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Seria GEOGRAFIE

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ORIGIN AND EVOLUTION OF A PEAT BOG FROM NORTHEASTERN ROMANIA

Gheorghe BĂDĂLUȚĂ
Stefan cel Mare University of Suceava, Department of Geography,
Universității 13, 720229 Suceava, Romania; e-mail: badalutagheorghe90@gmail.com

Carmen Andreea BĂDĂLUȚĂ*
Stefan cel Mare University of Suceava, Department of Geography,
Universității 13, 720229 Suceava, Romania; e-mail: carmen.badaluta@usm.ro

Marcel MÎNDRESCU
Stefan cel Mare University of Suceava, Department of Geography,
Universității, 13, 720229 Suceava, Romania; e-mail: mindrescu@atlas.usv.ro

Diana ISTRATE
Stefan cel Mare University of Suceava, Department of Geography,
Universității 13, 720229 Suceava, Romania; e-mail: rotidia@yahoo.com

Ionuț Bogdan NIGA
Stefan cel Mare University of Suceava, Department of Geography,
Universității 13, 720229 Suceava, Romania; e-mail: bogdan.niga@yahoo.com

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Abstract: Peatlands are highly sensitive ecosystems that respond to hydrological, climatic, and geomorphological changes. In this study, we investigate the origin and historical evolution of a peatland located in Northeastern Romania, on the Suceava plateau. Our approach includes the analysis of historical maps and physical characteristics of both the peat (grain size, LOI - loss on ignition) and water (pH, dissolved oxygen, electrical conductivity). Our findings suggest that the development of this peatland has been more prominent along the surface than the depth. The presence of gravel and sand at the base of the peat deposit, along with surface morphological evidence, supports the hypothesis that this peatland originated in an ancient paleomeander. pH analysis indicates that the peatland is mesotrophic, while granulometric and LOI analyses suggest a fluviogenic origin.The significant changes observed in the sedimentary structure of the peatland may be attributed to climate

* Corresponding Author

change, with potential anthropogenic influences over the past 50 years. Furthermore, our study contributes valuable insights to geomorphological research in the Suceava valley, revealing visible changes spanning the last 250 years.

Key words: peatland, lithostratigraphy, grain-size, LOI, Suceava Plateau, Northeastern Romania

* * * * * *

INTRODUCTION

Peatlands serve as valuable archives of paleoenvironmental and paleoclimatic data, as they are highly sensitive ecosystems (Bragg & Tallis, 2001) influenced by hydrological, ecological, and geomorphological conditions (Evans & Warburton, 2007). Although they do not cover extensive surface areas, peatlands play a significant role in controlling CO_2 levels and thereby have a major impact on climate changes over time. As climate change becomes increasingly acute, there is a growing interest in the study of peatlands.

Due to their high organic matter content (comprising 20-30% of the total), which can exist in the form of decomposed or decomposing organic material (Myślińska, 2003), peat deposits provide valuable insights into past climates and environments. The formation of peat deposits is primarily influenced by hydrological, geomorphological, and ecological conditions (Evans, 2013). These three natural factors are critical in determining the size and typology of peatlands. In addition to these natural factors, anthropogenic influences have a negative impact.

The present study was triggered by the anthropogenic factor, specifically fire, particularly the burning of the marshland area in 2014. The prolonged duration of the fire, characterized as a smoldering soil burn, the persistent coal-like smell that lingered for three months, and the brownish-red remnants left from the burning, prompted a more detailed investigation of this area. In subsequent field investigations conducted in 2015, numerous snail shells were discovered, confirming the presence of a wetland area once. Additionally, a series of coring, each reaching a depth of 2 meters and located 200 meters away, were drilled in August 2016 in the immediate vicinity of the previously burned area. These boreholes intercepted various layers of snail shells at different depths, suggesting fluctuations in moisture levels over time.

The aim of this study is to identify the typology of the peatland in Părhăuți, as well as the factors contributing to the genesis, origin, and evolution of the peatland over time. The present study immediately draws attention, through its initial field investigations, to its significance within the context of recent climate fluctuations and their implicit impacts on the surrounding environment.

STUDY AREA

The Părhăuți peatland is situated in the Suceava Plateau at ~ 300 m altitude, in northeastern Romania. Geomorphologically, it lies at the contact of the T 8-10m and T 10-12m terraces in the central section of the Suceava River (Figure 1). Administratively, this peatland falls within the boundaries of Părhăuți village, Todirești commune, Suceava county, spanning multiple parcels of privately-owned agricultural land. The area of the peat is 2.42 ha. The region's lithology predominantly comprises sedimentary rocks, including gravel, sands, and clayey marls. Detailed analysis of Quaternary deposits, especially the terrace deposits, has provided valuable insights into the lithological structure that facilitated the formation of the peat deposit in the territory of Todirești commune (refer to Figure 2).

Sediment core F1 reveals a gradual and slow transition into the T10 terrace deposits, featuring fine sedimentary deposits at the upper portion (sand and clay) and coarser deposits towards the base of the borehole (coarse sand and gravel). The climate in the area is temperate continental with Baltic influences, characterized by severe, cold winters and warm, dry summers. The average annual

temperature stands at 8°C, with January recording a minimum of -6°C and a maximum of 18°C. The region receives annual precipitation of 565 mm/year (as reported by the Suceava Meteorological Station).

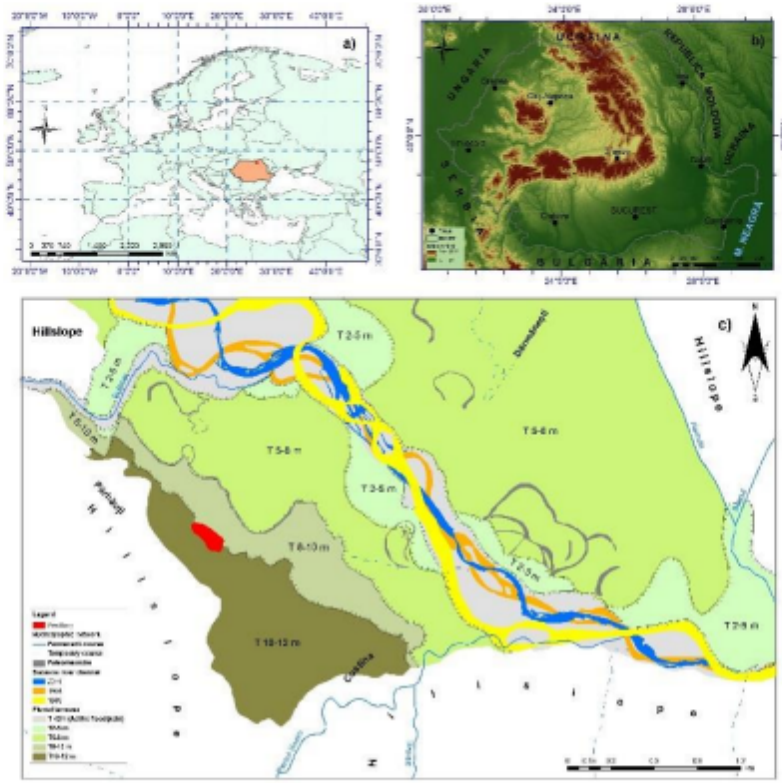

Figure 1. Location of the study site (red dot) in: a) Europe and b) Romania. The geomorphological map (c) show the position of the study area in relation to the Suceava and Solonet rivers. Fluvial terraces are labelled with "T" and their corresponding height range.

Groundwater plays a significant role in the formation of peat areas, alongside atmospheric precipitation, nurturing their development. In the study area, based on sediment cores, local wells, and existing drainage systems, it was determined that groundwater is typically found at depths ranging from 1.5 to 3 meters.

Visual and cartographic analysis places the study area within a zone characterized by marsh vegetation typical of wetlands, despite significant transformation into agricultural land due to surface drainages and underground artificial drainage systems. Consequently, on the relatively limited surface where the peatland has developed, hygrophilic species are found including: *Carex riparia*, *C. vulpina*, *Juncus effusus*, *Scirpus silvaticus*, *S. lacustris*, *Bolboschoenus maritimus*, *Phragmites communis*, *Typha latifolia*, *T. Angustifolia*, *Salix alba*, *Populus alba* and *Salix triandra*.

METHODS

The identification of the study site became possible following a wildfire incident in the winter of 2013, which resulted in a smoldering surface and ground burn. This smoldering fire persisted for approximately four months before being extinguished, primarily through human intervention aimed at preventing its spread towards nearby populated areas. The scarcity of references to peatlands in the Suceava plateau (Olaru, 1965) area prompted the examination of various cartographic materials, including the first Austro-Hungarian military topographical survey dating back to 1765 and the

second Austro-Hungarian military topographical survey from 1860. These historical maps were used to identify past land use patterns.

The main drilling activities were conducted in the immediate vicinity of the area affected by the fire in April, specifically on the 10m terrace adjacent to the Suceava River. During these drilling operations, it was confirmed that the extracted sediments were indeed peat. In the subsequent field campaign, a total of 21 cores were extracted using Edelman coring equipment, with coring points following a grid-type system at distances of approximately 40-50 meters apart. Geographical coordinates for these coring points were recorded using a Garmin GPS device. Following extraction, the cores were placed in PVC tubes, wrapped with polyethylene film, and stored at a temperature of 4°C until further analysis.

Additionally, for core number 17, a series of parameters related to water quality (pH, dissolved oxygen, electrical conductivity) were analysed using a multiparameter HQ40d Portable. These measurements were essential for characterizing the type of peat present in the core. A lithostratigraphic description of all cores was conducted based on sediment color and texture. Grain size analysis and the determination of organic and inorganic carbon content (loss on ignition; LOI) were carried out specifically for core F1 and F2 to provide a clearer understanding of the structure between the peat deposit and the underlying deposits on which this peat developed. For grain size analysis we used the protocol by Rădoane (Rădoane, Ichim, Rădoane, Dumitrecsu, & Ursu, 1996) and for LOI we applied the methodology by Heiri, (Heiri, Lotter, & Lemcke, 2001).

RESULTS AND DISCUSSIONS

STUDY AREA DELIMITATION AND CHARACTERISTICS

The delineation of the study area was conducted using a grid-based method, with borehole F1 located in the vicinity of the burned area serving as a starting point (Figure 2).

To define the study area, a total of 22 boreholes were drilled, each with dimensions ranging from 150 to 350 cm (Figure 2). The primary objectives of these boreholes were to outline the peat deposit, investigate its origin and evolution, and determine its thickness and maximum depth. Consequently, we identified the presence of peat starting from a depth of 25 cm in select cores (F2, F6, F21, and F22), with depths reaching 107-121 cm in boreholes F18 and F14 in the northern and northeastern areas, respectively. The deepest point at which peat was identified lies on the edge of the T 10m terrace, at a depth of 338 cm, where the peat layer also reached its maximum thickness of 290 cm.

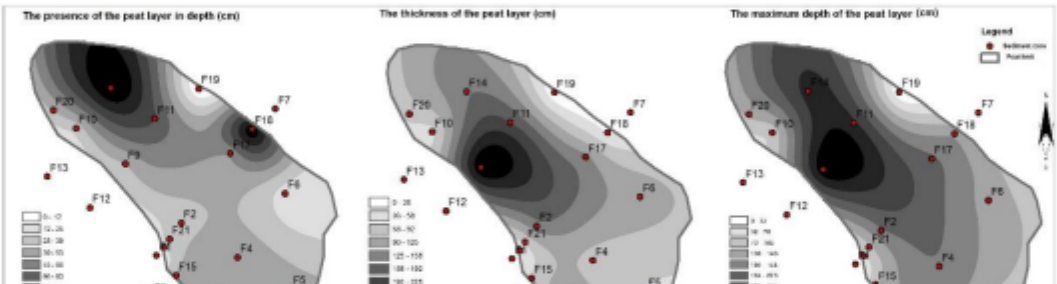

Figure 2. a) Presence, b) thickness and c) maximum depth of the peat layer

As depicted in Figure 2, the peat deposit exhibits its greatest thickness at the forefront of the terrace, as indicated by a concave interpolation. This leads us to speculate about the potential for its expansion, especially in areas where alterations in the hydrographic network may have occurred.

ORIGIN AND EVOLUTION OF THE PEATLAND

To investigate the origin and evolution of the peatland, we established two longitudinal sections and two transverse sections. Out of the total of 22 boreholes, six of them were positioned in approximately parallel alignment along the contour line at 300 meters. These boreholes were arranged in a southeast to northwest direction at varying intervals.

The boreholes labeled F5, F4, F2, F9, F10, and F20 contributed to the creation of longitudinal profile A (Figure 3), which provides the most comprehensive and complex insights into the development of the peat deposit in the longitudinal direction. Along this southeast to northwest longitudinal section, we observed a sequence of peat layers with varying thicknesses developed in a continuous alignment. According to longitudinal profile A, , the peat layer exhibits progressive growth from the southeast to the northwest until reaching borehole F9, where it attains a thickness of 290 cm (the maximum inflection recorded). Subsequently, there is a significant reduction in peat thickness (F10, with a 50 cm peat layer), followed by a slight increase in the last borehole (85 cm of peat). The soil layer covering the peat also varies in thickness along the same longitudinal profile, with the southeastern part being thicker and relatively compacted, while in the northwest part, the soil layer thins, becoming less compact, and the soil-peat mixture becomes visible (refer to Figure 3). Below the peat layer, the transition predominantly leads to gray clay, which, with increasing depth, shifts into sandy clay, clayey sand, and further below, these sands with varying grain sizes merge with fine gravel. There are exceptions where the transition from peat directly to sand (with minimal clay content) occurs, along with coarse sand, and at the base of some boreholes, sand mixes with gravel (such as F2 and F20). Approximately 40 meters to the north, while maintaining the same alignment, four boreholes are unevenly spaced.

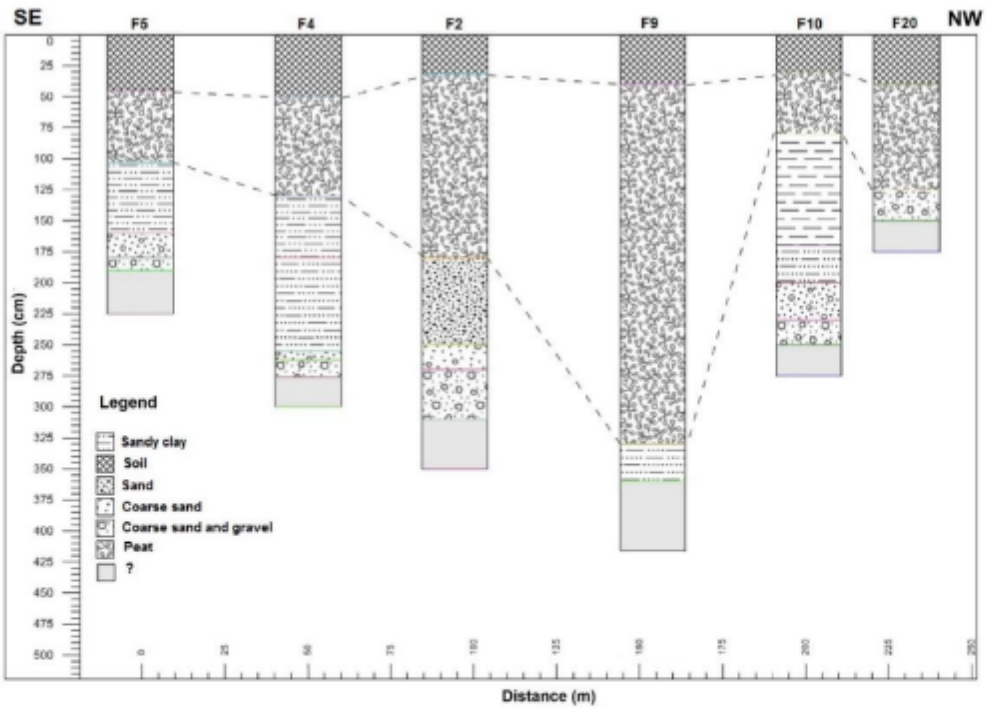

Figure 3. Longitudinal profile A in the SE – NW direction

Longitudinal profile B, which runs parallel to the direction of the first profile, provides additional insights into the peat layer's distribution. This profile reveals that the peat layer descends from the southeast (starting at F6 with a depth of 20 cm of peat) towards the northwest. In core F14,

the peat layer is encountered at a depth of 120 cm beneath a layer of clay. The relatively consistent thickness of the peat layer, its depth orientation, and the presence of clay above the peat in borehole F14 suggest that the development of the peat deposit likely occurred from northwest to southeast, with subsequent coverage by clay.

From core F1, a series of six cores were drilled in the southwest to northeast direction, intersecting perpendicularly with the 300-meter contour line. This arrangement creates a transverse profile referred to as profile C (as shown in Figure 4.5). Transverse profile C spans a length of 95 meters, cutting across the front and a portion of the ridge of the T 10-12m terrace. This profile aids in delineating the positioning of sedimentary layers in which the peatland developed. Based on the data collected, it becomes evident that the peat deposit extends between boreholes F18 to F22, with the maximum thickness observed in core F2, which is located right on the edge of the T 10-12m terrace. At the base of the front of this terrace, peat was identified at a slightly greater depth (approximately 50 cm), with a development depth similar to that of the borehole positioned on the edge of the terrace. Notably, there is a significant change in peat layer thickness between cores F17 and F18, and the presence of sandy clay below the soil layer (which exhibits its maximum thickness in this section) raises the possibility of deposition-related changes. Additionally, the transition between terraces can be discerned by examining the arrangement of layers in a northwest-southeast direction, perpendicular to the front of the terrace.

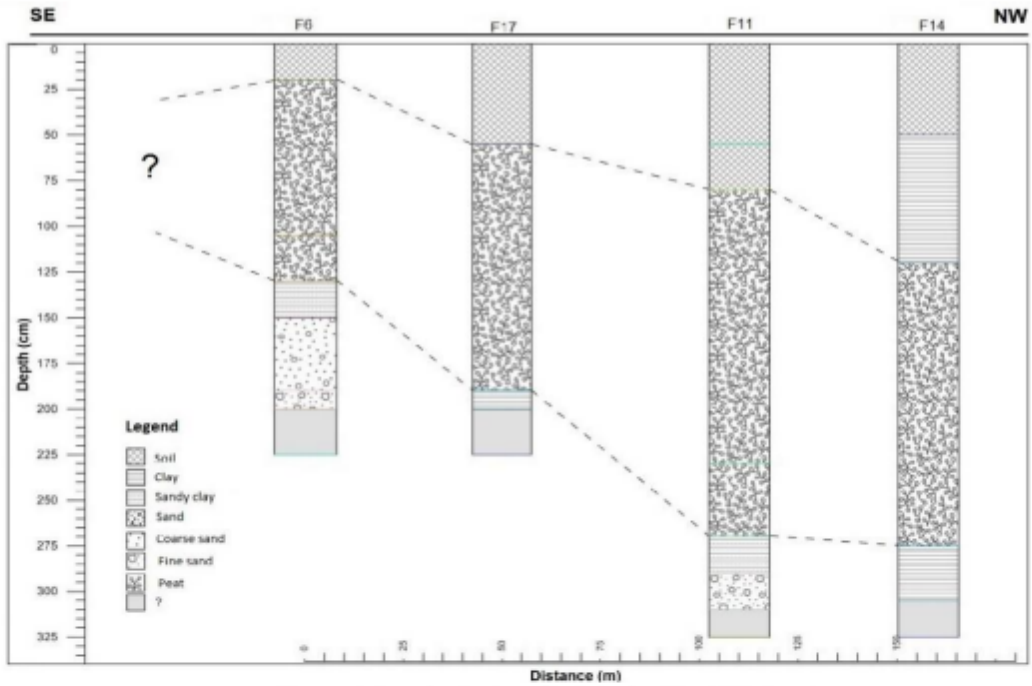

Figure 4. Longitudinal profile B in the SE – NW direction

Transverse profile D runs in a southwest to northeast direction, situated approximately 60 meters north of transverse profile C (as shown in Figure 5). This profile comprises four boreholes: F9, F11, F12, and F19. Much like transverse profile C (depicted in Figure 5), transverse profile D (illustrated in Figure 6) exhibits similar characteristics and a roughly equivalent layer arrangement. Specifically, boreholes F9 and F11 mirror the arrangement observed in boreholes F2 and F17. This observation suggests that the deposition of sediment began in the central portion, or the front of the terrace, and proceeded upward (toward the ridge of the terrace). Subsequently, due to erosion or drag processes, sediment was transported towards the T 8-10m and T 10-12m terraces.

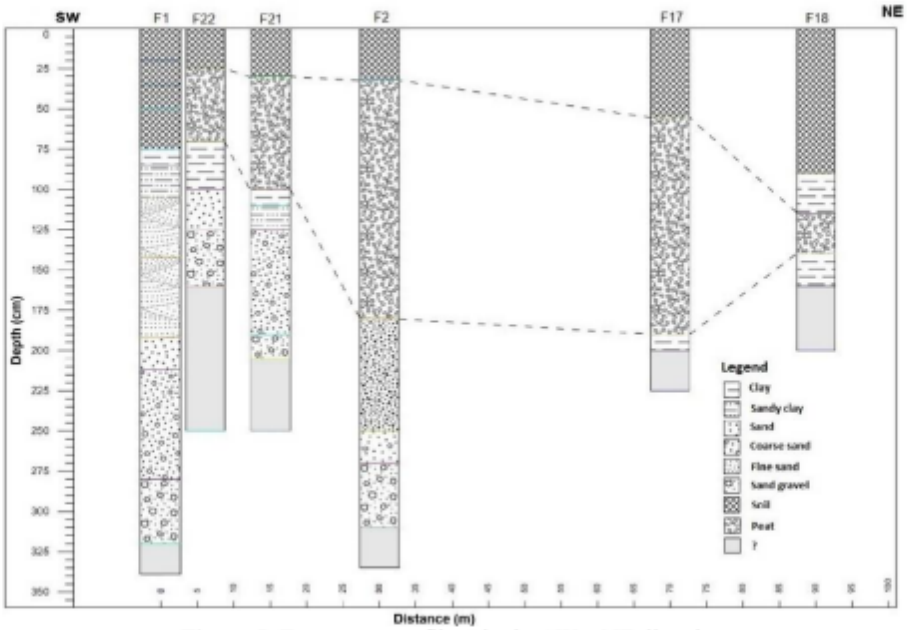

Figure 5. Transverse profile C in the SW – NE direction

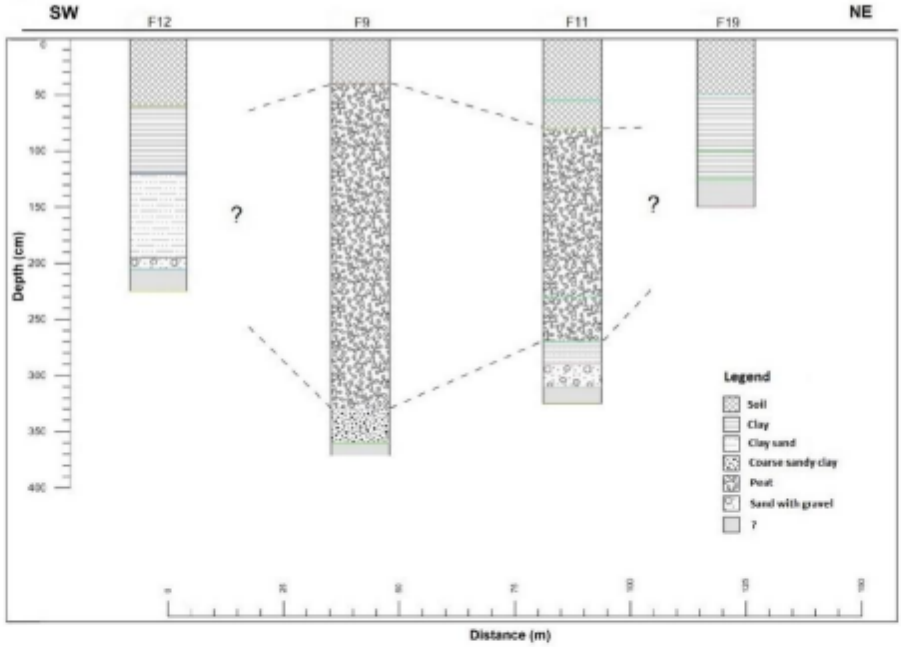

Figure 6. Transverse profile D in the SW – NE direction

GRAIN SIZE AND LOI ANALYSIS

In order to obtain a clearer picture of the structural differences between the peat deposit and the sediments t on which this peat was developed, we analyzed two physical indicators, namely grain size and the analysis of the organic matter and carbonates content (LOI - loss by combustion method).

These parameters were analyzed based on the F1 borehole - necessary for the description of the sedimentary structure of the T 8-10m and the F2 borehole - for the peat deposit. For the present study we chose to correlate the median particle size (D50, the particle diameter at which 50% of the material is coarser, and 50% is finer) with the parameters analyzed through the LOI method.

In the case of the D50 (phi units), a relatively uniform distribution is observed in the first 2/3 of the F1 borehole and a sudden increase towards its base, where we identified the fine gravel (Figure 7). D50 values of the peat are lower, due to the much finer material of its composition, with higher values at the top of the profile and lower values at the bottom of the profile.

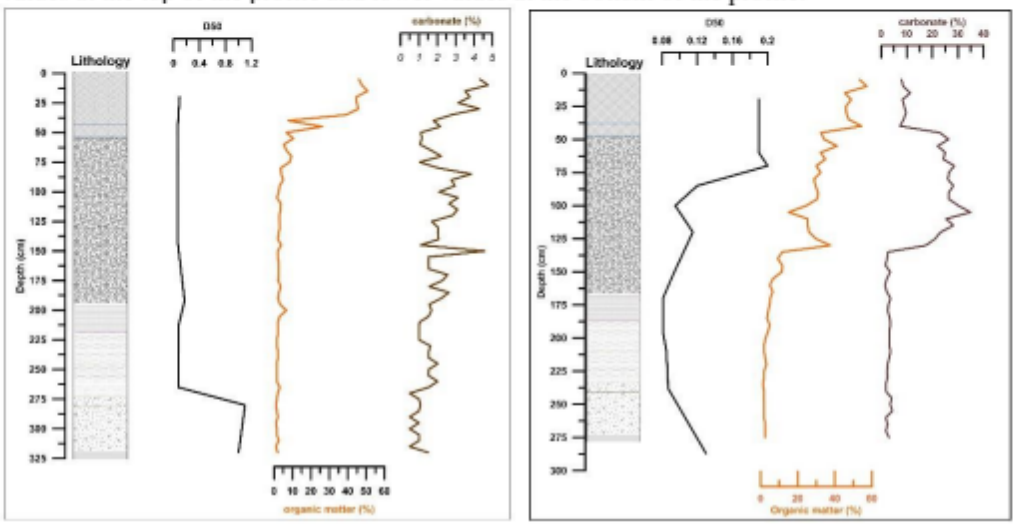

Figure 7. Particle size analysis and content of carbonate and organic matter in the borehole F1 (left) and F2 (right)

The results obtained by LOI method indicate the larges variation of carbonates in the sedimentary material extracted from F1, compared to the material from F2 (Figure 7), where a maximum of them is observed in the peat deposit, where the material is not very compacted (Figure 7). A much greater loss of carbonates is also observed in F2, compared to F1, which suggests that the accumulation of carbonates is much greater in the peat deposit than in the detrital sedimentary deposits stored in the T10-12 m.

ORIGIN AND EVOLUTION OF THE PEAT

The formation of peat deposits is the result of a complex interplay of physical, chemical, and biological processes, all of which contribute to the distinct characteristics of such deposits.

These characteristics are reflected in the sedimentary layers, with the principle of superposition of layers being a fundamental concept in understanding their formation. This principle, first articulated by Nicholas Steno in 1669 (MacLeod, 2005), dictates that the lowermost layer is the oldest, while the topmost layer is the most recently accumulated, making it the youngest in terms of formation.

Over the past two decades, research has shed light on the significance of peat deposits as valuable environmental archives, offering the opportunity to reconstruct past climates and environments. Currently, peat bogs in the mountainous regions of Romania have been the focus of extensive study, with the most renowned archives located in the Eastern Carpathians. Notable examples include Tăul Mare Bardău (Fărcaş, Tanţău, Mîndrescu, & Hurdu, 2013) (Cristea, et al., 2014) and Cristina in the Maramureş Mountains, both of glacial origin and characterized as oligotrophic. Other significant peatlands in the region include those in the Rodna Mountains, such as Poiana Ştiol (Tanţău & Fărcaş, 2004) and Gărgălău (Tanţău, Geantă, Feurdean, & Tămaş, 2014).

