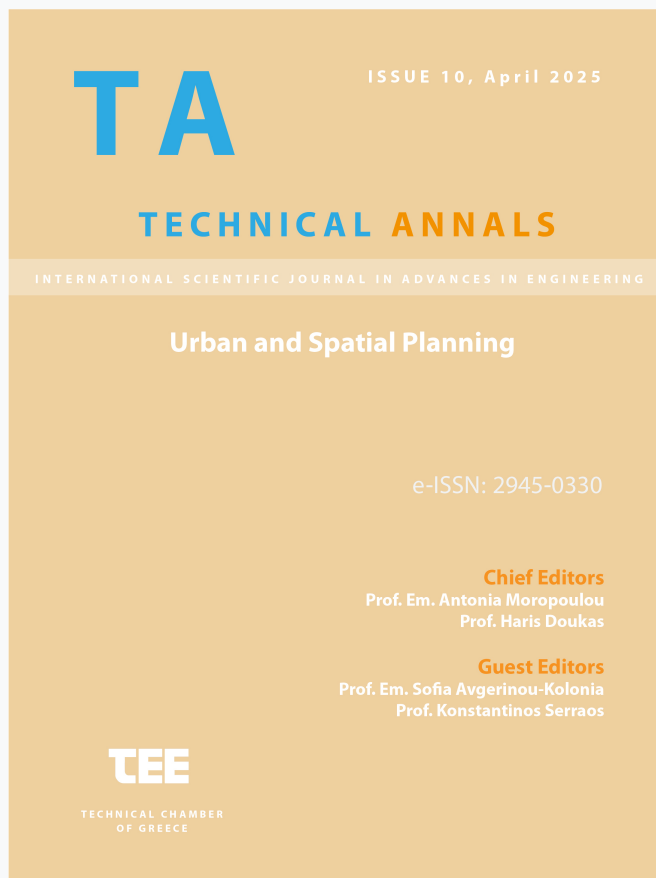


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Spatial Planning and Tourism Development of Serifos: Towards a Framework for Sustainable Development

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Abstract. This study investigates the complex interplay between tourism development and spatial planning on Serifos, a Cycladic island undergoing rapid transformation under seasonal visitor pressure. Drawing from the principles of sustainable development, the paper presents an integrated analytical approach combining geospatial diagnostics, empirical indicators, and policy evaluation. Using building footprint data and short-term rental distributions, the analysis identifies spatial stress zones, development conflicts, and regulatory gaps, especially in non-designated urban areas and protected environmental zones. The findings demonstrate that over 50% of the built surface lies outside statutory boundaries, exacerbating infrastructure strain and landscape fragmentation. A composite zoning strategy and thematic interventions are proposed, culminating in a spatial framework aligned with the island's ecological thresholds and cultural assets. The paper concludes with legal recommendations and a proposal for establishing a permanent monitoring mechanism (DMMO) to ensure adaptive and participatory governance.

Keywords: Spatial Planning, Tourism, Building, Small islands, Sustainable development

1 Introduction

Tourism is widely acknowledged as a cornerstone of Greece's macro-economic performance and a principal catalyst of regional development, especially in island territories endowed with pronounced geomorphology and a layered cultural palimpsest such as the Cyclades. Over the last two decades the national strategy has, either tacitly or explicitly, prioritised visitor-led growth as a vehicle for job creation and infrastructural modernisation. Yet the very landscapes that attract visitors are also among the most ecologically fragile and socially complex.

Serifos epitomises this tension. The island's dramatic relief, semi-arid ecosystems and distinctive industrial-heritage landscape have propelled it into the international tourism gaze, leading to a steep rise in arrivals each summer. Notwithstanding the attendant economic dividends, the accelerated transformation of land, water and

sociocultural practices risks eroding the very qualities that constitute Serifos's comparative advantage. Unplanned tourism can push local ecosystems towards tipping points, inflate land rents, destabilise demographic structures and displace traditional livelihoods.

Against this backdrop, this paper deliberately places sustainable development -understood as the indivisible triad of environmental stewardship, social justice and economic viability- at the analytical centre. Drawing on the Brundtland Commission's emphasis on inter-generational equity and subsequent elaborations within the Sustainable Development Goals (SDGs), the paper adopts the normative stance that development trajectories in small-island contexts must be evaluated not only in terms of contemporaneous gains but also through the lens of their legacy for future residents and visitors. The island's natural capital and cultural assets are treated as non-substitutable commons held in trust for succeeding generations.

The study pursues three interrelated objectives-. First, it synthesises the theoretical and institutional underpinnings of sustainability oriented spatial planning in Greece, with a view to identifying- levers that can translate abstract principles into enforceable policy instruments. Second, it operationalises a suite of quantitative and qualitative indicators designed to reveal Serifos's developmental thresholds across critical sectors -energy, water, waste, mobility, landscape integrity and community acceptance- thereby providing an empirical basis for anticipatory governance. Third, it formulates a portfolio of strategic interventions that collectively sketch a resilient 2030 horizon: a vision in which the island retains its traditional character and unspoilt landscape while cultivating gradually a year-round tourism economy capable of distributing benefits broadly and fairly among residents.

Serifos is not simply a case study; it is a test bed for policy innovation. Its limited capacity concerning infrastructure, pronounced seasonality and heterogeneous settlement pattern render it acutely sensitive to incremental shocks, making the cost of inaction disproportionately high. At the same time, its manageable scale and strong place identity furnish fertile conditions for participatory planning experiments that can be monitored, evaluated and subsequently transplanted to other Aegean islands.

By interweaving normative commitments with empirically grounded diagnostics, the study aspires to offer a replicable template for place-based planning that privileges inter-generational justice in tourism-dependent economies.

The article proceeds as follows. Section 2 develops the theoretical and institutional foundations of carrying capacity within the framework of sustainable development, while examining its legal codification and planning deficits in the Greek context. Section 3 outlines the methodology, detailing the geospatial indicators, datasets, and analytical models employed for diagnosing tourism-induced spatial pressures on Serifos. Section 4 presents the empirical findings, identifying stress zones, regulatory mismatches, and development conflicts across protected and urban areas. Section 5 articulates a strategic vision for the island's spatial development, proposing zoning strategies, thematic interventions, and institutional mechanisms aligned with sustainability objectives. The final section synthesises key insights and formulates policy recommendations at three levels: operational governance, spatial planning for small islands, and

long-term monitoring through a dedicated Destination Management and Monitoring Organisation (DMMO).

2 Theoretical Framework

2.1 Reframing Carrying Capacity within the Paradigm of Sustainable Development

The concept of carrying capacity (CC) has emerged as a foundational instrument for evaluating a destination's resilience to tourism-induced stress. As articulated by Cocco [1] CC represents the highest level of tourism activity that can be accommodated without compromising the natural, social or economic substrate of an area. In the case of the Greek islands—characterised by acute seasonality, geomorphological fragility and pronounced institutional asymmetries in spatial planning—CC assumes particular analytical and policy relevance.

CC is typically disaggregated into four interlocking dimensions: physical, social, economic and perceptual [1,2,3]. Contemporary scholarship operationalises these dimensions through multi-criteria decision analysis (MCDA), spatial models embedded in Geographic Information Systems (GIS) and composite indicators such as the Carrying Capacity Development Index [4] and the Social-Ecological System Carrying Capacity (SES-CC) framework [5].

The concept continues to evolve through state-of-the-art applications that integrate GIS, ontological frameworks and decision-support systems to assess land suitability for complex tourism uses [6]. Methodological innovations employing Geographically Weighted Regression (GWR) have further elucidated the spatial heterogeneity of CC [7]. In parallel, evidence increasingly highlights the critical role of Destination Management and Marketing Organisations (DMMOs) and the institutionalisation of locally grounded coordination mechanisms in facilitating a transition towards more resilient tourism models [8].

Collectively, these advances underscore that carrying capacity is not a static threshold but a dynamic, context-responsive construct—one that must be continually re-calibrated to support the overarching goal of sustainable, inter-generationally equitable development.

Recent scholarship further problematises the notion of a single, optimum threshold and instead advocates for adaptive CC—a moving envelope adjusted through iterative monitoring and stakeholder deliberation [9,10]. This perspective aligns CC with complementary paradigms such as Limits of Acceptable Change (LAC) and the Tourism Area Life Cycle (TALC), thereby embedding it within a broader repertoire of sustainability-assessment tools.

