Annexure-I

Definitions of wastelands classes adopted in the Project

1) Gullied and/or Ravinous Land

Gully is a narrow channel when surface water flow increases in response to clearing and excessive use of land. Other factors that play a role in gully initiation are the type of landscape, geology, rainfall, soil texture, hill-slope length and seasonal climatic extremes. The intricate network of gullies is referred to as ravines. Two categories of ravines viz., medium ravines and deep ravines could be delineated based on their depth.

Medium Ravines: These are the ravines with a depth of gullies ranging between 2.5 and 5 meters. Generally, these are seen confined to the head region of the stream close to agricultural land.

Deep Ravines: The depth of ravines is more than 5 meters. Deep ravines, generally, occur along the higher order stream areas that are close to the main river.

2) Scrubland

This is the land, which is generally prone to deterioration due to erosion. Such lands generally occupy topographically high locations, excluding hilly/mountainous terrain. Based on the presence of vegetation cover, two sub-classes could be delineated i.e., land with dense scrub and land with open scrub.

Land with dense scrub

These areas have shallow and skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and are subjected to excessive aridity with scrubs dominating the landscape. They have a tendency for intermixing with croplands.

Land with open scrub

This category is same as mentioned in the earlier category except that it has sparse vegetative cover or is devoid of scrub and has a thin soil covers.

3) Waterlogged / Marshy Land

Waterlogged land is that low lying land where the water is at/or near the surface and the water stands for most part of the year. Depending on duration of waterlogging, two sub-classes viz., permanently waterlogged and seasonally waterlogged areas could be delineated.

Permanent: Permanently waterlogged areas are those where the waterlogging conditions prevail during most part of the year. These areas are mostly located in low-lying areas, with impervious substratum along the canals/ river banks, coastal inlands, etc.

Seasonal: Seasonally waterlogged areas are those where the waterlogging condition prevails usually during the monsoon period. These lands are mostly located in plain areas associated with the drainage congestion. Use of multi-season satellite data enables delineation of this category.

4) Land affected by salinity/alkalinity

Land affected by salinity/alkalinity have excess soluble salts (saline) or high exchangeable sodium. Salinity is caused due to capillary movement of water, during extreme weather conditions leaving salt encrustation on the surface. Alkali soils have exchangeable sodium percentage (ESP) values of 15 or more, which is generally considered as the limit between normal and alkali soils. The predominant salts in alkali soils are carbonates and bicarbonates of sodium.

Considering the degree of salinity and or alkalinity, the following two sub- classes viz., moderately saline / alkali and strongly saline / alkali areas could be delineated.

Moderately Saline/Alkali land: These are the areas located in the fluvial plains with the degree of salinity (ECe) ranging from 8 to 30 (dS/m), pH between 9.0 – 9.8 and the Exchangeable Sodium Percentage (ESP) values ranging between 15 – 40.

Strongly Saline/Alkali land: These are the salt-affected lands with ECe values greater than 30 dS/m, pH values more than 9.8 and ESP values of >40.

5) Shifting Cultivation Areas

Shifting cultivation is a traditional practice of growing crops on forested/ vegetated hill-slope by the slash and burn method.

Current: The areas that are used for cultivation by the slash and burn practices and are clearly perceptible on the satellite image in pre-burnt /post-burnt conditions.

Abandoned: Are those areas that were earlier under shifting cultivation but subsequently left idle for more than one year but less than 5 years, thereby giving a scope for the regeneration of secondary vegetation such as bamboo or grasses. This category has a tendency to get mixed with forests.

6) Scrub Forest

Two sub-classes viz., scrub dominated degraded forest land and agriculture land inside notified forest area have been delineated

Scrub dominated: Land, as notified under the Forest Act and those lands with various types of forest cover with less than 20 % of vegetative cover, are classified as degraded forest. These lands are generally confined to the fringe areas of notified forest.

Agricultural land inside notified forest land: This category refers to land that have been notified under the Forest Act, in which agriculture is being practiced, (except for the de-notified forest areas)

7) Degraded pastures/grazing land

These are the lands in non-forest areas that are either under permanent pastures or meadows, which have degraded due to lack of proper soil and water conservation and drainage development measures.

8) Degraded land under plantation crop

These are the degraded lands that have been brought under plantation crops after reclamation, and are located outside the notified forest areas.