Additionally, there are peatlands in the Moldo-Transylvanian Carpathians, including the Mohoș peat bog (Tanțău, et al., 2003) and Luci (Tanţău, Feurdean, De Beaulieu, Reille, & Fărcaș, 2014a), as well as in the Apuseni Mountains, such as Padiș, Molhaşul Mare, Călineasa, Ic Ponor, and Pietrele Onachii (Feurdean & Willis, 2009) and Meridionali Carpathians (Longman, et al., 2021), among others. While in most cases in Romania, peat deposits are of an oligotrophic nature, with origins related to glacial, limnological, or ombrogenous processes, in the case of the Părhăuți peatland, it has a fluvial origin. This hypothesis is based on the identification of detrital sedimentary rocks - sand and fine gravel in all 20 boreholes within the peatland area, which have been directly related to cartographic materials from the past three centuries. The analysis of the transverse profile along the Suceava Valley, the location of the peatland on the front and ridge of the T 8-10 m terrace, and the immediate part of the T 10-12 m terrace (Figure 5), the identification of a watercourse called Solonica B (Figure 8 – Phase I), and the possibility of the existence of an ancient paleo-meander (Figure 8) where water stagnated for an extended period can explain the formation of the peat deposit in this area. Furthermore, old cartographic materials highlight a marshy area that favoured the development of this peat deposit.

The development and expansion of the peat deposit (Figure 8) are represented by a model adapted and modified after (Łajczak, 2013) and are based on three distinct stages:

I. The first stage or Phase III (Figure 8) in which the accumulation of the peat deposit occurs from the paleo-meander, located on the T 8-10 m terrace towards the front of the T 10-12 m terrace, with a more pronounced development along the x-axis and less along the y-axis.

II. The second stage or Phase IV (Figure 8 shows that the peat deposit expands along both axes, reaching an equilibrium. This lengthwise expansion may be due to surface water runoff in the opposite direction of the maximum peat deposit development, a process that can lead to deposition by drag. During this stage, it can be assumed that the material was deposited in an anaerobic environment, due to the existence of a marsh developed on the former paleo-meander. This is explained by the presence of the peat deposit starting from a depth of 107-121 cm and with reduced thickness (0-25 cm) in the eastern part of the peat deposit, observations indicated by the stratigraphy of boreholes F18 and F19.

III. The third stage or Phase V (Figure 8) represents the final deposition phase in which accumulation has reached its maximum extent. This maximum expansion of the peatland may be attributed to hydrological modifications, as these deposits are directly linked to the atmosphere (Chamber, Daniell, & Members, 2010), and its formation is based on climatic, hydrological, geological, geomorphological conditions (Charman, 2002) that give it a specific, unique character.

To establish the typology of the Părhăuți peatland, consideration was given to its physical and chemical properties: temperature, color, structure, pH, salinity, and organic matter content (Table 1).

Tabel 1. Physico-chemical properties of the peat from Părhăuți (sediment core F15)

Water T(°C)	pH (units)	NaCl (mS/cm)	Dissolved oxygen(mg/l)	Color	Structure
15.4	8.16	2.25	2.01	brown -black	fibrous-grassy

From a geological perspective (Giulescu, 1996), peat deposits can be classified as reserves when their thickness exceeds 30 or 50 cm.

Considering the pH measurement result, with a value of 8.16 in borehole F15 (Table 1), we can categorize the peatland as mesotrophic, referred to as 'transitional marshes,' which still have nutrient salts with a mitigating acidic reaction. Due to the lack of age determinations for the deposit, a direct correlation with recent climate changes cannot be established. The only information that can provide a chronological context are the radiocarbon ages of elm tree trunks from the minor bed of the Suceava River, which are approximately 6300 years BP in Iţcani and 3600 years BP in Milișăuți (Kern & Popa, 2016). In addition to these determinations, we can also consider the ages of oak tree

trunks from the Siret River, located on the T 5-7 m terrace, which are 5300 years BP old (Rădoane, et al., 2015), as well as those from the Moldova River, situated on the T 1-2 m terrace with an age of approximately 3000 years BP (Chiriloaei, Rădoane, Perşoiu, & Popa, 2012). Taking into account the ages of tree determinations found in sedimentary material related to the T 5-7 m terrace of the Siret River (5300 years BP), it can be estimated that the age of the T 10-12 m terrace of the Suceava River is much older, possibly exceeding 6300 years BP, as indicated by the study by (Kern & Popa, 2016).

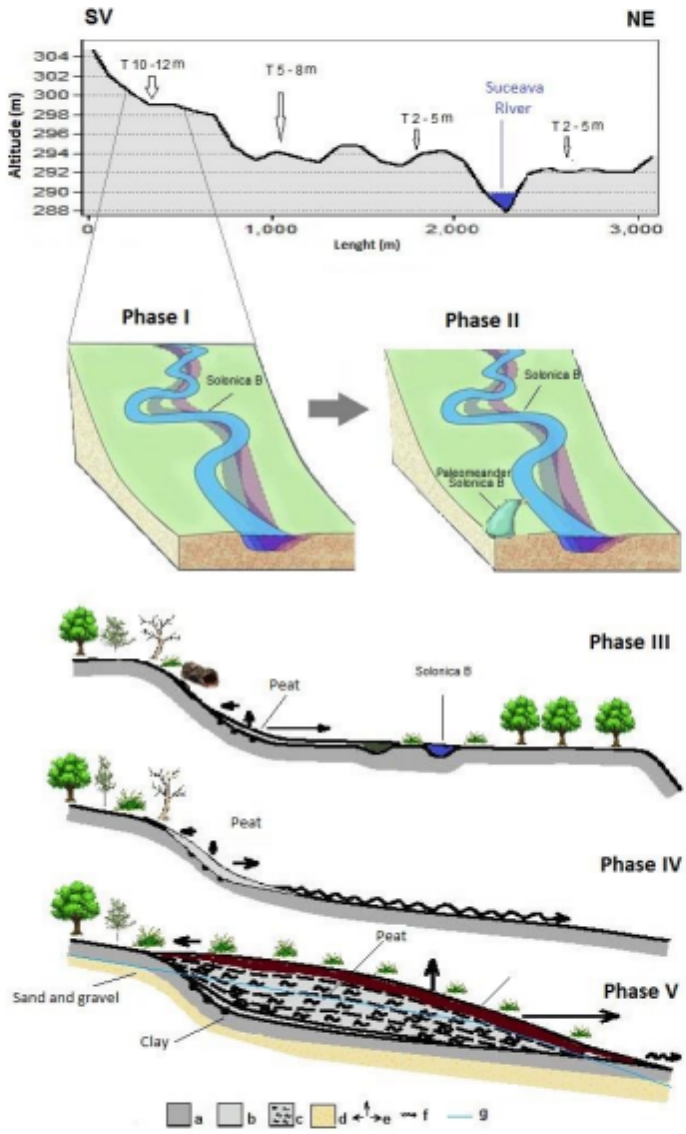

Figure 8. The development model of the Pârhăuți peatland, in which is represented: a) the cross-sectional profile of the Suceava valley in the right of the peatland; b) the evolution of the hydrographic network – Phase I and Phase II and c) the peatland development scheme – Phases III, IV, V. (after Łajczak, 2013, with modifications) The legend signifies the following elements: a – the clay layer; b – the first layer of peat; c – the peat deposit; d – the layer of sand and gravel; e – the development direction of the peat deposit; f-surface water runoff; g-ground water level.

The evolution of the Pârhăuți peatland is based on four sets of topographic maps and a satellite image (Figure 9), from which the following changes in land use within the peatland's vicinity were identified:

i) A marshland area in the period 1773-1776 (Figure 9a), with the possibility of the peatland expanding into a marshy environment, reflected by the abundance of palustrine plant remains, especially roots, in most of the boreholes where the peat layer was identified.

ii) The mid-19th century witnessed a significant change in vegetation attributed to hydrological and climatic modifications. During this period, the peatland transitioned from a marsh to an area with softwood vegetation, typical of high-moisture terrains. In this period, the existence of a Soloneț River branch, called Solonica B, can also be observed, which may have served as drainage for the marshy area noted in the 18th century.

iii) The transformation of the studied area into agricultural land in the 20th and 21st centuries is evident on the topographic map from 1984 and the satellite image from 2023. Therefore, all these changes over the past three centuries are attributed to human activities, particularly those related to land reclamation and drainage for the expansion of arable land (Bădăluță, Bistricean, & Nagavciuc, 2013), with less influence from external forces (climatic, hydrological, or tectonic).

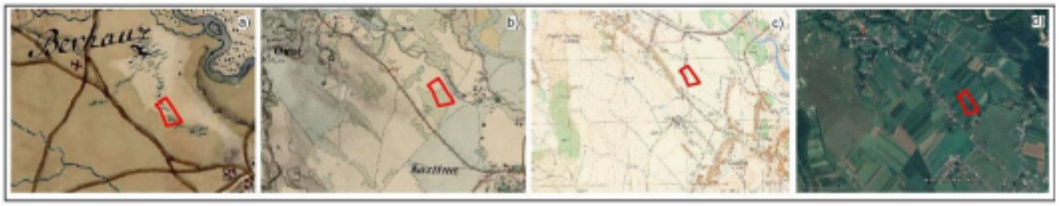

Figure 9. Evolution of peatland based on: a) First Military Survey Map of the Habsburg Empire (conducted between 1773 and 1776), b) First Military Survey Map of the Habsburg Empire (conducted between 1861 and 1864), c) topographic map from 1984 and d) satelite image from 2023.
(Source: for images a) and b) https://maps.arcanum.com/en , c) topographic military map, scale 1:25.000, edition 1974/'75 and d) GoogleEarth)

CONCLUSIONS

This paper focuses on two major aspects, namely the origin and evolution of the Pârhăuți peatland. Based on 22 boreholes, its dimensions, both horizontally and vertically, were determined. The data generated reveal that this peatland developed more along the x-axis than the y-axis.

Moreover, the intersection of fluvial gravel and sand at the base of the peat deposit and the morphological indications on the surface argue for the formation of this peatland in an ancient paleomeander, at the contact between the T 8-10m and T 10-12m terraces. pH analysis demonstrates that the Pârhăuți peatland is of mesotrophic type, while grain size analysis and LOI analysis determine its fluviogenic origin. Regarding the evolution of the peat deposit, successive cartographic sets covering the last three centuries indicate a transition from a marshy area (1773-1776) to one with arboreal vegetation (mid-19th century), and finally, to agricultural land (20th and 21st centuries). All these changes were primarily caused by human actions, especially deforestation (after the Austro-Hungarian occupation: 1773) and area drainage (during the communist period: 1970).

This paper provides new contributions to geomorphological studies in the Suceava Valley and highlights a series of visible modifications over the past approximately 250 years.

AUTHOR CONTRIBUTIONS

G.B. designed the study. G.B. and C.A.B. performed the fieldwork. G.B. performed the grain size and L.O.I., C.A.B. and G.B. performing the evolution model. M.M., D.I. and B.I.N. analysed evolution of the peat based on maps. C.A.B. and G.B. prepared the paper with contributions and input from all authors.

COMPETING INTERESTS

The authors declare that they have no conflict of interest.

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QUANTITATIVE ANALYSIS OF GEOMORPHIC RESPONSES AND TOPSIS APPROACHE ANALYSIS TO ACTIVE TECTONIC PROCESS: A CASE STUDY OF THE NORTHEAST OF THE AURES (TEBESSA)

Taib HASSAN*
University Frères Mentouri Constantine 1, Department of Geological Sciences,
Faculty of Earth Sciences, Geography and Regional Planning,
P.O. Box, 325 Ain El Bey Way, Constantine, 25017, Algeria;
Ferhat Abbas University, Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment,19137, Setif, Algeria;
e-mail: hacen-taib68@gmail.com

Hadji RIHEB
Ferhat Abbas University, Department of Earth Sciences, Institute of Architecture and Earth Sciences, Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, 19137, Setif, Algeria;
e-mail: hadji.rihab@univ-setif.dz

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Abstract: This study combines GIS and remote sensing technologies to analyze geomorphological changes in the Tebessa basin, focusing on key indices such as hypsometric integral (HI) and stream sinuosity (SS). The objective was to assess how drainage anomalies and tectonic activity influence flow and relief patterns. Asymmetry and topographic factors were incorporated into a geographic information system, and the region was classified into four IRAT classes: high, medium, low, and rank. Results identified highly deformed areas near active tectonic anomalies, highlighting subsurface fault activity and its influence on river sinuosity. A new diagram illustrates the spatial evolution of these structures, providing insight into the region's geological dynamics. The study also applied the TOPSIS method to prioritize watershed areas based on tectonic activity, offering a comprehensive analysis of the basin's geomorphological changes.

Key words: Geomorphometric, GIS, Morpho-structural, Tebessa,Tectonic

* Corresponding Author

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INTRODUCTION

The case study provides a quantitative analysis of the responses of geomorphic elements to the active tectonic processes in Algeria. The Tethys' closure during the Miocene-Lower Palaeocene period triggered the orogeny in the region. Following this collision, a new deformation zone emerged starting in Burdigalian. However, the exact number and timing of tectonic events in the region remain a topic of debate among researchers. Geological records have revealed previously unknown structures, including compression, distension, strike-slip fault systems, contributing to the area's complex tectonic framework. The collapse basins in Algeria highlight how significant the influence of the Earth's crust is on the development of the NE African Basin (Philip, et al., 1986; Chihi, 1988; Tamani, Hadji, Hamad, & Hamed, 2019; Taib, et al., 2023). The continuous effect of crustal dislocation persisted until the emergence of Pantelleria rift. During the Plio-Quaternary period, the region experienced an extensional tectonic event characterized by high-angle normal faults intersecting pre-existing structures, resulting in tectonic depressions. This research aims to elucidate the behaviour, dynamics of one such collapse basin within the Tebessa region. Given the area's geological significance and the intricate interplay between tectonic forces and geomorphic responses, a quantitative analysis of the geomorphic changes in the Tebessa region is of paramount importance. Understanding the dynamics, characteristics, interactions of active tectonic processes in this area will significantly enhance our knowledge of the region's geological evolution. It has practical implications for hazard assessment, land management strategies in the context of active tectonics. This comprehensive understanding of geomorphic responses facilitates better planning and mitigation strategies in regions affected by ongoing tectonic activity. The practical interest of this study lies in its potential to improve hazard assessment, land management strategies, contributing to more effective planning in tectonically active areas. Hypsometric analysis is an essential tool for assessing, comparing the geomorphic evolution of various landforms, regardless of the factors driving this evolution. In regions experiencing rapid uplift; the hypsometric integral (HI) shows a strong correlation with uplift rates. Differences in regardless of the factors that influence the geomorphic changes, the Hypsometric Analysis method is an ideal tool for studying and comparing the changes in landforms (Taib, et al., 2022), demonstrated through a mathematical model that the hypsometric curve depends on the drainage network, landscape runoff processes, basin geometry, that HI correlates positively with uplift rate.

GEOLOGICAL SETTING

The NE African Basin is located in the northeast part of the Aure Nememcha chain. It falls within the Saharan Atlas' North Auresian autochthon (Dubourdieu & Durozoy, 1950) (figure 1). The region's structural style is characterized by folds and faults in various directions. Analyzing geomorphic features like lineaments and drainage patterns provides insights into the region's tectonic setting and landscape evolution. Figure 3 displays a structural context depicting the NE-SW orientation of fold axes, with accompanying NW-SE oriented grabens. Numerous research studies have focused on the area, investigating various aspects such as geology, geomorphology, and the environment (Zeqiri, et al., 2019). The neotectonic aspect has not been specifically addressed in these studies. The Trias diapiric is responsible for the displacement of carbonate structures at Djebel Jebissa and Djebel Belekfif. The thick limestone-marl formations are visible along the borders. The contrasting features of these deposits, which are located in the Piedmonts, contrast the previous structures (Vila, 1980; Hadji, et al., 2014). The region is characterized by the presence of several collapsed Plio-Quaternary basins, some of which are located in Kasserine, Morsot-Tebessa-Hammamet, Sbiba-Cherichira, and Kalaa Djerad. However, limited research has been conducted on these basins in Algeria. According to a study (Hamad, et al., 2021), the formation of the Tebessa basin can be attributed to multiple faults, with the region exhibiting significant fractures that have shaped its current physiognomy.

Figure 1. Geographic location of the study area

The study area displays three primary lineaments: North-West-SouthEast, NorthEast-SouthWest and East-West. The two first are more prominent, while the others exhibit a relatively uniform distribution. Gravimetric data collected (Hamad, et al., 2021) indicate the presence of well-developed faults in the Tebessa basins. Mapped faults align with observed fractures (figure 3). Through field studies conducted in the Jebel Doukkane and Jebel Mestiri deposits, the researchers were able to gain a deeper understanding of the fractured index in the limestones of the Eocene and Cretaceous periods.

MATERIALS AND METHODS

They utilized various tools, such as geological and topographic maps, and Geographic Information Systems (GIS) to perform a comprehensive morphometric study of the region around Tebessa. By examining variations in hypsometric characteristics across different catchment areas, we identified clusters of high and low hypsometric values, evaluating their significance in relation to lithology and tectonics. This method has been used by several researchers in Neogene basins and has produced very realistic results (Taib, et al., 2022; Manchar, Hadji, Bougherara, & Boufaa, 2022). The morphometric indices were extracted from a 30m*30m Digital Elevation model, using ArcGIS 10.8 software. The computed geomorphological indices utilized in this research are based on well-established parameters commonly employed in similar studies (Keller & Pinter, 1996; Peters & Van Balen, 2007). These parameters include hypsometric integral, asymmetry factor, stream sinuosity, relative tectonic uplift, flux length gradient index, and basin elongation ratio index. By considering these indices, we aim to achieve a thorough analysis of the overall regional trend (Shamurailatpam, 2014; Esmaeil, et al., 2017; Ghedoui, 2014).

The methodology employed in this study has been successfully applied in various geological domains where active tectonics is present. For example, the researchers were able to analyze the Zagros center (Dehbozorgi, et al., 2010) and the North Rhine Graben using the Hypsometric Analysis method (Peters & Van Balen, 2007). Furthermore, this methodology has been applied to study the southwest Sierra Nevada in Spain (El Hamdouni, et al., 2008). By utilizing this established methodology and adapting it to our study area. The goal of the researchers is to provide a comprehensive analysis of the various active tectonic processes that are taking place in the area.

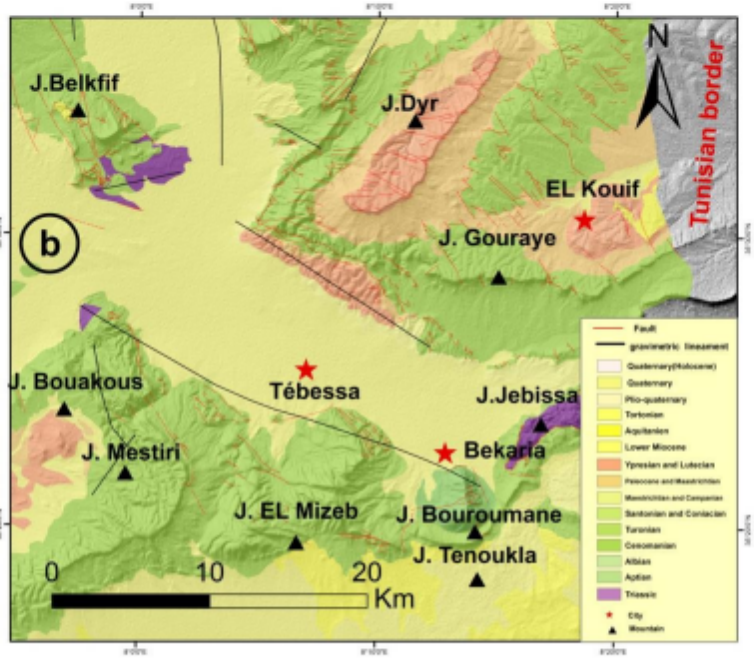

Figure 2. Stratigraphic simplified map of the study area

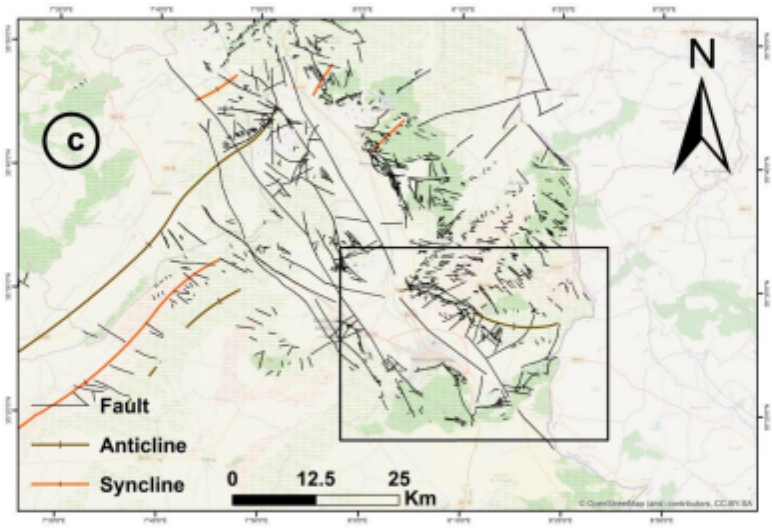

Figure 3. Structural map of the study area

Basin Prioritization by TopSIS Model

The researchers used the various parameters of the Tebessa basin to determine the level of activity. They then used the rankings to identify ideal and anti-ideal positions. The anti-ideal or optimal point can be determined by comparing the lower seismic activity values of SI or AF with those of these higher indices. The more active tectonic activities can also be observed if these two lower values are compared with those of the high activity tectonic. The ideal point is identified by the distance between the two solutions.

The researchers used Excel to perform a procedure that involved identifying the ideal point between two solutions **(Step 1**) (Aouragh & Essahlaoui, 2018). The researchers utilized the AHP to generate the TopSIS model's parameters. The alternatives were evaluated using the Xij criterion, while the C1 and C2 criteria were used to measure them. After the matrix was created, normalization exercises were then performed (**Step2**).

$$nij = \frac{Xij}{\left(\sqrt{\sum_{n=1}^{Xij} Xij^{2}}\right)} (equ\ 1)$$

The parameters used in the creation of the TopSIS model were derived by using the AHP.

Step 3. The weighted normalized value is calculated.

vij =wj ∗ nij, i=1,…,m, j=1,…, n (equ 2)

Step 4. The researchers then identified the ideal solutions based on the negative and positive criteria. the researchers used the classification method to identify the optimal positions.

$$W+= ((\max/ i\ wij \mid J \in J), (\min/ i\ wij \mid J \in J') \mid i = 1,2, \dots\dots, m) (equ\ 3)$$

$$= \{w_1^+ + w_2^+, \dots\dots, w_m^+ \}$$

$$W-= ((\min i\ wij \mid J \in J), (\max i\ wij \mid J \in J') \mid i = 1,2, \dots\dots, m) (equ\ 4)$$

$$= \{w_1^- + w_2^-, \dots\dots, w_m^- \}$$

Positive and negative criteria are associated with J and J′.

Step 5. involves dividing the distance between two points by taking into account the Euclidian dimension.

$$S_i^+ = \sqrt{\sum_{j=1}^{n}(w_i^+ + w_{ij})^2} \quad i = 1,2, \dots\dots, m (equ\ 5)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(w_i^- - w_{ij})^2} \quad i = 1,2, \dots\dots, m (equ\ 6)$$

Step 6. Determine the relative closeness of the suggested solutions.

$$C_I^+ = \frac{S_i^+}{S_i^+ + S_i^-} (equ\ 7)$$

RESULTS

The Asymmetry Factor (Af):

Hare & Gardner introduced in 1985 the Asymmetry factor, which can be used to detect shifts in the direction of the drainage (figure 2).

$$\mathbf{AF = (Ar \div At) \times 100}$$

At: watershed total surface**; Ar:** right bank watershed surface

To avoid confusion between the different catchment areas, the absolute value of Af is used (Pérez-Peña, Azor, Azañón, & Keller, 2010).

$$\mathbf{AF - 50} = |50 - (\mathbf{Ar} \times 100) \div \mathbf{At}|.$$

Figure 4 shows the spatial distribution of asymmetrical factors in different watersheds. They are indicated as follows: moderately asymmetrical Af = 10-15, slightly symmetrical Af = 5 and strongly symmetrical Af = 15. Figure 4 shows the average values of the various catchment areas within the study area. They indicate that the highest values are in the areas between 17 and 24. Accidents NE-SW, E-W, and NW-SE directions within the graben borders can also be associated with these values.

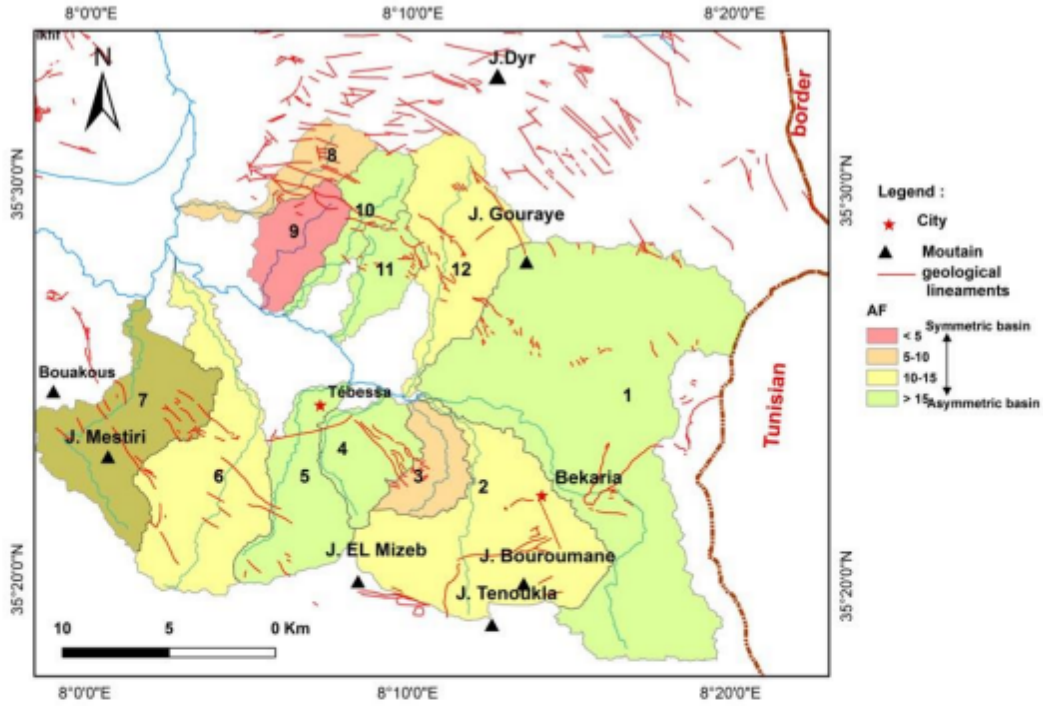

Figure 4. Geomorphometric Asymmetry Index Distribution Map AF

Hypsometric Integrals (Hi):

The hypsometric curve of a watershed is shown in figure 5. According to Kusre (2013) & Strahler (1952), the altitude can influence the distribution of a watershed's hypsometric curve. Its shape allows one to determine the area's degree of evolution and maturity.

The hypsometric curves and integrals of watersheds are also determined by the different age groups and processes of erosion.

The mature advanced basins' integrals and curves are regarded as the most accurate indicators of erosion's various phases. On the other hand, the immature basins' integrals and curves are interpreted differently. The hypsometric index is a type of calculation that shows the curve's shape.

The integral hypsometry index is a calculation that shows the shape of a hypsometric curve (Keller & Pinter, 2002; Kusre, 2013):

$$\mathbf{Hi} = ((\mathbf{Hmean} - \mathbf{Hmin}) \div (\mathbf{Hmax} - \mathbf{Hmin}))$$

A quantitative analysis of the drainage basin evolution was performed by Kusre (2013) & Strahler (1952). All sub-basins (figure 3) within the study area were analyzed using a single family with a specific interval and shape (Hi~ 0.5).

The researchers focused on the relationship between the various control parameters of a drainage basin and its hypsometric integral. They discovered that the high values exhibited by the integral can trigger a rejuvenation of the area's relief.