Technological advances since 2022 have markedly enhanced the granularity and temporal resolution of CC diagnostics. High-frequency data streams from mobile-phone location services, atmospheric sensors and remote-sensing platforms are now integrated via machine-learning algorithms to generate near real-time pressure indices [11].

Climate change adds an additional layer of complexity by altering baseline resource conditions—especially freshwater availability and energy reliability—upon which CC computations rest [12]. In arid Cycladic islands, for instance, diminishing aquifer recharge rates necessitate more conservative water-based CC thresholds, underscoring the need for scenario-based planning that couples hydrological projections with tourism-demand forecasts.

Finally, a growing body of evidence highlights the efficacy of participatory governance in recalibrating CC to local values and aspirations. Co-design workshops involving residents, businesses and municipal authorities in Naxos and Paros have resulted in jointly agreed sustainability indicators and a shared monitoring platform [13]. Such inclusive processes not only enhance the legitimacy of planning decisions but also foster a collective stewardship ethos, thereby reinforcing the social dimension of carrying capacity.

2.2 The Greek Experience: Jurisprudence, Planning Deficits and Operational Practice

At the national level, the Hellenic Council of State (CoS) has repeatedly underscored the constitutional obligation to respect carrying capacity as an integral facet of environmental protection [14,15]. In its settled interpretation of Article 24 of the Constitution, the CoS calls for stringent scrutiny of development activity against CC thresholds, particularly in land- and seascapes designated under the Natura 2000 network or already heavily saturated by tourism.

Yet operational performance remains weak Tsilimigkas et al. [16] document the chronic failure to apply supporting indicators, while Gourgiotis et al. [17] highlight a fragmented allocation of competences that privileges investment logics over sustainability objectives, perpetuating the long-standing disconnect between spatial planning and tourism policy. Kioussis & Papadopoulou [18] further observe that fast-track investment schemes frequently outpace plan-making procedures, reinforcing a culture of ‘permissive exceptionality’.

Empirical reviews since 2022 bring three structural deficiencies into sharp relief:

- **Governance fragmentation** between central and local tiers inhibits integrated decision-making and blunts accountability chains [19]
- **Enforcement deficits** vitiate the deterrent effect of statutory limits; sanctions for CC breaches remain rare and largely symbolic
- **Absence of mandatory CC assessments** in statutory planning instruments: Environmental Impact Assessments (EIAs) occasionally reference CC metrics, yet these are neither standardised nor binding, limiting their regulatory bite

A potential inflection point is the ongoing spatial-planning overhaul launched under the “Konstantinos Doxiadis” programme. For the first time, the under development Local Spatial Plans (LSPs) and Special Spatial Plans (SSPs) mandate the preparation of a Carrying Capacity Assessment Report for every delineated planning unit. Early pilot studies in the South Aegean reveal that embedding CC thresholds within zoning ordinances can dampen speculative land-value spirals and facilitate phased infrastructure upgrades [20].

Nevertheless, the translation of procedural advances into substantive outcomes hinges on three enabling conditions: (i) detailed methodological guidelines, (ii) targeted capacity-building at municipal level and (iii) a transparent, digital monitoring architecture that links CC indicators directly to permitting decisions. Absent these safeguards, there is a clear risk that CC assessments will devolve into formalistic appendices lacking regulatory traction.

Greece's trajectory evidences a gradual-though uneven-transition from rhetorical acknowledgement of carrying capacity towards its procedural institutionalisation. The critical tests ahead concern the standardisation of metrics, the resourcing of municipal enforcement capacities and the embedding of CC into fiscal and investment conditionalities. In summary, while the Greek jurisprudential framework robustly acknowledges the principle of CC, persistent planning gaps and implementation deficits hamper its effective deployment as a sustainability lever in tourism-intensive island regions.

2.3 Tourism Carrying Capacity and the Built Environment

Applied studies in Sifnos, Amorgos and Santorini illustrate how CC can be spatially operationalised [21,22,23]. In Santorini, institutional gaps in parking, water, sewerage and building control critically erode resilience; Athens-municipality research [24] links the boom in Short-Term Rentals (STRs) to urban congestion. A spatial impact-and-resilience index [25] recommends integrating STR data into statutory plans, yet no pilot indicators have been codified so far.

STR proliferation poses an acute CC challenge. Kardoulia [26] shows that Airbnb growth distorts property markets and strains infrastructure; fiscal laws (4446/2016, 4472/2017) tackled taxation but not spatial limits, allowing clustering and legal grey zones. European literature confirms STRs as accelerants of overtourism [27]; Koliotasi et al. [28] link waste-management deficits to image degradation; Di Felicianantonio et al. [28] trace social polarisation under tourism pressure. Papageorgiou [13] calls for adaptive-capacity design tools.

Spatial regression by Iliopoulou et al. [7] finds STR prices in Athens driven by location, host profile and infrastructure, with rising rents displacing vulnerable groups-patterns echoed in Thessaloniki [30].

Building-height exemptions under Law 4838/2021 intensify skyline congestion, eroding experiential value [31]. Conversely, GIS-guided infill on Syros cuts landscape fragmentation by 23% while absorbing forecast demand [32].

Digitally enabled governance is emerging: the Smart Aegean Planner (live since 2024) overlays real-time utility consumption with permit data, flagging applications that would push a micro-zone beyond 90% of weekly CC. Initial results show a 12% drop in ad-hoc variances and a 17% faster permit turnaround [33].

Taken together, STR impacts and built-form pressures call for geo-spatial regulatory instruments, participatory design and legally embedded CC thresholds. Proposals span geofenced permit caps and infrastructure levies earmarked for capacity upgrades [34].

3 Case study area

3.1 Serifos: Contextual Rationale

The selection of Serifos as the locus for assessing the adequacy of the existing spatial-planning regime rests on a combination of comparative advantages and multi-layered challenges. These challenges stem from insularity, environmental sensitivity, pronounced seasonality in tourism demand and the limited ability of the current institutional framework to embed binding sustainability tools.

Serifos presents a distinctive ensemble of natural, cultural and settlement assets that confer high aesthetic and symbolic value-attributes that make the island particularly attractive for tourism exploitation while simultaneously rendering it prone to overload. Administratively, the island forms a single municipality within the South Aegean Region and covers c. 75 km².

According to the 2021 census, its permanent population stands at 1,241 residents—an 8.1% decline from 2011—yet the island receives an estimated 110,000 visitor-nights between June and September, implying a peak-season population multiplier of ~6.5. Such seasonality amplifies pressure on finite resources, notably potable water, which is procured through a hybrid system of limited well abstraction and reverse-osmosis desalination. Desalination already accounts for 62% of summer demand, raising both fiscal costs and carbon intensity.

The island has been designated a Landscape of Outstanding Natural Beauty and hosts Natura 2000 sites, subjecting new development to strict control.

Tourist activity is spatially diffuse, avoiding excessive concentration in the main settlements of Livadi and Chora. Livadi's port-hinterland and the Chora–Koutalas axis are exceedance zones, guiding priority interventions.

Diffusion helps to relieve pressure on settlement cores yet, in the absence of a functional management framework, it fragments the landscape and complicates service provision. Tourism demand has also shifted land-use patterns, with holiday homes and short-term rentals proliferating in peripheral locations, thereby amplifying infrastructure stress and environmental pressures.

