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EXAMINING THE (GEO)DEMOGRAPHIC AND SOCIAL EVOLUTION OF ROMANIAN VILLAGES DURING THE PAST CENTURY. CASE STUDY: STRAJA COMMUNE IN BUCOVINA

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Abstract: Since the late eighteenth century the rural settlements of Romania have undergone significant transformations under the influence of evolving population structures, shifting political regimes, economic reorganisation, and cultural change. Within this historical context, this investigation focuses on Straja commune located in the mountainous region of Bucovina near the Ukrainian border. Straja benefits from continuous statistical records, which make it a valuable case study for tracking demographic and social developments across generations. The research examines

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population dynamics by analysing birth, fertility, and mortality rates, alongside internal and international migration based on archival sources, numerical data spanning over two centuries, and insights gathered through fieldwork, including a student-led survey. This comprehensive perspective enables the reconstruction of past trajectories and the projection of future trends through 2050. The findings reveal how variations in population structure have shaped community organisation, exposing forms of continuity, adaptation, and vulnerability in a peripheral context. Beyond its empirical scope, the work contributes to ongoing debates on sustainability, territorial cohesion, and the resilience of historically rooted settlements, providing a relevant reference point for researchers and decision-makers engaged in planning strategies for marginal rural regions.

Key words: rural Romania; Straja commune; Bucovina; demographic dynamics; migration patterns; population forecasting

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INTRODUCTION

Romanian rural settlements have evolved towards a distinctive way of life, shaped by the natural environment, ancestral customs, and strong social cohesion. After the Great Unification of 1918, Romania became a predominantly agrarian country, where the majority of people relied on rural agricultural settlements not only for work and livelihood, but also for identity and social belonging. Rural population was prevalent in the national structure, serving as a key demographic for agricultural production, as well as a keeper of cultural legacy shaped by many generations through close interaction with the land. This form of social organization, rooted in collective values and inherited practices, played an important role in strengthening national identity during the early twentieth century (Șandru, 1996).

The interwar period brought increased political and intellectual attention to the rural condition. Land reform initiatives aimed at redistributing property sought to alleviate structural inequalities yet failed to overcome persistent vulnerabilities such as land fragmentation, subsistence agriculture, and technological backwardness. Later on, a decisive rupture came with the rise of the communist regime after World War II, when forced nationalization and collectivization, initiated in the late 1940s and early 1950s, dismantled traditional structures of rural life (Avram, Radu, & Bărbieru, 2014).

Peasants were dispossessed of their fields and absorbed into collective farms, leading to the gradual erosion of personal autonomy and the disintegration of historical relationships between people and the land they had once owned. The socialist centralized state imposed an ideological standardization across the countryside, deliberately sidelining centuries-old customs in favour of a homogenized social model that reflected its vision of order and progress. Despite these pressures, rural communities demonstrated enduring resilience, even when it was not visible within the dominant ideological discourse. By the end of the communist period, villages in Romania displayed signs of social atomization, economic stagnation, and the fading of cultural continuity.

The collapse of the totalitarian regime in 1989 ushered in a new transition period marked by the restitution of agricultural land to former owners. However, the resulting landscape was fragmented, with many holdings too small or economically unviable to support competitive agriculture (Rusu & Florian, 2003). In the absence of strong institutional support, and access to modern technologies and know-how, a large portion of the rural economy reverted to subsistence-level practices, and the infrastructure lagged significantly behind that of urban areas.

The long-term evolution of rural population in Romania reveals the layered impact of evolving social, economic, and political conditions on the demographic profile of the nation. Statistical data from national censuses shows that while in 1948, rural residents accounted for 76.6%

of the country's total population, this share declined steadily to 68.7% in 1956, 61.8% in 1966, and 56.4% in 1977, following a trend driven by socialist modernization policies that encouraged rural-to-urban migration and redirected the workforce toward industrial sectors. After the disintegration of the authoritarian regime, the 1992 census revealed that the rural population had dropped to 45.7%. Although subsequent censuses recorded small fluctuations (47.3% in 2002, 46.0% in 2011, and 47.8% in 2021), these were not signs of genuine rural revitalization but reflected demographic trends, such as declining birth rates in urban areas and continued outbound migration.

This gradual decline of the rural population, from more than 75% of the national total in 1948 to under half by the early 1990s, underscores the scale of structural transformation in the Romanian society, while also revealing the mounting demographic pressures confronting villages: diminishing birth rates, pronounced aging, and large-scale outmigration, both internal (toward urban centers) and international (Stașac, Albu, & Stupariu, 2010). Young people, in particular, have increasingly pursued better economic prospects and improved living conditions elsewhere, leaving behind a population largely dominated by adults and elderly residents, with significant implications for labour supply, the viability of local services, and social cohesion.

Traditional agricultural practices which were previously the economic backbone of the countryside, have declined due to mechanization, land consolidation, and shifting market demands. In response, many rural residents have sought alternative livelihoods, embracing non-agricultural sectors such as rural tourism, services, small-scale manufacturing, and entrepreneurship. These transitions also point to opportunities for diversification and rural renewal (Mihalache & Croitoru, 2011).

While present day Romanian villages continue to posess natural and man-made assets, inherited knowledge, and a strong cultural identity, their long-term sustainability depends on the capacity to integrate innovation with the preservation of traditional values. In this context, mountain villages have undergone notable transformations, reflecting their vulnerabilities and efforts to pursue enduring development while preserving local identity. Each community narrates its own story, shaped by geography, history, and human agency.

Straja commune, which has been selected as a case study for this analysis, is an emblematic settlement within the historical region of Bucovina, in the northern part of Suceava county, at the national frontier with Ukraine. While the origins of the settlement likely date back before the 18th century, documented evidence attests to its function as a guard outpost of the Putna Monastery around 1750. The name, deriving from the Old Slavic term straža (meaning "watch post" or "place of vigilance") reflects the role of its inhabitants as guardians.

This study examines the population changes in Straja from the late eighteenth century to the modern era, by combining historical reconstruction with contemporary demographic analysis, and tracing the impact of political, economic, and cultural forces on the local population, in order to provide a deeper understanding of the evolution of rural areas in Romania.

