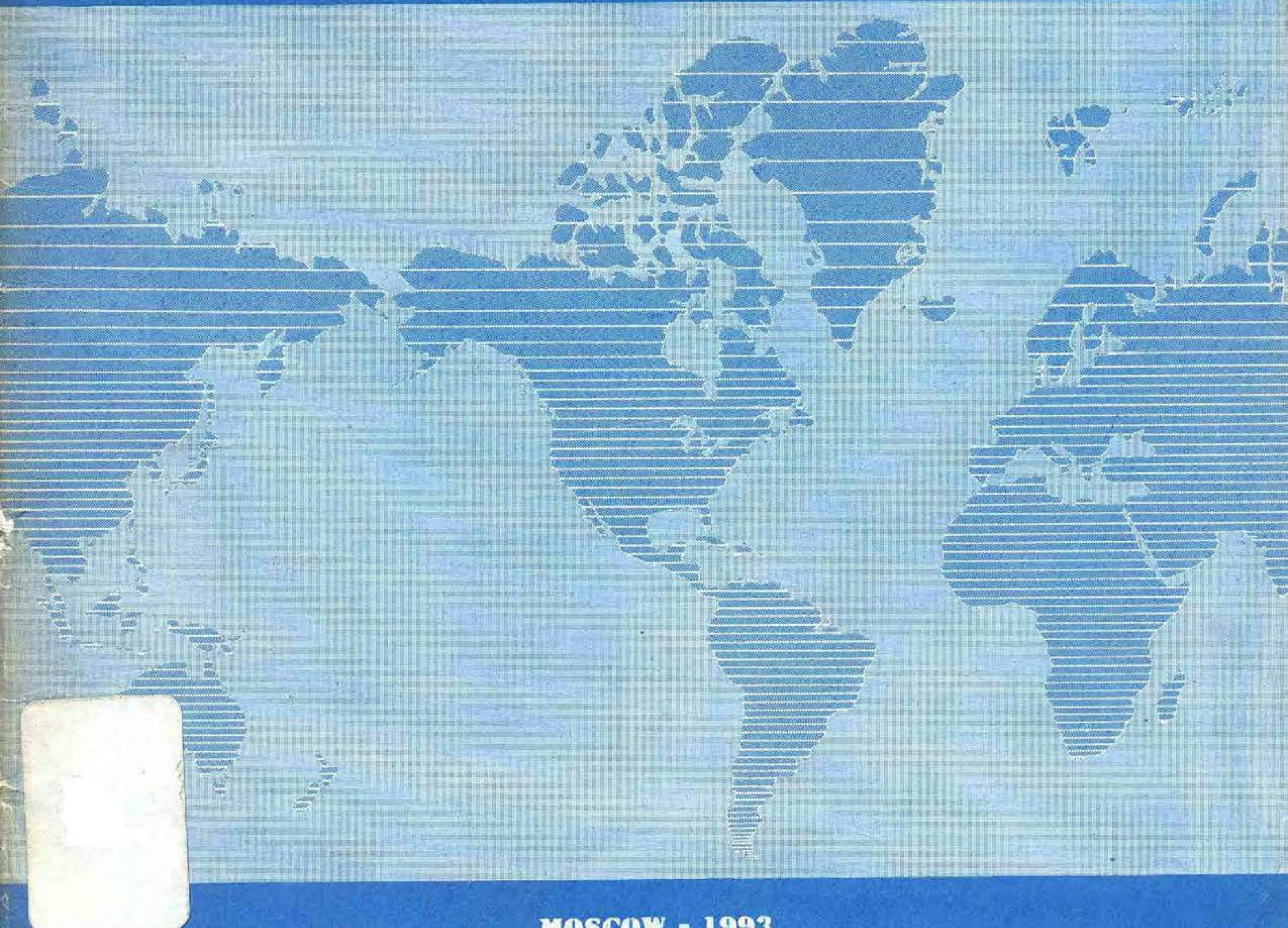
UNITED NATIONS
ENVIRONMENT PROGRAMME
(UNEP)

MOSCOW STATE UNIVERSITY
(MSU)

WORLD MAP OF PRESENT-DAY LANDSCAPES

AN EXPLANATORY NOTE



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AN EXPLANATORY NOTE

Edited by
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MOSCOW - 1993

CONTENTS

INTRODUCTION

In October 1990, the United Nations Environment Programme (UNEP) and the Centre for International Projects (CIP) of the USSR State Committee for Environmental Protection signed a Memorandum of Understanding implementing a project to assess and map the present status of the world's landscapes. Following this decision, and in accordance with the recommendations of the Third Technical Advisory Group Meeting on Desertification Assessment and Mapping (Nairobi, June 1991), Moscow State University was entrusted with the task of compiling a world map of present-day landscapes at the scale of 1:15,000,000, based on its recent experience in the preparation of the two maps *Geographical Belts and Zonal Types of Landscapes of the World* and *Land Use Types of the World* at the same scale.

The wall-chart *World Map of Present-Day Landscapes* is designed to raise awareness among policy-makers and decision-makers, as well as among students, scholars and the environmentally concerned public at large, on the scope and tendencies of human-induced landscape transformation at the global level. The publication of this wall-chart is closely linked to the appearance of the *World Atlas of Desertification* and is in accordance with other recent UNEP projects, such as the *Global Assessment of Soil Degradation*, the initiators of which stated that "politically it is important to have an assessment of good quality *now* instead of having an assessment of very good quality in 15 or 20 years." The map also displays the continuity of efforts by Moscow State University in the compilation of a thematic series of global wall-charts.

This explanatory note for the *World Map of Present-Day Landscapes* is intended to be a useful guide for scientific institutions and/or individual researchers compiling regional maps, databases and Geographical Information Systems (GIS) on the present status, use and trends of landscape development. The first section overviews general objectives of the global assessment and mapping of present-day landscapes, the practical value of the map and its possible applications.

In the second section, a closer look is taken at the base map characteristics and information sources used to compile the map. The third section of this report provides a detailed explanation of the principal terms and concepts employed in the map, and the fourth section explains how to read and understand the map and its legend. Quantitative area estimates from the map will be available upon completion of the follow-up Diskette GIS and Database Project currently being implemented by MSU in collaboration with the Institute of Geography of the Russian Academy of Sciences (*see Appendix III for the Project outline*).

The concept, design and preparation of the map result from a long-term environmental research project implemented at the Department of World Physical Geography and Geoecology, Faculty of Geography, Moscow State University, Moscow, 119899, Russia. The contributors to this project are listed below.

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1. OBJECTIVES OF A GLOBAL ASSESSMENT OF THE PRESENT STATUS OF LANDSCAPES

There is wide agreement that the future of planet Earth is at risk. Environmental problems, such as global desertification and deforestation, result from human activities that threaten the sustainability of global life-support systems. However, the information and understanding needed by decision-makers to address the situation is wholly inadequate. Appropriate priorities for action programmes can only be established with a realistic understanding of the geographical scope, trends and driving forces of global environmental change. Such understanding requires proper acquisition, dissemination and use of scientific knowledge on the nature and economics of different parts of the world land surface. Environmental scientists who provide this knowledge must be joined by policy-makers, resource managers, opinion-formers and the public at large to mobilise the intellectual and logistic resources needed to achieve the goal of sustainable global management.

