SOIL EROSION ASSESSMENT SURVEY OF SUMANDAR KATHA CATCHMENT AND ADJOINING AREAS OF HARRO RIVER, ABBOTTABAD DISTRICT

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Abstract

The soil erosion assessment survey of Sumandar Katha catchment and adjoining areas of Harro River was carried out in order to investigate and identify the extent and types of soil erosion that are taking place and to evaluate the risk of erosion in the study area. For this purpose, initial data were collected from 1:20,000 aerial photographs followed by field visits. The survey revealed that extent of the gully erosion, rill erosion, patches of land sliding, land sliding and stream bank erosion was 46.31, 22.08, 1.00, 8.85 and 17.33 hectares, respectively. The general slope of the study area was 10-80% of which 10-30% was slope of the terraced area and 50-80% was slope of the forested/pasture lands. Major causes of erosion in the study area were poor land and crop management, slope gradient, accelerated erosion near villages, erodibility of soils, low stream bank stability and heavy concentrated rains. All the above causes and features have been mapped using 1:50,000 scale.

Introduction

Damage done by accelerated erosion may be loss of fertility, diminished soil workability, decreased water holding capacity or more frequently a combination of these. It has been estimated that in NWFP moderate to severe soil erosion covers about 287000 hectares surface area which is 25% of rainfed cultivated land (Mian *et al.*, 1993). Due to the peculiar characteristics of NWFP, the erosion problem is more severe as compared to other provinces and regions. Due to high average annual rainfall, i.e. 1200 mm and snow fall that occurs on high mountainous areas of Abbottabad district results in numerous hill torrents which further aggravate erosion problems by eating up alterable lands situated in foot hills and plains, converting them into gullies and streamlets.

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Elahi (1991) carried out a semi detailed erosion risk assessment survey in Swabi and thus evaluated the erodibility of the soils, past and future erosion by preparing a comprehensive programme of soil conservation measures.

Saha and Singh (1991) developed and modified the land evaluation approach for qualitatively assessing soil hazards in hilly watershed of Uttar Pradesh, India using physiography, soil, terrain-topography and land use/land cover information. Similarly, Girondano *et al.* (1991) methodogically discussed soil erosion and importance of land resources for assessing soil erosion risk and land quality in the Mediterranean region.

Davidson and Theocharopoulous (1992) presented data which were collected for land resource survey of agricultural area in Viotia Greece, on a scale of 10,000. Assessment of erosion was based on the extent to which subsurface Horizons have exposed as a result of past and present erosional processes. The incidence of erosion was related with slope angle which resulted in high erosion.

However, no research work has so far been done to conduct the semi-detailed erosion assessment and to prepare a survey report of Abbottabad district in farm planning and land management. The issue is of a serious challenge, therefore, the present study was conducted to investigate and identify the extent and types of soil erosion and to evaluate the risk of erosion in the future.

Materials and Methods

The study area is situated along the Murree road at a distance of about 30 km from Abbottabad. The study area consists of colluvial slopes where two perennial streams i.e. the Sumandar Katha and the Harro river both flow from east to west and join each other near a village Puna. The total area under this study was 8054 hectares. Seven different soil series lie in the study area (Din 1976). These are Ayubia, Bagnotore, Baragali, Barian, Kohala, Makhnial and Thipra series. Major crops of the survey area are maize, potato, wheat, rape and mustard.

The desired data were collected by the interpretation of aerial photograph available in the Library of Forest Management Centre (FMC), Peshawar. During interpretation the following steps were taken to complete this study:

1. Intensive study of the available aerial photographs to delineate areas where

erosion had occurred in the past. All information relevant to the study were transferred to these maps for use in the field, particularly on slopes and soils.

2. Detailed study of the topographic and the reconnaissance soil maps.

3. Field survey of the study area using the base map for location. The severity of erosion was recorded by simple coding system (Morgan, 1995).