STUDY AREA

Straja commune is located in Suceava county, within the Northern Group of the Eastern Romanian Carpathians, at their eastern limit, on the upper valley of Suceava River (Figure 1). The neighbouring administrative units are Crasna-Ilschii to the north (across the border in Ukraine), Putna to the south, Brodina to the west, and the town of Vicovu de Sus to the east. Access is provided by county road 209 (Rădăuți-Brodina), whereas prior to 2008 the area was also accessible by railway (Dornești-Nisipitu). The latter was decommissioned following the major floods in the summer of 2008 and is no longer in use.

Straja is positioned in the relative vicinity of two important border crossing points to Ukraine, located at Siret and the neighbouring town of Vicovu de Sus. Additionally, two more crossing points are currently under construction near Izvoarele Sucevei and Ulma. The existence of 4 functional border crossing points to Ukraine near the study area, as well as the construction of the express road connecting the A8 highway from Siret to Vicovu de Sus, which is under progress, are regarded as

major assets for the development of rural areas in northern Bucovina along the border with Ukraine. Furthermore, the modernization of the county road linking Brodina to Brodina de Sus-Izvoarele Sucevei-Carlibaba (the Hutsul road) will facilitate considerably the connection of rural communities in this mountain region, while also providing an alternate connection between Transylvania and Bucovina and Northern Moldova (Botosani).

Straja commune covers an area of 4663 ha, extending in altitude between 488 m asl and 1141 m asl, at an average of 683 m asl. In terms of the land use/land cover, forests composed mainly of coniferous species (spruce and fir) account for approx. 63% of the communal territory (2922 ha), whereas the remaining area is occupied predominantly by pastures. Straja has a total population of 5,940 inhabitants (July 1st 2024), the majority of which are Romanian ethnics, despite the closeness to the border with Ukraine and the predominance of Hutsul population in neighbouring communes along Suceava River valley.

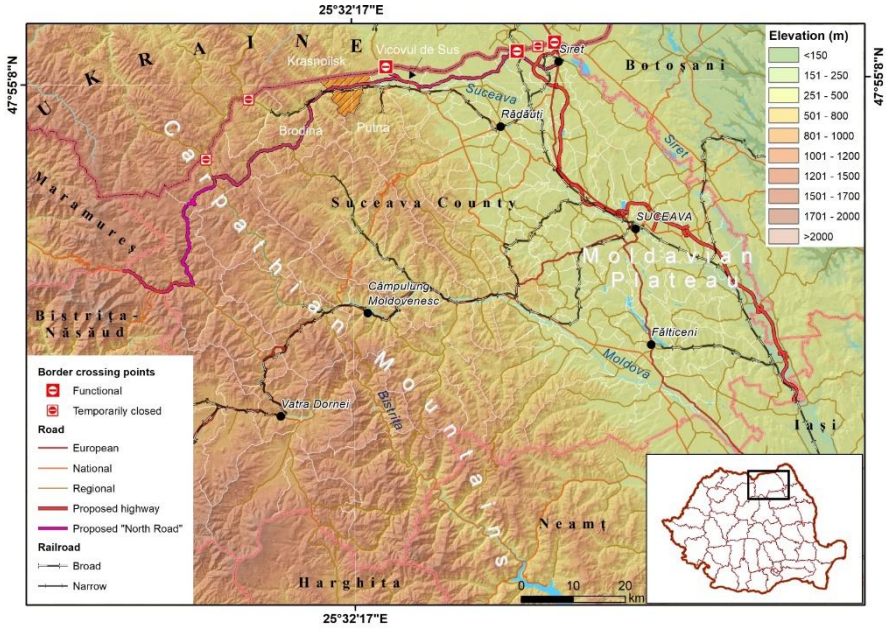

Figure 1. Location of the study area: Straja commune in Suceava county

METHODS

For this investigation, we employed a mixed methodological approach that integrated historical investigation, statistical interpretation, and field-based qualitative insights. The initial phase consisted of a thorough examination of literature and documentary evidence related to the past of Bucovina and Straja commune in particular, including mainly the Austrian conscriptions and census records from 1775 to 1918, on which the reconstruction of long-term demographic trajectories is based. For the more recent period (i.e. the late twentieth and early twenty-first centuries) the relevant data was provided by the Suceava County Directorate of Statistics and the Tempo Online platform, which supported the construction of a coherent data set reflecting the evolution of the local population over time.

Furthermore, fieldwork was carried out in the Straja commune to address data gaps and to add context-specific interpretation to the statistical perspective, by including direct observation, semi-structured interviews, and researcher field notes as supplementary resources. Such methods provided a valuable qualitative layer to the demographic analysis, helping to contextualize observed

trends. By using standard indicators, the quantitative study traced population shifts between 1992 and 2023, concentrating on birth and mortality patterns, natural increase, and migration dynamics. Additionally, an original segment of the methodology involved online data collection using Google Forms, where a questionnaire was distributed to 8th-grade students at the local school in Straja to gather perspectives on migration intentions and aspirations of the younger demographic.

RESULTS AND DISCUSSIONS

Trends in population size

Between 1775 and 2024, the population of Straja experienced fluctuations determined by important political and historical events: the annexation of the northwestern part of the Principality of Moldavia by the Austrian Empire; the unification of Bucovina with Romania, officially recognized through the Treaty of Saint-Germain on September 10, 1919; the two world wars; the establishment of the communist regime; the 1966 abortion ban; the liberalization of family planning after 1990 and the increased freedom of movement; the accession of Romania to the European Union in 2007 and the subsequent elimination of visa requirements; the onset of the global economic crisis in 2008; the COVID-19 pandemic (2020-2022); and the ongoing Russian invasion of Ukraine which started on February 24, 2022.

The Austrian conscription records from 1775 to 1784 are the basis for the demographic reconstruction. Some inhabitants avoided being counted, fearing new tax burdens. The estimated population figures rely on an average household size of five, in line with commonly accepted demographic standards of the 18th and 19th centuries. These early censuses reveal moderate fluctuations in the number of families and total inhabitants during the first decade of the Habsburg administration. Straja was inhabited by 78 families (approximately 390 people) in 1775, with an increase up to 91 families (around 455 people) in 1779. This growth trend did not persist, as by 1780 the population had declined to 430 inhabitants (86 families), and around 400 people (80 families) by 1784 (Werenka, 1895). By the early 19th century, following the Napoleonic Wars, military service became mandatory across the empire. The military census of Galicia in 1808 recorded 108 families and 634 inhabitants in Straja (Kumor, 1972), indicating and increase corresponding to an average annual growth rate of 1.9% compared to 1784 (Figure 2).