Realistic understanding of global landscapes can only be achieved through an integrated approach to the terrestrial environment as an amalgamation of hierarchically subordinated geosystems - present-day landscapes.

Present-day landscapes (PDLs) are specific units of land surface characterised by a structurally organised combination of natural and economic components, whose close interaction gives birth to spatially distinct territorial systems in a dynamic equilibrium.

Any landscape unit of any dimension is a complex natural-anthropogenic territorial supersystem, where two subsystems - natural and anthropogenic - coexist and interact within the boundaries of their comparatively stable natural basis. The present-day characteristics of any landscape unit reflect the anthropogenic transformation of its natural state. The notion of *present-day landscapes* employed in the map corresponds to, and significantly deepens, the notion of *land** adopted at the UNEP *Ad-Hoc* Consultation Meeting *Assessment of Global Desertification: Status and Methodologies* (Nairobi, February 1990) as an object of desertification studies.

The *PDL* approach stresses that the natural foundation of any specific landscape should be regarded as an indispensable basis for the economic activities carried out on it. Optimal environmental management can only be achieved if economic structures and processes fit these dynamic natural structures. Ignoring this local compatibility principle proves to be the major cause of most local and regional ecological problems.

The *PDL* approach also emphasises the elaborate definition and comprehensive consideration of the whole global hierarchy of existing landscape organisation, an important consideration given the belief that sustainable use of the present-day geobiosphere can only be achieved by preserving the diverse mosaic of natural landscapes. Thus, the *World Map of Present-Day Landscapes* enables and encourages users to consider both interrelated principal levels of environmental management - global and local - thus contributing to the realisation of the well-known environmental motto: "act locally - think globally".

The major objective of this map was a rapid assessment of existing, though admittedly incomplete, scientifically credible global spatial information on the present status of landscapes.

Specific goals of the global mapping of present-day landscapes can be defined as:

① *to provide a quick reference and easily understandable presentation of the general geographical distribution of different stages of landscapes' evolution under human impact - from landscapes that are to all intents and purposes unaffected, or modal, to landscapes*

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* *Land* in this concept includes soil and local water resources, land surface and vegetation or crops that may be affected by one or a combination of processes acting on it.

affected to varying degrees by human action - as an aid to understanding how far the status and patterns of specific present-day landscapes are from their potential natural conditions;

② *to show the current trends in landscape evolution in each geographical zone or region (e.g., development of secondary savannahs and shrublands in place of tropical rain forests caused by clear-cutting, agriculturally-induced secondary steppe advancement in continental temperate forests, technogeneous tundra degradation in the extreme polar environment);*

③ *to help rapid identification of landscape areas with similar or analogous present status in order to locate as precisely as possible sample territories with a better or more advanced environmental management experience that can be applied in similar circumstances elsewhere:*

④ *to reveal the territorial extent of areas with the most heavily transformed landscapes that may need prompt rehabilitation actions.*

The wall-chart format of the *World Map of Present-Day Landscapes*, is designed to serve a variety of users. Its scale (1:15,000,000) enables it to be used for both cognitive and practical purposes (see *Fig.1*).

The map's cognitive value lies in the uniformity of the complex and diverse environmental data that are systematically "folded" within the notion of present-day landscapes. This organisation of environmental data can be further effectively exploited in developing more elaborate digitised spatial databases and/or GIS at different scales (both global and regional) and for a variety of geoecological studies. Such an approach has already been tested by Moscow State University in a detailed inventory and diagnosis of the present-day landscapes at two regional-scale (1:1,000,000) pilot areas in Asia and Africa - one in the Aral Sea region (Kazakhstan and Uzbekistan), the other in Tunisia (see *UNEP World Atlas of Desertification*, p 66-69).

The map has practical value in the domains of education, research, and decision-making.