Spatial planning and Governance. The island falls under the multi-layered Greek planning hierarchy. Key instruments include:

- **Special Spatial Framework for Tourism** (SSF-Tourism)—currently under development. The draft SSF-Tourism divides the national territory into three qualitative land-allocation categories (Zones A, B, C). Serifos is placed in **Zone B**, labelled a *developing island municipal unit*. This second-tier designation—below “developed” areas and above “areas to be encouraged”—applies to islands with a sizeable yet not saturated visitor economy; any further expansion is permissible only if stringent sustainability safeguards are met. For Zone B islands the draft SSF-Tourism stipulates:
 - **High-quality accommodation only.** New tourist construction is limited to 3-, 4- and 5-star establishments, with minimum plot sizes set regionally

- **Mandatory carrying-capacity proof.** A Tourism Carrying-Capacity Assessment (TCCA) must accompany every major planning instrument (Local or Special Spatial Plan, organised reception area, large resort) before approval
 - **Control of short-term rentals.** Municipalities may impose an upper limit on short-term-rental beds, expressed as a percentage of total capacity, where crowding can be evidenced
 - **Heritage-compatible and soft tourism.** Regeneration of traditional or listed buildings and low-impact products (hiking, geo-tourism, mining-heritage trails) receive priority
 - **Performance-linked incentives.** Grants or tax relief for off-grid energy, water efficiency and circular-waste systems are conditional on full compliance with the island’s carrying-capacity thresholds
- **Regional Spatial Plan of the South Aegean (RSP–SA, 2022).** The 2022 revision of the RSP–SA classifies Serifos as a *Type II small-island destination*—an island of moderate visitor volume and heightened landscape sensitivity. The Plan accords priority to “mild, spatially dispersed tourism” that capitalises on cultural heritage and low-impact outdoor activities. To this end, it advocates graduated density ceilings, whereby permissible plot coverage and building height diminish progressively with distance from settlement cores, and identifies the historic mining corridor from Megalo Livadi to Koutalas as a flagship cultural itinerary eligible for EU funding. These provisions, however, are advisory rather than prescriptive; their transposition into local zoning instruments remains optional, and systematic monitoring mechanisms have yet to be established at municipal level.
 - **Sustainable Urban Mobility Plan (SUMP, 2021).** The SUMP, endorsed by the Municipal Council in 2021, outlines a ten-year mobility strategy centred on a 5.6 km electrified minibus loop linking the port of Livadi with Chora, the Koutalas junction and principal beaches. Complementary measures include the complete pedestrianisation of the upper nucleus of Chora (with time-restricted service deliveries), the installation of 120 e-bike docking stations and the introduction of an on-demand water-taxi service to peripheral coves. Scenario modelling indicates potential reductions of 18 % in summer automobile entries to Livadi and 22% in road-traffic CO₂ emissions by 2031. Notwithstanding these projected benefits, implementation is contingent upon securing approximately €4.8 million in capital expenditure and upgrading the local electricity grid to accommodate vehicle-charging infrastructure—both prerequisites currently unfunded.
 - **Regional Climate-Adaptation Plan (PESPKA, 2019–2027).** The PESPKA designates Serifos as Drought-Risk Class A3, the highest regional category. It prescribes a 15% reduction in potable-water demand by 2027 through leak-loss mitigation, smart metering and tiered pricing, and sets a renewable-energy target of 3 MWp of rooftop photovoltaics—equivalent to approximately 40% of peak summer electricity load. Additional actions include rehabilitating nineteen traditional cisterns and piloting grey-water reuse schemes in two hotel complexes. Progress remains uneven: only 17% of ageing water mains have been replaced since the 2022 leakage audit; photovoltaic deployment is stalled at 0.6 MWp owing to grid-

congestion curtailment orders; and the cistern-restoration programme awaits heritage-conservation approval and dedicated financing.

- **Integrative assessment.** Collectively, these instruments furnish an ostensibly coherent strategic framework-spatial vision (RSP-SA), modal-shift agenda (SUMP) and resource-resilience pathway (PESPKA). Their practical efficacy, however, is circumscribed by the absence of binding performance indicators and secure funding streams. Embedding enforceable targets from all three plans within the forthcoming LSP, and linking project approvals to a rigorous TCCA, will be indispensable to translating strategic intent into verifiable sustainability outcomes for Serifos.
- Administrative capacity is constrained not only by limited human resources but also by deeper structural dysfunctions in the governance system. The enforcement of building regulations and STR licensing depends on an under-resourced Single Property Authority office based on the neighbouring island of Milos. These deficiencies reflect broader administrative pathologies, including fragmented responsibilities, inconsistent inter-agency coordination, and limited monitoring capability, all of which hinder the effective implementation and adaptive revision of spatial plans.

Natural and Environmental Baseline

- **Land-use mosaic:** Only 1.4% of the island ($\approx 1.05 \text{ km}^2$) is formally urbanised; dryland pasture occupies 57%, maquis shrubland 21%, and fallow terrace agriculture 11%. Two discrete Natura 2000 sites (GR4220009, GR4220029) envelope 38% of the landmass.
- **Topography:** Relief ranges from sea level to 585m at Mt. Troulos; slopes $>25\%$ cover 41% of the territory, complicating infrastructural expansion and heightening erosion risk under extreme-rainfall events.

- **Heritage fabric:** The island hosts 117 listed vernacular structures and an extensive mining-heritage ensemble (late-19th-century loading bridge, adits and inclined planes), designated as a Monument Complex of National Significance.

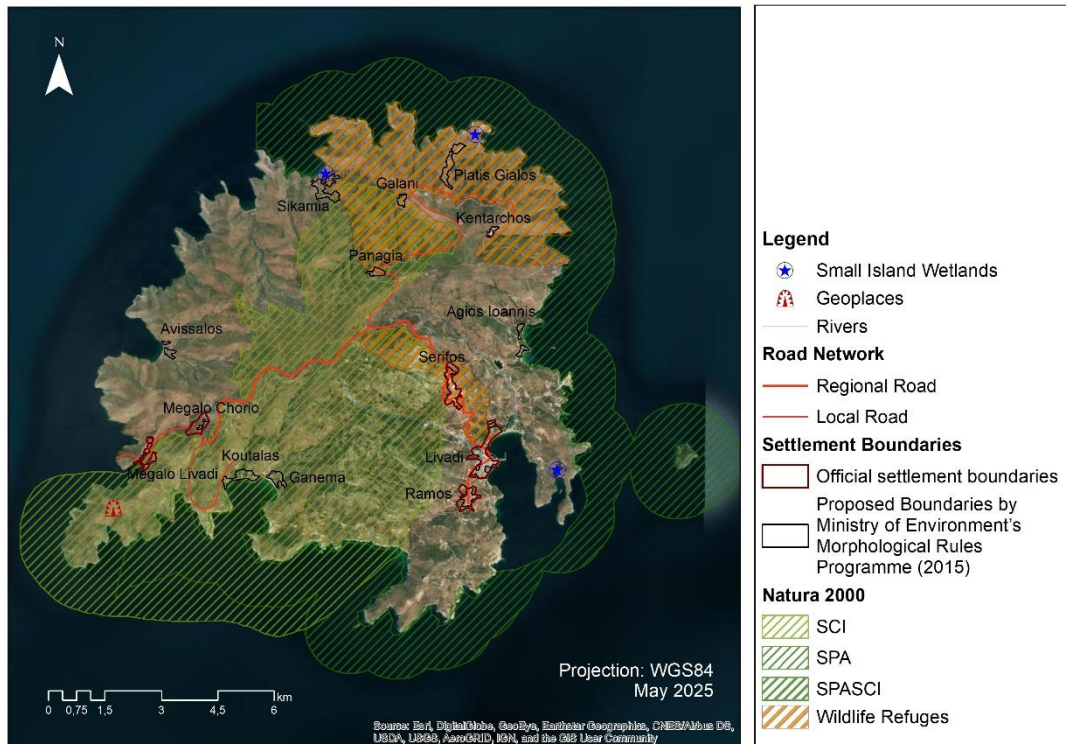


Fig. 1. Environmental and Cultural Baseline Map of Serifos

A comparison between observed peak-day values and the sustainable thresholds reveals a mixed resilience profile for Serifos. Potable-water demand reached $1.620 \text{ m}^3 \text{ day}^{-1}$, or 93% of the island's safe-yield limit ($1.750 \text{ m}^3 \text{ day}^{-1}$). Although the system did not breach its threshold, the narrow margin underscores the island's vulnerability to inter-annual drought variability and to even modest increments in visitor numbers. Priority should therefore be accorded to demand-side management—smart metering, tiered tariffs and accelerated leak-loss reduction-coupled with supply diversification beyond reverse-osmosis desalination, which is both capital- and carbon-intensive.

The electricity network exhibited a similarly tight buffer, with the peak load of 6.9 MW utilising 92% of the installed capacity (7.5 MW). Projected uptake of electric mobility and air-conditioning suggests that without grid reinforcement or rapid deployment of distributed photovoltaics plus storage, the system could be forced into load-shedding during forthcoming peak seasons. In contrast, two indicators already exceed their design thresholds. Solid-waste generation stood at $48 \text{ t} \cdot \text{week}^{-1}$, surpassing the engineered landfill capacity ($40 \text{ t} \cdot \text{week}^{-1}$) by 20%; continued overshoot will compress the

facility's lifespan and heightened contamination risk. Likewise, daily vehicular arrivals at the port (790 entries) exceeded the functional limit of 650 vehicles by 22%, contributing to congestion, emissions and queuing at the waterfront interface.

