IS THE SOMEŞ-TISA HYDROGRAPHIC AREA PRETABLE FOR PEDOLOGICAL STUDIES CARRIED OUT WITH MOBILE APPS?

Bogdan-Vasile CIORUŢA[1-3#], Kateryna RADLOVSKA[4], Mirela COMAN[1,5]

[1]University of Agricultural Sciences and Veterinary Medicine in Cluj-Napoca, Doctoral School, 3-5 Calea Mănăştur, 400372, Cluj-Napoca, Romania; mail: bogdan-vasile.cioruta@usamvcluj.ro
[2]Technical University of Cluj-Napoca - North University Center of Baia Mare, Office of Informatics, 62A Victor Babeş Str., 430083, Baia Mare, Romania; mail: bogdan.cioruta@staff.utcluj.ro
[3]Technical University of Cluj-Napoca - North University Center of Baia Mare, Department of Specialty with Psychopedagogical Profile, 76 Victoriei Str., 430072, Baia Mare, Romania; mail: bogdan.cioruta@campus.utcluj.ro
[4]Ivano-Frankivsk National Technical University of Oil and Gas, Department of Ecology, 15 Karpatska Street, Kolomyia, Ivano-Frankivs'ka oblast 76008, Ukraine; mail: kateryna.radlovska@nung.edu.ua
[5]Technical University of Cluj-Napoca - North University Center of Baia Mare, Faculty of Engineering, 62A Victor Babeş Str., 430083, Baia Mare, Romania; mail: mirela.coman@irmmm.utcluj.ro

RESEARCH ARTICLE

Abstract

Monitoring and protection of soil resources are concerns of particular interest, which have more recently been achieved through the use of mobile devices that come bundled with a wide variety of applications. In order for such applications to be used to their full potential (to efficiently collect, process, store and disseminate information of interest to users), the space understudy needs to be truly highly diversified. The diversification of the spatial configuration, as well as the dynamics of the field conditions, must be sufficiently well represented, in order to be able to support and validate the incursion of mobile applications in research. In these conditions, for this paper, we aimed to verify whether the hydrographic area Someş-Tisa is appropriate (suitable) to support the development of agro-pedological studies using mobile applications. The results, according to the literature consulted (especially the Methodology for the Development of Pedological Studies) and the functionalities of some applications created in the MIT App Inventor® environment, showed that in the considered area mobile applications can be used for agro-pedological studies. meet, for the most part, all the basic ecopedological indicators. Consequently, it can be stated that the Someş-Tisa hydrographic area corresponds to the requirements of the research undertaken and that the incursion of mobile applications is more than welcome.

Keywords: Someş-Tisa hydrographic space, water collection area, land use, application testing.
#Corresponding author: bogdan-vasile.cioruta@usamvcluj.ro

INTRODUCTION

The Someş-Tisa hydrographic area is located in the northern and northwestern parts of Romania (Fig. 1), occupying an area of 22380 km^2, ≈9.42% of the Romanian territory (ABAST, 2016-2021). It is bounded on the north by Ukraine - by the natural border of the river Tisza on a length of 61 km, on the west by the border with the Republic of Hungary, and on the territory of the country, it borders the Siret basins to the east, the Mureş basin to the south and Crişuri basin to the southwest.

From an administrative point of view, the Someş-Tisa hydrographic area extends over the territory of 7 counties: Maramureş (≈97%), Bistriţa-Năsăud (≈94%), Sălaj (≈88%), Satu Mare (≈77%), Cluj (≈66%), Alba and Bihor; the share of the last two being insignificant, ≈0.06% and ≈0.7% (ABAST, 2016).

From the development regions (Covăsnianu, 2011; CJ Maramureş, 2018) and implicitly from the hydrographic network of the country perspective, which is managed on basins (Fig. 2), the Someş-Tisa hydrographic space includes administrative territories from the North-West development region; together it has a share of ≈65.52% (ABAST, 2021; ADRNV, 2021). The total population of the Someş-Tisa hydrographic area was according to the data from the INS, at the level of 2011, 1835850 inhabitants, of which 1005310 inhabitants (≈54.76%) in the urban area and 830540 inhabitants (≈45.24%) in rural (ABST, 2016-2019). The main urban agglomerations are Cluj-Napoca, Baia Mare, Satu Mare, Bistriţa, Zalău, Sighetul Marmaţiei, Dej, Borşa, Lăpuş, Jibou, Beclean, Năsăud. The degree of industrialization of the territory of the Someş-Tisa river basin is relatively high, represented by many economic

branches, of which the share is held by the extraction and preparation of minerals, building materials industry, chemical industry, textile industry, food industry, wood exploitation and processing (ABST, 2016-2021; CJ Maramureș, 2018). The distribution of the main economic activities in the Someș-Tisa hydrographic area represented by ranges of industrial and agricultural products is as follows: industrial products - timber, processed PVC and polyethylene products, textiles and metals, furniture, etc., and agricultural products - bakery products, meat, and meat products, dairy products, etc. (CJ Maramureș, 2018; ABAST, 2019-2021; ADRNV, 2021).