9) Sand (coastal / desert / riverine)

This category refers to land with accumulation of sand, in coastal, riverine or inland areas. Generally, these lands vary in size, occur in various shapes with contiguous to linear pattern. These lands are mostly found in deserts, riverbeds and along the shores.

10) Coastal sand

Coastal sands are the sands that are accumulated as a strip along the seacoast due to action of seawater. These are not being used for any purpose like recreation.

11) Desertic sand

Desertic sands are those confined to arid environment where the rainfall is scanty. These lands are characterized by accumulation of sand in the form of varying size of sand dunes and height that have developed as a result of transportation of soil through aeolian processes. The following two categories of desert sands could be mapped based on their vertical approximate heights.

Semi-stabilized to stabilized dunes with >40 m height Semi-stabilized to stabilized moderately high dunes with heights ranging between 15 and 40 m

12) Riverine sand

Riverine sands are those that are accumulated in the flood plain of the river as sheets, or sand bars. It also includes inland sand which was accumulated along the abandoned river courses or by reworking of sand deposits by wind action leading to long stretches of sand dunes or sand cover areas noticed in Indo-Gangetic alluvial plains

13) Mining /Industrial wastelands

Mine dumps: are those lands where waste debris is accumulated after extraction of minerals. Included in this category is the mine / quarry areas subject to removal of

different earth material (both surface and sub-surface) by manual and mechanized operations. Large scale quarrying and mechanical operations result in creation of mine dumps. It includes surface rocks and stone quarries, sand and gravel pits, soil excavation for brick kilns, etc

Industrial: These are areas of stockpile of storage dump of industrial raw material or slag/effluents or waste material or quarried/mixed debris from earth's surface.

14) Barren Rocky Area

These are rock exposures of varying lithology often barren and devoid of soil and vegetative cover. They occur amidst hill-forests as openings or as isolated exposures on plateau and plains. Barren rocky areas occur on steep isolated hillocks/hill slopes, crests, plateau and eroded plains associated with barren and exposed rocky/stony wastes, lateritic out-crops, mining and quarrying sites. The category also includes steep sloping areas devoid of vegetation cover that were classified separately in the earlier exercise.

15) Snow Covered and / or Glacial Area

These lands are under perpetual snow cover and are confined to the Himalayan region. The mountain peaks and slopes and high relief areas are the places where snow/glacial areas occurs

Annexure-II

NNRMS Standards – Parameter and Values for Thematic / GIS Database and Output for 1:50,000 Scale

A]	**Thematic / Cartographic Mapping Standards**	
	Image Registration accuracy (RMS) in meter	12
	Map Projection	LCC/TM
	Datum	WGS84
	Position (Planimetric) Accuracy in meter	50
	Minimum Mappable Unit (MMU) in sq. mts.	22500
	Thematic Accuracy of Classification / Mapping	90/90
B]	**GIS Database Standards**	
	Spatial Framework	Seamless
	Coordinate units for precision	meters
	Projection	LCC / TM
	Datum	WGS 84
	Coordinate Precision	Single
	Minimum frame size for NRR	15` x 15`
	GIS DB Tic Registration Accuracy (RMS) in meter	12.5
	Position (Planimetric) Accuracy in meter	50
	Sliver Polygon Tolerance (SPT) (LESS-THAN MMU) in m	<22500