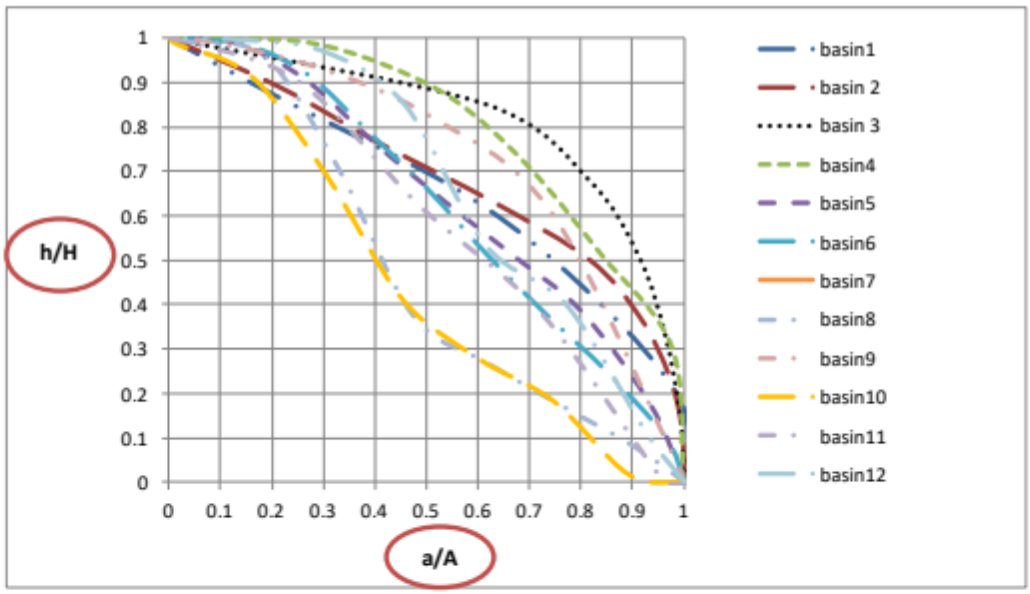

Figure 5. The hypsometric curves

Relative Tectonic Uplift

According to Singh & Jain (2009), the concept of an uplift(U) index was proposed to help in the evolution of the active tectonics in a given catchment area.

$$\mathbf{U} = \boldsymbol{hm} + (\mathbf{1} - \mathbf{HI})$$

where, **hm** is the average elevation of the catchment and **HI** is the integral hypsometry.

The values of relative tectonic upflit in all basins between (1.276-1.609). This index is divide into 2 Class (U <1) that's associated with slight uplift or influence of lithological and (U>1), that's associated with strongly uplifted block, which are located in areas that have recently undergone vertical movement, indicate that the erosion rate has reached the base level. This is due to the relative tectonics in the region (Keller & Pinter, 2002; Bull, 2007). The index has been used to calculate the UP index for various mounting fronts in the study area (Silva, Goy, Zazo, & Bardají, 2003; Pedrera, et al., 2009) For instance, the index for the whole basin is characterized by strongly uplifted block.

Stream sinuosity (SS)

The stream sinuosity can be used to evaluate an area's tectonic activity. It can be calculated by comparing the length of streams with the length of the curvilinear paths or the straight lines connecting the two ends of a channel.

$$SS = \frac{CL}{L}$$

The length of the channel is shown as CL, while the line connecting it to the other ends is L. A high SS value indicates that the river has become stable and is close to equilibrium. On the other hand, a low SS value indicates that the basin is active (Mueller, 1968). The value of SS < 1.05 represent tectonic activity, 1.05 < SS < 1.5 are semi-active and SS > 1.5 are inactive (Bull & McFadden, 1977). In the present study, the minimum value of the SS index is 1.011 for basin 2, and the maximum value is 1.589 for basin 7. The values were classified into hree classes (Mohsen, Ali, Mahmoud, & Mehran, 2020), i.e., Class 1 (1.011–1.174), Class 2 (1.175–1.280), and Class 3 (1.280–1.589) and spatially distributed. Table 1 provides a summary of the geomorphic indices of each of the twelve basins.

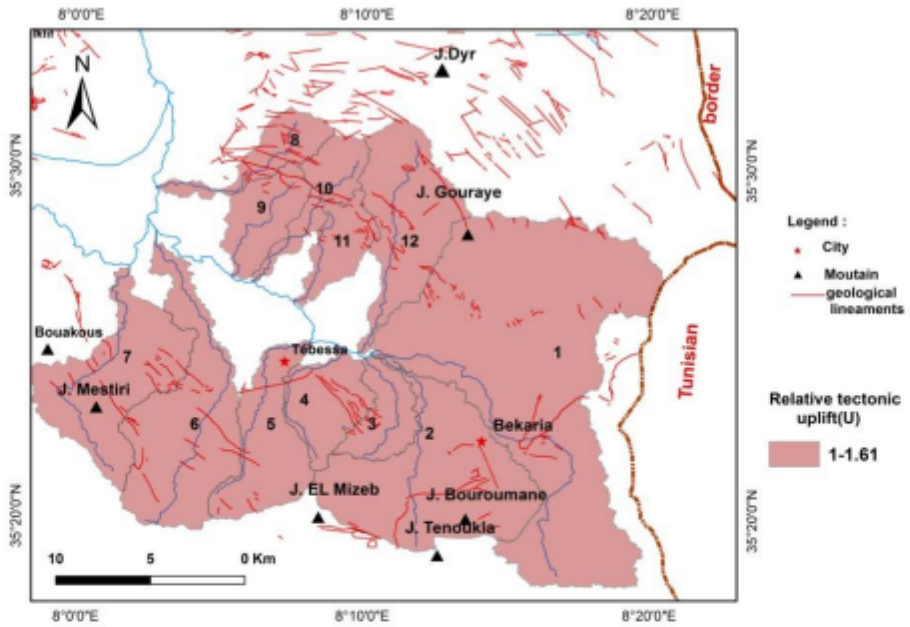

Figure 6. The Relative tectonic uplift index distribution map (U)

Flux Length Gradient Index (SL) (Hack, 1973): The channel slope index, which can be sensitive, can allow for the evolution of features in response to tectonics or rock resistance (Keller & Pinter, 2002).

$$SL = (\Delta H)/(\Delta L)/L$$

$(\Delta H)/\Delta L$): stream segment slope

L: entire distance from the source to the middle of the segment under study

The SL index's value can also vary depending on the area's rock resistance. For instance, its value can increase in areas that have high rock resistance while it can decrease in lower rock resistance zones. A qualitative map of this type of rock was then generated (Keller & Pinter, 2002). The four different rock resistance levels are indicated in figure 9. They are very high, moderate, low, and moderate. The soil resistance level is also classified into three classes based on the data presented in figure 8. The lowest level is shown in the basin 9, while the maximum is in basin 6. The study area has been divided into two-class SL categories, with the highest values being recorded in basin 7. These categories correspond to the area's high rock resistance, which is mainly composed of natural limestone. These high values can be linked to the region's tectonic activities. Some of these are attributed to the area's interaction with different types of limestone and clay.

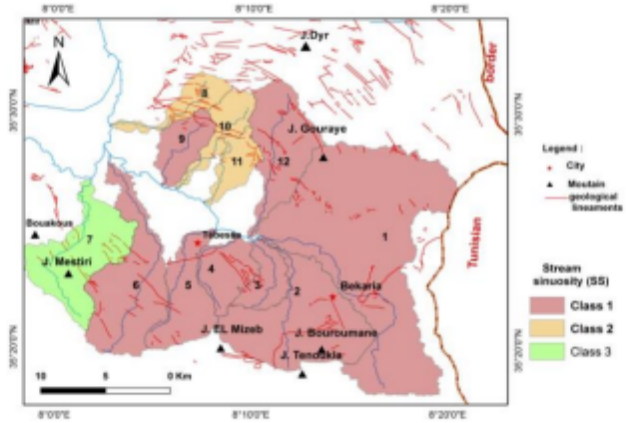

Figure 7. Stream sinuosity Index Distribution Map (SS)

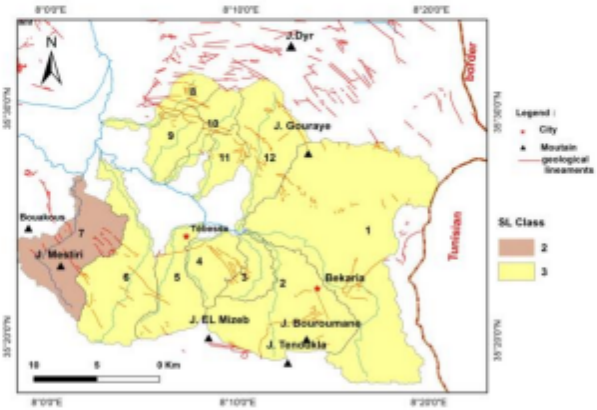

Figure 8. SL Index Class Distribution Map

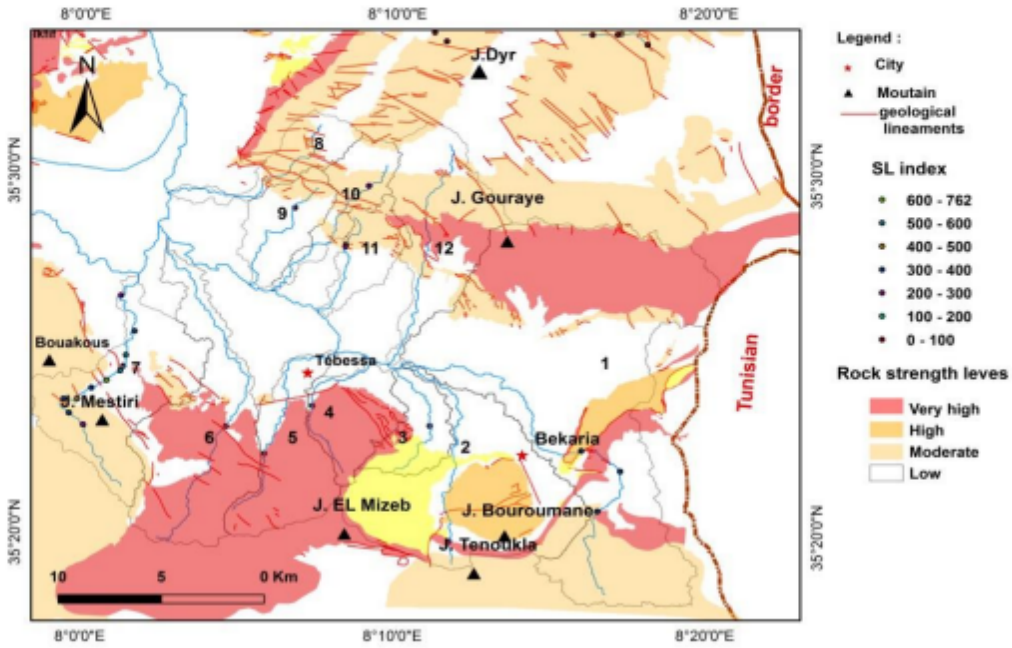

Figure 9. The Rock Resistance and SL index Map

Basin elongation ratio (BE)

The shape of the basin has changed due to its elongation ratio, which now exhibits a circular shape. The extension and rate of the area can be calculated to determine its projected shape:

$$\mathbf{BE} = \mathbf{2}\left(\frac{\boldsymbol{A}}{\boldsymbol{\pi}}\right)^{\mathbf{0.5}} \mathbf{/BL}$$

A: the area of basin

BL: maximum length of the basin

The high value of the index can be attributed to the existence of elongated pools near mountain fronts, which are known to rise and fall due to the natural break method. As stated by Chang et al. (2015), there are classified into 3 class namely Bs. Class 1(BE > 0.5) tectonically active areas, Class 2 (0.5< BE< 0.75) slightly active, and Class 3 (BE < 0.75) r inactive tectonic regions.

Figures 8 show the values of BE for different catchment areas within the study area. They show that the activities within these catchments are categorized into three classes: moderate, high, and low Activity tectonic as Class 1 (0.121-0.484), Class 2 (0.485-0.605), Class 3 (0.606-1694), in that order.

Accidents in the graben borders in the NE-SW, E-W and NW-SE directions coincide with these values. The values of BE for different graben borders are shown in figure 10. The highest one is in the 3rd basin, while the lowest one is in the 1st basin.

Transverse Topographic Symmetry Factor (T)

The quantity of the main stream is a factor that determines the asymmetry of its flow in a watershed. This is done by taking into account the varying characteristics of the different sections of the watershed.

$$T = Da / Dd$$

Da: Distance from the generator of the basin to the main river.
Dd: distance from the middle to the water-sharing line.

This measure is classified into three categories: class 1 (T 0.4), class 2 (0.4<T<0.2), and class 3 (T 0.2). The index's T-values are also consistent with the AF-values, which show the symmetry and inclination of the river's transverse topography (figure 11).

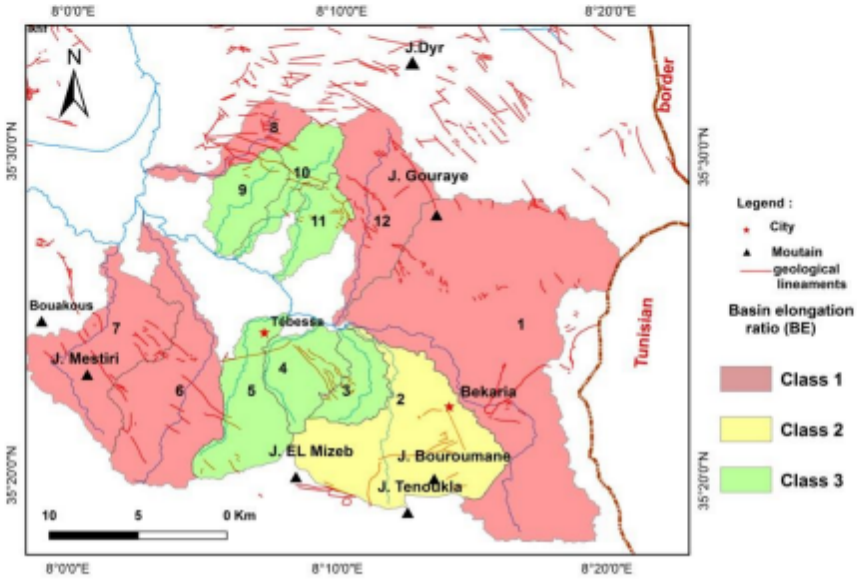

Figure 10. Map of BE Index Class Distribution

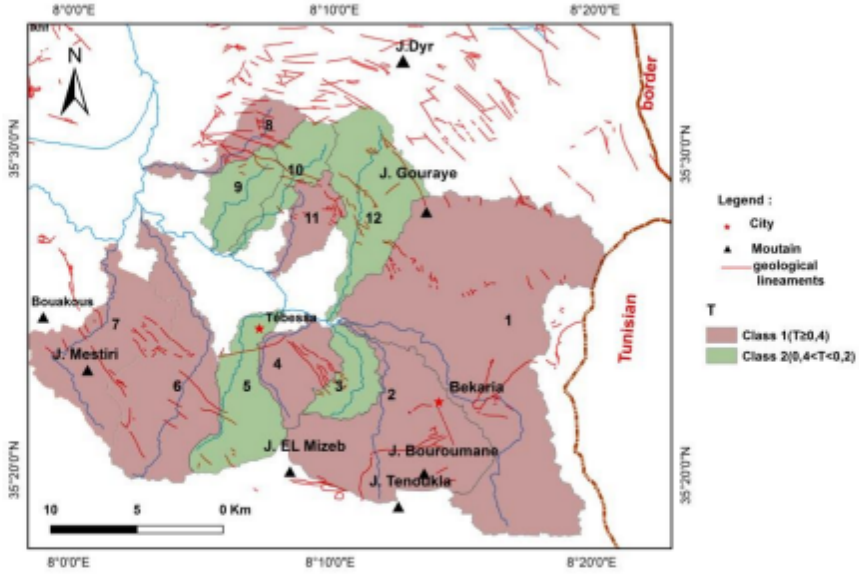

Figure 11. Map of Distribution of T-Index Classes

DISCUSSIONS

Understanding the relationship between geomorphology and neo-tectonic activity can provide valuable insight into the development of tectonic activities. A morpho-structural maps can also help identify the various structures and elements within a region. For instance, the mountainous area shows a significant distribution of morphological elements.

Due to the recent and current tectonic activities in the region, it is difficult to determine the exact levels of these marl masses. The findings of this study can also be used to identify the factors that triggered the development of the collapsed basin. The case of the Oued El Ksob valley, which is located in the Tebessa region, is a good example of the recent activity in the collapsed ditch. The numerous accidents that have been detected intersect the formation of the collapse ditch's plio-quaternary structures.

Table 1. Values of morphotectonic indices for the different watersheds studied
(Data source: Taib Hassan)

Basin	HI	AF	AF-50	BE	SS	Mean SL	Mean T	U
1	0,5	12,75	-37,25	0,121	1,053	151,59	0,63	1,276
2	0,49	35,33	-14,67	0,605	1,011	100,69	0,45	1,336
3	0,47	55,12	5,12	1,694	1,043	93,78	0,23	1,355
4	0,48	12,48	-37,52	1,331	1,048	122,29	0,82	1,337
5	0,5	15,39	-34,61	0,627	1,100	135,36	0,38	1,328
6	0,5	63,09	13,09	0,242	1,042	205,76	0,52	1,323
7	0,5	29,47	-20,53	0,15	1,589	303,74	0,56	1,325
8	0,49	56,33	6,33	0,25	1,280	172,83	0,83	1,333
9	0,49	48,57	-1,43	1,21	1,076	72,47	0,32	1,331
10	0,49	32,79	-17,21	0,847	1,120	161,51	0,39	1,488
11	0,5	85,97	35,97	1,33	1,257	100,48	0,4	1,332
12	0,5	61,13	11,13	0,484	1,174	115,63	0,37	1,609

IRAT Assessment and Discussion

The study area, which spans 12 sub-basins, is composed of various valleys. The quantitative and qualitative analysis of the IRAT of our region is carried out through the combination of the drainage and geo-morphometric indices. This allows us to identify anomalous features in the river system and the mountain fronts.

The identification of the drainage anomalies was carried out using the topographic factor index (T). This allows us to determine the hydrographic network's deviation and its relative asymmetry. The other component of the study is the determination of morphometric anomalies. These were derived from the Relative tectonic uplift (U) and (Hi) indices. The yield and IRAT of the seven calculated indices were then combined to determine the distribution of tectonic activity within the study area. Three classes of IRAT values were then established. The average of the seven geomorphic indices, which include the U, SS, Af, BE, SL, Hi, and T (table 1), was then used to determine the distribution of tectonic activity within the study area. The resulting index, which is a modified active tectonic index, was then classified into four classes (table 2). The first class was established as very high (1 Iat < 1.5), and by 2 high (1.5 <Iat < 2), 3 moderate (2 <Iat< 2.5), and 4 low (2.5< Iat) (El Hamdouni, Irigaray, Fernández, Chacón, & Keller, 2008).

Figure 12 shows the distribution of the four classes. The moderate and high Iat values dominate the map.

Table 2. Iat classification (relative tectonic activity index) in sub-basins
(Data source: Taib Hassan)

Basin	Class of							S/n	IATclass	Assessments
	SL	BE	AF	HI	U	T	SS			
1	3	1	1	2	1	1	1	1.429	1	Very high
2	3	2	2	2	1	1	1	1.714	2	High
3	3	3	2	2	1	2	1	2.000	2	High
4	3	3	1	2	1	1	1	1.714	2	High
5	3	3	1	2	1	2	1	1.857	2	High
6	3	1	2	2	1	1	1	1.571	2	High
7	2	1	2	2	1	1	3	1.714	2	High
8	3	1	2	2	1	1	2	1.714	2	High
9	3	3	3	2	1	2	1	2.143	3	Moderately
10	3	3	2	2	1	2	2	2.143	3	Moderately
11	3	3	1	2	1	1	2	1.857	2	Moderately
12	3	1	2	2	1	2	1	1.714	3	Moderately

Table 3 displays the decision matrix' weighted average according to the equation Eq. (2), wherein the W+ ideal solution takes into account the criterion's best performance, and the W- is derived from its poor output.

Table 3. Normalized matrix of morphometric pparameters of sub-basins
(Data source: Taib Hassan)

Basin	ER	AF	HI	UP	T	SL	SS
1	0.00107	0.00476	0.00253	0.02104	0.02776	0.00436	0.00992
2	0.00538	0.01320	0.00248	0.02203	0.01983	0.00289	0.00952
3	0.01507	0.02059	0.00238	0.02234	0.01013	0.00270	0.00983
4	0.01184	0.00466	0.00243	0.02204	0.03613	0.00352	0.00988
5	0.00646	0.00575	0.00253	0.02189	0.01674	0.00389	0.01036
6	0.00215	0.02357	0.00253	0.02181	0.02291	0.00592	0.00981
7	0.00133	0.01101	0.00253	0.02185	0.02467	0.00874	0.01497
8	0.00222	0.02105	0.00248	0.02198	0.03657	0.00497	0.01206
9	0.01076	0.01815	0.00248	0.02194	0.01410	0.00208	0.01013
10	0.00753	0.01225	0.00248	0.02453	0.01718	0.00465	0.01055
11	0.01183	0.03212	0.00253	0.02196	0.01762	0.00289	0.01184
12	0.00430	0.02284	0.00253	0.02653	0.01630	0.00333	0.01106

Table 4. Positive-ideal (W+) and negative-ideal (W-) solutions
(Data source: Taib Hassan)

Basin	ER	AF	HI	UP	T	SL	SS
W+	0.015074	0.032127	0.002538	0.026533	0.036576	0.008747	0.009529
W-	0.001076	0.004663	0.002385	0.021041	0.010135	0.002087	0.014979

Table 4 presents the two kinds of ideal solutions for a given criterion. These are denoted by the W+ and the W-. The comparability index's values can be calculated taking into account the alternatives. The priority list is sorted in ascending order. The results of the various sub-watersheds are obtained by equation Eq. (5.6. and 7) and presented in table 5. The scores ranged from 1.0099 to 1.0314, with the lowest being for the weakest sub-watershed and the highest for the strongest one.

Table 5. Prioritization of Tectonic activeness by Model TOPSIS
(Data source: Taib Hassan)

Basin	SI+	SI-	CI+	Rank Priority
1	0.0327391	0.01848066	1.01848066	7
2	0.02805236	0.01472451	1.01472451	10
3	0.02976989	0.02187313	1.02187313	5
4	0.02850342	0.02865327	1.02865327	3
5	0.03476836	0.00996043	1.00996043	12
6	0.02137697	0.02375281	1.02375281	4
7	0.02877158	0.01723076	1.01723076	9
8	0.01814351	0.03141157	1.03141157	1
9	0.02801351	0.01777075	1.01777075	8
10	0.02914726	0.01368983	1.01368983	11
11	0.02073828	0.03061783	1.03061783	2
12	0.02539166	0.02064203	1.02064203	6

The Topsis model take into account the tectonic activity of the watersheds and ranks them according to their active and passive status. For instance, the subbasin 8 and 5 are regarded as the least active and most active (figure 13).

The gols of the TopSIS methods is to identify watersheds that are affected by the tectonic changes that have occurred in their region (Kale, Sengupta, Achyuthan, & Jaiswal, 2014), along with colleagues, utilized the IAT to classify the different sub-basins into their respective categories.

The TopSIS framework can be utilized to rank the different types of watersheds according to their relative activeness and performance. It can be additionally used to group them into a single category. According to the researchers, the model's simple and logical design makes it an ideal tool for users to solve their problems.

Among the disadvantages of the TopSIS system is its capability to alter the order of rank by removing or adding alternatives. This method can lead to a total rank reversal, as the previous option becomes known as the worst after being regarded as the best.

CONCLUSIONS

The morphometric indices utilized in this investigation to assess the rate of erosion and tectonic activity in the Tebessa study area include Sl, BE, SS, Hi, Af, U, and T. The analysis of HI values reveals a convex to sub-rectilinear shape, while SL anomalies are typically observed in the fault zone. The high U values ($U > 1$) indicate that tectonic activity is influenced by relative tectonics. Moreover, the sinuosity observed in Smf values along the fault suggests the presence of tectonic activity. The significantly higher asymmetrical factor, exceeding 50, indicates a high level of tectonic activity in the study area. Additionally, the calculated T-values corroborate the presence of relatively high tectonic activity. However, Class 1 BE values demonstrate localized tectonic activity in certain parts of the study area, while Classes 2 and 3 exhibit more dispersed occurrences elsewhere.

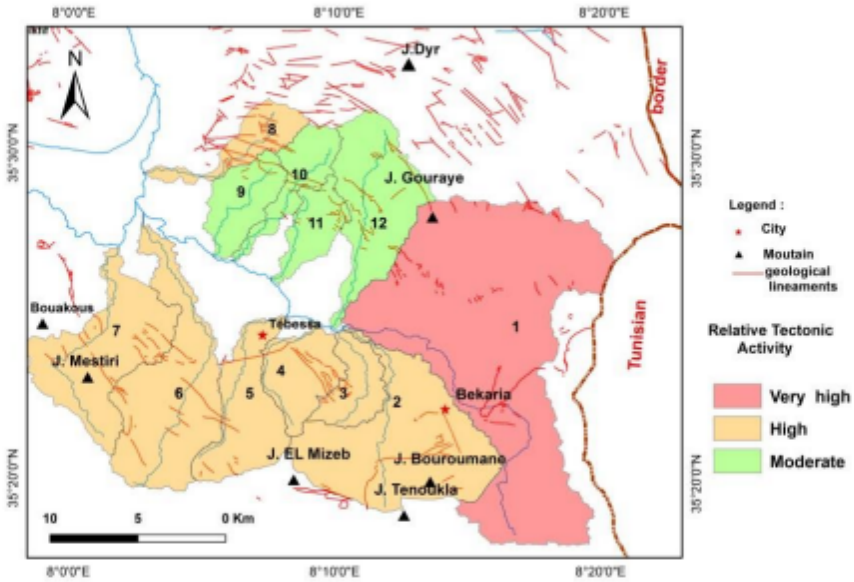

Figure 12. Tectonic activity index (IRAT) Map

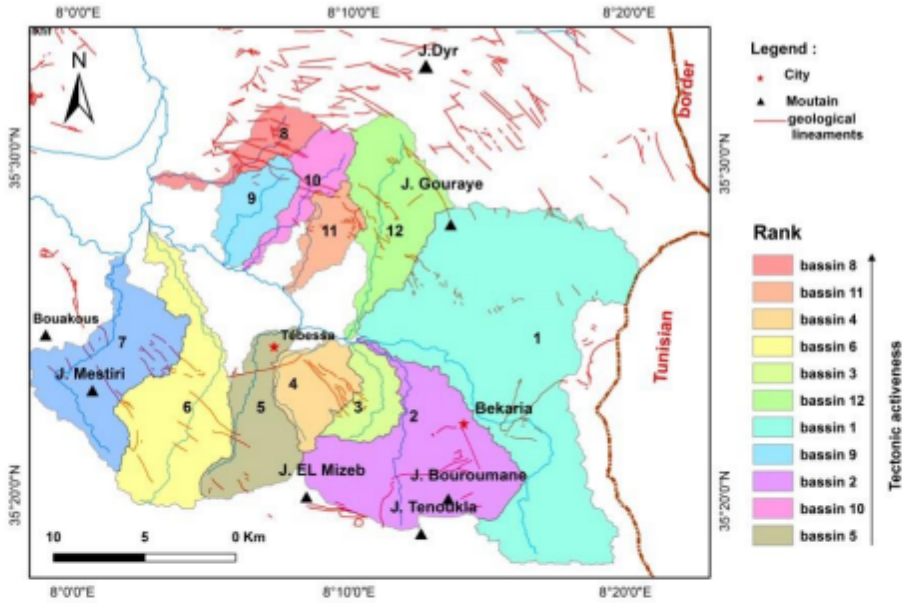

Figure 13. Ranking of the 12 watersheds of Tebessa by model TOPSIS

Throughout the study, comprehensive spatial data preparation was conducted, and the Geographic Information System (GIS) was employed for the analysis. These procedures facilitated the examination of various morphometric records and the evaluation of the impacts of tectonic activities on the landscape. Furthermore, they facilitated the investigation of the relationship between tectonic-geomorphological and hydrographic characteristics in the study area.

The morphometric indices employed in this study provided valuable insights into the rate of erosion and tectonic activity in the watershed. The results indicated the influence of tectonic forces on the landscape, as evidenced by the observed patterns and anomalies in the morphometric data. The integration of GIS technology and the analysis of spatial data proved to be essential in unraveling the complex relationship between tectonic processes and geomorphological features. The findings contribute to our understanding of active tectonics in the study area and provide a foundation for further research and monitoring efforts. The use of RS tools and GIS for prioritizing watersheds can be very simple and cost-effective. The TOPSIS approach can also help decision-makers develop activity tectonics.