4. Discussions with District Soil Conservationist Abbottabad about the nature and severity of the erosion.

5. Meeting with the farmers to assess the state of awareness and perception which they have about the soil erosion.

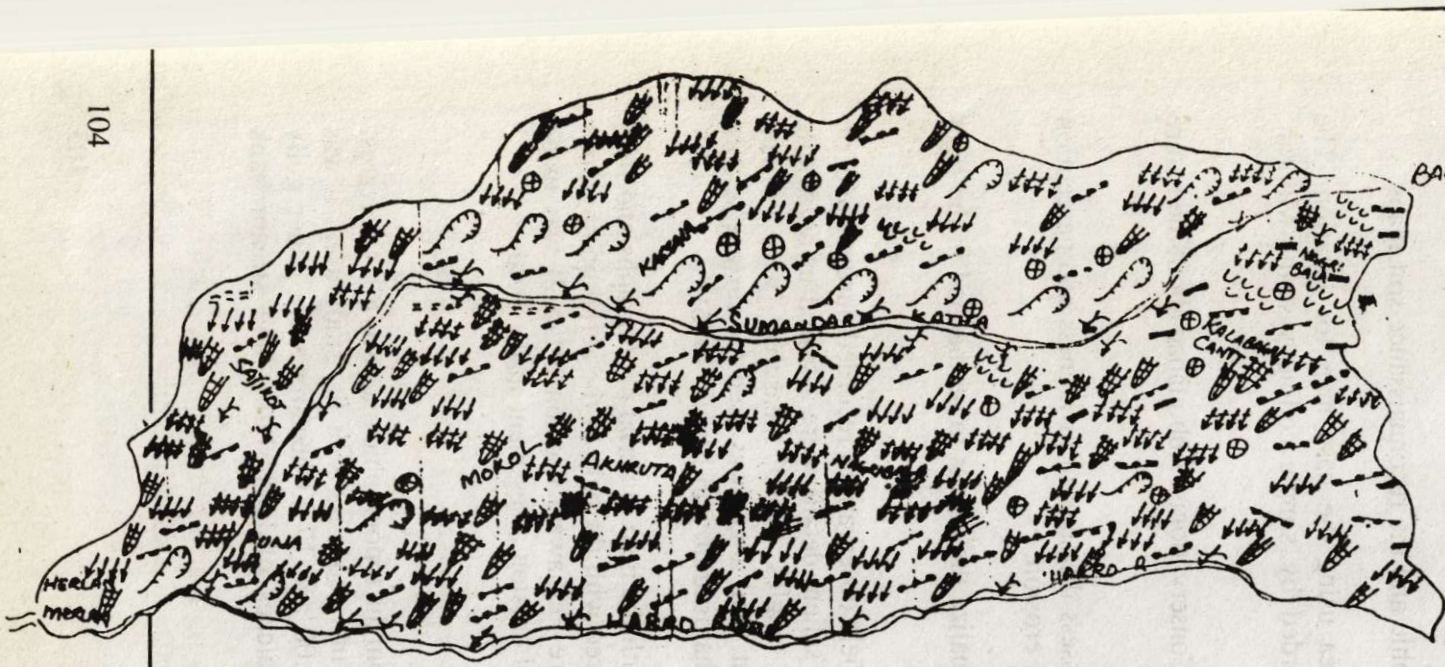
6. Stereoscopic examination to finalize the details to be mapped in the light of the field work.

Maps were prepared from the field observations recorded during travel on foot. All erosional features and other salient details were assessed using simple coding system (Table 1). Slope angles were measured with Abney level/Clinometer to the nearest percent. Soil auger was used for surface texture and analysis by personal field tests (Shamsuddin and Bhatti, 1996).

Erosion maps were prepared with the help of aerial photographs and field study. The erosion (Map 1) was prepared with the help of the aerial photographs arranged at Forest Management Centre Peshawar. Erosion (Map 2) was made with the help of coding system for soil erosion assessment in the field.

