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An Overview of GIS Applications in Landscape Planning

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Abstract. Landscape planning is a branch of the interdisciplinary profession of landscape architecture, which is based on landscape quality protection, and focuses on harmonising different values and interests in spatial development. The modern paradigm of the landscape is based on multidimensionality and interdisciplinarity, which makes the application of GIS indispensable in researching and analysing landscape approaches. This paper presents the application of GIS within the methods and tools of landscape planning, from the perspective of the landscape architecture profession in Croatia, involving the following methods: landscape evaluation, spatial modelling, development of strategic plans, landscape and environmental impact assessment including visual analysis and simulations, landscape character assessment, and landscape plans. The paper also highlights the diversity of potential landscape planning approaches within the instruments of different sectors, concentrating on responsibility for the landscape, spatial planning, natural and environmental protection, conservation of cultural heritage, land policies, rural and tourist development, and energy issues.
The paper also indicates that, despite signing the European Landscape Convention, via which Croatia showed interest in innovative planning, conservation and management approaches, there has still been no significant shift at the institutional level, with the occasional implementation of the landscape approaches in practice. The lack of use of GIS tools is especially evident within different sectoral instruments, at all levels of spatial thinking and decision-making.

Keywords: landscape planning, landscape architecture, GIS, landscape analysis, landscape evaluation

1 Introduction

Landscape planning is a branch of landscape architecture, an interdisciplinary profession whose basic task is to analyse landscape as (1) a material objective structure in space that is constantly changing as a result of human activities, and (2) a subjective, culturally determined, type of perception and valuation of the material structure and space where we live, which we experience according to our interests (Ipsen 2012, Marušič 1993). Landscape planning is based on the protection of landscape qualities, and focuses on the harmonization of different values and interests in spatial development (Marušič 1993, Butler 2016). Alongside visual qualities, landscape planning takes into consideration structures and processes which may have an impact on changes to the landscape (Sarlöv Herlin 2004). Today's common planning processes have the characteristics of holistic-intuitive procedures, so there is a danger of overlooking certain relations between structures and processes (Breskvar Žaucer et al. 2009). Modern landscape planning has developed using systematic computer analysis, which reduces risks significantly. The contemporary landscape paradigm is multidimensional and interdisciplinary, which makes GIS indispensable in research and analytic landscape approaches. Therefore, GIS is recognized as an unavoidable tool, not only in landscape planning, but also within other professions which influence spatial decisions (Pietsch, 2012).

The development and use of various tools and techniques for simulation and analysis in exploring and communicating design and planning ideas have long provided support for landscape architects (Mengots, 2016, pp.72). Steintiz (2012) highlights this, while relying

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Pregled mogućnosti primjene GIS-a u krajobraznom planiranju

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Sažetak. Krajobrazno planiranje grana je interdisciplinarne struke krajobrazne arhitekture koja se temelji na očuvanju kvaliteta krajobraza, a usmjerena je usklađivanju različitih vrijednosti i interesa u prostornom razvoju. Moderna paradigma krajobraza utemeljena je na višedimenzionalnosti i interdisciplinarnosti, što u istraživačkim i analitičkim krajobraznim pristupima neizostavnim čini korištenje GIS-a. U ovom radu prikazana je primjena GIS-a u metodama i alatima krajobraznog planiranja iz perspektive struke krajobrazne arhitekture u Hrvatskoj, a obuhvaćeno je: vrednovanje krajobraza, izrada prostornih modela i strateških planova, procjena utjecaja na krajobraz uključujući vizualne analize i simulacije, procjena karaktera krajobraza te krajobrazni planovi. Radom je ujedno ukazano na raznolikost primjena alata krajobraznog planiranja u instrumentima različitih sektora koji imaju interes i odgovornost prema krajobrazu: prostornom planiranju, zaštiti prirode i okoliša, zaštiti kulturne baštine, zemljišnoj politici, ruralnom i turističkom razvoju i energetici.
Također je ukazano na činjenicu da je, unatoč potpisivanju Europske konvencije o krajobrazu kojom je Hrvatska iskazala interes za inovativnim alatima planiranja, zaštite i upravljanja, do danas na institucionalnoj razini učinjeno vrlo malo, a upotreba krajobraznih pristupa u praksi je stihijska. Posebno je evidentno neprimjenjivanje GIS-a u različitim sektorskim instrumentima na svim razinama promišljanja i donošenja odluka o prostoru.

Ključne riječi: krajobrazno planiranje, krajobrazna arhitektura, GIS, analiza krajobraza, vrednovanje krajobraza

1. Uvod

Krajobrazno planiranje je grana interdisciplinarne struke krajobrazne arhitekture kojoj je osnovni zadatak analizirati krajobraz kao (1) materijalnu objektivnu strukturu u prostoru koja se neprestano mijenja uslijed čovjekovih aktivnosti, te (2) kao subjektivni, kulturno određeni, oblik percepcije i vrednovanja te iste materijalne strukture, odnosno prostor u kojem živimo i koji doživljavamo kroz svoje interese (Ipsen 2012, Marušič 1993). Krajobrazno se planiranje pritom temelji na očuvanju kvaliteta krajobraza, a usmjereno je usklađivanju različitih vrijednosti i interesa u prostornom razvoju (Marušič 1993, Butler 2016). Osim vizualnih kvaliteta, krajobrazno planiranje uzima u obzir i strukture i procese koji mogu utjecati na promjene u krajobrazu (Sarlöv Herlin 2004). Današnji uvriježeni planerski procesi imaju karakter holističko-intuitivnog postupka i stoga postoji opasnost da se određene veze između struktura i procesa previde (Breskvar Žaucer i sur. 2009). Upravo iz tog razloga moderno se krajobrazno planiranje razvija uz pomoć sustavne računalne analize u kojoj je taj rizik značajno smanjen. Moderna paradigma krajobraza utemeljena je na višedimenzionalnosti i interdisciplinarnosti, što u istraživačkim i analitičkim krajobraznim pristupima neizostavnim čini korištenje GIS-a. GIS je stoga danas prepoznat i promoviran kao nezaobilazan alat, ne samo u krajobraznom planiranju, već i u nizu drugih struka koje utječu na prostorne odluke (Pietsch 2012).

Razvoj različitih alata i tehnika za simulacije i analize u istraživanju i prenošenju planskih i oblikovnih ideja te njihova primjena od začetaka struke, krajobraznim su arhitektima bili podrška u radu (Mengots 2016). Isto ističe i Steinitz (2012) oslanjajući se pritom na važnost

on the importance of information technologies in geodesign development, a branch which, due to GIS development, has emerged as a new, integral approach, derived from geography, the spatial-oriented sciences, and design professions such as architecture, landscape architecture, urban and spatial planning, and civil engineering.

Within the planning process, GIS tools are used mostly to connect and simultaneously analyse different data (Gonzáles et al. 2013). Within landscape architecture, GIS is particularly evident in multiple criteria analyses of landscape evaluation that simultaneously incorporate the subjective and objective aspects of a space. Using maps contributes to communicating spatial information, with stakeholders providing analytical input for the spatial evaluation of alternatives and interaction in decision-making (Arciniegas and Janssen 2012). According to van der Brink and Bruns (2014), the most frequent qualitative methods in landscape architecture are spatial analysis, interviews and document analysis, while the most used quantitative method is spatial analysis in GIS. It is important to mention modelling as a method used in the management of qualitative and quantitative parameters (Falconer et al. 2013), and also the importance of linking qualitative and quantitative analyses, and resolving the problem of the cartographic representation of subjective perception of space, which is specific to landscape analysis.

This paper presents the application of GIS in landscape planning methods and approaches from the perspective of the landscape architecture profession in Croatia. The tools presented represent a synthesis of several internationally accepted models, and their application and development through the scientific, educational and professional work of the authors. It should be emphasised that most of the approaches presented still lack a legal basis, and in practice, can only be applied occasionally. The level of awareness of interested parties, mostly from the public sphere, is also important in producing spatial plans, management plans for protected natural areas, historical and natural studies, local development strategies, environmental impact assessments, and other spatial analyses. Although Croatia has shown interest in innovative tools for landscape planning, protection and management, through signing the European Landscape Convention (OG-IC 12/02), there has been no significant shift at the institutional level. This refers to the application of GIS tools in different sectoral instruments, which is still negligible at all levels of spatial thinking and decision-making. Thus, this paper emphasises the applicability, purpose and innovation of tools derived from a GIS analysis.

2 Analytical Approaches to Landscape Architecture

2.1 Landscape evaluation and spatial modelling

Landscape evaluation is the procedure that determines the values of a landscape, and the elements within a space and human perception that define its characteristics. Thus, value is considered a quality of an object, and is defined by the relations between people or a social group with a landscape element, or a landscape as a whole (Butula 2004, Fabos 1979). Knowledge of landscape values is important due to the need for information and improvement of land use planning and environmental management (Brown and Brabyn 2012). In order to protect the quality of the landscape, several core values can be distinguished; (1) naturalness of the landscape, (2) qualities of the human landscape comprising visual and cultural aspects, and (3) qualities of natural resources comprising resources protection for the future development of primary activities characteristic of a certain area.

Landscape evaluation starts with the definition of criteria, the basis for shaping models, obtained from an overview and categorization of spatial data, and the weighted linear combination method (Eastman 1999) in the ProVal2000GIS application (Figure 1) whose role is to simulate landscape qualities: attractiveness, vulnerability, and suitability for development. Making the evaluation model (Figure 2) is based on the overlapping method developed by McHarg (1969).