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THE EVOLUTION OF THE STRUCTURE BY AGE GROUPS AND THE AGEING OF THE POPULATION IN ROMANIA BETWEEN 1992-2021

Ionel MUNTELE* [1,2]
[1] "Alexandru Ioan Cuza" University, Faculty of Geography and Geology,
Boul. Carol I 11, Iași 700506, Romania;
[2] Geographical Research Center, Iași Branch of Romanian Academy,
Boul. Carol I 8, Iași 700506, Romania;
e-mail: imuntele@yahoo.fr

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Abstract: The ageing of the population has become a problem of maximum interest, in the context of the completion of the demographic transition, especially in European states. Romania, like all of Eastern Europe, is facing the acceleration of this process, against the background of a strong demographic decline after 1990, generated by the drastic decrease in fertility and the massive migration of labor force abroad. The present study proposes a diachronic analysis of the evolution of the age group structure and, implicitly, of the ageing process, based on the four censuses carried out after 1990. The main objective is to detect territorial disparities, on various levels, with the hypothesis of the differentiated action of of factors that can stimulate or inhibit demographic aging. The double analysis (descriptive, respectively factorial) highlighted a series of regional models of evolution that express various ways of adapting to the socio-economic and political transition. The faster expansion of the process studied in cities is an observation that can be the basis of specific studies. On the other hand, the relative rejuvenation of the population in the metropolitan areas expresses a population transfer generated by the change in lifestyle, the relocation of economic activities and the increase in mobility. At the same time, the isolation, the predominance of agricultural activities and the decline in the exploitation of some resources constitute the motive of an ageing without precedent, illustrating certain trends of depopulation of vast areas.

Key words: demographic ageing, typology, drivers, territorial disparities, Romania

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* Corresponding Author(s)

INTRODUCTION

One of the most problematic trends in the demographic evolution of recent decades is the accelerated ageing of the population, one of most typical features of second demographic transition (van de Kaa, 1987, cited by Káčerová, Ondačková, & Mládek, 2014), a key challenge rooted in past fertility cycles (Reher, 2015). In Europe, this process has been studied and anticipated for a long time (Sauvy, 1948). This unprecedented process is expected to be worldwide, and identifying its causes, patterns of evolution and implications becomes a priority (Davies & James, 2011). Romania, like all European countries, is no exception, with its own evolution, in line with the evolution and duration of the demographic transition. And geography, with its focus on territorial disparities and regional patterns of development, can contribute to a deeper understanding of the ways in which this process manifests itself. From descriptive studies focusing on the distribution of the elderly population in the territory, correlations with environmental problems or well-being, the search for spatial patterns has gradually moved on since the latter part of the last century (Rowles, 1986). At the same time, ideas, concepts and models of approach specific to gerontology have been learned which have strengthened the need for holistic conceptualization with the aim of identifying the historical bases of this process (Warnes, 1990). The impact of the shift from descriptive to analytical studies, based on the manipulation of detailed databases, has been felt with the use of computer processing tools (Harper & Laws, 1995). A true "geography of ageing" has thus developed (Skinner, Cloutier, & Andrews, 2015), overlapping somewhat with health geography, population geography and social geography, sometimes even referred to as "geographical gerontology" in the context of interdisciplinary studies, increasingly oriented towards the relationships between older people and the spaces and places they frequent (Cutchin, 2009). Since the 1990s, three key themes have been developed in this new field: analysis of trends in the evolution of the ageing process in spatial profile, often linked to the mobility of older people; the issue of territorial disparities induced by access to health and social care services; analysis of factors influencing the quality of life for this category of population, often linked to the quality of the environment. They are part of public policies for "healthy (active) ageing", fostering the formation of "age-friendly" communities (Golant, 2014), often imagined according to the principles of sustainable development and inclusive governance (Han, et al., 2021). In this sense, the complex aging active index was created and implemented, with the aim of providing effective policies for monitoring the aging of society. The periodic reports that use this index at the European level indicate an unfavorable position of Romania (1-33, 2019). Society's response to population ageing, identified by international organisations as one of the global "megatrends" shaping this century (alongside population growth, international migration and rapid urbanisation (Messerli, et al., 2019), involves a complete rethinking of how society functions, including from a spatial perspective (MacCarthy, 2022). This is even though, as some authors point out, governments have difficulty perceiving ageing and, above all, anticipating its effects (Thumerelle, 2000).

This study proposes a diachronic analysis of the evolution of the ageing process of the Romanian population after the fall of the communist regime. Closely linked to the completion of the demographic transition, postponed by the pro-natalist demographic policy until 1989, this process has been pushed forward rapidly, stimulated by the massive emigration of a significant part of the young working population or by the significant increase in life expectancy, particularly after 2000 (Rotariu, 2014). This development is in line with the general trends observed in Central and Eastern Europe, marked by significant gaps compared to Western Europe, especially in terms of active ageing (Olivera, 2020) or determinants, first of all the importance of the contribution of international migration which helps to reduce the share of the elderly population in attractive countries (Długosz & Kurek, 2006; Lewandowska-Gwarda & Antczak, 2020) or the incomplete epidemiological transition (Kinsella, 2000). The specific context of Eastern Europe imposes in Romania a combination of the three established forms of ageing: at the bottom, through declining fertility; at the middle, through significant emigration of the young adult population; at the top,

through increasing life expectancy at birth (Sardon & Calot, 1999). There are a number of similarities with the development of this process in Southern Europe (Marcaletti, Iñiguez-Berrozpe, & Caravaglia, 2020). In contrast, in the western part of the continent there has been a succession between ageing at the bottom and ageing at the top, with a significant time lag. This combination coincided with profound political, economic and social transformations brought about by the shock of the fall of communism, with the older generation often seen as the main losers of the transition (Botev, 2012). The rapid pace of ageing, affecting both rural and urban areas, has generated increased attention among social scientists, particularly in recent decades, especially on the effects on public welfare services, which are ill-equipped for coping (Asandului, 2013; Bodogai & Cutler, 2014). Special attention was also paid to the analysis of Romania's specific situation in the European context, in order to identify solutions for the implementation of EU policies (Gabor et al., 2022). There are also studies that have focused on the factors favouring the rise of this process, such as international migration (Nemenyi, 2011), transformations generated by widening economic and social gaps (Jemna & David, 2021) or the capacity of territorial structures to adapt to this process (Istrate, Muntele, & Bănică, 2015). A review of the literature shows that most studies have been limited to the national or regional scale or to comparisons with other European countries. The option for a more detailed analysis using the basic administrative structure (the 3181 communes, towns and municipalities) is indicated in order to identify the manifestation of regional patterns in the evolution of the ageing process, including the extent to which they express the influence of socio-economic, cultural or geographical factors. In this respect, a number of questions have been formulated which require a response:

- Can we talk about the generalization of the demographic ageing process in Romania?
- Are there regional differences in the timing and pace of this process?
- Do regional patterns express particularities derived from the differentiated evolution of the demographic transition?
- Have profound transformations of the transition such as urban population decline (shrinking) or the formation of metropolitan agglomerations influenced the pace of evolution of this process?
- Is there local or regional resistance to this process? What factors are at play?

The working hypothesis arising from these questions is based on the observation that, beyond the general trends observed in various works, there are significant territorial disparities generated by the differentiated action of factors that stimulate or slow down the ageing process. As a result, the study comprises two mutually complementary approaches: one descriptive, focusing on the typology of ageing evolution, and the other based on a multivariate analysis testing a number of explanatory variables.

MATERIALS AND METHODS

In order to answer the questions raised and to test the hypothesis put forward, two separate databases were created. The first of these contains primary information on the age structure of the population as recorded in censuses after 1990 (in 1992, 2002, 2011 and 2021). The second database consisted in the selection of variables with an explanatory role for the evolution of indicators expressing demographic ageing. The ageing index (*Ai*=+65 years/0-14 years) was preferred as the dependent variable, after previously testing its correlation with mean age, which was found to be very strong.

For the descriptive analysis, three distinct classifications were made: on the evolution of the structure by major age groups (0-14 years, 15-64 years, over 65 years), expressed as a percentage of the total population; on the evolution of the ageing index, as formulated above; on the evolution of the average age : $X=(\sum(x+0.5)Px)/(\sum Px)$, where X is the average age, Px is the number of the population of age x and 0.5, the average equivalent of the variation of deviations from the exact date of attainment of a given age.

Table 1. Variables used in factor analysis - description and source of information

Variable type	Variable	Acronym	Description	Source of information	Standardisation
Dependent variable	Ageing index	AI	Ratio of population aged 65+ to 0-14 years	Romanian population censuses of 1992, 2002, 2011, 2022	Z-scores, with elimination of outliers
Variabilele explicative	Bottom ageing	BA	Ratio of the average birth rate of the last intercensal period to that of previous period	INS Tempo Online Database (1966-2021)	
	Middle ageing	MA	Average net migration in recent intercensal periods	INS Tempo Online Database (1966-2021)	
	Top ageing	TA	Ratio of age groups 50-64 years and +65 years	Romanian population censuses of 1992, 2002, 2011, 2022	
	Oldest old	OO	Share of the population aged +80 in the total population aged +65	Romanian population censuses of 1992, 2002, 2011, 2022	
	Average altitude of settlements	ALT	Considered for main localities	Topographical map 1:100 000 Military Topographical Directorate	
	Fragmentation of settlement areas	FS	Ratio of population to number of localities	Romanian population censuses of 1992, 2002, 2011, 2022	
	Location to major cities	LMC	Distance in km on the shortest route to cities with more than 50 000 inhabitants	România. Marele atlas rutier 1:200000	
	Access to the major transport network	AMT	Factor scores according to the importance of transport routes. Maximum value (1) given for railways & European roads, minimum value given for local roads	România. Mare atlas rutier 1:200000	Factor scores
	Share of population employed in agriculture	PEA	Percentage of employed labour force	Romanian population censuses of 1992, 2002, 2011. INS Tempo Online Database (2021)	Z-scores, with elimination of outliers
	New houses built	NHB	Number of new dwellings completed as a share of total population in each intercensal period	INS Tempo Online Database (1966-2021)	
	Building index	BI	Average share of households with access to water supply, sewerage and central heating out of all households	Romanian population censuses of 1992, 2002, 2011, 2022	
	Education index	EI	Share of population with secondary and tertiary education	Romanian population censuses of 1992, 2002, 2011, 2022	
	Income	INC	Wages, social benefits average income (lei/person), extra-polated on population socio-professional structure basis	INS Tempo Online Database (1966-2021)	
	Roma weight	RR	Share of ethnic Roma population (% of total)	Romanian population censuses of 1992, 2002, 2011, 2022	

Although seemingly redundant, the three typological analyses were conducted precisely to observe the inconsistencies between them. The statistical processing of the information used the XLSTAT function of Excel (Addinsoft, version 2015), opting for agglomerative hierarchical clustering that uses Euclidean distance and groups statistical individuals by degree of similarity (Ward's method of clustering), aiming to keep the intra-class dispersion coefficient values as low as possible for a higher quality of classification. Adobe Illustrator CS12 was used for the graphic processing of the results. A total of 15 variables were used for the factor analysis, four of which were constant for the entire analysis period, the rest were calculated for each of the four time series (Table 1).

Standardised data sets for each of the four time sequences (1992, 2002, 2011 and 2021) were subjected to multivariate analysis. The PLS (partial least square regression) model was chosen, using XLSTAT functions. It is based on covariance analysis, recommended for series with a large number of explanatory variables with a high probability of multicollinearity. The main results sought were correlation matrices, factor axis distributions and regression quality coefficients (R_2, standard deviation).

RESULTS AND DISCUSSIONS

Descriptive analysis

The first AHC (agglomerative hierarchical clustering) analysis, according to the methodology presented, aimed at tracking changes in the specific weighting of each age category. The first and last of these correspond to the accepted divisions (young, 0-14 years, and old, 65+ respectively). The median category, the adult population (15-64 years), has been divided into three broad subgroups: 15-29 years, 30-49 and 50-64 years). The use of 5-year age groups at this scale of detail proved to be inconclusive, with too much dispersion of values within classes. The gender structure has not been taken into account as the last census did not provide this information at a detailed scale. The relative diversity of the resulting patterns is due to time lags in the incidence of determinants ranging from declining fertility to increasing life expectancy or various social, economic or cultural factors (figure 1, table 1).

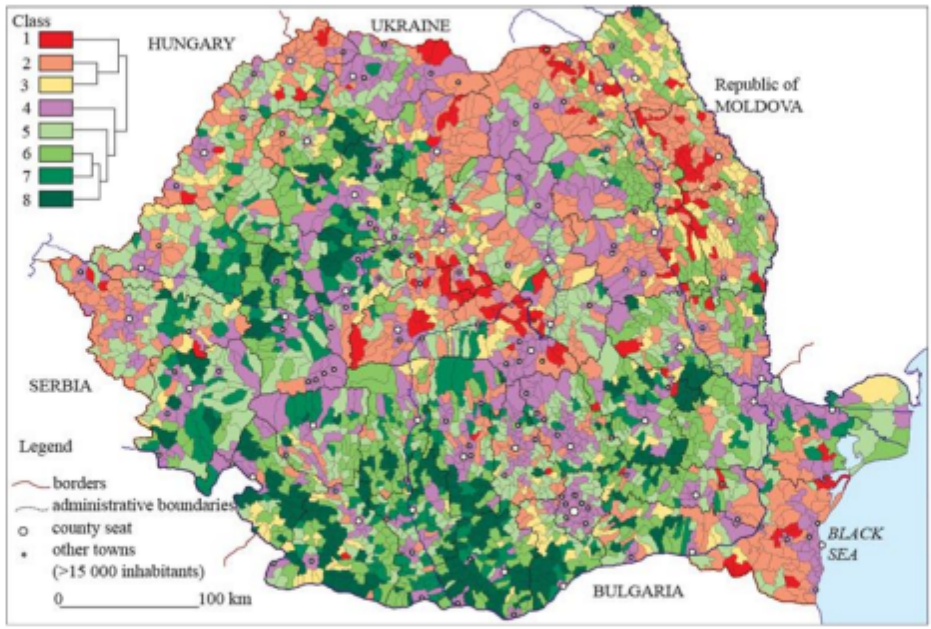

Figure 1. Typology of population structure by large age groups
(Source: RPL 1992, 2002, 2011, 2021, INS)

Table 1. Profile of classes

Age group	*Year\Class*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
		in % from total population							
0-14 years	1992	**29,1**	24,8	19,4	22,9	19,8	17,0	17,1	13,0
	2002	**27,8**	22,7	20,3	18,5	18,8	16,8	16,2	13,2
	2011	**27,2**	20,5	20,0	15,9	16,9	15,3	13,7	12,4
	2021	**26,1**	18,8	18,9	15,2	15,4	13,5	12,3	11,1
15-29 years	1992	**25,2**	24,9	22,1	23,8	22,6	21,7	21,3	18,3
	2002	**24,4**	23,5	19,9	22,9	20,9	18,3	19,0	14,6
	2011	**21,6**	20,0	17,5	18,2	17,8	15,2	16,0	12,5
	2021	**21,3**	18,6	18,3	15,3	16,8	15,5	14,6	13,0
30-49 years	1992	19,6	21,5	18,8	**25,6**	21,4	19,7	22,0	18,3
	2002	22,4	24,7	21,0	**28,6**	24,1	21,2	24,0	18,5
	2011	25,0	27,9	25,0	**30,0**	27,5	24,8	26,8	21,9
	2021	25,8	28,2	25,9	**28,6**	27,6	24,8	26,2	22,3
50-64 years	1992	15,6	17,3	22,0	17,2	20,6	23,6	22,4	**27,0**
	2002	12,9	15,2	17,7	16,7	17,8	20,2	20,0	**23,2**
	2011	13,9	16,7	16,5	20,3	18,4	18,8	**20,6**	20,2
	2021	14,8	18,5	17,6	21,6	20,2	20,4	**22,3**	20,9
over 65 years	1992	10,6	11,6	17,6	10,5	15,5	17,8	17,2	**23,3**
	2002	12,5	14,0	21,2	13,3	18,3	23,5	20,7	**30,5**
	2011	12,3	14,9	21,1	15,6	19,4	25,9	22,8	**33,1**
	2021	12,0	15,9	19,3	19,4	20,1	25,7	24,6	**32,6**

The eight classes retained from this analysis are well highlighted both in terms of geographical distribution, which is significantly regionalised, and in terms of the profile of changes.

A first cluster concerns classes 1-3, grouped mainly in the north-east, centre and south-east of the country. The first class, with a very high proportion of young people (0-14 years) and young adults (15-29 years) is also distinguished by a relatively stable structure, with a slow advance of the elderly population (over 65 years) and a stagnation of the 50-64 age group. They form relatively coherent areas in the regions mentioned, being closely linked to the preservation of a relatively high female fertility, partly explained by belonging to certain ethnic (Roma) and confessional (neo-Protestant) communities (Muntele, 2022). Class 2, located in continuity with the previous one, shows a more advanced pattern of evolution, with a significant decline of the young population and a clear advance of the elderly, without having crossed the threshold of chronic ageing. Class 3 is often located in the extension of the first two, with significant areas also in the south or south-west of the country, with a stable share of young and old, at an average level, with a relatively equal distribution of the share of the five population categories. It can be considered the more advanced, mature version of the other two classes.

A second cluster joins five distinct classes that stand out for the rapidity of their transformations, either among the young (classes 4-7) or the old (all five) population. Class 4, groups most urban centres and their peri-urban areas but is also well represented in the Carpathian area. It is marked by the most profound transformations, with a massive decline in the share of the first two groups (0-29 years) and a strong increase in those aged over 50, leaving room for a very strong accumulation in the middle ages (30-49 years). This trend reflects the profound demographic changes experienced after the fall of communism, primarily the decline in fertility but also the massive accumulation of an older population from the generations that migrated following the policy of forced industrialisation (Sobotka, 2011). Class 5, which is particularly common in rural areas with relatively easy access to urban centres, is the more advanced version of the previous one, in which the accumulation of the elderly population was earlier, resulting in

relatively strong ageing. Classes 6, 7 and 8 form distinct, coherent areas, particularly in the south and west of the country, without being absent in the rest (especially class 6), and are distinguished by the massive reduction in the proportion of young people (both 0-14 and 15-29 years), while in contrast there is a massive accumulation of older people, more evident in the case of class 8, the ratio between the extreme groups being clearly favourable to it. The high and relatively increasing share of the 50-64 age group favours a trend towards a deepening of the ageing process, in parallel with the massive shrinkage of the adult population (30-49 years).

The picture of spatial distribution described above holds for the other two typological analyses that tested the ratio of extreme ages (ageing index) to mean age. Taking into account only extreme ages or average age, these classifications are simpler, with a stronger homogeneity within the 6 classes retained (average dispersion within classes being below 20%).

In the case of the ageing index, the first class, the only one that has maintained clearly subunit values throughout the period, is dispersed in the north-east and centre of the territory, in those conservative areas mentioned in the first typological analysis (figure 2). Class 2, comprising mainly urban centres, with no hierarchical differentiation, in which the ageing process, although absent in 1992, became a certainty in the 2011-2022 period, showing a strongly accelerated evolution, attributable to inevitable phenomena during the transition to a market economy, primarily deindustrialisation and the migration of a large part of the young population either to their rural areas of origin or, especially after 2000, when European integration became certain, abroad. Class 3 is characterised by stability at relatively high values of the index, close to 1, and is more characteristic in the west and centre of the country, around the capital and other large cities, closely linked to processes such as peri-urbanisation, relocation or decentralisation of certain economic activities which have favoured well-positioned rural areas over major transport axes (particularly those oriented towards the west) or over more dynamic cities. Class 4 represents the degraded version of the previous one, particularly characteristic of mountain areas which, during the communist period, had experienced a certain stability in the overall demographic development due to the exploitation of mineral or forest resources. Some agricultural areas in the south-east (Dobrogea, Bărăgan), where the agro-industrial economic model dominates, are also close to this pattern (Sandu, 2010). The reduction of previous advantages after 1990 has led to a rapid deterioration of the age structure in these areas, particularly through the migration of young people abroad, resulting in extremely rapid ageing, especially after 2002. Class 5 includes localities located mainly in the western mountainous area (Western Carpathians) and in the south-west of the country, areas where the ageing process was already advanced during the communist period but after 1990 it did not advance so much, even levelling off in the last period. Class 6, with a similar starting point to the previous one, has experienced, on the contrary, a critical degradation, inevitably accompanied by depopulation tendencies, especially in the mountainous areas of the western part of the country (Muntele, Istrate, Athes, & Bănică, 2023). The areas most affected by ageing form a circular arc, starting in northern Transylvania along the Western Carpathians and descending south and south-east into the Danube Plain.

The distribution and dynamics of average age values are similar, with differences stemming from the evolution of life expectancy, traditionally lower in the north-west and south-east of the country and higher in the cities (figure 3). The six classes are grouped in pairs, with the first representing the slower and the other the faster evolving variant. The first class coincides with the north-eastern and central areas of the country which still have a very favourable age structure of the population, with a high share of young people and young adults and, consequently, a relatively low average age compared to the national average. Class 2 is mainly characteristic of urban centres, reflecting a rapid transformation of the age structure as already mentioned. It is likely that this rapid increase in average age also reflects greater progress in extending life expectancy, with access to health services more efficient than in rural areas. Class 3, marked by slow growth, while maintaining average values in relation to the national profile, is particularly characteristic of dynamic, attractive areas (western part of the country, capital region). Class 4, with values already

higher than the national average in 1992, has seen a fairly strong increase and is characteristic of mountainous and sub-mountainous areas and the south-east of the country. Classes 5 and 6 stand out for being well above average since 1992, corresponding to the vast areas strongly affected by ageing in the south of the country and in the Western Carpathians. However, they are distinguished by a relative stability (class 5) and a sharp increase (class 6), which in 2021 will reach an average of 50 years, indicating a drastic reduction in the potential labour force in the affected areas.

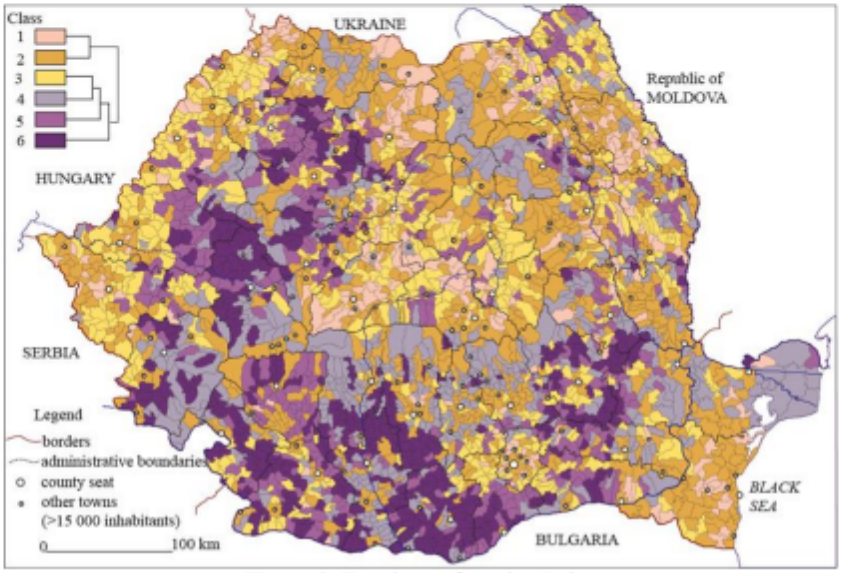

Figure 2. Typology of Ageing Index
(Source: RPL 1992, 2002, 2011, 2021, INS)

Table 2. Profile of classes

Class	1992	2002	2011	2021
	over 65 years / 0-14 years			
1	0,38	0,49	0,53	0,58
2	0,45	0,66	0,89	1,14
3	0,81	0,92	0,96	0,98
4	0,73	1,04	1,40	1,80
5	1,25	1,45	1,56	1,56
6	1,56	2,01	2,49	2,90
National Average	**0,48**	**0,80**	**1,02**	**1,21**

It can be concluded from the descriptive analysis that there are strong regional differences in Romania in terms of the evolution of the population structure by major age groups, expressing well-defined regional patterns, closely linked to the differentiated diffusion of economic and social modernization processes, despite the trend towards homogenization manifested during the communist period. The post-communist transition has disrupted previous trends, marked by a strong gap between urban and rural areas, introducing new disparities corresponding to the more rapid integration into the market economy of some regions favoured by their geographical position (the west of the country, metropolitan areas) and the decline of activities which previously provided stability, especially in mountainous and agricultural areas (Mitrică, et al., 2020). With the notable exception of the Western Carpathians, the intra-Carpathian regions seem to correspond rather to patterns marked by a relative stability of the indicators monitored, while the extra-Carpathian regions (except for the metropolitan areas, especially the capital) are strongly marked

by the speed of the ageing process (Nancu, Guran-Nica, & Perșu, 2010). From a certain perspective, Romania is in an intermediate position between Hungary and Bulgaria. For example, in terms of average age, Romania's increase between 1992-2021 was 21% from 34.9 to 42.4 years, lower than Bulgaria's (24% from 36.3 to 44.8 years) but higher than Hungary's (18% from 36 to 42.7 years). The intra-Carpathian regions developed at a pace closer to that of Hungary and the south of the country to that of Bulgaria, with the north-east in an intermediate position, also due to the somewhat higher fertility rate.

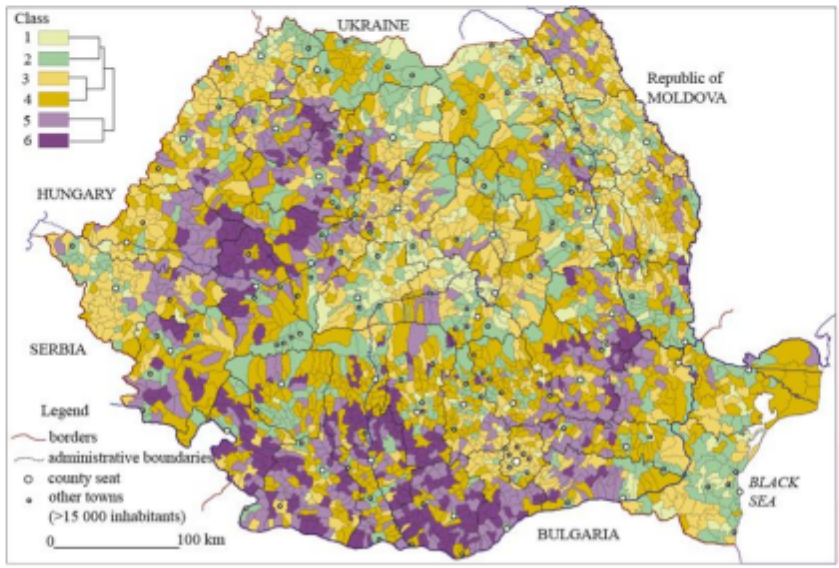

Figure 3. Typology of median age
(Source: RPL 1992, 2002, 2011, 2021, INS)

Table 3. Profile of classes

Class	1992	2002	2011	2021
	ani			
1	32,7	33,9	35,2	35,9
2	32,7	35,8	39,4	42,0
3	36,8	37,8	39,2	40,1
4	38,1	40,0	42,5	44,2
5	42,1	43,3	44,6	44,9
6	44,3	46,8	48,9	49,9
National average	**34,9**	**37,8**	**40,6**	**42,4**

Factorial analysis

From the descriptive analysis, a number of local or regional particularities, general trends, forms of restructuring generated by the social-economic transformations of the last decades have emerged. These cannot be properly interpreted without a multivariate analysis based on PLS multiple regression. The 14 variables retained were tested for each of the four censuses carried out after 1990 (1992, 2002, 2011 and 2022), with the ageing index as the dependent variable, which, as the three typological analyses showed, has a more homogeneous distribution, likely to be easier to interpret in a correlational analysis than the average age or the weight of certain age categories.

The quality of the PLS analysis is illustrated by the coefficient of determination R2 which, with its high values, attests to the validity of the factor analysis (Table 4). It should be noted that between 1992 and 2002, the value of this coefficient seemed to decrease, corresponding to the

upheaval caused by the fall of the communist regime and the manifestation of a variety of forms of adaptation. Subsequently, however, its value increases steadily, showing a strong interaction with most of the factors included in the analysis.