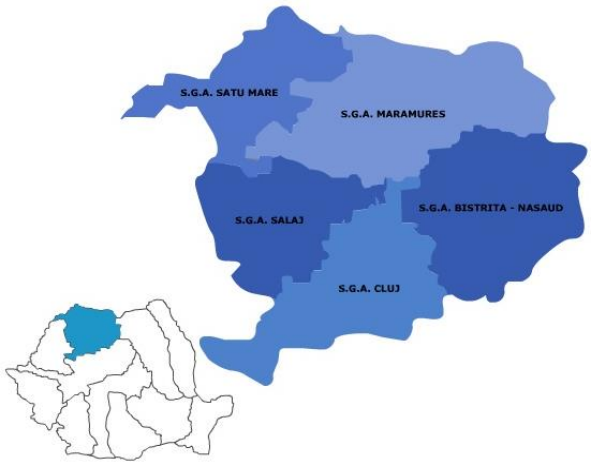

Figure 1. **Territorial water management subunits of Water Basin Administration Someș-Tisa (ABAST, 2019)**

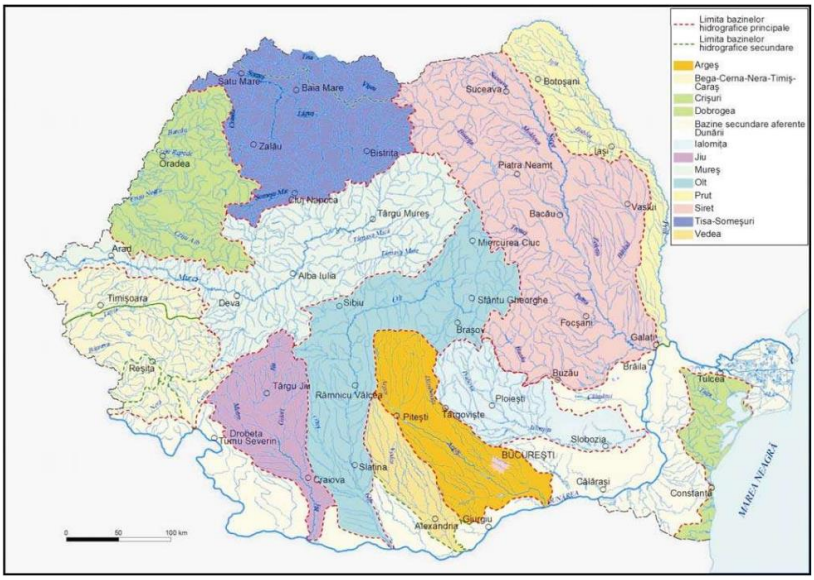

Figure 2. **Romania's hydrographic network managed by river basins (Gâștescu, 2010)**

The infrastructure in the Someș-Tisa hydrographic area is represented by the road with a length of 4540 km, the railway with non-electrified lines of around ≈90%, and the electrified lines and double lines representing the difference between the regional network and air transport through Avram Iancu International Airport in Cluj, Satu Mare International Airport and Baia Mare International Airport.

The area of the Someș-Tisa hydrographic area has a high tourist potential, among which are listed only some of the tourist objectives that can be visited, namely: Rodna National Park located in Maramureș and Bistrița-Năsăud counties being included in the biosphere reserve and UNESCO Biosphere, Apuseni Natural Park on the Someș Cald and Beliș rivers, Maramureș Mountains Natural Park and Pietrosul Mare Scientific Reserve in Maramureș, Ocna Șugatag Spa (Maramureș), Alexandru Borza Botanical Garden (Cluj) (ABAST, 2019; CJ Maramureș, 2018).

In the Rodna Mountains National Park there are several natural areas of special scientific, geological, landscape, floristic, faunal, and speleological interest, among which we mention: Pietrosu Mare, Piatra Rea, Poiana cu Narcisse on the Saca Massif, Izvorul Tăuşoarelor Cave, Izvorul Bătrâna, Izvoarele Mihăiesei, Peştera şi izbucul Izvorul Albastru al Izei.

S.P.A. (areas for special protection) according to H.G. no. 1284/2007 are: The lower meadow of the Tour, the Nir Plain - Ierului Valley, the Lower Meadow of the Tour - on the Tur and Valea Rea rivers, etc.; S.C.I. (areas of Community importance) according to O.M. no. 776/2007 are: Valea Izei and Dealul Solovan - on the rivers Iza, Boicu, Ieud and Botiza, Câmpia Careiului, etc (ABAST, 2019; CJ Maramureş, 2018).