Bibliography

1. Abrol, I. P. and Dhruva Narayana, V. V. (Technical Eds.) (1990): Technologies for Wasteland Development; Publication and Information Division, ICAR, New Delhi.
2. Aggarwal J. P. (1988) : Role of remote sensing techniques in site identification for afforestation programme in wasteland areas. Wasteland Development for fuel-wood and fodder production Ed. G. P. Maithana, Forest Research Institute, Dehradun. Pp 11–13.
3. Anderson, J. (1971) : Land use classification schemes used in selected recent geographic application of remote sensing. PE& RS, 37 : 379 – 387.
4. Aronoff, S. (1982) Classification accuracy: a user approach. Photogrammetric Engineering and Remote Sensing, 48, pp 299 – 1307.
5. Belward, Alan S. and Valenzuela, Carlos R. (Ed.) (1991) : Remote Sensing and Geographical Information Systems for Resource Management in Developing Countries ; Kluwer Academic Publishers, Dordrecht.
6. CAZRI (1998) : Inventory of geographical distribution of arid wastelands and testing of existing technologies in participatory mode. Jodhpur.
7. Congalton, R. G. (1991) : A review of assessing the accuracy of classifications of remotely sensed data. Remote Sensing of Environment, 37, pp. 35 – 46.
8. Edwards JR, T. C., Moisen, G. G. and Cutler, D. R. (1998) : Assessing map accuracy in a remotely sensed, eco-region-scale cover map. Remote Sensing of Environment, 63, pp. 73 – 83.
9. Forest Research Institute (1988) : Wasteland Development for Fuel-wood and Fodder Production. FRI Press, New Delhi.
10. Gadgil M., Guha R. (1995) : Ecology and Equity : The Use and Abuse of Nature in Contemporary India (Routledge, London).
11. Government of India Ministry of Environment and Forests (1990) : Developing India's Wastelands (Government of India, New Delhi).
12. Hooja B (1984) : Rajasthan 2000 A. D. and the challenges of land management. Resource Management in Drylands Eds. H.G. Mensching, R. C. Sharma. Rajesh Publications, New Delhi, pp 237 – 254.
13. ISRO (2005) : NNRMS Standards. A National standard for EO images, thematic, cartographic maps, GIS databases and spatial outputs. NNRMS, Department of Space, Bangalore.
14. Karale, R. L., Saini, K. M. & Narula, K. K. (1988) : Mapping and monitoring ravines using remotely sensed data, Journal Soil Water Conservation India 31 (1, 2), 76.
15. Lillesand T. M., Kiefer R. W. (1994) : Remote sensing and image interpretation. John Wiley, New York.
16. Muthana K. D. (1988) : Afforestation of arid zones wastelands for fuelwood and fodder production. Wasteland development for fuelwood and fodder production. Ed. G. P. Maithani, Forest Research Institute, Dehradun, pp 40 – 42.
17. NRSA (1987): Manual of procedure for wasteland mapping using remote sensing techniques.
18. NRSA (1989) : Manual of nationwide land use / land cover mapping using satellite imagery.
19. NRSA (1990) : IRS – Utilisation programme ; soil erosion mapping. Project report.
20. NRSA (1991) : Guidelines to use wasteland maps pp 1 – 72.
21. NRSA (1997) : Manual of procedure for preparation of wasteland digital data base using remote sensing & GIS techniques, pp 1 –90.

22. NRSA (2001) : Management of salt affected soils and rational land use at village level using remote sensing and GIS techniques in part of south coastal region of Andhra Pradesh. Project Report.
23. NRSA (2002) : Integrated Mission for Sustainable Development – Path to Progress.
24. NRSA and Ministry of Rural Development (2005) : Wastelands Atlas of India, 2005. NRSA, Dept. of Space, Govt. of India, Hyderabad.
25. NRSA (2006) : Manual of national land use/land cover mapping using multi-temporal satellite data.
26. NRSA (2007) : Manual of national wastelands monitoring using multi-temporal satellite data.
27. NRSC (2010) : Wastelands Atlas of India - 2010
28. NRSC (2011): Wastelands Atlas of India – Change Analysis Based on Temporal Satellite Data of 2005-06 and 2008-09 - 2011
29. NWDB (1991) : Description and classification of wastelands. National Wastelands development Board, Ministry of Environment & Forests, Government of India, New Delhi.
30. Punjab Remote Sensing Centre (2008) : Land use atlas of Punjab.
31. Ravi Shankar, G., Raghavaswamy, V. Gautam, N.C., (2003) : Land use management practices: Retrospect and prospects. Land use/ land cover management in India. B.S. Publications, Hyderabad, India.
32. Ravi Shankar, G., Raghavaswamy, V. Nagaraja, R., Gautam, N.C., (2003) : Remote sensing and GIS for land use/land cover data generation at national level: An Indian experience. Land use/ land cover management in India. B.S. Publications, Hyderabad, India.
33. Reeves, R.G., Anson, A and Landen, D. (1975) : Manual of remote sensing. Vol – II. American Society of Photogrammetry, Falls Church, Virginia, USA.
34. Sabins, F.F. (1997) : Remote Sensing principles and interpretation. W.H.Freeman&Co., New York.
35. Space Applications Centre (1997) : National (Natural) Resource Information System (NRIS) – Node Design and Standards. SAC document No. SAC/RSA/NRIS-SIS/SD-0197.