The most pronounced over-capacity relates to cruise tourism: 1,150 passengers were disembarked on the reference day, 28 % above the quay-throughput threshold of 900 passengers. This episodic influx overwhelms public spaces and surface-transport links, eroding visitor experience and resident well-being. Temporal staggering of berthing slots and a congestion-indexed port fee would internalise these externalities while preserving high-value calls.

In synthesis, three of the five indicators—solid waste, vehicular inflow and cruise arrivals—already breach sustainable limits, while the remaining two (water and electricity) operate within precariously narrow safety margins. The findings validate the TCCA's function as an early-warning system and justify embedding its quantitative triggers into the forthcoming LSP. A dual strategy is required: (i) technical interventions—circular-waste infrastructure, smart-mobility deployment, decentralised renewables and water-efficiency retrofits—and (ii) regulatory measures—upper caps on cruise berths and short-term rentals, dynamic road-pricing and conditional project approvals linked to real-time capacity dashboards. Only through this integrative approach can Serifos avoid a trajectory toward structural over-saturation and secure a resilient, inter-generationally equitable tourism economy.

Strategic Relevance. Serifos should be regarded not merely as a case study but as a laboratory for policy innovation. Its constrained infrastructure, pronounced seasonality, and fragmented settlement structure heighten its vulnerability to incremental shocks, thereby magnifying the consequences of inaction. Simultaneously, the island's manageable scale and robust sense of place offer an advantageous setting for participatory planning interventions whose outcomes can be systematically monitored, evaluated, and subsequently transferred to other islands in the Aegean.

3.2 Tools, Indicators and Analytical Models

The analytical framework employed in this study integrates spatial indicators, geo-spatial diagnostics, and decision-support methodologies to assess tourism-induced pressures and guide sustainable spatial planning on Serifos. Central to this approach was the spatial analysis of built form and short-term accommodation patterns, using a combination of validated spatial datasets and GIS-based techniques.

Building footprint data were sourced from Microsoft's **Global ML Building Footprints** dataset (<https://github.com/microsoft/GlobalMLBuildingFootprints>), which provides polygon vector data of global coverage derived from the processing of high-resolution satellite imagery (2014) through machine learning and deep neural networks. The dataset exhibits high positional and thematic accuracy, with European validation reporting 94.3% positional accuracy, 85.9% information retrieval, 65.1% precision in footprint overlap, a polygon rotation error of 10.28 degrees, and a 1.4% misclassification rate based on a 5,000-building sample.

To improve spatial reliability, the footprint geometries were cross-validated using ESRI basemaps and Google Earth Pro. Built-up areas were then calculated separately

for land parcels located within and beyond the statutory boundaries of settlements. However, given that only five settlements on Serifos possess formally established urban limits, the analysis adopted the **morphological boundaries** defined by the Ministry of Environment's Morphological Rules Programme, specifically from the regional unit study of the Cyclades. GIS-based delineation employed the "Select by Location" function with the "Intersect" criterion, meaning any building partially or fully intersecting the designated morphological boundary was classified as falling within the effective settlement area.

This spatial disaggregation enabled precise quantification of the built environment both inside and outside the urban planning framework, offering a basis for analysing urban sprawl, development pressure, and exposure to infrastructure limitations.

In parallel, tourism-specific spatial diagnostics were carried out using STR data. Listings were manually extracted from the Airbnb platform for the South Aegean region, filtered for relevance, and geocoded into a point dataset. To model the spatial intensity of tourism pressure, **Kernel Density Estimation (KDE)** was applied. KDE is a non-parametric interpolation method that estimates the density of point-based phenomena over a continuous surface, generating higher values at the location of the points and gradually decreasing with distance. It is widely used in spatial planning and tourism studies to visualise hotspots and clustering patterns [35,36].

In this study, KDE was implemented both for Airbnb listings and the total building footprint dataset, producing high-resolution raster surfaces that reveal patterns of tourism concentration, built density, and spatial fragmentation. These diagnostic layers contributed to identifying pressure zones, sprawl trajectories, and candidate areas for policy intervention.

3.3 Use of Geospatial Data and Decision Support

Geospatial data constituted the empirical foundation of this study's CC framework and scenario modelling. All spatial layers-ranging from cadastral boundaries and topography to utility networks and STR points-were harmonised within a geodatabase. This allowed for consistent geoprocessing and integration of environmental, infrastructural, and socio-economic variables.

Key spatial analysis and decision-support techniques employed include:

- **Overlay and proximity analysis**, to assess interaction between tourism infrastructure and environmentally sensitive zones;
- **Zonal statistics**, to compute infrastructure pressure indices by administrative or ecological unit;

A core focus of the spatial analysis was the **visualisation of spatial mismatch** between the official urban structure and actual development trends. Building footprints-previously validated and quantified-were spatially cross-referenced against both the official urban boundaries and the **"real" settlement extents** delineated by the Ministry of Environment's Morphological Rules Programme. This overlay revealed that a **slight majority (≈53%) of the building stock lies outside statutory limits**, providing visual confirmation of diffuse urbanisation and regulatory leakage.

Outputs were compiled into a spatial dashboard format to support scenario-based planning, enabling local authorities to simulate the cumulative impact of land use changes and to link permitting thresholds with carrying capacity exceedances. However, geospatial reliability is partly constrained by the STR dataset: listings from Airbnb are often geolocated to approximate positions rather than actual property coordinates, especially in small-island contexts where address standardisation is weak.

3.4 Limitations and Assumptions

The study is subject to several limitations that may influence the interpretation and replicability of results:

(a) Building data and temporal lag

Footprint data are based on satellite imagery from circa 2014–2017. While cross-validated against more recent basemaps, newer developments may be undercounted, particularly outside settlement cores.

(b) Non-statutory settlement boundaries

Only five settlements in Serifos have official urban boundaries. The use of morphological boundaries from the Ministry of Environment's typological study, although spatially accurate, lacks regulatory status, limiting enforceability in land-use planning.

(c) STR data reliability

Short-term rental data were manually extracted from the Airbnb platform for the South Aegean region. This approach introduces two key limitations:

- Listings are often pinned to **approximate or anonymised map locations**, which reduces geolocation precision and may distort KDE outputs;
- The dataset reflects a **single temporal snapshot** (2024 high season), precluding longitudinal trend analysis or off-platform STR detection (e.g., Booking.com, private sites)

(d) Threshold generalization

CC thresholds are derived from standardised methodologies and infrastructure design limits, which do not fully account for future efficiency gains or behavioural adaptation.

(e) Uniform KDE bandwidth

KDE was performed with a consistent spatial bandwidth. This generalisation may obscure intra-island differences in topography, accessibility, or settlement morphology that influence development pressure.

(f) Institutional limitations

Scenario simulations and policy recommendations assume a minimum level of municipal enforcement capacity, which is not currently met on Serifos. This gap may hinder the operationalisation of regulatory proposals, including STR limits or smart permitting frameworks.

In sum, while the applied methodology offers a detailed spatial diagnostic of tourism intensity and resource pressure, results must be interpreted as indicative rather than definitive. The framework is intended as a decision-support tool to inform iterative planning processes and adaptive governance, rather than as a static zoning or threshold-setting mechanism.

4 Findings and Empirical Analysis

4.1 Spatial Patterns and Stress Zones

Spatial Patterns of Settlement Intensity and STRs. Analysis of the built-up surface confirms a pronounced development pressure in non-designated zones, with approximately 53% of total building footprint located outside the statutory urban boundaries. This spatial dispersion—illustrated in **Figure 2**—reflects a persistent trend of informal expansion facilitated by the absence of binding perimeter controls in most settlements on Serifos.

