भारतीय मानक **IS 6748 (Part 1) : 2024**

Indian Standard

मृदा संरक्षण से संबंधित जलसंभर प्रबंधन के लिए सिफारिशे

भाग 1 कृषि संबंधी पहलू

(पहला पुनरीक्षण)

Recommendations for Watershed Management Relating to Soil Conservation

Part 1 Agronomic Aspects

(First Revision)

ICS 93.160

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November 2024 **Price Group 9**

Water Resources Planning, Management and Evaluation Sectional Committee, WRD 06

FOREWORD

This Indian Standard (Part 1) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Water Resources Planning, Management and Evaluation Sectional Committee, had been approved by the Water Resources Division Council.

Sedimentation of reservoirs is a matter of vital concern for any project whether irrigation, hydro-electric power, flood control etc, since it adversely affects the life and functions of the reservoirs. For this, effective measures of soil conservation in the watershed are essential.

Soil conservation is an integrated approach of three disciplines namely, engineering, agronomy and forestry and involves a coordinated effort of these disciplines for a comprehensive and composite programme of development and management of watersheds.

The roles of these three disciplines are outlined below:

a) Engineering — Bank protection and roadside control measures, abutment, spurs check-dams, gully plugging, masonry or concrete water disposal system, etc. The engineering aspects of watershed management have been covered in IS 6518.

b) Agronomy — Retirement of severely eroded land to permanent protection of vegetation, pasture development, vegetative waterways, contour farming, strip cropping, crop rotation, etc.

c) Forestry — Like forest conservancy, management and protection, and forest plantation, etc.

In the formulation of this standard due consideration has been given for relating this standard to the practices in the field in this country. This has been met by deriving assistance from the Soil Survey Manual, 1970 of the All India Soil and Land Use Survey Organization, IARI.

This standard was first published in 1973. The first revision of this standard has been brought out to update the standard with respect to the latest technological advancements and the best practices being followed in the field. The major changes incorporated in this revision are:

a) Clause **3.2**, **3.3**, **3.4** have been added for quick erosion surveys or rapid reconnaissance surveys of soil requiring soil conservation measures;
b) The title of **3.4.1** has been modified;
c) Clause **3.4.2**, **3.4.3**, **3.4.4** have been added to classify soil/land based on the characteristics and qualities of various mapping units. Clause **4.1.1** has been modified and a table has been inserted for recommending crops for soil conservation;
d) Annex A has been added for symbols used in soil and land use mapping during detailed soil survey; and
e) Annex B has been added for the classification of land based on cultivation practices.

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 ‘Rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded-off value should be the same as that of the specified value in this standard.

Indian Standard

RECOMMENDATIONS FOR WATERSHED MANAGEMENT RELATING TO SOIL CONSERVATION

PART 1 AGRONOMIC ASPECTS

(First Revision)

1 SCOPE

This standard (Part 1) covers the recommendations on the agronomical aspects for soil conservation in the catchment area and the appropriate method(s) to be adopted.

2 REFERENCES

The standards given below contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards:

IS No.	*Title*
IS 5510 : 1969	Guide for soil surveys for river valley projects
IS 6518 : 2017	Guidelines for control of sediment in reservoirs (*second revision*)

3 IDENTIFICATION OF AREAS REQUIRING SOIL CONSERVATION MEASURES ON PRIORITY BASIS

3.1 To achieve the maximum benefit of soil conservation and covering as many critical areas as feasible in the minimum possible time, one should know the pockets of sediment-contributing areas and the amount of sediment contributed by them and then have a comprehensive plan to tackle these areas in the order of priorities taking sub-watershed as a unit of management.

3.2 A quick erosion survey or rapid reconnaissance survey should be carried out by soil survey parties on a watershed basis using the micro-watershed layer of the Digital Micro-Watershed Atlas of India (2019) (source SLUSI) through remote sensing and GIS techniques. This survey aims to determine the pattern of present land use and the degree of erosion in order to establish priorities for soil conservation measures. Digital Micro-Watershed Atlas of India recognizes each micro-watershed with a distinct spatial extent and unique national code. It will guide the planners in designing location-specific development plans under various agricultural and rural development programs. This will also help in the prevention of overlapping of planning and duplication in the implementation of developmental activities by various agencies.

3.3 Based on the findings of the quick erosion survey or rapid reconnaissance survey report, the areas falling under the very high and high priority categories of micro-watersheds should be selected for a detailed soil survey at the micro-level planning using remote sensing and GIS techniques at a 1 : 10 000 scale. This will facilitate the generation of a village-wise plan for soil conservation measures. The standard symbols for soil and land use mapping are placed in Annex A.