The identification of landscape values is not only based on the structural elements of a landscape which must be preserved from negative changes because of its uniqueness, but also on the potential for development activities whose prerequisites are based on certain spatial characteristics. Starting points were established by the framework of the European Spatial Development Perspective adopted in Potsdam in 1999 by the Council of Ministers responsible for Spatial Planning, where landscapes were deemed valuable as locations for the sustainable use of natural resources, habitats for wild animal species, open spaces, and beauty spots, while their cultural elements provide economic benefits (European Communities 1999). Within the spatial planning instrument – Report on the State of Space in the Republic of Croatia, the country is required "to incorporate landscape evaluation of the space into the spatial planning process" (MGIPU 2013). According to the recommendations for the implementation of the European Landscape Convention (Council of Europe 2008), regardless of regulatory and operational

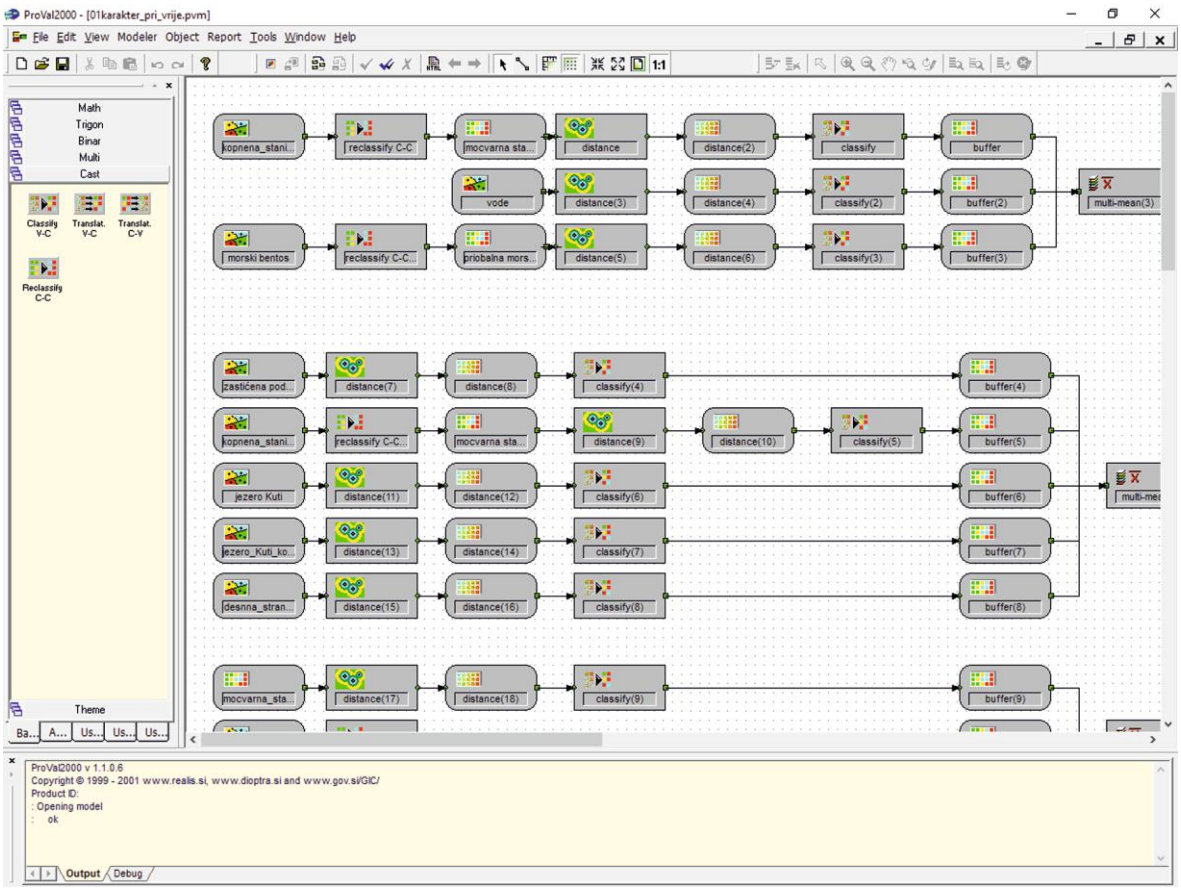


Fig. 1 Modelling landscape qualities in the ProVal2000 GIS application
Slika 1. Postupak modeliranja kvaliteta krajobraza u ProVal2000 GIS aplikaciji

informacijskih tehnologija i u razvoju geodizajna, grane koja je upravo zahvaljujući razvoju GIS-a nametnuta kao novi integrirani pristup koji proizlazi iz geografije, prostorno orijentiranih znanosti, ali i dizajnerskih profesija poput arhitekture, krajobrazne arhitekture, urbanog i prostornog planiranja, građevinarstva.

U planerskom procesu GIS alati koriste se pretežito za povezivanje i istodobno analiziranje više različitih podataka (Gonzáles i sur. 2013). U krajobraznoj arhitekturi to je posebno vidljivo u multikriterijskim analizama vrednovanja krajobraza koje istodobno uključuju i subjektivni i objektivni aspekt prostora. Kartografski prikazi doprinose u komunikaciji prostornih informacija s dionicima kao analitički alat za prostorno vrednovanje alternativa te kao ulazni podatak za interakciju u donošenju odluka (Arciniegas i Janssen 2012). Prema van der Brink i Bruns (2014) u krajobraznoj se arhitekturi najčešće koriste kvalitativne metode poput analize prostora, intervjua i analize dokumenata, dok se od kvantitativnih pretežito koriste prostorne analize u GIS-u. Ovdje je važno spomenuti i "modeliranje" kao metodu koja se može koristiti u upravljanju i kvalitativnim i kvantitativnim parametrima (Falconer i sur. 2013), ali i nužnost povezivanja kvalitativnih i kvantitativnih analiza te rješavanje problema kartografskog prikazivanja subjektivnih doživljaja prostora karakterističnih za analize krajobraza.

Ovim će se radom prezentirati primjena GIS-a u metodama i alatima krajobraznog planiranja i to iz perspektive struke krajobrazne arhitekture u Hrvatskoj. Prezentirani alati i metode čine sintezu niza inozemnih priznatih modela, ali i njihovu primjenu i razvoj kroz znanstvenu, edukacijsku i stručnu djelatnost autora. Treba napomenuti kako veći dio prikazanih pristupa još uvijek nema zakonsko uporište, stoga je u praksi njihova primjena stihijska i ovisi o senzibilitetu zainteresiranih strana, uglavnom iz "javne sfere", i to za različite potrebe: prostorne planove, planove upravljanja zaštićenim područjima prirode, konzervatorske i prirodoslovne podloge, strategije lokalnog razvoja, procjene utjecaja na okoliš i općenito u analizama prostora i prostornih mogućnosti. Međutim, iako smo kao država potpisivanjem Europske konvencije o krajobrazu EKK (NN - MU 12/02) iskazali interes za inovativnim alatima planiranja, zaštite i upravljanja krajobrazima, do danas je na institucionalnoj razini učinjeno vrlo malo. Navedeno se posebno odnosi na primjenu GIS-a u različitim sektorskim instrumentima što je još uvijek zanemarivo na

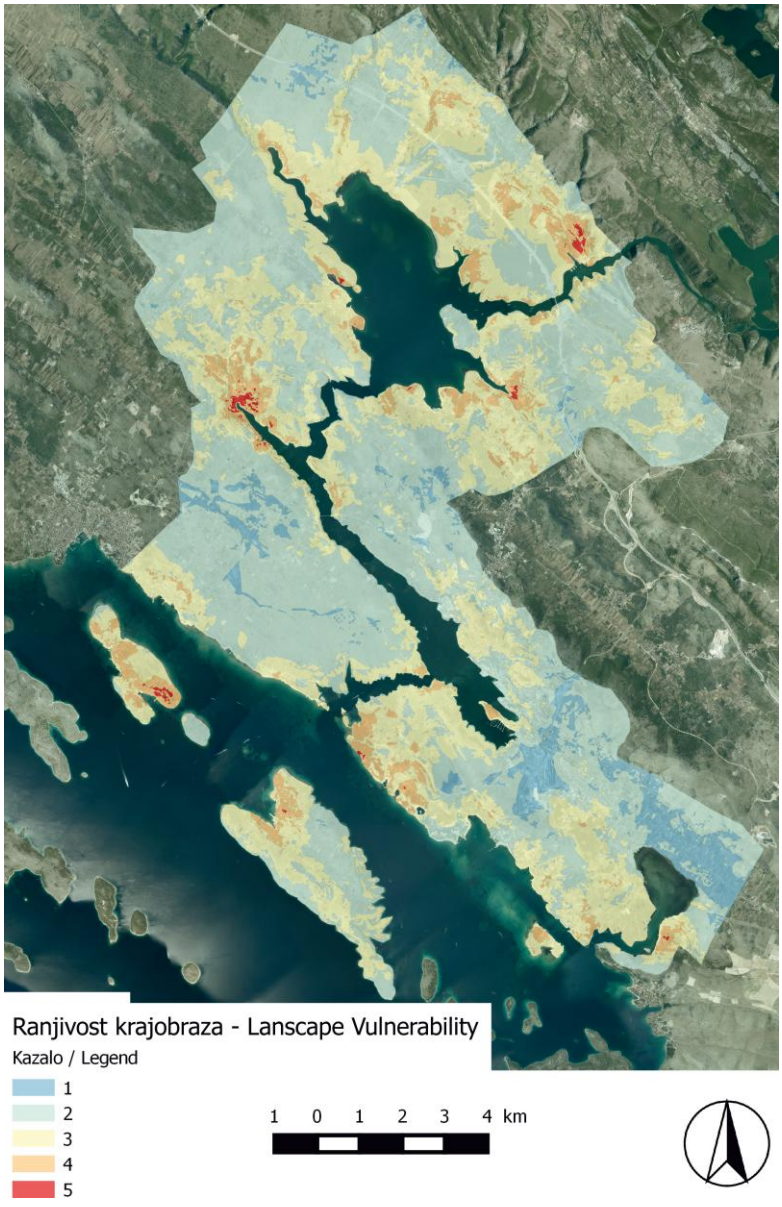


Fig. 2 Landscape vulnerability map
Slika 2. Karta ranjivosti krajobraza

autonomy, it is important to conduct specific spatial evaluation studies from the landscape perspective. Landscape qualities should be determined according to the general and operative demands of development activities, and according to measures necessary for the enhancement of existing landscape qualities within analysed locations (Council of Europe 2008). Therefore, landscape evaluation and spatial modelling are considered very important in drafting spatial plans, while planning interventions and land uses may impact the landscape values of a space.

2.2 Spatial development strategic plan

The renewed interest in the strategic approach to spatial planning that occurred in Europe during the 1990s has led to a review of the tools and approaches used, and demand for greater flexibility in determining precise land use (CEC 1997). At the same time, growing complexity and rapid development have led to a dramatic increase in interest in environmental issues and a re-examination of the need for long-term thinking that uses strategic approaches (Albrechts 2004, Healey 2009). Albrechts defines strategic spatial planning as a socio-spatial process through which vision, actions, and means of implementation are produced that shape and frame what a place is, and what it may become. Strategic frameworks and visions for territorial development, with the emphasis on existing qualities with spatial impacts, complete and provide a context for specific development projects (Albrechts 2004). The development of computer-based geo-information tools and the increased availability of geo-data have led to a greater number of alternative scenarios (Carsjens 2009).

