Prin intermediul setărilor, pentru fiecare tip de limită, pe care expertul o poate selecta, se poate apela la variantele DA/NU pentru: Afişare etichete – este afişată denumirea ariei protejate, afişare haşuri – pentru o mai uşoară identificare a suprafeţelor ariilor, la o scară de vizualizare suficient de mare, acestea sunt haşurate diferenţiat, afişare neconcordanţe – prin intermediul unor semne distinctive punctele în care experţii în biodiversitate sau experţii GIS au identificat problema de neadecvare a traseului limitei.

Pentru analiza traseului limitelor ariilor protejate, la dispoziţia utilizatorului sunt puse unelte dedicate realizării măsurătorilor de distanţă în sistem metric.

Filtrarea/selecţia ariei pentru lucru - utilizatorul are posibilitatea de a selecta aria protejată, ale cărei limite doreşte să le vizualizeze sau pe care urmează să lucreze. Aria protejată poate fi selectată în cel puţin două feluri:

a) prin scrierea unui cuvânt din denumirea ariei protejate în câmpul Nume. Se va derula o fereastră în care sunt selectate toate ariile protejate, în al căror titlu se regăseşte cuvântul specificat. Utilizatorul urmează să selecteze aria sa de interes,

b) prin alegere din listă.

Pentru o mai bună selecţie, utilizatorului îi sunt puse la dispoziţie variante de selectare a ariei protejate, prin aplicarea de filtre ce cuprind:

Cat. – categoria ariei protejate (toate, monument al naturii, parc natural, parc naţional etc.), în lista pentru selecţie vor apărea doar ariile protejate care fac parte din categoria selectată.

Ariile protejate pot fi selectate în funcţie de neconcordanţele semnalate şi gradul de progres al rezolvării acestora. Există posibilitatea selecţiei acelor arii protejate, pentru care expertul este asignat (ariile protejate pe care le are în analiză expertul) şi/sau ariile protejate pentru care expertul a semnalat probleme de neconformitate a traseului limitei (figura 3).

Activitatea se realizează în cadrul aplicaţiei Web GIS şi constă în principal în identificarea pe hartă a segmentelor de limită, pentru care se observă diferite probleme de ne-adecvare şi în soluţionarea acestor probleme.

Analiza şi adecvarea limitei existente se vor efectua din punctul de vedere al elementelor de interes conservativ, pentru care a fost declarată aria naturală protejată, în acord cu elementele fizico-geografice perene existente pe teren.

USING GIS FOR IDENTIFICATION OF POTENTIAL AREAS FOR AFORESTATION IN THE REPUBLIC OF MOLDOVA

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Rezumat: Studiul în cauză a avut drept scop identificarea şi cuantificarea ariilor favorabile pentru reîmpădurire sau împădurire în Republica Moldova, ca parte a măsurilor de prevenire a eroziunii, determinate de scurgerea de suprafaţă şi de reducerea impactului inundaţiilor. Cercetarea se bazează pe o serie de factori care determină gradul de favorabilitate a teritoriului pentru împădurire: utilizarea terenurilor, tipurile genetice şi gradul de eroziune a solului, panta reliefului şi cantitatea de precipitaţii. Se poate constata că 49% din clasa terenurilor cu favorabilitate „foarte ridicată" şi 43% din clasa de favorabilitate „ridicată" sunt deja acoperite de păduri, pe când clasa „moderată", „scăzută" şi „foarte scăzută" sunt acoperite doar în proporţie de 9%, 4% şi respectiv 4%, ceea ce demonstrează oportunitatea metodei utilizate. Cele mai importante arii pentru reîmpădurire sunt localizate în Podişul Codrilor, precum şi în Podişul Nistrului şi Podişul Moldovei de Nord, şi parţial în Podişul Tigheciului. Aproximativ 51% din teritoriul Republicii Moldova are un grad de favorabilitate moderat pentru împădurire/reîmpădurire. Aceste suprafeţe sunt ocupate de teren arabil, au panta medie de 6-10 grade şi dispun de soluri mediu erodate.

Key-words: reforestation, aforestation, GIS, Republic of Moldova, soil, land use.

Introduction

The objective of this study has been to identify and quantify and areas suitable for reforestation as an integral part of rainwater run-off and flood management and erosion prevention in the Republic of Moldova.

This study was conducted within the "Management and Technical Assistance Support to Moldova Flood Protection" Project, financed under the Eastern Partnership Technical Assistance Trust Fund (EPTATF), Service contract No TA2011038 MD EST (Ramsbottom et al., 2014).

Materials and methods

The attributes used to identify these areas can be grouped in two sets:

1. Variables that depict the soil degradation propensity: erosion, land use/land cover and slope.

2. Variables that favor successful reforestation: soil type and precipitation.

To combine the different attributes and select the sites that maximize the reforestation benefit in the