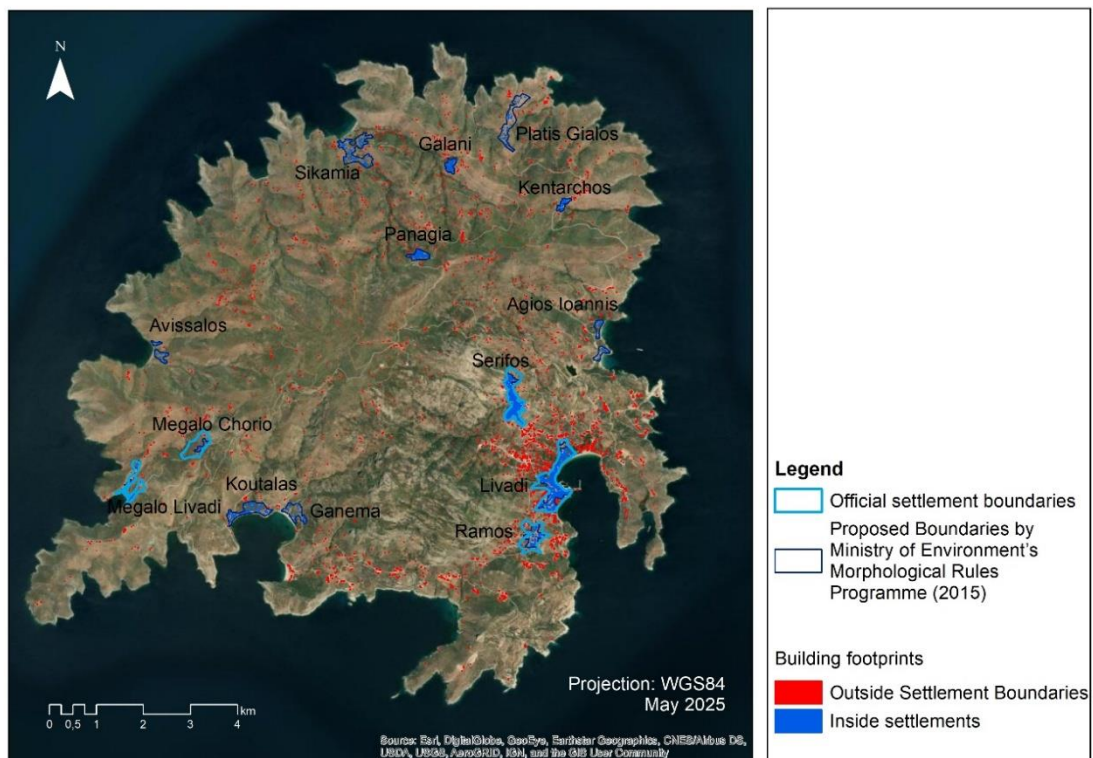


Fig. 2. Built-up Area Inside and Outside Settlements

Kernel density analysis (Figure 3) reveals spatial clustering in and around key settlements, including Chora, Livadi, and Ramos, but also identifies emerging high-density zones in the south and southeast of the island. Particularly concerning is the linear development along the Chora–Livadi corridor, where construction intensity suggests a gradual merging of historically separate settlements. This trend of spatial contiguity may compromise zoning coherence and intensify pressure on shared infrastructure.

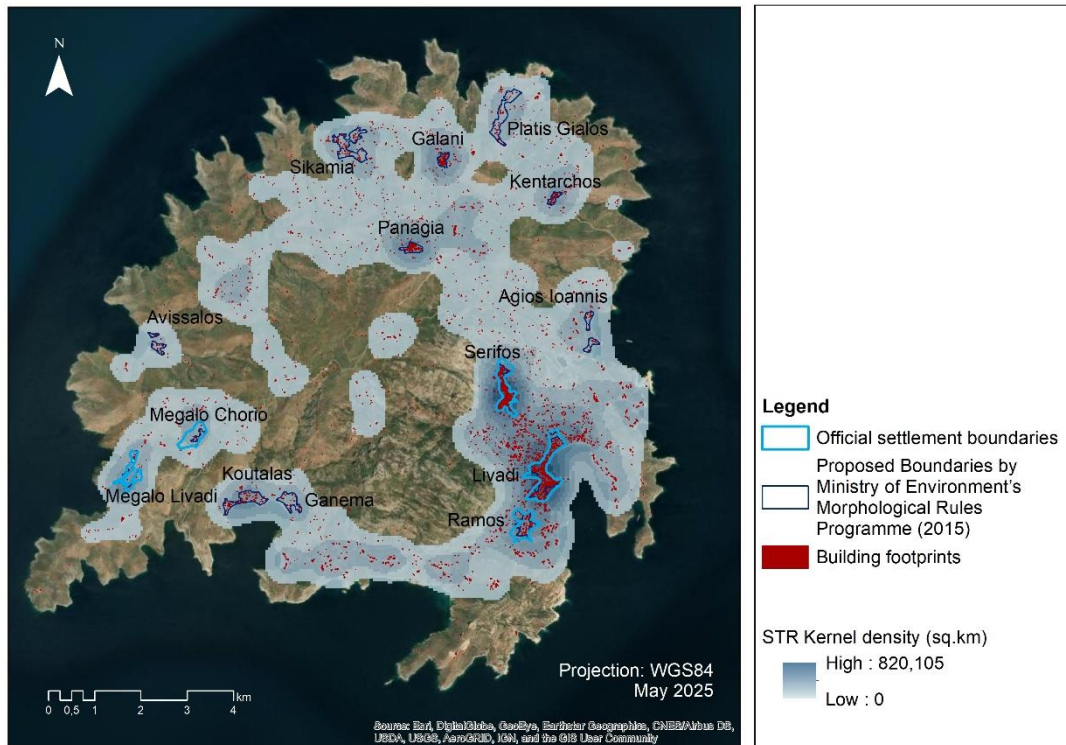


Fig. 3. Kernel Density of Building Footprints

The spatial footprint per resident further illustrates these dynamics. Settlements such as Gánema (1,168.79 m²/capita) and Koutalas (603.79 m²/capita) exhibit disproportionately high built-up areas relative to their population, indicative of low-density, high-impact development—likely driven by demand for second homes and STRs. By contrast, traditional upland villages such as Kéntarchos (78.20 m²/capita) and Megálon Choríon (130.79 m²/capita) maintain more compact, demographically consistent forms.

In proportional terms, the largest shares of the island's total constructed area are concentrated in Sérifos (28%), Livádi (21%), Galaní (16%), Panagía (15%), and Megálon Livádion (12%), as presented in Table 1. These percentages reflect both their demographic weight and their role as tourism-driven development nodes.

Table 1. Settlement Analysis Table

	Pop 2011	Pop 2021	STRs	Buildings	area (sq.m)	built-up area (sq.m)	built-up area/ total area	Built-up area per capita (sq.m)
Serifos Municipality	1414	1241			75207000	510463	1%	411,33
Serifos, Chora	357	333	78	479	243499,03	67259,10	28%	201,98
Avyssalos	24	15	0	28	61007,14	2575,58	4%	171,71
Agios Ioannis	33	10	0	38	84623,89	4174,79	5%	417,48
Galani	71	45	0	77	53972,34	8503,38	16%	188,96
Ganema	13	4	2	44	116260,90	4675,17	4%	1168,79
Kentarhos	46	58	2	44	41371,50	4535,57	11%	78,20
Koutalas	23	17	0	88	172653,45	10264,40	6%	603,79
Livadi	537	505	69	512	408825,40	87841,07	21%	173,94
Megalo Livadi	52	45	4	74	75467,19	9198,14	12%	204,40
Megalo Chorio	24	10	0	19	30069,55	1307,94	4%	130,79
Panagia	102	69	6	89	69812,76	10422,93	15%	151,06
Platis Gialos	29	26	1	49	204728,49	4802,10	2%	184,70
Ramos	67	79	10	85	115455,02	13258,15	11%	167,82
Sykamia	34	22	2	69	242273,75	8736,82	4%	397,13

This spatial differentiation is further substantiated in **Table 1**, which compiles demographic, land use, and building stock metrics at the settlement level. The data reveal marked disparities in building density, total coverage, and STR intensity. For instance:

- **Ganema** exhibits the **highest built-up area per capita** (1,168.79 m²/resident), a figure significantly above the island-wide average, suggesting either sparse habitation or speculative second-home development
- **Koutalas** also demonstrates a disproportionately high land consumption rate per resident (603.79 m²), despite having minimal STR presence, reinforcing the trend of fragmented construction in low-density zones
- Conversely, compact traditional settlements like **Kentarhos** (78.20 m²/resident) and **Megalo Chorion** (130.79 m²/resident) maintain low per capita footprints, reflecting a more sustainable pattern
- **Chora, Livadi, and Galani** collectively account for over 65% of the island's total built surface, echoing their role as central hubs in the tourism and service economy

This granular data substantiates spatial inequalities in development intensity and demographic load, underscoring the need for differentiated planning responses across the island.

