

Mini review Paper

Wide-area planning as a strategic tool for resilient territories and protected ecosystems

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Received: May 31th, 2021 Revised: June 15th
2021 Accepted: June 26th, 2021.**Introduction**

Spatial planning of a large area is not just a technical matter, but a fundamental building block for building a future where environment and community coexist in harmony. In a world increasingly affected by the effects of climate change and the consequences of human activities, managing land intelligently and responsibly has become imperative to ensure the safety of people and preserve ecosystems.

his type of planning is not limited to drawing maps or planning infrastructure works. It is a broad and integrated vision that embraces the challenges of urban development and the protection of natural resources.

On the one hand, it aims to protect people from natural hazards such as landslides, floods and earthquakes; on the other, it aims to promote development that enhances the unique characteristics of each territory, while keeping its environmental richness intact.

But how is this achieved? Through a meticulous study of the territory, considering elements such as geology, hydrology and seismicity, to understand each of the area's strengths and weaknesses.

Today, with the help of advanced technologies such as geographic information systems (GIS), these analyses are more precise and detailed than ever

before, allowing data to be transformed into concrete and strategic choices.

Think of a territory where every decision, from road construction to water management, is made taking into account natural dynamics and community needs. A place where the areas most at risk are constantly monitored, and where preventive actions are implemented to mitigate the damage caused by natural events. A place where precious resources such as water and soil are carefully managed, not only to meet current needs, but also to bequeath them to future generations.

An enlightening example is the management of river areas. Every year, the news reminds us of the importance of intervening in these areas, which are often vulnerable to disastrous floods. With wide-area planning, it is possible to map the most critical points, designing solutions that combine engineering and renaturation work. This reduces the risks for people living near rivers and, at the same time, promotes the restoration of natural habitats, creating new spaces for biodiversity.

Large-area spatial planning is not the work of a single sector or a single professional. It is a process involving multiple disciplines: engineering, urban planning, environmental science, sociology and economics. Only by bringing these skills together is

it possible to find solutions that are truly effective and sustainable.

But this is not enough. It is crucial that local communities are involved early in the process. Citizens, businesses and associations must be able to express their needs, because each area has a history and culture that deserve to be respected. Participatory planning not only increases the quality of decisions, but also creates a sense of shared ownership and responsibility.

The idea that environmental protection is a brake on economic development is a prejudice that belongs to the past. Today we know that protecting ecosystems is not only a matter of ethics, but also an indispensable condition for building a prosperous and lasting future. Wide-area planning is based on this very principle, integrating technological innovation, sustainability and social inclusion.

Investing in planning means building resilient territories, capable of adapting to change and facing unforeseen challenges with readiness. It also means promoting a new cultural model, where every project - from the construction of a building to the management of a forest - is guided by respect for the environment and awareness of its limits.

Spatial planning of a vast area is not only a technical challenge, but also an extraordinary opportunity to rethink our relationship with the environment and natural resources. In an increasingly complex and interconnected world, it is an indispensable tool to ensure the security of communities, protect ecosystems and promote balanced development.

To achieve this, we need a long-term vision, a shared commitment and the courage to change perspective. Every choice must be guided by the knowledge that progress cannot exist without sustainability. Only in this way can we build truly resilient territories, where communities can live and prosper while respecting the resources that sustain us and that we must preserve for those who will come after us.

Natural Environment Protection

Large-scale spatial planning is an essential tool for protecting the natural environment and ensuring the well-being of communities.

Every territory has its fragilities: landslides, floods, earthquakes. These risks, if not properly managed, can turn into tragedies for those who live and work in those areas.

Planning makes it possible to prevent such events by combining scientific expertise, advanced technologies and a responsible vision.

Thanks to detailed studies analysing geological, geomorphological and hydrogeological factors, we can map the most vulnerable areas. This data, often underestimated, is actually invaluable for developing effective mitigation strategies that can save lives and protect vital infrastructure such as roads, bridges and buildings.

These are not just numbers or graphs, but decisions that have a direct impact on people and the environment around them. Careful planning not only prevents disasters, but also avoids unsustainable anthropogenic interventions, which would threaten the balance of ecosystems.