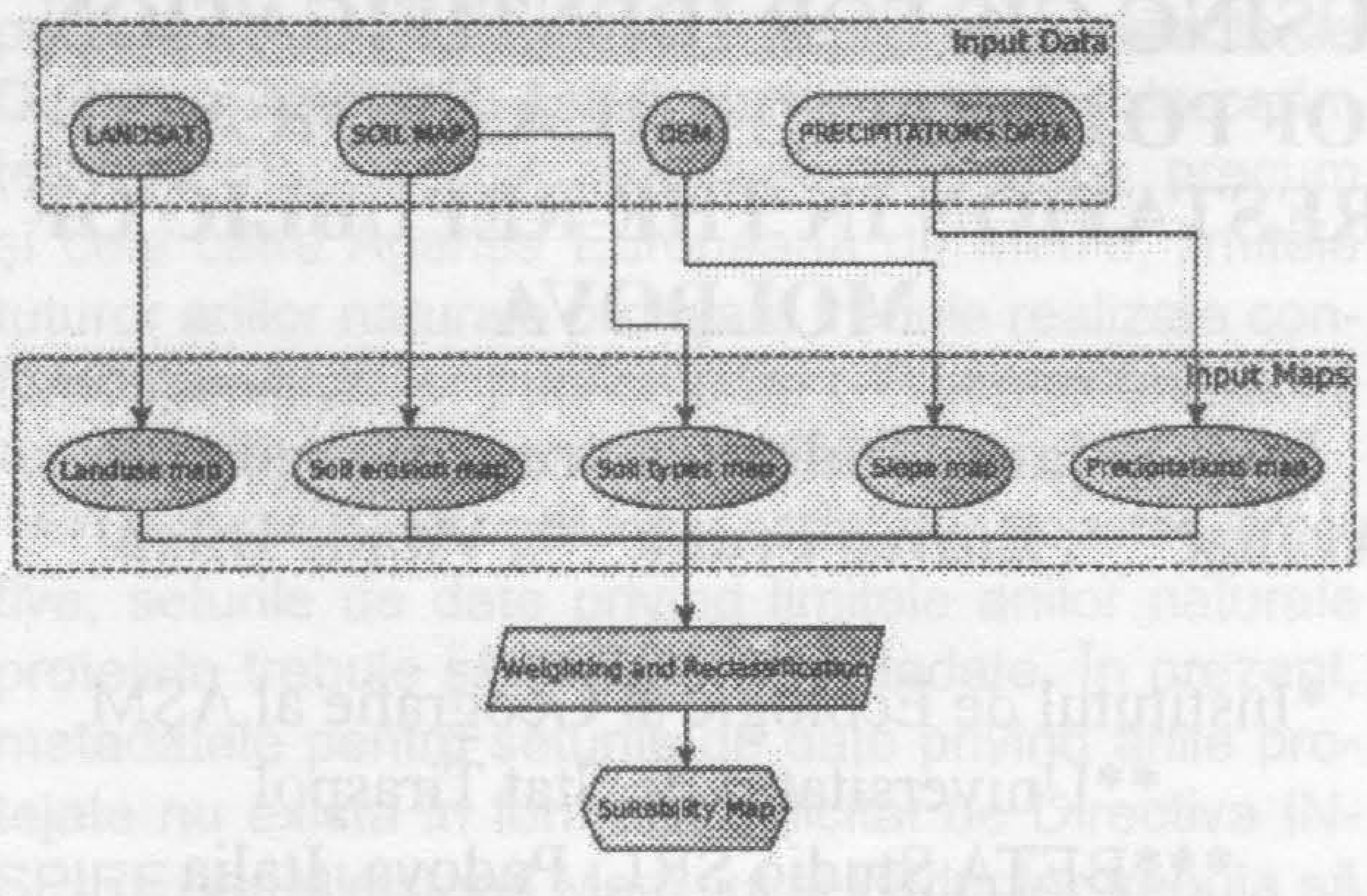

Figure 1: Scheme of input data and methodology applied for the identification of areas suitable for reforestation

territory of Moldova, the Simple Multi-Attribute Rating Technique *"SMART"* (selection and ranking of the attributes according to their importance) have been used. Figure 1 shows a scheme of input data used and methodology applied.

For each of the attributes, a vector or a raster map layer was generated from available data. Using a direct rating approach (Goodwin and Wright, 2000), for each attribute the suitability for reforestation from 1 (very low suitability) to 5 (very high suitability) have been defined as follow.

1. Land use map (fig. 2) - CORINE Land Cover Map generated from Landsat Images. Land use map permit to identify arable, pastures, lands covered by vineyards and orchards (multi-annual plantations), water bodies, forest, etc. The following class have been defined:

A. Very low suitability: water bodies, pastures

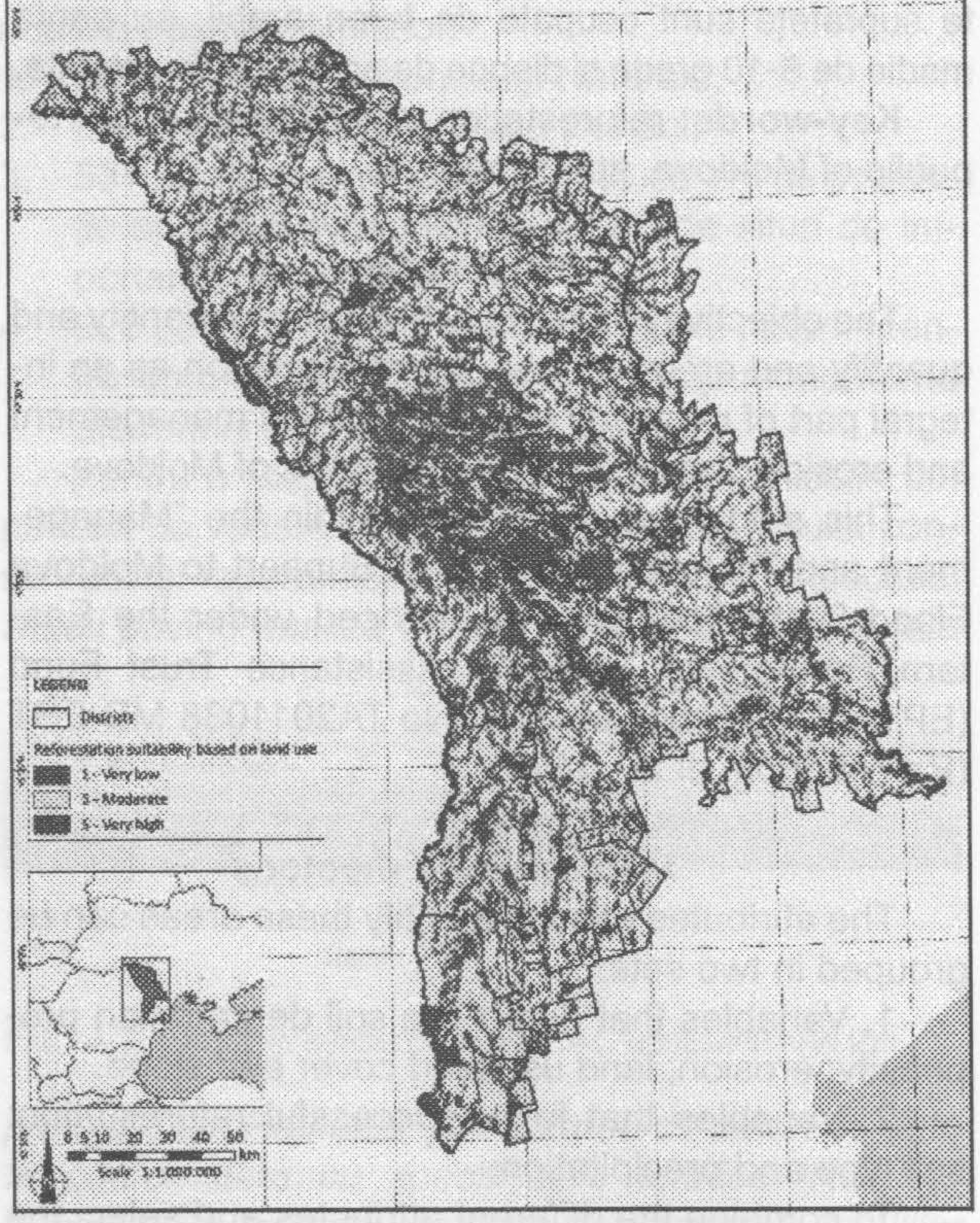

Figure 2: Suitability based on land use

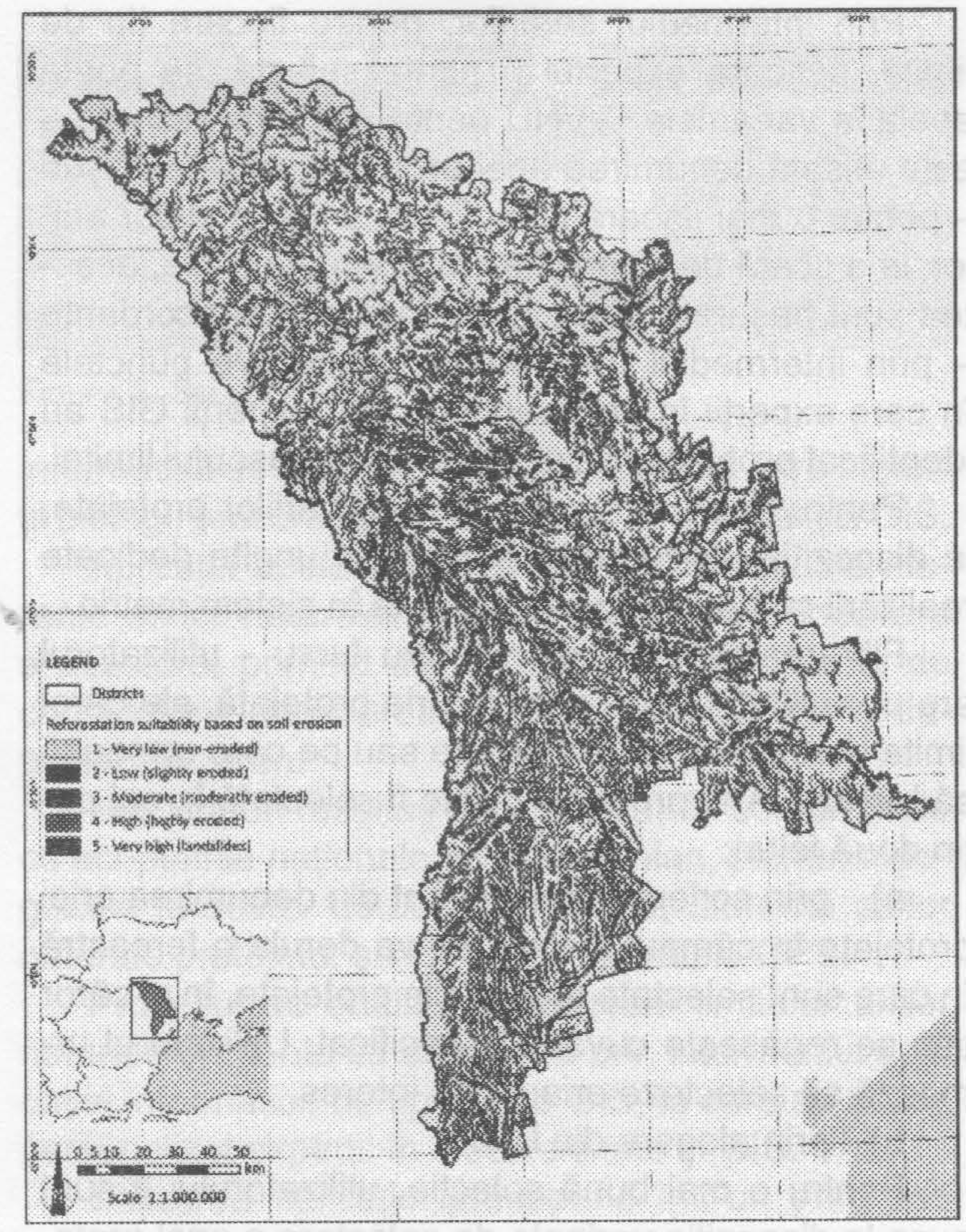

Figure 3: Suitability based on soil erosion

and settlements (ranking 1). These lands basically cannot be transferred from one category to another: pastures are located predominantly in the floodplains with excess of moisture and settlements and water bodies cannot be afforested;

B. (not considered);

C. Moderate suitability: arable land (ranking 3). Arable land accounts for approximately 53% of the country. Two thirds of these lands are affected by some degree of erosion, but their transfer to another land use category can be made only by a decision of the Government or Parliament.

