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NAMING THE PERIPHERY: RURAL AND PERI-URBAN STREET NAMES IN THE TIMIȘOARA METROPOLITAN AREA — A SPATIAL STATISTICAL APPROACH

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Abstract: *Street names are one of the least-studied components of rural toponymy, yet they carry a surprising amount of information about how a village relates to the city pulling at its edges — whether it resists that pull, absorbs it, or something in between. The present study looks at rural and peri-urban hodonyms across the Timișoara Metropolitan Area (TMA), a territory made up of 63 administrative units grouped into 25 constituent localities, most of them commune centres and the villages attached to them, ringing the city on almost every side. The work was organised around four objectives: assembling a georeferenced database of street names, sorting them into typological*

categories, checking whether distance from Timişoara has any bearing on whether streets have been formally named in a locality, and finding out how often the same hodonyms turn up in more than one place. Working in ArcGIS Pro with the "Near" tool and a Getis-Ord Gi hot spot analysis, we classified 1,546 streets into ten typological categories and tested them for spatial clustering. Phytonyms turned out to dominate by a wide margin — 26.2% of all names — followed by a residual "other" category (17.08%), then by names referring to towns and capital cities (14.49%) and commemorative names honouring public figures (13.39%). Just over half of the localities in the metropolitan area, 37 out of 63 (58.7%), have officially named streets; the other 26 (41.3%) do not have an official street-naming system. The hot spot analysis picks out a compact arc of localities immediately east and south-east of Timişoara — Ghiroda, Giroc, Bucovăţ, Şag, Remetea Mare and Giarmata — where hodonymic richness clusters significantly, while the two localities with the highest raw counts, Moşniţa Nouă and Dumbrăviţa, turn out not to form part of that cluster at all, registering instead as statistically non-significant despite their high raw totals — a distinction that a simple ranking of totals would never have revealed. As far as we have been able to establish, this is the first study in Romania to bring quantitative spatial statistics to bear on rural and peri-urban street-naming practices.*

Key words: *street names, rural and peri-urban toponymy, hot spot analysis, spatial statistics, Timişoara Metropolitan Area*

1. INTRODUCTION

Street-naming - the branch of onomastics dealing with the names given to roads, streets and other communication routes — sits somewhere between linguistics, history and geography. Similarly, the term hodonym derives from the Greek hodos (‘road’) and onoma (‘name’). Structurally, a street name or a hodonym pairs a generic term — street, avenue, lane — with a specifying element that does the actual work of telling one street from another. What makes these names interesting is that they are attached to a place, start accumulating memory, and signalling identity and spatial orientation.

One well-established strand of literature in critical toponymies treats street names primarily as instruments of symbolic politics and collective memory. Maoz Azaryahu (1996)'s foundational work on the "power of commemorative street names" made the case that renaming a city's streets is one of the more effective and least visible ways a regime can write itself into daily life, a pattern he traced through postwar and post-Nazi Germany, later through East Berlin after reunification, and again through a comparative study of Mannheim and Potsdam (see Azaryahu, 1997; Azaryahu, 2011). The research of Derek Alderman (2003) on how Martin Luther King Jr. has been commemorated across American cities — later extended together with Josua Inwood into a fuller argument about spatial justice — showed that the geography of commemoration is rarely neutral: which streets get renamed, and in which neighbourhoods, tracks lines of racial and economic power as much as it tracks historical merit (Alderman and Inwood, 2013). Brasher, Alderman and Subanthore (2020) pushed this further still with their account of Tulsa's Brady Street, where a renaming publicly framed as a practical, apolitical fix turned out, on closer inspection, to be nothing of the sort. Rose-Redwood, Alderman and Azaryahu (2010) eventually drew these threads together under the heading "toponymic inscription," and their later edited volume on the political life of urban streetscapes (Rose-Redwood, Alderman and Azaryahu, 2018) gave the field something it had previously lacked: a shared

vocabulary and a recognised research programme, cited widely enough that it now functions as the default entry point for anyone starting work in critical toponymy. Around this core, a wider array of studies has filled in adjacent questions — Giraut and Houssay-Holzschuch (2016)'s theoretical account of place naming as a governmental "dispositif," Berg and Kearns (1996)'s early work on naming and identity politics in Aotearoa/New Zealand, and Algeo (1999)'s lighter, but more descriptive studies of trans-Atlantic naming fashions and of how street names go in and out of style over time (Algeo, 2015). This body of works establish street naming, in an urban context, as a mature and thoroughly theorised object of study.

A second strand, more directly relevant to the geography of this paper, follows the toponymic upheaval that came with the end of state socialism across Eastern Europe and Romania in particular. Butnaru (2013, 2025) has written on current trends in official hodonymy in north-eastern Romania, and on tradition and innovation in street naming. Moving beyond a descriptive, locality-by-locality inventory, Light and Young (2014)'s account of how many socialist-era street names in Bucharest have simply outlasted the regime that produced them. Rusu (2019) made parallel studies of how the "namescapes" of three Romanian cities have shifted since 1989 — first as a qualitative account, then reworked into a quantitative comparison (Rusu, 2020), and later folded into a broader systematic review of the field (Rusu, 2021) — all converge on the same conclusion: political rupture rarely produces a clean break in the toponymic record. Old names linger get contested or survive quietly under new administrations that have little appetite for the cost and confusion of a full renaming campaign. Comparable dynamics have been documented well beyond Romania: Gnatiuk (2018) examined regional strategies of post-revolutionary renaming in Ukraine, Gnatiuk and Melnychuk (2023) traced the de-Russification of Ukrainian hodonyms at street level, and Atencio (2018) extended the same basic logic to post-conflict Nicaragua and Brazil, where renaming became entangled with competing accounts of political violence. Working on Timisoara as a Romanian martyr city, Crețan and Matthews (2016) added an important qualification to all of this: public resistance to renaming, in their case, owed less to ideological attachment than to a kind of practical inertia — people push back against changes that make everyday navigation and address-keeping harder, largely independent of what the old or new name actually stood for. This study was complemented by a longitudinal study on street naming in Timisoara (Timofte, Crețan and Dragan, 2026).

A third strand—and the one with which this study is most closely aligned—examines the relationship between street naming and ethnolinguistic identity in mixed or historically contested territories. Felecan's (2013) work on Romanian hodonymy approaches street naming through the lenses of local rootedness, cosmopolitan borrowing, and the sacred–profane divide. Complementing this perspective, Bartos-Elekes (2016) traces the history of street-name changes in Transylvania, documenting how Hungarian, German, and Romanian toponymic layers have overlapped, competed, and occasionally displaced one another. Felecan's later studies (2015, 2017, 2019) of urban place-name transformations in twentieth-century Romania further situate hodonymy within the broader and much longer-established tradition of Romanian toponymic scholarship. Particularly relevant is the recent study by Timofte, Crețan, and Drăgan (2026), which examines street (re)naming and spatial ethnolinguistic contact longitudinally in Timișoara. As Timișoara also anchors the present study, that article provides the most direct point of comparison,

establishing an urban baseline against which the rural and peri-urban patterns examined here can be assessed.