3.4 The detailed soil survey provides a complete diagnosis of soils that can be interpreted for various purposes. The soil survey database/information is utilized for the appropriate grouping of soils/lands based on preset criteria/norms. The evaluation of soil/lands on the basis of characteristics and qualities of various mapping units followed in the interpretative groupings of soils/lands are:

a) Land capability classification;

b) Soil irrigability classification;

c) Land irrigability classification;

d) Hydrological groups of soils; and

e) Suggested conservation measures/ agronomic practices.

3.4.1 *Land Capability Classification*

3.4.1.1 Land is classified into the following types:

a) Suitable for cultivation; and

b) Unsuitable for cultivation.

3.4.1.2 These are further subdivided and the details are given in Annex B, based on IS 5510 with additions in Classes VI and VII.

3.4.2 *Soil Irrigability Classification*

It deals with the evaluation of soils for their suitability for irrigation on the basis of quantitative limits of soil characteristics pertinent to irrigation. Classification of soil on the basis of their suitability for irrigation is given in Table 1. The main characteristics of these irrigability classes are: effective depth, texture, structure, consistence, infiltration, permeability, available water holding capacity, presence of coarse fragments, rock-out crops, bulk density, salinity, alkalinity, clay mineralogy, drainage, erosion, etc. The criteria for classification of soils into various irrigable soil classes based on soil properties are provided in Table 2.

3.4.3 *Land Irrigability Classification*

The suitability of lands for irrigation depends on physical and socio-economic factors, in addition to the soil irrigability classes. It also depends on the drainability of the land, the quality and quantity of water, and the cost of land development. Classification of lands on the basis of their suitability to irrigation is given in Table 3. The criteria for classification of lands into various irrigable lands classes based on their characteristics are provided in Table 4.

3.4.4 *Hydrological Soil Groupings*

3.4.4.1 Hydrological grouping of soils involves estimating their runoff potential, which is useful for conducting hydrological studies in watershed management programs. Various soil properties that influence runoff, such as effective depth, texture, clay content in the surface layer, average clay percentage in the profile depth, drainage, infiltration, and permeability, are considered when determining the hydrological soil groupings. Based on soil properties, four hydrological groups have been defined as given in Table 5.

3.4.4.2 The runoff potential of the soil, in combination with terrain features and land use patterns, not only indicates the erosion hazard and sediment yield from the sub-watershed but also provides information about the peak rate and coefficient of runoff perception, which helps assess the flood pattern. Soil infiltration, which is the most crucial hydrological property, determines not only the potential for runoff generation in a sub-watershed but also serves as a valuable input for designing efficient water harvesting structures.

3.4.4.3 The criteria for classifying soils in hydrological soil groups on their characteristics are provided in Table 6.

4 AGRONOMIC PRACTICES

4.1 The agronomic practices in respect of soil conservation are the following and they are described in detail in **4.1.1** to **4.1.11**:

a) Retirement of severely eroded cultivated land for permanent protection by vegetation;
b) Planting severely erodible areas with feed and cover plants for rehabilitation of wild life;
c) Pasture development and their protection;
d) Construction of small water storages;
e) Vegetated waterways;
f) Contour farming by bunding and terracing;
g) Strip-cropping;
h) Modified strip cropping;
j) Stubble mulch farming;
k) Seasonal cover crops; and
m) Crop rotation.

NOTE — All these aspects are to be simultaneously taken note of for minimizing the erosion and appropriate method(s) should be adopted.

Table 1 Classification of Soil on Irrigability

(*Clause* 3.4.2)

Sl No.	Soil Irritability Class	Limitation Criteria for Sustained Use Under Irrigation
(1)	(2)	(3)
i)	Class A	None to slight soil limitations for sustained use under irrigation
ii)	Class B	Moderate soil limitations for sustained use under irrigation
iii)	Class C	Severe soil limitations for sustained use under irrigation
iv)	Class D	Very severe soil limitations for sustained use under irrigation
v)	Class E	Not suitable for irrigation

Table 2 Criteria for Soils Irrigability Classes

(*Clause* 3.4.2)