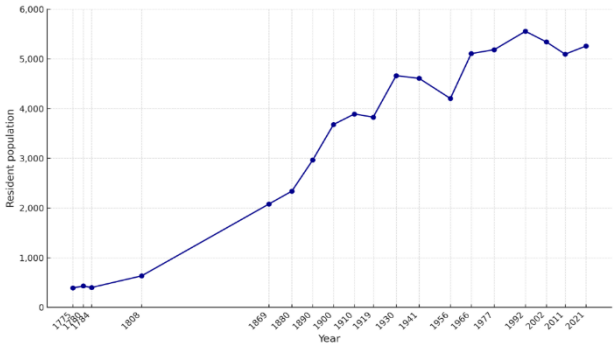

Figure 2. Evolution of the resident population in Straja (1775-2021)

The March 1869 implementation of the Census Law (also known as the Taaffe Law) established the framework for subsequent population enumerations under the Austrian administration. The five Austrian censuses indicated continuous population growth between 1869 and 1910, reaching a total of 1,812 individuals, with an average annual increase of 44 persons and a growth rate of 1.5% (Figure 2).

The population of Straja declined by 64 people between 1910 and 1919 as a consequence of World War I, due to decreased fertility, increased health-related mortality, and military service

deaths, with soldiers serving in the 22nd and 80th regiments on multiple fronts. In the aftermath of the Great Unification of 1918, the Romanian society experienced significant reforms, and by 1930, the population had increased by 835 individuals (Figure 2).

Following the signing of the Ribbentrop-Molotov Pact on August 23, 1939, the Soviet Union annexed Northern Bucovina, along with Bessarabia and the Hertza region, on June 28, 1940, which affected all administrative units separated by the newly established border, including our study area. Thus, the census of April 1941 determined that Straja was inhabited by 4,608 people (Figure 2) living within an area which had been significantly reduced after the loss of more than 2,700 hectares of forests and pastures to the Soviet Socialist Republic of Ukraine. Although initially regarded as provisional, the new border became permanent in March 1944, producing long-term economic consequences for the commune, as well as the entire region of Bucovina.

The change in political regime after World War II brought about a shift in demographic policy, particularly with the Decree 463 of 1957, which liberalized access to abortion, ultimately leading to a decline in birth rates across Romania. In response, the Communist Party enacted Decree 770/1966, which prohibited abortion and Decree 779, which restricted access to divorce, measures aimed at preventing family dissolution and stimulating population growth. Locally, between 1956 and 1977, Straja experienced an average annual growth rate of 1%, and this upward trend continued, with the population reaching 5,278 inhabitants in 1986 and 5,497 in 1990 (Figure 2).

Conversely, the post-1989 period was marked by a steady demographic decline, driven primarily by the repeal of Decree 770 and the liberalization of borders, which facilitated labor migration, especially toward Western and Southern Europe. After the 1992 census which recorded a resident population of 5,555 inhabitants, ensued a slow decrease, reaching 5,094 in 2011. However, by 2021, the population increased slightly to 5,258 people (Figure 2). From a long-term perspective, population numbers between 1775 and 2021 show an absolute increase of more than 13x and an average annual growth rate of 1.06% throughout the entire time frame.

Trends in village size and number of buildings

A spatial analysis of the village size and the number of buildings throughout the period between 1856 and 2014 shows significant changes between the three distinct socio-political periods as follows. During the time frame when Bucovina was under Austrian administration (i.e. in 1856), the inhabited area of Straja consisted of 334 housing buildings and annexes covering 3.2 ha, which accounted for approx. 0.07% of the territory of the commune (Figure 3).

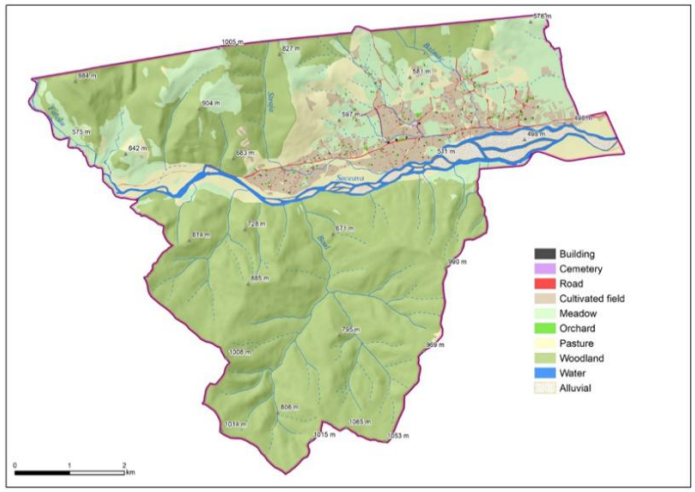

Figure 3. Reconstructed land use and settlement pattern in Straja (1856), based on the Second Austrian military survey

By the late socialist period (1980), the territory of the settlement had increased significantly, by expanding particularly towards the north, in the direction of the national border with Ukraine, where the characteristics of the terrain were more suitable for the developing village, as well as upstream along the valley of Suceava River (Figure 4). Thus, in 1980, the inhabited space of Straja included 2405 buildings and annexes, covering a total area of 36.9 ha (0.8% of the current area of the commune). Overall, the number of households increased by more than 7 times compared to the previous period, when the village was under Austrian administration.