STR Concentration. STR activity-derived from geocoded listings scraped directly from the InsideAirbnb platform—is heavily concentrated in Chora, Livadi, and Ramos, as illustrated in **Figure 4**. KDE was used to smooth out discrete listing points and reveal underlying spatial patterns, with hotspot intensities peaking around the port area and peri-urban fringes.

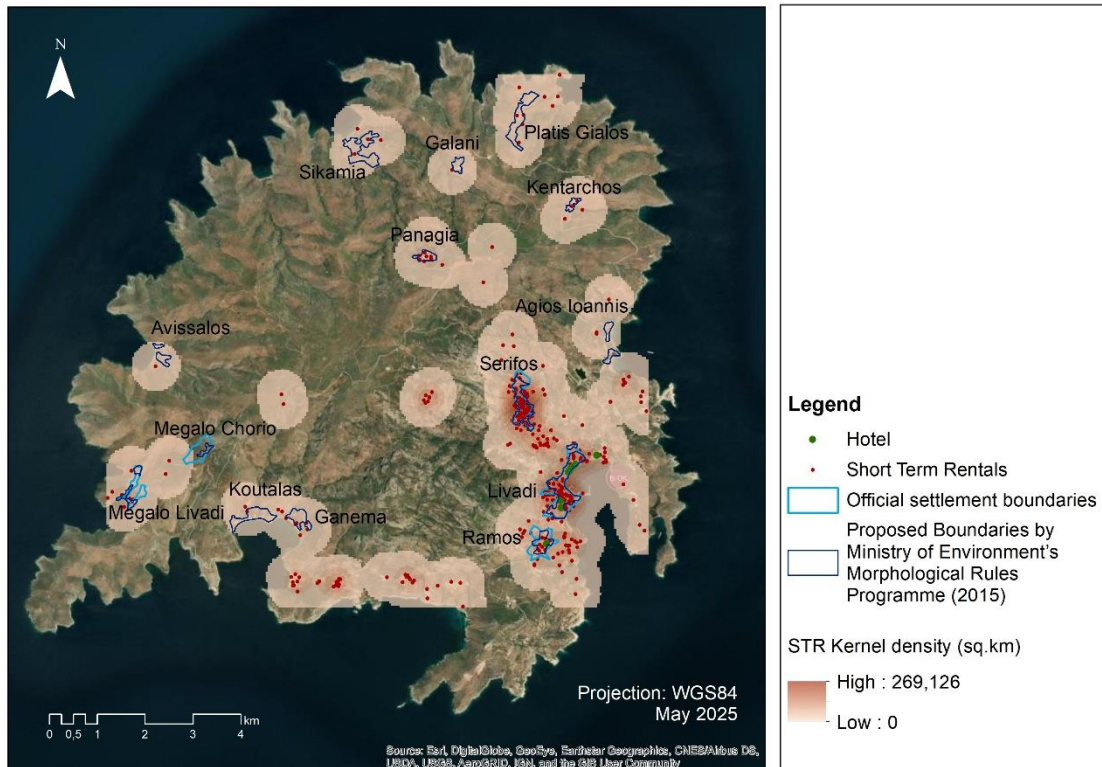


Fig. 4. STR Kernel Density and Settlement Distribution

It is important to note a limitation of the dataset: many listings lack precise geolocation, introducing an inherent positional uncertainty. Nonetheless, the aggregate distribution clearly indicates that the proliferation of STRs is not confined to traditional settlement cores, but rather extends into semi-rural zones and unregulated development areas.

This expansion of STRs exacerbates multiple sustainability concerns, including infrastructure overuse, land-use fragmentation, and weak fiscal oversight. In ecologically sensitive zones, the spatial overlap between STR clusters and protected landscapes also poses risks to conservation goals. These pressures highlight the need for inclusion of STR density thresholds and permit caps in the LSP.

4.2 Development Conflicts in Protected Areas

Serifos hosts multiple protected zones, including three Natura 2000 sites (GR4220009 and GR4220029) and extensive areas designated as Landscapes of Outstanding Natural Beauty (Government Gazette 1176/B/2000). Overlay analysis between development patterns and these zones indicates that while formal construction remains limited within strictly protected perimeters, fringe development is encroaching upon buffer zones.

The most sensitive interfaces include:

- The hinterlands surrounding Koutalás and Gánema, where proximity to mining heritage zones and biodiversity corridors raises conservation concerns
- Eastern slopes near Megalon Livadion, where isolated buildings approach the boundaries of Natura zones
- Cliffside zones east of Livadi, where topographic constraints, visual impact, and ecological fragmentation coincide

The current regulatory framework does not yet provide sufficient enforcement to prevent encroachment. Without stricter demarcation, monitoring, and permit-linked carrying capacity assessments, these peri-protected zones risk irreversible degradation.

5 Strategic Development Proposals for Serifos

This section articulates a coherent vision and a set of specialised strategic objectives for the long-term spatial development of Serifos. Building upon the analysis of current conditions and identified challenges, it proposes a series of institutionally grounded and operationally applicable interventions.

5.1 Vision

The Serifos of 2030 is envisioned as a model small island where tourism coexists harmoniously with the natural environment and the local community. It is a place that retains its traditional character and unspoiled beauty, while simultaneously offering high-quality experiences to visitors year-round and ensuring prosperity for its residents. At the core of this vision lies balanced development, environmental sustainability, social cohesion, and economic resilience.

5.2 Strategic Objectives

Achieving the above vision presupposes the formulation of a network of strategic objectives that embed the principles of sustainability, participation, and resilience.

The protection of the natural environment and the sustainable management of natural resources form the foundation of all development efforts. Preserving landscape integrity, enhancing biodiversity, and rationalising water and energy use require institutional safeguards for environmentally sensitive areas and the adoption of green technologies—especially in fragile insular ecosystems such as that of Serifos.

In parallel, the promotion of cultural heritage and local identity must contribute to the development of a high-quality and differentiated tourism product. Traditional

settlements, the island's industrial heritage (e.g. the historic mining infrastructure), and local cultural events can serve as key pillars for enhancing the authenticity of the visitor experience, while their conservation ensures the intergenerational transmission of cultural identity.

The upgrading of essential infrastructure and services is of critical importance for the well-being of both residents and visitors. Ensuring water sufficiency through desalination units, implementing effective solid waste management via new biological treatment facilities, and strengthening public transport and health services are pressing priorities to support sustainable tourism development.

The promotion of a polycentric spatial development model can enhance social cohesion and contribute to a more equitable distribution of the benefits of tourism. The development of agritourism in northern settlements and the positioning of Megalo Livadi as a historical and cultural hub are examples of decentralised strategies.

Extending the tourism season and relieving peak-period pressure requires the enrichment of the tourism offering through alternative forms of tourism, such as cultural, educational, and nature-based tourism. The creation of tailored experience packages for spring and autumn, collaboration with specialised tour operators, and thematic diversification enhance the island's resilience to seasonal fluctuations.

Finally, the establishment of a sustainability performance monitoring mechanism-using indicators such as water consumption per visitor or infrastructure load-is a key institutional tool for evidence-based decision-making. The adoption of a "smart threshold" policy would empower the Municipality to assess and, if necessary, limit further expansionary initiatives.

5.3 Spatial Zoning Strategy

The implementation of a holistic and functional zoning strategy can provide clear direction for spatial planning on the island and prevent the emergence of unregulated and unsustainable development. Serifos could be structured into distinct zoning categories, based on the particular characteristics and needs of each area.

In zones designated for residential and tourism development-primarily centred around Livadi and adjacent areas-priority should be given to planned urbanisation with explicit regulatory frameworks. This includes the delineation of street grids, provision of public spaces, and strict adherence to established building codes.

At the same time, areas such as Megalo Livadi, which possess significant historical and cultural value, should be classified as zones of special intervention. These zones would benefit from the implementation of integrated revitalisation plans that preserve existing building shells, highlight cultural heritage, and enable mixed-use development that supports low-impact tourism.

The northern and less developed parts of the island are particularly suitable for the promotion of agritourism and ecotourism activities. These areas could benefit from the cultivation of local products, the renovation of traditional homes, and the establishment of new small-scale productive enterprises.

By contrast, areas of high ecological value-particularly those included in the Natura 2000 network-should be placed under strict protection zones. These would involve a

total prohibition of new construction, while allowing for soft enhancement interventions such as ecological trails and designated nature observation points.