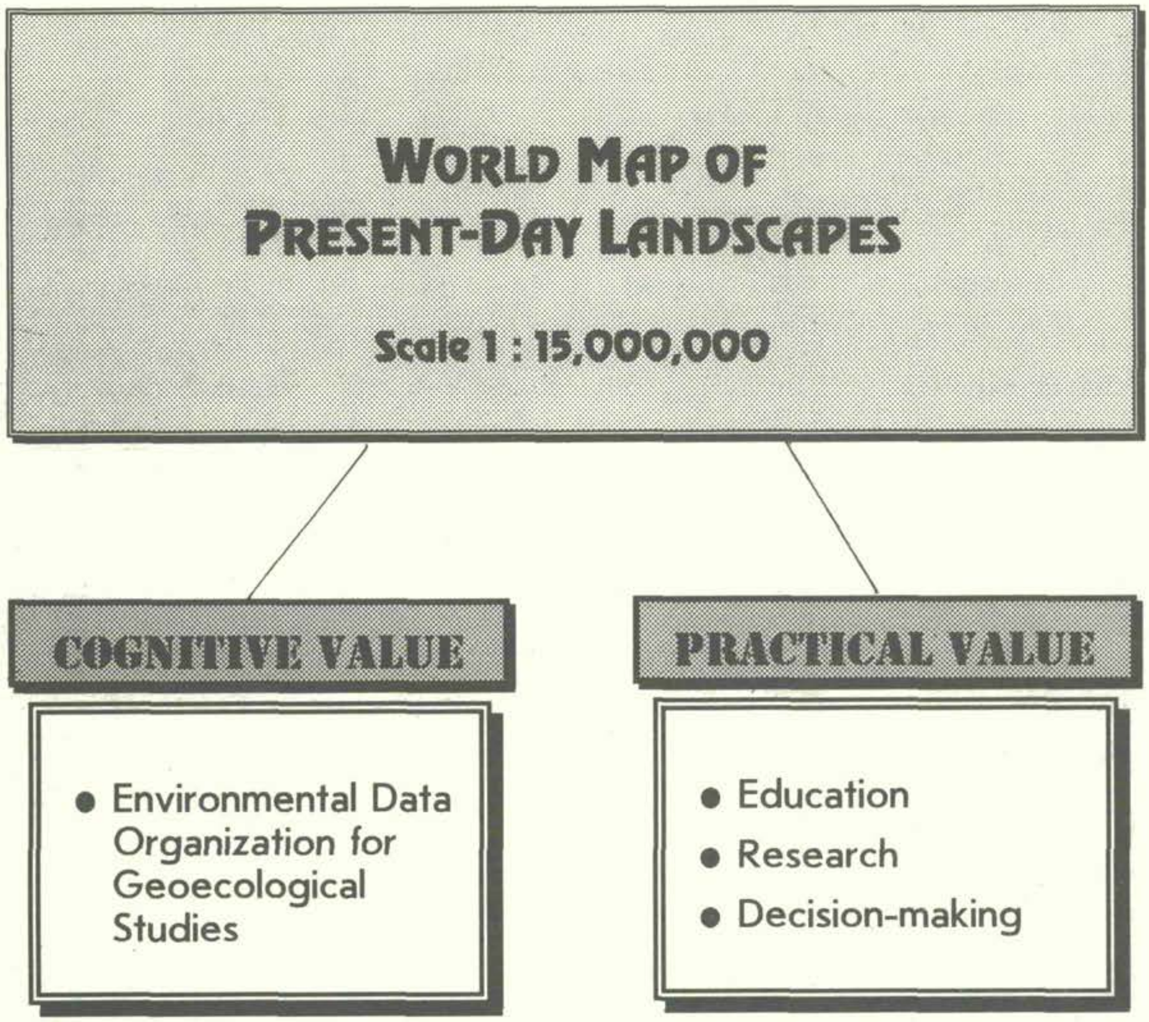


Fig.1. Basic fields of application of the *World Map of Present-Day Landscapes*

Possible *educational* applications of the wall-chart include lecturing on environmental issues before the general public, and classroom seminars for college and university students in environment, technology, development and related disciplines.

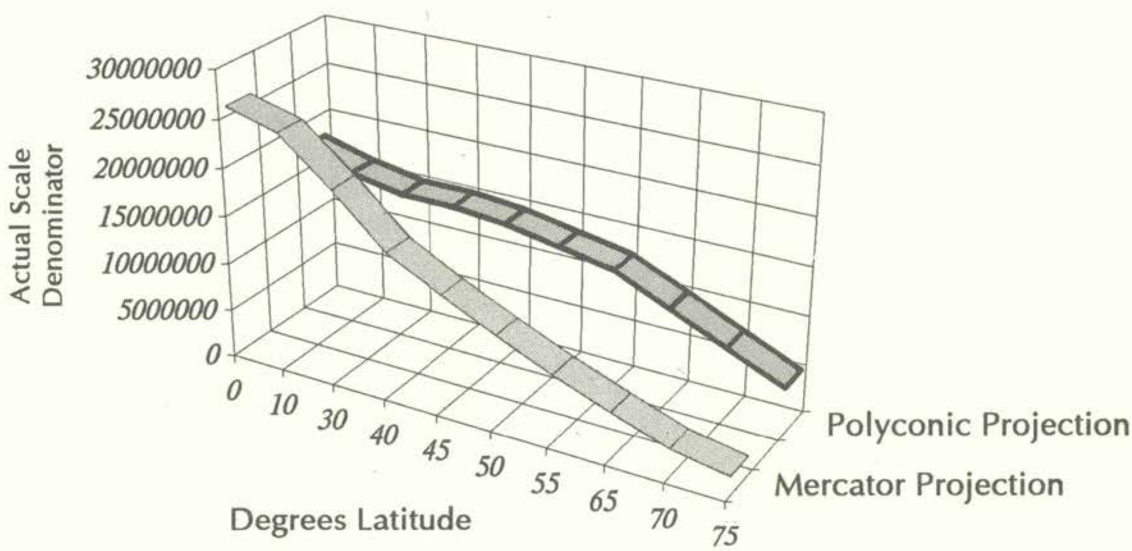
Researchers in global ecology and environmental change (especially those involved in activities under the International Geosphere-Biosphere Programme, or IGBP) may find the map useful for developing a global land cover status GIS, for incorporating the map's unit boundaries as a basic land surface data overlay into global climatic models and into the global coarse-resolution satellite data sets (e.g., the global 1-km resolution digital data set currently developed by the IGBP Data and Information System), as well as for further evaluating and cross-referencing quantitative information on anthropogenic processes in the environment.

Environmental *decision-making* also can be facilitated through the use of this map. By providing a quick worldwide reference and clearly visible presentation of the geographical distribution of different degrees of transformation of landscapes under human impact (including those critically transformed by specific activities), the map may serve as a handy tool for the establishment of regional priorities for various environmental action programmes.

2. BASE MAPS AND REMOTE SENSING DATA

The wall-chart format was chosen so that the map can be conveniently displayed in all sorts of locations, such as on an office wall, in conference centres or in classrooms. The polyconic projection, specially developed in the USSR for wall-chart world maps, was chosen for the project since it provides a much better combination of area and angle distortions than the Mercator projection used in previous UNEP world maps (*Fig.2*). For a more detailed description of this cartographic projection see *Appendix II*.

Fig.2. Area Distortions on World Maps (1:15,000,000)



Scale distortions still limit the map's usefulness for quantitative data analysis. However, it is possible to calculate actual surface areas once the map units are digitised and linked to a GIS capable of converting this polyconic projection into an equal-area projection by means of the so-called "rubber-sheet transformation" procedure now available on many commercial and academic GIS software packages.

Two world maps were used as the basis for compiling the *World Map of Present-Day Landscapes*:

① *Geographical Belts and Zonal Types of Landscapes of the World*, 1988. -- Moscow: GUGK SSSR (1:15,000,000);

② *Land Use Types of the World*, 1986. -- Moscow: GUGK SSSR (1:15,000,000).

These two maps are widely regarded to be among the most detailed cartographic overviews of the global environment. Moreover, both were compiled and published in the above-mentioned polyconic projection. Information from these sources was supplemented with data from regional cartographic, remote sensing and ground-truth field survey sources.

The map *Geographical Belts and Zonal Types of Landscapes of the World* represents several taxonomic levels of terrestrial landscape differentiation.

Geographical belts, with their relative macroclimatic homogeneity in terms of solar radiation and atmospheric circulation, stand as the major zonal subdivisions of the geosphere. Traditionally, there are 13 geographical belts distinguished: one *equatorial*, two *subequatorial*, two *tropical*, two *subtropical*, two *temperate*, two *subpolar* and two *polar* belts. Each of these belts is characterised by a suite of natural processes, and its own zonal pattern and set of natural landscapes. Therefore the belts have the adjective *"geographical"*, rather than *"climatic"*.

Within these geographical belts, ***geographical (or natural landscape) zones and subzones*** are delineated according to the local balance of heat and humidity, which determines the set of inherent natural processes and their dynamics, as well as typical natural soil-vegetation cover and geomorphological processes within each zone and subzone. ***Altitudinal spectra of landscapes*** are shown for various mountainous areas, since their type depends to a large extent on the location of the mountain system within the geographical belt and sector.

The map *Land Use Types of the World* represents generalised information on the present status of lands, the major types of utilisation thereon, and the spatial distribution of various land use combinations.

The classification is based on the principal forms of productive land utilisation *(e.g.* arable lands, lands under perennial crops, pastures and meadows, forests). More detailed characteristics of land use are introduced at the next level of classification. Thus, arable lands are further subdivided into regularly cultivated and occasionally cultivated areas (mainly in the tropics); lands under perennial crops are either irrigated or non-irrigated areas; and pastures are classified as improved or unimproved, the latter being differentiated according to the character of existing vegetation cover into tundra, forest, steppe, desert pastures, and so on. Land seldom used by human populations, such as glaciers, solonchaks and shifting sands, are excluded from the matrix legend, and are shown on the map by special symbols.