Every choice has consequences: building a road in a fragile area, for example, could trigger erosion or flooding, with irreparable damage. Protecting the natural environment also means making choices that respect its limits and enhance its resources.

But protecting the environment is not only about the present, as it means protecting biodiversity, maintaining ecological balances and ensuring that future generations can enjoy what we take for granted today: clean air, safe water, landscapes rich in life.

This commitment requires a collective approach, where public authorities, experts and citizens work together to build a future where humans and nature coexist in harmony. Ultimately, large-scale spatial planning is not just a technical matter, but an act of responsibility and foresight.

Protecting the natural environment is not only about responding to the challenges of our time, but planting the seeds for a better tomorrow, where the balance between man and nature is at the centre of every decision.

Sustainable Development

A well-structured spatial plan is not just a technical tool, but an act of vision that combines economic development, social progress and environmental protection.

Sustainability, often at the centre of the debate, represents a balance between human expansion and respect for the planet's natural limits.

In this context, spatial planning is the key to promoting development that not only meets present needs, but also guarantees a future in which man and nature can coexist harmoniously.

Every territory has its peculiarities and fragilities: permeable soils, limited water resources, complex morphologies.

Considering these limits is not a constraint, but an opportunity to plan intelligently, preventing

irreversible damage. Ignoring them inevitably leads to soil degradation, water pollution and the destruction of natural habitats, with serious repercussions on the environment and quality of life. Instead, sustainable development results in cities and communities that thrive in harmony with their natural surroundings, using resources efficiently and minimising waste.

In addition to sustainability, another key concept is that of resilience, which is not only the ability of an area to withstand the impacts of climate change and extreme events, but also to adapt and transform itself to meet future challenges.

The increasingly frequent heat waves, floods and droughts remind us that climate change is not a distant threat, but a reality that requires concrete and immediate action.

A resilient territory is capable of absorbing the impact of adverse events, limiting damage and recovering quickly. This is achieved through preventive and integrated planning that takes into account natural hazards and local vulnerabilities.

For example, designing urban areas to effectively manage stormwater by increasing green areas and improving drainage systems is a solution that not only reduces the risk of flooding but also improves the quality of the urban environment.

Sustainability and resilience are not separate concepts, but parts of the same goal: ensuring that territories are not only liveable, but also capable of facing the challenges of the future.

Resilience is based on the sustainable management of natural resources, avoiding their overexploitation and protecting the ecosystems that provide us with essential services, such as water purification, climate regulation and soil protection.

A resilient and sustainable territory is also one that harnesses innovation. Green technologies, such as renewable energy systems, resilient infrastructure and nature-based solutions, can significantly improve adaptive capacity.

For example, the installation of green roofs in urban areas helps to reduce heat islands and improve stormwater management, while the adoption of renewable energy makes communities less dependent on fossil fuels and more prepared for energy crises. An element that is often overlooked is the role of people in creating sustainable and resilient territories.

It is not just a matter of designing infrastructure or applying advanced technologies, but of actively involving local communities.

Citizen participation is essential to identify priorities, develop shared solutions and create a sense of belonging and responsibility towards one's territory.

Resilient communities are built not only with technical plans, but through knowledge sharing and sustainability education. For example, teaching citizens practices such as saving water, recycling and adopting renewable energy not only reduces environmental impact, but also strengthens their ability to adapt to change.

Ultimately, sustainable development is not just about environmental protection, but a broader vision that integrates sustainability, innovation and resilience.

Planning means making bold choices today to ensure that future generations can thrive in a safer, more equitable and livable world.

The goal is not just to mitigate risks or limit damage, but to transform territories into places where nature and human communities are not in conflict, but allies. A sustainable and resilient territory is not a pipe dream, but a collective responsibility and a possible goal.

Every decision, from a small local intervention to a large infrastructure project, can make a difference in building a future where development and the environment are finally in balance.

Integration of Environmental Matrices

Integrating environmental matrices is fundamental to effective and sustainable spatial planning. Understanding how human activities interact with the geological, hydrogeological and geomorphological parameters of the territory allows us to avoid decisions that could compromise the environment and the safety of communities.