Table 4. Matrix of Ageing Index correlations with explanatory factors

Variables	Ageing Index				
	1992	2002	2011	2021	Trend
BA	**0,333**	0,070	**0,240**	0,155	decreasing
MA	**0,252**	0,156	0,017	**0,653**	growing
TA	**0,606**	**0,593**	**0,661**	**0,651**	high stable
OO	0,091	0,156	**0,251**	**0,338**	growing
ALT	0,114	0,071	0,023	-0,011	low stable
FS	**0,413**	**0,383**	**0,328**	**0,275**	decreasing
LMC	0,191	**0,214**	**0,212**	0,195	middle stable
AMT	**0,283**	**0,309**	**0,273**	**0,246**	middle stable
PEA	**0,343**	**0,349**	**0,285**	0,195	decreasing
NHB	**0,218**	**0,201**	0,195	**0,209**	middle stable
BI	**0,430**	**0,413**	**0,350**	**0,246**	decreasing
EI	**0,275**	**0,244**	0,158	0,039	decreasing
INC	**0,273**	**0,239**	0,171	0,058	decreasing
PR	0,103	0,168	**0,268**	**0,333**	growing
Coefficient R_2	*0,5364*	*0,4661*	*0,5692*	*0,6264*	decreasing

In 1992, there is a strong dispersion of correlations, with 10 of the 14 factors having a value above a level indicating a significant influence (0.2). The variables TA, FS, BI and PEA were the most important, illustrating the differences between urban and rural environments, the latter being characterised by a more fragmented habitat, a lower quality of housing comfort and a high proportion of the population in agriculture. The strongest influence was exerted by ageing at the top, imposed by the accumulation of elderly population, against the background of the massive decline in the birth rate which, as indicated by the BA value, also generated significant ageing at the base, together with the median ageing (MA) generated by the massive rural exodus specific to the communist period. The reduced influence of other factors can be specifically explained. Thus, OO expresses the stagnation of life expectancy in the last two decades of the communist period which did not allow for an additional accumulation of population over 80 years. The low level of correlation with ALT indicates the generalisation of the ageing process, regardless of the geographical context as well as the position in relation to the main urban centres, their polarising capacity being limited by communist planning. The cultural factor, expressed here by the share of the Roma population, is not strongly expressed, with much smaller gaps in demographic behaviour compared to the majority population.

In 2002, the explanatory valence changes visibly, with the accumulation of the elderly population (AP) remaining the main driver of the evolution of the ageing index. The onset of peri-urbanisation, stimulated by the decline in industrial activities and the rise in unemployment as a result of privatisation measures, increases the influence of the PMC factor, with distance from the city becoming a significant variable in the change in the age structure. The factors that illustrated the differences between urban and rural areas retain their explanatory value (AMT, PEA, BI, etc.), proving the manifestation of an inertia generated by the massive accumulation of young people in cities during the last decades of communism.

The year 2011 brings new changes, following pre- and post-accession transformations. The resumption of the decline in the birth rate with the increase in international migration for work, facilitated by the relaxation of travel formalities in the Schengen area, is boosting ageing at the bottom and the significant increase in life expectancy (from 70.8 years in 2002 to 74.2 years in 2011, the fastest increase since 1990) has accentuated ageing at the top. This is also reflected in the

increased significance of the correlation of the Oldest Old variable, which certifies for the first time in Romania's history, a strong increase in the population aged over 80 (between 1992-2002 it had even decreased, from 280 534 to 258 400, to reach 726 069 people in 2011; as a percentage, from only 1.2% in 1992-2002 it reached 3.6% in 2011). Variables expressing urban-rural relations maintain their importance, except those related to education, income and the dynamics of new housing construction. The role of cultural factors, expressed by the proportion of Roma communities, becomes more important, closely linked to their demographic conservatism, which requires resistance to the ageing process.

At the end of the study period, in 2021, further changes attest to the importance of the socio-economic transformations that have taken place since accession to the European Union. The influence of the economic crisis of 2008-2011 or, finally, the pandemic crisis can also be invoked, the consequences of the latter being too early to be seen in the age structure. Thus, the importance of population mobility becomes more important than ever, the median ageing generated by the massive departure of the young adult population after 2001, mostly permanent, being the main explanatory factor of the acceleration of demographic ageing, together with the increasingly strong accumulation of the elderly population, including the oldest old category (4.5% of the total in 2021), attesting to the continuation of the upward trend in life expectancy (stopped, however, in the years marked by the pandemic, especially in 2020 and 2021). The disparities between the urban and rural environments are limited, the explanatory value of the factors related to the relationships between them or the specificity of some socio-economic variables is reduced. At the same time, the share of the Roma population increases its explanatory value, showing the importance of some socio-cultural variables, more difficult to notice on a detailed scale of analysis.

The analysis of the evolution trends of the explanatory capacity of the 14 variables highlights a constant increase or a spectacular return of three of them towards the end (MA, OO and RR) but also stability at a high level in the case of TA. Three other variables (PMC, AMT and NHB) stand out for their relative stability, having an average explanatory capacity, six others following a downward trend. Thus, a relative stabilization of the fertility level is attested, the variation in the birth rate, which in the first post-communist decade fueled the bottom ageing, reducing its importance. Fragmentation of the settlements, access to modern transport routes, the share of the agricultural population or the urban variables, although they know a downward trend, maintain their explanatory role at the limit, possibly related to the constant amplification of the processes of peri-urbanization and metropolisation. The massive reduction in the explanatory role of the income or educational variables, possibly due to interference with cultural factors, illustrated by the RR variable, is debatable. The high income and the higher level of education thus seems rather related to a high level of ageing, possibly related to the massive emigration of the young population, especially the highly qualified one.

CONCLUSIONS

As an inevitable process of economic modernization, demographic ageing manifested itself relatively rapidly in Romania, in close correlation with the shock felt following the fall of the communist regime, which hastened it through its effects. If we can talk about the generalization of this process on a national scale, it is a certainty, proven by the almost threefold increase in the ageing index during the analyzed period (from 0.48 to 1.21). Practically, during a single generation, Romania went from a relatively young structure of the population to one marked by accentuated ageing. If in the European context the age structure of the Romanian population may seem more favorable, this is primarily due to the lower life expectancy. Romania is far from the ageing level of Italy or Germany (1.65 and 1.76 respectively in 2021, according to Eurostat) but close to that of France (1.25 in the same year), states with a constant intake of young adult population through immigration. Comparatively, neighboring states such as Hungary or Bulgaria, with similar characteristics from a demographic perspective, appear significantly older (1.39 in

2021). The pace of the ageing process was, however, just as alert in Bulgaria or Hungary (the ageing index was 0.54 and 0.65, respectively, in the early 1990s). Germany was showing a level above unity since 1990 (1.07), Italy was approaching (0.86) and France was in an intermediate position (0.7). If at the national level ageing is beyond any doubt, the typological analyzes highlighted the presence of some conservative areas, where this process is at an early stage. Isolation and predominantly rural character, often marked by a certain ethnic or confessional specificity, can be invoked as explanatory factors, as was partially demonstrated in the factor analysis. The differentiated evolution of the demographic transition, earlier in the southwest of the country and later in the northeast, highlighted for a long time (Trebici & Hristache, 1986), still maintains its imprint. Thus, the aging of the rural population started much earlier, since the interwar period in Banat and southern Transylvania (Muntele, 1994).

Significant gaps in the chronology of the manifestation and the pace of the ageing process were highlighted. The main cleavage opposes the urban environment to the rural environment. In just three decades, Romanian cities went from an ageing index of 0.31 to 1.26. On the contrary, in the rural environment its evolution was slow, from 0.72 in 1992 to 1.16 in 2021. The increase in life expectancy can also be discussed, more consistent in urban areas thanks to higher accessibility to medical services but also relative rural conservatism. The decline in fertility was much steeper in the countryside, or the emphasis on mobility in various forms drains especially the young population of the cities, either to the neighboring rural areas or abroad. The rapidity of urban ageing in post-communist Romania is in stark contrast to the rapid urbanization of the decades of forced industrialization. Is this a sufficient reason for a more detailed analysis of the causes, forms and effects produced by this very little studied phenomenon. The methodological approach of convergence analysis may be of interest, which has highlighted, in other studies, the precariousness of the urban-rural distinction, the demographic processes that change the age structure being much more complex (Kashnitsky, De Beer, & Van Wissen, 2021). Significant gaps also appear according to other criteria, both in urban and rural areas. Hierarchy and administrative status produce distortions in the case of cities, as does the position towards urban localities with an important polarizing role over rural localities. In the case of cities, the differences are not so great but, in a seemingly paradoxical way, the evolution of the ageing index was much faster in urban centers with over 50,000 inhabitants, county capitals in general, compared to medium or small cities (table 5).

Table 5. Evolution of Ageing Index by urban and rural hierarchy
(Source: RPL, 1992, 2002,2011,2021, INS)

Type of localities, by hierarchy	*Ageing Index*			
	1992	*2002*	*2011*	*2021*
Urban localities over 50 000 inhabitants	0,32	0,71	0,99	**1,30**
Urban localities with 10 000 - 50 000 inhabitants	0,28	0,55	0,83	1,19
Urban localities under 10 000 inhabitants	0,41	0,66	0,91	1,22
Rural localities over 10 000 inhabitants	0,40	0,60	0,67	0,64
Rural localities with 1 000 - 10 000 inhabitants	0,73	0,94	1,10	1,20
Rural localities under 1 000 inhabitants	1,23	1,72	2,06	**2,39**

At the same time, the large communes, with over 10,000 inhabitants, located almost exclusively in the vicinity of the main cities experienced a much slower pace, with rejuvenation trends even in the last interval. The transfer of the young urban population to the peri-urban areas is thus certified. This way links can be established between the decline of the urban population and the advance of the ageing process correlated with the formation of metropolitan agglomerations.

The compensation of this decline is often complete in the case of the big poles of development (the capital in the first place). Between the rural localities, the contrasts are strong, the communes with low population, marked by imminent depopulation, being heavily aged.

Reduced accessibility, predominantly agricultural character and more dispersed habitat partially explain this contrast, as certified by factor analysis.

The study highlighted the diversity of the forms of evolution of the population structure by age groups, each constituting an adaptation of the overall transformations produced by the transition. The local scale thus becomes very important for a complete territorial diagnosis from the perspective of human capital analysis. The perspectives opened by this study can be used in the more in-depth research of the specific structures of distinct categories such as cities, metropolitan areas, spaces strongly affected by ageing or, on the contrary, those that preserve a more favorable age structure. Although there were limits imposed by the access or lack of some information, we believe that the objective of finding an answer to the formulated questions, by testing the advanced hypothesis, was achieved.

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URBAN REGENERATION AND TOURIST DEVELOPMENT: THE CASE OF THE FORMER INDUSTRIAL SUBURB OF BAGNOLI (NAPLES, ITALY)

Silvia IACUONE*
University "G. d'Annunzio" of Chieti-Pescara, Department of Economics,
Viale Pindaro 42, 65127, Pescara, Italy; e-mail: silvia.iacuone@unich.it

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Abstract: This article analyses the tourist perspectives of former industrial suburbs through the case study of Bagnoli (Naples, Italy). In fact, despite at the end of XIX century the district of Bagnoli was an emerging seaside and thermal area, in 1910 it was chosen as the location of a huge iron and steel industrial plant. Even today, unfortunately, the district is characterized by dismissed facilities and a heavy industrial landscape that constitute a landmark. However, at the same time, Bagnoli still retains great potential and tourist resources, which could help it in the process of urban regeneration and recovery of tourism, until now largely hampered by bureaucracy, corruption and incapacity of the political class. After a qualitative analysis of the existing literature, a field analysis was conducted, in order to observe the resources of the territory and the strong dualism with the former industrial landscape. Finally, to support the analysis, a questionnaire was submitted to the residents of Bagnoli in which a renewed optimism for the regeneration of the neighborhood emerged, but also a strong awareness of the weakness of the institutions.

Key words: Urban regeneration, suburbs, tourist development, Bagnoli, Naples

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INTRODUCTION

The article explores the topic of urban regeneration and its impact on tourism in peripheral and former industrial neighborhoods, with an in-depth analysis of Bagnoli (Naples, Italy). Consolidated international experience highlights how the suburbs, often associated with negative connotations of marginality and degradation (Salet & Savini, 2015; Molinari, 2021), can be reevaluated and transformed into a tourist key, through focused actions of urban regeneration (Ashworth & Page, 2010; Tallon, 2010; Barbini & Presutti, 2014; Fredriksson, 2017). Successful

* Corresponding Author

examples include Lisbon (Zarrilli & Brito, 2013; Zarrilli, Brito, & Cappucci, 2019), Barcelona, Bilbao and Valencia (Miani, 2005; Albanese, 2008; Caparrós i Gironés, 2019; Mansilla & Milano, 2019). However, the case of Bagnoli demonstrates that such transformations require long and complex processes, often hindered by various factors. This article will retrace the history of the neighborhood, from its origins to the industrial tradition up to the post-industrial phase (Cento Bull, 2006; Mazzetti, 2008; Manceau, 2014; Selvaggio, 2015; Felice, 2017; Esposito De Vita, Ragozino, & Varriale, 2018; Romanelli, 2018; Romanelli, 2019; Lepore, Palermo, & Basile, 2020), highlighting its considerable potentialities and trying to understand if and how Bagnoli – which is located between two emerging tourist areas, the Posillipo hill (figure 1) and the Campi Flegrei – can participate in the tourist boom that the city of Naples has been experiencing for some years.

Figure 1. Ex-industrial area from Posillipo hill

RESEARCH METHODOLOGY

The research adopts a qualitative approach, based on a combination of review of existing literature, field work and administration of a questionnaire. This method allowed us to analyze the resources of the territory, the infrastructures, the urban fabric and the social landscape, highlighting a strong dualism between the residential neighborhood and the abandoned and peripheral ex-industrial area. As mentioned, to support the research a questionnaire was submitted to two Facebook groups of people resident or connected to Bagnoli, with questions relating to the quality of life and the prospects for tourism development.

FROM ÉLITE TOURISM TO THE POST-INDUSTRIAL ERA: REGENERATION ATTEMPTS

The Bagnoli district is part of the municipality of Naples, together with Fuorigrotta and the islet of Nisida, and is known for its natural resources, its volcanic nature (Bagnoli is located on the eastern edge of the volcanic area of the Campi Flegrei) and a rich historical and archaeological heritage. In fact, the toponym Bagnoli comes from the Latin *Balneolis*, which means area of thermal baths, appreciated and frequented by the ancient Romans.

Precisely thanks to the beauties of its territory, between the end of the Nineteenth century and the beginning of the Twentieth century, Bagnoli was an emerging center for élite seaside and thermal tourism, with a consequent prestigious residential development, so that the Scottish architect

Lamont Young proposed a forward-looking tourist development project for the neighborhood, which unfortunately was never realized due to a lack of investors.

Despite the promising tourist perspectives, in 1910 Bagnoli was chosen as location of the Ilva (later named Italsider) steel plant for logistical reasons and for a less congestion compared to the eastern part of Naples. The plant ceased its activity in 1992, but still today the neighborhood is marked out by a landscape of abandoned and ghostly warehouses and machineries.

Until now, the failure of the regeneration projects of the ex-industrial area of Bagnoli is evident, due to wrong policies on multiple levels, from the municipal to the national level, corruption, interference from organized crime, bureaucracy. Notwithstanding that, in an attempt to resume the regeneration of the ex-industrial area, some recovery works have been carried out so far: Città della Scienza (City of Science), a science museum and a research and scientific dissemination centre; Pontile Nord (North Jetty), formely used for the docking of large tonnage ships, now converted into a panoramic promenade; the Auditorium "Porta del Parco"; a partial decontamination of the land.

The redevelopment of Bagnoli has been characterized by a series of attempts and projects which, over the years, have tried to transform this area from an ex-industrial pole to a modern urban neighbourhood, with a focus on tourism and landscape potential. Since 1991, Bagnoli began to be imagined as a scientific-technological centre. This project involved the recovery of abandoned industrial areas and the construction of modern infrastructures to attract investments in the innovation and research sector, as well as the recovery of bathing areas and the increase in tourist facilities. However, a lack of funding led to this ambitious vision being shelved. In 1994, the architect Vezio De Lucia proposed the "Napoli 2000" project, with an approach more oriented towards enhancing the resources of the territory. The idea was to create a bathing sea and an equipped beach, restoring access to the coast to citizens and tourists. The project also included the construction of parks and green spaces, the recovery of historic industrial facilities and the promotion of cultural and recreational activities. However, the lack of specific details and a solid financial plan made this dream of revival unrealistic.

There were then years of confusion and failed interventions, due to the lack of an action plan and continuous regulatory stratifications. The establishment of Bagnoli Futura SpA in 2002 marked a more structured attempt to address the regeneration of the neighborhood. This company was in charge of managing the reclamation and redevelopment processes of the ex-industrial area. In the following years, several projects were defined, including the recovery of contaminated land, the creation of an urban park, new infrastructure for leisure and sport, and the construction of residential and commercial buildings. However, bureaucratic problems, difficulties in obtaining financing and accusations of corruption limited the concrete results, until in 2013 Bagnoli Futura ended up under investigation (then failed in 2015) and, in the same unfortunate year, the interactive scientific center of "Città della Scienza" was set on fire.

A significant turning point occurred in 2015 with the "Decreto Sblocca Italia", which transferred the responsibility for recovery and redevelopment to a special commissioner, together with governmental agency Invitalia, excluding the Municipality of Naples from territorial planning. This new commissioner management led to an acceleration of the decontamination processes, with the start of works for the removal of polluting materials and the redevelopment of the ex-industrial areas. The construction of a conference center, the recovery of the beaches and the creation of new green spaces were planned. Several concrete actions followed, including the inauguration of other scientific facilities in the context of "Città della Scienza" (Planetarium and Corporea) and, in 2021, the victory of the project "Balneolis and the new felix season" in response to the Invitalia call for bids for the redevelopment of the ex-industrial area of Bagnoli.

In January 2024, the mayor of Naples, Gaetano Manfredi, proposed a series of further and future actions regarding reclamation, infrastructure, parking, building and waterfront redevelopment, the creation of an urban park and the recovery of the "Parco dello Sport" (Park of the Sport), realized in 2010 and never implemented. In May 2024, 1.2 billion euros were allocated by the Italian government for the realization of these objectives.

THE TOURIST POTENTIAL OF BAGNOLI

Clearly the promising tourist perspectives of Bagnoli were hindered by the localization of the Ilva industry. Despite this, however, the neighborhood has various tourist resources and potentialities which, with some interventions, could still favor its revitalization.

First of all, Bagnoli is a coastal neighborhood with several stretches of free beach that could be equipped by the Municipality, and some beach resorts managed by private companies; furthermore, Bagnoli is well connected to the center of Naples by railway lines. The only limit is that the sea of Bagnoli is not considered officially bathing due to pollution, and to make it suitable for swimming an extremely expensive intervention is needed. Therefore, it is included in the list of actions to be completed. Another great potential of Bagnoli is thermalism, both in relation to the facilities that were active between the 1950s and 1970s, to be restored (Noviello and Smętkiewicz, 2019), and to the "Terme di Agnano", a still operating high-end spa in financial difficulties with a glorious past: nowadays it is owned by the Municipality of Naples, which is trying to relaunch the activity. From the point of view of cultural tourism, Bagnoli district is known for a particular type of tourism, the so-called "edutainment" (term composed by the words education and entertainment), thanks to the great tourist attractiveness of the interactive centre of "Città della Scienza", much visited by school groups visiting the city of Naples. This visit is often combined with a guided tour of the adjacent "Pausilypon Archaeological Park", an area of extraordinary interest both from a naturalistic and historical-cultural point of view, located in Posillipo district but easily accessible from Bagnoli. Another cultural attraction is the islet of Nisida (figure 2): it hosts the Juvenile Penal Institute of Naples and therefore it is not open to public. However, guided tours are organized periodically to visit the Literary Park which was created by virtue of the many authors who have described its beauties since the classical era.

Figure 2. Islet of Nisida

Recently, the "Pontile Nord" (figure 3) was chosen as the location for the trailer of a successful television series, rising to the rank of a real landmark for Bagnoli, as well as a favorable observation point of the ex-industrial area, within hypothetical but possible thematic tours focused on industrial tourism (Gelbman, 2007; Xie, 2015). From a naturalistic point of view, it can be mentioned that in Bagnoli is located the entrance to the "Cratere degli Astroni" State Nature Reserve, in the past a thermal area, then a royal hunting reserve and, today, an important WWF Oasis.

Figure 3. Pontile Nord

Thanks to its favorable position between Posillipo and Campi Flegrei and well connected to the center of Naples, and with a strong seaside vocation, Bagnoli has a great potential for the development of the tourist-residential function, as an alternative to the center of Naples. Until now, in Bagnoli there are four hotel facilities (two 4-star hotels and two 3-star hotels, for a total of 236 beds), while the non-hotel offer is still limited, with only 68 (i.e. 0.7 %) of the 10,385 Neapolitan facilities present on the Airbnb portal (as of 31st December, 2023; source: www.airbnb.it).

THE QUESTIONNAIRE

To support the analysis, a questionnaire was developed which, through 11 questions, aims to evaluate the general satisfaction of those who live the daily life of Bagnoli and their vision of the future. Respondents were asked to express an opinion on aspects concerning the quality of life and leisure facilities, but also the development perspectives, especially from a tourist point of view, in light of the urban planning activities implemented so far and the phenomena of bradyseism and volcanic risk that characterize the territory of the Campi Flegrei.

The questionnaire, drawn up using the Google Form format, was published in November 2023 in two Facebook groups ("Bagnoli 80124" and "Info X Municipalità Napoli") of residents and people connected to the neighborhood and recorded the participation of 254 respondents. Most of these are women (67.5%) aged between 41 and 60 years (51.6%), resident in Bagnoli for more than 40 years (84.3%) (figures 4, 5, 6, 7).

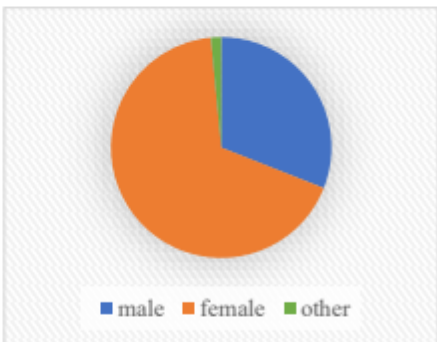

Figure 4. Gender

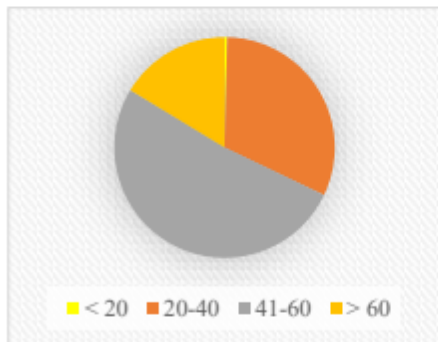

Figure 5. Age

Figure 6. Resident in Bagnoli

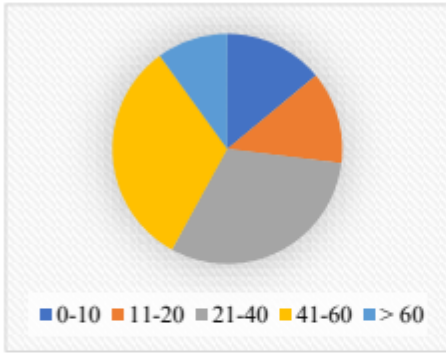

Figure 7. Years of residence

For each of the aspects reported in Figure 8, we asked to assign a score from 1 (minimum) to 5 (maximum). The features of Bagnoli that are most appreciated are the position (4.24) and the landscape (4.28), confirming the excellent potential of the neighborhood in these respects. Next, with a rating of 3.4, are transport and bars/restaurants. The score given to parking was not very high (2.8), perhaps due to the difficulties that residents encounter on the seafront in the night hours of weekends, given the presence of nightclubs. Security does not appear to be one of Bagnoli's strong points (2.26): in addition to the concerns common to all large metropolitan areas, in this case must be considered the perception of seismic and volcanic risk (of which will be said later). However, the assessment of the level of cleanliness was very low (1.97), probably due to the lack of care taken by the municipal administration in ensuring the maintenance and cleaning of streets and pavements and, more generally, urban decorum.

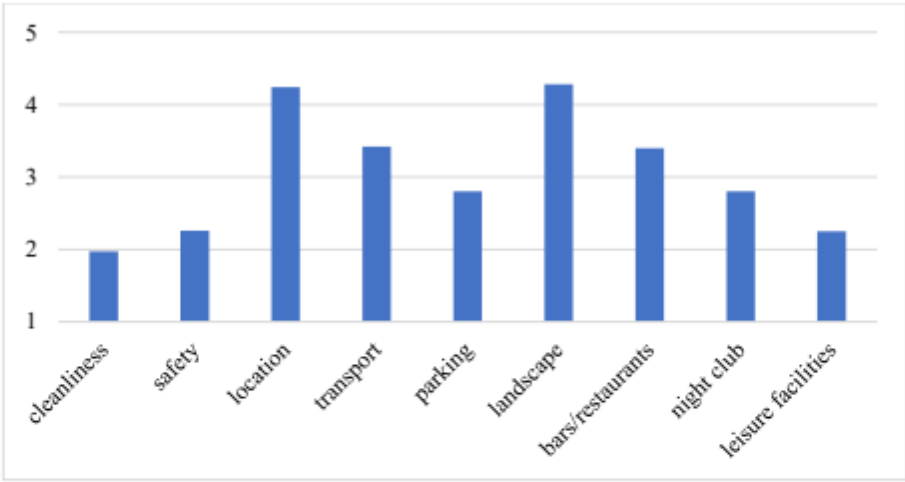

Figure 8. Assessment of territorial features

The most popular leisure facilities are the Pontile Nord (3.7), the Riserva Naturale degli Astroni (3.6) and the Città della Scienza (3.5). These are good but not enthusiastic evaluations, perhaps motivated by disappointment at the lack of or insufficient valorization of the neighborhood's resources and the ineffectiveness of territorial and tourist development policies, despite the good potential (figure 9). A disappointment that is largely confirmed by the evaluation of the regeneration policies implemented so far, considering that over 90% of respondents has expressed a very negative opinion (figure 10). Furthermore, two thirds of respondents complain that the neighborhood has worsened in the last ten years (figure 11). Nonetheless, the large

majority (71.5%) still believes in a future tourist development of Bagnoli, perhaps indicative of a sense of belonging and territorial identity of those who, aware of the qualities of their territory, hope that things can change for the better (figure 12).

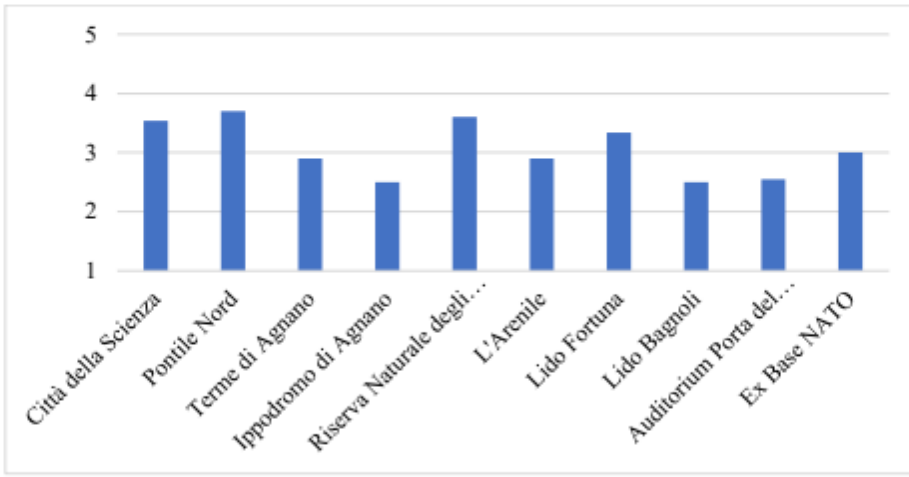

Figure 9. Assessment of leisure facilities

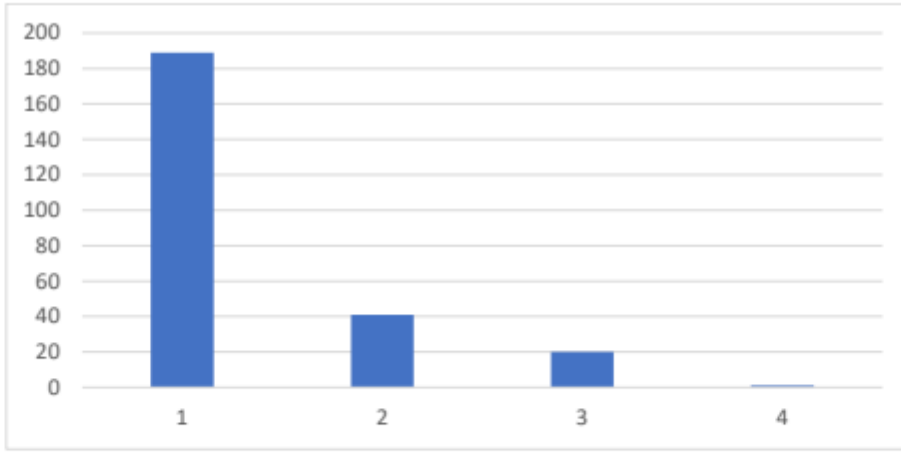

Figure 10. Assessment of regeneration policies

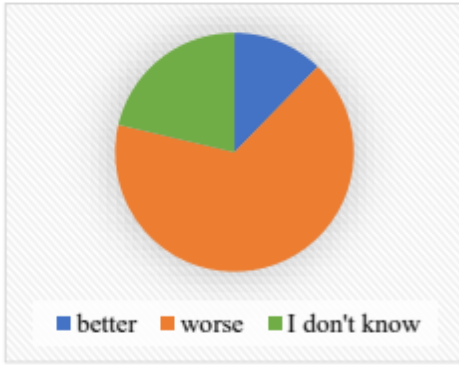

Figure 11. Evolution of Bagnoli over the past decade

Figure 12. Prospects of tourist development

Unfortunately, the seismic and volcanic nature of the Campi Flegrei, if on the one hand contributes to the charm of that *locus amoenus* described since ancient times by great poets, on the other hand is perceived as a risk (65.2%) and a serious limit to a future development of the neighborhood (60.9%) (figures 13, 14). However, it should be underlined that the questionnaire was carried out in a period in which there was a significant recovery in seismic activity in the Campi Flegrei area, with tremors that reached and even exceeded a magnitude of 4, which largely explains the pessimistic view emerged from the questionnaire. The questionnaire administered to residents revealed a general awareness of the tourism potential of Bagnoli, but also a widespread mistrust towards the institutions responsible for the regeneration. Residents expressed a desire for improved infrastructure and services, and an interest in the development of tourism activities that can create jobs and improve the quality of life in the neighborhood.