The present-day landscapes mapped at the scale of 1:15,000,000 are the result of synthetic generalisation of the above-mentioned maps and the analytical reprocessing of their information.

Satellite images have been widely used to evaluate data reliability, to fill information gaps, to identify new areas of change, and to reveal the dynamics of such forms of land use as irrigation and clear-cutting. They were especially necessary for clarifying the distribution and spatial structure of those anthropogenically modified landscapes that are clearly observable against an undisturbed natural background. The photo atlases and satellite image collections for North America, Western Europe, Asia and the CIS, as well as small-scale photo-mosaics of different continents, countries and major physiographic regions, along with the remote sensing image sets for the CIS and other countries were used in this study.

Photo-mosaics compiled of space images from the *Meteor*, *Landsat* and other meteorological and resource satellites are most appropriate for thematic mapping at the scale of 1:15,000,000. Specific geographical situations in particular regions were more easily detected with the help of space imagery from the *Salyut* and *Mir* orbital stations or the *Landsat* resource satellite that has a medium resolution of 70-80 m, scales between 1:3,360,000 and 1:2,400,000 and an area coverage of 30 to 50 thousand sq.km per image.

Data derived from years of field observations in diverse natural zones of the CIS, made by the faculty members of Moscow State University, were widely used to ground-truth remotely-sensed information for the map. Additional ground-truthing was carried out during field trips to two sample areas in Tunisia and Central Asia, research supported by the UNEP Desertification Control Programme Activity Centre (DC/PAC).

3. DEFINITIONS

3.1. DEGREE OF LANDSCAPE TRANSFORMATION

All present-day landscapes have been classified according to their degree of transformation into two groups: *modal* (primary, or essentially unaffected) and *natural-anthropogenic*, the latter being further subdivided into *derivative* (or secondary) landscapes, landscape *anthropogenic modifications* and *technogeneous complexes* (*Fig.3*).

The main criteria used for determining the degree of landscape transformation are the more sensible landscape components, like those of vegetation, as well as the extent and intensity of the current human impact.

Vegetation is an easily detectable yet dynamic component of a landscape that is widely used as an indicator of the spatial distribution of certain properties of the territory, such as climatic and soil differences; groundwater levels, movement and chemical composition. Commonly, it is the vegetation cover that is the first aspect of the landscape to be altered by human impact. This feature was used to develop a simple and reasonable approach to the definition of four major degrees of landscape transformation (*see Table 1*).

In this way, the mapping procedure for this study implies four degrees of *vegetation cover transformation**. The first degree represents landscapes with practically no anthropogenic transformation of vegetative components. The second is associated with the emergence of secondary biotic successions under the influence of human action, while the third reflects a vegetation cover that has been altered in a fundamental way so that an anthropogenically-induced vegetation dominates. The forth transformation degree embraces areas where technogeneous structures have almost totally replaced the natural vegetation cover (*e.g.* in urban or mining industrial zones).

Also, four degrees of the *intensity of present-day human intervention* are distinguished:

① *virtually absent to low*,

② *medium-intensive or territorially limited* (e.g. unimproved pastures, mowed meadows, extensive forestry),

③ *dominantly high-intensive* (>50% of the mapping unit area under e.g. arable lands, improved pastures, intensive forestry and plantations), and

④ *dominantly very high-intensive and technogeneous* (>50% of the mapping unit area under suburban, urban, industrial or similar uses).

Dominant combinations of these parameters are used to divide landscapes into four major categories by *degree of anthropogenic*

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* The term *"transformation"* used here is societally neutral, i.e. does not imply any "positive" or "negative" meaning. Its main idea is to denote the magnitude of the system's deviation from its original equilibrium state. Therefore, *"transformation" may mean either "degradation" or "aggradation"*.