By implementing innovative methods and modern GIS technology, and using knowledge from several

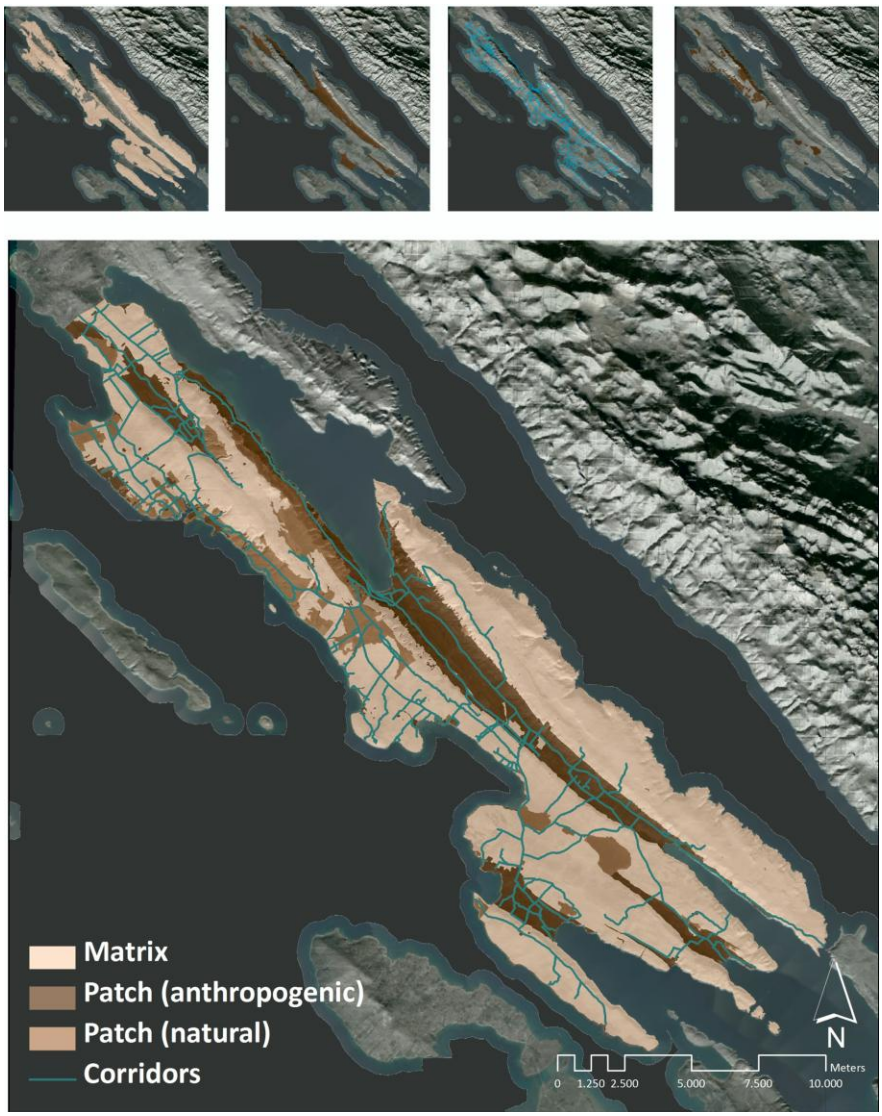


Fig. 3 Example of spatial analysis by Forman and Godron
Slika 3. Primjer analize prostora po Formanu i Godronu

svim razinama promišljanja i donošenja odluka o prostoru. Stoga ovaj rad poseban naglasak stavlja na ukazivanje primjenjivosti, svrsishodnosti i inovativnosti prikazanih alata koji proizlazi iz upotrebe GIS-a.

2. Analitički pristupi u krajobraznoj arhitekturi

2.1. Vrednovanje krajobraza i izrada prostornih modela

Vrednovanje krajobraza je postupak kojim se utvrđuju vrijednosti određenog krajobraza te komponente u prostoru i ljudskoj percepciji koje određuju njegove značajke. Pritom se vrijednost poima kao kvaliteta određenog objekta, a definirana je kroz odnos čovjeka ili određene društvene skupine prema sastavnom dijelu krajobraza ili krajobraza u cjelini (Butula 2004, Fabos 1979). Znanja o vrijednostima krajobraza važna su zbog potrebe za informacijama i unapređenjem planiranja namjene površina i okolišnog upravljanja (Brown i Brabyn 2012). S ciljem zaštite kvaliteta krajobraza razlikujemo osnovne vrijednosti: (1) prirodnost krajobraza, (2) kvalitete čovjekovog krajobraza koje obuhvaćaju vizualne kvalitete krajobraza i kulturne kvalitete krajobraza te (3) kvalitete prirodnih resursa koje obuhvaćaju očuvanje resursa za budući razvoj primarnih djelatnosti karakterističnih za neko određeno područje.

Vrednovanje krajobraza uvijek započinje određivanjem kriterija – eksplicitnim pravilima koja pomažu odabiru između varijanti. Određivanje kriterija je ishodište za oblikovanje modela koji se dobivaju pregledom i kategorizacijom prostornih podataka te metodom ponderirane linearne kombinacije (weighted linear combination) (Eastman 1999) u GIS aplikaciji ProVal2000 (slika 1), a imaju ulogu simulirati kvalitete krajobraza, odnosno privlačnost, ranjivost i pogodnost krajobraza za razvoj. Izrada vrijednosnih modela (slika 2) utemeljena je na metodi preklapanja kojoj je začetnik McHarg (1969).

Identifikacija krajobraznih vrijednosti ne temelji se samo na strukturnim elementima krajobraza, koje je

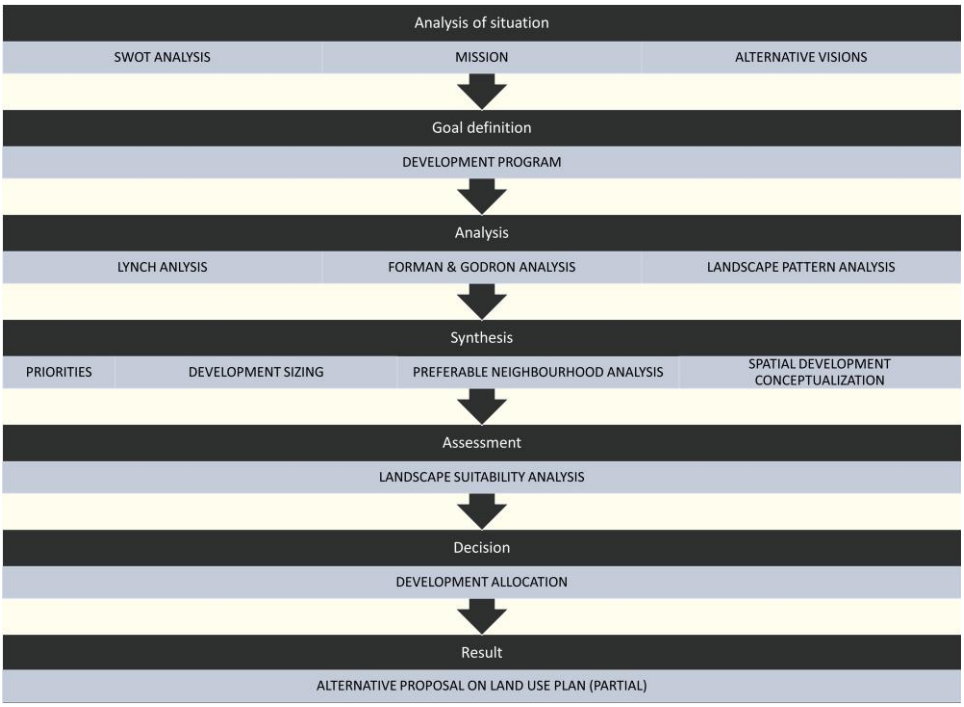


Fig. 4 Planning spatial development procedure
Slika 4. Planski postupak strateškog prostornog razvoja

disciplines, strategic, spatial, urban, and landscape planning can adopt an interdisciplinary approach to space. Such an approach considers strategic analytic procedures such as (1) setting the mission and vision for the development (2) defining strategic goals based on a SWOT analysis, and (3) an analysis of developmental trends which serve as a basis for the creation of possible scenarios for the development of a certain area.

Landscape planning analytical procedures such as the Lynch analysis (1960), or the landscape-ecological analysis by Forman and Godron (1981), and analyses of spatial patterns, lay the foundation for understanding the structure and function of the landscape and changes over time, as basic indicators of landscape heterogeneity.

Based on analytical and evaluation results, the desired neighbourhood matrix and analysis of activity dimensions, it is possible to determine alternative spatial diagrams and concepts in the synthesis phase.

The scenarios of spatial development design presented here (Figure 4) involve environmental criteria and represent the basis for the transformation of development programmes into spatial categories, and the analysis of space in regard to the implementation of a development programme, including environmental protection measures.

2.3 Strategic and Project Environmental Impact Assessment

The goal of Strategic Environmental Assessment (SEA) is to determine the effects of certain plans, programmes and strategies on the environment, so as to take them into account when making decisions about development in an area (Directive 2001/42/EC, SEA Directive). In order to apply sustainability in a spatial planning system, it is necessary to verify every proposal on land use through SEA. A vulnerability analysis can be used to determine environmental qualities at the strategic level. Its outcomes indicate potential impacts and the corrections required in order to apply the philosophy of sustainable development consistently. Although vulnerability analyse have been developed within landscape planning, Golobič (2010) emphasizes that the "concept of vulnerability" can be applied as a method within SEA.

In order to verify the strategic plan of spatial development, an environmental vulnerability analysis must be conducted for every activity. In line with the impact assessment, corrections and interventions are possible. Next, physical planning guidelines must be drawn up for each activity.