Figure 13. Concerns about bradyseism and volcanic risk

Figure 14. Repercussions on future development

CONCLUSIONS

Thanks to its strategic position and the resources of the area, Bagnoli is a neighborhood with a high tourist potential; after all, the urban suburbs are often characterized by dynamism, creativity and innovation (Petrillo, 2018).

After the decommission of industrial activity in 1992, several attempts to redevelop the area followed, almost always unsuccessful; the history of Bagnoli, in fact, highlights the difficulties of the urban redevelopment of this suburb, underlining the importance of organic planning and effective management of resources and of an integrated approach that involves local institutions, residents and private investors, essential for the revitalization of the territory.

So far, the new proposed projects, the allocation of funds for their realization and the residents' confidence that emerged from the questionnaire, lead in a new optimism. If the current regeneration projects are implemented, it will be realistic to enhance and give value to the relevant tourist resources of Bagnoli – which are mostly in a potential stage – in the context of the considerable tourist flows that reach the city of Naples. It will be therefore possible to create a diversified and integrated offer ranging from bathing to spa, from nature to culture, from archaeology to industrial tourism, aimed at a tourist segment – niche but growing – that is attracted by unusual and alternative landscapes and atmospheres: landscapes and atmospheres that a rediscovered and regenerated *Balneolis* would certainly be able to supply.

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STRUCTURAL EVOLUTION OF DEMOGRAPHIC INDICATORS ON DIVORCES IN ROMANIA: A COMPARATIVE ANALYSIS BY RESIDENCE, REGIONS, AND SOCIO-DEMOGRAPHIC CHARACTERISTICS

Marius I. STUPARIU*
University of Oradea, Department of Geography, Tourism and Territorial Planning,
1 University St., 410087, Oradea, Romania; e-mail: marius_stupariu@yahoo.co.uk

Marcu Simion STAȘAC
University of Oradea, Department of Geography, Tourism and Territorial Planning,
1 University St., 410087, Oradea, Romania; e-mail: marcu_stasac@yahoo.com

Ribana LINC
University of Oradea, Department of Geography, Tourism and Territorial Planning,
1 University St., 410087, Oradea, Romania; e-mail: ribanalinc@yahoo.com

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Abstract: The present study analyzes the evolution of the divorces in Romania over the period 1992-2023, aiming to investigate the social, economic, and cultural factors that have shaped family behaviors and decisions regarding the dissolution of marriages. Using an approach based on official statistical data, the research explores significant differences between urban and rural areas, identifying divergent and convergent trends regarding divorce rates, influenced by modernization, urbanization, and economic crises. The study also examines the impact of economic migration and access to education on family behavior, highlighting how these elements have contributed to structural changes in marriages and divorces in different regions of the country. The analysis focuses on factors such as the age group of spouses, marriage duration, number of minor children, and the geographical structure of divorces, providing a deep understanding of the social dynamics and changes related to the stability of marital relationships. Another important aspect of the research is the evolution of the woman's role in marriage, influenced by increased economic independence and changes in the social perception of marriage. Additionally, regional

* Corresponding Author

disparities are discussed, varying depending on cultural traditions, urbanization level, and the economic development of counties, as well as common challenges faced by families in different areas of Romania. The study emphasizes the complexity of divorces, offering a comprehensive perspective on current and future trends, as well as the factors that influence marriage and divorce decisions, within a constantly changing social and economic context. The research conclusions will contribute to a deeper understanding of this dynamic phenomenon, as well as to the formulation of public policies better adapted to the contemporary realities of Romanian society.

Key words: divorce; territorial disparities of divorces; duration of marriage; age at the time of divorce; minor children remaining after divorce

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INTRODUCTION

Divorce represents the legal dissolution of a marriage, with significant implications for the individual, family, and society as a whole. In Romania, the phenomenon of divorce has experienced a complex evolution in recent decades, considering the economic, social, and cultural changes in the post-communist period. Over the years, the divorce rate has varied significantly, reflecting the transformations in Romanian society, such as urbanization, internal migration, changes in family structure, and the influence of economic factors like financial crises. In this context, the analysis of divorces in Romania provides an opportunity to better understand the dynamics of couple relationships and their impact on family and social structures.

This study aims to examine the phenomenon of divorces in Romania between 1992 and 2023, a period marked by major economic, political, and cultural transformations. The post-communist period brought significant changes in the perception and behaviours toward marriage and divorce, and this study will focus on analysing the evolution of this phenomenon based on residency areas (urban and rural), counties, age, marriage duration, and the number of minor children. Additionally, the study will explore how various socio-economic factors, such as financial independence, migration, and cultural values, have influenced divorce decisions in different regions of the country.

By utilizing official statistical data and subsequently processing it, this study will allow us to identify the general trends of divorces, as well as the significant differences between various age groups, counties, and residency areas. The impact of various social changes, such as the increased level of education and changes in the status of women, on divorce behaviour will also be analyzed. The study aims to contribute to understanding the factors that shape family behaviours in Romania, thus providing a framework for public policies that support the prevention of divorces and the strengthening of family relationships.

This research has a significant impact, considering the social importance of the institution of marriage and the consequences of divorce on family stability and the community. Understanding the causes and trends of divorces can offer solutions and recommendations for supporting families in preventing this phenomenon and promoting an environment conducive to stable and healthy relationships.

THE IMPORTANCE OF THE STUDY OF DIVORCES

Numerous studies conducted on divorces provide a deeper understanding of the evolution and impact of this phenomenon on social, economic, and cultural relationships. The importance of divorce research cannot be underestimated, as divorce is not merely a legal act but also a significant change in the personal lives of individuals and within the broader societal context. In this paper, we will explore various aspects of the importance of studying divorces, ranging from their impact on

individuals to their effects on economic, political, and social structures, as well as the analysis of cultural changes and marital norms.

Divorce represents a major disruption in an individual's life, and the process can have profound consequences on the mental, physical, and financial well-being of those involved. It can lead to feelings of loss and uncertainty, significantly impacting self-perception and identity for those experiencing it. In many cases, divorce can trigger a long-term adaptation process that affects individuals over time, even in the absence of external factors. Additionally, children are often the most vulnerable following a divorce. The impact on them can depend on various factors, including their age, the type of relationship they had with each parent, and the stability of the post-divorce family environment. Studies show that divorce can lead to emotional and psychological challenges for children, manifesting as behavioural issues, learning difficulties, or social adaptation challenges. In this context, researching divorces helps identify factors that can mitigate these effects and create a stable environment for children, even within a divided family. Divorce can also have a significant impact on individuals' interpersonal relationships, often resulting in social isolation, difficulties in forming new relationships, and higher levels of stress. Studies analysing the behaviours and relationships of individuals post-divorce provide valuable insights into how these individuals can be supported in rebuilding their lives and overcoming the social or psychological difficulties that follow divorce (Stupariu & Josan, 2006; Macarie, 2008; Guran-Nica, 2015; Birta, Iftimoaei, & Gabor, 2024).

The social impact of divorce not only affects the individuals directly involved but also has a significant influence on the entire social structure. As divorce rates increase in many societies, including Romania, traditional social norms related to marriage and family may undergo changes (Clarke-Stewart & Brentano, 2008; Hetherington, 2014b; Grant, 2016; Everett, 2021; Drăghici, 2022; Arendell, 2023; Mihăilă, 2023).

In addition to personal effects, divorce can also have a considerable *economic impact*. It can create significant financial instability for both partners and their children. In many cases, women are more economically vulnerable after a divorce, with more limited access to financial resources and a lower economic status compared to men. This is a recurring issue, particularly in contexts where women have traditionally played a primary role in raising children and managing the household. After divorce, they often face the challenge of reintegrating into an economic system where financial independence has not always been a priority (Dnes & Rowthorn, 2002; Grossbard-Shechtman, 2003; Clarke-Stewart & Brentano, 2008; Andreß & Hummelsheim, 2009; Mihalache, 2010; Everett, 2014; Litra, 2015; Kreyenfeld & Trappe, 2020; Everett, 2021).

The study of divorces is also important from the perspective of *public policy* formulation. In many countries, governments are directly involved in regulating divorces through legislation, as well as in providing support services for those affected divorce (Olaf, 2022). Public policies must address the needs of individuals experiencing this unwanted event, and research can help develop more effective and better-adapted policies for the current context. In this regard, authorities can use the findings of divorce studies to implement pre- and post-divorce education and counselling programs. These programs can help couples make more informed decisions before resorting to separation and provide greater support to those affected by divorce. Additionally, it can contribute to the development of more effective social protection measures for individuals facing economic difficulties after divorce (Trebici, 1994; Dnes & Rowthorn, 2002; Grossbard-Shechtman, 2003; Douglas, 2006; Walker, 2015; Sclater & Piper, 2019; Kreyenfeld & Trappe, 2020; Everett, 2021)

Divorce is also connected to the *legal system*, as it is a process regulated by national and international laws. The study of divorces from a legal perspective is essential for understanding the evolution of legal norms and their impact on the family. The legal system influences decisions related to custody, the division of shared assets, and financial obligations between former spouses (Freeman, 2010; Mareș, 2013; Murphy & Singer, 2015; Nicolae, 2018; Romitan, 2019; Neamț, 2022; Clemente-Díaz, 2022; Neamț, 2023).

Divorce can have a significant impact not only on the individuals separating but also on *intergenerational relationships*. Children, parents, and even grandparents may be affected by the separation of a couple. In many cases, relationships between parents and children can undergo significant changes, and the study of divorces can explore how extended families respond to and adapt to this change (Connidis, 2001; Wolfinger, 2005; Chistruga-Sinchevici, 2009; Izuhara, 2010; Stanciu, 2016; Claster & Blair, 2021).

Mass media also plays a crucial role in shaping public opinion and reflecting social phenomena. The study of divorces can include an analysis of how the media portrays and influences public perceptions of divorce. Whether through television, films, news, or social networks, messages about divorce can shape how individuals and societies view this phenomenon. Additionally, the media can contribute to educating the public about the rights and responsibilities of those involved in a divorce, as well as its impact on children and the community (Krantzler & Krantzler, 2003; Du Toit, 2019; Benedek & Huettner, 2019; Harlow, 2021; Slotter & Markey, 2021).

Religion is a determining factor in many cultures, and religious perspectives on divorce often influence both individual and collective decisions. In many religions, divorce is considered a sin or a last-resort solution. In this context, the study of divorces can include an analysis of religious influence on decisions to divorce and how religious institutions respond to divorces. These perspectives are important for understanding how various individuals and families cope with religious and social pressures, as well as for identifying religious support resources that can help people navigate this process (Efird, 2001; Nichols, 2002; Onedera, 2007; Mayo, 2008; Soroştineanu, 2010; Jenkins, 2014; Marks & Dollahite, 2016; Rutten, Deogratias, & Kruiniger, 2019; Răcilă, 2021)

From a *psychological* perspective, divorce has profound implications for individuals and their interpersonal relationships. Psychological studies on divorce focus on identifying the factors that contribute to the breakdown of relationships and on how individuals adapt after a divorce (Voinea, 2005; Lebow, 2018; Ackerman, Kane, Gould, & Dale, 2020).

Another important aspect of the study of divorces is related to the family transformations that occur in a society marked by a high divorce rate (Cuturela, 1995; Popescu, 2001; Jeynes, 2002; Rotariu, 2003; Clarke-Stewart & Brentano, 2008; Root & Clark, 2010; Behrendt, 2023). These changes reflect a redefinition of the concept of family, where traditional forms of marriage and parenthood may be replaced by more flexible family structures (Mitrofan, 1995; Smart, Neale, & Wade, 2001; Popescu, 2003; Harvey & Fine, 2004; Demo & Fine, 2010).

Therefore, the study of divorces can help in understanding the social, economic, and cultural changes that are transforming our family and society.

METHODOLOGY

The methodology of the study on divorces in Romania between 1992 and 2023 aims to provide a detailed analysis of this phenomenon, considering factors such as the evolution of divorces based on residency environments (urban and rural), counties, age, duration of marriage, and number of minor children remaining after the dissolution of marriage. The study will use official data and will include both a descriptive analysis of trends and an evaluation of the factors that influenced the increase or decrease in divorce rates. This approach will involve a quantitative analysis based on official statistical data and, possibly, secondary data.

The main goal of the study is to understand the trends and factors that have influenced divorces in Romania, with specific objectives including analysing data based on residency environments (urban and rural), counties, age groups, duration of marriage, and the number of minor children left after the divorce. The study will include a comparison between regions and examine the socio-economic and demographic influences on divorce frequency.

Data sources will include official databases from the National Institute of Statistics, especially from the POP212A, POP212B, POP212C, POP212D, POP212E, and POP213A sets, which provide detailed information on divorces (INS, 2024). Additionally, annual reports and

previous research will be used to gain a comprehensive understanding of the divorce phenomenon in Romania.

The study analyses data from the period 1992-2023, taking into account that significant changes occurred in Romania's social and economic structure during this interval. The study period will include both general trend analyses and examinations of factors that have caused fluctuations in divorce numbers, such as urbanization, migration, and changes in legislation.

The units of analysis include residency environments (urban and rural), counties, age and gender groups, duration of marriage, and number of minor children. Each of these dimensions will be evaluated to identify patterns and differences in divorce behaviours, and the data will be correlated to uncover significant relationships between various variables. The influence of economic and social factors on divorces will also be analyzed.

Data collection will be based on the aforementioned official sources, and the data will be processed and interpreted to ensure their quality and consistency. After processing, statistical analyses will be applied to highlight correlations between the variables of interest. Descriptive analysis will include tables and graphs to present the evolution of divorces over time, while comparative analysis will identify significant differences between counties and regions. Regression will also be used to explore the relationships between various variables.

Among the measurement tools will be statistical indicators such as the divorce rate, divorce structure by residency environments and counties, and more detailed analyses based on age and number of children. The analysis will rely on statistical software (e.g., SPSS, R, Excel) to perform complex analyses such as regressions and correlations and to extract meaningful conclusions from the collected data.

The stages of the study will include first collecting and organizing the data, followed by processing to remove any errors. After the statistical analysis, the results will be interpreted in the context of social, economic, and cultural factors. Finally, the study will include a detailed report presenting the conclusions and recommendations for public policies in the fields of family, education, and marital counseling.

The study's limitations will include possible data gaps or errors in secondary sources, and external factors such as economic crises and legislative changes may influence divorce trends during a specific period. However, the study will aim to identify relevant determinants and propose solutions to support couples in preventing divorces and addressing emerging social needs.

DIVORCES IN ROMANIA. DYNAMICS BY AREAS OF RESIDENCE

Divorces are an important indicator of family and social dynamics, reflecting structural changes in society and how these impact family relationships. The analysis of the divorces number evolution in Romania between 1992 and 2023, differentiated by residency environments (urban and rural), highlights relevant trends regarding their distribution, associated factors, and social implications. This study focuses on identifying extreme indicators, both in terms of total number of divorces and their share according to residence, in order to better understand these phenomena.

During the analyzed period, the total number of divorces in Romania experienced significant fluctuations, influenced by factors such as economic, social, and legislative changes. In 1998, the maximum number of divorces was 39,985, marking a period of economic and social instability in the context of the post-communist transition. In contrast, in 2020, the lowest number of divorces was recorded, with 22,785, which can be attributed to the COVID-19 pandemic, which created difficulties in legal procedures, as well as economic and social pressures on families.

In general, the number of divorces has shown a gradual decrease in the last two decades, which may reflect either a change in attitudes toward marriage or a trend toward increased stability in family relationships. Additionally, in the context of demographic changes, the smaller number of marriages and a declining birth rate have contributed to the reduction in the incidence of divorces.

Divorces in urban residency. During the analyzed period, the urban residency dominated in terms of the number of divorces, reflecting the complex influences of modernization, urbanization,

and cultural changes. In 1992, urban divorces accounted for 76.6% of the total, marking the highest proportion. This dominance can be attributed to the social and economic transformations after 1989, when cities were the first to experience the structural changes of the market economy. Increased unemployment, housing instability, and political and economic adjustments created a tense climate within families, leading to a higher incidence of divorces. The maximum number of urban divorces was reached in 1998, with 28,702 cases, highlighting the impact of the economic crisis of that period. Large cities, such as Bucharest or Cluj-Napoca, were the epicentres of these transformations, and families here faced major financial pressures, which exacerbated couple conflicts. Moreover, the urban residency, by its nature, was more receptive to cultural changes and offered greater social acceptance of divorce compared to rural residency. Over time, the share of urban divorces gradually decreased, reaching 61.8% in 2023, the lowest value in the analyzed period (14,041 cases). This reduction is explained by several factors, including the migration of the active urban population to rural areas or abroad, the increase in informal cohabitation, and the decrease in the number of marriages in the urban environment. Additionally, better access to education and marital counselling contributed to the stabilization of couple relationships in certain segments of the urban population (Figure 1).

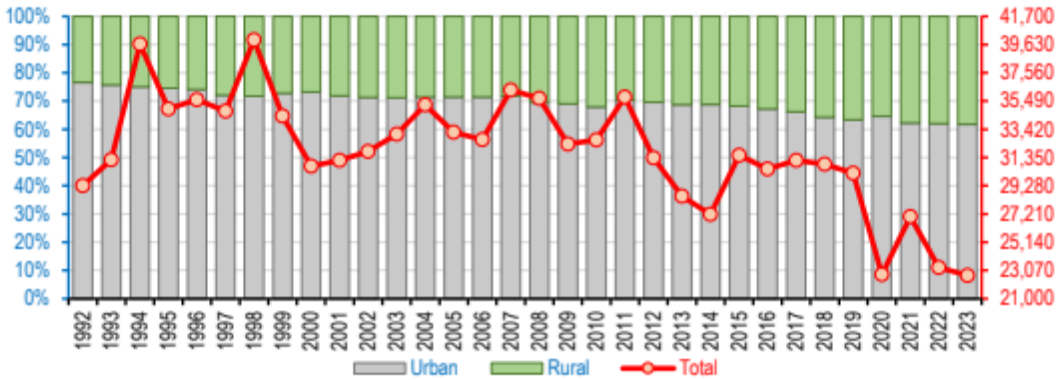

Figure 1. Divorces by living environment in Romania during the period 1992-2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

Divorces in rural residency. In contrast to the urban residency, divorces in the rural residency initially had a lower share but showed a significant upward trend over time. In 1992, only 6,847 divorces occurred in the rural environment, accounting for 23.4% of the total. This low percentage reflects the traditional characteristics of rural life: greater economic dependence between partners, stronger social control exerted by the community, and greater stigmatization of divorce. During this period, most rural families relied on agricultural labour or extended family support, which discouraged legal separation. Starting in the 2000s, divorces in the rural residency began to increase significantly, both in absolute numbers and as a share. The highest number of rural divorces was recorded in 2008, with 10,879 cases, marking a turning point in the dynamics of this phenomenon. This increase can be explained by several structural changes, such as rural modernization, better access to legal services, and greater economic independence of women. Additionally, the mass migration of the active population to other countries led to physical separations, which favored the dissolution of families. The share of rural divorces continued to rise, reaching 38.2% in 2023 (8,674 cases), indicating a significant reduction in the urban-rural gap. This evolution reflects a transformation of values and norms in the rural residency, with wider access to education and technology, as well as a diversification of economic opportunities, allowing partners to become more financially and socially independent (Figure 1).

The ratio between urban residency and rural residency divorces. The ratio between urban and rural divorces underwent significant changes over the analysed period, indicating a gradual

convergence of family behaviours between the two environments. In the early years of the post-communist transition, the differences were very marked, with urban divorces accounting for nearly three-quarters of the total. In 1992, the urban-rural ratio was about 3:1, reflecting a society still strongly divided culturally and economically. This initial discrepancy can be explained by the traditional structure of rural communities, where divorce was rarely accepted, as well as by the economic differences between the two environments. Urban areas, more dynamic and exposed to rapid changes, were much more prone to marital instability, while rural areas remained anchored in conservative values. However, over time, the ratio between divorces in the two environments became more balanced, as social values and practices in rural areas modernized. In 2023, divorces in the rural residency accounted for 38.2%, the highest level in the entire period. This evolution can be attributed to factors such as equal access to education and information, as well as economic changes that reduced the familial dependence between partners. Moreover, international migration and the situation of some families returning to rural areas contributed to the introduction of modern values, which redefined family structure and dynamics. This urban-rural convergence highlights a broader change in Romanian society, where cultural and economic differences between the two environments are becoming increasingly blurred. However, this trend also points to common challenges, such as the rising instability of families and the need for adapted social policies to support vulnerable families in both environments (Figure 1).

TERRITORIAL DISPARITIES IN DIVORCES IN ROMANIA

Between 1992 and 2023, the dynamics of divorce in Romania show significant variations across counties and regions, shaped by factors such as the level of urbanization, cultural traditions, ethnic structure, and local economic dynamics. Analysing the evolution of divorces at the regional level provides a deeper perspective on the demographic and social differences within Romania, highlighting how various local factors influence the decision to separate and the stability of marriages.

Highly urbanized and economically developed regions (Bucharest, Ilfov, Timiș, Cluj). In these counties, the divorce rate is significantly higher than in other regions. For example, Bucharest, where the divorce rate is among the highest, is marked by a constant frequency of divorces over the years. Contributing factors here include the financial independence of partners, low pressure from traditional social norms, and greater acceptance of divorce. In Bucharest, for instance, the post-communist transition period saw a significant number of divorces, with a peak reached in 1994. This was a time when economic instability and rapid social transformations led to a revaluation of personal priorities, resulting in a separations' increment. In the counties of Cluj and Timiș, rapid economic development and the attractiveness of young people from across the country of these areas had similar effects. The 2000s and the period following Romania's EU integration brought economic opportunities and growing careers for the urban population. In this context, economic independence, especially among women, and changes in social values led to an increase in divorces. In Cluj, for example, a peak in divorces was recorded in 2008, during the global economic crisis, which added additional stress to marital relationships (Figure 2-3).

Regions with strong ethnic homogeneity and traditional values (Harghita, Covasna). The counties of Harghita and Covasna, predominantly inhabited by the Hungarian ethnic population, have some of the lowest divorce rates in the country. Here, communities are characterized by strong cultural and religious norms that support marital stability and discourage divorce. The low number of divorces in these counties can be explained by social pressure to maintain marriages and the central role of the extended family, which provides emotional and financial support. For example, in Harghita County, the divorce rate has remained relatively constant over the past decades, with no significant increases even during economic crises, suggesting strong cultural resistance to external social changes. Moreover, the influence of the Church and traditional values is more pronounced here, making divorce perceived as a last resort (Figure 2-3).

Regions affected by economic migration and workforce exodus (Moldova, Oltenia). The counties in Moldova and Oltenia, such as Bacău, Vaslui, and Dolj, have been strongly affected by economic migration, with many residents choosing to work abroad to financially support their families left behind. This geographical separation between spouses has contributed to an increase in divorce rates in these regions, as physical distance and long-term separation have led to tensions and misunderstandings. In Bacău County, for example, the divorce rate was notably high between 1998 and 2000, coinciding with the early years of workforce exodus abroad. Also, in the context of economic hardship, divorce appears as an option to overcome financial difficulties or as a consequence of changes in family dynamics. Similarly, Dolj County recorded increased divorce rates, as many residents who left for abroad struggled to maintain family relationships due to the lack of economic stability and physical distance (Figure 2-3).

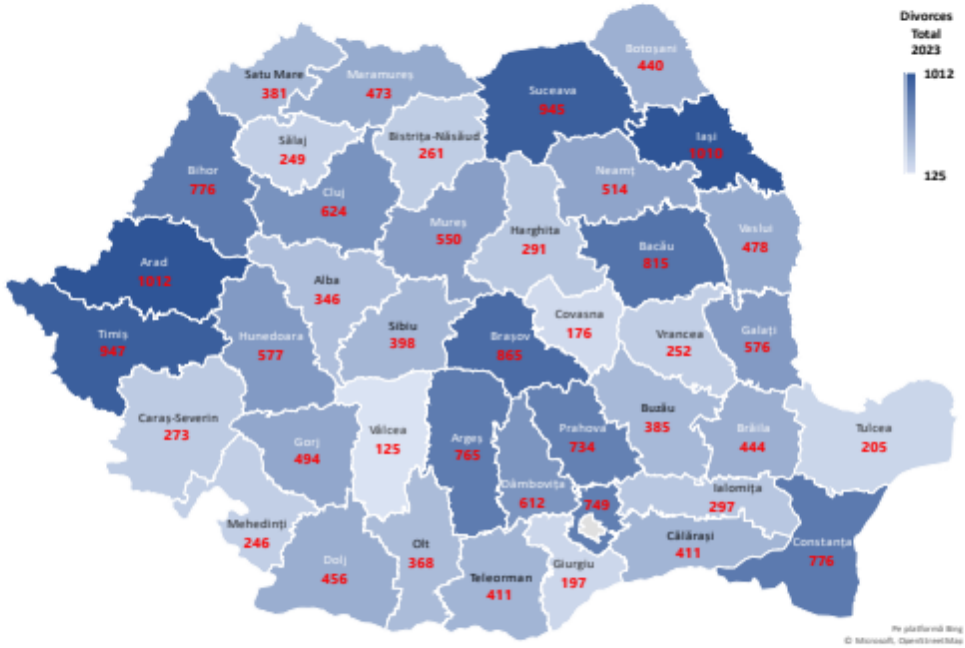

Figure 2. Territorial disparities in divorces in Romania in 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

Emerging urban areas and tourism (Braşov, Constanţa, Sibiu). In the counties of Braşov, Constanţa, and Sibiu, economic development and the explosion of the tourism industry have attracted an increasing number of young people who settled in these areas for employment opportunities. While tourism and economic development bring prosperity, they also introduce a more permissive culture regarding personal relationships. In Constanţa, for example, the number of divorces peaked between 2008 and 2011, during the years of the global economic crisis, but also a period of growing tourism and seasonal migration. In Braşov, a city recognized as a cultural and economic hub, divorces are also influenced by a more cosmopolitan population exposed to modern values that support independence and personal fulfilment. Furthermore, in Sibiu, a city with a strong cultural orientation and significant ethnic diversity, external influences and more liberal standards contribute to the acceptance of divorce as a solution for unstable relationships (Figure 2-3).