Set against this fairly substantial urban literature, rural street-naming/hodonymy looks almost bare by comparison, and the imbalance is worth stating plainly rather than gesturing at. Only a handful of works have dealt directly with village or countryside street names, and all of them are more recent. At international level, Racca (2024) has documented the Italian case, on how old microtoponyms disappear as urban sprawl eats into the surrounding countryside — a process of loss rather than of formal naming, and one studied qualitatively rather than through any spatial statistical method. Gnatiuk and Zapototska (2025) have offered a cross-regional account of the "political lives" of rural hodonyms in Ukraine, the closest existing analogue to the present study in subject matter, yet their approach, like the rest of the field, remains qualitative and comparative rather than quantitative and spatial. That all three of these direct precedents were published within the last years consider that rural hodonymy is not simply a neglected sub-field with a long, thin back-catalogue, it is a genuinely new one, still being defined by the handful of papers that constitute it

Against this background, three separate gaps emerge in the street-naming literature that this study covers. First, a thematic deficit: the overwhelming majority of street-naming research, both in Romania and internationally, has focused on urban aspects, and the theoretical apparatus built up around memory, commemoration and regime change was designed with cities in mind — it does not obviously transfer to villages. Second, a methodological gap is also evident: current studies are more descriptive, working through case narratives and typologies rather than through formal spatial statistics. Quantitative and GIS-based analyses that test naming patterns against measurable variables — distance from a dominant urban core, administrative rank, documented settlement age — are almost absent in the rural street-naming literature. Third, and most specifically, a technical gap also appears: spatial statistical techniques of the sort routinely applied in crime mapping, epidemiology or retail geography to distinguish genuine spatial clustering from a mere ranking of high values — Getis-Ord Gi* chief among them — have, as far as we have been able to establish through a targeted search of the onomastic, geographical and GIS literature, never before been applied to rural and peri-urban settings, and certainly not in Romania. Studies that rank localities by raw street names exist, studies testing whether rural street names cluster spatially are almost entirely absent.

This paper aims to cover the three mentioned gaps, using the Timișoara Metropolitan Area (TMA) as a concrete Eastern European case study, through a reproducible method that pairs a typological classification of hodonyms with a spatial proximity analysis and a formal hot spot analysis (Getis-Ord Gi*) run relative to the urban core. We want to be explicit about the novelty claim rather than leave it as a passing remark: to the best of our knowledge, and after a targeted search of the relevant onomastic, geographic and GIS literature, there has been no earlier study conducted in Romania that combined a rural hodonym typology with local spatial statistics of this kind, and there have been no studies that have applied a Getis-Ord Gi* hot spot analysis to rural or peri-urban street naming specifically. On both counts, this appears to be the first study of its type — not only the first in Romania but also worldwide to bring formal spatial statistics to bear on rural and peri-urban street names.

The broader aim of this study is to understand how street names are distributed across the TMA and how that distribution relates to distance from the urban core and to

administrative rank — the two structural variables the analysis is actually equipped to test. The area's wider natural and socio-economic setting, described in section 2, provides context for interpreting these patterns rather than a set of variables tested directly against hodonym counts. Four specific objectives follow from this: (H) building a georeferenced database of street names; (O2) classifying hodonyms by category; (O3) analysing how close each locality sits to Timișoara; and (O4) checking how often the same street names repeat across the study area. Two working hypotheses guide the analysis: (H1) distance from Timișoara is associated with whether, and how fully, street names get formalised in a given locality; and (H2) not every street name reflects something particular to the place it belongs to — a fair share are drawn from a generic, recurring stock of toponyms rather than from local history or geography.

2. STUDY AREA

The Timișoara Metropolitan Area lies in western Romania (Figure 1), within the Western Plain and, more broadly, the Pannonian Basin — flat, low-lying land with very little variation in elevation (Dragan, Crețan and Triponescu, 2024). The city itself grew up along the Bega river, on what was once marshy ground crossed by a network of minor streams; its documented existence as a town, under the name "Castrum Temesiensis," goes back to 1203 (Crețan & Frățilă, 2007).

Administratively, metropolitan areas are best thought of as a form of intercommunal cooperation, resting on the complementarity between an urbanised, polarising core and the peri-urban communes around it (Săgeată, 2008). The concept itself has an American pedigree, having first taken shape in the 1950s as the "Standard Metropolitan Statistical Area," and it typically rests on demographic and functional thresholds involving population density, the share of the workforce employed outside agriculture, and how strongly the core city pulls on the surrounding counties (Bastié & Dézert, 1980).

The TMA is made up of 63 administrative-territorial units organised into 25 constituent localities: sixteen commune centres and a larger number of villages attached to them. (An earlier delimitation of the study area also included the town of Recaș and its six attached villages; these were left out of the present analysis, since Recaș functions as its own distinct urban pole rather than as part of Timișoara's commuting field — which leaves 63 units across 25 localities as the working dataset.) The relief is tabular and piedmont plain, part of the Pannonian Depression, sitting on a crystalline schist basement buried under Cretaceous and Neogene sediments (Posea, 1997). Chernozems dominate the soils here — fertile and well suited to agriculture — with alluvial soils taking over in the floodplains of the Bega and Timiș.