D. (not considered);

E. Very high suitability: forests and multi-annual plantations (ranking 5). These land use categories received the highest ranking value as perennial plantations, in most cases, are degraded, covering slopes with a high degree of erosion. Forests are assigned with maximum value to keep these areas as forests.

2. Soil erosion maps (fig. 3) have been obtained from the soil map (scale 1: 200 000) and the following classes have been defined taking into account the objective to afforest lands with a high degree of erosion and those affected by landslides:

A. Very low suitability: non-eroded soil (ranking 1);

B. Low suitability: slightly eroded soil (ranking 2);

C. Moderate suitability: moderate eroded soil (ranking 3);

D. High suitability: highly eroded soil (ranking 4);

E. Very high suitability: soil affected by landslides (ranking 5).

3. Map of soil types (fig. 4) have been obtained from the soil map (scale 1: 200 000), and the fol-

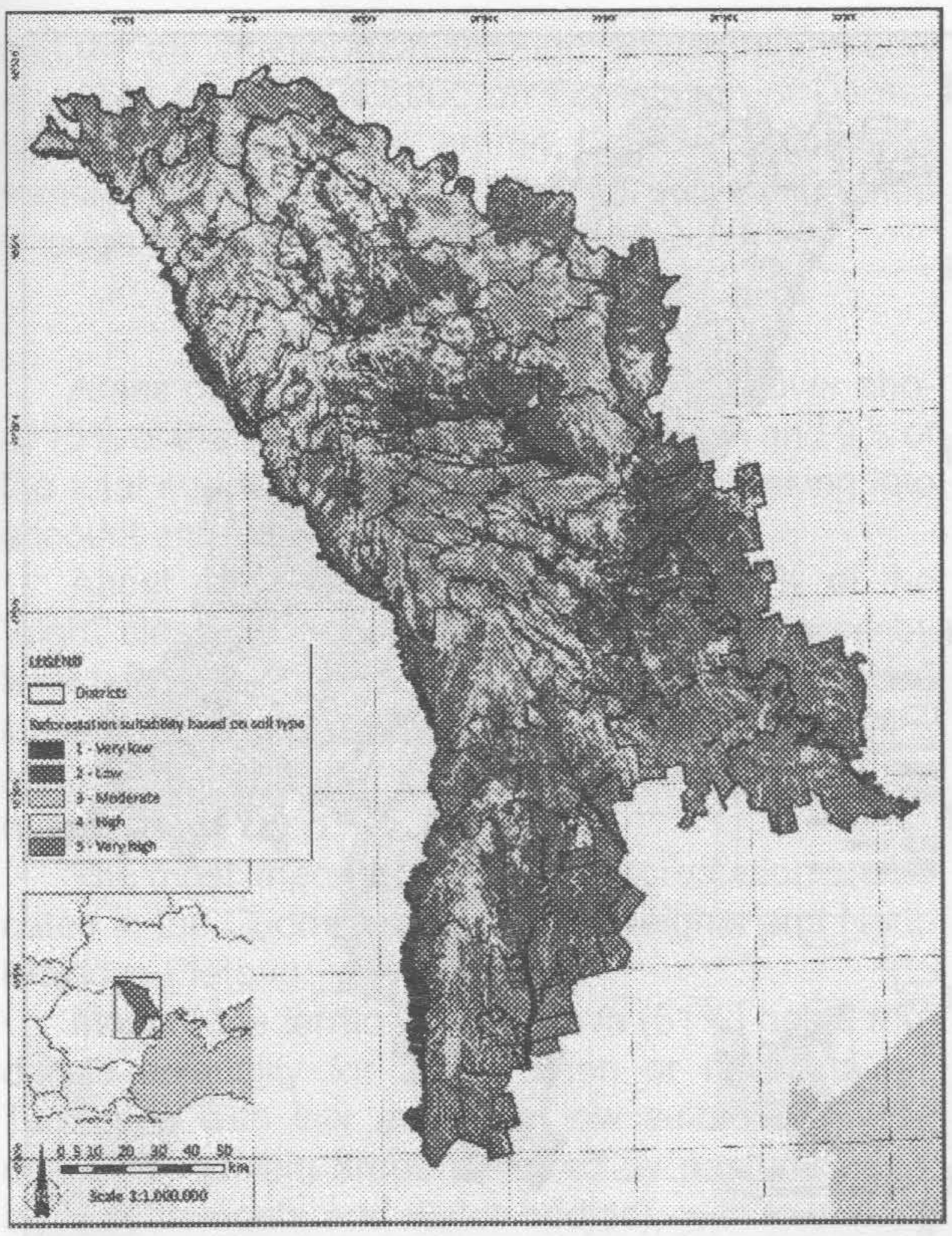

Figure 4: Suitability based on soil type

lowing classes have been defined taking into account the mechanical composition of the soil (texture) and its influence on the degree of water infiltration, thus the favorable soil condition for reforestation success:

A. Very low suitability: salty soils with excess moisture: solonchaks, saline alluvial soil, etc. (ranking 1);

B. Low suitability: soils with excess moisture: typical alluvial soil; xerophytic soils: typical chernozem with low humus content, carbonatic chernozem, calcareous soil, etc. (ranking 2);