By thoroughly analysing the relationships between these aspects, it is possible to draw a clear map of the fragilities and potentialities of a given territory, providing a solid scientific basis for the definition of planning and management that is aware of the totality of its resources.

These analyses allow us to predict the consequences of our actions on the environment and to develop strategies that balance development with the protection of natural resources. For example, by identifying areas vulnerable to flooding, we can implement preventive measures such as building flood control works or adopting more sustainable land use practices.

Therefore, the integration of environmental data with human actions goes beyond the simple

collection and representation of information; this process of integration and analysis implies a continuous debate of interpretation and updating that considers natural dynamics in constant evolution and in constant interaction with human actions.

With the help of advanced technologies such as Geographic Information Systems (GIS), we can visualise and analyse complex data in an intuitive and immediate way, as GIS allows us to overlay information on environmental matrices such as geology, hydrology, land use, and variations in climatic parameters, helping us to accurately identify the areas most suitable for new development and those in need of protection or restoration.

In urban contexts, GIS also supports the design of infrastructure that is resilient to natural events and compatible with the surrounding environment, not only reducing risks to the community, but also helping to create urban spaces that are more sustainable and pleasant to live in.

Adopting a holistic approach in spatial planning means seeing the territory as a complex and interconnected system, in continuous fluid evolution.

Natural matrices such as soil, water and biodiversity cannot be managed in isolation, as they require a coordinated and forward-looking management and planning process. This approach allows us to find solutions that can maximise the benefits for the environment and local communities, while enhancing the unique characteristics of each territory.

The conservation of natural areas is not only an environmental issue, which must always be preserved, but also has economic and social implications. Well-managed green areas can promote sustainable tourism, improve air and water quality and provide spaces for socialising and well-being.

Protecting and restoring ecosystems means ensuring that natural services - such as climate regulation and protection from extreme events - continue to sustain human life.

Integrating environmental matrices is not an option, but a necessity to ensure that planning decisions are evidence-based and long-term oriented, highlighting how only a systematic and integrated approach can address global challenges such as climate change and ensure that development does not occur at the expense of biodiversity and natural resources.

Ultimately, well-structured spatial planning supported by the integration of environmental matrices not only improves quality of life, but also promotes the resilience and sustainability of territories.

Every decision must be made with the awareness that the environment is a finite and precious resource, to be preserved for future generations.

Integrating environmental matrices into spatial planning represents the meeting point between science and social responsibility. It is not just a matter of protecting the territory from immediate risks, but of building a long-term vision that enhances the potential of each area while respecting its natural limits.

With a holistic approach and advanced technological tools, not least satellite data, we can ensure that development is not only sustainable, but also equitable, resilient and future-oriented

The Use of GIS in Spatial Planning: fluid and updatable planning

Planning the territory of a vast area is increasingly complex and requires advanced tools to manage, analyse and visualise spatial and geographical data accurately, effectively and efficiently.

The Geographic Information System (GIS) is proposed as an indispensable, fluid technology, capable of integrating multiple data matrices and supporting, as a result of their analysis, strategic decisions.

In fact, the GIS is not only a technical tool, but one must imagine it as a dynamic system that allows us to develop fluid, updatable and mainly evidence-based spatial planning, since this tool allows the integration of complex, continuously updatable data, which allow the required spatial information to be analysed and synthesised in real time.

The use of GIS is to be understood as an integrated platform that collects, analyses and visualises spatial and geographical data, facilitating effective management of spatial information, aggregating disparate data sources, such as geological maps, hydrogeological maps, seismic data and climatic indicators, offering a complete and detailed view of the territory and quickly highlighting critical issues in the matrices, defining the opportunity for rapid optimal solutions for sustainable development.

For example, by using GIS to integrate data on land use, seismic risk areas and water resources, it enables the design of urban settlements that respect natural limits, reduce environmental impact and improve community safety, as well as elaborating

complex scenarios by simulating different development options and assessing the environmental, social and economic impacts of different hypothesised scenarios.