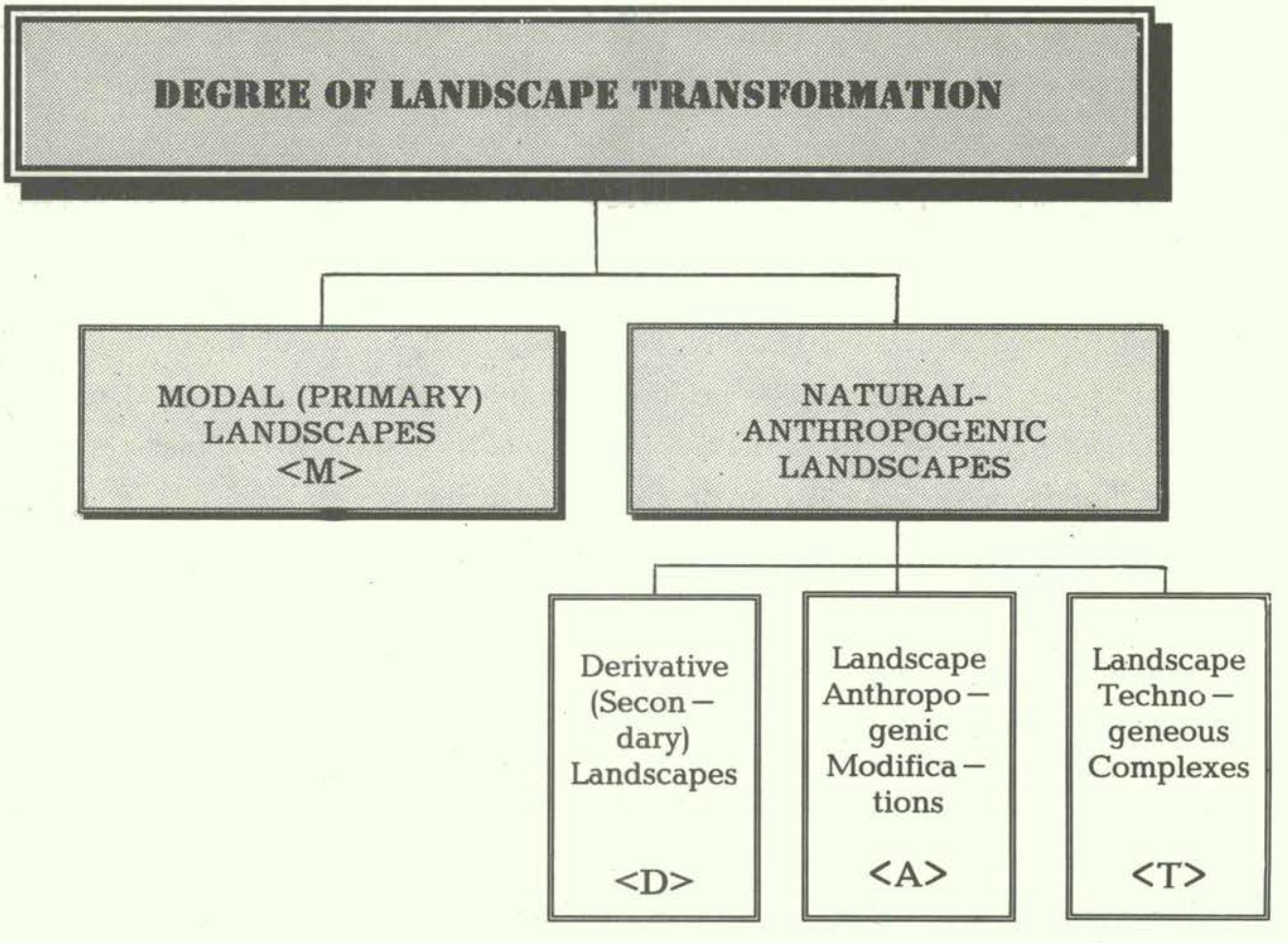


Fig.3. Major categories of present-day landscapes

Table 1. Degrees of transformation of present-day landscapes

DEGREE OF LANDSCAPE TRANSFORMATION		
Present-Day Landscape Categories	**Vegetation Cover Transformation**	**Intensity of Present-Day Human Impact**
MODAL LANDSCAPES M	Practically no transformation	Low-intensive or virtually absent
DERIVATIVE LANDSCAPES D	Secondary biotic successions	Medium-intensive or territorially limited
LANDSCAPE ANTHROPOGENIC MODIFICATIONS A	Cultural vegetation cover	Dominantly high-intensive on > 50% of area
LANDSCAPE TECHNOGENEOUS COMPLEXES T	Replacement by technogeneous structures	Dominantly very high-intensive and technogeneous on > 50% of area

transformation: modal (or essentially unaffected) landscapes; derivative (secondary) landscapes; landscape anthropogenic modifications, and landscape technogeneous complexes.

It is important to realise that this classification synthesizes only two related sequences indicating landscape transformation - vegetation and land use change. There are, of course, many other ways in which human action affects the landscape, with a host of feedback mechanisms, thresholds and lags that are interrelated in multiple and diverse ways.

3.2. MODAL (ESSENTIALLY UNAFFECTED) LANDSCAPES

Modal landscapes (MLs) are present-day landscapes that correspond to the main zonal type of landscape of the given area and have not undergone any direct impact of economic activities, or may be occasionally influenced by local factors, but without causing any qualitative changes.

This category includes landscapes of ice deserts and some tropical deserts, high mountain regions, certain areas of tropical forests and mountain forests, as well as a part of boreal forest and tundra landscapes. The largest areas of MLs are typical of the zones of polar and subpolar ice and stony deserts, tropical deserts, evergreen tropical forests, and the taiga (or boreal forests) of Eurasia and North America. This category also includes a number of barely developed or unused marsh, floodplain, deltaic and solonchak intrazonal landscapes. Landscapes of specially managed territories with a regime of strictly protected reserves are also included in this category, which is why the mapped pattern of the boundaries of some *MLs* does not look "natural" at all.

MLs are mapped by the colour of the corresponding zonal type from the map *Geographical Belts and Zonal Types of Landscapes of the World.* This mapping technique emphasises the genetic connection and proximity of the two notions: *modal landscapes* and *potential natural landscapes* (zonal types of landscapes).

3.3. DERIVATIVE (SECONDARY) LANDSCAPES

> *Derivative (secondary) landscapes (DSLs) are defined as natural-anthropogenic landscapes, emerging in place of modal ones as a result of some human activities (or on previously cultivated abandoned lands), but existing in a relatively steady state (for decades to centuries) through natural self-regulating processes, i.e. with no sensible current human impact.*

The term indicates this category's intermediate position between modal ("primary") landscapes and landscape anthropogenic modifications. There are numerous and diverse types of landscapes within this wide category. They include Mediterranean landscapes of xerophytic shrubs (maquis, garrigue, shibliak, chaparral), savannized open woodlands of the humid tropics, degraded dry steppe landscapes of the subboreal forest-steppe zone, deciduous hardwood forests of the taiga zone, and many others.

Common to all *DSLs* is the dominance of vegetation communities that have been significantly altered by human action. However, the notion of "secondary landscape" should not be confused with "secondary vegetation", since in *DSLs* significant changes in all landscape components are possible (not only in vegetation, but in soils, microclimate, and landforms as well).

These landscapes are kept in their quasi-stationary equilibrium by the forces of natural self-organisation without any external (anthropogenic) controlling impact. The present-day human activities within *DSLs* are typically low-intensive (*e.g.* extensive unimproved pastures, domestic and low-commercial forestry, *etc.*) and/or locally dispersed. They are characterised by a fairly homogeneous spatial pattern of landscape units, with the area of subdominant units not usually exceeding 10 to 15 % of the total area of the mapping polygon. In fact, present-day *DSLs* are mostly "marginal" degraded landscapes, deprived of some of their socio-functional qualities by the formerly poor land uses practiced on them, and left with a biological productivity that is lower than that of the original modal landscapes. A phenomenon of "edaphic aridization" (or drying-up) is typical of the present-day *DSLs* of warm and hot geographical belts, as opposed to corresponding modal landscapes; similarly, the present-day *DSLs* of temperate climates have acquired certain features of greater continentality.

Since natural (primarily biological) self-organisation plays a leading role in the present-day functioning of *DSLs*, these landscapes, when mapped, are subdivided into six minor categories according to the dominant trends of their biotic functioning and evolution:

① secondary tundras;
② secondary forests;
③ secondary forest-steppes;
④ secondary steppes;
⑤ secondary savannahs, open woodlands and shrubs;
⑥ secondary deserts.

3.4. LANDSCAPE ANTHROPOGENIC MODIFICATIONS

Landscape anthropogenic modifications (LAMs) are defined as present-day transformed landscapes, where the natural components have been more-or-less changed through intentional anthropogenic impact. In terms of pattern and degree of environmental transformation, LAMs can be divided into three broad categories: agricultural, silvicultural, and recreational. (Fig.4).

LAMs are defined as landscapes formed within the past 10,000 years and characterised by a much higher speed of environmental transformation than that of natural invariants. A knowledge of the age and history of *LAMs*' formation is a crucial prerequisite for the objective evaluation of their present-day status and of their further development trends.

LAMs are divided into agricultural, silvicultural, and recreational groups. In terms of land use, *agricultural* modifications include arable, horticultural, and pastoral *LAMs*, which differ according to such parameters as anthropogenic impact, agrotechnology used and the cycle of biological matter. *Arable LAMs* are further subdivided in terms of the efforts to improve them, into "irrigated" and "non-irrigated" categories. Agriculturally improved *LAMs* are subdivided into "intensively improved" and "poorly improved", according to the type and degree of chemical, biological or other techniques used. Improved pastoral *LAMs* (meadows and improved pastures), for example, are mostly typical of Western Europe, North America and Australia. Non-improved pastoral *LAMs*, found largely in the same regions, are represented primarily by natural pastures that are frequently overgrazed or in a degraded state.