Sl No.	Soil Properties	Irrigable Soil Classes				Non Irrigable Soil Classes
		A	B	C	D	E
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Effective soil depth (cm)	> 100	50 to 100	25 to 50	10 to 25	< 10
ii)	Surface texture (upto 30 cm)	Sandy loam to clay loam	Loamy sand, clay	Sand, clay	Sand, clay	Any texture
iii)	Soil permeability* (mm/h) (of least permeable layer)	5.0 to 50	1.3 to 5.0 50 to 130	0.3 to 1.3 130 to 250	< 0.3 > 250	Not applicable
iv)	Available water holding capacity to depth of 100 cm	> 12 cm	9 cm to 12 cm	6 cm to 9 cm	2 cm to 6 cm	< 2 cm
v)	Coarse fragments (percent) cobbles and stones (> 75 mm)	< 5	5 to 15	15 to 35	35 to 65	> 65
vi)	Gravel and Kankar (> 25 mm to 75 mm)	<15	15 to 35	35 to 55	55 to 70	>70
vii)	Rock out-crops (distance apart in meters)	40	20	15	5	< 5
viii)	Salinity (in 1 : 2 dilution) (mmhos/cm)	< 1	1 to 1.5	1.5-2.5	2.5-3	> 3
ix)	Salt affected (percent of area affected)	< 20 percent	< 20 percent	20 percent to 50 percent	20 percent to 50 percent	> 50 percent
x)	Severity of alkali problem	ESP < 15 percent	ESP < 15 percent	ESP > 15 percent	ESP >15 percent	—
xi)	Sub-soil or substrata drainage characteristics	Lower subsoil is at least moderately permeable or a permeable layer of at least 6 inch thickness occurs immediately below the soil but within 10 feet (sand, gravel)		No moderately permeable subsoil or other permeable layer of at least 6 inch thickness occurs within depth of 10 feet		—
xii)	Soil erosion status	Effects of sheets and rill erosion are reflected in effective soil depth, available moisture holding capacity and in some other factors shown above. Moderately or severely gullied soils may be classified based on local experience				—

NOTE — Soil permeability as a criterion is not applicable to very deep black soils due to their unique properties. Very deep and deep black soils (vertisols), which are inherently slowly permeable due to the presence of expanding 2 : 1 lattice-type clay minerals, do not qualify for the irrigability soil class A. Instead, they would be classified under classes C, D, and E.

Table 3 Classification of Land on Irrigability

(*Clause* 3.4.3)

Sl No.	Land Irritability Class	Limitation Criteria for Sustained Use Under Irrigation
(1)	(2)	(3)
i)	Class 1	Lands that have few limitations for sustained use under irrigation
ii)	Class 2	Lands that have moderate limitations for sustained use under irrigation
iii)	Class 3	Lands that have severe limitations for sustained use under irrigation
iv)	Class 4	Lands that have marginal for sustained use under irrigation because of very severe limitations
v)	Class 5	Lands that are temporarily classed as not suitable for sustained use under irrigation and pending for further investigation.
vi)	Class 6	Lands not suitable for sustained use under irrigation.

Table 4 Specification for Land Irritability Classes

(*Clause* 3.4.3)

Sl No.	Land Characteristics	Irrigable Land Class				Temporarily Non-irrigable (Unclassified)	Non-Irrigable Land Class
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		SOILS					
i)	Soil irritability class	A	A to B	A to C	A to D		
		TOPOGRAPHY					
ii)	Slope	< 1 %	1 % to 3 %	3 % to 5 %	5 % to 10 %	Further investigation needed	Includes lands which do not meet the requirements for which other land classes are not suitable for irrigation or small isolate tracts (specifying size of distance from the canal) not susceptible to delivery of irrigation water
iii)	Surface grading	(No restriction)	(Moderate restriction)	(Moderately severe restriction)	(Severe restriction)		
		DRAINAGE					
iv)	Outlet	Suitable outlet available	Suitable outlet available	Suitable outlet available	No drainage outlet available		
v)	Surface drainage	Specifications to be developed for each project area					
vi)	Subsurface drainage	No Subsurface drainage needed	No Subsurface drainage needed	No Subsurface drainage needed	No natural drainage needed		
vii)	Depth of water table	> 5 m	3 m to 5 m	1.5 m to 3 m	1.5 m and below		

Table 5 Hydrological Grouping of Soils

(*Clause* 3.4.4)