The cultural objectives on the territory of the Someş-Tisa hydro-graphic space are numerous; thus, the most interesting objectives can be enumerated, such as: "George Coşbuc" and "Liviu Rebreanu" Memorial House, Săpânţa Merry Cemetery, Baia Mare County Museum of History and Archeology, Sighetu Marmaţiei Ethnography Museum and Bârsana Monastery, wooden churches (UNESCO monuments) from Rogoz, Poienile Izei, Surdeşti, Plopiş, Ieud and Budeşti, Ardud Fortress, etc (ABAST, 2019; Cioruţa et. al, 2020). Based on the above information, and taking into account that the monitoring and protection of soil resources are concerns of particular interest (which has more recently been achieved through the use of mobile devices that come bundled with various applications), through this paper, we set out to analyze whether the Someş-Tisa hydrographic area can be a representative one for soil monitoring and protection, as well as for carrying out agro-pedological studies using mobile applications (Cioruţa et. al, 2014; Cioruţa and Coman, 2019; 2021).

MATERIAL AND METHOD

In order for mobile applications to be used to their full potential (to efficiently collect, process, store and disseminate information of interest to users) (Cioruţa et. al, 2014), the space considered for research needs to be extremely diverse. The diversification of the spatial configuration, as well as the dynamics of the field conditions, must be sufficiently well represented, to be able to support and validate the incursion of mobile applications.

In these conditions, we set out to verify whether the Someş-Tisa hydrographic area is suitable (suitable) to support the development of agro-pedological studies in accordance with the specifications of the literature, especially the Methodology of Elaboration of Pedological Studies (1987, with subsequent amendments and completions) (Florea et. al, 1987; Cioruţa and Coman, 2022), to see which of the basic ecopedological indicators are needed in agro-pedological studies. The next step coincided with checking the functionality of applications created in the MIT App Inventor® (Cioruţa and Coman, 2021-2022) to see if they can be adapted to the conditions of the Someş-Tisa watershed.

RESULTS AND DISCUSSIONS

On the Romanian territory, the Someş-Tisa hydrographic area includes the Tisa sub-basin (also the Tour) with 123 coded watercourses (surface 4540 km^2 and network density of 0.35 km/km^2), Someş with 403 codified watercourses (surface 15740 km^2, network density of 0.35 km/km^2) and Crasna with 54 coded watercourses (area 2100 km^2 and network density of 0.34 km/km^2) (ABAST, 2016; ABAST, 2019; CJ Maramureş, 2018).

From a geological perspective, the Someş-Tisa hydrographic area includes the north and northwest of the Transylvanian Basin, the northern and eastern massifs of the Apuseni Mountains, as well as parts of the Eastern Carpathians and the Pannonian Depression, with a predominantly siliceous structure and a wide range of metamorphic and sedimentary rocks.

The relief of the Someş-Tisa hydrographic space is varied in morphology and geologically complex, being represented by mountains (≈20%), hills and plateaus (≈55%), and plains (≈25%). Among the main relief units of the considered area, represented in Fig. 3, identify:

- the area of high mountains - present in larger areas in the north and south (Maramureş, Rodna, and Gilău-Vlădeasa Mountains), as well as in the southeast (Călimani Mountains); are mountains that exceed 1800 m with the maximum altitude in the peak Pietrosul Rodnei (2303 m), with relief with steep slopes.
- the area of medium and low mountains - represented in the north and northeast by the mountains of volcanic origin Oaş, Gutâi, and Ţibleş, and in the southwest and west by the Meseş and Plopiş Mountains with altitudes between 500 and 1400 m.

- Someşan plateau area - characterized by a complex of gentle shapes, with medium altitudes (≈600 m), having the appearance of platforms with frequent shapes of monoclinic structures.
- the plain area - located in the western part and represented by the Someş Plain, which has a slight inclination from southeast to northwest; it consists of a higher portion (≈180-200 m), a piedmont plain with wide interfluves and fan terraces and a lower portion (≈115-125 m), represented by a floodplain, with valleys few deep and deserted whites.

Regarding the hydro-meteorological and climatic conditions (see Fig. 4), the Someș-Tisa hydrographic space presents, by reference to the weather station from Baia Mare, a moderate continental temperate climate with clear oceanic nuances and without exaggerated variations of temperature and precipitation (Marcu and Coman, 2005; Coman, 2006; Cioruța et. al, 2013).