Results and Discussion

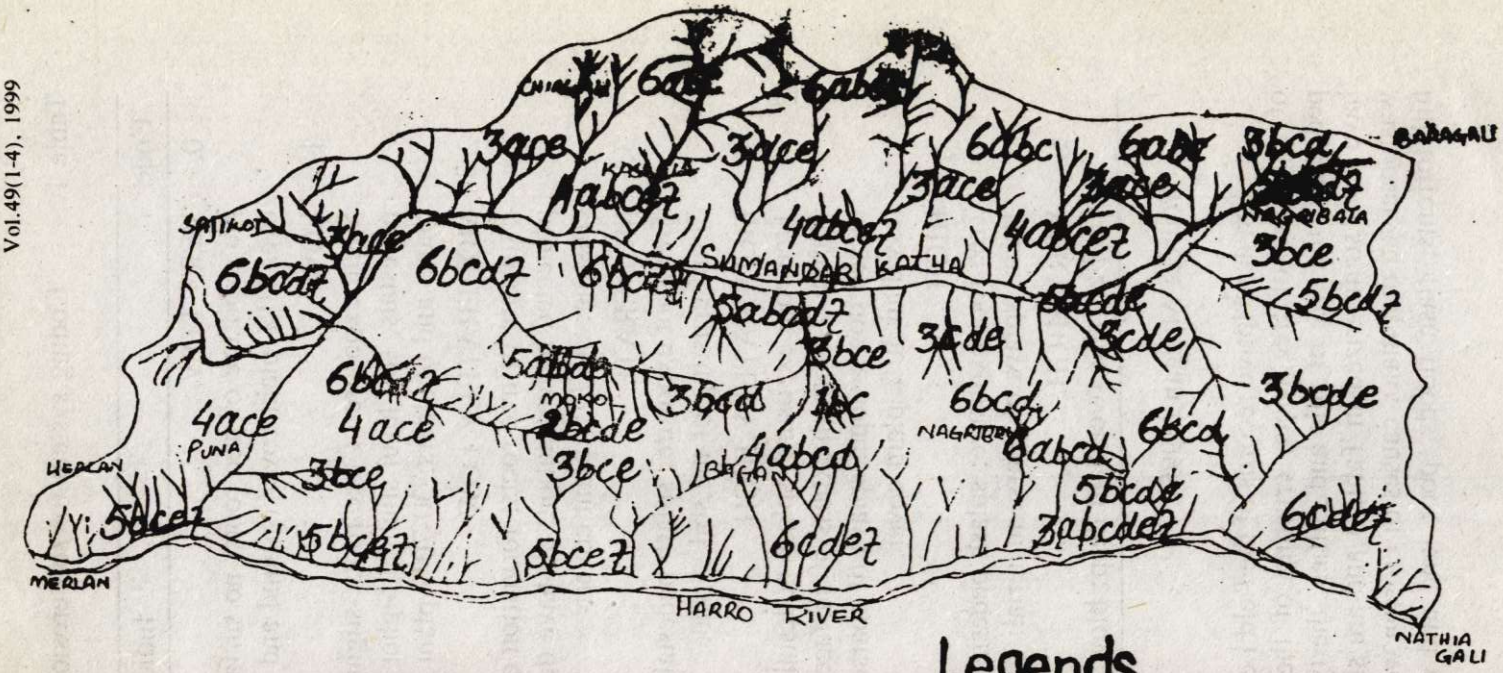
Total survey area, calculated from the topographic map was 8054 hectares. By counting the extent of the erosion in various parts of the study area, it was estimated that, 46.31, 22.08, 8.85, 1.00 and 17.33 hectares were under gully erosion, rill erosion, land sliding, batches of land sliding and stream bank erosion, respectively (Table 2).



Map 1

Legends

- Active Gullies
- Stable Gullies
- Active Rills
- Stable Rills
- Land Sliding
- Patches of Land Slides
- Hill Torrent
- Sheet Wash Erosion
- Road Erosion
- Convex or Concave Slope
- Rivers



Legends

Low Erosion	1
Moderate Erosion	3
Moderately Low	2
Moderately High	4
High	5
Very High	6
Poor Land & Crop Mangement	e
Poor Vegetative Cover	a
Slope Gradient	b
Erodibility Of Soils	c
Erosion Accelerated By Humans	d
Low Stream Bank Stability	7

Map 2

Table 1. Coding system for soil erosion appraisal in the field.

Code	Indicators
0.	VERY LOW No exposure of tree roots; no surface crusting; no splash pedestals; over 70% plant cover (ground and canopy).
1.	LOW Slight exposure of tree roots; slight crusting of the surface, no splash pedestals; soil level slightly higher on upslope or windward sides of plants and boulders; 30-70% plant cover.
2.	MODERATELY LOW Exposure of tree roots; formation of splash pedestals; soil mounds protected by vegetation; all have depths of 1-10mm; slight surface crusting; 30-70% plant cover.
3.	MODERATE Tree root exposure; splash pedestals and soil mounds to depths of 1-5mm; crusting of the soil surface; 30-70% plant cover.
4.	MODERATELY HIGH Tree root exposure; splash pedestals and soil mounds to depths of 5-10mm; 2-5mm thickness of surface crust; grass muddied by wash and turned down-slope; splays of coarse material due to wash or wind; less than 30% plant cover.
5.	HIGH Tree root exposure; splash pedestals and soil mound to depths of 5-10cm; splays of coarse material; rills up to 8cm deep; bare soil.
6.	VERY HIGH Gullies; rills over 8cm deep; blow outs and dunes; bare soil.

Source: Morgan (1995).