One of the great qualities of GIS is its ability to make spatial planning and programming flexible and continuously updatable. This quality appears very important in a social context in which rapidly changing environmental, economic and social conditions require continuous new additions in real time, as it allows new planning strategies to be rapidly formulated to respond to emergencies, climate change and consequent political development choices.

A case study that often hits the headlines concerns catastrophic flash floods: the use of GIS enables immediate updating of spatial planning in order to quickly identify the most vulnerable areas and thus define priority interventions or plan more effective mitigation strategies, preventing the occurrence of human losses and material damage. This flexibility increases the resilience of the territory, ensuring more effective and timely management of natural resources and risks.

A further advantage of GIS is the possibility of sharing information among different stakeholders: local administrations, civil protection agencies, town planners and local communities, fostering collaborative and transparent land management, through truthful and effective communication and cohesion among the various actors involved in ante- and post-operam planning.

Moreover, one excellence of GIS systems lies in their ability and versatility to analyse and synthesise large quantities of data, making them comprehensible and immediately readable even when related to more complex information. This occurs through the construction of detailed thematic maps, in which it is possible to visualise the relationships between environmental matrices and anthropic interventions, identifying patterns and trends that are not immediately apparent.

This value is amplified by the GIS's ability to support advanced predictive analysis and spatial modelling tools, which in fact allow the simulation of the impact of different development options, such as the construction of new infrastructures or urban expansion, assessing their potential effects on the environment and communities, not only improving the effectiveness of planning, but also promoting a more sustainable development that respects natural resources.

These characteristics, in an era of very rapid climate change and increasingly frequent man-made disasters, the use of GIS technology plays an indispensable role in strengthening the resilience of territories, making it possible to identify the areas most vulnerable to extreme events, such as flood-prone areas, slopes prone to landslides and territories prone to desertification, and to plan targeted predictive interventions that reduce the related and direct risks to communities.

If GIS technology were consciously used to design resilient infrastructures, such as urban drainage networks that prevent flooding, or to create green areas capable of absorbing rainwater and mitigating heat islands, it would be possible to mitigate the continuous damage to the territory highlighted by the chronicles. Thanks to predictive modelling, GIS helps to develop long-term strategies to prepare the territory for changes in environmental matrices, promoting a balance between human development and environmental conservation.

This methodology is therefore essential for effective and efficient spatial planning of vast areas, as it has the capacity to integrate, analyse and visualise complex data that can be continuously updated and easily shared among various stakeholders, making it an essential methodology for effective, resilient and sustainable land management.

Thanks to GIS, spatial planning can address not only the challenges of the present, but also those of the future, promoting development that respects natural resources and improves the quality of life of communities.

In an ever-changing world, GIS is not just a technical tool, but a strategic ally in building safer, sustainable and resilient territories.

Conclusions

Spatial planning of a large area is an indispensable tool for protecting the environment and ensuring sustainable and resilient development.

Thanks to the integration of in-depth studies of environmental matrices and the adoption of advanced tools such as geographic information systems (GIS), it is possible to draw up spatial plans that not only meet current needs but are also capable of adapting to future challenges.

One of the main advantages of a holistic approach to spatial planning is the possibility of constantly monitoring areas at risk, such as those prone to landslides, floods and earthquakes.

These tools make it possible to prevent and mitigate natural disasters, protecting the environment, infrastructure and, above all, human lives.

The ability to identify spatial vulnerabilities at an early stage enables the development of targeted intervention strategies that reduce risks and promote greater security for communities.

This type of planning is not limited to environmental protection, but also extends to protecting biodiversity and maintaining ecological balances.

Preserving ecosystems means not only respecting the natural heritage, but also ensuring the continuity of the services they provide, such as climate regulation, water purification and soil protection.

Another crucial aspect of spatial planning is its ability to foster sustainable urban and economic development.

By considering the natural limits of the territory, such as soil permeability, water availability and geomorphological characteristics, it is possible to design development that minimises negative impacts on the environment. This approach ensures that cities and communities can thrive in harmony with nature, using resources efficiently and minimising waste. In addition, well-structured planning promotes the adoption of green technologies and innovative practices.