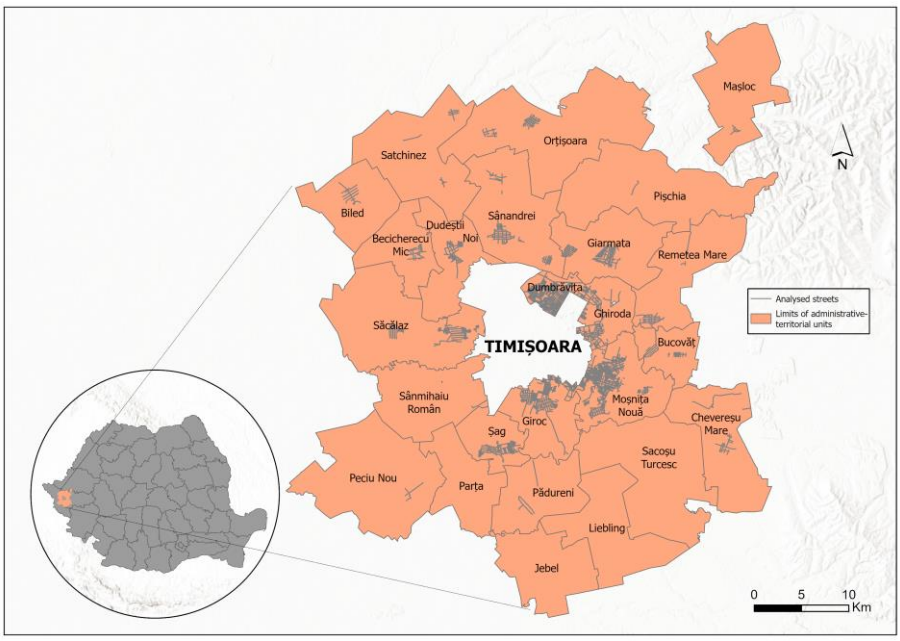

Figure 1. Location of the study area: the Timișoara Metropolitan Area and its 25 constituent localities

Looking at when these settlements were first documented, two periods stand out: the fourteenth century, accounting for 22 localities (about 34.9% of the total), and the eighteenth century, with 17 (about 27.0%). The gap between the two periods is covered by an early wave of medieval settlement, followed centuries later by a distinct phase of resettlement and demographic recovery across the Banat. More recent demographic trends, tracked through birth, death, immigration and emigration rates between 1990 and 2022, show the area's overall balance tipping back toward positive values after 2016, helped along by economic stabilisation and EU integration, though briefly interrupted by the COVID-19 pandemic in 2020 (Triponescu, Dragan and Crețan, 2023).

3. DATA AND METHODS

3.1 Data sources

The study draws on official administrative records for localities, administrative units and the street network, supplemented by OpenStreetMap vector data obtained through geospatial.org and geofabrik.de. Demographic figures come from the online database of Romania's National Institute of Statistics (statistici.insse.ro). Where official cadastral street-naming records were incomplete or unavailable for a given locality, OpenStreetMap contributor data (extracted in 2026) was used as a supplementary source; this carries the usual caveats of volunteered geographic information, including occasional duplicate entries,

inconsistent transliteration of diacritics, and uneven mapping completeness across localities, which we mitigated through manual cross-checking against the administrative dataset wherever the two sources overlapped.

3.2 Methods

The research follows a descriptive-analytical design, built around a geographic information system (ArcGIS Pro) used to map and analyse how hodonyms are distributed across the rural TMA. All 63 constituent localities were digitised as separate shapefiles, alongside a point layer marking Timișoara as the reference centre.

The proximity analysis (O3) relied on ArcGIS's "Near" tool, which computes the Euclidean distance between each locality's centroid and the reference point marking Timișoara's centre — rather than between administrative boundaries — and writes the result into a new attribute field (NEAR_DIST). These values were then mapped as proportional circles across six distance classes: under 5 km, 5–10 km, 10–15 km, 15–20 km, 20–25 km, and over 25 km.

For the typological analysis (O2), every street across the 63 localities was checked individually and sorted into one of ten predefined categories: (1) personal names; (2) localities, towns or capital cities; (3) water bodies; (4) plants; (5) animals; (6) landform or relief units; (7) trades or crafts; (8) other, for names that fit none of the preceding types; (9) numerals or roman numbers; and (10) celestial bodies. An earlier, eleven-category version of the scheme also included a category for historical events, following commemorative-naming conventions well documented in the urban literature; it was dropped once it produced zero hits anywhere in the study area — a small but telling result, since it points to the absence of any local tradition of naming streets after specific historical events, in contrast to what is routinely found in cities.

Repeatability (O4) was assessed by identifying street names that recur, unchanged, across more than one locality — a way of gauging how much of the area's street toponymy is genuinely local, as against how much is drawn from a shared, generic stock of names.

3.3 Spatial statistics: hot spot analysis

Raw counts and choropleth-style rankings, the usual currency of hodonym studies, say nothing about whether high values cluster together in space or simply occur in isolation. To test for clustering directly, we computed a Getis-Ord Gi* local statistic for each of the 21 localities holding at least one officially named street, using settlement centroids drawn from the same administrative-boundary layer used for the proximity analysis. Four variables were tested: the overall count of classified hodonyms per locality, plus the counts for the three numerically largest categories — phytonyms (category 4), personal names (category 1), and names of localities or capital cities (category 2). The overall count is better understood as a proxy for the size of a locality's formally named street network than for hodonymic "intensity" or "richness" in any deeper sense: larger, more populous localities with more extensive street networks will tend to score higher on this measure regardless of any distinctive naming behaviour, a confound we return to among the study's limitations.

For each locality i, the Gi* statistic compares the weighted sum of the values at i and its neighbours against what would be expected if those same values were scattered randomly across the study area:

$$Gi^* = [\ \Sigma_j\, w_{ij}\, x_j - \bar{X}\, \Sigma_j\, w_{ij}\ ] \,/\, \{\ S \cdot \sqrt{[\ (n\, \Sigma_j\, w_{ij}^2 - (\Sigma_j\, w_{ij})^2) \,/\, (n-1)\ ]}\ \}$$

where x_j is the value of the variable at locality j, w_{ij} is the spatial weight linking locality i to locality j, $\bar{X}$ and S are the mean and standard deviation of the variable across all n localities, and the summations run over all j (Getis & Ord, 1992; Ord & Getis, 1995). Spatial weights were defined as the inverse of the great-circle (haversine) distance between locality centroids, so that closer localities carry proportionally more weight in a given Gi* value than distant ones, without imposing an arbitrary cut-off. The resulting z-scores were read against three confidence levels (90%, 95% and 99%), following the standard classification into statistically significant hot spots (positive z, clustering of high values), cold spots (negative z, clustering of low values), and areas showing no significant local clustering. As a complementary, area-wide check, we also computed the global Moran's I statistic for each variable, using the same inverse-distance weights matrix, to see whether the clustering picked up locally by Gi* was matched by an overall tendency toward spatial autocorrelation across the metropolitan area as a whole (Anselin, 1995). All spatial statistics were implemented in Python (NumPy/SciPy), following the standard Getis-Ord formulation used in ArcGIS's Hot Spot Analysis (Getis-Ord Gi*) tool, so the results can be reproduced directly in a GIS environment.

4. RESULTS AND DISCUSSION

4.1 Proximity analysis

Timișoara functions as an economic and functional hub for the localities around it, driving daily commuting for work, education and services. The distances computed with the "Near" tool show that most TMA localities sit within 25 km of the core. Ghiroda comes closest, at 6 km centre-to-centre; Alioș sits furthest out, at roughly 45 km.