The descriptive records of the field i.e; the severity of erosion, the account of exposure of tree roots, crusting of the soil surface, formation of splash pedestals, the size of rills and gullies, the type and structure of the plant cover have been summarized in Table 3 and are shown in the sketch map (Map 3). It was observed that major causes of erosion were intensive summer monsoon rain, hill torrents, flash floods, poor land and crop managements, slope gradient,

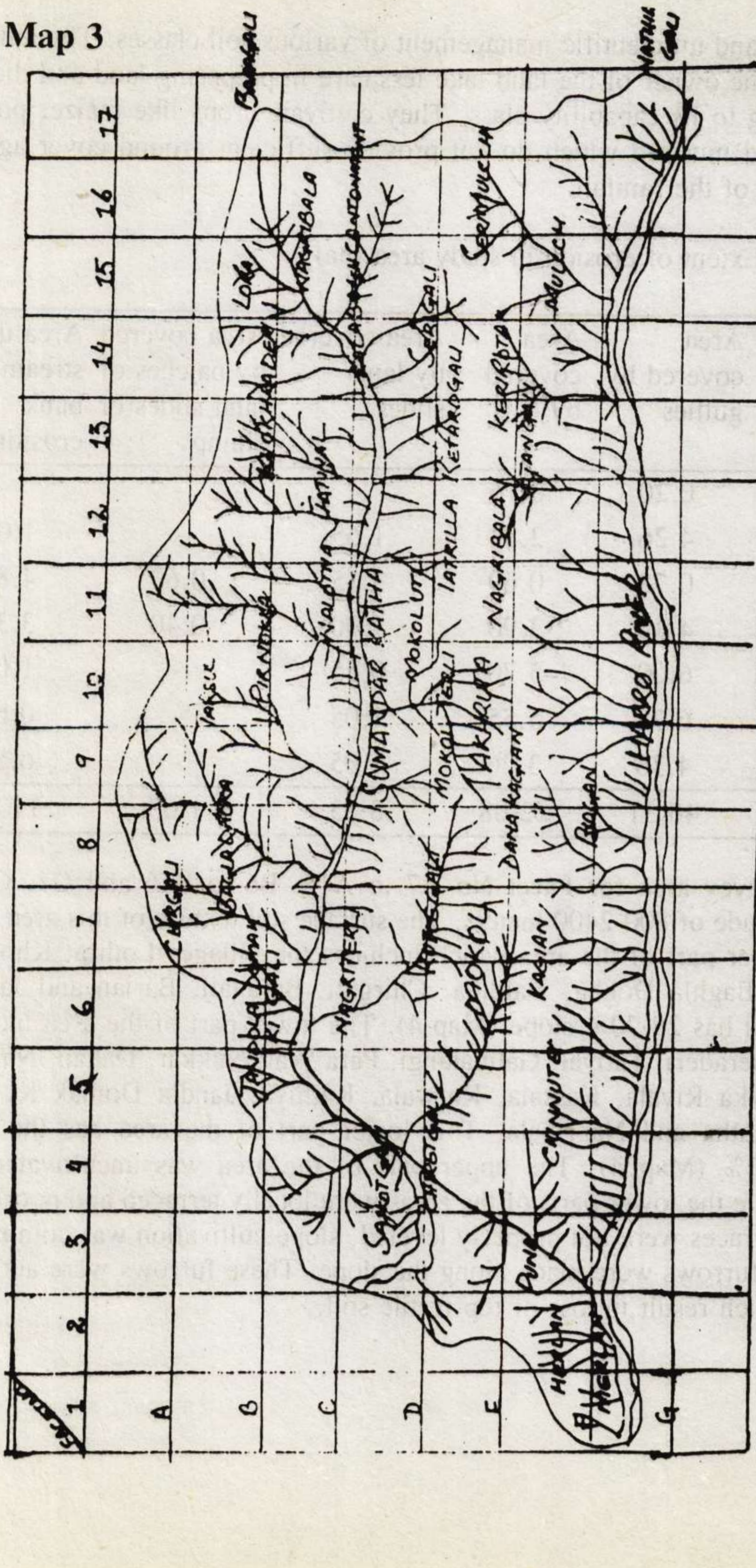
misuse of land and unscientific management of various soil classes. The tenants, who were not the owner of the land take less care in preparing land and did not use it according to its capability class. They cultivate crops like maize, potato, wheat, rape and mustard which do not provide sufficient ground cover against high intensities of the rainfall.