The procedure for preparing an Environmental Impact Assessment Study on actual selected examples, emphasising the spatial aspects, is an expert task for landscape architects. As a starting point for the assessment, the negative environmental impact of the activity is determined; environmental systems are analysed, and environmental changes and impacts are determined. The qualitative and quantitative components of environmental changes are evaluated. Several analytical tools are used, such as a list of environmental impacts, list of environmental components, list of activity components,

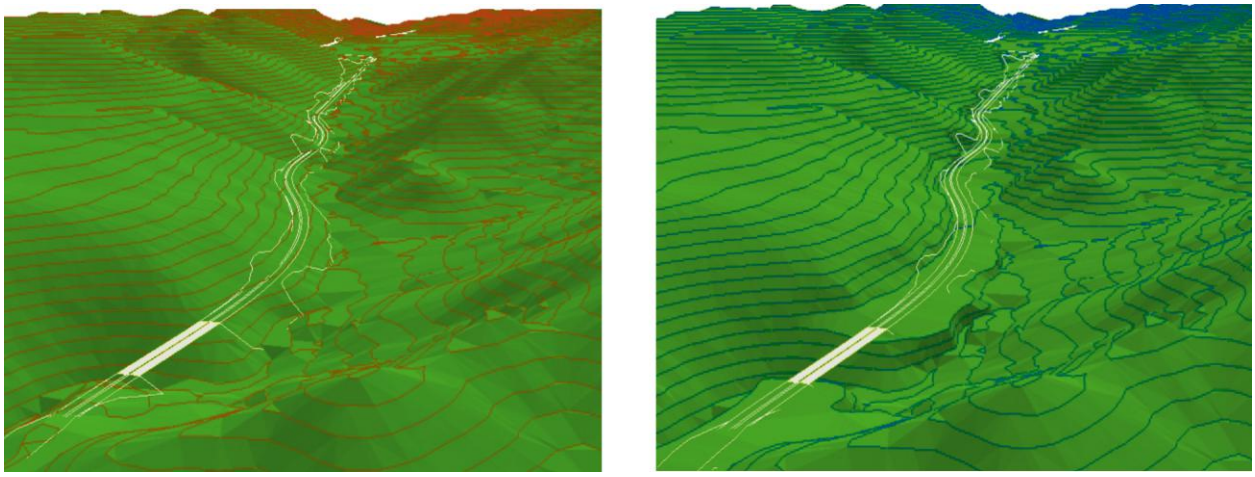


Fig. 5 Representation of part of relief analysis within EIA
Slika 5. Prikaz dijela analize promjene reljefa iz PUO postupka

zbog jedinstvenosti potrebno očuvati od negativnih promjena, već i njegovog potencijala za razvoj djelatnosti, tj. aktivnosti kojima su određena obilježja prostora osnovni preduvjet za razvoj. Polazišta za to utvrđena su okvirom Europske perspektive prostornog razvoja koji je Vijeće ministara odgovornih za prostorno planiranje prihvatilo u Potsdamu 1999., gdje se krajobrazi poimaju kao vrijedni sa stanovišta održivog korištenja prirodnih resursa, kao staništa divljih životinjskih vrsta, kao otvoreni prostori te sa stanovišta ljepote ili kulturnih elemenata koje sadrže, ali i koji pružaju gospodarske prednosti (European Communities 1999, str. 53–54). Instrument prostornog planiranja – Izvješće o stanju u prostoru RH također predlaže "u izradu prostornih planova obvezno uključiti krajobrazno vrednovanje prostora" (MGIPU 2013, str.227). Prema Preporukama za provedbu Europske konvencije o krajobrazu (u nastavku EKK) Vijeća Europe (2008, str. 15), neovisno o regulatornim i operativnim autonomijama, važno je da uvijek postoje specifične studije vrednovanja prostora iz krajobrazne perspektive. Pritom se naglašava da se kvalitete krajobraza moraju odrediti s obzirom na generalne i operativne zahtjeve određenih aktivnosti te s obzirom na potrebne mjere unapređenja postojećih kvaliteta krajobraza analiziranih lokacija (Vijeće Europe 2008, str. 17). Stoga se smatra da je vrednovanje krajobraza i priprema prostornih modela vrlo važna stručna podloga za izradu prostornog plana prilikom planiranja zahvata i namjena u prostoru koje bi mogle utjecati na ugrožavanje krajobraznih vrijednosti prostora.

2.2. Strateški plan prostornog razvoja

Obnovljeni interes za primjenu strateškog pristupa u prostornom planiranju, koji se javlja u Europi tijekom 90-ih godina 20. stoljeća, doveo je do revizije alata i pristupa korištenih u planiranju, kao i traženja veće fleksibilnosti u određivanju namjene površina (CEC 1997). Istodobno su rastuća kompleksnost i brzina gospodarskog razvoja dovele do povećanog interesa za okolišne probleme i potrebe za dugoročnim promišljanjem koje koristi strateški pristup (Albrechts 2004, Healey 2009). Albrechts (2004) definira strateško prostorno planiranje kao društveno prostorni proces kroz koji se određuje vizija, akcije te sredstva za provedbu koja oblikuju i određuju što mjesto je i može biti. Strateški okviri i vizije prostornog razvoja, s naglaskom na postojeće kvalitete, zajedno s potencijalnim utjecajima upotpunjuju i osiguravaju kontekst za specifične razvojne projekte. Razvoj GIS-a i veća dostupnost prostornih podataka omogućuju veći broj alternativnih scenarija razvoja (Carsjens 2009).

Primjenom inovativnih metoda i modernih GIS tehnologija te korištenjem znanja više disciplina, strateškog, prostornog i urbanističkog te krajobraznog planiranja omogućuje se interdisciplinaran pristup prostoru. Takav pristup pritom podrazumijeva strateške analitičke postupke poput (1) određivanja misije i vizije razvoja, (2) utvrđivanja strateških ciljeva na osnovi rezultata SWOT analize te (3) analizu razvojnih trendova, što zajedno čini osnovu za definiranje mogućih scenarija razvoja područja.

Analitičke metode krajobraznog planiranja poput strukturne analize po Lynchu (1960), krajobrazno-ekološke analize po Formanu i Godronu (1981) (slika 3) te analize uzoraka prostornog uređenja osnova su za razumijevanje strukture i funkcije krajobraza, ali i njihovih promjena kroz vrijeme kao osnovnih pokazatelja heterogenosti krajobraza.

Na osnovi rezultata analiza i vrednovanja prostora te matrice poželjnog susjedstva i analize dimenzija djelatnosti, u fazi sinteze moguće je definirati alternativne

interaction matrices and impact networks. Environmental vulnerability is used as a method for impact assessment in cases where spatial alternatives are possible within the location of the activity.

Special attention is given to landscape impact assessment as a synthesis component of the environment, particularly the importance and visibility of the structural (relief, hydrology, vegetation, etc.) and visual characteristics of the landscape. GIS technology and tools are exceptionally important in producing spatial analyses, visual simulations and 3D models (Figure 5) to represent complex environmental changes and their consequences.

2.4 Landscape character assessment procedure within landscape typology/landscape atlases

Landscape character assessment is the standard procedure of identifying, typologising, mapping and describing a landscape, but also it can cover assessment of conditions, sensitivities and/or preferences (Raymond et al. 2015, Nogué et al. 2017, Swanwick 2002, Tudor 2014). Depending on its purpose, it can be carried out at several hierarchical levels. Its theoretical starting point is the concept of landscape character, defined as the specific combination of natural and cultural factors of landscape formation that creates a unique, distinctive and consistent pattern of elements making one particular landscape different from another, whether better or worse (Swanwick 2002, Tudor 2014). The application of the landscape character concept in the division and interpretation of landscape units is based on the overlapping and analysis of different spatial data (factors of a landscape) using GIS tools. Therefore, a very extensive part of this procedure is the preparation of a GIS database with different vector and raster data. Along with digital orthophoto maps from different time periods, a Croatian base map, topographic maps to the scales of 1:25 000 and 1:100 000, old cadastral maps, and other thematic maps (pedological, geological, climate, hydrological, vegetation, DEM, maps of protected areas and objects, maps of spatial patterns) are digitally prepared. A very important step is the preparation of detailed maps of land use for settlements, traffic and other infrastructure. A time analysis of land use changes is also necessary. Today, this is easier to achieve thanks to the availability of old Austro-Hungarian maps and aerial maps made since 1986.

Depending on the map scale, various maps and spatial data are analysed simultaneously; at the higher levels relief, geology, general land use categories and settlement types are observed, while at the lower levels detailed types of land use and vegetation, parcelling and settlement patterns, micro relief, slopes, and so on, are observed.

Mapping the areas of common character is carried out by mapping polygons with attributed data on the names of an identified unit, its condition and values. Field trips and aerial photography are also necessary. The next step is to plan GPS routes and define points of interest to be transformed into GPS or mobile devices. Field research usually involves gathering a huge amount of photos, and digitally archiving is essential for easier systematization and previewing. All photos are geotagged according to data on synchronisation of the time and coordinates. Geosetter is a well-known free tool used to preview and organize geo and other meta data.

Geotagged photos can be easily imported into the GIS database as vector points, or integrated in a shape file using the link for the photo saved on the internet server.

Quantitative information generated from mapped GIS data is essential in describing landscape units (the predominance of the elevation, proportions of land use types, number of certain objects, road length etc.) and can be obtained through different functions for vector and raster analysis.

Landscape character assessment usually does not include evaluation judgements, but the final product can be used as a basis for evaluating and assessing landscape sensitivity. Mapped areas are evaluated according to a common system: cultural-historical, natural, and aesthetic qualities. Evaluation principles can be diverse, but in the context of this paper, a specific approach is presented (Andlar et al, 2015, Tomić Reljić et al, 2016).

Besides vector data on landscape units (*.shp), vector data on landscape vulnerability to planning development is needed to conduct analysis of landscape sensitivity. The data are overlapped and the average vulnerability of each landscape unit is calculated. Classification of average values provides a basis for landscape sensitivity maps.

The basic concept behind a landscape atlas or landscape character map is its dynamic application and the possibilities of updating, correcting and connecting with compatible results over time, which is impossible without GIS tools. GIS tools play a very important role in the final presentation of the product. A wide range of possibilities for overlapping spatial data in the context of graphical design is a necessary element in bringing the results closer to users.