Sl No.	Hydrological Soil Groupings	Runoff Potential	Characteristic
(1)	(2)	(3)	(4)
i)	Group A	Low run off potential	Soils which have high infiltration rates, even when thoroughly wetted, consist mainly of deep, well-drained to excessively drained sand gravels. These soils exhibit very rapid to rapid rates of water transmission.
ii)	Group B	Moderately low run off potential	Soils which have medium infiltration rates when thoroughly wetted consist mainly of medium to deep, moderately well-drained to well-drained soils with moderately coarse textures. These soils exhibit rapid to moderate rates of water transmission.
iii)	Group C	Moderately high run off potential	Soils which have low infiltration rates when thoroughly wetted consist mainly of moderately deep to deep, moderately well-drained to well-drained soils with moderately fine to moderately coarse textures. These soils exhibit moderate rates of water transmission.
iv)	Group D	High run off potential	Soils which have very low infiltration rates when thoroughly wetted consist mainly of clay soils with a high swelling potential, soils with a permanently high-water table, soils with a clay pan or clay layer at or near the surface, and shallow soils lying over nearly impervious materials. These soils are poorly drained and exhibit slow rates of water transmission.

Table 6 Criteria for Classifying Soils in Hydrological Soil Group

(*Clause* 3.4.4)

Sl No.	Hydrological Soil Group and Their Runoff Potential	Effective Soil Depth cm	Soil Texture Average Clay Contents (%)	Soil Structure	Basic Infiltration Rate cm/h	Soil Permeability cm/h
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Group A Low runoff potential	100 or more	Sand, loamy sand (0 percent to 8 percent)	Single grain	5 and above	Rapid to very rapid (13 and above)
ii)	Group B Moderately low runoff potential	51 to 100	Sandy loam, silty loam, loam (9 percent to 25 percent)	Granular or crumb	3.1 to 5	Moderate to moderately rapid (2 to 13)
iii)	Group C Moderately high runoff potential	26 to 50	Silty, sandy clay loam, silty clay loam (26 percent to 40 percent)	Sub-angular columnar	1.6 to 3	Moderately slow (0.5 to 2)
iv)	Group D High runoff potential	< 26 cm	Sandy clay, silty clay, clay (41 percent and above)	Angular blocky prismatic, platy, massive	< 1.6	Slow to very slow (less than 0.5)

4.1.1 *Retirement of Severely Eroded Cultivated Land for Permanent Protection by Vegetation*

Gullies tend to form wherever runoff is concentrated in unprotected depression channel ways. Once started, they increase in size and, unless checked, ultimately develop into deep, spreading chasms which ruin the land. The best method of treatment for severely eroded cultivated land is to provide permanent vegetal cover. Crops proposed to stop/minimize soil erosion, soil conservation, and soil stabilization are provided, based on soil depth, are provided in Table 7.

Table 7 Crop Proposed to Stop/Minimize Soil Erosion/Soil Conservation/Soil Stabilization

(*Clause* 4.1.1)

Sl No.	Descriptions	Depth cm	Depth Class	Crops	Effect
(1)	(2)	(3)	(4)	(5)	(6)
i)	Very shallow	0 to 10	d1	Switchgrass, rough grass, turf, vetiver grass	It is shallow-rooted grass. Effective for erosion control with a dense root network. Deep root system ideal for soil stabilization. Tolerant to shallow soil conditions.
ii)	Shallow	10 to 25	d2	Vetiver grass, buffalo grass, clover, cactus, bushes	Deep root system ideal for soil stabilization. Tolerant to shallow soil conditions. Forms a dense mat to protect shallow soils from erosion.White clover (*Trifolium repens*) provides ground cover and fixes nitrogen.
iii)	Moderately deep	25 to 50	d3	Lucerne (alfalfa), lupins, cactus	Medicago sativa's deep roots provide good soil structure and prevent erosion. Blue lupin (*Lupinus angustifolius*): Deep-rooted and helps in soil stabilization.
iv)	Deep	50 to 100	d4	Fescue, broom grass, siberian peashrub, bamboo, babul, agro-forestry crops.	Tall fescue (*Festuca arundinacea*): Deep-rooted grass ideal for soil conservation. *Thysanolaena maxima*: Effective in preventing erosion on moderate slopes. *Caragana arborescens*: A hardy, deep-rooted shrub that aids in soil stabilization.
v)	Very deep	> 100	d5	Acacia, eucalyptus, leucaena, napier grass, creeping juniper, bamboo, neem, karanja, ber, teak, sisam, agro-forestry crops	*Acacia mangium*: Deep-rooted and helps bind soil particles together. *Eucalyptus globulus*: Fast-growing and helps in soil stabilization. *Leucaena leucocephala*: Fixes nitrogen and has deep roots that stabilize soil. *Juniperus horizontalis*: A groundcover plant that helps prevent soil erosion. Pennisetum purpureum: Deep-rooted and ideal for erosion control.