C. Moderate suitability: soils with clayey and loamy texture favourable for forests, but suffering from severe humidity penury: typical chernozem with moderate humus content (ranking 3);

D. High suitability: brown and grey eroded forests soils (ranking 4);

E. Very high suitability: brown and grey non-eroded forests soils (ranking 5);

4. Map of slopes (fig. 5) was obtained from the Digital Elevation Model (35 m DEM). Taking into account that the slope directly influences water infiltration, its speed and the degree of erosion, the following classes have been defined:

A. Very low suitability: slope less than 2°, flat, no erosion (ranking 1);

B. Low suitability: slope between 2° and 6°, slightly inclined lands, weak susceptibility to erosion to erosion (ranking 2);

C. Moderate suitability: slope between 6° and 10°, inclined slopes, moderately susceptible to erosion (ranking 3);

D. High suitability: slope between 10° and 15°, steep slopes, prone to erosion (ranking 4);

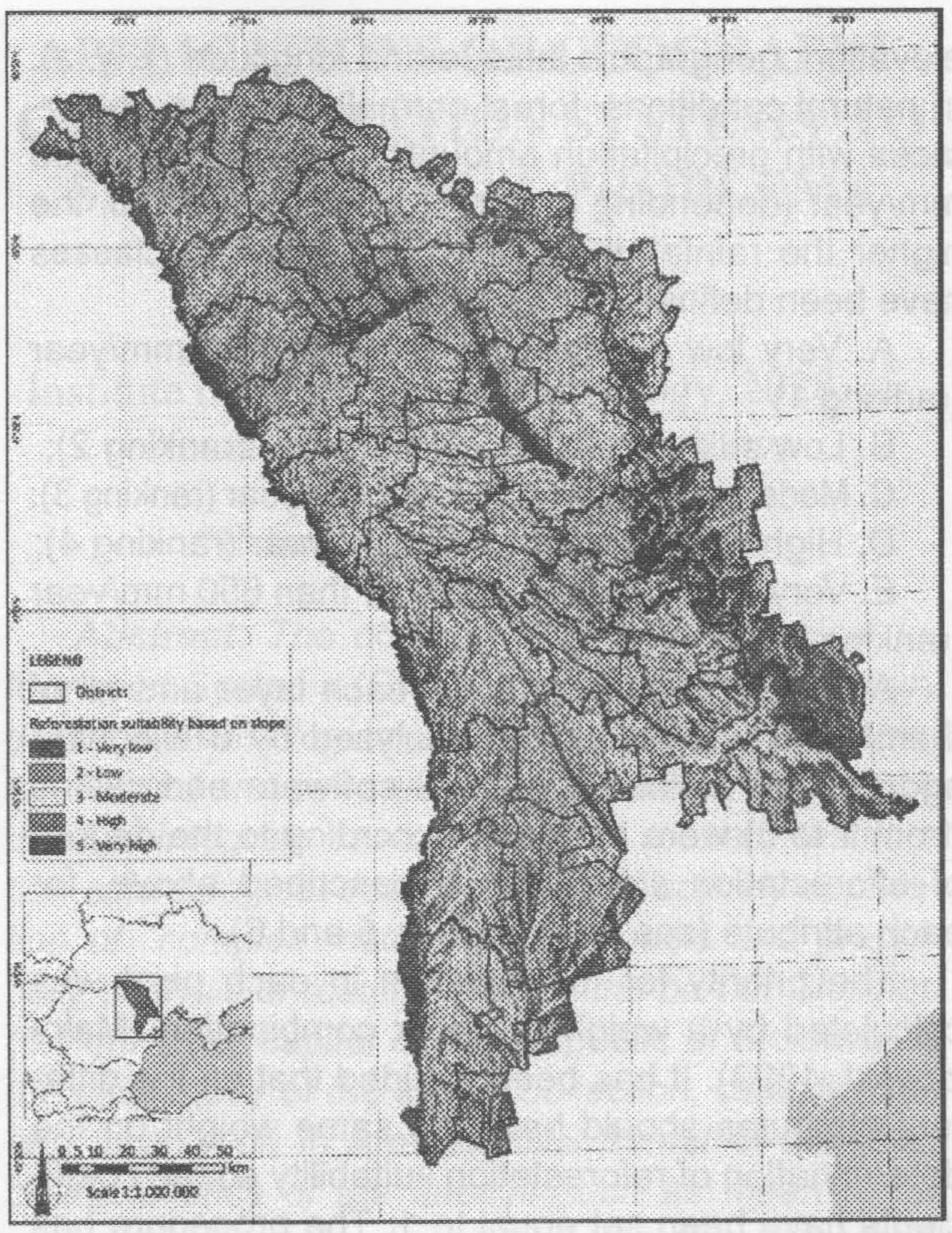

Figure 5: Suitability based on slope

E. Very high suitability: slope greater than 15°, very steep slopes, highly susceptible to erosion (ranking 5);

5. Map of annual precipitation (fig. 6) (in mm/year), was generated by a regression resulting from the precipitation records of the State Hydro-Meteorological Service corrected with factors including