These not only improve quality of life, but also promote social and economic equity. More sustainable cities mean more resilient communities, able to adapt to climate change and economic pressures without compromising their future. A key element that makes spatial planning even more effective is the integration of data through GIS.

This technology allows large amounts of data to be collected, analysed and visualised, facilitating the understanding of spatial dynamics and the interactions between environmental and human variables. The ability to visually represent complex data, such as geological, hydrogeological and seismic features, allows planners to identify patterns and correlations that may not be evident through traditional methods.

Furthermore, GIS facilitates the creation of continuously updatable plans that can be adapted in real time to new information or emergencies. This dynamic approach is essential in a context where environmental and social conditions are constantly changing. Thanks to GIS, planning decisions are based on sound scientific data and can be shared among different stakeholders, promoting more transparent and collaborative land management.

Ultimately, spatial planning of a large area, supported by advanced tools such as GIS, is a strategic and responsible approach to ensure sustainable land management.

It is not just about responding to immediate challenges, but about building a future in which human development and the natural environment can co-exist in balance.

This holistic approach not only improves the quality of life for today's communities, but also ensures the preservation of natural resources for future generations.

Spatial planning, when implemented with a systematic and organic vision, becomes a bridge between the present and the future, combining environmental protection, sustainable development and territorial resilience.

It is only through conscious and integrated management that global challenges, such as climate change and increasing urbanisation, can be addressed, ensuring that any intervention on the territory respects its natural limits and enhances its resources.

Spatial planning, therefore, is not just a technical practice, but a commitment to harmonious and lasting progress, in which the environment is not a constraint, but a precious resource to be preserved.

Bibliography

- 1) **"Adattamento delle città ai cambiamenti climatici: integrazione di soluzioni basate sulla natura"** , Routledge, 2019.
- 2) **"Applicazioni dei GIS nella valutazione del rischio urbano"** , Journal of Geographical Systems, 2017.
- 3) **"Applicazioni GIS e telerilevamento nella gestione ambientale"** , CRC Press, 2015.
- 4) **"Approcci basati sugli ecosistemi ai cambiamenti climatici"** , Cambridge University Press, 2017.
- 5) **"Città intelligenti e resilienza: il ruolo del GIS"** , Springer Series in Geoinformatics, 2019.
- 6) **"GIS come strumento per l'integrazione dei dati ambientali nella pianificazione urbana"** , Environment and Planning Journal, 2020.
- 7) **"GIS per la gestione ambientale"** , ESRI Press, 2006. ESRI Press, esplora l'uso del GIS nella gestione ambientale.
- 8) **"GIS per la gestione dei disastri e la pianificazione urbana"** , Banca Mondiale, 2020.
- 9) **"Il ruolo del GIS nella riduzione del rischio di catastrofi"** , International Journal of Disaster Risk Reduction, 2016.
- 10) **"Infrastrutture resilienti per uno sviluppo sostenibile"** , Nature Sustainability, 2018.
- 11) **"L'impatto della pianificazione urbana sui servizi ecosistemici"** , Ecological Economics, 2015.
- 12) **"Pianificare città resilienti nel contesto del cambiamento climatico"** , Journal of Urban Planning, 2019.

- 13) **"Pianificazione delle infrastrutture verdi per città sostenibili"** , Landscape and Urban Planning, 2018.
- 14) **"Quadro di resilienza urbana"** , Nazioni Unite Habitat, 2018.
- 15) **"Sfide e opportunità nella sostenibilità urbana"** , Science Advances, 2016.
- 16) **"Sostenibilità e resilienza nella pianificazione urbana"** , Agenzia europea dell'ambiente (AEA), 2020. Rapporto dell'Agenzia Europea per l'Ambiente sui metodi di pianificazione urbana sostenibile.
- 17) **"Sostenibilità urbana: una prospettiva globale"** , Elsevier, 2015.
- 18) **"Sviluppo di parametri di resilienza per i sistemi urbani"** , Urban Studies Journal, 2020.
- 19) **"Tecnologie geospaziali per la mitigazione dei cambiamenti climatici"** , Springer, 2018.