4.1.2 *Planting Severely Erodible Areas with Feed and Cover Plants for Rehabilitation of Wild Life*

In severely erodible areas wildlife plantings offer the best solution to the erosion problem. This is because the plant species adapted to wildlife succeed under the ecological conditions imposed by such sites and also because the areas are too small or too inconveniently located for the profitable production of economical plants even if they thrive under such conditions. The plantings may be trees, shrubs, vines, or grasses. The ideal condition to be realized is adequate food and cover at all times.

4.1.3 *Pasture Development and Their Protection*

One of the chief causes of soil deterioration on grazing land is the loss of plant cover due to overgrazing and poor management practices that expose the ground to wind and rain. Properly prepared and managed pastures produce several times more than ill-managed grazing ground. It has been found that an abundance of high-quality forage is the very foundation of any type of livestock farming. Three aspects essential in pasture development are:

a) Addition of lime and fertilizers according to soil test;

b) Use of proper seed rates and mixtures; and

c) Controlled grazing.

4.1.4 *Construction of Small Water Storages*

Small dams for use in farm and grazing lands are usually not expensive, yet they add considerably to the value of dry land farm or grazing lands. Besides supplying water and some recreation facilities, they play an important part in controlling floods. The size and cost of such dams are largely governed by the terrain.

4.1.5 *Vegetated Waterways*

These are waterways protected by vegetation to prevent conversion into gullies. Natural drainage depressions, seeded with an adaptable grass-legume mixture, often may be utilized as satisfactory water channels and meadows at the same time. The vegetated waterways should not be less than 6 m wide. Seeding should not only cover the channel but extend well back on the shoulders.

4.1.6 *Contour Farming by Bunding and Terracing*

Contour farming is preparing, planting, or drilling and cultivating of crops along and parallel to level lines that have been laid out across the field slope. When farming contour strip-cropped fields, terraced fields, fields with diversions, and contour orchards, cultivation should be parallel to guidelines.

4.1.6.1 Contour cultivation is effective in controlling erosion by surface flow. When carried out properly, it is one of the most effective mechanical control measures for cultivated cropland. It is effective in increasing crop yields, reducing runoff and scour-erosion losses. When contour farming is used alone, new guidelines should be established each time the crop is planted, unless erosion is made to maintain original lines by contour hedges, back furrows or other means.

4.1.6.2 Contour bunding consists of the construction of small bunds across the slope of the land along contours so that the long stretch of slope is cut into a series of small ones and each contour bund acts as a barrier to the flow of water. This practice is generally followed in gently sloping lands.

4.1.6.3 Terraces may be of bench type or graded channel type which is designed to intercept and divert runoff at non-erosive velocities. This practice is generally followed on hill slopes.

4.1.7 *Strip-cropping*

Strip-cropping is the practice of growing crops in a systematic arrangement, of strips or bands which serve as vegetative barriers to erosion. It includes the utilization of crop rotation, contour cultivation, proper tillage, cover crops, and other related practices. The arrangement of crops in strips should be such that erosion and semi-erosion resistant crops are alternated with clean cultivated crops that are conducive to erosion.

4.1.7.1 In choosing any system of strip-cropping the following guiding principles should be kept in mind:

a) Strip-cropping should be made to fit into the farm management;

b) Strip should be laid out as nearly on the contour as possible; and

c) Consideration should be given to the degree of erosion, the percentage of slope, the length of the rotation, and the ratio of erosion-resisting and erosion-permitting crops.

4.1.8 *Modified Strip Cropping*

Field stripping is a modified form of contour strip cropping under which strips are laid parallel and across the general slope but not exactly on the contour. This system is best suited to land of uniform slopes and to gentle slopes with minor surface irregularities that make accurate strip-cropping impracticable. Field stripping is very

beneficial for checking wind and water erosion. If strips deviate from the contour for only short distance, not more than 30 m, and little damage may result especially on soil of high credibility. However, if the deviation is more than 3 percent, and the distance of such deviation greater than 30 m, field stripping should give way to contour stripping.

4.1.9 *Stubble Mulch Farming*

Leaving stubble on the surface in sufficient quantity is one of the surest ways to prevent wind erosion, conserve moisture, and add organic matter to the soil. Subtitled stubble mulch gives high yields.

4.1.10 *Seasonal Cover Crops*

Seasonal cover crops are very important in protecting fields from erosion. They also serve to absorb plant nutrients that otherwise would be lost by leaching and thus aid in their preservation for subsequent crop use. Green manure crops are included under cover crops. Other examples of cover crops are catch crops of various kinds, which leave the soil exposed to erosion for a minimum period during the year and protect the soil when the regular cultivated crops are off the ground.