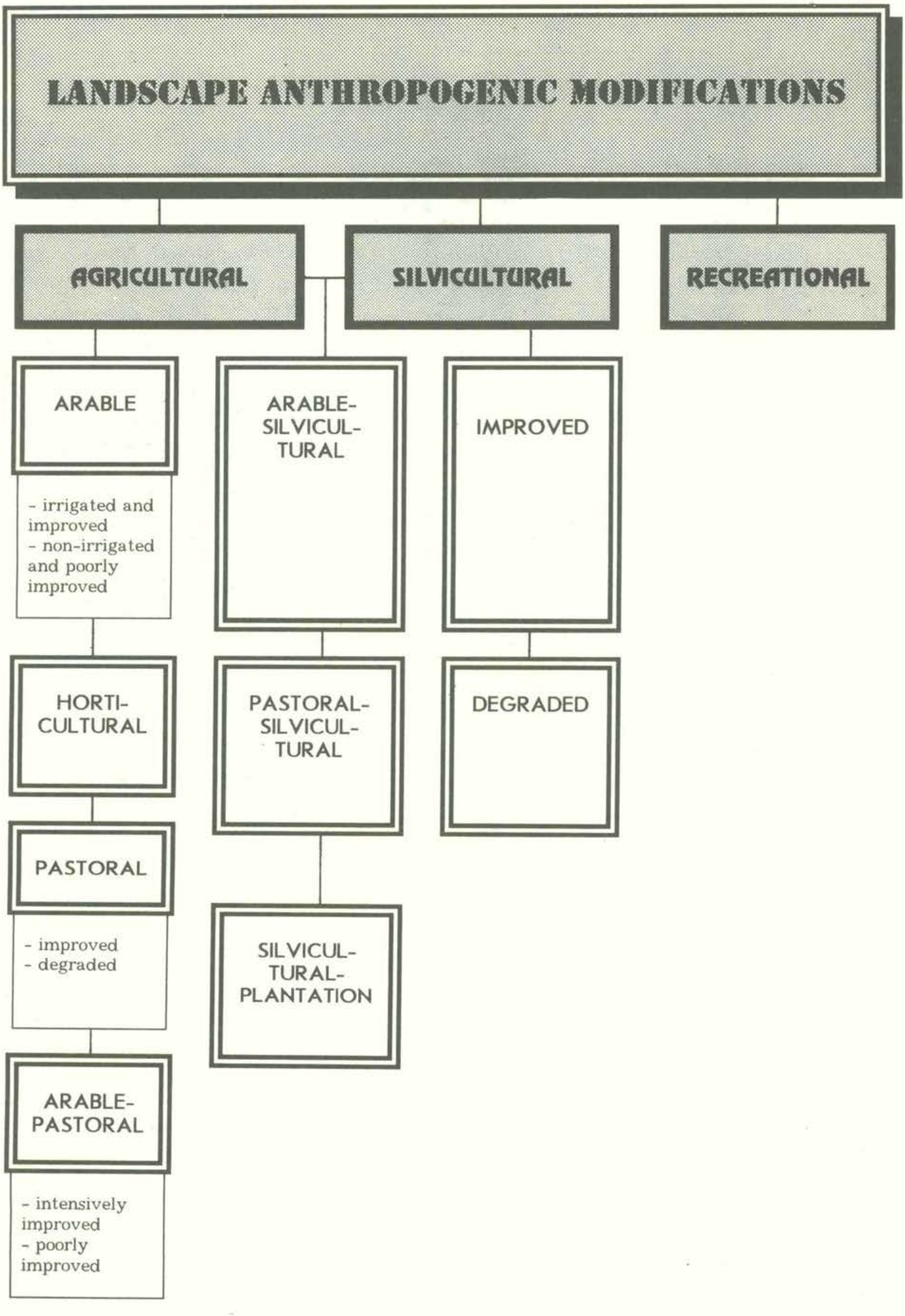


Fig.4. Classification of landscape anthropogenic modifications

3.5. LANDSCAPE TECHNOGENEOUS COMPLEXES

Landscape technogeneous complexes (LTCs) are present-day landscapes, where the current dynamics, environmental status and socio-economic functions are almost totally determined and controlled by conscious anthropogenic impact.

This category is subdivided into three major groups: *hydraulic* (or hydroconstruction projects), *industrial* (extraction and processing) and *settlement* complexes. Mapped as *hydraulic LTCs* are major water reservoirs and anthropogenic lakes, navigable and irrigation canals. *Extracting-industrial LTCs* denote territories altered by open extraction of the following groups of mineral resources: combustible fuels (coal, oil, tar shale, natural gas); ores (ferrous, non-ferrous, polymetallic); non-ore minerals; construction materials, and others. *Settlement LTCs* are divided into urban (with the two optional subdivisions by metropolitan population size - over 5 million residents, and under 5 million residents) and rural (with compact settlement). An additional category of *radioactively polluted LTCs* is also depicted, showing areas most heavily affected by fallouts from nuclear tests and accidents.

4. MAPPING PRINCIPLES, TECHNIQUES AND SYMBOLS

Since present-day landscapes are understood as geosystems which emerge and develop through the interaction of natural and anthropogenic subsystems, the mapping technique should adequately reflect both components. The system of their subordination is reflected in the key to the map, where each mapping unit is labeled with a special "formulae", composed of indices denoting both the unit's natural subsystem classification and its anthropogenic subsystem classification.

4.1. NATURAL SUBSYSTEM

The first level of classification of the natural bases of landscapes is assigned to *geographical belts* (see definition on page 11) that are delineated in the map by the first-order boundaries and shown by colours from different parts of the colour spectrum. In the legend to the map the following geographical belts are distinguished:

* *polar belts,*
* *subpolar belts,*
* *temperate belts,*
* *subtropical belts,*
* *tropical belts,*
* *subequatorial belts,* and
* *equatorial belt.*

Geographical belts are further divided into *natural landscape zones* (see definition on page 11) that are delineated on the map by second-order boundaries and shown by different shades of the basic colour of the belt. In the legend and on the map these landscape zones are denoted by numerical indices (*see Appendix I*).

The next level in the classification and mapping of the natural characteristics of landscapes is referred to as *class* and defined through the landscapes' physiography and relief. Two major classes of landscapes are distinguished - plains and mountains.

The basic characteristics for the division into classes are major relief structures (plains and mountains) and the type of natural zonality (horizontal or vertical). Patterns of landscape types and uses therefore reflect both latitudinal and altitudinal variations.

Thus, all present-day landscapes are divided into four *classes* (indicated by Roman numerals) mainly in terms of elevation and topography, as well as some genetic and dynamic characteristics:

I - plains;
II - plateaus;
III - low mountains;
IV - medium and high mountains.

On the world map all the mountain landscapes (classes III and IV) are given a corresponding number and the basic colour of the zonal landscape type of their lowest altitudinal belt (or that of the foothills).