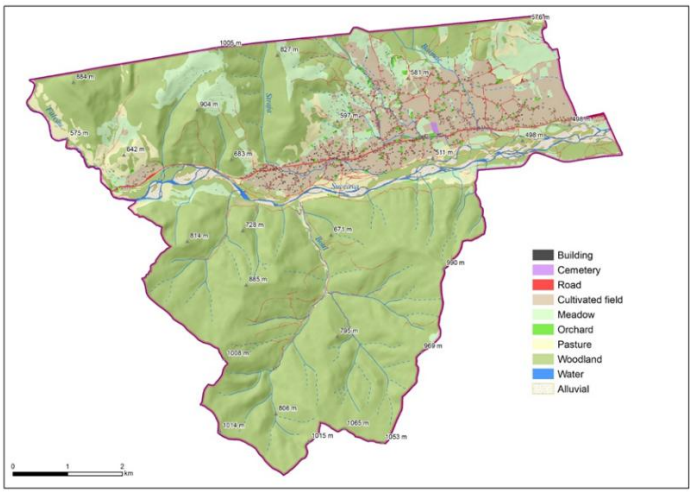

Figure 4. Reconstructed built environment in Straja in 1980, based on CORINE Landcover data

In the post-socialist period (2014), the number of housing buildings and annexes had nearly doubled compared to the previous time framer (1980), reaching a total of 4721, which covered an area of 47.5 ha (1.02% of the current area of the commune). Despite the consistent outbound emigration occurring particularly after the integration of Romania into the European Union, the inhabitants of Straja continued to build new housing units and preserve, at least for the time being, a relatively constant size of the population, which has increased slightly in the last decade, illustrating a positive trend, in contrast with some of the neighbouring communes.

Geodemographic changes over the last 32 years

Understanding recent population dynamics in Straja requires access to structured and comparable data spanning the last three decades. The Tempo Online platform, developed by the National Institute of Statistics (Institutul Național de Statistică, INS), provides detailed information across multiple territorial levels, allowing for an interpretation of demographic patterns, from broad national tendencies to local particularities. The total population data used in this analysis refers to the number of individuals officially registered by domicile on July 1st of each year (INS, 2024a). Although these numbers do not fully reflect the resident population, especially in rural areas with active seasonal as well as long-term migration, they provide the most consistent and accessible basis for longitudinal demographic assessment. We focused on several core indicators that describe natural population change and aspects of family structure, including birth and death rates, general fertility, marital dynamics etc. These variables illustrate the pace and direction of demographic transformation, offering insight into comprehensive social change, including reproductive behavior and partnership patterns.

Nuptiality is a demographic phenomenon closely tied to the organization of family life and the evolution of household arrangements. Shifts in marriage patterns provide insight into the timing and frequency of unions, intergenerational structures, and the cultural norms that shape long-term

commitment. The marriage rate in Straja between 1992 and 2023 presents a nuanced demographic profile, marked by alternating phases of contraction and relative stability, especially when compared with rural trends in Romania (see Figure 5). In 1992, the marriage rate in Straja was 7.3‰, close to the rural national average of 7.7‰, whereas in the following year, Straja exceeded the rural average with a marriage rate of 8.0‰, compared to 7.2‰ in rural Romania. By 1994, the average rural marriage rate had already begun to decline significantly, thus signalling a more immediate demographic response to the broader societal transformation, while the marriage rate in Straja dropped to 4.7‰ in 1994 and 4.5‰ in 1996, well below the rural averages of 6.9‰ and 6.3‰ for the same years.

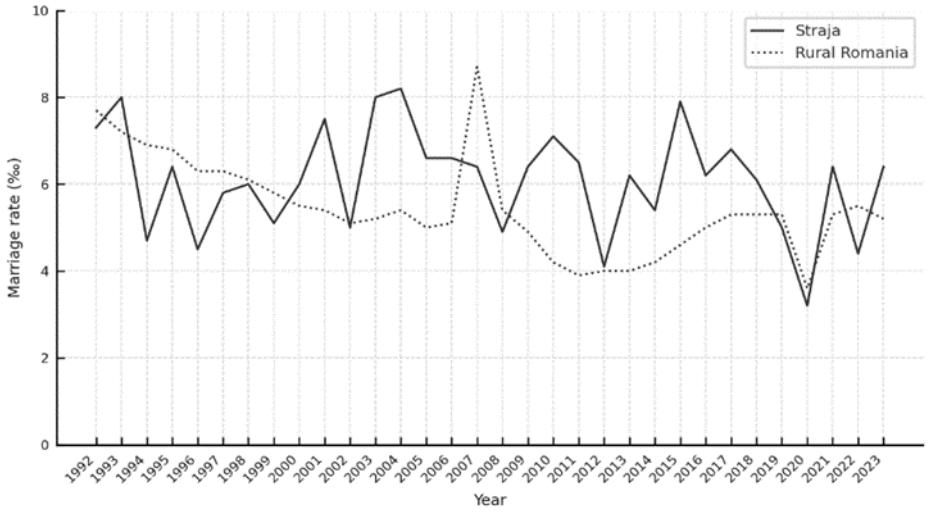

Figure 5. Marriage rate dynamics in Straja compared to rural Romania, 1992-2023

These discrepancies highlight the village's heightened demographic sensitivity to post-transition uncertainty, economic restructuring, and increasing individual mobility. Such shifts led many locals to postpone or avoid formal unions altogether, diverging from the more gradual adjustment in the rural landscape. After a period of relative stagnation, the early 2000s brought a temporary rebound of the marriage rate in Straja, reaching 8.0‰ in 2003, 8.2‰ in 2004, and maintaining high values in the following years, of 6.5‰ in 2005 and 2006. In 2007, marriage rates in rural Romania peaked at 8.7‰, following the implementation of Law no. 396/2006, which introduced a one-time financial incentive for first-time married couples. However, in Straja the rate in 2007 remained at 6.4‰, virtually unchanged from the prior years, suggesting that government incentives did not resonate equally across rural areas. A particularly sharp decline occurred in 2020, when the marriage rate in Straja dropped to just 3.2‰, the lowest value recorded over the entire interval, and slightly below the rural national average of 3.6‰. The COVID-19 pandemic, which restricted civil ceremonies, travel, and social gatherings in general, resulted in delayed or cancelled weddings across the country, including in small rural communities such as Straja. In the following years, both Straja and rural Romania experienced a modest recovery: 4.4‰ and 6.4‰ in 2022 and 2023 in Straja, compared to 5.5‰ and 5.2‰ at the rural national level. These post-pandemic figures, however, remain well below the rates observed in the early 1990s, underscoring the broader demographic shift toward delayed or foregone marriage, shaped by evolving social norms and increasing cohabitation without legal union.