4.2 Distribution of street-naming categories

Of the 1,546 streets classified across the TMA's 63 localities, the breakdown by typological category is shown in Figure 2.

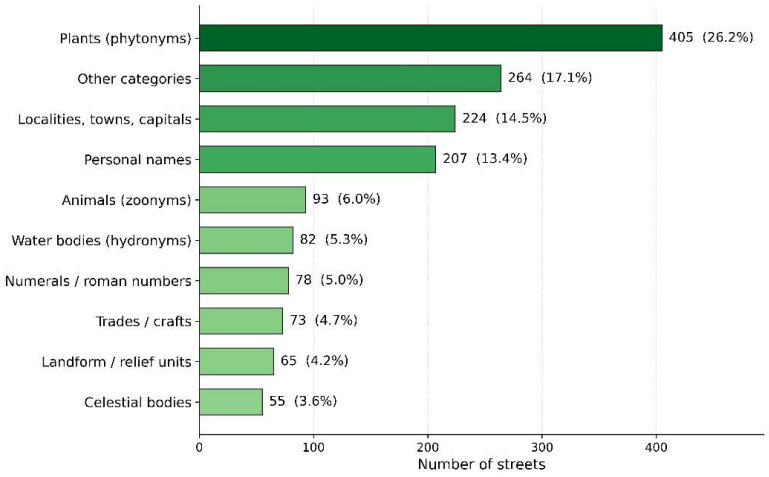

Figure 2. Distribution of TMA's street names by typological category

Street names with origins in phytoponyms come out well ahead of everything else, with 405 streets — 26.2% of the total, more than a quarter of the area's entire street toponymy (Figure 3). Moșnița Nouă (81), Giroc (76) and Dumbrăvița (52) account for most of them, all three sitting right next to Timișoara and all three having expanded rapidly and recently as residential suburbs. Names such as Narcisei, Crizantemei, Frezei, Ghioceilor, Gladiolei, Lăcrimioarei and Nufărului read less like references to anything specific about these places and more like a deliberate attempt to build a pleasant, generically attractive residential image.

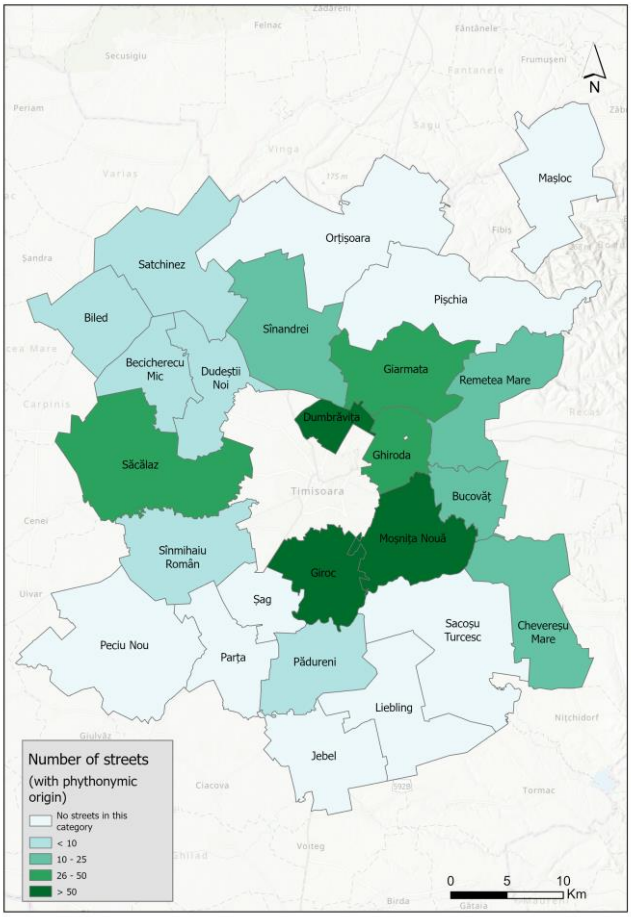

Figure 3. Number of streets based on phytoponymic origin

Names drawn from towns, cities and capitals form the third-largest group (224 streets, 14.49%), and here too Moșnița Nouă dominates, with 125 of them — more than half the category's total on its own. Streets there are named after Belgrade, Berlin, Bern, Bucharest, Brussels, London, Madrid, Monaco, Oslo and Prague. It is hard not to read this as a deliberate cosmopolitan gesture, an attempt to project a certain worldliness onto a recently expanded residential settlement, not unlike the pattern Felecan describes for cosmopolitan-inflected urban naming elsewhere in Romania.

Commemorative names rank fourth (207 streets, 13.39%), concentrated heavily in Dumbrăvița, which alone accounts for 108 of them — well over half (Figure 4). Traian Vuia and Crișan turn up most often, each appearing in three different localities, followed by George Enescu, Ion Creangă, Mihai Eminescu, Lucian Blaga, Nicolae Bălcescu and Octavian Goga, each present in two. Unlike the contested commemorative landscapes and critical place-naming studies described by Azaryahu (2011) or by Alderman and Inwood (2013), where street naming becomes a genuine site of political dispute, the pattern here

looks considerably more settled: these are broadly consensual figures from Romanian national culture — writers, scientists, historical personalities — and there is no visible sign of toponymic conflict around any of them.