4.1.11 *Crop Rotation*

Crop rotation reduces runoff and soil loss, both of which are important in maintaining yields. Crop rotation refers to the growing of different crops in regular succession on the same land. For erosion control, a rotation should embody the principle of alternating cultivated crops with erosion-resistant and organic matter building crop. Methods of increasing the erosion control value of a rotation are:

a) Increasing the number of years of hay and pasture;

b) Improving the seed mixture to include legumes;

c) Adequate fertilization; and

d) Addition of cover crops to provide continuous covers on the field.

NOTE — The capability of the land limits the kind of rotation to be recommended on any field.

5 GENERAL TYPES OF CONSERVATION PRACTICES AND USES RECOMMENDED ON THE BASIS OF LAND CLASSIFICATION

The recommended type of conservation practice for several of land on the basis of cultivation is given briefly in Annex C.

ANNEX A

(*Foreword* and *Clause* 3.3)

SYMBOLS FOR SOIL AND LAND USE MAPPING UNDER DETAILED SOIL SURVEY

C-1 SOIL DEPTH

Sl No. (1)	*Description* (2)	*Depth* (cm) (3)	*Depth Class* (4)
i)	Very shallow	0 to 10	d1
ii)	Shallow	10 to 25	d2
iii)	Moderately deep	25 to 50	d3
iv)	Deep	50 to 100	d4
v)	Very deep	> 100	d5

C-2 SOIL TEXTURE

Sl No. (1)	*Textural Classes* (2)	*Symbol* (3)
i)	Sand	a
ii)	Very fine sand	b
iii)	Loamy sand	c
iv)	Sandy loam	d
v)	Loam	e
vi)	Silt loam	f
vii)	Silt	g
viii)	Clay loam	h
ix)	Sandy clay loam	k
x)	Silty clay loam	m
xi)	Sandy clay	n
xii)	Silty clay	p
xiii)	Clay	r

C-3 SLOPE

Sl No. (1)	*Slope Classes* (2)	*Symbol* (3)	*Slope* (percent) (4)
i)	Nearly level	A	0 to 1
ii)	Very gently sloping	B	1 to 3
iii)	Gently sloping	C	3 to 5
iv)	Moderately sloping	D	5 to 10
v)	Strongly sloping	E	10 to 15
vi)	Moderately steep sloping	F	15 to 25
vii)	Steep slopes	G	25 to 33
viii)	Very steep slopes	H	33 to 50
ix)	Extremely steep slopes	I	> 50

C-4 Erosion

Sl No. (1)	*Description* (2)	*Symbol* (3)
i)	Slight erosion	e1
ii)	Moderate erosion	e2
iii)	Severe erosion	e3
iv)	Very severe erosion	e4

C-5 Stoniness

Sl No. (1)	*Description* (2)	*Symbol* (3)	*Percentage* (4)
i)	Slight	S	15 percent to 30 percent of average percent of stoniness coverage of area
ii)	Moderate	$\overline{S}$	31 percent to 60 percent of average percent of stoniness coverage of area
iii)	Severe	$\underline{S}$	above 60 percent of average percent of stoniness coverage of area

C-6 Rockiness

Sl No. (1)	*Description* (2)	*Symbol* (3)	*Percentage* (4)
i)	Slight	R	15 percent to 30 percent of average percent of rockiness coverage of area
ii)	Moderate	$\overline{R}$	31 percent to 60 percent of average percent of rockiness coverage of area
iii)	Severe	$\underline{R}$	above 60 percent of average percent of rockiness coverage of area

C-7 Soil Management

Sl No. (1)	*Description* (2)	*Symbol* (3)
i)	Unmanaged	M0
ii)	Poorly managed	M1
iii)	Moderately managed	M2
iv)	Well managed	M3
v)	Very well managed	M4

C-8 Land Use/Land Cover

Sl No.	*Major Land Use*	*Description*	*Symbol*
(1)	(2)	(3)	(4)
i)	Agriculture lands	Single crop cultivation (RF/single-crop)	C1
ii)	Agriculture lands	multiple crop cultivation (IR/multi-crop)	C2
iii)	Agriculture lands	Occasional cultivation /home estate farming	Cx
iv)	Waste land	Culturable wasteland	W1
v)	Waste land	Unculturable wasteland	W2
vi)	Forest land	Poor forest (< 10 percent canopy cover)	F1
vii)	Forest land	Medium forest (10 percent to 20 percent canopy cover)	F2
viii)	Forest land	Medium forest (20 percent to 40 percent canopy cover)	F3
ix)	Forest land	Dense forest (40 percent to 60 percent canopy cover)	F4
x)	Forest land	Very dense forest (> 60 percent canopy cover)	F5
xi)		Pasture land	P1
xii)		Bunded land	B
xiii)		Unbunded land	UB

ANNEX B

(*Foreword* and *Clause* 3.4.1.2)

CLASSIFICATION OF LAND ON THE BASIS OF CULTIVATION

A-1 LAND SUITABLE FOR CULTIVATION

A-1.0 Land is categorized under four different classes as given in **A-1.1** to **A-1.4**.