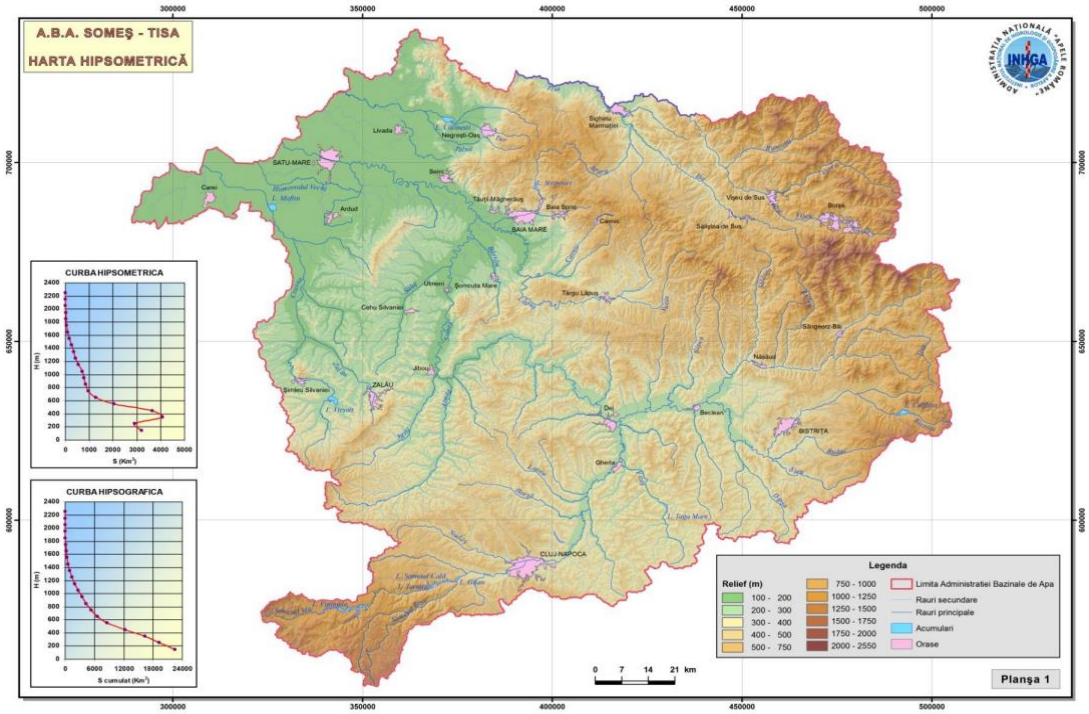

Figure 3. **Hypsometric map of the Someș-Tisa hydrographic area (ABAST, 2016-2019)**

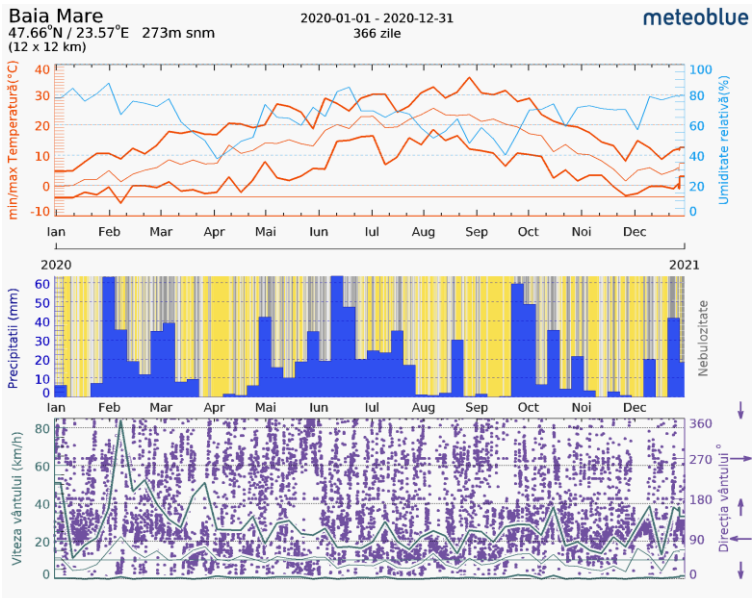

Figure 4. **Temperature variation, relative humidity, precipitation, nebulosity, speed and wind direction in the Someș-Tisa hydrographic area (Cioruța and Coman, 2022)**

Precipitation registers values between ≈1000-1400 mm on the tops of high mountains (Rodna, Gutâi, Tibleş, Bîrgău, and Călimani Mountains), between ≈800-1200 mm in the Apuseni Mountains area from west to east, and ≈600-700 mm in the low regions (Transylvanian Plain and Someş Plain, Someş Plateau). The average annual temperature varies from ≈0°C in the mountain area to over ≈9.4°C in the plain area (Coman, 2006; Cioruţa et. al, 2013; Coman and Cioruţa, 2017).

Regarding the total surface water resources, they amount to ≈6830 mil. m^3/year, of which the usable resources are ≈1287 mil. m^3/year. Of these, ≈70% are insured in the natural regime, the main watercourses being: Tisa, Someş, Vişeu, Someşul Mic, Lăpuş, Iza, and Şieu, and their tributaries. The difference in water resources is ensured by accumulations.

The hydrographic network of the Someş-Tisa area identifies both an impressive number of hydrometric stations (Fig. 5) and a number of 580 cadastral watercourses totaling a length of 8423 km, with an average density of 0.376 km/km^2.

