ASSESSMENT OF THE LAND AND SOIL DEGRADATION IN HILKOT WATERSHED AREA, DISTRICT MANSEHRA

Abdul Hameed Khan*, Bashir Ahmed Wani and Hakim Shah*****

Abstract

The soil survey was conducted from August 21 to September 8, 1999 for six mapping units of erosion in the Hilkot watershed project area. The analysis revealed that 98 ha (6.8%) of the area was under slight sheet erosion, moderate rill and river bank erosion, 350 ha (24.2%) were under slight rill erosion and moderately gully erosion, 263 ha (18.2%) under moderate rill and gully erosion, 517 ha (35.8%) area depicted moderate sheet, rill erosion and gully erosion, 104 ha (7.2%) area showed severe sheet, rill, gully erosion and land sliding and 111 ha (7.7%) area was under the grip of rill, gully erosion and land sliding.

Introduction

The Hilkot Watershed project covers an area of about 1,940 hectares. It lies between 34° 35' N to 34° 40' N latitudes and 73° 5' E to 70° 35' E longitudes north of Shinkiari town in Mansehra District. It represents a mountainous landscape with elevation ranging from 1,400 to 2,700 meters. It consists of a narrow alluvial valley formed by the Hilkot river which is bounded by a system of steeply dissected mountain ridges composed of mainly fine-grained rocks, i.e. schists, slates and phyllites, in their southern major part (about 75%) and of mainly coarse-grained rocks, i.e. granites and gneisses, in the northern part. Climatically the area falls in humid temperate climate with an average annual precipitation of more than 100 mm, warm summers and cold winters. The climatic conditions, however, change with the elevations as well as with the slope direction. The land in the valley is used for irrigated farming, while that of the ridge slope is used differently, i.e. for forestry at higher elevations and for rainfed farming or grazing combined with agroforestry at middle and lower elevation.

During the past few decades the problem of soil erosion and subsequent loss of valuable agricultural land has received considerable attention in tropical and sub-tropical regions of the world. Deforestation and soil degradations, removal of vegetation cover and over grazing, have been observed in the country with great concern. As a result, problems like siltation of dams reservoirs, removal of top soil

* Director, Soil Survey of Pakistan, Peshawar
Inspector General of Forests, Ministry of Environment, Islamabad
*** Country Coordinator, PARDY-Project, Pakistan Forest Institute, Peshawar

cover, erosion and land degradation have been observed thorough out the country especially in the Northern upland areas which needs a through study and appropriate control measures.

Material and Methods

The data required for assessment of land degradation due to soil erosion in the project area was collected during the course of Soil Survey of the area. The related data included study of relative soil thickness on different slopes compared to that on the adjoining flat land, noting of erosion features such as rills, gullies, land sliding, slumping and cutting along stream banks etc. along with their depths and density occurring in different soil units. The available data on rocks types, surface slopes, vegetation cover (type, density), prevalent land use/management and other human activities was then integrated with the physical data collected during the surveys and a tentative soil erosion map was prepared immediately after the field work. A systematic study of the whole project area was made through aerial photointrpretation to improve the delineation on the map, especially with regard to the surface slopes, pattern, density and depths of gullies formed, natural vegetation coverage and land use. Finally, the map prepared on "Present Land Use" and "Physiography and Soils" were super-imposed on the soil erosion map for matching it with the two maps, which led to further improvement and finalization of the soil erosion map.

Results and Discussion

In order to accurately assess the erosion hazards, the information about soils, topography and land use are pre-requisites. The information regarding the soils and land use/vegetation of the area collected during the field observations revealed that the soils of the project area vary in characteristics mainly due to differences in physiography, parent material and land use types. All soils types are, however, very similar in certain characteristics that include calcareousness (i.e. lime or carbonate content), soluble salt content (electrical conductivity), base saturation (relative proportion of exchangeable bases or available nutrients on its clay particles). The soil are being formed under a predominantly humid climate and therefore effecting deep leaching, all the soils are non-calcareous (with no lime content) with a very low salt content (ECe < 3dSm-1) and an acidic reaction of varying degree but still having a high base saturation (> 50%) which is very favourable for agricultural use.