Landscape atlases, or landscape character maps, resulting from landscape character assessment, may

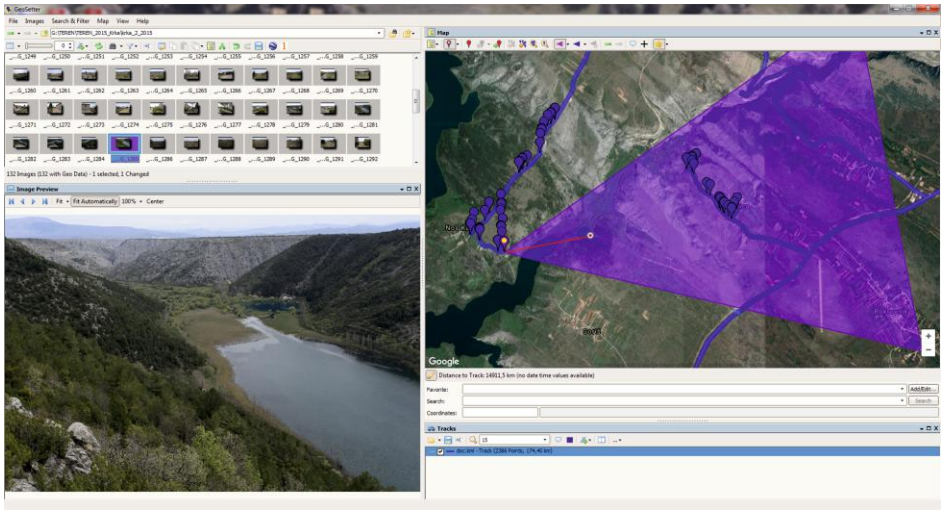


Fig. 6 Photo preview in the Geosetter application
Slika 6. Prikaz pregledavanja fotografija s pomoću Geosettera

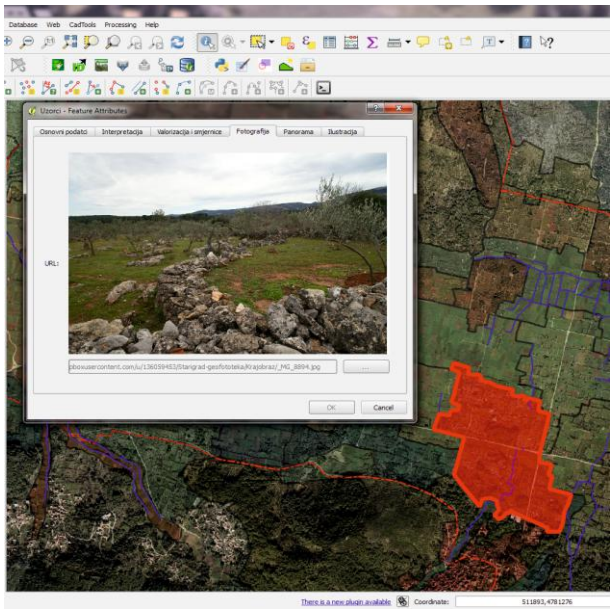


Fig. 7 Multiple attribute table of a shape file; photos can be embedded along with textual and numeric information
Slika 7. Prikaz višestruke funkcije atributne tablice pojedinog vektorskog podatka u koju se, osim tekstualnih i brojčanih informacija, mogu ugrađivati i fotografije

prostorne dijagrame i koncepte. Ovdje prikazani razvojni scenariji uređivanja prostora (slika 4) pritom uključuju zaštitno-okolišne kriterije te su osnova za transformaciju razvojnih programa u prostorne kategorije i na analizi prostora u pogledu mogućnosti realizacije razvojnog programa uz uključivanje zaštitno-okolišnih mjera.

2.3. Strateška i projektna procjena utjecaja na okoliš

Strateška procjena utjecaja na okoliš (SPUO) ima za cilj odrediti okolišne posljedice pojedinih planova i programa kako bi se omogućilo da budu uzeti u obzir prilikom donošenja odluka o razvoju u prostoru (Direktiva 2001/42/EZ o procjeni učinaka pojedinih planova i programa na okoliš Vijeća Europe od 27. lipnja 2001. – SEA Direktiva).

Kako bi se primijenila održivost u sustavu prostornog planiranja, potrebno je sve prijedloge korištenja zemljišta izložiti okolišnoj provjeri putem procjene utjecaja na okoliš. S ciljem provjere plana korištenja zemljišta s aspekta zaštite okoliša mogu se koristiti analize ranjivosti koje utvrđuju kvalitete okoliša na strateškoj razini. Njihovi rezultati ukazuju na potencijalne utjecaje te upućuju na korekcije plana kako bi se dosljedno primijenila filozofija održivog razvoja. Premda je ranjivost kvaliteta okoliša razvijena u okviru krajobraznog planiranja, Golobič (2010) naglašava da je isti "koncept ranjivosti" primjenjiv kao metoda u SPUO. Kako bi se provela okolišna provjera strateškog plana prostornog razvoja, provode se analize ranjivosti okoliša za svaku aktivnost. Sukladno ocijenjenom utjecaju, moguće su korekcije plana, tj. lokacije za svaku od planiranih aktivnosti, te se za svaku djelatnost izrađuju smjernice za uređenje prostora.

Postupak izrade studije o utjecaju na okoliš za izabrane aktualne primjere, s naglaskom na prostorne vidike procjene, također je jedan od stručnih zadataka krajobraznih arhitekata. Polazište za procjenu je utvrđivanje negativnih utjecaja zahvata na okoliš, analiziraju se sustavi okoliša, utvrđuju promjene okoliša i utjecaji na okoliš. Vrednuju se promjene okoliša – njihova kvantitativna i kvalitativna komponenta. Od analitičkih alata koriste se popisi utjecaja na okoliš, popisi sastavnica okoliša, popisi planirane djelatnosti, interakcijske matrice i mreže utjecaja. Također se koristi ranjivost kao osnova procjene utjecaja na okoliš u slučaju kada su moguće prostorne alternative unutar lokacije zahvata.

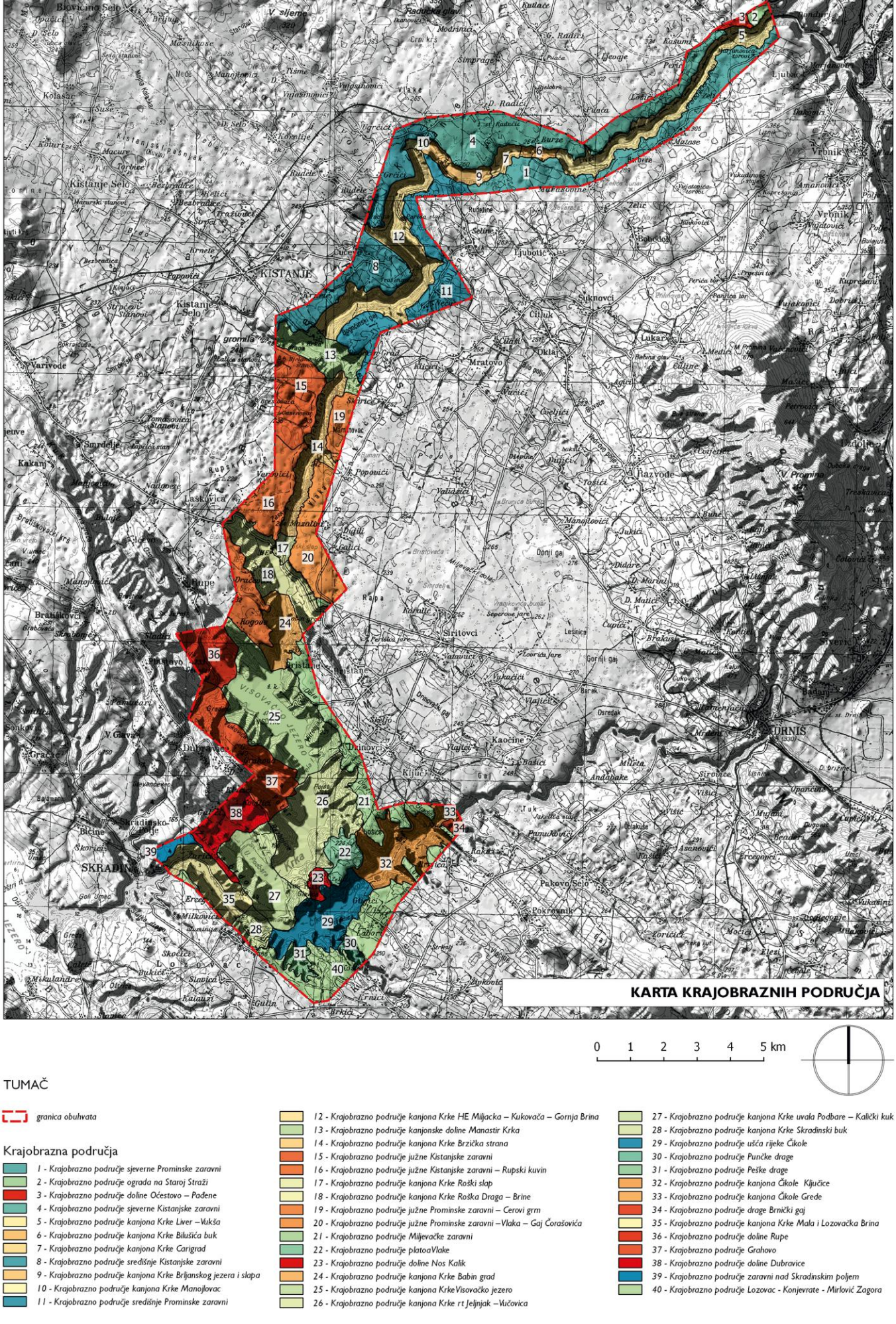


Fig. 8 Final map of landscape areas overlapped with 1:100 000 topographic map and DEM

Slika 8. Konačna karta krajobraznih područja preklopljenih topografskom kartom mjerila 1:100 000 i digitalnim modelom reljefa

Posebna se pozornost posvećuje procjeni utjecaja na krajobraz kao sintezne sastavnice okoliša, odnosno važnosti promjena strukturnih (reljefnih, hidroloških, vegetacijskih itd.) i vizualnih značajki krajobraza, kao i njihove vizualne izloženosti. Iznimna je važnost GIS-a u izradi prostornih analiza, vizualnih simulacija i 3D modela (slika 5) kako bi se što bolje prikazale kompleksne okolišne promjene i njihove posljedice.

2.4. Postupak procjene karaktera krajobraza u izradi atlasa krajobraza ili krajobrazne osnove

Procjena karaktera krajobraza standardni je postupak identifikacije, tipologije, kartiranja i opisivanja krajobraza nekog područja, a može obuhvaćati i procjenu stanja, osjetljivosti i/ili preferencija krajobraza (Raymond i dr. 2015., Nogué i dr. 2017, Swanwick 2002, Tudor 2014). Ovisno o svrsi, može se provoditi na više hijerarhijskih razina. Temeljno teorijsko polazište jest koncept karaktera krajobraza koji je definiran kao specifična kombinacija određenih prirodnih i kulturnih čimbenika tvorbe krajobraza koja gradi svojstven, prepoznatljiv i konzistentan uzorak elemenata čineći tako određeni krajobraz drugačijim od drugog, prije nego boljim ili lošijim (Swanwick 2002, Tudor 2014). Primjena koncepta karaktera krajobraza u izdvajanju i interpretaciji krajobraznih jedinica temelji se na preklapanju i analizi različitih prostornih podataka (čimbenika krajobraza) uz pomoć GIS-a. Stoga je opsežan dio ovog postupka uspostava GIS baze podataka koju čine različiti rasterski i vektorski podatci. Osim DOF-a iz različitih razdoblja, HOK-a, TK25 i TK100 i povijesnih katastara, izrađuju se i/ili digitaliziraju različite tematske karte (pedološke, geološke, reljefne, klimatske, hidrološke, vegetacijske, karte zaštićenih prostora i objekata, karte prostornih uzoraka itd.) Posebno je važno izraditi detaljne karte načina korištenja zemljišta, naselja, prometne i druge infrastrukture. Za razumijevanje promatranog krajobraza nužna je i vremenska analiza promjena u korištenju zemljišta, a koja je danas u Hrvatskoj olakšana zbog dostupnosti starih austrougarskih karata te aerosnimaka od 1968. do danas. Ovisno o razini kartografskog mjerila simultano se analiziraju različite kartografske podloge i prostorni podatci; npr. na višim se razinama promatraju reljef, geologija, opće kategorije načina korištenja zemljišta i tipovi naselja, dok se na nižim detaljnijim razinama promatraju detaljni tipovi načini korištenja zemljišta i vegetacije, uzorci parcelacije i naselja, mikroreljefne forme, nagibi itd.