The Tisza River (cadastral code I.1) with a length of 1592 km has its sources in the Forest Carpathians, in the western territory of Ukraine, and flows into the Danube. On the Romanian territory, the Tisza basin has an area of 4540 km^2, with an average slope of 2‰, gathering a number of 123 cadastral watercourses. The left tributaries of the Tisza that drain the Maramureş Depression are Vişeu (L=82 km; S=1581 km^2), Iza (L=80 km; S=1293 km^2), Săpânţa, Baia, Valea lui Francisc and the rivers that enter the Tisza over the border are Bătarci with Tarna Mare, Egher with Hodoş, and Tur.

The Tur River (L=66 km, S=1008 km^2) is considered to belong to the middle course of the Tisza, as well as the Someş, but in the territory of our country, it enters the group of northern rivers, draining the western slopes of the Oaş-Gutâi volcanic group. It springs from an altitude of approx. 950 m, the slope of the watercourse in the mountain sector reached 20 m/km, decreasing to the values of 2-8 m/km at the bottom of the depression and below 1 m/km in the plain sector (ABAST, 2016-2019).

In the first convergence area located north of Remetea Oaşului, Turul receives on the right its largest tributary, Lechincioara (L=29 km, S=286 km^2), with its tributaries Valea Rea and Valea Alba, and on the left on Slatina or Strâmba. The next tributary is the Talna (L=35 km, S=186 km^2), (ABAST, 2016-2019) which crosses the southwestern region of the Oaş Depression, flowing parallel to the Turul, after collecting tributaries from the southern branch of the depression.

The Someş River (cadastral code II.1) with a length of 376 km, drains a river basin with an area of 15740 km^2, a general slope of 3‰, gathering the waters of a number of 403 cadastral watercourses. Someşul, by uniting Someşul Mare with Someşul Mic upstream of Dej, crosses to the N-V the Someşan Plateau, between Clujului and Ciceului Hills, receiving symmetrically a series of tributaries from both sides. The important tributaries of the Someş are Almaş (L=65.4 km, S=810 km^2) and Lăpuş (L=114.6 km, S=1820 km^2) (ABAST, 2016). Someşul Mare has its springs at the end of the Rodna Mountains and results from the union of several streams with a length of 130 km, which drains 5033 km^2. Its largest tributary is the Şieu.

Someşul Mic with a length of 178 km and a basin area of 3773 km^2 is formed by two mountain streams: Someşul Cald and Someşul Rece, which join at the eastern foot of the Gilău Mountains. Given the large size of the Someşul Cald, it is considered the source of the Someşul Mic. The largest tributary of the Someşul Mic is Fizeşul.

Someşul Cald (L=66.5 km, S=526 km^2) springs from under the Piatra Arsă peak, from the central massif of Bihariei-Vlădeasa. Its largest tributary is the Belis. Someşul Rece (L=45.6 km, S=331 km^2) (ABAST, 2016), drains through its tributaries in the central part of the Gilău Mountains, having its source near the Great Mountain. Its largest tributary is Răcătău.

The Crasna River (cadastral code II.2) with a length of 134 km and a basin area of 1931 km^2, collects the waters of 54 cadastral watercourses. Its main tributaries are Zalău, Maja, and Maria, all with insignificant flows and with lengths not exceeding 38 km.

In the Someş-Tisa hydrographic area, there are also eight important accumulation lakes (with an area of more than 0.5 km^2), which have a complex use and which amount to a useful volume of ≈328.3 mil. m^3. Compared to the population of the basin, the specific usable resource is ≈504 m^3/inhabitant/year, and the specific resource calculated from the available stock is ≈3426 m^3/inhabitant/year (ABAST, 2016-2019).

The water resources in the Someş-Tisa hydrographic area are sufficient, there is a reserve potential, being evenly distributed in time and space. The average multiannual flows

for the main rivers in the Someș-Tisa hydrographic area are ≈130 m³/s (Tisa river at the exit from the country), ≈129 m³/s (Someș river at Satu Mare hydrometric station), ≈6 m³/s Crasna at Domănești station). Of the total length of watercourses registered in the Someș-Tisa hydrographic area, non-permanent watercourses represent ≈54.6%.

The usable groundwater resources at the basin level are estimated at ≈316 mil. m³, of which ≈59% come from groundwater sources and the rest from deep sources (ABAST, 2016-2019; Gâștescu, 2010). Zonal climatic conditions and surface water resources ensure rich biodiversity. As such, the vegetation must be viewed both in terms of zonal dynamics and vertical layering.