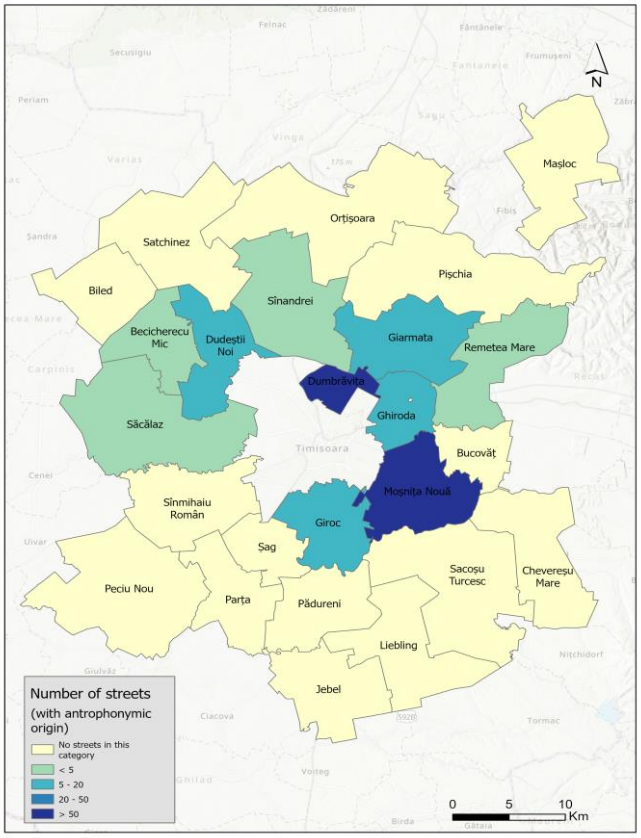

Figure 4. Number of streets with anthroponymic origin

The "other" category (264 streets, 17.08%) sweeps up names that resist the typology altogether, mostly functional or generic ones — Principală (Main Street), Gării (Station Street), Școlii (School Street), Bisericii (Church Street) — pointing to institutional or functional landmarks rather than to anything culturally or geographically distinctive. Its relatively high share is a useful reminder of how any fixed classification scheme runs up against the messiness of an actual toponymic stock, and it also hints at an older, functional-descriptive layer of naming that predates the more recent aesthetic turn toward flowers and foreign capitals.

Everything else trails well behind: zoonyms (93 streets, 6.02%), with names like Berzei (Storks), Cucului (Cuckoo) and Lebedei (Swan); hydronyms (82 streets, 5.30%), naming the region's main rivers — Bega, Timiș, Bârzava, Mureș, Someș, Nera; numerals and roman numbers (78 streets, 5.05%), almost entirely concentrated in Șag (65 of them);

trade and craft names (73 streets, 4.72%); relief-based names (65 streets, 4.20%); and, last, celestial names (55 streets, 3.56%) — Cometei (Comet), Constelației (Constellation), Lunei (Moon), Uranus. Figure 5 highlights the four numerically largest categories.

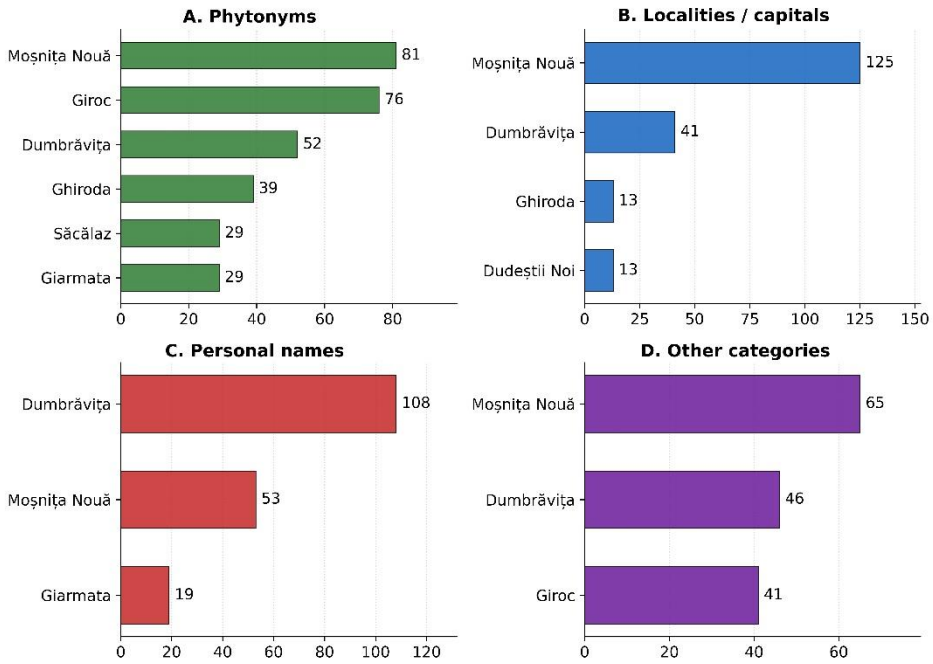

Figure 5. Localities with the highest hodonym counts, by main category

Taken together, the picture is one of typological diversity concentrated in a handful of localities right on Timișoara's doorstep — Dumbrăvița, Moșnița Nouă, Giroc, Ghiroda — which, being the most dynamic in terms of residential growth, have also built up the widest and most varied stock of street names. This lends some support to H1: proximity to the urban pole shapes not just whether a locality names its streets at all, but how many different kinds of names it ends up with.

4.3 Spatial statistics: hot spot analysis

Before getting to the results, it is worth pausing on what a hot spot analysis actually adds. A ranking by raw counts, such as Figure 5, can only ever say which localities scored highest taken one at a time; it cannot say whether those high-scoring localities sit next to one another, forming a genuine cluster, or whether they are scattered exceptions surrounded by ordinary neighbours. The Getis-Ord Gi* statistic answers exactly this question for each locality: it weighs that locality's value together with its neighbours' values

and asks whether the local total is higher (a "hot spot") or lower (a "cold spot") than would be expected under a null hypothesis of spatial randomness, in which the observed hodonym counts bore no relationship to location. A locality can therefore post a very high raw count and still fail to register as a hot spot, if its neighbours do not share that high value — which turns out to be exactly what happens to the two leading localities in this dataset, as shown below.

Figure 6 plots the resulting z-scores for all 21 localities with at least one classified hodonym, across the same four variables discussed above. Dashed vertical lines mark the conventional 90%, 95% and 99% confidence thresholds (z = 1.645, 1.96 and 2.576): bars extending past a line indicate a statistically significant hot spot at that confidence level. No locality, for any variable, crossed the corresponding thresholds on the cold-spot (negative) side — meaning that low hodonym counts, though common, are not spatially clustered into a coherent low-value core. They are simply scattered.

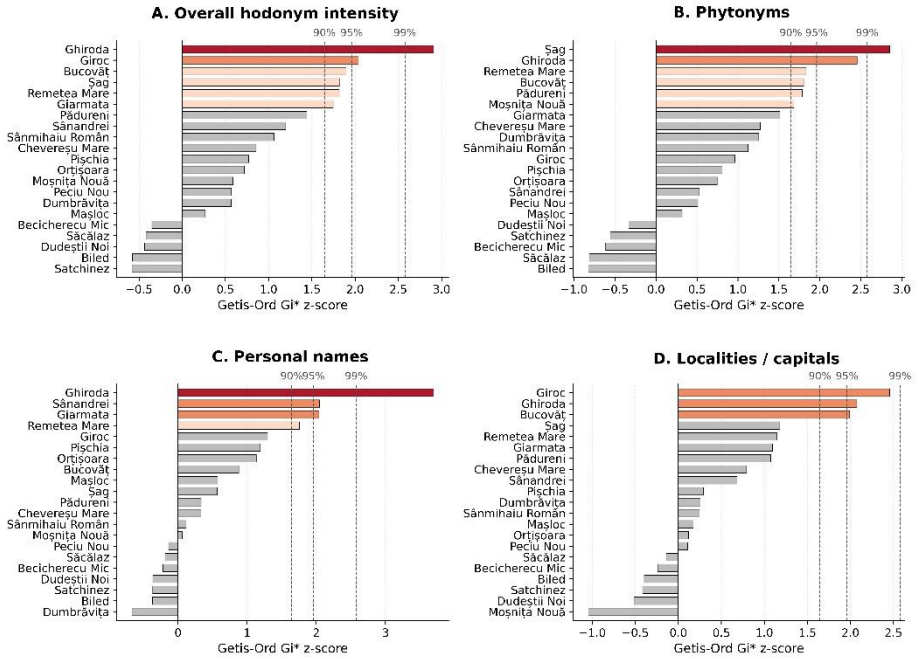

Figure 6. Getis-Ord Gi z-scores by locality and variable, with 90/95/99% confidence thresholds*