By comparison, *the divorce rate* reveals an even more striking contrast. In rural Romania, divorce rates remained generally low, mostly below 1.1‰, with only moderate increases during periods of economic or social stress. In Straja, however, the divorce rate shows a pattern of episodic spikes and longer intervals of very low values (Figure 6). In some years, such as 1993 or 1997, the rates were extremely low (0.2‰), while in others, like 1996 or 2005, the annual averages reached 1.2‰. These variations may result from the small population size of the commune, where even a modest number of divorces can influence the rate significantly. A sharp and unexpected spike occurred in 2012, when the divorce rate more than doubled, reaching 2.2‰, the highest value recorded in the entire interval. This abrupt change stems from the adoption of Law No. 202/2010, aimed at accelerating legal procedures, which introduced simplified administrative routes to divorce, including the possibility of mutual consent procedures handled by civil registrars or public notaries. This legislative reform significantly lowered both the bureaucratic and financial barriers to marriage dissolution, thereby influencing the dynamics of divorce in smaller, more traditional communities such as Straja. However, the long-term trend remains aligned with the national rural pattern, showing low and relatively stable levels of divorce rates, which may reflect the endurance of cohesive family structures and limited formal dissolution of marriages.

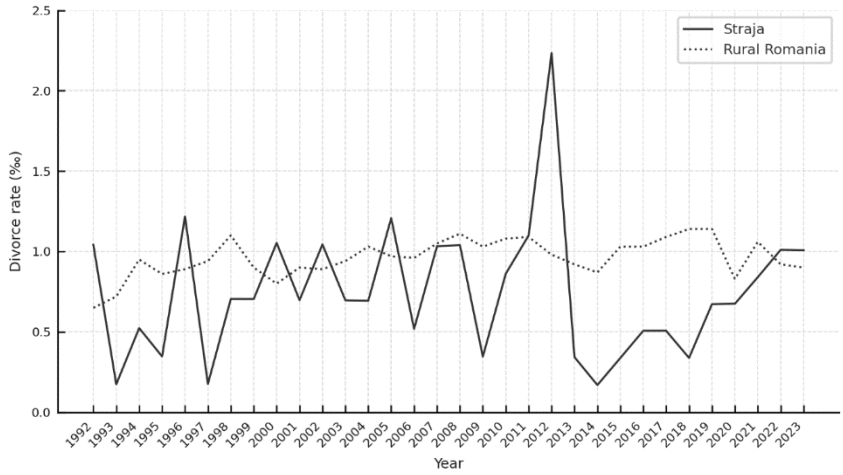

Figure 6. Divorce rate dynamics in Straja and rural Romania, 1992-2023

The fertility rate in Straja, defined as the number of live births per 1,000 women of reproductive age (15-49), has shown noticeable fluctuations over the past three decades, shaped by a mix of structural, social, and economic factors (Figure 7). In 1992, the fertility rate stood at a remarkable 90.4‰, illustrating the continuation of traditional reproductive norms in rural Northern Romania during the early post-communist period. However, this elevated level proved unsustainable in the context of rapid societal transformation. By 1997, the fertility rate had dropped to 55.9‰, and although it fluctuated in the following years, the long-term trend was downward. Throughout the 2000s, the rate oscillated between 52‰ and 62‰, with brief increases such as in 2001 (64.9‰), but without stabilizing at those higher thresholds. Several factors help explain this decline: greater access to education and contraception, evolving family aspiration, economic insecurity, and the emigration of young adults, including many women of childbearing age (Sobotka, 2011). These dynamics gradually reduced the size of the reproductive-age population and the average number of children per woman.

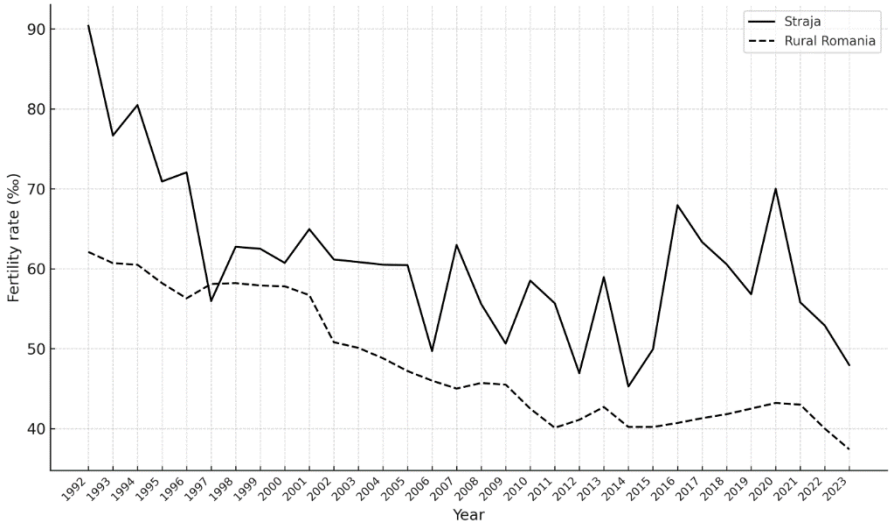

Figure 7. Comparative trends in the fertility rate in Straja and rural Romania, 1992-2023

The fertility rate reached its lowest levels in 2012 (46.9‰) and 2014 (45.3‰), before rebounding in 2016 to 67.9‰, a rare deviation from the overall trajectory. A similar upward shift occurred during the first year of the COVID-19 pandemic, when the fertility rate unexpectedly climbed to 70.0‰. Several pandemic-specific factors contributed to this temporary rise, including return migration, postponed emigration, and changes in reproductive intentions. Nevertheless, the recovery was short-lived: the values for 2021 (55.8‰), 2022 (52.9‰), and 2023 (47.9‰) point to a renewed decline, with the last figure being among the lowest of the entire interval (Figure 7).

The national rural trend reveals a more gradual yet consistent contraction. In 1992, the fertility rate in rural Romania was 62.1‰, but by 2023 it had dropped to just 37.4‰, the lowest value of the entire period (Figure 7). This steady decline reflects broader demographic transitions, including population ageing, sustained outmigration, and the ongoing reshaping of reproductive behavior. While the fertility pattern in Straja includes sharper fluctuations and temporary surges, both trajectories ultimately converge toward the same outcome: decreasing fertility potential and heightened demographic fragility across the rural landscape.