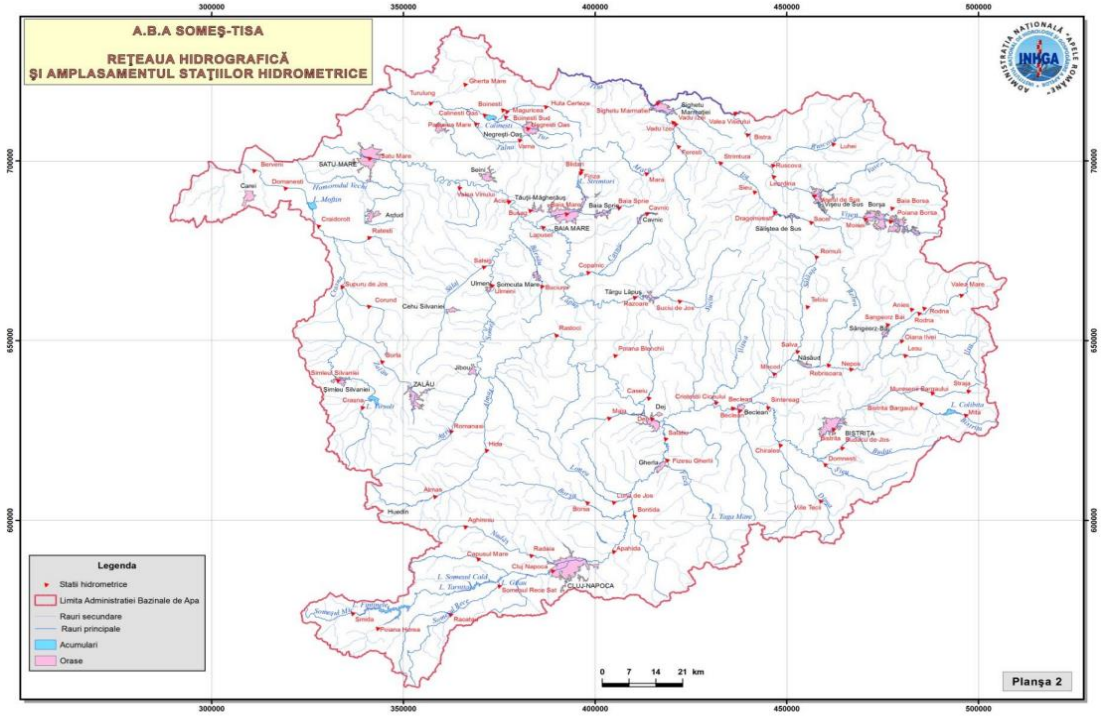

Figure 5. **Hydrographic network and location of hydrometric stations in the Someș-Tisa hydrographic area (ABAST, 2016-2019)**