Read across the four panels, a fairly consistent geographical story emerges. A compact arc of localities immediately east and south-east of Timișoara — Ghiroda, Giroc, Bucovăț, Șag, Remetea Mare and Giarmata — recurs as a hot spot across all four variables, with Ghiroda alone crossing the 99% threshold for both overall intensity and personal names, and the 95% threshold for localities/capitals. This is a cluster in the strict statistical sense: these localities are not simply high in isolation but sit next to other localities that are also comparatively high, producing a mutually reinforcing local pattern that Gi* is specifically designed to pick up.

What stands out just as much is who is missing from the hot spot bars. Moșnița Nouă and Dumbrăvița hold, respectively, the highest and second-highest raw totals in the entire dataset (417 and 319 classified hodonyms), yet neither crosses even the 90% threshold for overall intensity (Gi* z = 0.59 and 0.57 respectively — barely above zero, well short of the 1.645 needed for significance). The reason becomes clear once their surroundings are taken into account: both localities are flanked mainly by settlements with comparatively modest hodonym counts — Sânandrei and Orțișoara to the north of Dumbrăvița, Chevereșu Mare and Pădureni to the south-east of Moșnița Nouă — so their own high values are not echoed locally. Put plainly, they are prolific, but prolific alone. In Getis-Ord terms, they register as high-magnitude localities that fall outside the significant cluster, rather than as its centres — a distinction invisible to a ranking by raw counts, and one of the clearest illustrations of why hodonym research benefits from local spatial statistics rather than descriptive counts on their own. It is worth being precise about what this does, and does not, show: a non-significant Gi* score means the locality does not sit inside a statistically significant cluster of high (or low) values — it is not, by itself, a formal identification of a spatial outlier in the stricter sense used by Local Indicators of Spatial Association (LISA), which classify High-Low and Low-High configurations explicitly (Anselin, 1995). Confirming outlier status in that stronger sense would call for a local Moran's I analysis alongside Gi*, which we did not run; we return to this as a direction for future work below.

The picture is reinforced, in a slightly counter-intuitive way, by the global Moran's I values computed for the same four variables, all of which come out weak and close to their expected value under spatial randomness (total: I = 0.043; phytonyms: I = 0.066; personal names: I = −0.038; localities/capitals: I = −0.047, against an expected value of −0.050 for n = 21). Taken at face value, this would seem to suggest an absence of meaningful spatial structure across the metropolitan area as a whole. Yet the local Gi* results say otherwise: significant clustering does exist, just not everywhere — it is confined to the specific arc of localities identified above and mapped in Figure 7. This is a textbook instance of what the LISA literature describes as clustering that a global statistic can mask, precisely because it operates at the local rather than the area-wide scale (Anselin, 1995; Ord & Getis, 1995): most of the metropolitan area's 63 localities carry no named streets at all and so contribute little more than noise to a global measure, while a genuine, spatially coherent cluster of hodonymic richness sits quietly within that noise, detectable only at the local scale.

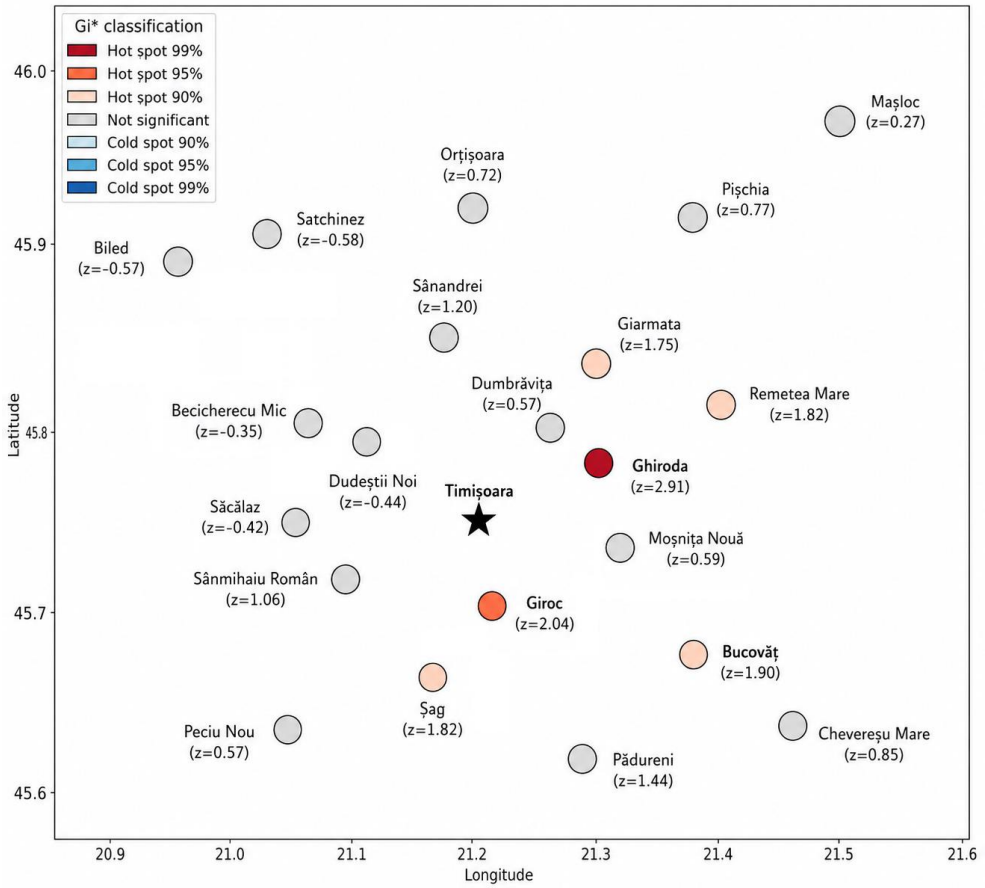

Figure 7. Getis-Ord Gi hot spot map for overall hodonym intensity in the Timișoara Metropolitan Area*

4.4 Repeatability of hodonyms

Of the 63 localities in the TMA, a majority — 37 (58.7%) — have officially named streets, whether across the whole network or only part of it, while the remaining 26 (41.3%) still get by without formalised names. The localities that do have named streets tend, unsurprisingly, to be either close to Timișoara or to hold commune-centre status, which again points to proximity and administrative rank working together to explain the pattern; the 26 without formalised names are disproportionately the smaller, more peripheral villages attached to those commune centres rather than the commune centres themselves.