The *birth rate* indicates the frequency or intensity of births within a population and is influenced by various economic, political, and social factors. In the early 1990s, birth rates remained relatively high; in 1992, Straja recorded 19.4‰, in line with reproductive patterns still rooted in rural traditions (Figure 8). Over time, birth rates declined as the commune moved from a state-run system to market-based structures, and local life reorganized around new norms and constraints, while women regained the right to abortion which had been completely restricted after 1966 under the communist regime. The dissolution of state-supported industries, rising unemployment, and financial insecurity discouraged family formation. At the same time, large-scale outmigration, particularly among young adults, reduced the number of potential births, amplifying the natural demographic contraction. Socio-cultural changes also played an important role, as the growing participation of women in the workforce contributed to shifting preferences toward smaller families, delayed parenthood, and the increasing costs of raising children further influenced reproductive behaviour (Mureșan, Hărăguș, Hărăguș, & Schröder, 2008). Overall, Straja recorded consistently higher birth rates compared to the national rural average throughout the analysed timeframe, particularly due to demographic inertia inherited from earlier decades.

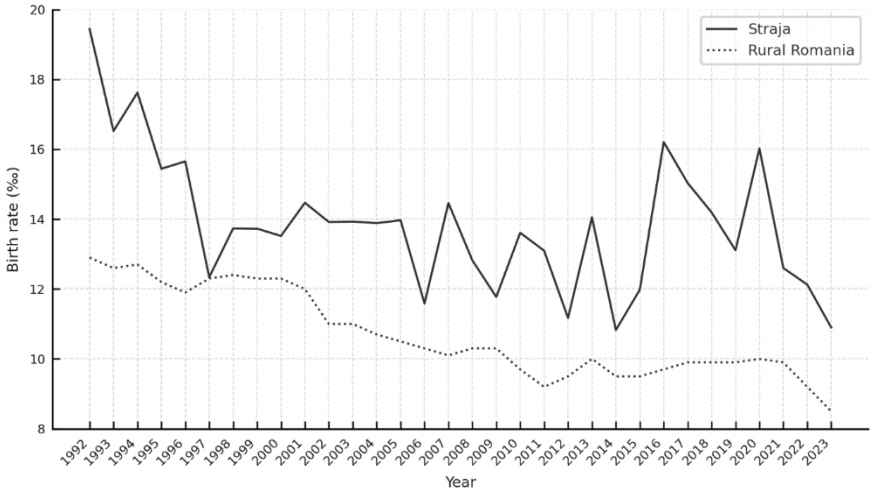

Figure 8. Comparative trends in the birth rate in Straja and rural Romania, 1992-2023

Rural Romania followed a similar yet more gradual path of decline, with an average birth rate of 12.9‰ in 1992. Over the next decades, the rate followed a consistent downward trajectory, reflecting the cumulative impact of depopulation, aging, migration, and social transformation. Unlike the irregular pattern observed in Straja, where local dynamics triggered occasional rebounds, the national rural average declined steadily, with fewer oscillations. Despite the overall decrease, Straja showed isolated episodes of increase, most notably in 2016 (16.2‰) and 2020 (16.0‰). These temporary improvements may have been generated by state incentives, such as child allowances and maternity benefits, designed to encourage family growth. Additionally, return migration, either permanent or seasonal, may have played a role in boosting local birth numbers during these years (Figure 8).

Nevertheless, the general trend continued downward, with the birth rate dropping to 12.6‰ in 2021, 12.1‰ in 2022, and 10.9‰ in 2023, the second-lowest value of the entire period. In contrast, rural Romania saw its rates stabilize slightly above 9‰ in 2021-2022 before dipping to 8.5‰ in 2023, its lowest point in the entire interval (Figure 8). This parallel decline underlines the fragility of natural population growth and raises serious questions about the long-term viability of generational replacement in local and regional rural settings.

Throughout the last three decades, *mortality* in Straja showed a generally irregular pattern, marked by a gradual upward tendency shaped by demographic aging further accentuated by the migration of younger residents. In 1992, the rate reached an average of 11.1‰ and remained relatively stable during the 1990s, with occasional declines, such as 7.9‰ in 1995 and 8.0‰ in 2001, alternating with years of noticeable increase (e.g., 13.7‰ in 1997). The mortality saw sharp rises in 2010 (14.1‰) and 2016 (14.2‰), standing out as the highest values in the reference interval (Figure 9). These surges mirror mainly the progressing aging of the local population, the reduced share of younger adults due to outmigration, and the growing health issues often observed in rural settings with limited access to medical services. After 2005, the increasingly elderly structure of the population maintained the annual death rates above 11‰ in most years.

Figure 9. Mortality rate dynamics in Straja and rural Romania, 1992-2023

The high mortality of 2020 and 2021 (12.6‰) likely reflects the prolonged impact of the COVID-19 pandemic, which disproportionately affected older inhabitants of the village. In 2022, the rate dropped to 8.6‰ (the lowest since 2001), before climbing again to 10.2‰ in 2023 (Figure 9). These recent fluctuations may point to a partial post-pandemic recovery and some improvements in healthcare availability.

By contrast, rural Romania followed a more linear and consistently elevated trajectory. The national rural mortality rate reached 14.8‰ as early as 1992 and stayed above this threshold throughout much of the period. The rate peaked in 2021 at 17.4‰, underscoring the severe toll of the pandemic on structurally vulnerable populations (Figure 9).

Overall, the national rural average remained consistently higher compared to the death rate recorded in Straja, likely reflecting underlying contrasts in local age distribution, health infrastructure, or social cohesion. Nevertheless, both trajectories point to the cumulative effects of population aging and health vulnerability in the rural regions of Romania.

The natural increase, reflecting the balance between birth and death rates, provides a comprehensive perspective on the demographic vitality of the Straja community. In 1992, this demographic indicator reached a positive value of 8.3‰, driven by the relatively high birth rates and moderate mortality (Figure 10). However, the trend reversed soon after, signaling the onset of demographic decline. By 1997, the natural balance had dropped to -1.4‰, marking the first year with more deaths than births. Subsequent years, such as 2012 and 2014, continued this negative trajectory, with values of -0.7‰ and -1.7‰, respectively. The downward shift resulted from the combined effect of falling birth rates and elevated mortality.Persistent outmigration further weakened the potential for demographic renewal, as the exodus of young, reproductive-age individuals reduced the potential for population growth. Economic difficulties, including financial instability and limited employment opportunities, discouraged larger families and contributed to a lower birth-to-death ratio. Despite these long-term challenges, occasional signs of recovery emerged, for instance, in 2001 (6.4‰) and 2018 (4.4‰).