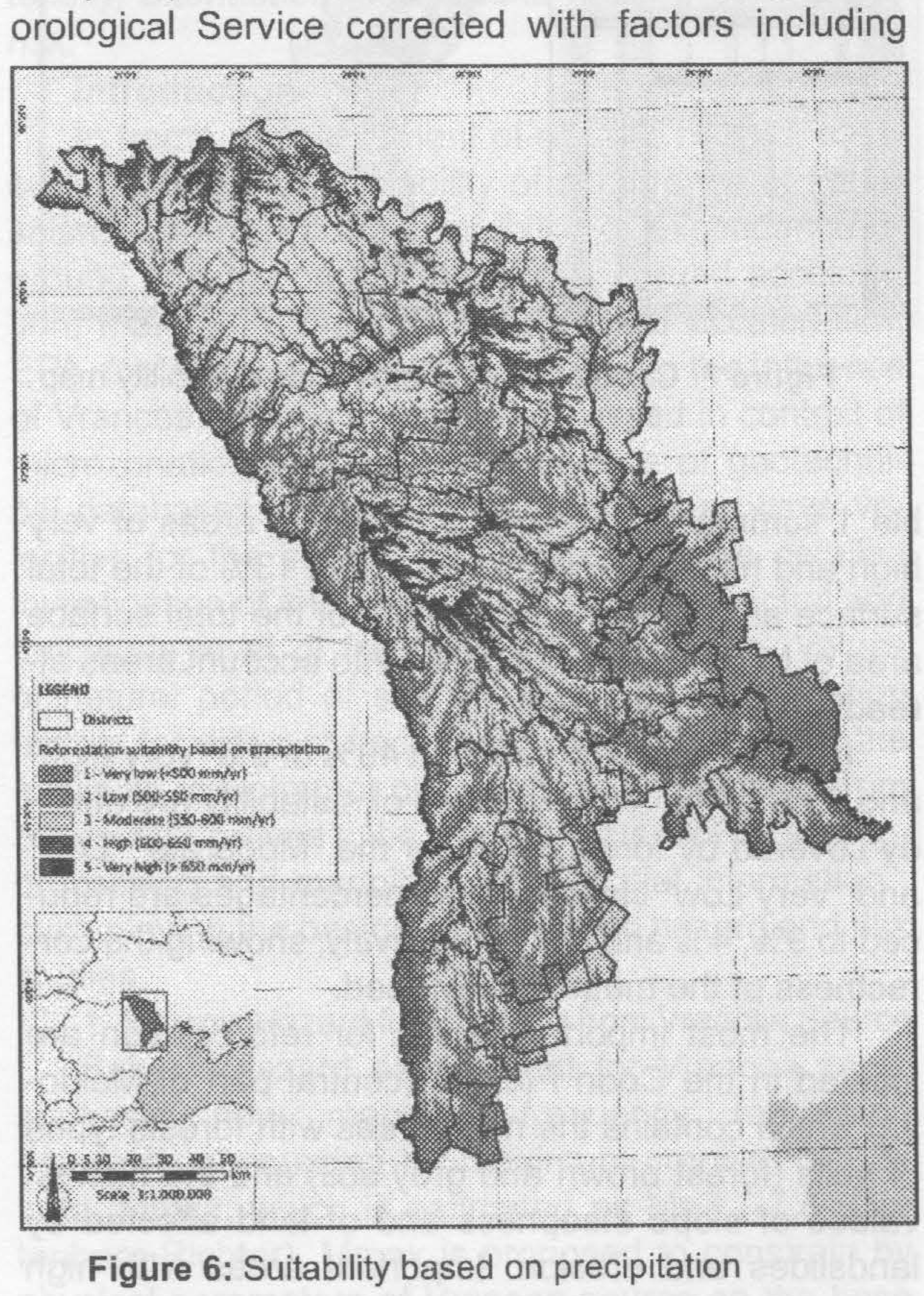

Figure 6: Suitability based on precipitation

elevation, geographic latitude and longitude (x, y, z). In natural conditions, forest normally develop on surfaces with precipitation amounts exceeding 550-600 mm/year (depending on forest type). In general, the higher the rainfall the better. The following classes have been defined:

A. Very low suitability less than < 500 mm/year (ranking 1)

B. Low suitability: 500-550 mm/year (ranking 2);

C. Moderate suitability: 550-600 mm/year (ranking 3);

D. High suitability: 600-650 mm/year (ranking 4);

E. Very high suitability: greater than 650 mm/year (ranking 5).

A database was made for each layer and all of them were integrated and analyzed by a weighted aggregation method in ArcGIS software and values (from 1 to 5) were assigned according to the degree of afforestation suitability, as described above, for each attribute (see maps 2, 3, 4, 5 and 6).

The priority for reforestation in each pixel was calculated by a weighted linear combination (Malczewski, 1999). It has been decided that all the different attributes should have the same weight on the determination of reforestation suitability so the coefficients have been set equal to 1. The procedure has been implemented in ArcGIS, as shown in Figure 7.

Results

The final map obtained is shown in Figure 8. Table 1 summarize the results obtained: areas of very high and high suitability cover about 13% of the total surface area of Moldova and 9% of the total surface area of Moldova without taking into account areas already covered by forest.