Kartiranje područja zajedničkog karaktera krajobraza provodi se izradom vektorskog poligona s pripadajućim podatcima o nazivu identificirane jedinice, stanju i vrijednostima. Nužan korak u karakterizaciji krajobraza imaju terensko istraživanje i snimanje iz zraka pri čemu je opet nužna upotreba GIS-a. Izrađuje se plan GPS ruta i utvrđuju točke interesa koje se prenose na GPS ili mobilne uređaje. Terensko istraživanje se obično temelji na prikupljanju velikog broja fotografija pri čemu je, radi lakšeg sistematiziranja i pregledavanja, neophodno digitalno arhiviranje. Zbog toga se u fotografiju ugrađuje geo-oznaka (geotagg) i to temeljem sinkronizacije podatka o vremenu i koordinati točke snimanja fotografije. Poznati besplatni program koji se koristi za prikaz i uređivanje geopodataka i ostalih metapodataka fotografskih datoteka je aplikacija Geosetter.

Fotografije s geooznakama lako se unose kao podatak u GIS bazu kao vektorske točke ili se mogu integrirati u *.shp datoteku ugrađivanjem poveznice na fotografiju pohranjenu na internetskom servisu.

Pri opisivanju krajobraznih jedinica neophodne su kvantitativne informacije koje se mogu generirati iz kartiranih GIS podataka: npr. prevladavajući nagib terena, udio određenog tipa načina korištenja zemljišta, brojnost određenih objekata, duljina prometnica, a za što se koriste različite funkcije analize vektorskih i rasterskih podataka. Procjena karaktera krajobraza uobičajeno je lišena vrijednosnih prosudbi, međutim njezin krajnji rezultat može služiti kao podloga za vrednovanje i procjenu osjetljivosti krajobraza. U tom smislu kartirana se područja vrednuju po uvriježenom sustavu: kulturno-povijesne, prirodne i estetske kvalitete. Principi ocjenjivanja mogu biti različiti, no u kontekstu ovog rada prezentiran je specifičan pristup (Andlar i sur. 2015, Tomić Reljić i sur. 2016). Uz izvedeni vektorski podatak o krajobraznim jedinicama, za određivanje osjetljivosti krajobraza potreban je i vektorski podatak o ranjivosti prostora na planirani razvoj. Navedeni se podatci preklapaju, a za svaku krajobraznu jedinicu računa se prosječna ranjivost. Klasifikacijom prosječnih vrijednosti dobivaju se karte osjetljivosti krajobraza.

Osnovna filozofija atlasa krajobraza ili krajobrazne osnove jest njezina dinamička primjena i mogućnost naknadne nadopune, korekcije, razrade te povezivanje s kompatibilnim rezultatima, a što bez GIS-a nije moguće. GIS ima vrlo važnu ulogu i u konačnom prikazu proizvoda. Raznolikost mogućnosti preklapanja prostornih podataka u smislu grafičkog dizajna neophodna je stavka u približavanju rezultata korisnicima.

Atlasi krajobraza/krajobrazne osnove kao rezultat provedbe karakterizacije krajobraza u praksi mogu imati različite primjene. Integralni inventar o prostoru te prostorna generalizacija na cjeline sličnog karaktera, stanja i

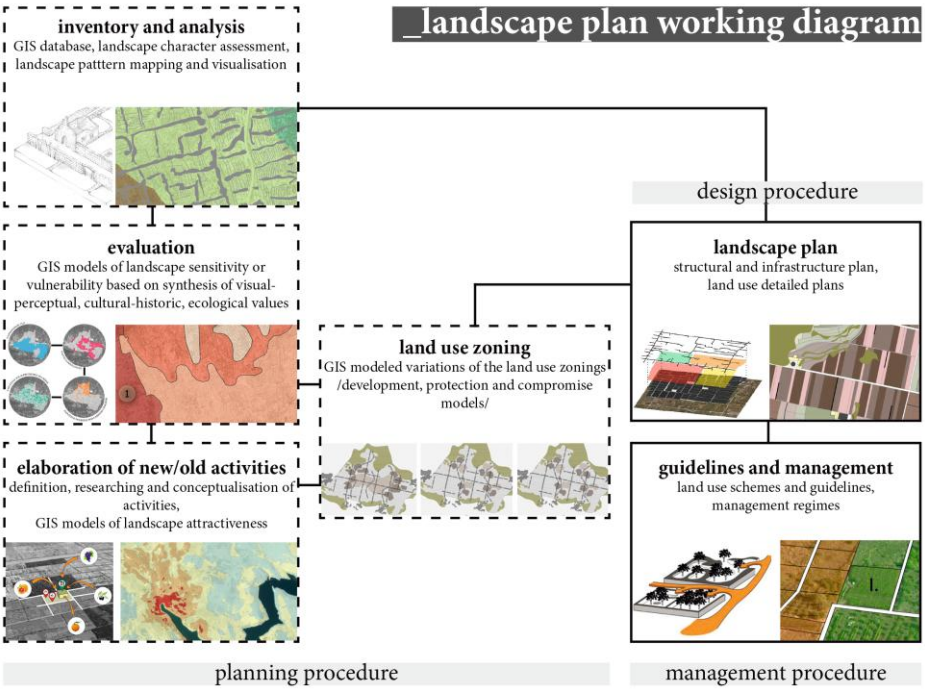


Fig. 9 Creating a landscape revitalisation plan; GIS modelling, CAD drawing, compilation of photographs, manual sketching, and 3D block diagrams

have different practical applications. An integral inventory and spatial generalization with similar units, conditions and values provide a specific framework for articulating the management regime within natural protected areas (management plans), protected immovable cultural heritage (conservation studies) and local development plans. They are necessary expert studies for SEA and EIA, but also can be useful as exploratory studies for spatial plans, and help prescribe measures for the preservation of landscape values, while recognizing the limits of accommodating specific spatial purposes.

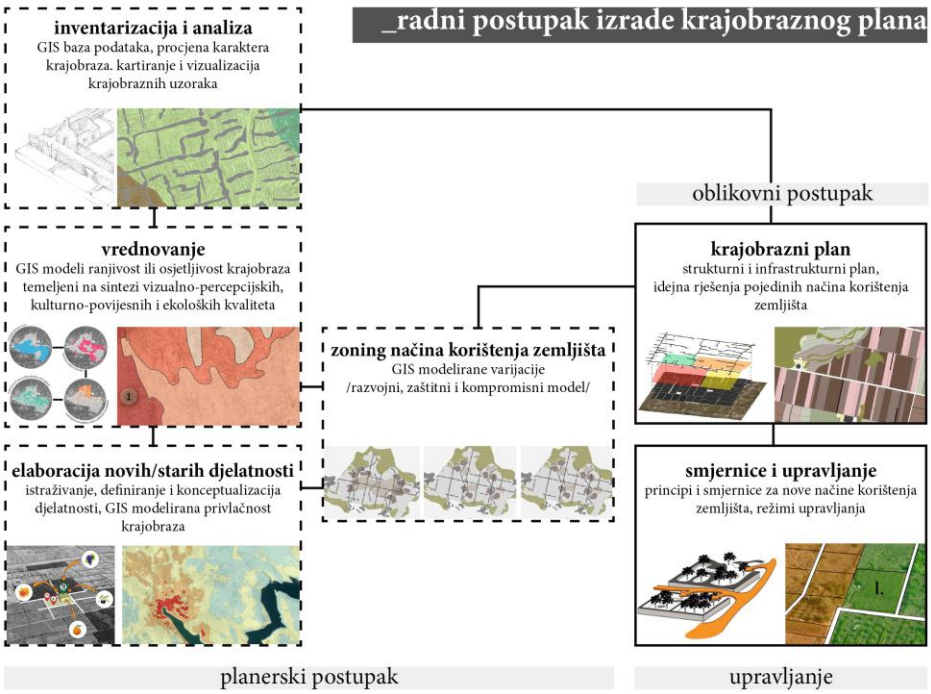
2.5 Landscape plans in the revitalization of rural landscapes

Landscape plans can have different meanings, levels, and applications in sectoral instruments for spatial planning and management. As the general starting point, it is important to accept the Recommendations for the implementation of the ELC (2008) which states that landscape plans, as separate documents or supporting studies, are key instruments in the implementation of landscape policies in cartographic form, supported by reports, measures and quality objectives. Plans should include protection provisions, management, planning and revitalization of the landscape, educational provisions for public information and awareness arising from the landscape, and the direct participation of local communities to monitor change processes and encourage efficient decision implementation.

In European practice, this has proved beneficial in planning and managing rural areas, for example in Germany, France, Great Britain, Switzerland and the Netherlands (Sala et al 2015), especially in dealing with conflicts between development and conservation interests, bridging the constraints derived from administrative limits, and coping with the lack of instruments for the articulate, integral planning of the countryside, unbuilt and/or rural areas.

This kind of pilot model, or plan for the revitalization of the rural landscape, has been developing in Croatia through the activities of the landscape architecture profession (Andlar et al. 2014, Aničić et al. 2007, Aničić 2004). It is a local level plan, including landscape planning procedures, design and management. In the planning aspect, it introduces a land use plan (or several alternatives); in the design aspect at the concept level, it introduces a structural, functional and aesthetic vision of implementationally planned activities into a research area; while in the management aspect, it provides guidelines and simulated principles for new ways of using land.