The main soil variables recorded during the field observations and laboratory studies are:

- Surface slope/topography
- Depth or thickness of effective soil material
- Texture
- Gravel/stone content
- Colour
- Drainage
- Organic matter content
- Structural development
- Reaction or pH

In general, the soils of the alluvial valleys have a gently to moderately sloping surface transformed into almost flat terraces, a depth of more than 100 cm, brown to dark yellowish brown colour, slightly to moderately gravely loamy texture, high organic matter content, weak to moderate structure and an almost neutral reaction (pH 6.5-7.7). They are generally well drained.

The soils of the residual and colluvial slopes occurring on the mountain ridges have moderately sloping to very steep surfaces that are partly modified by terracing, mainly fine to coarse loamy texture and medium to high gravel and stone content, except for terraced farmland from which the stones have partly been removed. They are generally shallow (<50 cm thick) on sloping surfaces but deep (<100 cm thick) on flat to coarse surfaces and crevices, especially at sites protected by vegetation. Where terraced for farming, the soils are relatively shallow in upper parts of the terraces and moderately deep to deep in their lower parts. Most of the shallow soils are relatively low in organic matter, have brighter colours and are excessively drained while the deep soils are mostly rich in organic matter, have dark brown to very dark greyish brown colours and are well drained to somewhat excessively drained. They have weak to moderate structure and a weakly to moderately acidic reaction (pH 5.5-6.5), except for some soils formed from acidic rocks (granite, gneiss) that have a moderately to strongly acidic reaction (pH 4.0-5.0).

The soils formed from loess material are generally non-gravely having fine silty to clayey texture, dark to very dark brown colour, high organic matter content and moderate to strong structural development. They are deep to very deep (>100 cm thick) and well to somewhat excessively drained. The soil reaction is slightly acidic to natural (pH 5.5-7.0)

The land in the survey area is used in a number of different ways, depending upon elevation, slope, climate, soil conditions, relief and water availability etc. The relatively gentle slopes having sufficiently thick soil cover are commonly used for cultivation, with irrigation where occurring within command of the water channels or springs, or rainfed if occurring out of command of water sources. The steep and very steep mountain slopes or lower and middle elevations are mostly under shrubs land used for grazing and partly under moderately thick forests. The higher mountain slopes having relatively cool and humid climate are mostly under thick coniferous forests. However, the differences in the local socio-economic conditions also considerably influence the land use.

The following five categories of generalized land use types were identified in the area.

- Irrigated farmland (terraced)
- Rainfed farmland (terraced)
- Very thick forest land)
- Moderately thick forest land with patches of rainfed farmland
- Shrub land with some grasses and small trees

Interpretation of the relevant remote sensing data (air-photos) followed by field observations and assessment of the erosion risk from related land characteristics soils, topography, climate, vegetation, land use etc. resulted into six mapping units of erosion in the project area. These six mapping units were showing very slight to moderate degree of erosion in the rainfed, irrigated loess, piedmont plains, and moderate to very severe degree erosion in high slopes and bare soil/rocky areas. Detail of each unit is as followed. (See the Soil erosion map)

Soil erosion mapping unit 1: Land with slight sheet and moderate rill & river bank erosion

This unit, covering 98 ha (6.8%) of the project area, represents the Hilkot river valley consisting of moderately sloping land having deep, slightly gravely loamy soils that have been benched for irrigated cultivation with gentle slopes toward the river (soil mapping unit No. 1). The soil loss that occurs mainly through sheet and rill erosion on the arable land and deep cutting along

the river banks during the rainy season is estimated to be of slight to moderate, being least in the parts provided with a good crop cover.

Soil erosion mapping unit 2: Land with slight rill erosion and moderate gully erosion

This mapping unit occupies about 350 ha (24.2%) of the steep to very steep land consisting of moderately deep to deep, gravely/cherty loamy soils with a thick forest cover (soil mapping unit No. 4, forested parts). Due to interception of rain by the nearly continuous trees canopy, high organic matter content and hence moderate to high permeability of the soils, the water run-off is relatively low which flows mostly through rills and concentrates to form various gullies deepening toward the lower slopes. In general, the soil loss due to erosion in this unit is estimated to be low at higher elevations but moderate at lower elevations, especially along the main drainage ways.

