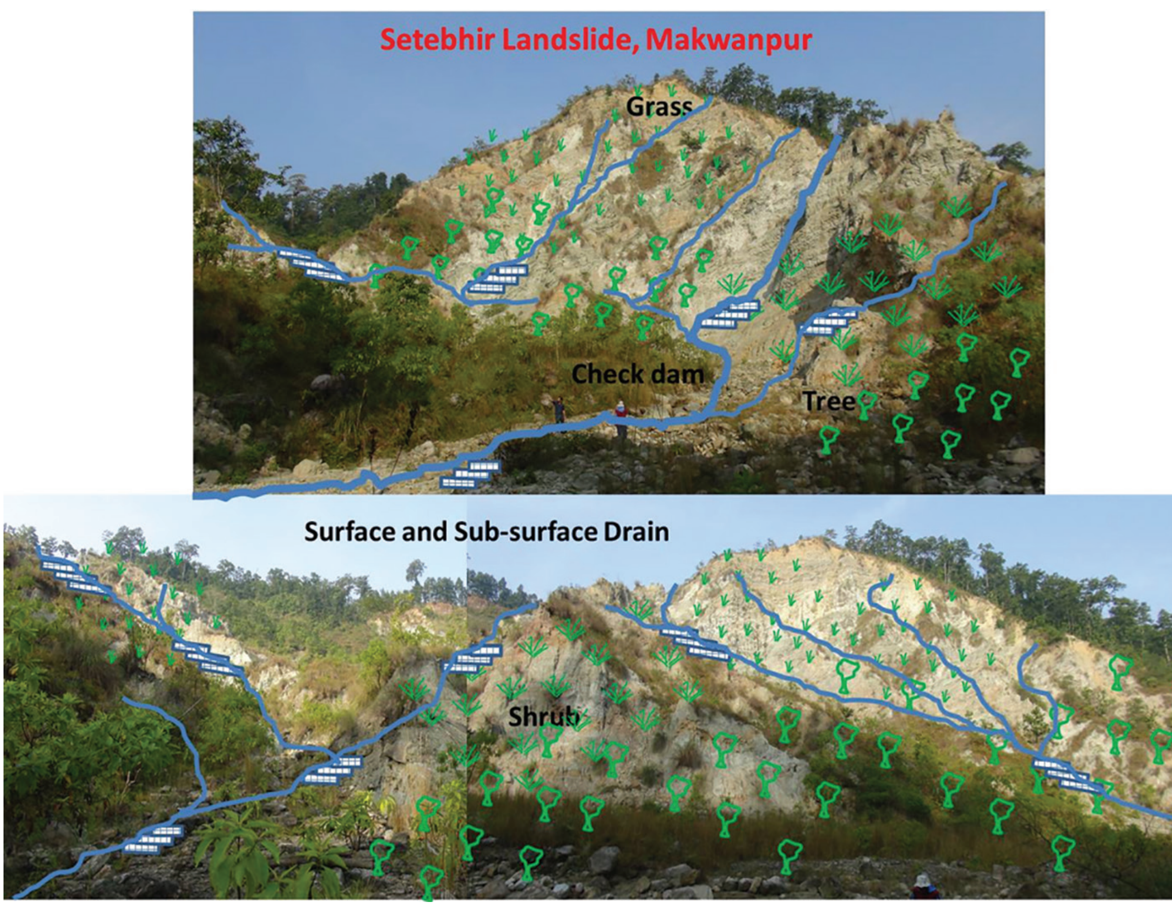

Figure 14: Mitigation design details in field photographs showing measures such as vegetative structures, surface and sub-surface drain and check Dam

5.0 Conclusions & Recommendation

This study presents the slope stability assessment of the Setebhir landslide in the Makwanpur Chure region, along with proposed mitigation measures. The FEM-based software, Rocscience Phase2, was employed for the analysis, with results validated against existing literature, achieving a correlation coefficient of 0.956. The study focuses on developing effective mitigation models incorporating slope modification, vegetation, drainage systems, check dams, and retaining structures. The findings highlight the need for both site-specific solutions and generalized, research-based guidelines to address the widespread landslide occurrences across the Chure region. Recommendations are provided to improve the effectiveness and feasibility of mitigation efforts in the region. The conclusions and recommendation are listed below.

- Significant Improvements in Slope Stability: The proposed mitigation model resulted in significant improvements in slope stability for both sections of the Setebhir landslide.
- Drainage Measures: In section 1, the application of drainage measures increased the Factor of Safety (FoS) from 0.81 to 1.00, representing a 23.5% improvement, where as in section 2, the FoS increased from 0.74 to 1.00, indicating a 35.1% enhancement.
- Vegetation Measures: In section 1, the introduction of vegetation increased the FoS from 1.00 to 1.16, corresponding to a 16% increase, where as in section 2, the FoS increased from 1.00 to 1.07, representing a 7% increase.
- Slope Modification: In section 1, slope modification led to an increase in the FoS from 1.00 to 1.81, a 81% increase, where as in section 2, the FoS increased from 1.00 to 1.73, a 73% increase.
- Effectiveness of Slope Modification: Slope modification proved to be the most effective intervention in improving slope stability, with the highest FoS increases, making it the most effective mitigation approach for the Setebhir landslide site under current conditions.
- Feasibility of Groundwater Table Reduction: Achieving the required reduction of the groundwater table—24 meters in Section 1 and 28 meters in Section 2—using conventional subsurface drainage systems, such as French drains, is not feasible. To achieve such reductions, advanced interventions like drainage wells, pumping stations, or drainage tunnels would be necessary, but these may not be practical or economically viable for this landslide project.
- Generalized Solutions for the Chure Region: Considering the large number of landslides across the Chure region, which affects 33 districts, site-specific solutions alone may not be sufficient. There is a need for generalized, research-based guidelines that can be applied to similar landslide situations in the region using the methodologies developed in this study. These guidelines would improve the effectiveness and feasibility of landslide mitigation efforts across the region.
- Validation of Analysis Results: The FEM-based software Rocscience Phase2 was effectively utilized for slope stability analysis, with the results validated against existing literature, achieving a high correlation coefficient of 0.956.

Modelling with higher material models in three-dimensional domain will be recommended.

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