The fundamental principle for making a revitalisation plan is to adopt an integral, compromise approach, taking into consideration all the recognized characteristics, values and interests. This is based on researching the character of a certain area (with the emphasis on the landscape pattern level, e.g. Andlar et al. 2017) and elaborating existing and new activities in the space. It aspires to alternative, rather than one-way solutions, starting from the simulation of potential spatial changes (positive/negative) and planned activities. Such a tool



Slika 9. Generiranje plana revitalizacije; GIS modeliranje, CAD crtanje, fotomontaže, skiciranje i 3D blok dijagrami

vrijednosti donose konkretan okvir za artikuliranje režima upravljanja unutar područja zaštićene prirode (planovi upravljanja), zaštićenih nepokretnih kulturnih dobara (konzervatorske podloge) te u planovima lokalnog razvoja. Neophodna su stručna podloga u SPUO i PUO, a mogu biti korisni i kao podloga u polazištima svih razina prostornih planova i pomoći pri propisivanju mjera očuvanja krajobraznih vrijednosti te uočavanju ograničenja za smještaj određenih namjena prostora.

2.5. Krajobrazni plan u funkciji plana revitalizacije ruralnog krajobraza

Inozemna iskustva upućuju na činjenicu kako "krajobrazni plan" može imati različita značenja, razine i primjene u različitim sektorskim instrumentima planiranja i upravljanja prostorom. Za opća polazišta valja uvažiti Preporuke za implementaciju EKK (2008) u kojima se navodi kako je krajobrazni plan (kao autonomni dokument ili prateća studija) jedan od ključnih instrumenata u provedbi krajobraznih politika. Uvriježena mu je forma kartografska, potkrijepljena izvještajem, smjernicama i ciljevima kvalitete. Navodi se također kako bi plan trebao uključivati odredbe zaštite, upravljanja, planiranja te revitalizacije krajobraza, edukacijske odredbe u smislu informiranja i podizanja svijesti o krajobrazima, izravnu participaciju lokalne zajednice, te pratiti procese promjena i poticati učinkovitost provedbe donesenih odluka. U europskoj se praksi krajobrazni plan posebno pokazao korisnim u planiranju i upravljanju ruralnim područjima, primjerice u Njemačkoj, Francuskoj, Velikoj Britaniji, Švicarskoj i Nizozemskoj (Sala i dr. 2015), i to u rješavanju konflikata između razvojnih i zaštitnih interesa, prevladavanju ograničenja uzrokovanih administrativnim granicama i općenito nepostojanjem instrumenata za artikulirano i cjelovito planiranje izvangradskih, neizgrađenih i/ili poljoprivrednih područja. Upravo takav pilot model u formi plana revitalizacije ruralnog krajobraza u Hrvatskoj se razvija kroz djelovanje struke krajobrazne arhitekture (Andlar i sur. 2014, Aničić i sur. 2007, Aničić 2004). Riječ je o planu lokalne planerske razine, a specifičnost mu je da objedinjuje postupke krajobraznog planiranja, oblikovanja i upravljanja. U planerskom smislu donosi plan namjene površina (ili više varijanata), u oblikovnom smislu, na idejnoj razini donosi strukturnu, funkcionalnu i estetsku viziju ugradnje planiranih djelatnosti, a na razini upravljanja donosi smjernice i simulaciju principa novih načina korištenja zemljišta.

Osnovno načelo izrade plana revitalizacije je integralni i kompromisni pristup promatranom prostoru, uzimajući pritom u obzir sve prepoznate karakteristike, vrijednosti i interese. Temelji se na istraživanju karaktera promatranog prostora (s naglaskom na razinu krajobraznih uzoraka, kao npr. kod Andlara i sur. 2017) te na istraživanju i elaboraciji postojećih i novih djelatnosti. Ne teži jednosmjernim, već varijantnim rješenjima, a polazi od simuliranja potencijalnih prostornih promjena (pozitivnih/negativnih) i planiranih djelatnosti. Takav alat može biti koristan u planiranju poljoprivrednog zemljišta, rekreacijskih i turističkih namjena zemljišta, regulaciji vodnih resursa, upravljanju uslugama

may be useful in planning rural areas, recreational and tourist land uses, water regulations, managing ecosystem services, and others, especially in areas of multiple interests and conflicts. Therefore it is compatible with spatial plans, land consolidation plans, management plans of protected areas, conservation studies, and local development projects, etc.

There is no single approach to planning landscape revitalization. It may include a series of tools described in this paper, combined in a unique approach depending on goals, purposes, and the size of the research area, etc. However, at the general level, the main principle is dealing with:

- landscape characteristics (atlas of landscape areas and/or patterns)
- landscape values (landscape vulnerability, evaluation of landscape areas, public preferences) and
- developmental interests (planning activities).

The first step in the process is to overlap landscape values with planned development activities, whereby land use plan alternatives are modelled. This aims at the optimal distribution of activities according to the character and values of the landscape. These alternatives are usually based on development, protection and compromise scenarios, and are made using suitability modelling.

Based on landscape character, and according to design thinking, the final scenario is implemented in the structural revitalisation plan. Structural characteristics of planned land use can be elaborated and simulated in more detail using various techniques; a combination of GIS, CAD tools, photo simulations, sketching techniques, block diagrams, etc.

The great advantage of GIS tools in this procedure is the fast generation of alternative solutions and simulations. The ability to provide the public or target group with fast presentations of alternative solutions objectifies the procedure. It also neutralizes the role of planners in decision-making and emphasizes their role in moderating different interests and conflicts. Quick and easy access to all the gathered and generated spatial data, and the extensive database of spatial characteristics and values, provide a broad integral context for spatial professionals, impacting on the integrity of their judgement, and finally, contributing to a better sensibility regarding space.

3 Conclusion

The modern landscape paradigm considers a holistic approach, including the inherent anthropogenic and natural aspects of a space, and an understanding of the interdependence of biophysical cultural-historical, material and immaterial elements.

Contemporary development processes change the environment significantly, which indicates the need for careful developmental direction, i.e. the development of environmental protection methods, and process-oriented, transparent, scientific approaches. This can be achieved though landscape planning, whose basic principle is sustainability, and land management based on understanding the different human and natural processes within a space (McHarg, 1969; Pietsch, 2012; Steiner,1991; Ndubisi, 2002). Considering landscape as an integral concept means using different spatial data, analysing them simultaneously, and evaluating them as a whole, which is impossible without GIS tools. Through the development of landscape planning approaches, many GIS tools have been expanded. There are many such approaches today, and their application and benefits in practice form part of the sectoral policies of developed countries, while they are also being promoted in many international documents and conventions.

From the review of landscape planning approaches in this paper, (similar to Pietsch's (2012) conclusions), GIS is clearly needed at all levels of procedures:

1. Inventory, establishing the database
2. Scientifically based, verifiable analysis and evaluation
3. Generating scenarios for future development and alternative solutions
4. Generating objectives and decisions
5. Presentation and visualization of results, thus influencing better participation procedures, collaboration and decision-making.

This paper also shows diverse applications which are targeted towards various sectoral instruments which have interests in and responsibility for the landscape; spatial planning, natural and environmental protection, conservation of cultural heritage, land policies, rural and tourist development, and energetics.

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We are grateful to the students of the School of Landscape Architecture whose maps from seminars and final theses were used as examples in presenting landscape planning approaches. The maps presented here were developed through projects by the Department of Ornamental Plants, Landscape Architecture and Garden Art; *Landscape Character of Krka National Park* and *Historical Study of Stari Grad Plain.*

ekosustava, posebno u područjima u kojima su uočeni višestruki interesi i konflikti. Kao takav kompatibilan je s prostornim planovima, planovima komasacija, planovima upravljanja zaštićenim područjima, konzervatorskim podlogama, projektima lokalnog razvoja.

Nema jedinstvenog načina izrade plana revitalizacije krajobraza. Može uključivati niz alata opisanih u ovom radu; a, ovisno o ciljevima, svrsi i veličini promatranog teritorija, oni se modeliraju u jedinstven pristup. Međutim, na općoj razini glavno načelo je suprotstavljanje:

- karakteristika krajobraza (atlas krajobraznih područja i/ili uzoraka)
- vrijednosti krajobraza (ranjivost, vrednovanje krajobraznih područja, društvene preferencije) i
- razvojnih interesa (planirane djelatnosti).

Prvi vid suprotstavljanja čini preklapanje krajobraznih vrijednosti i planiranih/razvojnih djelatnosti pri čemu se modeliraju alternativni planovi namjene koji teže optimalnoj distribuciji aktivnosti sukladno karakteru i vrijednosti krajobraza. Te su varijante obično utemeljene na razvojnom, zaštitnom i kompromisnom scenariju, a izrađuju se korištenjem modela pogodnosti. Usuglašeni scenarij plana namjene preklapa se s karakterom krajobraza, pri čemu se u duhu oblikovnog promišljanja izrađuje strukturni plan revitalizacije. Pritom se strukturna obilježja svake planirane namjene/zone mogu razrađivati, ali i simulirati različitim tehnikama, poželjno kombinacijom GIS-a, CAD-a, računalnim fotosimulacijama, tehnikom skiciranja, blok dijagrama i sl.

Velika prednost upotrebe GIS-a jest brzo generiranje alternativnih rješenja, ali i njihovo simuliranje. Mogućnost brzog prikaza alternativnih rješenja javnosti ili ciljanoj skupini također objektivizira postupak te neutralizira ulogu planera kao donositelja odluka i naglašava njegovu ulogu moderatora različitih interesa i konflikata. Brz i jednostavan pristup svim okupljenim i generiranim prostornim podatcima, te spoznaja o karakteristikama i vrijednostima prostora, planerima pruža široki integralni kontekst koji utječe na neparcijalnost prosudbe i, konačno, doprinosi boljem senzibilitetu prema prostoru.

3. Umjesto zaključka

Moderna paradigma krajobraza podrazumijeva holistički koncept u kojem je antropogeni i prirodni aspekt prostora nerazdvojiv, u kojem je neophodno razumijevanje međuovisnosti biofizičkog i kulturno-povijesnog te materijalnog i nematerijalnog.