Soil erosion mapping unit 3: Land with moderate rill and gully erosion

This unit covers 263 ha (18.2%) of the steep to very steep land consisting of moderately deep, gravely/cherty loamy soils having a moderately thick cover of shrubs, grasses and forest trees (soil mapping unit No 2 & 5, uncultivated/forested part). The soil loss that occurs mainly through rill and gully erosion during the rainy periods, especially in summer, is estimated to be of moderate degree.

Soil erosion mapping unit 4: Land with mod. sheet & rill erosion & severe gully erosion

This mapping unit covers 517 ha (35.8%) of moderately sloping to steep, terraced land that is currently used for rainfed farming. It consists of moderately deep, gravely/cherty loamy soils (soil mapping unit No. 2, 4 & 5, cultivated parts). The soil loss, occurring mostly with summer rains and in parts not provided with a crop cover is mainly in the form of sheet and rill erosion within the parcels and any gully forms out of the parcels. It was estimated to be of moderate to sever degree.

Soil erosion-mapping unit 5: Land with severe sheet, rill & gully erosion and land sliding

This unit represents about 104 ha (7.2%) of steep to very steep land which has mainly been terraced for rainfed farming. It has shallow to very shallow, gravely loamy soils with moderate to low organic matter content (soil

mapping unit No. 6, cultivated parts). Due to steep slopes, low water holding capacity and relatively slow permeability of cover provided during rainy season. Very steep slopes are subject to land sliding during the spells of high rainfall.

Soil erosion mapping unit 6: Land with very severe rill and gully erosion and land sliding

This unit occupies 111 ha (7.7%) of very steep to steeply dissected mountain slopes that are mainly under shrubs and grasses with moderate to density and a few scattered low trees/bushes. It has shallow to very shallow, cherty loamy soils having a relatively low organic matter content (soil mapping unit No. 3 & 6, uncultivated parts). Due to very steep slope and low water holding capacity of the related soils, the soil loss is estimated to be colossal; in fact, most of the soil cover has already been lost and the underlying rocks have got exposed.

Recommendations

The following recommendation can be made from the present study.

- Improvement of the irrigation structure by regularizing water supplies through the controlled channels in the irrigated land.
- Citing tillage across the contour on sloping terraces for proper control of irrigation water and over flow just after rain showers.
- Planting of suitable forest/orchard trees and shrubs/bushes along field embankments to protect soil from erosion.
- Protection of streams from erosion/cutting by lining with stones, planting with trees and controlling/diverting the water, where required.
- Proper institutional arrangements to protect the existing forest trees from their illegal/ pre-mature cutting of young trees, burning and browsing of young shoots by animals.
- Discourage shifting cultivation (clearing land for cultivation).
- Plugging of gully heads and gully formation by regulating the water runoff through properly designed grass waterways.
- Fencing of gullies, bare rocks and landslides to reduce their further erosion and allow vegetation regeneration.

- Reseeding of relatively bare parts with suitable species of shrub, grasses and trees in order to provide forage and protection against erosion.
- The sites of slight to moderate erosion risk must have at least their present levels of management, otherwise there is risk of the land becoming un-vegetated.
- Sites with steep slopes and shallow soil depth should be conserved with agronomic or biological measures.