Table 2. Extent of erosion in study area (ha)

Facet No.	Total area	Area covered by gullies	Area covered by rills	Area covered by land slides	Area covered by patches of land slides or slumps	Area under stream bank erosion
A	134	0.20	0.16	-	-	-
B	110	4.26	2.82	1.65	-	1.00
C	1185	0.78	0.69	3.55	0.60	4.80
D	1445	4.16	3.90	1.00	0.40	3.38
E	1525	6.00	5.70	0.55	-	1.05
F	1540	6.75	5.55	1.05	-	0.60
G	1125	4.36	3.26	1.05	-	6.50
Total	8054	46.31	22.08	8.85	1.00	17.33

The survey area for Facet No A7 to A12, B6 to B16 and C4, C5, is situated at altitude of 800-2400 meters. The surface soil texture of this area is silt loam. The upper part of the area which includes the villages Lothra, Khokhera Deri, Tarsul, Baghla Dokha, Nalotha, Chirgali, Baragali, Barian and Jandola Domak Ki Gali has 25-70% slope (Map 4). The lower part of the area includes the villages Kheraderi, Tatiyal, Galibatangi, Para Wali Nukkar, Dakan, Nalotha, Goni, Pir Nakka Riyala, Kassala, Karwala, Kathiya, Jandla Domak Ki Gali, Summandar Katha and Nagribala. This lower part of the area has the slope between 13-80% (Map 4). The upper part of the area was uncultivated and deforested while the lower parts of the areas were locally terraced and poorly dry farmed. As terraces were not properly leveled, slope cultivation was common in practice. The furrows were made along the slope. These furrows were acting as active rills which result in loss of top fertile soil.

Map 3


BARAGALI
NATHIA GALI
SUMANDAR KATHA
HARRO RIVER
NAGRIBALA
NAGRITERI
KAGIAN
1
2
3
4
5
6
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A
B
C
D
E
G

Map 4

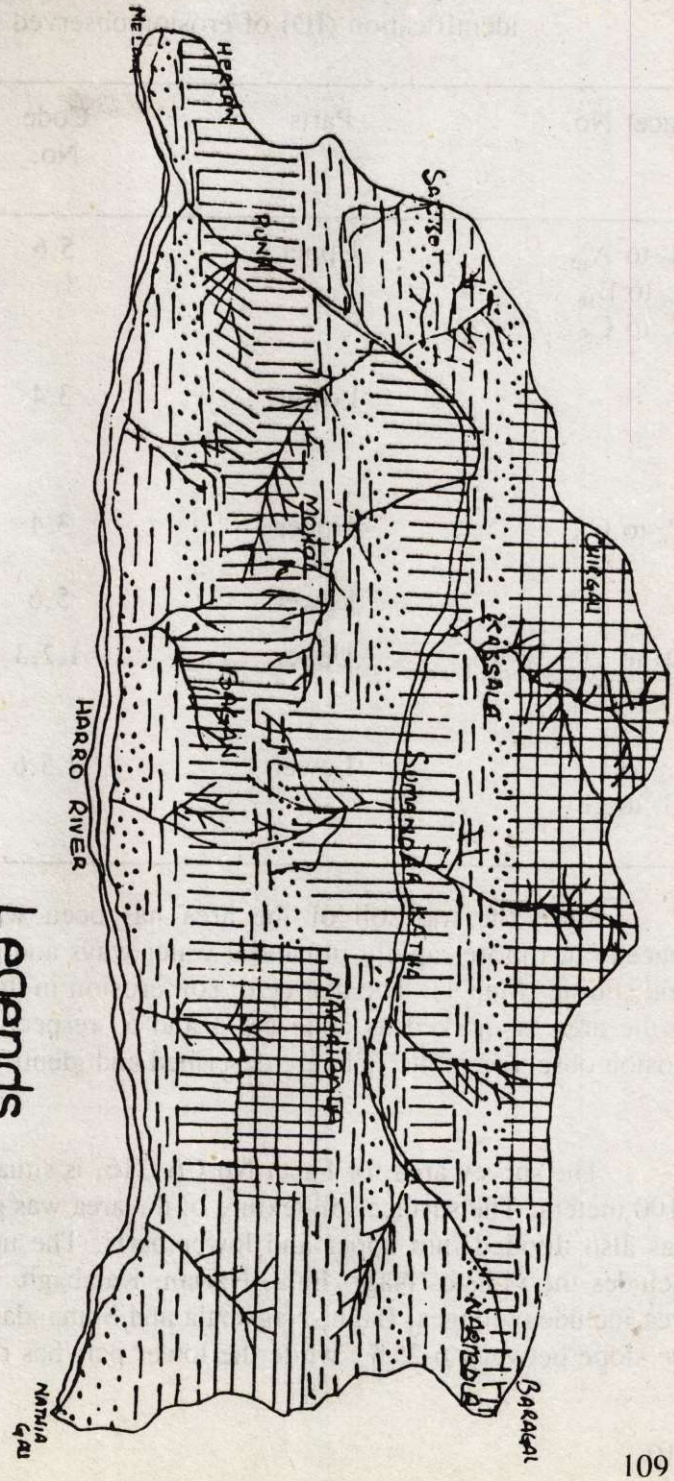
HARRO RIVER
KHAIRABAD
BARAGAL
NATHIA GALI
Legends
PERCENT SLOPE
5—15%
16—30%
31—45%
46—60%
61—75%
76—90%