Sve prisutniji suvremeni razvojni procesi značajno mijenjaju okoliš, što upućuje na potrebu pažljivog usmjeravanja razvoja, tj. razvoj zaštitno-okolišnih metoda, ali i tzv. procesno orijentiranih, transparentnih, znanstveno provjerljivih postupaka. Upravo se to donosi kroz krajobrazno planiranje čije je osnovno načelo održivo planiranje i upravljanje zemljištem utemeljeno na razumijevanju kombiniranih ljudskih i prirodnih procesa u prostoru (McHarg 1969, Pietsch 2012, Steiner 1991, Ndubisi 2002). Razmatrati krajobraz kao integralni koncept (trijada kulturno-povijesno – ekološko – vizualno doživljajno) znači koristiti se različitim prostornim podatcima, simultano ih analizirati i sintezno ih vrednovati, što nije moguće bez GIS-a. Upravo kroz razvoj metoda/pristupa krajobraznog planiranja razvijaju se i mnogi GIS alati. Paleta pristupa krajobraznog planiranja danas je široka, njihova primjena i dobrobit u praksi su vrlo brzo našli mjesto u sektorskim politikama razvijenih zemalja, a bivaju i temom promoviranja kroz niz međunarodnih dokumenata i konvencija.

Iz pregleda pristupa krajobraznog planiranja prikazanih u ovom radu vidljivo je (slično kao što i Pietsch (2012) navodi u svom radu) kako je GIS neophodan u svim razinama postupaka:

1. inventarizaciji, uspostavi baze prostornih podataka
2. znanstveno utemeljenoj i provjerljivoj analizi i vrednovanju
3. generiranju scenarija budućeg razvoja i alternativnih rješenja
4. generiranju ciljeva i odluka
5. prezentaciji i vizualizaciji rezultata te utjecaju na bolje postupke participacije, kolaboracije i odlučivanja.

Iz pregledanog je također vidljivo kako su primjene raznolike, odnosno kako ciljaju prema različitim sektorskim instrumentima koji imaju interes i odgovornost prema krajobrazu: prostornom planiranju, zaštiti prirode i okoliša, zaštiti kulturne baštine, zemljišnoj politici, ruralnom i turističkom razvoju i energetici.

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References / Literatura

Albrechts L (2004) Strategic (spatial) planning re-examined, Environment and Planning B, Planning and design, 31:239-256

Andlar G, Aničić B, Šteko V (2014) Landscape plan as an instrument for revitalization of the cultural landscape – case of the UNESCO's Stari Grad Plain landscape plan Contemporary Development of European Rural Areas - International Scientific Conference. Zadar, 4-6 September. Book of abstracts. Šiljković Ž, Čuka A, Pejdo A (ed) (2014) Zadar: Department of Geography, University of Zadar, Croatia; Department of Geography, Faculty of Arts, University of Ljubljana; Department of Geography, Faculty of Science and Education, University of Mostar; Bosnia and Herzegovina (ISBN: 978-953-331-065-7)

Andlar G, Šrajer F, Trojanović A (2017) Classifying the Mediterranean terraced landscape: The case of Adriatic Croatia. Acta Geographica Slovenica - Geografski Zbornik. vol. 57, nr. 2, Jan 2017

Andlar G, Šteko V, Tomić D (2015) Krajobrazna osnova Nacionalnog parka Krka, Sveučilište u Zagrebu, Agronomski fakultet, Zavod za ukrasno bilje, krajobraznu arhitekturu i vrtnu umjetnost, rujan 2015, Zagreb

Aničić B, Ogrin D, Andlar G, Pereković P, Hrdalo I, Rechner I (2007) Revitalisation of the landscapes on the Island of Korcula – Case study of the municipality of Blato. JCEA - Journal of Central European Agriculture 8, 2, 243-256

Aničić B (ed) (2004) Revitalisation of the fire damaged areas in the Dubrovnik-Neretva County: International workshop, April 16-13, Dubrovnik, Croatia. Zagreb: Department of Ornamental Plants, Landscape Architecture and Garden Art, University of Zagreb, Faculty of Agriculture

Arciniegas G, Janssen R (2012) Spatial decision support for collaborative land use planning workshops, Landscape and Urban Planning 107: 332-342

Breskvar Žaucer L, Zupan B, Golobič M (2009) Analysis of preference maps using data mining methods. Geodetski vestnik 53/2009 – 1

van den Brink A, Bruns D (2014) Strategies for Enhancing Landscape Architecture Research, Landscape Research, 39:1, 7-20, DOI: 10.1080/01426397.2012.711129

Brown G, Brabyn L (2012) An analysis of the relationships between multiple values and physical landscapes at a regional scale using public participation GIS and landscape character classification. Landscape and Urban Planning. 107: 317-331

Butler A (2016) Dynamics of Integrating Landscape Values in landscape character assessment: the hidden dominance of the objective outsider. Landscape Research. 41(2), 239-252, DOI: 10.1080/01426397.2015.1135315

Butula S (2004) Vrijednosni sustavi riječnih krajobraza kao osnova za planiranje. Doktorska disertacija, Sveučilište u Zagrebu, Agronomski fakultet

Carsjens G J (2009) Supporting Strategic Spatial planning: Planning support systems for spatial planning of metropolitan landscapes, PhD thesis, Wageningen University, Wageningen (ISBN 978-90-8585-807-7)

CEC (1997) European Spatial Development Perspective: First Official Draft, presented at the Informal Meeting of Ministers Responsible for Spatial Planning of the Member States of the European Union, Noordwijk, June, Luxembourg: Office for Official Publication of the European Communities

Council of Europe (2008) Recommendation of the Committee of Ministers to member states on the guidelines for the implementation of the European Landscape Convention. Source: http://www.coe.int/t/dg4/cultureheritage/heritage/landscape/versionsorientation/anglais.pdf

Eastman R (1999) Multi-criteria evaluation and GIS. In: Longley PA, Goodchild MF, Maguire DJ, Rhind DW (eds) Geographical information systems, Chap 35, Wiley, New York

European Communities (1999) European Spatial Development Perspective Towards Balanced and Sustainable Development of the Territory of the European Union, Informal Council of Ministers Responsible for Spatial Planning, European Commission, Potsdam

European Commission (2010) Towards green infrastructure for Europe. Developing new concepts for integration of Natura2000 network into a broader countryside. EC Study ENV.B.2/SER/2007/0076. Source: http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure_integration.pdf

European Commission (2015) Supporting the Implementation of Green Infrastructure Final Report. ENV.B.2/SER/2014/0012 Source: http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructures/GI%20Final%20Report.pdf

Fabos J GY (1979) Planning and landscape evaluation. Landscape Research. 4:2, pp. 4-10

Falconer L, Hunter D, Telfer T C, Ross L G (2013) Visual, seascape and landscape analysis to support coastal aquaculture site selection. Land Use Policy. Vol. 34 (2013), pp. 1-10

Forman R T T, Godron M (1981) Patches and Structural Components for a Landscape Ecology. BioScience. 31(10): 733-740.

Golobič M, Breskvar Žaucer L (2010) Landscape planning and vulnerability assessment in the Mediterranean: thematic study, final report. Ljubljana. Regionalni centar programa prioritetnih akcija, PAP/RAC, Split, p. 92.

Gonzáles A, Donnelly A, Jones M, Chrysoulakis N, Lopes M (2013) A decision-support system for sustainable urban metabolism in Europe. Environmental Impact Assessment Review. 38. 109-119

Healey P (2009) In Search of the "Strategic" in Spatial Strategy Making. Planning Theory & Practice. 10:4 pp. 439-457

Ipsen D (2012) The sociology of landscape in: Bell S, Sarlöv Herlin I, Stiles R (eds) Exploring the boundaries of landscape architecture. Routledge. London, New York

Krause C L (2001) Our visual landscape: managing the landscape under special consideration of visual aspects. Landscape and Urban Planning. 54:239-254

Lynch K (1960) The Image of the City. The MIT Press. Massachusetts Institute of Technology. Cambridge, Massachusetts, and London, England

Marušič J (1993) Conservation planning within the framework of landscape planning in Slovenia. Landscape and Urban Planning. 23. 233-237

McHarg I (1969) Design with Nature. The Natural History Press. Garden City. New York

Mengots A (2016) Review of digital tools for landscape architecture. Scientific Journal of Latvia University of Agriculture, Landscape Architecture and Art. 8:8 pp. 72-77

MGIPU (Ministarstvo graditeljstva i prostornog uređenja Republike Hrvatske) (2013) Izvješće o stanju u prostoru Republike Hrvatske 2008-2012, Zagreb. Source: http://www.mgipu.hr/doc/Prostorno/Izvjesce_SPRH_08_12.pdf

Ndubisi F (2002) Ecological Planning; A Historical and Comparative Synthesis. The Johns Hopkins University Press. Baltimore and London

NN-MU 12/02. Zakon o potvrđivanju konvencije o europskim krajobrazima. Hrvatski sabor. Zagreb.

Nogué J, Sala P, Grau J (2016) Landscape catalogues of Catalonia: methodology. Olot: Landscape Observatory of Catalonia; ATLL. (Documents; 3). ISBN: 978-84-617-6545-4

Pietsch M (2012) GIS in Landscape Planning, Landscape Planning, M. Ozyavuz (ed), InTech, DOI. Available from: http://www.intechopen.com/books/landscape-planning/gis-in-landscape-planning

Raymond R, Luginbühl Y, Seguin J-F, Cedelle Q, Grare H (2015) Landscape Atlases. Landscape identification, characterisation and assessment method, La Défense, Ministère de l'Écologie, du Développement durable et de l'Énergie

Sala P, Puigbert L, Bretcha G (eds) (2015) La planificació del paisage en l'àmbit local a Europa = Landscape planning at a local level in Europe. Olot: Landscape Observatory of Catalonia; Andorra la Vella: Government of Andorra. (Documents; 2). ISBN 978-84-617-3805-2

Sarlöv Herlin I (2004) New challenges in the field of spatial planning: landscapes. Landscape Research. 29:4, 399-411, DOI: 10.1080/0142639042000289037

Steiner F (1991) The Living Landscape: An Ecological Approach to Landscape Planning. McGraw-Hill, New York

Steinitz C (2012) A framework for geodesign. Esri Press. Redlands, California

Swanwick C (2002) Landscape Character Assessment, Guidance for England and Scotland, The Countryside Agency and Scottish Natural Heritage, source: http://www.snh.org.uk/pdfs/publications/LCA/LCA.pdf

Tomić Reljić D, Butula S, Hrdalo I, Pereković P, Andlar G (2016) Overcoming the Institutional Approach to Protection through Landscape Modelling. Bridging the Gap. ECLAS Conference 2016, Rapperswil, Switzerland. Conference Proceedings. Bauer P, Collender M, Jakob M, Ketterer Bonnelame L, Petschek P, Siegrist D, Tschumi C (eds). Rapperswil, Switzerland: Series of the Institute for Landscape and Open Space, HSR Hochschule für Technik Rapperswil, Nr. 14, 2016. 375-378

Tudor C (2014) An Approach to Landscape Character Assessment. Natural England. Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/396192/landscape-character-assessment.pdf