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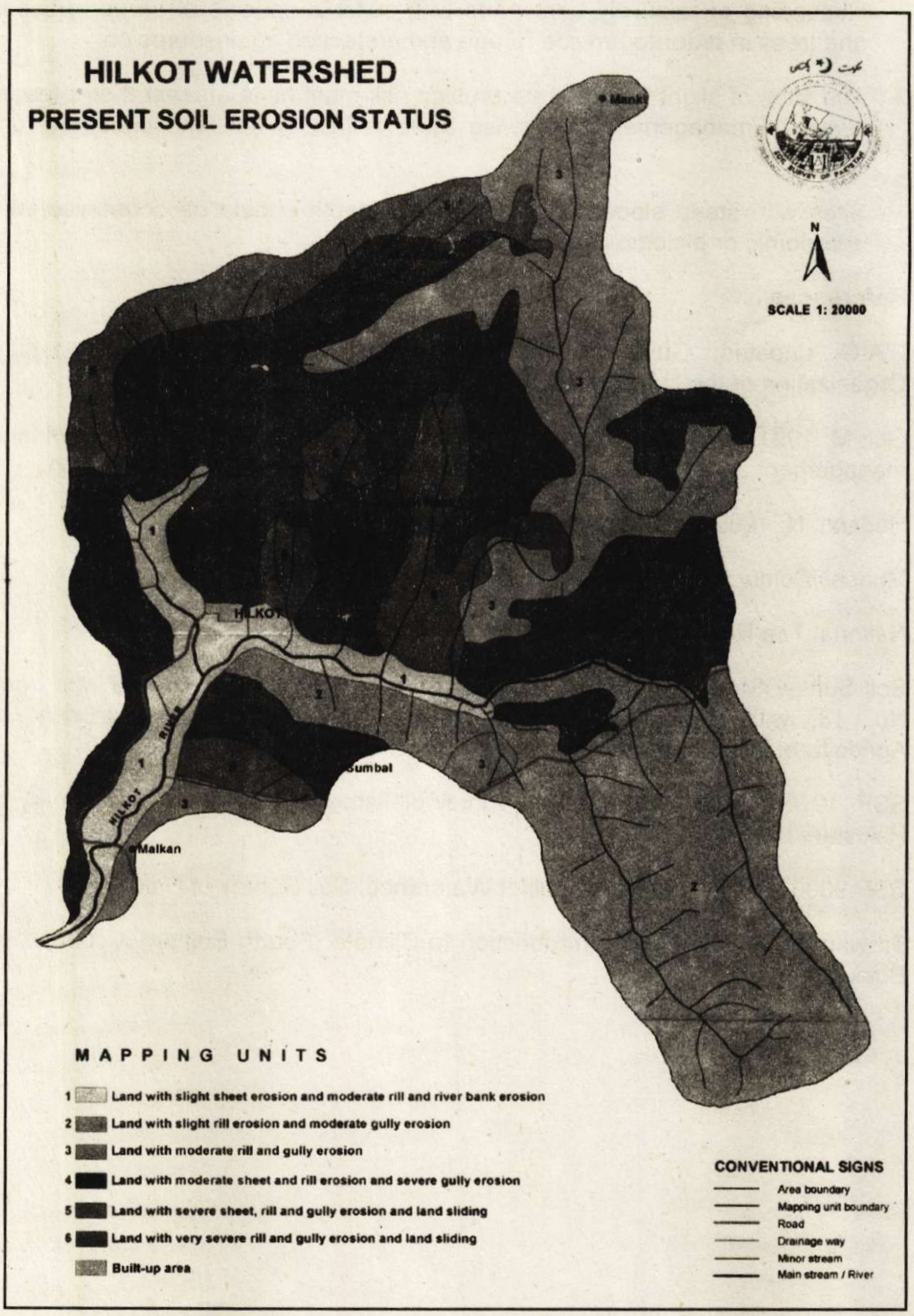
HILKOT WATERSHED
PRESENT SOIL EROSION STATUS
N
SCALE 1: 20000
Mankiali
HILKOT
Sumbal
Malkan
MAPPING UNITS
1 Land with slight sheet erosion and moderate rill and river bank erosion
2 Land with slight rill erosion and moderate gully erosion
3 Land with moderate rill and gully erosion
4 Land with moderate sheet and rill erosion and severe gully erosion
5 Land with severe sheet, rill and gully erosion and land sliding
6 Land with very severe rill and gully erosion and land sliding
Built-up area
CONVENTIONAL SIGNS
Area boundary
Mapping unit boundary
Road
Drainage way
Minor stream
Main stream / River