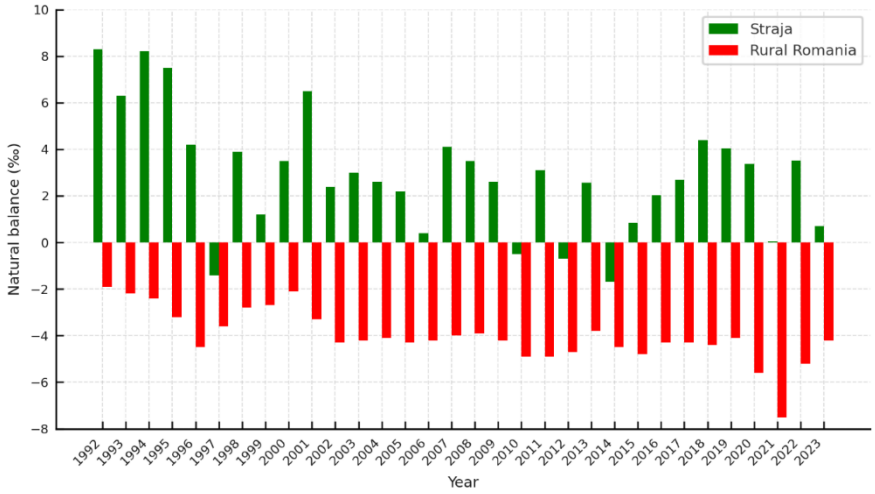

Figure 10. Long-term variation in natural balance in Straja and rural Romania (1992-2023)

However, temporary improvements, such as minor upturns in birth rates, sporadic return migration, and marginal decreases in mortality, proved insufficient to reverse the broader pattern of demographic decline. The evolution of the natural balance in this rural commune reveals the depth of demographic transformation: declining reproductive capacity and sustained emigration against the backdrop of an aging population. These dynamics underscore the urgent need for long-term strategies to counteract population loss and strengthen local demographic, social and economic resilience. Comparative data from rural Romania reinforce the relevance of these observations. In 1992, the national rural rate stood at just -1.9‰; over the next three decades, the annual rural average of the natural balance rate remained persistently negative, indicating a deeper and more consistent demographic contraction. The lowest value was recorded in 2021, at -7.5‰ (Figure 10). The comparison highlights a relative demographic advantage of Straja, though recent convergence between the two suggests that, without effective intervention, the commune may eventually align with the national trend.

Spatial mobility of the population

Mobility has strongly influenced the demographic and social landscape of rural communities throughout Romania. In the decades before 1989, many people left their home villages for nearby towns or industrial regions, drawn by employment opportunities offered by the rapidly growing socialist economy. Entire families moved from their rural homes into urban apartment blocks, exchanged agricultural routines for factory shifts, thus becoming part of a nationwide transformation project. After the Revolution of 1989 which overthrew the communist regime, the motivation and direction of migration shifted. State-run factories closed, and the rising cost of city life reduced the appeal of urban living. In parallel, the 1991 Land Fund Law returned land to former owners and encouraged people to reconnect with rural life, and agriculture, even at the subsistence level, became a fallback for many families. Moreover, family support networks provided stability where state institutions no longer could. The liberalization of borders opened new routes for international migration, while the 1996 Housing Law made it easier to own property, often in the form of new houses built near their parents' homes.

In Straja, these transformations became visible in everyday life, with some young couples returning and building new dwellings on inherited plots, while other locals left to study or work in cities like Cluj or Bucharest, or Western European countries such as Italy, Spain, and the UK. The rural landscape transformed: many homes stood empty, whereas others expanded and were modernized with new extensions or annexes. Thus, in the past three decades, movements in and out

of the commune added layers to its demographic story, shaped by departure, return, and a constant search for a higher quality of life.

In 1995 the net migration rate fell to -10.1‰, revealing the extent of demographic destabilization, while in the following year the emigration reached 16.9‰, reflecting a wave of departures amid ongoing uncertainty (Figure 11). Between 1999 and 2001 the migration balance temporarily steadied, with net rates close to zero. However, after Romania joined the European Union in 2007, adults and younger people took this opportunity to seek jobs as well as financial and social security elsewhere. In 2008, amid the global economic crisis, the emigration rose to 13‰, and the net loss reached -9.2‰.

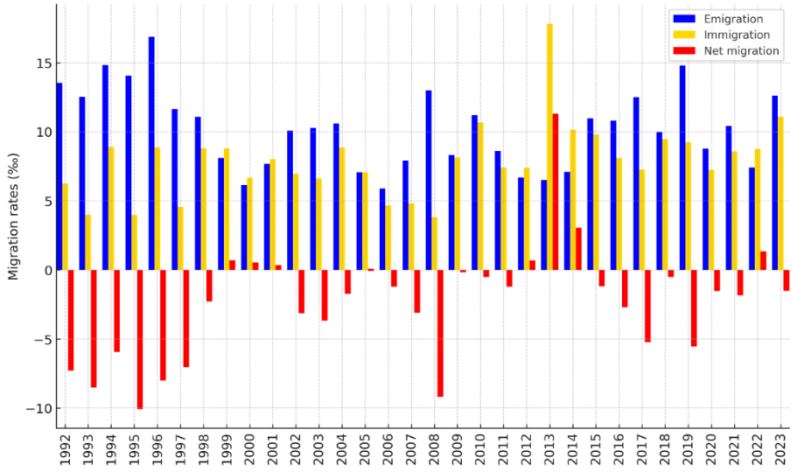

Figure 11. Evolution of migration rates in Straja commune, 1992-2023

In 2013 the immigration increased to 17.8‰, whereas the emigration dropped to 6.5‰, with the net migration reaching 11.3‰, the highest value of the three decades. The COVID-19 pandemic disturbed the established migration patterns and further influenced demographic movements. In 2021, the rate of the net migration was -1.9‰, while in 2022 it briefly turned positive (1.4‰), likely reflecting the return flows triggered by lingering health concerns or shifting job markets abroad (Figure 11). By 2023, the number of people leaving the commune once again surpassed those arriving, reflected by the drop in the net migration rate to -1.5‰ (INS, 2024b).