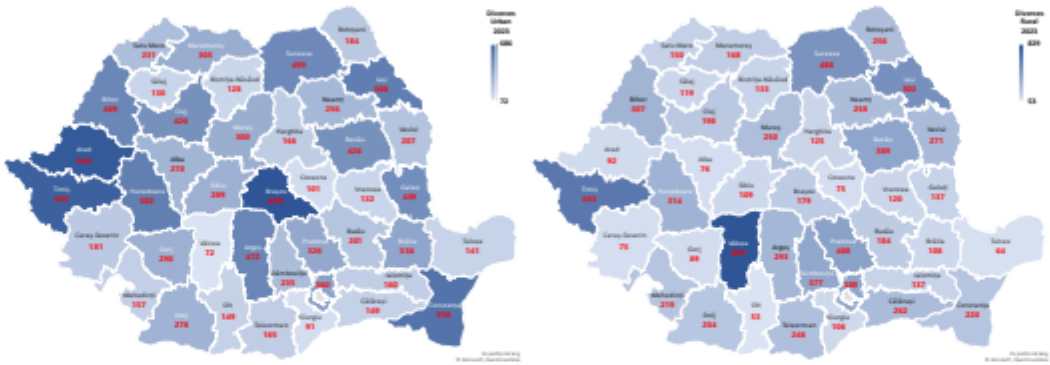

Figure 3. Territorial disparities in divorces in urban (left) și rural (right) areas of Romania in 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

Rural areas and less economically developed regions (Teleorman, Giurgiu). In the counties of Teleorman and Giurgiu, the predominance of a less developed economy and rural communities influences the low divorce rates. In these areas, the extended family plays a central role in supporting and maintaining marriages, and divorce is often avoided due to social pressure and stigmatization. For example, in Teleorman, the divorce rate has been among the lowest in the country, indicating a conservative tendency to preserve marriages, even in the face of economic difficulties. Additionally, the lack of economic independence for many women in these counties makes separation more difficult to achieve, both for economic and social reasons. Thus, the divorce rate remains low in these regions, where traditions and community norms play an important role in influencing marital decisions (Figure 2-3).

Mountain regions and isolated tourist areas (Maramureș, Suceava, Caraș-Severin). In the mountainous counties and more isolated regions, such as Maramureș, Suceava, and Caraș-Severin, divorces are rarer, but trends have evolved interestingly in recent years. These counties are characterized by a concentration of population in mountainous areas, where traditions are deeply rooted and religious and family norms remain very strong. In Maramureș, for example, divorce is rarer, mainly due to the religious influence and the dominant role of the extended family in everyday life. However, in the last two decades, certain localities have started to record an increase in divorces, especially among young people aged 25 to 35, as a result of migration to cities for better-paid jobs. Another important factor is tourism in the mountain regions, which brings a diversification of lifestyles and greater exposure to liberal values, potentially influencing personal life decisions. Also, in counties such as Suceava, which has significant cultural diversity due to Ukrainian, Polish, and Hungarian influences, divorces may be more frequent among young people who choose to leave these isolated areas in search of economic opportunities elsewhere in the country or abroad (Figure 2-3).

Regions with a young and student population (Iași, Timișoara, Brașov). Counties with a high concentration of young people, students, and young professionals, such as Iași, Timișoara, and Brașov, are characterized by a relatively high divorce rate. These cities are major university centers, where young people from all over the country and abroad gather for studies and careers. The diversity of lifestyle options, a greater openness to progressive values, and the possibility of building stable careers contribute to a more permissive perception of divorce. In these regions, divorce may be influenced by the desire for personal fulfilment and changes in life priorities, especially when partners have achieved economic independence and are exposed to more liberal social norms. For example, in Timișoara, in addition to the large student population, there is also a trend of internal migration of young people from other counties, which may contribute to an increase in divorces, especially among those who marry young and cannot adjust their expectations regarding marital life (Figure 2-3).

Regions with an elderly population (Vrancea, Botoșani, Giurgiu). In counties with an older population, such as Vrancea, Botoșani, and Giurgiu, divorces are less frequent, but the phenomenon has become more noticeable in recent years. Although divorce among older individuals was once a rare phenomenon, a more recent trend shows that some elderly individuals who have not adapted to the rapid changes in society choose to divorce, partly due to fatigue, accumulated frustrations, or feelings of isolation. Additionally, in these counties, some divorces may be related to the premature death of partners or retirement in rural areas, where new types of life relationships are formed. In many of these areas, divorce remains a relatively rare choice, often influenced by traditional norms and fewer economic options for the elderly (Figure 2-3).

Regions with a large immigrant population or strong external influence (Bucharest, Constanța, Iași). In counties with a large immigrant population or significant external influence, such as Bucharest, Constanța, and Iași, divorces are often linked to cultural and social tensions, as well as the forced migration of some partners to other countries. These counties have recorded an increase in divorces due to the cultural mix, exposure to external lifestyles, and, in particular, the phenomenon of labour migration, which leads to more fragile relationships and an increase in separations. For example, Constanța, with an important international port and a significant migrant worker community from other parts of the world, has seen an increase in divorces, especially among families who live abroad for a period and face difficulties in maintaining long-term relationship stability. Bucharest, another example of diversity and migratory flows, reflects the same trend, with a higher number of divorces recorded among young women from various parts of the world who seek to settle in the capital to build a career (Figure 2-3).

Regions with an ethnically diverse population (Suceava, Mureș, Harghita, Covasna). In counties in Romania with an ethnically diverse population, such as Suceava, Mureș, Harghita, and Covasna, divorces can be influenced by cultural and social factors related to the coexistence of different ethnic groups. In these areas, interethnic or mixed marriages are more common, and the phenomenon of divorce can reflect both the challenges of integrating different values and social norms, as well as tensions related to belonging to a particular ethnicity or religion. In Harghita and Covasna counties, where the Hungarian population is predominant, divorces are less frequent, but their occurrence may increase in cases of marriages between different ethnicities, especially in urban areas, where young people are more exposed to external influences. Additionally, in counties with a large ethnic diversity, divorces may also reflect the migration of young families to other parts of the country or abroad, which can lead to relationship instability due to physical distance and the difficulty of adapting to life in a different cultural context (Figure 2-3).

Regions with a significant presence of religious minorities (Bucovina, Dobrogea). In regions with religious minorities, such as Bucovina (with an important community of Orthodox and Greek Catholic Christians) and Dobrogea (with a diversity of religions, including Muslims, Orthodox Christians, and Catholics), divorces may be influenced by religious traditions and the norms specific to each community. In these counties, divorce may be much rarer in traditional religious families, where religious norms are strictly followed and there is significant social pressure to maintain the marriage. However, in urban areas of these regions, where religious values are more relaxed and where ethnic and religious diversity is more evident, divorces have become more frequent. For example, in large cities, such as Constanța, there is a growing trend of divorces, especially among mixed couples or those who follow more liberal values (Figure 2-3).

Regions with a population of young people who marry early (Sălaj, Bistrița-Năsăud, Neamț). In counties in Romania where young people marry at younger ages, such as Sălaj, Bistrița-Năsăud, and Neamț, divorces can be much more common. In these areas, early marriages are more frequent, and this is linked to social pressure and community traditions that encourage marriages before the age of 25. Young people who marry at a young age may face more difficulties in building a solid relationship due to emotional immaturity and the challenges of adapting to family life. In these counties, divorces are common among young people who marry before completing their education or before achieving financial stability. Additionally, the migration of young people to larger cities for

studies or jobs can contribute to relationship dysfunction, as partners fail to balance their time and resources between career and personal life (Figure 2-3).

Regions with a low divorce rate and economic stability (Cluj, Sibiu, Timiș). In counties with significant economic stability and a high level of urban development, such as Cluj, Sibiu, and Timiș, divorces are less frequent. These counties benefit from a well-developed economic infrastructure, career opportunities, and a higher standard of living, which can contribute to the stability of marriages. Thus, economic factors play a crucial role in maintaining stable relationships, as financial resources allow couples to better adapt to the challenges of daily life. In these counties, divorces are rarer, and the factors leading to separation are often related to personal misunderstandings or differences in lifestyles. Additionally, in large cities in these counties, divorce may be associated with a personal choice for those who wish to renew their life or seek new opportunities, rather than with major economic or social pressures (Figure 2-3).

Regions with significant international migration (Bucharest, Iași, Bacău, Galați). Another important factor in the analysis of divorces is international migration. Regions that have seen significant migration of Romanian citizens for business, such as Bucharest, Iași, Bacău, and Galați, have observed an increase in divorces among those who had partners abroad for business or other reasons. Migration for work has often led to the separation of couples, and the large distances between partners and the stress of life abroad have contributed to the rise in divorces. Additionally, in regions with significant migration, divorces are influenced by cultural and economic changes and the adaptation to life in another country. Moreover, those who remain in the country may choose to divorce due to the physical and emotional absence of their partner, which can lead to the breakdown of family ties.

AGE GROUP AT DIVORCES

Age group of the wife at divorces

Between 1992 and 2023, data on the age of women at the time of divorce in Romania provides a clear picture of the dynamics of divorce in relation to the age of women. These statistics reflect not only demographic changes but also significant developments in social attitudes towards marriage and divorce. In this analysis, we will examine the trends in each age group, focusing on extreme values, that is, the highest and lowest values recorded during this period, to better understand the factors that influence the decision to divorce.

Starting with the age group under 24 years, we observe a consistent decline in the number of divorces starting in 1993, with the exception of some minor fluctuations. In 1992, the number of divorces in this age group was 7,634, and in 2023 it dropped to 997 divorces, which represents a significant decrease of approximately 87%. This evolution can be explained by changes in Romania's social and economic structure. In the 1990s, divorces among young married women were relatively common due to unstable economic and social factors, which often placed pressure on fragile marriages. However, starting in the 2000s, the decline in the number of divorces in this age group can be attributed to a shift in the mentality of young women, who became more aware of the implications of divorce and less likely to marry at an early age (Figure 4).

For women aged 25-29, the number of divorces fluctuated much more over the analyzed period. In 1992, 5,214 divorces were recorded, and by 2023, the number had decreased to 2,362 divorces, indicating a significant decline, though more moderate compared to the previous age group. The peak of divorces in this group was recorded in 1994, with 10,041 divorces, an extremely high value, which can be explained by a combination of economic and social factors, including economic instability and pressure on young marriages. After 2000, the number of divorces in this group began to decline, amid greater economic stability and a change in how young people view marriage, with an increased emphasis on education and career before committing to a long-term relationship (Figure 4).

The 30-34 age group presents an interesting trend. In this category, the number of divorces significantly increased over the years, reaching a peak of 7,856 divorces in 2007, and in 2023, it

remained at a relatively high value of 3,590 divorces. This signals that many women in this group experienced divorces after a longer period of marriage, when relationships began to face greater pressures, including managing careers and family responsibilities. Another factor that could explain this trend is that women in this age group have gained greater economic and social independence, which has allowed them to make more radical decisions regarding their relationships. Additionally, starting a family or securing a more stable job may influence this decision, as women become more conscious of their own needs and life priorities (Figure 4).

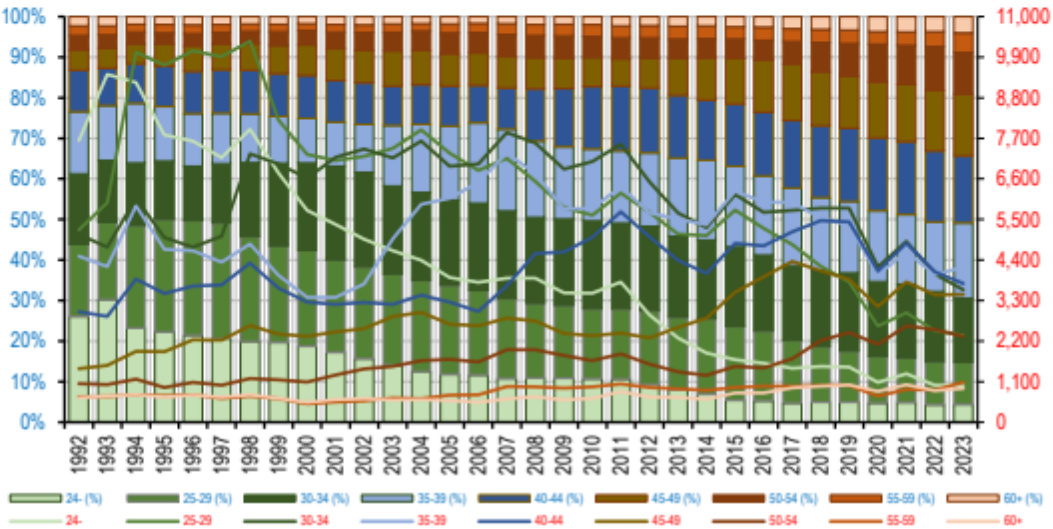

Figure 4. The age group of the wife at divorces in Romania from 1992 to 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

For women aged 35-39, the number of divorces recorded a significant increase until 2007, with a peak of 7,300 divorces. After this period, the number of divorces began to decrease slightly, reaching 4,210 divorces in 2023. This trend can be explained by a combination of factors, including the fact that women in this group are more established financially and professionally, but also because they typically have children who have reached a more advanced stage in their lives, which may lead to a reevaluation of the marriage. Women aged 35-39 are often in a period of self-discovery and reevaluation of their lives, and in this context, divorce may become a choice of self-definition and renewal of personal identity (Figure 4).

In the 40-44 age group, a steady increase in the number of divorces is observed until 2011, with a peak of 5,709. After this period, the number of divorces remained relatively constant, with a slightly higher value compared to the previous age groups, recording 3,764 divorces in 2023. This may be a period in which many women begin to feel increased pressure on their marriages due to hormonal changes, children leaving the parental home, and a general revaluation of life priorities. In this sense, divorce at this age may reflect a desire to improve personal life quality and rediscover happiness in a new phase of life (Figure 4).

For women aged 45-49, there is a consistent increase in the number of divorces until 2017, when 4,362 divorces were recorded, followed by a decrease until 2023, when the number of divorces dropped to 3,464. This is a period in which many women face a major transition in their lives. After 40, children have often left the family home, and women may reach a turning point where the marriage no longer meets their personal or emotional needs. Additionally, this age range may bring greater financial independence and more freedom to make decisions, making divorce a more accessible option (Figure 4).

Regarding women aged 50-54, the number of divorces increased significantly, reaching 2,326 divorces in 2023, compared to 1,047 divorces in 1992, with a maximum of 2,615 divorces in 2021. This is a period in which women often reach a phase of deep self-reflection and a desire to regain independence and meaning in their lives. Additionally, at this age, divorce may be motivated by the physical and psychological changes associated with aging, as well as a higher degree of financial and personal autonomy. Women in this age group are often less concerned with social norms and more focused on their own emotional satisfaction (Figure 4).

For women aged 55-59 and those aged 60 and above, divorces are relatively rare, but there has been a trend of increasing numbers in the past two decades, with a peak recorded in 2023 for women aged 60 and over, where the number of divorces reached 919. This phenomenon may reflect changes in the lifestyle of women in their later years, who become more open to change and the possibility of living an independent life (Figure 4).

Age group of the husband at divorces

The data on the husband's age at divorce for the period 1992-2023 in Romania reflect a series of important developments in behaviour towards marriage and divorce based on men's age. These statistics are useful for understanding the dynamics of divorce across different age groups of men and for analyzing the socio-economic factors influencing divorce decisions.

In the age group under 24, there is a consistent decrease in the number of divorces starting from 1992, from 3,345 divorces to 255 divorces in 2023. This significant decrease (almost 93%) is mainly due to social and economic changes, especially the trend of delaying marriages and divorces among young people. In the 1990s, divorces among young people were frequent due to economic instability and social pressures. However, since the 2000s, the number of divorces has decreased due to a change in the mentality of young people regarding marriage and divorce (Figure 5).

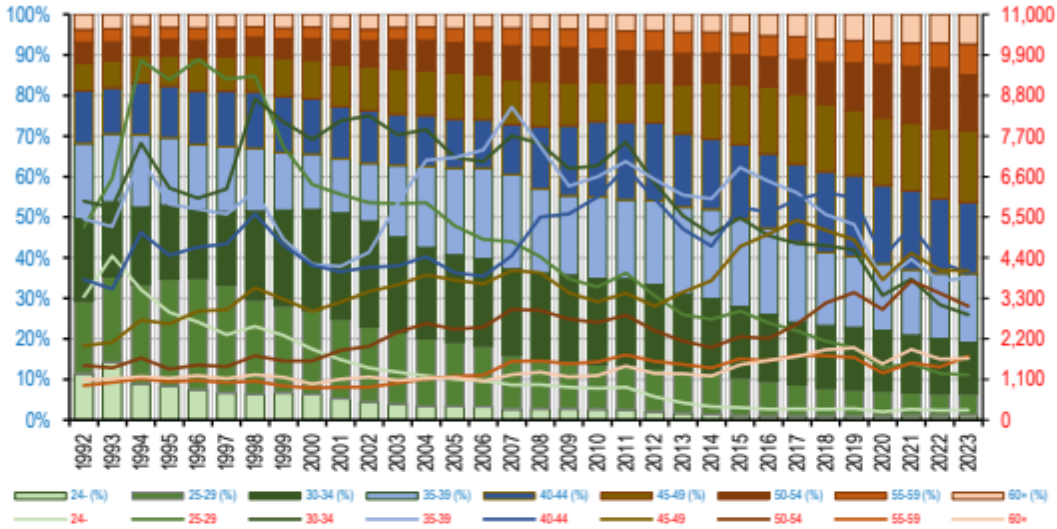

Figure 5. The age group of the husband at divorces in Romania from 1992 to 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

For men aged 25 to 29, the number of divorces followed a fluctuating trend. In 1992, 5,226 divorces were recorded, and in 2023, the number dropped to 1,220, representing a significant reduction of about 77%. Over this period, the peak of divorces was recorded in 1996, with 9,774 divorces, a high that can be explained by economic and social instability at that time. The decrease in divorces may also reflect changing attitudes toward marriage and divorce, as well as an increase in the number of men choosing to marry later and thus avoid early divorces (Figure 5).

In the 30-34 age group, there was a significant increase in the number of divorces until 2000, with a peak in 1998 (8,705 divorces). After this period, the number of divorces began to decrease slightly, reaching 2,853 divorces in 2023, compared to 5,941 divorces in 1992. This evolution can be explained by the fact that men in this age group tend to have more professional and financial stability, and divorce may be the result of more complex relationships with children and financial obligations. The decrease in divorces in this group may also reflect greater maturity regarding marriage-related decisions (Figure 5).

For men aged 35 to 39, the number of divorces increased until 2007, with a peak of 8,487 divorces, and in 2023, there were 3,864 divorces. This can be explained by the fact that men in this age group often face stability issues in marriage, being at a point where family and professional responsibilities can affect relationships. In recent years, the number of divorces in this category has slightly decreased, which could be linked to greater awareness of the impact of divorce on children and financial implications (Figure 5).

Men aged 40 to 44 experienced a significant increase in divorces until 2008, when the number reached 6,842 divorces. After 2008, the number fluctuated, and in 2023 it reached 3,984 divorces. This period is characterized by a revaluation of marriage, considering social and professional changes, as well as an increase in men's financial independence. In this age group, many men go through what is known as a "midlife crisis," which can contribute to the increase in divorces (Figure 5).

For men aged 45 to 49, the number of divorces increased steadily from 2,014 divorces in 1992 to 5,420 divorces in 2017, after which it decreased to 4,043 divorces by 2023. Additionally, in this age group, divorces are related to the process of reevaluating relationships as men reach middle age and face new personal and professional challenges. Another important factor is that, at this age, children have often left the family home, and men have more time and energy to focus on their own needs (Figure 5).

In the 50-54 age group, the number of divorces steadily increased over the years, reaching 3,776 divorces in 2021, compared to 1,476 divorces in 1992, after which it decreased to 3,084 divorces by 2023. This trend may be partly attributed to the fact that men in this age group have more financial independence and more time to reflect on the relationship. Additionally, at this age, men may feel the need for change in their lives, which can lead to the decision to divorce, especially after a long marriage (Figure 5).

Men aged 55 to 59 saw a general trend of increasing divorces from 933 divorces in 1992 to 1,731 divorces in 2023, with a peak of 1,764 divorces in 2011. At this age, many men go through a period of self-reflection and revaluation of life, and divorce may be seen as an opportunity to live an independent life. This change is also facilitated by the financial independence gained over the years (Figure 5).

For men aged 60 and over, the number of divorces has increased significantly in the past two decades, reaching 1,673 divorces in 2023, compared to 1,098 divorces in 1992. This trend can be attributed to demographic changes, as well as greater financial availability and a desire to live an active and independent personal life in later years (Figure 5).

Structure of age groups of wives at divorce

In the analysis of divorce trends in Romania, a key aspect is the age structure of women at the time of divorce. This indicator serves as a lens through which we can better understand not only the behaviors and attitudes associated with marriage and divorce but also the socio-cultural, economic, and demographic transformations that have shaped Romanian society over time. In this section, we will analyze data on the age of women at divorce for the years 1992 and 2023, highlighting the significant changes that have occurred in the structure of age groups and interpreting these changes in the broader context of Romania's social and economic developments.

In the comparative analysis between 1992 and 2023, we can observe a significant transformation in the distribution of divorces by age group of wives. In 1992, the majority of

divorces occurred among younger wives, aged under 24 years (26.1%), while in 2023, divorces were more concentrated among women of middle age, between 35 and 49 years (50.4%). This change is evident both numerically and in the relative share of each age group in the total number of divorces (Figure 6).

In 1992, divorces among women under 24 years old represented 7,634 cases, or 26.1% of total divorces. This percentage was significantly higher than in 2023, when the number of divorces for this age group dropped to just 997, representing only 4.4% of the total divorces. This dramatic decrease can be attributed to several factors, including changing attitudes towards marriage and divorce, as well as economic and educational changes in post-communist Romania.

Before 2000, divorces among young women were influenced by the country's social and economic instability, which led to earlier and less mature marriages. As Romania evolved economically and socially, young people became more cautious in choosing their partners and deciding to marry. The trend of postponing marriages and reducing the number of people marrying at a young age led to a decline in divorces in this age group. Additionally, changes in education and employment contributed to increased economic independence for women, allowing them to be more selective in choosing the timing of marriage and, implicitly, divorce.

In 1992, divorces among women aged 25-29 totalled 5,214, representing 17.8% of all divorces. By 2023, this number had decreased to 2,362 divorces, or 10.4% of the total. Although their relative share has declined, the absolute number of divorces in this age group was higher in 2023 compared to 1992. This suggests that, while divorces among young women are no longer as frequent as in the past, they remain a significant reality in the context of changes in the pace and nature of marriages.

Over these 30 years, most women in this age category have started to marry later, and divorces have become increasingly evident, especially due to differences between the initial expectations of marriage and the couple's realities. Moreover, the increase in women's economic independence has played a significant role, being an important factor in their ability to make the decision to separate when relationships no longer meet their needs.

The age group 30-34 years saw a significant increase in the number of divorces between 1992 and 2023, from 5,092 divorces (17.4% of the total) to 3,590 divorces (15.8% of the total), whereas the age group 35-39 years saw a slight decrease in divorces from 4,504 divorces (15.4% of the total) in 1992 to 4,210 divorces (18.5% of the total) in 2023. This change can be interpreted as a result of greater economic stability and a shift in attitudes towards marriage. Thus, women in this age group tend to stay married longer than before, but eventually face dissatisfaction with their relationship. Another significant factor is the increasing number of marriages where one or both partners are already involved in successful careers or have children, which can lead to tensions in the relationship and a revaluation of the marriage. Additionally, international migration and economic changes in Romania have impacted family dynamics, with visible effects on divorce decisions in this age group.

One of the most notable changes is the rise in divorces among women aged 40-44 and 45-49. In 1992, divorces among women aged 40-44 totalled 2,994, or 10.2% of the total, while in 2023, the number increased to 3,764 divorces (16.6% of the total). Additionally, for women aged 45-49, divorces increased from 1,452 (5.0% of the total) to 3,464 (15.2% of the total). This change can be explained by several factors, including greater financial independence for women, as well as a shift in perspective on marriage. As women reach middle age, they may undergo a revaluation of their relationship and choose to divorce when they feel dissatisfied with the marriage. Furthermore, many of them no longer have young or teenage children, which allows them to make the decision to separate without being influenced by parental responsibilities.

For women aged 50-54 and 55-59, there is a noticeable trend of increasing divorces. In 1992, 1,047 divorces were recorded for women aged 50-54 (3.6% of the total), and in 2023, this number grew to 2,326 divorces (10.2% of the total). Similarly, for women aged 55-59, divorces increased from 687 in 1992 (2.3% of the total) to 1,083 divorces in 2023 (4.8% of the total). This trend is significant and reflects the demographic and economic changes in Romanian society. Older women

tend to be less economically dependent on their partners and may more easily make the decision to divorce, especially in the context of increasing financial independence and more flexible life options. Additionally, once children reach adulthood, women may feel they have their own life, allowing them to make personal choices that focus more on their individual needs.

Divorces among women aged 60 and over showed a slight increase, from 666 divorces in 1992 (2.3% of the total) to 919 divorces in 2023 (4.0% of the total). This trend may reflect changes in society's views on age and retirement, as well as an increased desire among older women to regain their freedom and make decisions that align with their own needs and desires.

Structure of age groups of husbands at divorce

Divorce is a complex social phenomenon, influenced by a range of demographic, economic, and cultural factors. A study of the husband's age at divorce offers insight into the evolution of marital relationships as well as the behavioural and social changes within Romanian society. A detailed analysis of data on the husband's age at divorce in Romania in 1992 and 2023 highlights significant changes in the structure of divorces across age groups, reflecting the socio-economic and demographic trends of the post-communist period. This paper will examine these changes, focusing on the shifts observed in the distribution of divorces by age and interpreting their causes and implications.

By analysing the data from 1992 and 2023, it is clear that the husband's age at divorce has undergone significant transformations. In 1992, most divorces occurred among young men under the age of 34. However, in 2023, divorces were more concentrated among middle-aged and even older men, starting at age 35, suggesting a change in the patterns of marriages and divorces in Romania. Below, we will analyse each age group in detail, noting significant developments and interpreting these changes (Figure 6).

In 1992, divorces among men aged under 24 numbered 3,345, representing 11.4% of the total divorces. In 2023, this number dramatically decreased to just 263 divorces, accounting for only 1.2% of the total divorces. The significant decline in divorces in this age group can be attributed to several factors. First, in the post-communist period, marriages were considerably delayed, and young people became more reluctant to engage in stable relationships. Additionally, a large part of this decline can be explained by the fact that young people invested more in education and careers before deciding to marry. Thus, young couples have become rarer, and divorces in this age group have become less frequent. Furthermore, changes in the family and social structure in Romania have led to a redefinition of expectations regarding marriage, and social norms that favoured early marriages have changed significantly. Today, young people tend to be more careful when choosing a life partner and balancing personal life with career, leading to a postponement of marriages and, implicitly, divorces.

In 1992, divorces among men aged 25 to 29 numbered 5,226, representing 17.8% of the total divorces. By 2023, the number of divorces in this age group dropped to 1,220, accounting for 5.4% of the total. This decrease can be explained by changes in the structure of marriages, which are now later and more selective. Men in this age group marry less frequently and later than before, and divorces among those who marry are usually the result of relationships that were not established on solid foundations. Also, the increased level of education and the integration of women into the labour market have led to changes in the structure of couple relationships, with men becoming more selective in choosing a life partner. Additionally, women who have gained economic independence are more willing to divorce when they feel that the relationship no longer meets their expectations.

For men aged 30 to 34, the number of divorces decreased from 5,941 in 1992 (20.3% of the total) to 2,853 in 2023 (12.6% of the total). This change suggests a trend toward greater stability in marriages up to this point, but with an increasing tendency for divorces in this age group. A similar trend is also observed among men aged 35 to 39, where the number of divorces decreased from 5,447 in 1992 (18.6% of the total) to 3,864 in 2023 (17.0% of the total). These trends can be explained by a reevaluation of marriages, which become more complex as the years pass. After a period of relatively young marriage, couples in this age group may come to the conclusion that their

relationship is no longer satisfactory or does not meet their expectations. Moreover, the stress associated with careers, raising children, and other responsibilities can lead to a crisis in marital relationships, and some couples choose divorce as a solution.

One of the most significant changes between 1992 and 2023 is the increase in divorces among men aged 40 to 44 and 45 to 49. In 1992, divorces among men aged 40 to 44 totalled 3,810 (13.0% of the total), while in 2023, this number rose to 3,984 (17.5% of the total). Additionally, the number of divorces among men aged 45 to 49 increased from 2,014 in 1992 (6.9% of the total) to 4,043 in 2023 (17.8% of the total). These changes are significant and reflect a greater openness among middle-aged men toward the possibility of divorce. Once they reach middle age, men are more likely to reassess their relationships and opt for change, especially when they are no longer constrained by family or financial responsibilities. Another possible explanation is that, at this stage of life, men become more aware of their own desires and aspirations, which can lead to the decision to separate.

For men aged 50 to 54, divorces increased from 1,476 in 1992 (5.0% of the total) to 3,084 in 2023 (13.6% of the total), while for men aged 55 to 59, the number of divorces rose from 933 in 1992 (3.2% of the total) to 1,731 in 2023 (7.6% of the total). These moderate increases can largely be attributed to a shift in men's views on couple life and their personal futures. After a long period of marriage, some men choose to rebuild their lives, and divorce becomes a solution to live more in line with their own desires. Additionally, during this time, there may be a revaluation of their careers and personal roles within the family, and men may be more willing to make the decision to separate.