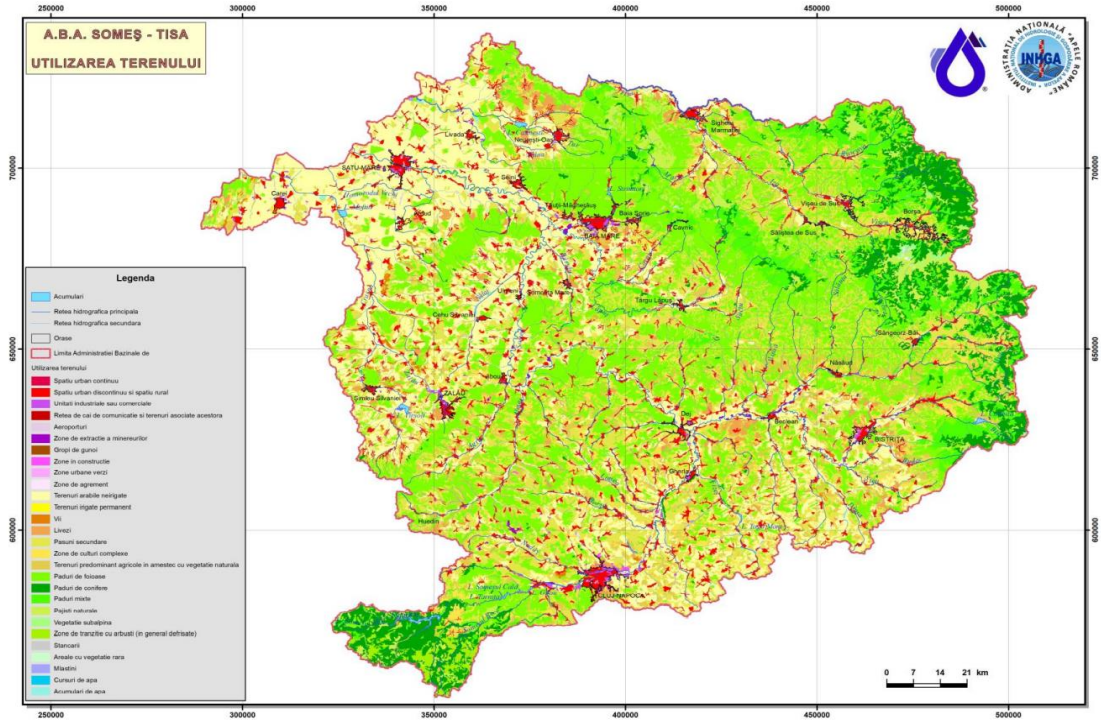

Figure 6. **Land use in the Someș-Tisa hydrographic area (ABAST, 2019)**

The territory of the Someș-Tisa hydrographic area is located almost entirely in the immoral area, except for some restricted parts of the Someș Plain located in the forest-steppe area and the territories under the influence of the altitudinal zoning (Carpathian chain and high hills), is delimited on the basis the presence of oak forests, located on forest soils. Some habitats specific to the area are mentioned: Dacian forests of pedunculate oak, Pannonian oak forests pedunculate, Dacian forests of oak, beech, and hornbeam with Lathyrus hallersteinii; southeastern Carpathian forests of beech with Festuca drymeia (Helindian and Cioruța, 2021). Along with the hydrographic space, the representative fauna is the one from the area of plains and plateaus, meeting mammal species such as the woodpecker, the gray grouse, the field mouse, the ferret, the lynx, the marten, the partridge, the badger, etc. Among the birds, the most common are the reeds, the quail, the woodpeckers, and the tit. The aquatic fauna is represented by scobar, clean, and barbel. The mountain fauna is represented by mammals: lynx, bear, wolf, black goat, marmot; through birds: capercaillie, scissor, blackbird; through aquatic fauna: trout, clean, grayling.

In accordance with the composition of biodiversity, at the level of the Someș-Tisa hydrographic area, 10 sites of community importance (S.C.I.) were designated, as well as 35 special avifauna protection areas (S.P.A.).

Along with the previously mentioned sites, within the Someș-Tisa hydrographic area, there are also lands that have other uses. Fig. 6 refers to land use in 2019, in order to have an overview of soils and their use in water catchment areas, where it is desired to apply the environmental information systems (software applications) proposed. In addition to the above, it can be mentioned that the hydrophysical properties of the soil are an essential factor in the water circuit, influencing infiltration, surface runoff, and water loss by evaporation; so that in the well-drained perimeter of the Someș-Tisa hydrographic space the following soil classes are found:

- the cernisols class includes soils chestnut, chernozem, phaeozium, rendzina);
- the luvisols class includes soils with polygenetic evolution, developed in good or moderate drainage conditions (intermontane and submontane depression areas, plateau and plain areas);
- the cambisols class includes eutricambosol, distrambambosol, and eutricambosol soils (common in mountainous areas, submontane and intermontane depressions, meadows, and wandering areas);
- the spodisols class includes prepodzol and podzol (present on a large scale in the Rodna Mountains, Maramureș, and Apuseni Mountains);
- the umbrisols class includes black soil and humosiosol (it appears in the Carpathians at altitudes of 1000-1400 m);
- the andisols class includes soils formed by volcanic ash, pumice stone, and other volcanic derivatives of different compositions, morphologically they are characterized by a vitreous and andic horizon (it develops especially on volcanic rocks);
- the hydrosols class includes gleiosols (located in poorly drained low plains, meadows, lower terraces, and depressions and on flat surfaces covered with clay deposits within the wetlands);
- salsodisols and vertisols that do not show a significant spread, being present only in isolation.

Regarding the land use in the entire Someș-Tisa hydrographic area, there is an uneven distribution of forests, pastures, arable lands, urban and industrial lands, depending on the type of relief of the respective areas.

Agricultural lands are predominant in all three river basins, Tisza (≈51.9%), Someș (≈64.3%), and Crasna (≈72.1%). The forests occupy a larger area in the Tisza sub-basin (≈42.8%) compared to the other sub-basins - Someș (≈28.3%) and Crasna (≈18.2%). Urban areas together with the water gloss have a share of ≈7% of the total areas (ABAST, 2016).

All these elements have been recorded in order to be able to easily correlate them with some of the basic ecopedological indicators that are necessary for carrying out agro-pedological studies. As such, some of the indicators set out in the Methodology for the Development of Pedological Studies - more precisely, indicators related to the characteristics of climatic zones (Table 1), the characteristics of relief categories (Table 2), the characteristics of non-uniformity of the territory (Table 3), to the degree of soil pollution (Table 4) and to the types of soil pollution, by nature and source of the pollutant (Table 5) - were extracted.

Table 1

Characteristics of the main climatic zones (Florea et. al., 1987; reproduction with changes)

Climate areas	Average annual temperature, (°C)	Solar radiation, kcal/cm^2	Average annual rainfall, mm	Identifiable elements in the Someș-Tisa area
warm-dry areas	10.5-11.5	124-132	400-600	☒
moderately warm & semidry areas	8.0-10.5	114-128	450-700	☑
cold-wet areas	5.0-9.0	110-117	550-800	☑
very cold-very wet areas	-2.0-6.0	<110	800-1400	☑

Table 2

Characteristics of the relief categories (Florea et. al., 1987; reproduction with changes)