Types of *altitudinal spectra* of medium- and high-mountain landscapes (class IV) are shown by Arabic numbers in brackets to the left of the class numerical indices (*see Appendix I*).

So, the natural basis of the present-day landscapes is represented in the world map as a four-level system of natural entities with different degrees of complexity (geographical belt - natural landscape zone - class - subclass).

4.2. ANTHROPOGENIC SUBSYSTEM

All present-day landscapes are divided into two major groups according to the trends and intensity of anthropogenic transformation of the natural components: *modal*, or *essentially unaffected* (M), and *natural-anthropogenic*, which are further divided into derivative (secondary) landscapes (D), landscape anthropogenic modifications (A), and landscape technogeneous complexes (T).

These categories are shown in the world map by shades of the basic colour of the natural landscape zone and by letter indices (M, D, A, and T).

The next hierarchical level in the division of landscapes is defined by the differences in trends of landscape change and trends of economic use, which have led to the formation of specific natural-anthropogenic complexes. These differences are shown in the map and in the legend by numerical indices in the unit "formulae".

For *DSLs* the following trends of evolution and functioning, characterised by different types of secondary biotic successions, are shown on the world map:

D^1 - secondary tundras;
D^2 - secondary forests;
D^3 - secondary forest-steppes;
D^4 - secondary steppes;
D^5 - secondary savannahs, open woodlands and shrubs;
D^6 - secondary deserts,

their concurrent land use practices (if any) being marked as:

a - arable;
b - pastoral;
c - silvicultural.

Different types of *LAMs* are shown at the global scale according to their trends of anthropogenic dynamics, as follows:

A^1 - arable irrigated *LAMs*;
A^2 - arable non-irrigated -;
A^3 - horticultural -;
A^4 - pastoral -;
A^5 - arable-pastoral -;
A^6 - silvicultural -;
A^7 - arable-silvicultural -;
A^8 - pastoral-silvicultural -;
A^9 - silvicultural-plantation -;
A^{10} - recreational -.

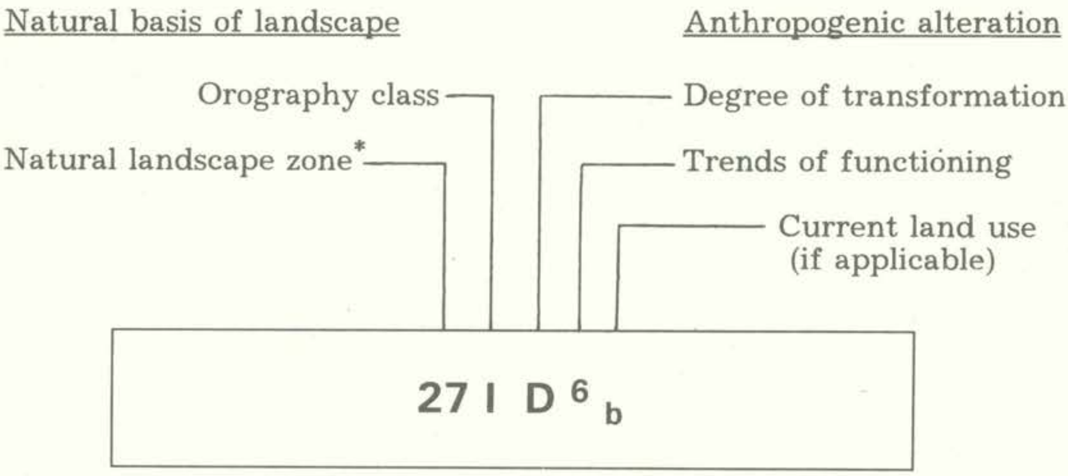
LTCs that can be mapped at the given scale are shown by numerical indices (otherwise they are depicted by special symbols):

T^1 - urban settlement *LTCs*;
T^2 - extracting-industrial -;
T^3 - hydraulic -;
T^4 - radioactively polluted -

4.3. EXPLANATION OF SYMBOLS

The mapping units are labeled on the maps by means of complex *formulae-indices.* All the numbers (both Arabic and Roman) in these formulae that stand *to the left* of the capital letter are the characteristics of the *natural basis* of the given landscape. The capital letter and everything *to the right* of it indicates the level and patterns of the given landscape's *anthropogenic alteration* (*see Example of Unit Indice*).

EXAMPLE OF UNIT INDICE



Total meaning of the indice: plains with secondary (derivative) deserts, locally grazed, in place of tropical savannahs and open woodlands on Chromic Xerosols.

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* For plains, plateaus and low mountains (classes **I**, **II** and **III**). If this number is in brackets, then it signifies *altitudinal spectrum type* for medium and high mountains (class **IV**).

APPENDIX I

LEGEND OF THE WORLD MAP OF PRESENT-DAY LANDSCAPES

LIST OF THE NATURAL LANDSCAPE ZONES (PLAINS)

POLAR BELTS

1. Ice and stony deserts
2. Arctic tundras on Gelic Regosols *

SUBPOLAR BELTS

3. Tundras on Foli-Humic Leptosols and Gleysols

. . .

4. Forest-tundras and open woodlands on Haplic and Leptic Podzols

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TEMPERATE BELTS (BOREAL SUBBELTS)

5. Maritime meadows on Foli-Humic Leptosols

. . .

6. Open woodlands on Foli-Humic Leptosols and Ochric Andosols

. . .

7. Taiga (boreal forests) on Haplic and Leptic Podzols, Dystric Podzoluvisols and Calci-Gelic Cambisols, Gelic Gleysols and Albic Luvisols

. . .

TEMPERATE BELTS (SUBBOREAL SUBBELTS)

* Soil categories were mapped according to the 1:15,000,000 *Soil Map of the World* by M.A.Glazovskaya (Moscow: GUGK, 1982). Translation of these categories into English according to the FAO Soil Classification (1975) was provided by M.I.Gerasimova (Moscow State University).

8. Mixed deciduous-coniferous forests on Albic Luvisols, Orthic Greyzems and Dystric Cambisols

. . .

9. Broadleaved forests on Albic Luvisols, Orthic and Eutric Greyzems and Dystric Cambisols

. . .

10. Forest-steppes and prairies on Orthic Greyzems, Haplic Phaeozems, Luvic and Haplic Chernozems and Haplic Kastanozems

. . .

11. Steppes on Calcic Chernozems, Luvic Kastanozems, Solonetzs and Solonetzi-Mollic Calcisols

. . .

12. Semideserts on Haplic Xerosols and Yermosols

. . .

13. Deserts on Yermosols

SUBTROPICAL BELTS

14. Broadleaved-coniferous evergreen forests on Dystric and Ferrallic Cambisols and Nitosols

. . .

15. Coniferous-broadleaved semi-evergreen forests on Ferrallic Cambisols and Nitosols

. . .

16. Broadleaved semi-evergreen forests on Ferrallic Cambisols, Nitosols and Chromic Luvisols

. . .

17. Coniferous open woodlands on Chromic Cambisols

. . .