To move beyond a handful of anecdotal examples, every hodonym in the database was checked against every other locality to find names that recur, unchanged, in more than one place. Twenty such names turned up, ranging from Strada Bega, shared by

five localities, to Strada Principală (Main Street), which recurs in ten — nearly a third of all localities with named streets.

Functional and generic names dominate the top of the list — Principală (10 localities), Trandafirului and Teiului (9 each), Liliacului, Magnoliei, Nucului and Plopului (8 each) — and the great majority are phytonyms, consistent with the earlier finding that flower and tree names make up more than a quarter of all classified hodonyms. Only two of the twenty, Bega and Bisericii, refer to anything place-specific (a river, a church), and even these recur across five localities that do not all sit on the Bega or share a single parish. This is about as direct a confirmation of H2 as the data allow: a substantial share of the TMA's street toponymy is drawn from a shared, generic repertoire rather than from anything particular to the locality it names.

Figure 8 takes this a step further, showing exactly which localities share which names, with both axes sorted by frequency. Reading down the columns, a clear pattern emerges: Moșnița Nouă, Giroc, Dumbrăvița, Ghiroda, Sînandrei, Giarmata and Săcălaz between them account for the great majority of the dark cells, meaning they draw on essentially the same pool of street names as one another far more than with any other locality in the dataset. Moșnița Nouă alone shares in 16 of the 20 recurring names, Giroc and Dumbrăvița in 15 each, Ghiroda, Sînandrei and Giarmata in 14 each, and Săcălaz in 12.

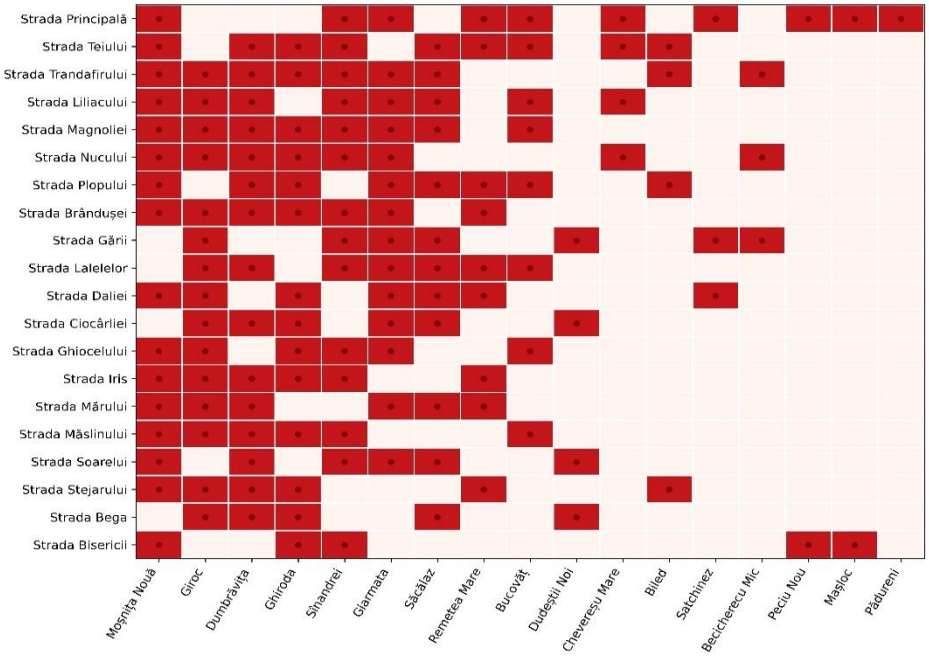

Figure 8. Co-occurrence of recurring street names across localities

This is a genuinely useful complement to the hot spot analysis in section 4.3. Ghiroda, Giarmata, Săcălaz and Sînandrei were already identified there as the statistically significant cluster of hodonymic intensity. Figure 8 shows they are also the core of a shared naming repertoire, consistent with the idea that neighbouring administrations either

coordinate naming decisions directly or simply draw on the same limited, conventional stock of names whenever a new residential street needs one. What the repeatability data add is that Dumbrăvița and Moșnița Nouă — the two localities that did not register as part of the significant cluster in the Gi* analysis, prolific but not clustered — turn out to be just as central to the shared-name network as the cluster core itself, if not more so. Dumbrăvița and Moșnița Nouă, in other words, are not adjacent enough to their neighbours to register as part of a statistically significant hot spot, but they draw on, and reinforce, exactly the same generic repertoire that the hot spot cluster does. The two findings describe different things — spatial clustering of raw intensity versus shared content of the names themselves — and the fact that they only partly overlap is itself informative: hodonymic "success" in a locality can mean either standing at the centre of a spatial cluster or simply drawing heavily on a common regional repertoire, and these need not be the same places.

Set against the wider literature, the picture here is more mixed than in some comparable cases. A clear majority of localities (58.7%) do have officially named streets, a somewhat more advanced state of formalisation than Racca (2024) describes rural microtoponymy under pressure from unplanned urban expansion in Italy. At the same time, more than four in ten localities in the TMA— mostly smaller villages rather than commune centres — still lack any formal street toponymy, which chimes with Gnatiuk and Zapototska (2025)'s observation that official rural hodonymy in Ukraine is often incomplete or arrives late. Taken together, the pattern suggests a process of formalisation that is well under way but still incomplete, tracking administrative rank and proximity to the city rather than reaching every locality uniformly. At the same time, the dominance of flower names and the near-total absence of visible commemorative disputes set the Banat case apart from the pattern that dominates the post-socialist urban literature (Light & Young, 2014; Rusu, 2019; Rusu, 2020; Rusu, 2021), where the central question is usually how communist-era names get contested or defended. That difference is worth taking seriously: in this rural setting, street naming looks less like a live arena of political memory and more like a fairly recent, largely depoliticised administrative exercise. We infer this from the naming patterns themselves — the prevalence of flower names and functional labels, the absence of contested commemorative figures — rather than from any direct evidence about decision-makers' motivations, which lies beyond what the present data can speak to; interviews or archival research with local authorities would be needed to confirm it.