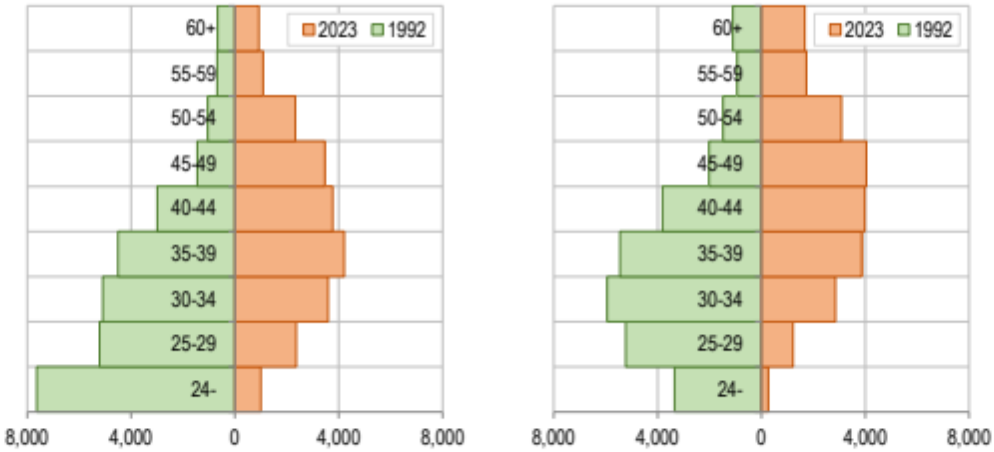

Figure 6. Structure of age groups of wives (left) and husbands (right) in 1992 and 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

THE DURATION OF THE MARRIAGE AT DIVORCE

The duration of marriage at divorce is an essential indicator in the analysis of family structures and in understanding the social and economic evolution of a society. In Romania, the period from 1992 to 2023 was marked by profound changes, both economically and culturally, and this time interval had a significant impact on the stability of marriages. By analysing data on marriage durations, we can observe general trends that reflect their evolution over different periods. This analysis will examine each category of marriage duration, highlighting the trends and structural changes observed over the 32 years of analysis.

Firstly, *marriages lasting less than 1 year* represent a significant category for analysis from the perspective of instability and vulnerability of relationships at the beginning of marriage. In 1992, there were 629 marriages lasting less than a year, representing approximately 2.15% of all marriages that ended in divorce. During these years, the transition from the communist regime to the market economy led to significant economic instability, and many young people married in a less stable

context despite socio-economic difficulties. In the following years, the number of marriages lasting less than 1 year that ended in divorce increased considerably, peaking at 1,336 in 1998, 1,364 in 1999, and 1,384 in 2000, which can be correlated with the rapid transition of Romanian youth to adult life marked by significant economic and social uncertainties. However, this period was also marked by a subsequent constant decline, and in 2023, the number of marriages lasting less than 1 year that ended in divorce decreased to 502, representing only 1.5% of the total divorces. This decreasing trend can be explained by a maturing social and family behaviour, with young people taking a more rational and responsible approach to the decision of marriage, with a greater awareness of its complexity and the economic and emotional factors involved (Figure 7).

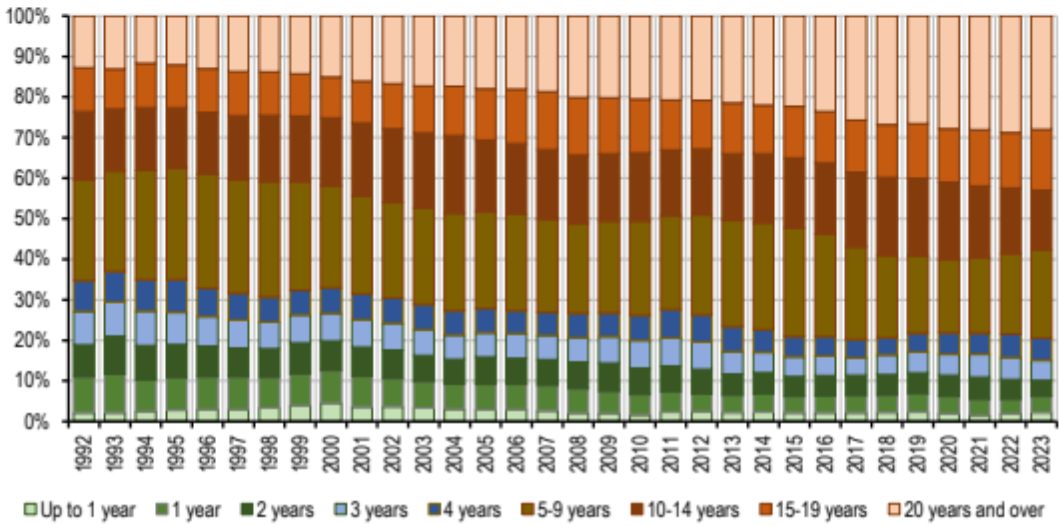

Figure 7. The duration of the marriage at divorce in Romania from 1992 to 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

Marriages lasting 1 year that ended in divorce had a significant share in the first post-communist decades. In 1992, they represented approximately 8.8% of all marriages that ended in divorce, with 2,582 cases. This period was characterized by significant economic instability, and many marriages during this period could not survive the economic and social challenges, including financial difficulties, precarious jobs, and the general uncertainty of those years. This type of marriage was common during a time when young people married spontaneously, without fully anticipating the complexity of a long-term relationship. However, this category has recorded a constant decline since 2000, and in 2023, the number of marriages lasting 1 year that ended in divorce reached 899, representing about 4.0% of the total divorces. This decrease reflects fundamental changes in how young people perceive marriage. More and more young people choose to settle into a stable relationship only after achieving financial security and overcoming adolescence, which allows them to approach marriage in a more responsible and conscious way (Figure 7).

Marriages lasting 2 years that ended in divorce represented a significant intermediate stage, where couples often face adjustment difficulties, especially in the face of economic and family responsibilities. In 1992, these marriages constituted 7.9% of all marriages that ended in divorce, with 2,305 divorces. This period was marked by a certain social volatility, with young people being subjected to economic pressures and the post-communist transition. Between 1992 and 2000, the number of marriages lasting 2 years that ended in divorce peaked, reaching a maximum of 3,342 in 1994. From 2000 onwards, the number of marriages lasting only 2 years that ended in divorce continuously decreased, reaching 895 cases in 2023, representing only 3.2% of the total divorces. This trend can be explained by the fact that young people have become more aware of the complexity

of marriage and choose to form relationships only when they have greater personal and economic stability. Moreover, more young people prefer to delay marriage until they have overcome the initial difficulties of adult life (Figure 7).

Marriages lasting 3 years that ended in divorce represent a significant intermediate stage in a couple's life, marked by relationship development and the strengthening of family bonds. In 1992, these marriages represented 8.3% of all marriages that ended in divorce. In 1992, 2,443 marriages lasting 3 years ended in divorce, and this number continued to rise until 1994, when it peaked at 3,371. However, starting from the 2000s, the number of marriages lasting 3 years that ended in divorce showed a significant decline, suggesting a shift in the perception of long-term commitments. In 2023, the number decreased to 1,125, representing only 5.0% of the total divorces. Economic and cultural changes, especially the migration of young families to large cities to seek stable jobs, led to a reassessment of the importance of stability in couple relationships (Figure 7).

Marriages lasting 4 years that ended in divorce are often significant because they represent marriages that begin to stabilize in the face of everyday challenges. In 1992, these marriages represented 7.5% of all divorces, with 2,203 cases. They peaked in 1994 with 3,059 marriages of 4 years that ended in divorce, reflecting a certain stability in relationships during that period. However, their number decreased significantly after 2000. In 2023, the number of marriages lasting 4 years that ended in divorce reached 1,265, representing only 5.6% of the total divorces, a significant decline compared to earlier periods. This reduction can be explained by changes in Romania's social and economic structure, with young people opting to choose their partners more rationally and with more detailed planning (Figure 7).

Marriages lasting 5-9 years that ended in divorce were the most frequent throughout the entire analyzed period, constituting a significant segment of stable marriages. In 1992, they represented 24.9% of all divorces, with 7,295 marriages of 5-9 years ending in divorce. These marriages are often those where the first signs of stabilization appeared, with couples having children or taking on family responsibilities. Between 1992 and 2000, this type of marriage had a growth trend, with a peak of 11,405 marriages of 5-9 years ending in divorce in 1998. After 2000, their share began to decline, and in 2023, the number decreased to 4,930, representing only 21.7% of the total divorces. This decrease may be linked to the trends of delaying marriage and family formation for economic or career reasons. Additionally, the migration of young people to urban areas and the diversification of family structures have led to a reassessment of the duration of marriage as a social institution (Figure 7).

Marriages lasting 10-14 years that ended in divorce represent those that are becoming extremely stable, with couples reaching a high level of family cohesion and responsibility. In 1992, they represented 16.8% of all divorces, with 4,930 cases. These marriages peaked in 2004, reaching 6,732 cases. In 2023, the number of marriages lasting 10-14 years that ended in divorce was 3,339, representing 17.7% of all divorces. This decline suggests a continuously changing social dynamic, with a reconfiguration of social and economic values, as well as a reconsideration of marriage as a traditional form of life (Figure 7).

Marriages lasting 15-19 years that ended in divorce are already long-lasting and stable relationships, reflecting a change in the approach to marriage. In 1992, 3,166 marriages of 15-19 years that ended in divorce represented 10.8% of all divorces. After a nearly constant increase until 2007, their number began to decrease slightly. In 2023, the number of marriages lasting 15-19 years that ended in divorce was 3,395, representing approximately 14.9% of all divorces. Although this number is significant, the constant decrease in these marriages suggests a shift in the social and cultural focus toward shorter and more flexible relationships (Figure 7).

Marriages lasting 20 years or more that ended in divorce reflect a profound maturation of relationships, being the most stable and long-lasting. These marriages represented 12.8% of all divorces in 1992 (3,737 cases). Their number increased significantly over the decades, reaching 6,365 in 2023 (28% of the total). These relationships indicate stability and commitment to the institution of marriage (Figure 7).

The structure of marriage durations at divorce

Between 1992 and 2023, the structure of marriages in Romania underwent significant changes, influenced by economic, political, and social developments, as well as by shifts in mentalities and values. These changes are particularly reflected in the duration of marriages, and analyzing each period can provide a deeper understanding of the trends in Romanian society. In the following, we will analyze structural changes for each marriage duration interval and the possible causalities behind them.

Marriages lasting up to 1 year experienced relatively small fluctuations, from 2.1% in 1992 to 2.2% in 2023, suggesting stability in social behaviours and the maintenance of traditional norms among younger generations. In the 1990s, young people in Romania were under social pressure to marry as a sign of stability and conformity to societal norms. In this context, many early marriages were motivated by the desire for a stable social status or economic reasons, particularly during the post-communist transition period. However, the phenomenon of short-term marriages was not necessarily amplified, and the decrease of only 0.1% in this interval suggests a relative permanence of the social model. One cause could be linked to the prevailing conservatism of that period, which encouraged maintaining the status of marriage even in the face of economic difficulties (Figure 8).

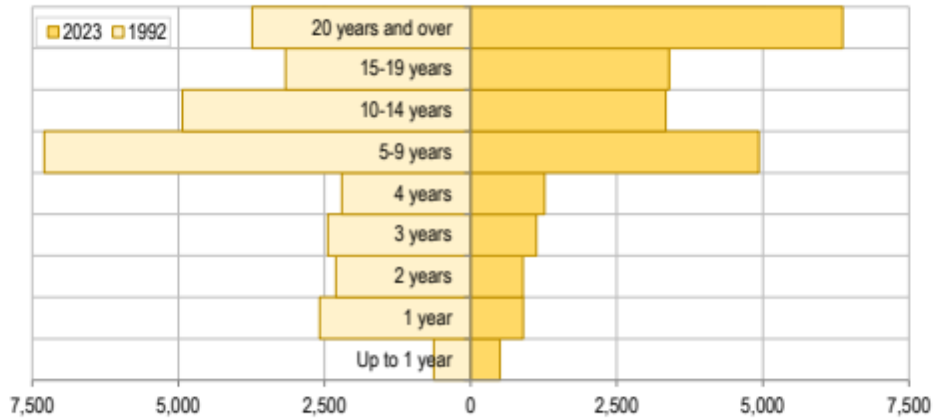

Figure 8. The structure of marriage durations at divorce in 1992 and 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

Marriages lasting 1 year saw a significant decline, from 8.8% in 1992 to 4.0% in 2023. This reduction reflects fundamental changes in the mentalities and social behaviors of couples in Romania. One possible cause of this decrease could be related to changes in the status of women in society. After 1990, broader access to education and independent careers significantly influenced young Romanians, and marriage became more of a personal choice than a social obligation. Additionally, in the post-communist period, divorce became more accessible and socially acceptable. Many couples who married quickly chose to separate after a short time, without the stigma that divorce had previously carried, leading to the decrease in marriages lasting 1 year (Figure 8).

Marriages lasting 2 years saw a decrease from 7.9% in 1992 to 3.9% in 2023. This decrease suggests a continuation of the trend observed in the 1-year period, reflecting a reassessment by couples regarding the sustainability of short-term relationships. A possible explanatory factor is that, after 1990, couples in Romania were influenced by a greater diversification of life options and increased independence. After a relationship initially marked by ideals and expectations, many faced difficulties related to daily life integration, education, careers, and economic conditions. Furthermore, the migration of the population, especially the younger generations, led many relationships to be tested and ultimately result in separation (Figure 8).

Marriages lasting 3 years saw a decrease from 8.3% in 1992 to 5.0% in 2023. While a decrease is noticeable, it is not as significant as in the case of other shorter marriage periods, suggesting some stabilization in short-term relationships, where couples start to know each other better and overcome initial challenges. During this period, couples who married usually did not separate due to financial reasons, as many were already integrated into the labour market. Economic stability may be an important factor in maintaining a short-term relationship, and some of these 3-year marriages could be seen as a stage in the maturation of relationships, where couples face initial challenges and important decisions about their future (Figure 8).

Marriages lasting 4 years saw a moderate decrease from 7.5% in 1992 to 5.6% in 2023, suggesting that many couples began to overcome the early stages of marriage and entered a period of consolidation. A factor contributing to this phenomenon could be the fact that, between 1992 and 2023, young people in Romania began to place more emphasis on career development and personal independence. This led to a reassessment of marriage and the emergence of a period focused on establishing family life. Furthermore, social and economic changes, such as starting a family, can lead to the consolidation of the relationship during these early years of marriage (Figure 8).

Marriages lasting 5-9 years saw a significant decrease, from 24.9% in 1992 to 21.7% in 2023, which may indicate a distancing from traditional marriage norms and an increase in divorces during this period. The reason for this decrease may be linked to the fundamental changes in Romania's economic and social structure after 1990. Couple life often becomes more difficult during this period, as couples face challenges related to careers, education, and managing a family. In this context, the decision to divorce becomes easier, and the number of marriages that fail to survive this stage could explain the decline in 5-9 year marriages (Figure 8).

Marriages lasting 10-14 years decreased from 16.8% in 1992 to 14.7% in 2023, suggesting a significant change in the perception of long-term relationships. However, this decline is not as large as in other time intervals. These marriages, traditionally seen as stable, have increasingly been influenced by the economic and social dynamics of post-communist Romania. Additionally, globalization and the migration of younger generations led to a reassessment of the traditional marriage model and, implicitly, an increase in divorces during this period (Figure 8).

Marriages lasting 15-19 years saw a significant increase, from 10.8% in 1992 to 14.9% in 2023. This phenomenon can be explained by a general trend of consolidating long-term relationships, where couples who have overcome initial difficulties choose to continue their lives together. One possible cause of this increase could be related to changes in the social perception of marriage. Couples who have surpassed the early years of marriage tend to value the relationship more and face more challenges together, which may strengthen their bond. This may also signify the maturation of relationships and the desire to stay together to build a solid family (Figure 8).

Marriages lasting 20 years or more saw a considerable increase, from 12.8% in 1992 to 28.0% in 2023. This dramatic change reflects a strong trend toward stability in long-term relationships, suggesting that Romanians have begun to place more value on long-term relationships. This trend may be explained by the fact that, in recent years, couples have learned to face economic and social difficulties together, and accepting long-term marriages has become a sign of stability. Moreover, the increase in this interval may also be linked to the fact that Romanians have learned to appreciate long-term relationships more and place a higher value on family and its stability (Figure 8).

MINOR CHILDREN AT THE DISSOLUTION OF THE MARRIAGE

The number of minor children left after the dissolution of marriage provides an important perspective on the evolution of divorce in Romania and its impact on families. By analyzing the distribution across categories of minor children, we can observe significant changes that reflect both demographic and social modifications, as well as their impact on the structure of families in Romania. We will now analyze the evolution of each category, with an emphasis on the extreme indicators.

The category with *no minor children* is by far the most frequently encountered in this database, with a constant number of divorce cases where there were no minor children. In 1992, the number of divorces without minor children was 13,568, and this number increased steadily until 2011, when it peaked at 19,910 divorces, likely influenced by the post-communist period, characterized by economic and social instability. After 2009, the number of these divorces began to decline, with a significant decrease in 2020, when only 13,521 divorces without minor children were recorded, suggesting a change in the behavior of couples in Romania. This decline could be explained by a number of factors. One of them might be changes in family structure, with a higher number of couples choosing to live together without having children, for various reasons such as careers, education, or economic pressures. Additionally, the social perception of relationship stability could be influenced by increased awareness of the negative effects of divorce, as well as changes in legislation that make the divorce process simpler (Figure 9).

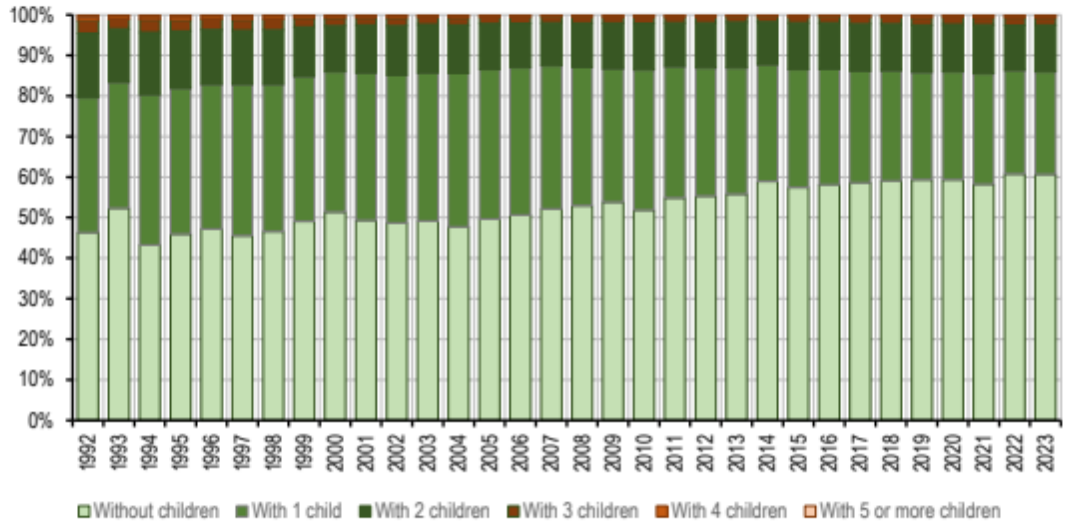

Figure 9. Minor children remaining after the dissolution of the marriage in Romania from 1992 to 2023
(Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table)

As for divorces involving *one minor child*, the number of these cases has fluctuated significantly from 1992 to 2023. In 1992, divorces with one child amounted to 9,737, and this number increased substantially between 1993 and 2000, reaching 14,672 in 1994. However, after 2000, a steady decline was observed, and by 2023, the number of these divorces had dropped to 5,741. This continuous decline suggests greater awareness among couples with one child regarding the impact of divorce on the child, as well as a change in family dynamics and the decision-making process regarding divorce. A possible factor in this decrease could be better access to family and psychological counselling, which helps couples manage conflicts before reaching the point of divorce. Moreover, the increasing number of single-parent families and the economic difficulties faced by parents could contribute to the preservation of marriages, at least in the short term, to ensure the child's economic stability. Furthermore, a possible influence could be that divorces are increasingly viewed as an extreme and less frequent solution, with many parents choosing to stay together to provide a stable environment for the child (Figure 9).

Divorces involving *two minor children* have evolved in a similar manner, with a gradual decline recorded between 1992 and 2023. In 1992, 4,648 divorces occurred among couples with two children, and by 2023, this number had decreased to 2,626. These fluctuations are significant, and the constant decline suggests a change in the behaviour of couples with more than one child. Like divorces involving one child, economic and educational factors play an important role, but another

factor could be that, as couples have more children, they become more reluctant to divorce due to additional financial and family responsibilities. A significant factor influencing this trend could also be the awareness of the impact of divorce on children. Couples with more children may perceive divorce as a radical change, and some prefer to stay together to ensure maximum stability in their children's lives. Additionally, economic instability and the lack of financial resources can make the decision to divorce more difficult, especially when two children are involved (Figure 9).

Divorces involving *three minor children* are less frequent and have shown greater volatility than those in the previous categories. In 1992, the number of these divorces was 925, and by 2023, it had decreased to 386, reflecting a significant decrease. The considerable drop in the number of divorces with three children can be attributed to the complexity of relationships in families with more children, where divorce decisions may be harder to make due to increased economic and emotional responsibilities. Families with three children may be more likely to stay together for financial reasons or to maintain stability in the children's lives. Moreover, divorces in families with three children may be seen as an especially difficult failure, considering the significant resources required to raise a large number of children. Social and economic stability factors play a significant role in these decisions, and couples may make greater efforts to maintain family unity (Figure 9).

Divorces involving *four minor children* are relatively rare, and their number has steadily decreased over the period 1992-2023. In 1992, the number of divorces with four children was 282, and by 2023, it had decreased to 117. These fluctuations reflect the fact that families with such a large number of children are less likely to divorce due to the responsibilities and complexities involved. Therefore, economic factors, as well as access to resources for raising a large number of children, may make the decision to divorce less likely. Furthermore, in families with four children, stability and social integration are often more pronounced, and parents tend to make more compromises to keep the family together. In these cases, divorce may be seen as a last resort, due to the significant effort required to manage such a family (Figure 9).

In the category of divorces with *five or more minor children*, the number is consistently low, and the fluctuations are minimal. In 1992, there were 130 divorces in this category, and by 2023, the number had decreased to 64. This can be considered the extreme category, with very large families, where divorce is seen as an extreme option due to the complexity and responsibility involved in raising such a large number of children. This category reflects remarkable stability among couples with a large responsibility in raising children. From a social and economic standpoint, families with five or more children are often more integrated into communities and may have more resources to cope with difficulties, which makes it less likely that they will separate. Additionally, on a personal and emotional level, the decision to divorce in such families may be felt as an extreme rupture (Figure 9).

CONCLUSIONS

The divorces in Romania reflect major social and economic changes between 1992 and 2023, highlighting an initially pronounced contrast between urban and rural areas, which has gradually diminished. In urban areas, the prevalence of divorces was associated with modernization, urbanization, and economic crises, peaking in 1998, when they represented 76.6% of the total. Over time, the proportion decreased to 61.8% in 2023, due to migration, informal cohabitation, and access to marital counselling. In rural areas, divorces, initially rare and influenced by traditions, increased with modernization and the economic independence of partners, reaching 38.2% in 2023. The uniformity in access to education and migration reduced urban-rural gaps, illustrating a convergence of family behaviours and common social challenges for both environments.

Divorces in Romania have shown significant disparities between counties, determined by factors such as the level of urbanization, ethnic structure, economic migration, and the dynamics of cultural values. In urbanized and economically developed regions (Bucharest, Cluj, Timiș), divorces are more frequent, influenced by financial independence and permissive social norms, while in counties with strong traditions (Harghita, Covasna), the divorce rate is low due to cultural pressures

to maintain marriages. Economic migration has increased the number of separations in Moldova and Oltenia, while in rural and underdeveloped areas (Teleorman, Giurgiu), divorces remain rare, discouraged by economic dependence and community norms. Tourist regions or those with cultural diversity (Brașov, Constanța, Sibiu) reflect an increase in divorces with exposure to modern values, while in isolated or mountainous areas (Maramureș, Suceava), traditions continue to influence marital stability, although migration and recent social changes have created new trends.

The analysis of divorces in Romania by age groups shows a significant decrease in the number of divorces among young women and men, especially those under 24, due to social and economic changes and changing attitudes towards marriage. However, in older age groups, divorces have shown an upward trend, particularly between 30 and 50 years old, which may reflect factors such as relational instability, increased financial independence, and revaluation of personal priorities. For men, middle age and the midlife crisis play a significant role in divorce decisions, while for women, divorces at older ages are often motivated by the desire to regain independence and personal satisfaction.

In the analysis of divorces in Romania, a significant change is noticed in the age structure of husbands and wives between 1992 and 2023. For women, divorces have increasingly concentrated among those aged 35 to 49, while at the beginning of the period, most divorces occurred among those under 24. This change reflects the postponement of marriages, increased economic independence for women, and changes in the perception of marriage. Divorces have also increased among older women, particularly between 45 and 59 years old, due to revaluations of relationships and financial independence. In the case of men, divorces among those under 24 have decreased significantly, while divorces have increased considerably among middle-aged and older men, between 40 and 59 years old, reflecting a greater openness to separation at middle age, when family and financial responsibilities become easier to manage. These changes are primarily attributed to the economic, social, and cultural evolution of Romanian society, which has influenced decisions regarding marriage and divorce.

The analysis of marriage duration at the time of divorce in Romania between 1992 and 2023 reflects significant changes in the social and economic structure of society. Marriages of less than a year have steadily decreased, signalling a maturation of young people's behaviour towards marriage, while marriages of 1-2 years were influenced by post-communist economic uncertainties. Marriages lasting 5-9 years, the most common during the analyzed period, started to decrease after 2000, reflecting a revaluation of the role of marriage due to economic and social reasons. In contrast, long marriages of 20 years or more increased significantly, indicating the stability of long-term relationships and a shift in the perception of marriage as an institution. These trends suggest a change in values and social behaviours, where young people choose more stable and planned relationships, and economic changes influence marriage decisions.

The structure of marriage duration in Romania has evolved significantly, reflecting economic, social, and cultural changes, as well as shifts in the perception of marriage. Short marriages (under 5 years) have decreased, highlighting a change in social mentalities and a greater acceptance of divorce, especially after 1990, when women's status and career choices influenced the decisions of younger generations. In contrast, long marriages (over 20 years) have increased significantly, indicating a trend toward relationship stability and greater emphasis on family and enduring values. This evolution suggests that, while couples in Romania have distanced themselves from traditional norms, there has been a strengthening of long-term relationships, supported by a more stable economic context and a revaluation of marriage in the post-communist period.

The analysis of divorces in relation to the number of minor children left after the dissolution of marriage reveals significant trends in Romania between 1992 and 2023. Divorces without minor children showed a steady increase until 2009, followed by a decrease, suggesting a change in couple behaviour and a possible awareness of the negative impact of divorce. Additionally, divorces involving one child gradually decreased, and economic factors and access to counselling may explain this trend. Divorce cases with two or three minor children showed a continuous decrease,

indicating a greater reluctance to divorce due to economic reasons and the desire to ensure stability for children. In families with four or more children, divorces were much rarer, reflecting the complexity of relationships and greater responsibilities for these couples. These trends emphasize a change in the social perception of divorce, which is becoming less frequent, particularly in families with multiple children, due to the emotional and economic complexities involved.

Divorces in Romania between 1992 and 2023 have reflected profound social and economic transformations, with significant differences between urban and rural areas. In urban areas, divorces were influenced by modernization, urbanization, and economic crises, while in rural areas, they increased as economic independence and modernization progressed. Differences between counties were determined by the level of urbanization, ethnic structure, and economic migration, while tourist regions and those with cultural diversity saw an increase in divorces. The age group analysis showed a decrease in divorces among young people, but an increase among those of middle age, influenced by relational instability and financial independence. In terms of marriage duration, divorces were more frequent in the early stages of marriage, but increased in long-term couples, reflecting a revaluation of family values and stabilization of long-term relationships. Additionally, divorces involving minor children showed a decreasing trend, suggesting a greater awareness of the impact on children and a reluctance to separate in families with greater responsibilities. These trends underline changes in the social and economic behaviours of Romanians, which have led to a revaluation of the institution of marriage and divorce.

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