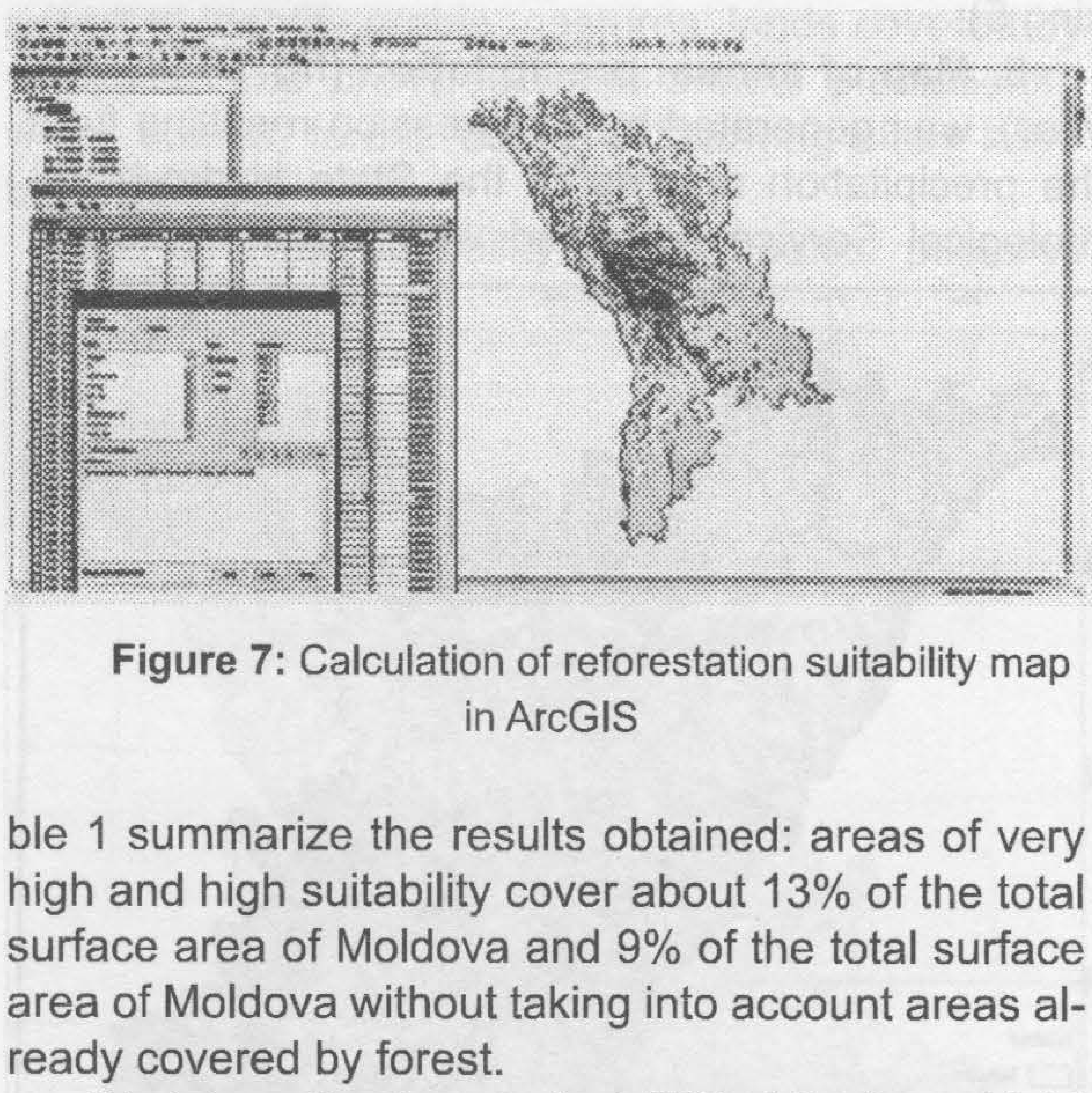

Figure 7: Calculation of reforestation suitability map in ArcGIS

It is interesting to note that 49% of the "very high" and 43% of the "high" classes of suitability are already covered by forest, while for the "Moderate" "Low" and "Very Low" classes these percentages are reduced to 9%, 4% and 4% respectively, showing the correctness of the methodology used.

The most important areas for reforestation are located in the Codri Plateau (central part of Moldova) which contains the main areas with forests types of soils (forest brown and grey soil) and the highest values of slope steepness and of land affected by landslides and erosion. Important areas with high and very high suitability for afforestation are recorded in the North (Nistru Heights and North Moldova Plateau), and, partly, in the South (Tigheci Hills).