5. CONCLUSIONS

This paper set out to examine rural and peri-urban hodonyms across the Timișoara Metropolitan Area, working toward four objectives: building a georeferenced database, classifying street names typologically, analysing how close localities sit to the urban core, and measuring how often names repeat across the area. A fifth, methodological aim was added along the way: testing whether the resulting patterns amount to genuine spatial clusters rather than a diffuse halo around the city. As the introduction argued at length, no earlier work — in Romania or, as far as we have established, anywhere else — had attempted this combination of a rural hodonym typology with formal local spatial statistics; the findings below should therefore be read as a first attempt to fill that gap rather than as a refinement of an existing body of quantitative rural hodonym research, since no such body yet exists. Coding 1,546 hodonyms into ten categories, running the results

through a GIS environment, and subjecting four key variables to a Getis-Ord Gi* hot spot analysis produced findings that support both working hypotheses and add a layer of spatial nuance that a purely descriptive approach would have missed.

On H1, the proximity analysis shows that distance from Timișoara is associated with whether streets get officially named at all and how varied those names turn out to be, and that this pattern coincides with administrative rank: commune centres are more likely than the villages attached to them to have formalised street names. The present descriptive design does not, however, formally model distance and administrative rank jointly — the two were not estimated together in a single statistical model — so their relative and combined contributions remain to be disentangled by future work. The hot spot analysis sharpens this further: rather than a uniform gradient of decreasing hodonymic richness with distance, the data reveal a specific, statistically significant cluster of high values along the eastern and south-eastern arc of the metropolitan area — Ghiroda, Giroc, Bucovăț, Șag, Remetea Mare and Giarmata — while the two localities with the highest raw totals, Dumbrăvița and Moșnița Nouă, register as statistically non-significant rather than as cluster cores. Meanwhile, 41.3% of the area's more peripheral localities still lack a formalised street toponymy altogether. On H2, the repeatability analysis confirms that a substantial share of these names — twenty recurring hodonyms in total, phytonyms especially, alongside functional labels like "Church Street" or "Station Street" — carry no particular connection to the place they belong to, drawing instead on a generic naming repertoire — one that, on the evidence of this single metropolitan area, appears widespread here, though whether it holds across the rest of rural Romania remains an open question for comparative research. That repertoire is concentrated in much the same handful of localities that lead the raw counts — Moșnița Nouă, Giroc, Dumbrăvița, Ghiroda, Sînandrei, Giarmata and Săcălaz between them account for most of the repeated names — tying the repeatability finding back to the spatial one: proximity to Timișoara appears to produce not only more streets and more named localities, but a more standardised, shared stock of names rather than a more locally distinctive one.

Set against the international literature on street naming (see Azaryahu, 1997; Azaryahu, 2011; Alderman, 2003; Alderman and Inwood, 2013; Rose-Redwood, Alderman, & Azaryahu, 2010; Light and Young, 2014; Rusu, 2019; Rusu, 2020; Rusu, 2021), this study addresses a still-underdeveloped strand of research — rural and peri-urban street naming — that has so far leaned almost entirely on qualitative, urban-focused work concerned with memory and the politics of commemoration. Three gaps were identified at the outset: a thematic one, in that the field's theoretical apparatus was built for cities and does not obviously transfer to villages; a methodological one, in that even the small rural literature that exists stays descriptive rather than quantitative; and a technical one, in that formal spatial statistics of the Getis-Ord Gi* type, routine elsewhere in human geography, had never been brought to bear on hodonyms outside an urban setting. The present study speaks to all three at once, and does so with a concrete, reproducible case — though closing any one of these gaps fully will take more than a single regional case study. What follows is offered as a contribution toward that closure, not a claim to have completed it. To our knowledge, and after a targeted search of the relevant onomastic, geographic and GIS literature, no earlier study conducted in Romania (Felecan, 2019; Butnaru, 2025) and worldwide (Gnatiuk and Melnychuk, 2023; Gnatiuk and Zapototska, 2025) have combined a rural street-naming typology with local spatial statistics of this kind, and no study located anywhere has applied a Getis-Ord Gi* hot spot analysis to rural or peri-urban street naming

specifically. This paper is, on both counts, one of the firsts of its type: to the best of our knowledge, the first in the country to bring formal spatial statistics to rural and peri-urban hodonymy, and one of a very small number worldwide to move this branch of onomastics beyond description and into testable, reproducible spatial analysis. The Timișoara case suggests that, unlike its urban counterpart, recent rural and peri-urban street naming in this part of Romania is driven mainly by aesthetic and functional considerations, clusters spatially in a specific, identifiable arc of localities rather than uniformly around the city, and shows little of the visible contestation that characterises commemorative naming in cities — a first empirical picture of a landscape that the literature, until now, had left almost entirely undescribed.

A few limitations are worth keeping in mind. The hot spot analysis was run on the 21 localities with at least one classified hodonym rather than on the full set of 63, since the remaining localities contribute no data to a variable defined only where named streets exist; repeating the analysis once more localities formalise their street names would be a natural next step, and could show the cluster expanding, contracting, or shifting outward as urbanisation proceeds. The settlement centroids used for distance calculations were drawn from the same administrative-boundary layer used throughout the study rather than from a dedicated cadastral point layer — standard practice at this analytical scale, but one that leaves some room for refinement in future work. Two further limitations concern the spatial statistics themselves. First, the overall-intensity variable reflects, in part, the sheer size and street-network extent of a locality rather than a purer measure of naming behaviour; a density-normalised indicator — hodonyms per unit of street length, or per capita — would help disentangle genuine naming richness from settlement size in future work. Second, distinguishing localities that merely fall outside a significant hot spot cluster from true spatial outliers in the formal sense requires a local Moran's I (LISA) analysis, which was beyond the scope of the present study; the global Moran's I values reported in section 4.3 speak to overall spatial autocorrelation but not to the outlier status of individual localities such as Dumbrăvița and Moșnița Nouă, and a LISA-based follow-up would be a natural way to confirm or qualify that reading. Extending the same method across the whole of Timiș County, comparing it against other Romanian metropolitan areas, or tracking how the spatial pattern evolves as new localities join the formally named cohort all seem like reasonable next steps for this line of research — one that, on the evidence gathered here, has considerably more to say about rural Romania than its current near-absence from the literature would suggest. The same methodological approach could be applied to other metropolitan areas worldwide to identify similarities and differences across peri-urban and rural settings.

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