Relief areas	Characteristics			Correlation with the main forms of relief	Identifiable elements in the Someș-Tisa area
	slope, %	fragmentation density	relief energy, m		
meadow relief (alluvial plain)	<1	extremely weak	<10	Meadow, wandering plain, coastal plain	☑
plain relief	<2(3)	very weak	10-50	Plain (terrace), plateau and foothills, slightly fragmented	☑
wavy relief	2(3)-5(8)	weak	50-150	Plain (terrace), plateau and foothills, poorly fragmented	☑
slightly rugged terrain	5(8)-12(18)	moderately	150-300	Moderately fragmented hill, plateau, and foothills	☑
moderately rugged terrain	12(18)-20(30)	strong	300-500	Highly fragmented hill, plateau, and foothills	☑
strongly rugged terrain	>20(30)	very strong	>500	Mountain	☑

Table 3

Characteristics of the classes of non-uniformity of the territory (Florea et. al., 1987; reproduction with changes)

Land areas	Characteristics	Identifiable elements in the Someș-Tisa area
uniform territories	• practically without unevenness; • does not require leveling;	☑
very weakly uneven territories	• bumps below 0.28 m; • for leveling requires a volume of less than 300 m^3/ha of the embankment;	☑
weakly uneven territories	• bumps of 0.29-0.50 m; • for leveling requires a volume of 301-500 m^3/ha of the embankment;	☑
moderately non-uniform territories	• bumps of 0.51-0.75 m; • for leveling requires a volume of 501-800 m^3/ha of the embankment;	☑
strongly non-uniform territories	• bumps of 0,76-1,50 m; • for leveling requires a volume of 801-1500 m^3/ha of the embankment;	?
very strongly non-uniform territories	• bumps of over 1,51 m; • for leveling requires a volume of over 1501 m^3/ha of the embankment.	?

Table 4

Degree of soil pollution (Florea et. al., 1987; reproduction with changes)

Pollution type	Quantitative and/or qualitative reduction of the crop production obtained, compared to the crop production that can be obtained in conditions where the soil is unpolluted	Identifiable elements in the Someș-Tisa area
(practically) unpolluted	≤5%	☑
poorly polluted	6-10%	☑
moderately polluted	11-25%	☑
heavily polluted	26-50%	?
very heavily polluted	51-75%	?
excessively polluted	≥76%	?

Table 5

Types of soil pollution - by nature and source of pollutant (Florea et. al., 1987; reproduction with changes; Cioruța and Coman, 2022)

Nature and source of pollution	Elemente identificabile în arealul hidrografic Someș-Tisa
no pollution (practically unpolluted)	☑
pollution by up-to-date excavation works (up-to-date mining operations, gravel pits, quarries, etc.)	☑
pollution with landfills, dumps, tailings ponds, floating tailings dumps, landfills, etc.	☑
pollution by inorganic wastes and residues (minerals, inorganic materials, including metals, salts, acids, bases) from industry (including extractive industries)	☑
pollution by airborne substances (hydrocarbons, ethylene, ammonia, sulfur dioxide, chlorides, fluorides, nitrogen oxides, lead compounds, etc.)	☑
pollution with radioactive materials	?
pollution with organic waste and residues from the food and light industry	☑
pollution with agricultural and forestry waste and plant residues	☑
pollution with animal and human residues	☑
erosion and landslide pollution	☑
salt and acidification pollution	?
excess water pollution	☑
pollution by excess or nutrient deficiencies	?
compaction pollution, including crusting, and sediment pollution produced by erosion	?
pesticide pollution	☑
pollution with contaminating pathogens (infectious agents, toxins, allergens, etc.)	?

As can be seen, in the research area (Someș-Tisa hydrographic area) there are almost all ecopedological indicators related to climate and relief (Florea et. al, 1987; Cioruța and Coman, 2022), except those related to strong and very strongly non-uniform territories (see Table 3), respectively those starting with a severe form of soil pollution - Table 4 and Table 5 (Cioruța and Coman, 2015; Hreniuc et. al, 2015, 2019; Coman et. al, 2016).

The results, according to the literature consulted (the Methodology for the Development of Pedological Studies) and the functionalities of some applications created in the App Inventor®, showed that in the considered area mobile applications can be used for agro-pedological studies because they meet, in the most part, all the basic ecopedological indicators.

CONCLUSIONS

Due to the spatial conformation, size of the area, and altitudinal layer, there are significant differences between the depression and the mountainous area of the Someș-Tisa hydrographic area.

These differences in relation to the characteristics of climatic zones (Table 1), relief categories (see Table 2), non-uniformity of the territory (see Table 3), the degree of soil pollution (see Table 4), and the types of soil pollution, by nature and source of the pollutant (Table 5), extracted from the Methodology for the Development of Pedological Studies, showed

that the mobile applications can be used for agro-pedological studies. Consequently, it can be stated that the Someș-Tisa hydrographic area corresponds to the requirements of the research undertaken and that the incursion of mobile applications is more than welcome.

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