A significant share of the migrating population once studied at the secondary school in Straja, the educational institution where we conducted a sociological research through using a questionnaire to which 8th-grade students responded in 2022, aiming to explore how young people perceive migration. Forty students responded, of which three-quarters were female, mostly aged 14. More than half reported that a close family member (usually the father) worked abroad, with Germany cited as the most common destination. When reflecting on their plans for the future, no less than 74% intended to leave Straja. The majority of students hoped to pursue higher education (85%) or to find better-paying jobs (50%). Some took into account settling in nearby towns, while others looked toward cities like Bucharest or destinations abroad: Italy, Spain, France, and the UK. For these adolescents, mobility was not regarded as a dramatic rupture, but more like an expected step, familiar for young people growing up with absent parents, with whom they had kept in touch through regular calls. Therefore, the vast majority of teenagers schooled in Straja see relocation as part of the life cycle, and their answers show a community in quiet transformation, where staying in their home village is no longer the default, and leaving is part of planning.

This insight brings depth to the demographic data and highlights the persistence of migration across generations and the manner in which households pass along attitudes shaped by mobility. In

Straja, as in many villages of the region, population change reflects stories, decisions, and directions envisioned by young people in the community, and connects them to everyday realities common across rural Romania.

Population projections and prospective challenges

Demographic projections play a key role in understanding population evolution and anticipating future developments, particularly in rural areas marked by structural and demographic vulnerabilities. For Straja commune, the current forecast draws on a combination of classical extrapolation techniques and advanced time-series models, applied to demographic records spanning from 1992 to 2024. The figures represent the population officially registered by domicile as of July 1st of each year, a commonly accepted statistical proxy in Romania, given the lack of continuous data on the de facto resident population.

The first method used for projection was linear regression, a basic approach that extends long-term tendencies along a straight trajectory, using the equation:

$$y_t = a + b \cdot t \quad (1)$$

where:

- y_t is the estimated population in year t,
- a is the intercept (baseline population),
- b is the annual rate of change.

According to this approach, the population of Straja is expected to grow slowly but steadily, from 5,940 in 2024 to around 6,027 by 2030, 6,154 in 2040, and 6,282 by 2050. The projection is based on the assumption that the gradual increase observed over the past thirty years will continue without major fluctuations.

The second technique uses polynomial regression of degree two, which is well-suited to capturing non-linear developments in historical population trends, and is defined by equation (2):

$$y_t = a + b \cdot t + c \cdot t^2 \quad (2)$$

where a, b, and c are coefficients estimated from the data.

This projection method infers a population of approximately 6,277 residents in 2030, increasing to 6,501 by 2040 and 6,693 by 2050. The upward curvature points to a modest acceleration in growth. However, without substantial improvements in local socioeconomic conditions, the model may overstate the long-term demographic capacity of Straja commune.

Finally, the third technique applied was an ARIMA model (AutoRegressive Integrated Moving Average), a time-series forecasting tool that builds on past values and their evolution over time. ARIMA integrates three components: an autoregressive term (AR(1)), which accounts for the influence of previous data points; an integration component (I(1)), which involves differencing the series once to achieve stationarity; and a moving average term (MA(1)), which adjusts the forecast based on prior errors. When we applied this method to our data for the 1992-2024 timeframe, the ARIMA (1,1,1) model generated a nearly flat projection: 5,946 residents in 2030, 5,952 in 2040, and 5,954 in 2050. These marginal increases indicate a state of demographic inertia, reflecting the stability observed in recent decades.

While statistically sound, all the models extrapolates past trends and cannot anticipate shifts driven by policy changes, economic renewal, or demographic adjustments. Therefore, the outcomes of these projections should be interpreted with caution and placed alongside scenario-based models that consider structural and contextual developments. The three forecasting exercises reveal the utility and the limits of relying on recorded dynamics to anticipate future demographic change. Although based on the same data series, the models point in different directions and suggest contrasting possibilities, indicating that projections serve best as tools for reflection and planning,

not as fixed predictions.Moreover, in Straja, the foreseeable future will be shaped by what people and institutions choose to do now, whether they find ways to support local life, to create reasons to stay, and to imagine continuity where decline once seemed inevitable.

CONCLUSIONS

Assessing demographic change in Straja proved essential for understanding the deeper social interactions that shape rural life in this part of Romania. The study offers a comprehensive view of local evolution over recent decades by analyzing key processes, respective birth and death rates, migration flows, and their combined effects on population structure. Anchoring the analysis in the local context allowed us to identify distinctive demographic patterns and persistent challenges, while pointing to shifts occurring across northern rural regions.

A defining historical trait for this rural area remains its exemption from collectivization, a rare national exception that reveals strong communal cohesion. This resistance stemmed from traditional agricultural practices, cultural continuity, and a deep attachment to land and identity, which continue to shape the local social tissue.

Beyond its empirical scope, the research contributes to current debates on post-socialist rural change by providing insight into the evolution of a traditional community from the mountain region of northern Romania. The integrative methodology, blending archival research, statistical analysis, and fieldwork, outlines a replicable approach for investigating demographic dynamics elsewhere. At the same time, the findings carry practical value for planners, decision-makers and professionals designing policies focused on population stability, territorial equity, and long-term revitalization.

Reinforcing rural vitality requires investment in infrastructure (transport, services, digital access) and people, through access to education, healthcare, and vocational training. Just as important is targeted support for small-scale agriculture, locally rooted businesses, and forms of tourism that respect and build upon the natural landscape and cultural identity of each community. Encouraging the return and reintegration of outmigrants can help restore demographic balance and foster resilience. Durable change depends on institutions, on community initiative, inclusive governance, and the ability to reconnect present decisions with long-standing social resources.

The evolution captured in this study reflects the tensions and transformations that have shaped rural Romania over the past century. Understanding these experiences remains essential for crafting place-sensitive strategies that meet the complex needs of peripheral territories while supporting their resilience and potential for renewal.

AUTHOR CONTRIBUTIONS

Conceptualization, D. Istrate, I. Grădinaru and M. Mîndrescu; methodology, D. Istrate and I. Grădinaru; formal analysis, D. Istrate, I.-A. Cristea and M. Barbacariu; investigation, D. Istrate, I.-A. Cristea and M. Barbacariu; writing - original draft preparation, D. Istrate; writing - review and editing, D. Istrate, I. Grădinaru and M. Mîndrescu.
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