Special attention must also be given to the port area, which serves as the primary entry point to the island. Planning in this zone should focus on improving port functionality and safety, alongside the development of facilities for the mooring of small recreational vessels. These interventions would support the growth of low-impact maritime tourism, aligned with the island’s broader sustainability objectives.

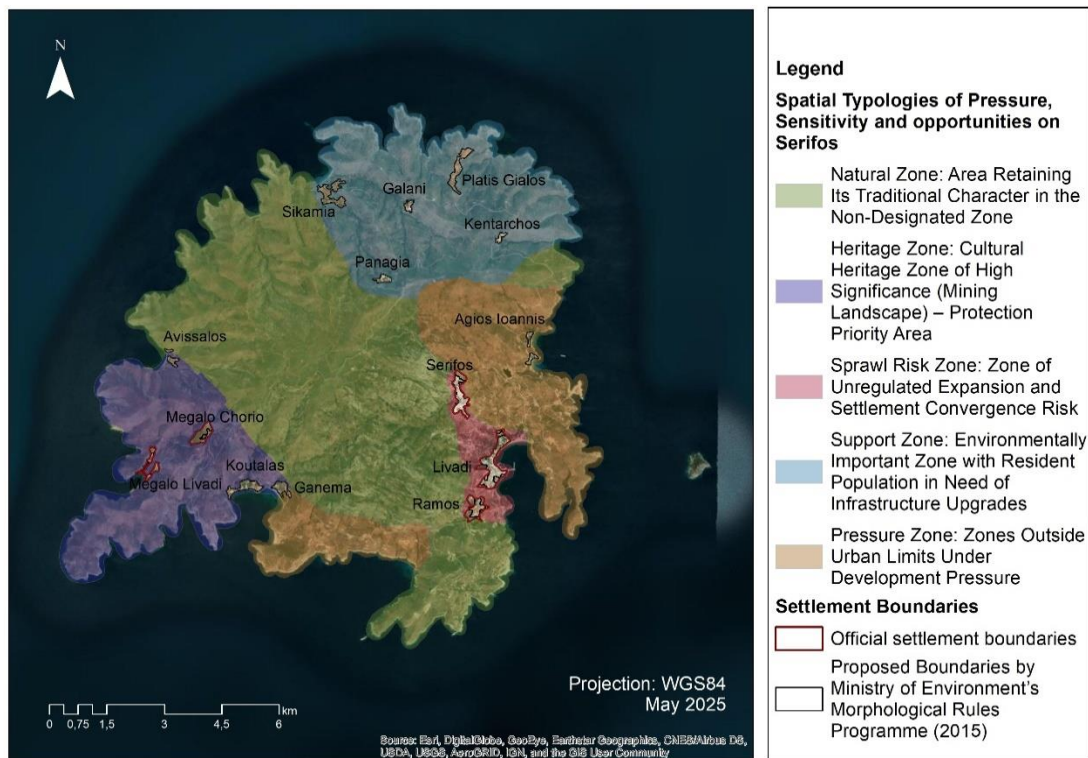


Fig. 5. Spatial Typologies of Planning Pressure and Sensitivity on Serifos

The composite map delineates five key spatial typologies relevant to land-use regulation, cultural protection, and infrastructure prioritisation.

First, it identifies **areas retaining their traditional character outside statutory urban boundaries**, where the landscape remains largely intact despite the absence of formal planning controls. These serve as benchmarks for visual identity preservation and minimal-impact development.

Second, it maps the **zone of special cultural protection** in **Megalo Livadi**, home to nationally significant mining heritage and industrial-era remnants.

Third, it highlights **non-designated areas under intense development pressure**, reflecting accelerated and often informal spatial expansion in need of regulatory intervention.

Fourth, it delineates a **zone of excessive sprawl and settlement convergence risk**, particularly between Chora and Livadi, where development threatens the functional distinction between settlements and strains shared infrastructure.

Fifth, it defines a **zone of ecological value and rural settlement support**, encompassing sparsely built areas with permanent residents and active agricultural production. These areas require coordinated investment in public infrastructure and offer high potential for soft tourism and sustainable livelihoods.

Collectively, these spatial typologies serve as a diagnostic framework for assigning functional zoning categories and regulatory designations in the forthcoming LSP for Serifos.

5.4 Thematic Interventions

Thematic interventions constitute a critical component of the island's development strategy, as they aim to enhance the functionality, aesthetics, and sustainability of the insular space. Urban design interventions are foremost among these, focusing on improving accessibility and circulation within traditional settlements. In Chora, it is proposed to establish a municipal parking facility on the settlement's periphery, combined with the introduction of a small-scale municipal vehicle transport system. In Livadi, pedestrianisation of part of the coastal zone and the development of a parking hub at the entrance to the settlement are expected to reduce strain on the residential fabric and enhance the visitor experience. Concurrently, the undergrounding of waste containers at central locations is anticipated to improve both the visual quality and sanitary condition of public space.

In terms of environmental infrastructure, priority should be given to energy-efficient desalination systems powered by renewable energy sources, the upgrading of the main wastewater treatment plant or the creation of decentralised systems for remote settlements, and the development of a local recycling network. The installation of smart water meters for high-consumption users will facilitate monitoring and control of use, thereby supporting resource conservation.

Diversification of the local economy is identified as a necessary strategic direction, involving the promotion of local products such as Serifos honey and aromatic herbs, the encouragement of start-up agricultural entrepreneurship, and the strengthening of small-scale fisheries. Visitor management also emerges as a critical challenge, which can be addressed through measures such as limiting the number of rental vehicles, promoting alternative transport modes like bicycles and electric vehicles, and introducing a municipal circular transit service during the tourism season. Furthermore, for sensitive or low-capacity attractions, the introduction of reservation systems or controlled entry schedules may be necessary to regulate visitation levels.

The implementation of these thematic interventions is intended to complement the spatial planning framework and enhance the internal coherence of the island's strategic development vision, ensuring Serifos's resilience to development pressures and the protection of its distinctive natural and cultural assets.

5.5 The Role of the Special Urban Plan (SUP)

The development policy of Serifos for the coming decades is expected to be shaped substantially by the forthcoming SUP, which must incorporate existing scientific studies and strategic datasets, including the findings of the present research. As part of the national spatial planning programme “Konstantinos Doxiadis,” the SUP-alongside LUP-is tasked with formulating new regulatory frameworks for approximately 70% of the national territory. This effort aims to modernise land uses, construction parameters, and spatial functionality regulations.

Serifos is included in an integrated SUP that also covers four neighbouring islands (Milos, Kimolos, Sifnos, and Kythnos). Delays in the commissioning of this plan have already raised concern, as irreversible interventions-particularly in tourism development-are progressing in the interim, such as the widely criticised projects in Sarakiniko, Milos. It is therefore essential that the new SUP establishes, as a fundamental principle, the containment of unregulated tourism expansion, primarily through limiting bed capacity-especially in the form of short-term rentals and rented rooms operating under residential construction permits.

Priority should be given to permitting new accommodation capacity exclusively in professionally managed tourist establishments, particularly in mid- to high-quality categories such as hotels and upscale serviced apartments. Simultaneously, there is an urgent need to delineate and progressively discourage construction outside designated planning zones, as such activity contributes to residential sprawl and the proliferation of informal tourist accommodations.

An alternative strategy-focused on strengthening tourism activity outside the peak season-offers greater sustainability potential. Extending the season into the shoulder months of May, June, and September can be achieved through the targeted promotion of thematic tourism products, experiential offerings, and the enhancement of the island’s cultural and natural identity. The use of digital tools, such as virtual tours, online experience bookings, and storytelling-based content dissemination, can enhance place branding and foster emotional connections with visitors.

Successful implementation of this strategy depends on achieving social consensus, ensuring active resident participation, and aligning infrastructure with development goals. Sustainability hinges on the adequacy of essential resources-water, waste management, infrastructure-and on institutional clarity in land-use regulation. A significant threat to this vision lies in large-scale strategic investments, which, through mechanisms of private urbanisation, risk generating new residential enclaves in environmentally vulnerable areas.

Given Serifos’s designation as a Landscape of Outstanding Natural Beauty (Government Gazette 1176/B/2000) and its inclusion in two Natura 2000 sites (GR4220009 and GR4220029), the prevention of such scenarios is imperative. The new SUP must convert the above considerations into binding policy directions and channel development within existing settlements, in full respect of the island’s natural and cultural heritage.