18. Mediterranean hardleaved evergreen forests, open woodlands and shrubs on Chromic Cambisols and Haplic Nitosols

. . .

19. Semideserts on Calcic Cambisols, Calcic and Chromic Xerosols

. . .

20. Deserts on sands, Chromic and Calcic Xerosols and Haplic Yermosols

. . .

21. Open woodlands and shrubs on Chromic Xerosols and Chromic Cambisols

. . .

22. Short-grass steppes on Chromic Xerosols, Haplic and Chromi-Haplic Phaeozems

. . .

23. Tall-grass steppes (prairies) on Chromic Cambisols and Chromi-Haplic Phaeozems

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TROPICAL BELTS

24. Deserts on Calcic Arenosols, Calcaric Desert Leptosols, Chromic and Calcic Xerosols

. . .

25. Semideserts on Chromic Xerosols and Eutric Leptosols

. . .

26. Steppes on Mollic Cambisols

. . .

27. Open woodlands, shrubs and savannahs on Chromic Xerosols, Rhodic and Haplic Nitosols and Calci-Chromic Cambisols

. . .

28. Semi-evergreen and evergreen forests on Acric Ferralsols and Rhodic Nitosols

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SUBEQUATORIAL BELTS

29. Evergreen forests on Acric Ferralsols, Rhodic Nitosols and Chromic Xerosols

. . .

30. Semi-evergreen forests on Acric Ferralsols, Rhodic and Haplic Nitosols

. . .

31. Deciduous forests on Rhodic and Haplic Nitosols and Pellic Vertisols

. . .

32. Open woodlands and savannahs on Rhodic and Haplic Nitosols and Chromic Xerosols

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EQUATORIAL BELT

33. Evergreen rain forests on Xantic and Gleyic Ferralsols

. . .

34. Deciduous forests on Acric Ferralsols

INTRAZONAL LANDSCAPES

35. River valley landscapes
36. Mangrove landscapes
37. Bog and marsh landscapes
38. Solonchak landscapes
39. Mountain glacier landscapes

LIST OF THE TYPES OF ALTITUDINAL LANDSCAPE SPECTRA (MEDIUM AND HIGH MOUNTAINS)

POLAR BELTS

(1) Polar desert

SUBPOLAR BELTS

(2) Tundra - polar desert
(3) Open woodland - tundra

TEMPERATE BELTS (BOREAL SUBBELTS)

(4) Meadow - tundra
(5) Taiga - tundra (- golets)

TEMPERATE BELTS (SUBBOREAL SUBBELTS)

(6) Mixed forest - coniferous forest - tundra (- golets)
(7) Deciduous or mixed forest - coniferous forest - meadow (mixed forest - steppe)
(8) Forest-steppe - coniferous forest - meadow - tundra
(9) Steppe - coniferous forest - tundra
(10) Steppe - mixed forest - meadow
(11) Semidesert - woodland - meadow

SUBTROPICAL BELTS

(12) Evergreen hardwoods - coniferous forest - shrub or meadow
(13) Mixed forest - meadow
(14) Mediterranean woodland or shrub - mixed or coniferous forest - steppe or meadow
(15) Steppe or semidesert - mixed or coniferous forest - alpine meadow or steppe
(16) Semidesert - shrub - open woodland - steppe or alpine meadow
(17) Semidesert - desert - semidesert

(18) Shrub or woodland - steppe - meadow
(19) Steppe or semidesert - mixed forest - alpine meadow or steppe

TROPICAL BELTS

(20) Desert - desert
(21) Desert or semidesert - open woodland or shrub - desert or steppe
(22) Steppe - meadow
(23) Open woodland or savannah - steppe
(24) Open woodland - deciduous forest - coniferous forest - steppe or meadow
(25) Forest - steppe

SUBEQUATORIAL BELTS

(26) Evergreen forest - meadow or *paramos*
(27) Mixed forest - meadow
(28) Savannah - forest - meadow or steppe

EQUATORIAL BELT

(29) *Hylaea - paramos*

APPENDIX II

DESCRIPTION OF THE WORLD MAP PROJECTION

The projection used for the preparation of the *World Map of Present-Day Landscapes* is known as the *1954 TsNIIGAiK polyconic projection*, specially designed for wall-chart maps by the USSR Central Research Institute for Geodesy, Remote Sensing, and Cartography (TsNIIGAiK). A full mathematical description of the projection can be found in: **Ginsburg, G.A., and Salmanova, T.D.** *The Atlas for Choosing Cartographic Projections.* Proc. TsNIIGAiK, # 110. - Moscow: Geodesizdat, 1957. (See also: *Spravochnik po Kartografii.* <Reference Manual on Cartography>. Edited by E.I.Khalugin. - Moscow: Nedra, 1988, pp.61-65).

The basic characteristics of this projection (with a few conventional alterations for practical purposes) are as follows:

- the middle meridian (+5°) is not shown;
- the zero meridian is visually perceived as a straight line;
- the map grid is symmetric around the equator and the middle meridian;
- angular distortions (ω) do not exceed 30° for most of the land areas (excluding the repeating portions of the continents in the corners of the map);
- the area scale (*p*) predominantly varies from 0.83 (in the centre) to 1.5 (around 60° latitude). For the polar regions *p* equals or exceeds 3.0. To compensate for this, map insets for the Arctic and Antarctic regions in the *normal equidistant azimuthal projection* may be optionally added.

The 1954 TsNIIGAiK polyconic projection was also used in the *International Tectonic Map of the World.*

APPENDIX III

GLOBAL LANDSCAPES GIS AND DATABASE

Digitisation of the *World Map of Present-Day Landscapes* is currently being undertaken to develop a *Global Landscapes GIS and Database*, with interactive data display and query capabilities. The project is a collaborative venture between the Department of World Physical Geography and Geoecology of Moscow State University and the Institute of Geography of the Russian Academy of Sciences.

Map units have been digitised as polygons at the original scale of 1:15,000,000 and converted to the ARC/INFO-compatible vector format. The database architecture is determined by the map data structure and is compatible with the map's hierarchical legend (see Section 4 of the main text).

All land polygons are characterised by three "independent" variables: *COVER, RELIEF*, and *MODIF*, that represent the machine codes of individual *natural landscape zones, landscape orography classes*, and *landscape transformation trends* respectively The identifiers of these variables are linked to the *landscape attribute database* that lists a set of characteristic attribute values and value ranges for every zone (average climatic and soil-vegetation patterns), class (elevation ranges, erosion potentials, vertical zonality types) and transformation trend (dominant and subdominant land use patterns, population densities and growth rates).

A specially developed software application allows for interactive menu-driven data visualisation, user-defined category selection and queries, and customised report generation, as well as hardcopy and other associated features.

The first version of the product will be available on diskettes in the first quarter of 1994 on a cost-of-production basis. Further information can be obtained by writing to: *Dr. Elena V. Milanova, Faculty of Geography, Moscow State University, Moscow, 119899, Russia.* ▼