A-1.1 Class I Land

This is a very good land that may be cultivated safely with ordinary good farming methods. It is nearly level land (slope less than one percent) and has deep, productive easily worked soils, and is subject to only slight erosion. It is well-drained and is suited for intensive cropping. The land is suited for a wide variety of crops. For continued good production, this land requires the use of fertilizers, green manure crops, and crop rotation.

A-1.2 Class II Land

This is good land that may be cultivated with easily available practices. Some of the limitations of this class of land are gentle slope, moderate susceptibility to erosion, moderate depth, moderate overflow, and moderate wetness. Each of these limitations requires special methods for correction, such as contour bunding, strip cropping, contour tillage, crop rotations that include grasses or legumes, drainage, and the application of fertilizers and manures.

A-1.3 Class III Land

This class of land has restricted use for cultivation. The land is moderately good and may be used for cropping provided intensive management measures are taken. This kind of land is characterized by one or more of the following limitations:

a) Moderate steep slope;
b) High susceptibility to erosion;
c) Moderate overflow;
d) Slow sub-soil permeability;
e) Excessive wetness;
f) Shallow depth;
g) Hard pan or clay pan;
h) Sand or gravelly with low moisture capacity; and
j) Low inherent fertility.

A-1.4 Class IV Land

This class of land has very restricted use for cultivation and needs special care in handling and management. The variety of crops that may be grown is limited. Its cropping use is restricted by slope, erosion, unfavorable soil characteristics and adverse climate.

A-2 LAND UNSUITABLE FOR CULTIVATION

The land is categorized under four different classes as given in **A-2.1** to **A-2.4**.

A-2.1 Class V Land

This land is not suited for cultivation, but is suited for pasture and grassland. Cultivation may not be feasible because of one or more factors, such as wetness, stoniness, or some other limitations. The land is nearly level and not subject to more than slight wind or water erosion. It occurs in many swampy areas that may not be drained easily.

A-2.2 Class VI Land

This land is subject to moderate limitations under grazing or forestry use or orchards and plantation crops under suitable geographical and climatic conditions. It is too steep, subject to erosion, shallow, wet, or dry but with careful management may be made suitable either for grazing or forestry. Gullies in such areas should be controlled by diversion of water, and provision of contour furrows or ridges.

A-2.3 Class VII Land

This land is very steep, eroded, stony, rough, shallow, dry, or swampy and is recommended particularly in humid regions only for forestry and woodland and not pasture, but the grazing has to be very limited.

A-2.4 Class VIII Land

This land includes such areas as marshes, deserts, deep gullies rocky escarpments, and very steep, rough, stony, barren land. It is suited only for wildlife, recreation, or watershed protection uses.

ANNEX C

(*Clause* 5)

GENERAL TYPES OF CONSERVATION PRACTICES AND USES RECOMMENDED ON THE BASIS OF LAND CLASSIFICATION

C-1 LAND SUITABLE FOR CULTIVATION

Sl No.	*Class*	*Land Classification*	*Subclass*	*Dominant Kind of Land*	*Suitable for**	*Special Needs or Precautions*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	I	Very good cultivable land	Deep nearly level productive valley land		Intensive cultivation to all climatically adapted crops	No special difficulty in farming usual goad farming practices to maintain soil fertility and conserve water
ii)	II	Good cultivable land	IIe	Good soil on gentle slopes subject to water corrosion or wind erosion on sandy soils	Cultivation with precaution	Protection from erosion, use conservation irrigation methods
			IIw	Good soil, slightly wet or subject to overflow	Cultivation with management of excess water and selection of crops adapted to wet conditions	Drainage improvement or flood protection
			IIs	Soil with minor soil problems such as clay or sandy texture, moderate depth, or slight alkali	Cultivation with selection of crops adapted to soil limitations	Treatments to offset soil limitations and to conserve irrigation water
iii)	III	Moderately good cultivable land	IIIe	Good soil on moderate slopes subject to water erosion, or sandy soil subject to wind erosion	Cultivation with precautions against permanent land damage	Special attention to erosion control and conservation irrigation
			IIIw	Good soil, moderately	Cultivation with careful management of	Intensive drainage, improvement or