Table 3. Coding system that refers to the degree of erosion and the identification (ID) of erosion observed in the field.

Facet No.	Parts	Code No.	ID
A_7 to A_{12} B_6 to B_{16} C_4 to C_5	Upper	5,6	a. b. c.
	Lower	3,4	a. c. e.
C_6 to C_{16}	Upper	3,4	b,c,e
	Lower	5,6	a,b,c,f
D_3 to D_{15} E_4 to E_{14}	Upper	1,2,3	b,c,e
F_4 to F_{16} G_3 to G_{13}	Lower	4,5,6	a,c,d,e,f

Since the top soil of the area has been washed away, so the water concentrates more rapidly in natural water ways and is forming rills, gullies and land sliding (Map 1). The degree of soil erosion in the upper part and lower part of the area is marked as code No.3 and 5, respectively. The major causes of erosion observed in the field are described and identified by a, b, c, d and f (Map 2).

The survey area for Facet No.C6-C16, is situated at the altitude of 900 to 2100 meters. The surface soil texture of the area was gravelly silt loam. This area was also divided into upper and lower parts. The upper part of the study area includes the villages Nagri Bala, Narian, Kalabagh, while the lower part of the area includes villages, Bagh, Nagribala and Sumandar Katha. The upper part has the slope between 6-25%, while the lower part has the slope between 6-80% as

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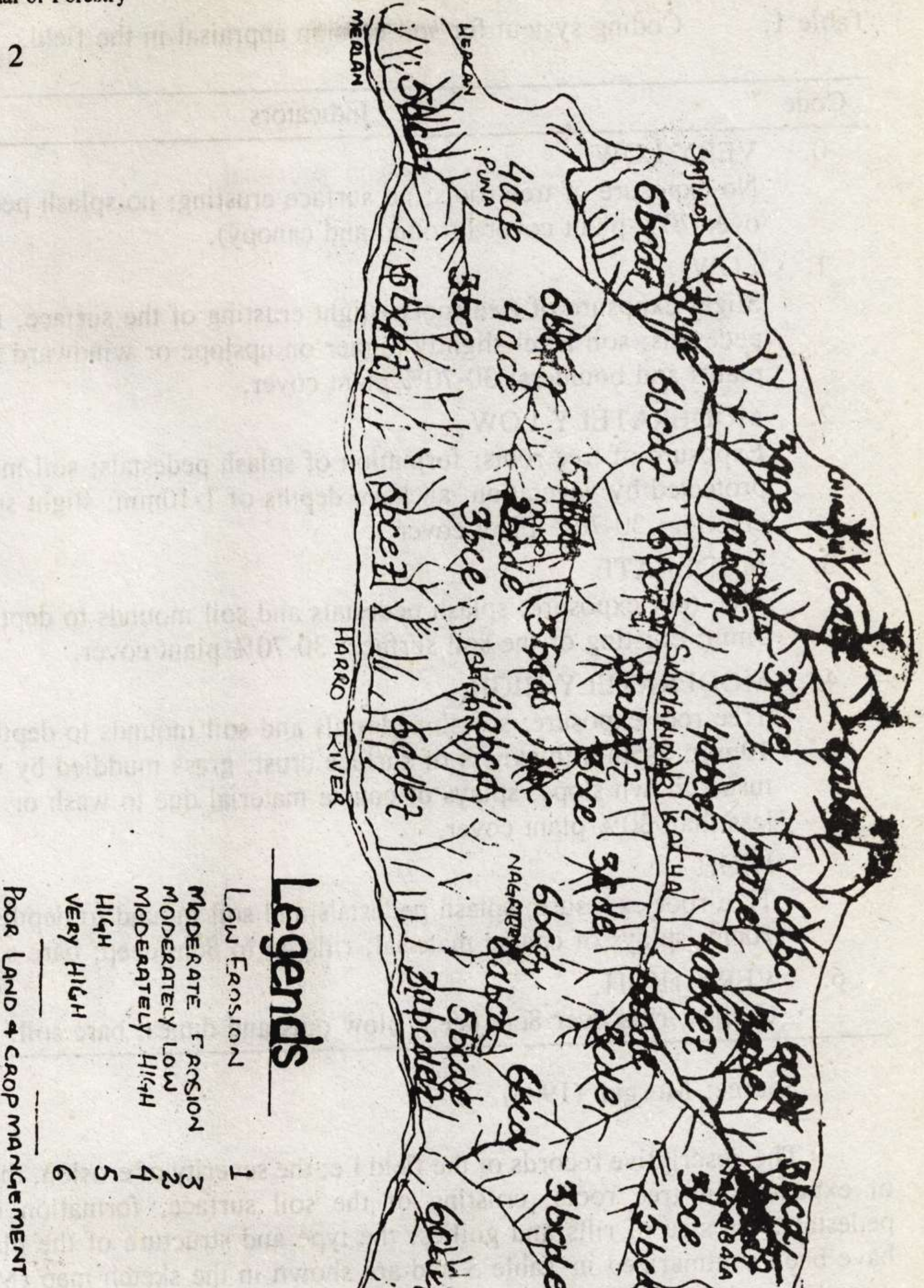
page for map 1

page for map 2



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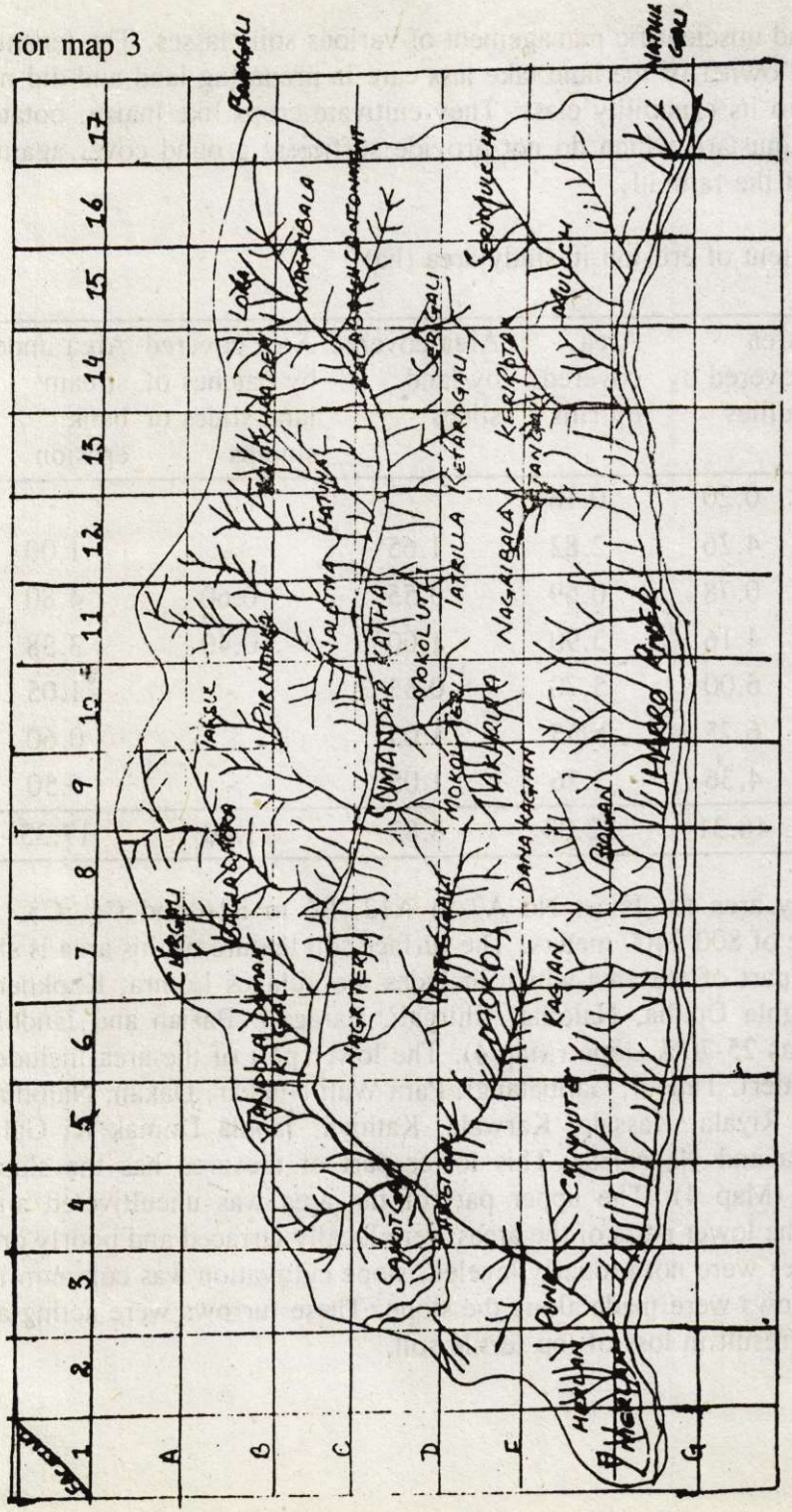

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Table 3. Coding system that refers to the degree of erosion and the identification (ID) of erosion observed in the field.

Facet No.	Parts	Code No.	ID
A_7 to A_{12}	Upper	5,6	a.
B_6 to B_{16}			b.
C_4 to C_5			c.
	Lower	3,4	a.
			c.
			e.
C_6 to C_{16}	Upper	3,4	b,c,e
	Lower	5,6	a,b,c,f
D_3 to D_{15}	Upper	1,2,3	b,c,e
E_4 to E_{14}			
F_4 to F_{16}	Lower	4,5,6	a,c,d,e,f
G_3 to G_{13}			

Since the top soil of the area has been washed away, so the water concentrates more rapidly in natural water ways and is forming rills, gullies and land sliding (Map 1). The degree of soil erosion in the upper part and lower part of the area is marked as code No.3 and 5, respectively. The major causes of erosion observed in the field are described and identified by a, b, c, d and f (Map 2).

The survey area for Facet No.C6-C16. is situated at the altitude of 900 to 2100 meters. The surface soil texture of the area was gravelly silt loam. This area was also divided into upper and lower parts. The upper part of the study area includes the villages Nagri Bala, Narian, Kalabagh, while the lower part of the area includes villages, Bagh, Nagribala and Sumandar Katha. The upper part has the slope between 6-25%, while the lower part has the slope between 6-80% as

shown in the slope map (Map 4). The upper part of the area has dense forest and mixed undergrowth of shrub and grasses, while the lower part of the area is exposed and has less plant cover. The erosion in the upper part is moderate while in the lower part of the area is more severe. The main features of erosion in the area are, land sliding, stream bank erosion and hill torrents (Map 1).

The degree of soil erosion in the upper and lower part of the survey area was marked as code No.3, 4, 5 and 6 respectively. Major causes of erosion observed in the field were described and identified by a, b, c, d, e and f (Map 2).

The survey area for Facet No.D_3-D_{15}, E_4-E_{14}, F_4-F_{16} and G_3-G_{13} is situated at an altitude of 1200-2400 meters. The surface soil texture of the area is slightly gravelly silt loam and slightly gravelly clay. The upper part of the area has slope between 25-70% and the lower part of the area has slope between 4-80% (Map 4). The area includes the villages of Sajangali, Kerirotak, Tatrilla, Retardgali, Nagri Bala, Mokolutli and Tarli, Akhrota, Bagan, Kothi Mian Nagri, Mulach, Makhnial, Kutle Gali, Chir Gali, Puna, Chinute, Banda Kagian, Herlan, Marlan, Mochi Dara and Nathiagali. The area is locally terraced and dry farmed. Due to overgrazing and deforestation, the upper part of the area has severe erosion while lower part of the area has moderate erosion. The main features of erosion were rills, gullies, hill torrents, splash erosion and road erosion (Map 1). The degree of soil erosion in the upper and lower part of the area was marked as code 1, 2, 3, 4, 5 and 6 respectively. Major causes of erosion observed in the field are described and identified by a, b, c, d and e (Map 2).

Conclusions

The following conclusions could be drawn from the present study:

Various types of erosion observed in different parts were splash erosion, rill erosion, gully erosion, land sliding and stream bank erosion.

The main causes of soil erosion in the study area were, poor land and crop management, slope gradient, erosion accelerated by human activities near villages, erodibility of soils and low stream bank stability.

- Soil erosion in different parts of the study area ranges from low to very high.

Based on results of the study, it is recommended that meetings with the farmers should be arranged in order to explain to them the extent and types of soil erosion that are taking place and to apprise them about the risk of erosion by educating them, about the scientific management of various soil classes, level land methods and land capability classification.

Acknowledgements

The authors are highly thankful to the staff of Forest Management Centre, Peshawar for providing the facilities of the aerial photographs interpretation.

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