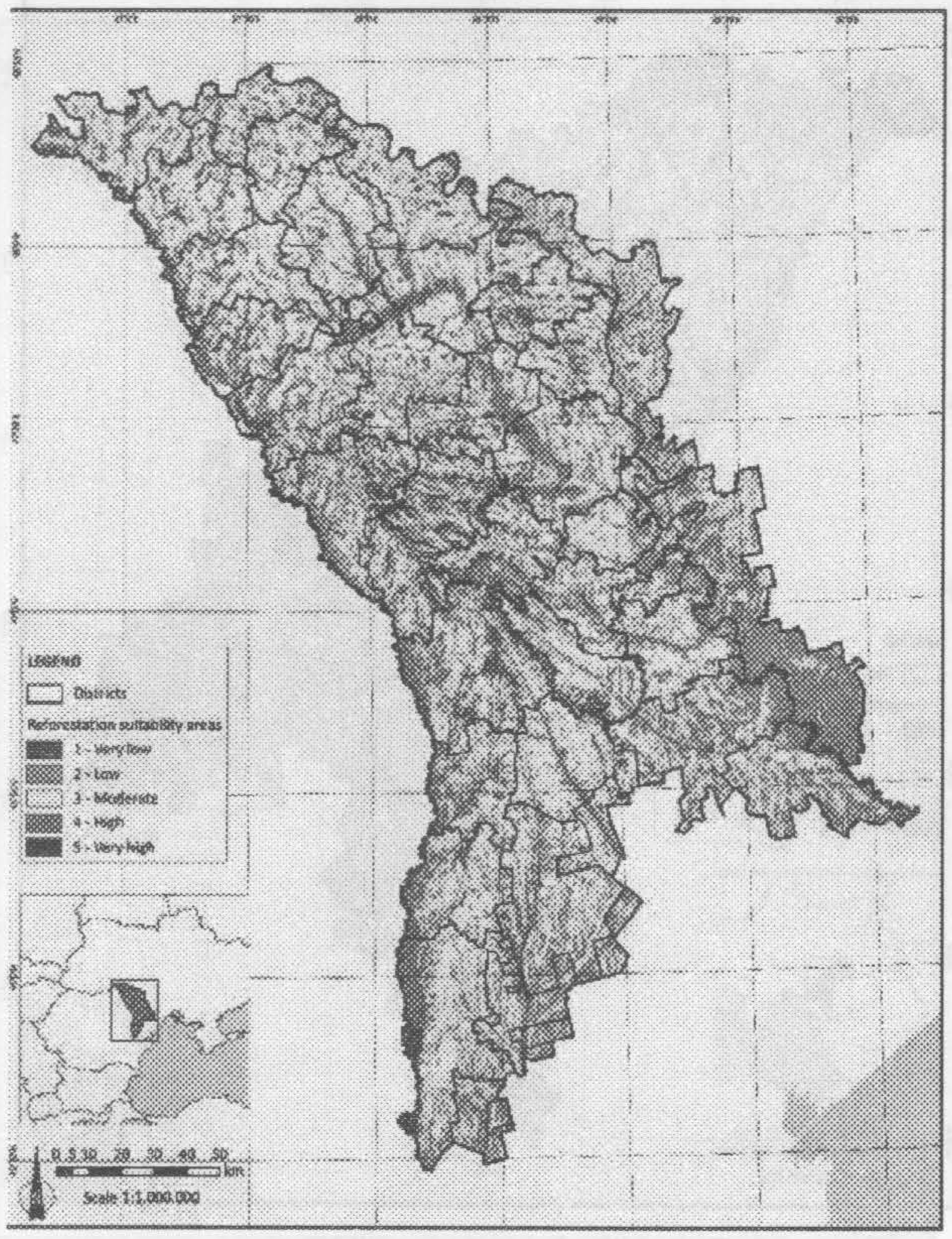

Figure 8: Reforestation suitability

Most of the territory of Moldova (51%) has a moderate suitability for afforestation or reforestation. These territories are occupied by arable land, have average slope (6-10^0), and low to medium eroded soils.

Table 1: Reforestation suitability are

Category of suitability	Reforestation suitability areas		Areas already covered by forest, km^2	Reforestation suitability areas (without areas already covered by forest)	
	km	%		km^2	%
Very high	385	1%	187	197	1%
High	3,968	12%	1,689	2,279	8%
Moderate	17,217	51%	1,550	15,667	52%
Low	11,845	35%	514	11,331	38%
Very low	431	1%	19	412	1%
Total	33,846	100%	3,960	29,886	100%

Territories with low and very low suitability (36%) occupy floodplain areas (covered by pastures, and, also, settlements and water bodies), with low slope (less than 6^0) and with weak eroded or non-eroded soils.

According to the Land Code (1998), agricultural lands cannot be used for other purposes if they have certain characteristics that make them suitable for agriculture. Nowadays, it is estimated that about 40% of the total surface of agricultural land has a certain level of erosion (Land cadaster of Republic of Moldova, 2013). For this reason these lands are subject to Law on amelioration through afforestation (Law no. 1041 from 15.06.2000 on Forestation of Degraded Land, Forest Code, art. 54, Ch. X) and could be transferred to the Reserve Fund for being afforested through the Government Decision.

Conclusions

Areas of very high and high suitability cover about 13% of the total surface area of Moldova and 9% of the total surface area of Moldova without taking into account areas already covered by forest.

About 49% of the "very high" and 43% of the "high" classes of suitability are already covered by forest, while for the "Moderate" "Low" and "Very Low" classes these percentages are reduced to 9%, 4% and 4% respectively, showing the correctness of the methodology used.

The most important areas for reforestation are located in the Codri Plateau, Nistru Heights and North Moldova Plateau.

Most of the territory of Moldova (51%) has a moderate suitability for afforestation or reforestation. Territories with low and very low suitability (36%) occupy floodplain areas (covered by pastures, and, also, settlements and water bodies), with low slope (less than 6^0) and with weak eroded or non-eroded soils.

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APPLICATIONS OF GEOGRAPHICAL INFORMATION SYSTEMS TO SEISMOLOGICAL PROBLEMS

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Abstract: *The concept of the Geographical Information Systems (GIS) which has found to be very useful in seismological problems, particularly, in seismic hazard and risk studies is presented. GIS can be used to integrate vast amounts of spatially distribution seismological data, provides effectively application of complex mathematical models and graphically analysis of results. The central part of Chisinau (6.3km² site), capital of the Republic of Moldova, is the case study of the study. Collection, classification and digitization in ArcView GIS format of the main characteristics of the subsoil such as mean shear wave velocity, natural period of vibration and amplification factor, compilation of database for existing structures as well as construction of digital terrain model (DTM) were performed. The final product is the GIS database and software module for purposes of seismic hazard and risk evaluation.*

Keywords: *earthquake, Vrancea, magnitude, intensity, attenuation, earthquake hazard, earthquake risk.*

Introduction

In frame of assessment of seismic hazard, measured in terms of probability of occurrence of future seismic event [8], the probability of exceedance of ground shaking parameters: peak ground acceleration, PGA, and effective peak ground acceleration, EPA, for the city of Chisinau exposed to the influence of Vrancea seismic source is discussed in context of microzonation studies. The presence of geotechnical databases, including measured shear wave velocities for the subsoil of Chisinau, allows detailed investigation of influence of soft soils on spectral and amplitude level of free-field ground motion. Values of natural period of soil vibration and amplification factors for different frequencies are calibrated by the available microtremor observations and records from blasts. GIS proved to be the adequate tool for storing, processing and mapping of the spatial information , such playing the basic role in seismic hazard and risk studies.

1. Seismic Hazard for Chisinau from Vrancea Source

Seismic hazard assessment for Vrancea zone, suggests new magnitude-frequency regression equations accounting for maximum credible magnitude, Mmax, which is estimated as M=7.7-7.8 (Gutenberg-Richter). Mmax is proposed to constrain by physical parameters of Vrancea source on the base