5.6 Development of Thematic Forms of Tourism

The promotion of thematic forms of tourism in Serifos can serve as a key lever for diversifying the local tourism offer and alleviating peak-season pressures. A first strategic direction is the development of geotourism, anchored in the island's mining history and distinctive geological formations. The area of Megalo Livadi, with its remnants of historical mining infrastructure and its unique geomorphological landscape, can be transformed into an open-air museum of geological heritage. The creation of thematic routes, the installation of appropriate interpretive signage, and the use of digital storytelling tools can enhance the appeal of the area for visitors with environmental and cultural interests.

Agritourism and Ecotourism. Despite the relatively modest scale of the island's primary sector, agritourism and ecotourism can serve as complementary pathways for sustainable tourism development. Organised visits to small-scale agricultural production units, along with the promotion of local products such as Serifos honey and aromatic herbs, may be combined with experiential activities including tastings and harvest participation. In environmentally protected or currently underutilised natural areas, low-impact ecotourism products can be developed—such as birdwatching, guided flora interpretation walks, and thematic trails led by specialists in botany and ecology.

Wellness Tourism. Wellness tourism represents another promising niche, centred on the thermal spring of Almyros, near Megalo Livadi. Although currently operating informally, this site could be upgraded through modest access improvements, interpretive infrastructure, and sustainable environmental management, establishing it as a destination for visitors seeking relaxation and well-being in an authentic natural setting. In addition, the favourable climatic conditions of spring and autumn support the development of wellness programmes and yoga retreats.

Cultural Tourism. Cultural tourism constitutes a central pillar for differentiation and strengthening of Serifos's tourism identity. The island is home to a significant architectural and monumental heritage, both in the historic core of Chora and in the post-industrial mining landscape of Megalo Livadi. In parallel, its intangible cultural heritage—including local festivities, traditional festivals, and customary practices—comprises a multidimensional cultural fabric capable of offering authentic and immersive experiences to visitors. The valorisation of these resources can be organised through thematic cultural itineraries, the creation of local museums and exhibition spaces, and the adoption of innovative digital storytelling technologies, such as augmented reality applications and interactive media. By enhancing the “tourist memory” and emotional engagement of the visitor, cultural tourism can contribute meaningfully to season extension, the reinforcement of local identity, and the advancement of a sustainable tourism model that prioritises authenticity over massification.

Yachting. Tourism via recreational vessels (yachting) represents a particularly favourable form of low-impact tourism for small-scale islands such as Serifos. The island's natural harbour at Livadi, as well as the presence of small, sheltered coves around the coastline, provide ideal conditions for the reception of sailing yachts and small craft. Upgrading port infrastructure, ensuring access to water, electricity, and basic services, and aligning with environmental safeguards (e.g. avoiding overconcentration) are

critical prerequisites for supporting this activity. Small-scale maritime tourism is associated with high per-capita expenditure, minimal environmental disturbance, and high flexibility for visitors—thereby enhancing the diversity and resilience of the island’s tourism product.

6 Conclusions

This section synthesises the key findings of the study and formulates recommendations on three levels: institutional-operational insights, spatial planning directions for small island municipalities, and the establishment of a permanent monitoring mechanism to ensure implementation continuity and adaptive governance.

6.1 Institutional and Operational Conclusions

The empirical analysis of Serifos confirms the existence of critical mismatches between formal planning instruments and actual development dynamics. Despite the presence of strategic frameworks such as the RSP, the SUMP, and the PESPKA, the absence of enforceable metrics and local enforcement capacities undermines their effectiveness. Key takeaways include:

- The need to translate sustainability principles into binding land-use designations and enforceable carrying-capacity thresholds within LSPs
- Persistent regulatory leakage in non-designated areas highlights the urgency of reforming the statutory boundary system and establishing clear urban-rural delineations
- The proliferation of STRs and speculative housing in unregulated zones is symptomatic of the limited operational capacity of municipal services, particularly in monitoring and permitting
- Infrastructure deficits, especially in water, waste and mobility, act as systemic constraints on sustainable tourism and require not only capital investment but coordinated governance

6.2 Planning Proposals for Small Island Municipalities

Small island municipalities face unique spatial and demographic pressures. To achieve sustainable development in such contexts, the following planning principles are proposed:

- **Polycentric Development:** Promote development across multiple nodes rather than concentrating growth in a single urban centre. This reduces congestion, distributes economic benefits more equitably, and supports smaller settlements at risk of depopulation
- **Thematic Zoning:** Implement functional zoning that reflects environmental sensitivity, tourism intensity, and local livelihoods. For example, combining strict protection zones (e.g. Natura 2000) with rural development zones focused on agritourism or ecological restoration

- **Context-sensitive Infrastructure Planning:** Design infrastructure systems (e.g., transport, waste, water) to reflect topographic constraints, population seasonality, and climate vulnerabilities
- **Integrated Heritage Management:** Recognise built and intangible cultural heritage not only as conservation priorities but also as anchors for tourism differentiation and place-based identity

6.3 Proposal for a Permanent Monitoring Mechanism (DMMO)

To ensure continuity in planning implementation and responsiveness to emerging pressures, this study recommends the institutionalisation of a **Destination Management and Monitoring Organisation (DMMO)** at the municipal level. Its key functions would include:

- **Integrated Monitoring:** Consolidate data from water, energy, mobility, accommodation and waste sectors to track sustainability indicators and flag threshold breaches
- **Permitting Alignment:** Link construction and STR licensing decisions to real-time spatial diagnostics and carrying-capacity dashboards
- **Participatory Oversight:** Establish an advisory board with representatives from residents, businesses, technical experts, and civil society to foster transparency and legitimacy
- **Scenario Testing:** Use dynamic modelling tools to simulate the impact of new developments or policy changes on resource consumption and spatial configuration
- **Capacity Building:** Act as a knowledge hub for local officials, providing training and technical support in the use of spatial planning tools and sustainability metrics

The DMMO model represents a departure from reactive, project-based planning toward a system of continuous observation, participatory adaptation, and evidence-based decision-making. As such, it could serve as a prototype for other Cycladic islands facing similar pressures.

6.4 Strategic Vision Recap and Transferability

The strategic vision and proposals developed for Serifos are oriented toward establishing a resilient, inclusive, and territorially coherent model of insular tourism development. This vision is grounded in the principles of sustainability, cultural heritage preservation, infrastructural adequacy, and transparent, participatory governance. Its foundational pillars encompass a polycentric spatial structure that redistributes development beyond primary coastal nodes; a diversified thematic tourism portfolio that leverages local identity and environmental assets; strengthened basic services aligned with peak-season needs; and the institutionalisation of carrying-capacity thresholds to guide decision-making within ecologically and socially acceptable limits.

Although these strategies are derived from Serifos's unique geophysical, socio-economic, and regulatory characteristics, they are of broader relevance to other small island municipalities across the Aegean and Mediterranean. Such territories-often

marked by seasonal tourism dependency, insufficient urban planning tools, limited building-code enforcement, and unregulated expansion-face parallel dilemmas in managing tourism-induced spatial pressure. The Serifos framework, through its emphasis on functional zoning, development containment, tourism diversification, and community integration, offers a transferable model that can support the elaboration of effective LSPs and SUPs.

The planning challenges faced by Serifos are echoed in similarly structured island municipalities such as Kimolos, Sikinos, Anafi, and Kythnos. These islands experience growing tourism demand but lack the institutional, regulatory, and operational infrastructure to manage spatial development coherently. The proposed Serifos model-anchored in clear zoning hierarchies, controlled accommodation development, and thematic tourism routes-provides actionable guidance for these communities.

At a broader scale, this approach aligns with emerging EU tourism governance principles, including visitor-flow management, preservation of landscape character, and place-branding through cultural assets. By converting strategic guidelines into binding regulations, embedding tourism development within statutory planning, and prioritising authenticity over volume, Serifos sets a normative benchmark for integrated tourism planning in insular environments.

In this context, Serifos does not function merely as a case study but as a forward-oriented demonstration of how small island municipalities can address unbalanced tourism expansion, diffuse development conflicts, and build institutional mechanisms that enhance spatial governance. Its strategic planning architecture-rooted in real-world constraints and grounded in spatial diagnostics-can inform the development of regulatory frameworks across the Aegean, offering a replicable blueprint for sustainable, tourism-led insular development.

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