Sl No.	*Class*	*Land Classification*	*Subclass*	*Dominant Kind of Land*	*Suitable for**	*Special Needs or Precautions*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
				wet or subject to overflow	excess water and selection of crops adapted to wet conditions	protection from flooding
			IIIs	Good soil, moderately wet or subject to overflow	Cultivation with careful selection of crops adapted to soil limitations	Intensive treatment to offset or overcome soil limitations and conserve irrigation water
iv)	IV	Fairly good land suited for occasional or limited cultivation	IVe	Moderately steep land subject to serious water erosion, or sandy soils subject to wind erosion	Occasional cultivation in rotation with hay or pasture, or orchards protected by permanent cover crops	Intensive erosion control when in cultivation
			IVw	Bottom land that is very wet or subject to severe overflow	Cultivation to special summer corps, hazard of crop failure is always present	Intensive drainage, special attention to seeding and harvest dates, to minimized crops failure on overflows land
			IVw	Fairly good land with limitations due to shallowness, gravel, stone, or strong alkali	Occasional cultivation in rotation with hay or pasture	Very intensive treatment to overcome soil limitations, careful selection of crops
			IVc	Good soil with just enough rainfall or crops in favorable years	Cultivation during wet years, frequent crop failure, better in permanent vegetation	Conserve all rainfall, develop water for irrigation or convert to pasture or grazing use
	* Only the most intensive safe use is mentioned.					

C-2 LAND UNSUITABLE FOR CULTIVATION

Sl No.	*Class*	*Land Classification*	*Subclass*	*Dominant Kind of Land*	*Suitable for**	*Special Needs or Precautions*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	V	Very well suited for grazing, not arable	Vw	Good productive mountain meadows that are wet and have short growing season	Grazing and production of wild hay	Proper season of use and rate of stocking; protect from gullying
ii)	VI	Well suited for grazing or forestry, not arable	VIs	Steep land subject to erosion if cover is depleted	Grazing or forestry of both	Manage grazing and logging to maintain sufficient residue and litter on the soil for soil and moisture conservation, fire protection.
			VIw	Flat land, occasionally with saline salts, permanently wet or subject to overflow	Grazing	Manage grazing to prevent soil puling, and to favour desire forage plants
			VIs	Flat to gently sloping, shallow, stony, gravelly, or alkali land	Grazing or forestry or both	Good range and forestry management, fire protection
			VIc	Good or fairly good soil not enough moisture for cultivation	Grazing primarily, some forestry, could be cultivated if water were available	Good range and gores try management practices, fire protection
iii)	VII	Fairly well suited for grazing or forestry, not arable	VIIe	Very steep land subject to erosion if cover is depleted	Grazing or forestry or both	Carefully manage grazing and logging to maintain enough plant litter for soil and moisture conservation, fire protection
			VIIw	Flat, permanently wet or overflow land along stream, tidal marsh areas	Limited grazing	Range grazing to favor desirable plants
			VIIs	Very shallow, stony, or strong alkali land	Grazing or forestry or both	Good range and forestry management, fire protection

Sl No.	*Class*	*Land Classification*	*Subclass*	*Dominant Kind of Land*	*Suitable for**	*Special Needs or Precautions*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			VIIc	Fairly good soil, not enough moisture for cultivation	Grazing or forestry or both	Good range and forestry management, fire protection
iv)	VIII	Suited only for wild life, recreation and protection of water supplies	VIIIe	Highly erodible gullies, bad lands, and dunes	Watershed and wildlife	Maintain maximum cover for erosion control
			VIIIw	Tidal land, stream channels and swamps	Wildlife, recreation, and water spreading	Improve for wildlife and recreation
			VIIIs	Barren mountain tops, little or no soil mantle	Recreation and watershed	Improve for wildlife and recreation

NOTE — These symbols denote sub-clauses:
e — erosion and runoff
w — excess water
s — root-zone limitations
c — climatic limitation.

* Only the most intensive safe use is mentioned.

ANNEX D

(*Foreword*)

COMMITTEE COMPOSITION

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Bhakra Beas Management Board, Chandigarh	DIRECTOR DESIGN DY SECRETARY (PLANNING) (*Alternate*)
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This Indian Standard has been developed from Doc No.: WRD 06 (22645).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi