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DESIGN OF DEVELOPMENT SCENARIOS FOR ŞANLIURFA REGION BASED ON GEODESIGN

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Abstract

Geographic Information Systems (GIS) have become an indispensable part of urban and regional planning since the 90'ies. Yet, one of the limitations of classical GIS is the lack to directly support the way how the planning process is carried out. They lack the capability to encourage the cooperation of stakeholders that have very different levels of computer literacy and come from very divers sectors. For this, different approaches for participatory planning have been developed among them Geodesign. It is a methodology that combines tools of design, GIS and web 2.0 to foster participatory planning. A complete framework for conducting Geodesign as applied to regional landscape studies has been generated by Carl Steinitz. With GeodesignHub (GDH), his framework was converted into its digital representation that enables a digital design workflow online. The purpose of this paper is to show how different development scenarios can be developed for an underdeveloped region in Southeastern Turkey based on the anticipatory change model defined by Steinitz"s Geodesign framework.

Keywords: Geodesign, GIS, Regional planning, Virtual reality.

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Özet

Coğrafi Bilgi Sistemleri (CBS) 90'lı yıllardan beri kentsel ve bölgesel planlamanın vazgeçilmez bir parçası haline gelmiştir. Bununla birlikte, klasik CBS'nin sınırlamalarından biri, planlama sürecinin nasıl gerçekleştirildiğini doğrudan desteklememesidir. Çok farklı düzeylerde bilgisayar okuryazarlığı olan ve çok farklı sektörlerden gelen paydaşların işbirliğini teşvik etme yeteneğinden yoksundurlar. Bunun için geo-tasarım arasında katılımcı planlama için farklı yaklaşımlar geliştirilmiştir. Katılımcı planlamayı teşvik etmek için tasarım, CBS ve web 2.0 araçlarını birleştiren bir metodolojidir. Bölgesel peyzaj çalışmalarına uygulandığı gibi geo-tasarım için eksiksiz bir çerçeve Carl Steinitz tarafından oluşturulmuştur. GeodesignHub (GDH) ile çerçevesi, çevrimiçi bir dijital tasarım iş akışı sağlayan dijital sunumuna dönüştürüldü. Bu çalışmanın amacı, Steinitz'in geo-tasarım çerçevesi tarafından tanımlanan beklenen değişim modeline dayanarak, Güneydoğu Türkiye'de az gelişmiş bir bölge için nasıl farklı kalkınma senaryolarının geliştirilebileceğini göstermektir.

Anahtar kelimler: Geo-tasarım, CBS, Bölgesel planlama, Sanal gerçeklik.

Acknowledgments

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1. INTRODUCTION

Although the term "Geodesign" was coined only some 20 years ago (Kunzmann, 1993) its concept is much older. The meaning of Geodesign is simply design or planning in space and thus, we can postulate that even hunters of the stone age applied this concept as the paintings in the cave of Lascaux show impressively. The roots of modern Geodesign that refers to urban, regional and landscape planning go back to Warren H. Manning who in 1912, for the first time introduced the methodology of spatial analysis by means of overlaying different layers each of them representing one aspect of the landscape like geology, soil, vegetation, etc. (Manning, 1923). Though then, the layers had to be made of sheets of mylars it opened the way for the development of computer based Geographic Information Systems (GIS). It is accepted that the first GIS was founded by Tomlinson while building a digital natural resource inventory system for Canada in the 60'ies (Tomlinson et al. 1999).While at that time GIS were heavy weighed systems running on mainframes that required a thorough understanding of related hardware and software this game has completely changed with the availability of web based solutions. Still, the building of a sound GIS database cannot be accomplished without the cooperate efforts of subject-matter experts in the fields of database design on the one hand and professionals in the fields of natural and social sciences on the other hand. However, once this database is available its deployment can be carried out using light-weight systems like ArcGIS Online (ESRI, 2020) by the layman who has little or no knowledge of the technology working in the background.

This leads to the question whether GIS has been applied successfully for solving problems related to urban and spatial planning in the past. This question can only be answered in the affirmative with certain limitations. Of course, GIS has become an indispensable part of planning in developed and developing countries as well since the 90ies (Harris et al., 1993: Klostermann, 1997: Yeh. 1999; Yeh, 2008). Yet, the limitations of classical GIS lie in two different fields: 1) In most cases, GIS deals only with the description of historical situations and the current state. In opposite to Computer Aided Drawing (CAD) tools, GIS tools currently available on the market are not suited for visualizing and analyzing ideas of future states. 2) They do not directly support the way how the planning process is carried out. They lack the capability to encourage the cooperation of stakeholders that have very different levels of computer literacy and come from very divers sectors. Currently, GIS outputs like printed maps are still often used as official methods in the form of public hearings and written statements in many cities (Healey, 1997; Halvorsen, 2001; Innes & Booher, 2004; Kingston, 2007). Bakır et al. (2018) analyzed the planning process and its results for the Turkish city of Kayseri. They concluded that usually, local government make zoning decisions in an arbitrary manner. Besides personal requests of land owners, insufficient participation in planning and lack of technical staff in municipalities were among the most important reasons for this deficiency.

With the penetration of GIS into academic institutions around the world, wide-spread use in local governments and virtually all vertical sectors and the availability of the first tools on the internet the foundation for the participation of the general public was led. Thus in 1996, at the meeting of United States National Center for Geographic Information and Analysis (NCGIA) the term "public participation geographic information system" (PPGIS) was contrived for the first time. With this term, a description how GIS can support public participation for various applications with the goal of inclusion and empowerment with emphasis on marginalized populations (Nedjeljko, 2011) has been given. This new paradigm is called participatory planning. Participation in this field can be defined as "the process of decision making and problem solving, involving individuals and groups who represents diverse interests, expertise and point of view and who act for the good of all those affected by the decisions they make and the actions that follows" (as cited in Fisher, 2001a, b).

Pettit et al. (2006) examined how 3D geographical visualization can facilitate communication in the urban and regional planning process. They stated that although traditional planning formally allowed for input and ideas from impacted groups it does not encourage the examination of ideas and alternative development scenarios. In contrast, according to them newest developments in the field of visualization offer the key for genuine community engagement in the planning process and the presentation of its outcomes.

Many tools for participatory planning have been developed. However, it was not before the availability of web 2.0 that such a participation could include a wider audience. Geodesign is a methodology that combines tools of design, GIS and web 2.0 to foster participatory planning. In 1995, Carl Steinitz who had been working with his colleagues and students over a period of approximately 30 years at the Harvard Graduate School of Design developed a comprehensive framework for doing Geodesign as applied to regional landscape studies (Steinitz, 2012).

In his book "Geodesign – Case Studies in Regional and Urban Planning" McElwaney (2012) listed seven key characteristics of Geodesign: 1. design in geographic space, 2. facilitation of science-based design, 3. facilitation of value-based design, 4. maximizing benefits to society while minimizing both short- and long-term effects on the natural environment, 5. support for multidimensional design, 6. provision of a framework for exploring issues and resolving conflict, and 7. improving the quality and efficiency of design: For the purpose of this study, in the following we will focus on the latter two key characteristics.

Geodesign fosters collaborative decision mapping. GIS mapping is a powerful visualization tool to provide insight in relations that might otherwise have been missed. Combined with innovative technologies like big touch tables, users can have instant access to such mapping without the necessity of being a GIS professional. At the same time, display of different scenarios might offer solutions that had not been considered yet. The development of a Planning Support System (PSS) in Madinah, Saudi Arabia, enabled planning engineers, managers and decision-makers who had little or no knowledge of GIS to use a new comprehensive plan for their daily work. The integration of a touch table facilitated decision-making by offering a user-friendly interface that could be easily used by managers. Drawing a new road with a finger was enough to let the system calculate and display the expected budget for compensating all the landowners affected by the road project (Ernst 2016).

Arciniegas et al. (2012) conducted several workshops for the land use planning of a peat-meadow polder in the Netherlands. Stakeholders worked together carrying out planning tasks using spatial decision support tools implemented in an interactive touch table. In the first workshop, stakeholders used drawing tools on this device in order to transfer and process local knowledge. In the second workshop, spatial multi-criteria analysis helped to wear together different types of expert knowledge and to produce feedback for quantitatively evaluating land use scenarios. In the last workshop, negotiation took place to reach a consensus land use plan for the polder. Surveys revealed that the participants of these workshops were satisfied with this new planning tool.

In Turkey, a few Geodesign projects have been implemented in an academic environment. Karadeniz, N. et al. (2016) developed different scenarios for landscape planning in a case study of Imrahor valley that lies at the outskirt of Turkey's capital and is threatened by encroaching settlements. Şenöz, E. et al. (2014) applied the Geodesign methodology for a residential area in Alpagut near Eskişehir to solve the problem of a continuous decline of the historical building structure.

Ballal (2015) described a web-based Geodesign software (“GeodesignHub”) that he had developed in cooperation with Carl Steinitz. He mentioned the challenges of 2D and 3D visualization technologies when applied to large areas or on regional planning problems. According to him, uncertainty is caused by impacts from long time scales, multiple factors affecting the area and competing interests and actors involved and the inadequate process of creation of design that is largely separated from that of analysis and visualization. He bridged the gap between GIS analysis and design's creativity with a new seamless process. Using simple sketching tools and a rational GIS based design analysis process a digital workflow that enables collaboration has been developed. During several workshops the digital workflow was employed to build a plan at a regional level with the participation of experts and non-experts. Using this software, they were able to cooperate and synthesize designs rapidly and analyze the design performance. The usually existing gap between analysis and design creation had been removed by means of an effective cooperation of various parties involved in the design process. This had been further facilitated by means of fast iteration and sharing portions of various designs.

With GeodesignHub (GDH), the "Steinitz framework" was converted into a digital representation of a digital design workflow, which was tested in several workshops. (Rivero et al. 2015; Ballal 2015; Nyerges et al. 2016). Then, this software has been successfully used in many planning efforts throughout the world (Campagna et al. 2016; Moura et al. 2016; Kim, 2017). Ernst et al., (2019) designed a new master plan for a university located in Southeastern Turkey based on Geodesign. They used the GDH software to create several scenarios for the 3000-ha campus involving all stakeholders from the university.

The use of Virtual Reality (VR) tools brings urban planning and architectural design to a new level. It allows a reality like experience of the results of planning efforts in the presence. For communication of complex spatial information such as virtual 3D city models immersive 3D virtual environments have been created. Such an immersion is related to user experience and can be described as a 'psychological state characterized by perceiving and experiencing oneself to be enveloped by, included in, and interacting with an environment' (Witmer & Singer, 1998). A lot of research has focused on different visualization methods including heat maps (Vakali et al. 2014), glyph annotated maps (Villanueva et al. 2014) and tradition 2D graphs (Hudson-Smith et. al. 1998). However, according to Jamei et al. (2017) research on the effectiveness of VR in modeling the future of smart cities and on showing the impacts of "what-if" scenarios to policy-makers and communities is lacking. Ernst et al. (2019) described a prototype of a workflow for visualization of planned projects in real time. They used GDH to create 2D outlines of development projects at the block level. After being transferred to ERSI's CityEngine to convert the 2D plans into 3D models a gaming engine simulated a real experience in a virtual environment.

The purpose of this paper is to show how different development scenarios can be designed for an underdeveloped region in Southeastern Turkey based on the anticipatory change model defined by Steinitz's Geodesign framework. To implement this model the public participation geographic information system (PPGIS) GDH was used. The collaboration with local governments proofed that even users without experience with GIS or CAD software could easily and rapidly create new projects that would fit into one of the proposed scenarios. As a further development of the used PPGIS it was tried to add Virtual Reality tools to make the results of the planning process more understandable.

2. METHODOLOGY

2.1. Study Area

The city of Şanlıurfa is the center of the Southeastern Anatolian Project (GAP) one of the world's biggest irrigation projects that is fed by the country's largest dam, the Atatürk dam. Şanlıurfa lies at the edge of the fertile Harran plain that has been described as the garden of Eden. This region is part of the Fertile Crescent where the first high cultures were established. Already in 10.000 BCE, in Göbekli Tepe near Şanlıurfa the world's oldest temple like structures were erected (Knitter et al., 2019).

Despite this glorious history, nowadays the region counts for one of the poorest in Turkey. Although the GAP project contributed substantially to the development of the region the recent crisis in Syria has enlarged existing problems by the influx of more than150,000 refugees. Now, they form 20 % of the current population in the research area that is made up of the central districts of Eyyübiye, Haliliye, and Karaköprü (see fig. 1). According to the current legislation the Municipality of the Metropolitan Area of Şanlıurfa has become the planning authority for the whole Province of Şanlıurfa including all its rural and urban areas.

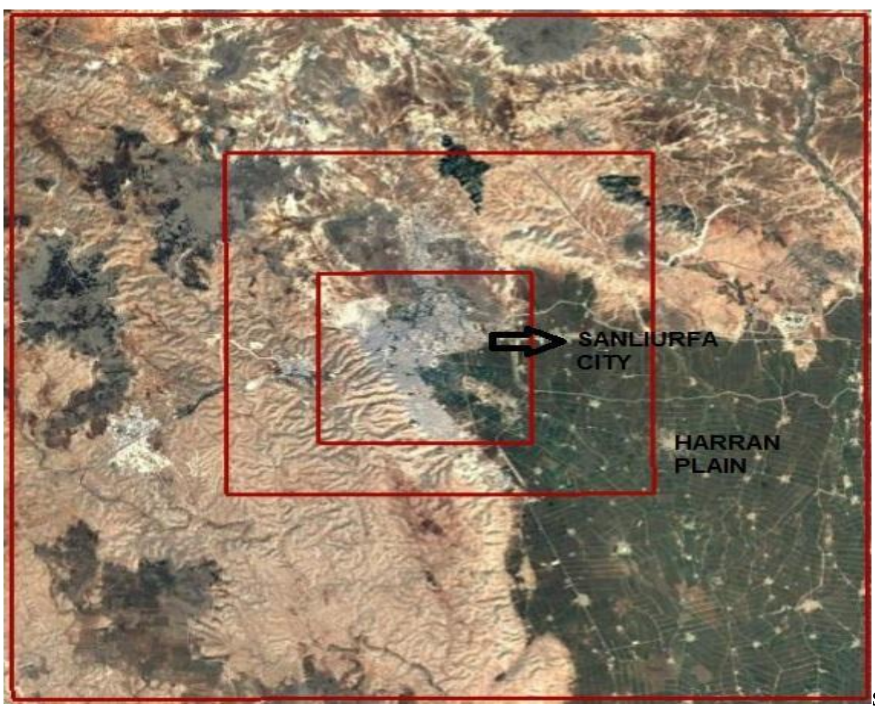

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Figure 1: Satellite image of the research area (40 x 40 km) with two nested smaller areas (20 x 20 km and 10 x10 km) where more detailed analysis had been carried out. The city of Şanlıurfa with its districts Eyyübiye, Haliliye, and Karaköprü is situated in the center of the image and shown in shades of gray.

The most striking problems that had to be addressed while coming up with new development proposals can be summarized as follows:

- Urban Sprawl: On one side, it is caused by high population growth, that will lead to a doubling of the population in 2050. On the other side, uncontrolled urbanization accelerated in the 80ies leading to the loss of fertile lands. Recently, new urban development projects have contributed to unhealthy living conditions characterized by high-rise buildings without enough open spaces.
- Unsuitable agricultural practices: Due to wrong irrigation practices, fertile lands are under increasing threat of salinization. Expected water shortcomings caused by climate change will require a new portfolio of agricultural products. Although the GAP Development plan envisaged plantation of fruit trees (especially pistachios requiring much less water than the currently dominating cotton) on 20 % of the area this goal was never reached (USIAD, 2008).
- Creation of new job opportunities: Currently, nearly 50 % of the whole population is under the age of 20. That means within the upcoming years hundreds of thousands new working places will be needed.

Uncontrolled urban sprawl can mainly be found in the Southern parts of Şanlıurfa. There, in the district of Eyyübiye "Gecekondu"s are prevailing. It literally means a house "erected over night" and refers to an old legal loophole that granted such house owners the temporarily right to stay. In order to address the needs of this poorest part of the population in most cases, by some way or another these inhabitants were granted a permanent stay in their houses. Naturally, these buildings even after having received some legal status do not adhere to any construction standards and are prone to different kind of hazards (landslides, flooding, etc.).

Despite their more romantic presentation in Turkish movies (Çelik, 2013) "Gecekondu" s in Eyyübiye lack any greenery or gardens. Moreover, they surround the historical center of the city and hinder its efforts to become a hub for tourism (see fig. 2).

Figure 2: Historical centre of Şanlıurfa with Balıklı Göl and squatter settlements in the background.

2.2. Usage of Decision Support System GeodesignHub

This research was conducted in the framework of ERASMUS + KA 203 project "Strengthening of research and training capabilities for Virtual Reality applications in the private and governmental sector" and the "International Geodesign Cooperation Project (IGC) initiated by Carl Steinitz in 2017 (IGC, n.d.). Facing a growing challenge to plan, manage and pay for essential infrastructure to address major demographic changes and weather events accompanying a changing climate, nations around the world are looking for new solutions. This gave rise to the IGC project, in which more than 50 universities around the world including Harvard Graduate School of Design, University College London, Peking University and Leibniz University Hannover participated. Each partner in the collaboration systematically studied change in his/her region, shared and compared the results, and produced guidance towards improved decision making on infrastructure investments. The overall objective of the project was to show collectively how Geodesign could help to solve very big problems.

In order to make the studies of the different participants comparable with each other a common methodology was agreed upon. This included the scientific methodology itself and the reporting format as well. The overall methodology should fallow the Geodesign framework as described by Steinitz (2012). Without stepping into the details of this framework it is important to understand the general workflow that is common to all Geodesign works. It is made up of six models that must be elaborated sequentially. As shown in the figure below the essence of each model can be described best by a question. It must be noted that due to changes in the municipality administration works on the decision model did not take place.

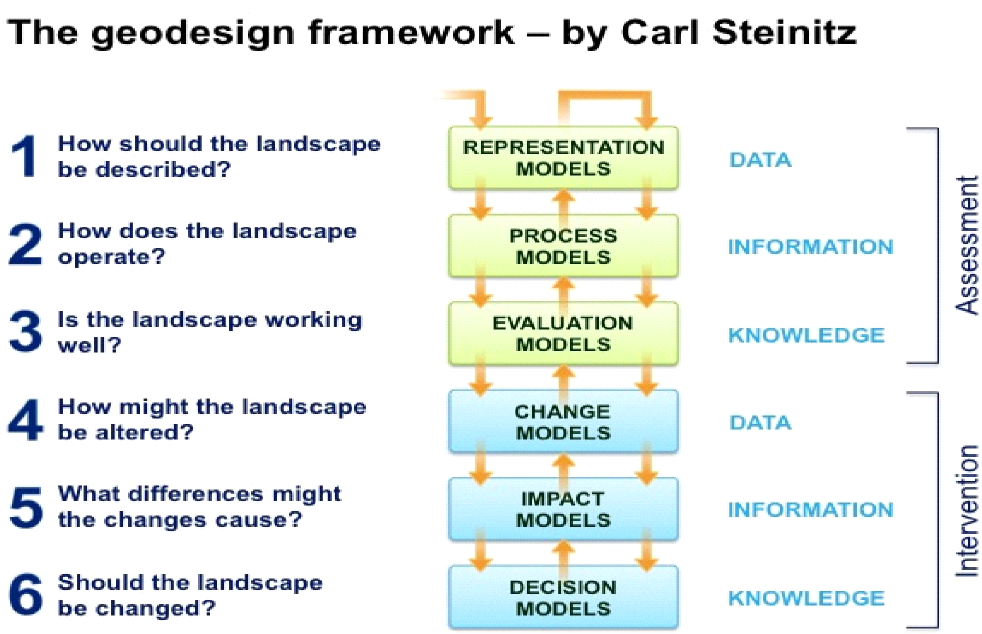

Figure 3: Workflow according to the Geodesign framework of Steinitz **Source***:* Steinitz (2012)

In addition, meeting a set of conditions was required:

- Commitment to study nine shared systems plus one unique one,
- Nested study sizes and scales of common dimensions. In this case, nested squares with sizes of 40 x 40 km, 10 x 10 km and 5 x 5 km were chosen.
- Adoption of a common time frame. Development scenarios for 2020, 2035 and 2050 had to be created.
- Adoption of common global future scenarios including climate change plus local ones.

The reporting format required representing the results on two A0 posters according to certain specifications to be displayed during the ESRI Geodesign Summit held in Redlands, USA, in February 2019.

In this study, the entire project team consisted of a core group, an expert group and the participants of a workshop. The core group was made up of one university professor and 5 assistants who collected all relevant information, prepared the GIS database, carried out the daily work and prepared the final posters. The expert group comprised 5 university professors whose fields of expertise presented the focal sectors of this study including agriculture, geomatics, social geography, landscape architecture and economy/administration. In addition, one representative of the Metropolitan Municipality of Sanliurfa participated. This group was charged with three major tasks: 1) Setting up of criteria and classification schemes for evaluation maps of the current situation as explained further below. 2) Coming up with scenarios for the years 2020, 2035 and 2050, and 3) Developing a first set of major infrastructure projects to be presented at the workshop. The participants of the workshop were composed mainly of university staff among them the core and the expert group and staff of the municipality among them the metropolitan municipality, district municipalities and municipality owned companies totaling 44 persons.

The different assumptions for these scenarios were determined by the expert group. Based on them, work on task 3 started where change models were defined that basically consisted of major agricultural, infrastructure and housing projects. This "anticipatory change model" according to the Geodesign framework of Steinitz (2012) was selected because the required amount of local subject-matter expertise was available and time constraints favored this approach. The idea behind this model is that the designer sees the whole solution from the beginning. While for an experienced professional this usually does not pose an obstacle, the difficulty lies more in the deduction on how to get from the imagined future back to the present condition and then, the design of projects whose implementation are a requirement to create the future (see figure 4).

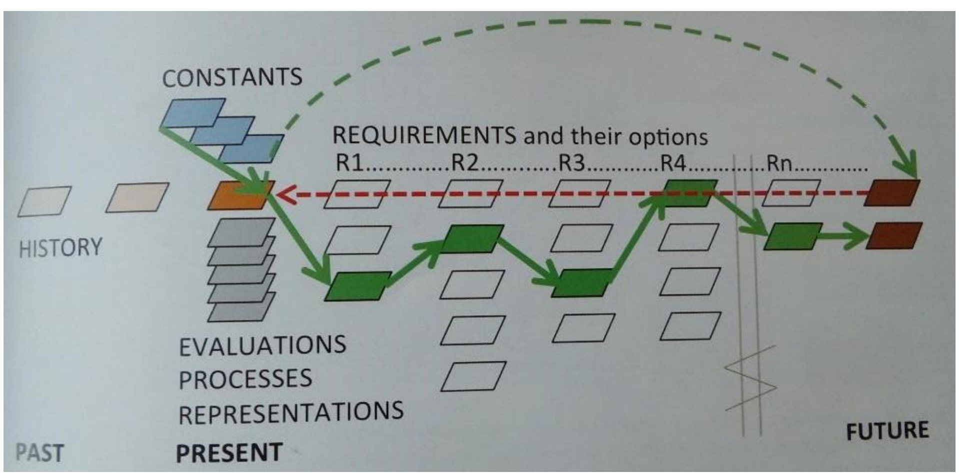

Figure 4: The anticipatory change model according to Steinitz (2012) **Source***:* Steinitz (2012)

Assumptions were made in the following fields:

1.Climate change: The research area is dominated by a semi-arid climate with an annual average temperature of 18 °C having dry hot summers (mean temperature in July: 30 °C) and cool wet winters. Rainfall occurs mainly in winter and autumn and the wet season ends in May totaling 283 mm of precipitation, while mean annual evaporation can reach up to 1848 mm (Yeşilnacar et al. 2011). Because most of the agricultural area is irrigated by means of channels originating from the Ataturk dam fed by the Euphrates River it is of much more importance how the climate will change in its upper watershed. In these high plains of Eastern Anatolia, a reduction of up to 200 mm of snow water equivalent is projected (OECD 2013). Then, the study area could be exposed to increased heat wave amplitudes by 6–10 °C (Zittes et al. 2016). These projections will change the current policy to provide water for irrigation purposes nearly for free. Higher water prices will cause a shift from the cultivation of field crops like cotton and maize that consume up to 1000 mm (Chapagain et al. 2005) (data for Turkey) to the cultivation of tree crops like pistachios that need only about half of this amount (Aydyn et al. 2003) (data for GAP/Turkey.). Increased temperature in combination with heat waves will have negative impacts on the health of the urban population. This will reverse the current trend to construct high-rise apartment buildings with a high surface/mass ratio, insufficient insulation and very little green areas between them. Instead, dense townhouse districts that feature roof gardens and much green space between them will be preferred.

2.Solar energy: Şanlıurfa region holds a great potential for the development of electricity production based on solar energy. Although the incoming solar radiation with about 1550 – 1700 Kwh/m2/year (International Renewable Energy Agency, 2017) is not as high as in other regions of Turkey other factors like suitable topography and existing land uses cause this region to be on the priority list for new installations. Turkey's general directorate of renewable energy, part of the country's Ministry of Energy and Natural Resources, has recently identified the regions that will accommodate the country's new solar PV capacity, based on the so-called Renewable Energy Resource Areas (YEKA) model. Accordingly, potential sites for the forthcoming PV tender comprising 1 GW of capacity are: Hatay-Erzin and Şanlıurfa-Viranşehir in the southeastern region, and Nigde-Bor in Central Anatolia (pv magazine, 2018). In addition, in 2016 the university in Şanlıurfa opened the "GAP Renewable Energy and Energy Efficiency Center (GAPYENEV)" to foster research especially on solar energy and support the private sector in this region in developing new solar energy facilities (International Energy Agency, 2016). In 2018, at the same university a first PV plant with a capacity of 5 MW started to produce electricity. Taking the above said into consideration, Şanlıurfa could become a center for the development and production of electricity based on solar energy technologies.

3.The service sector contributes already to more than half of total employment in the province of Şanlıurfa (Karacadağ Kalkınma Ajansı, 2018). Tourism based on archaeology and religion will become the backbone of this sector due to the history of this region reaching back to 10.00 years BCE in the case of Göbeklitepe. Although this site shares many similarities with Stonehenge dating back only to 3000 BCE, it is nearly unknown abroad. Due of the attraction of Stonehenge located in county Wiltshire, UK, visitor spending contributed £959 million to the Wiltshire economy in 2012, and with the multiplier effect of tourism supported business turnover this figure increased to £1.4 billion (hotels solutions, 2014). The economic potential of our region should even be higher because Göbeklitepe is only one of many other tourist destinations

The challenge of the IGC project was to create three different scenarios for predefined points of time (2020, 2035, 2050) for the Sanliurfa region. As there were no major projects to be started or implemented until 2020, this date was set as the baseline. For scenario A ("non-adapter") it was assumed that current negative trends, especially uncontrolled urban sprawl would continue. For this, development trends observed during the last 34 years (Bennet et al. 2016) were interpolated for the above-mentioned time frames. In addition, it was taken as granted that none of the 150,000 Syrian refugees would return to their home country. Scenario B (late-adapter) assumed that negative trends would continue until 2035 and then, the adoption of a more controlled urban planning and a sustainable development of the regions based on the introduction of environment-friendly technologies would take place. However, under Scenario C (early-adapter) a sustainable development of the region would start already in 2020. The main difference between the latter two scenarios resulted from the disadvantageous starting point of scenario B in 2035. For example, great parts in the South of Sanliurfa that had already been converted to high-rise apartment buildings would no longer have been available for the concept of "new urbanism". This required the creation of a separate set of evaluation maps for scenario B, year 2050, in which areas already build-up or used for other irreversible land uses had to be taken out as potential project sites.

During this project the framework for Geodesign (Steinitz, 2012) comprising six main phases i.e. presentation, process, evaluation, change, impact and decision models was followed. As required by the IGC project standards 9 systems, for which changes were anticipated, had to be worked on. These systems were green infrastructure (biodiversity and conservation), water infrastructure, gray infrastructure (transportation, communication), energy, agriculture, industry, housing (lower density), mixed use (high density housing + services), and institutional. As an additional system having high importance for this region archaeology/tourism was selected. For all these systems, data that could describe ongoing and future expected processes at the required scales had to be collected. Due to time and resource constraints it soon became clear that not for all systems this goal could be reached. Therefore, priority was given to the systems of energy, agriculture, housing, mixed use and archaeology/tourism. After a GIS database (ArcGIS and QGIS software was used) had been built work started on developing evaluation models. These models basically consisted of suitability maps created by means of multi-criteria analysis (MCA) within the GIS. The MCA was implemented according to rules described in MS Excel sheets. As an example, the criteria for the system energy are shown in figure 5. For this research, only energy production using photo voltaic panels was addressed. The selection of the used criteria resulted from discussions of the expert group. Moreover, the special characteristics of this geographic region and computational constraints preferring a maximum of three criteria had to be taken into consideration. Therefore, as the term "evaluation model" suggests in this step not only science-based information but, also priorities and values of the different members of the expert group are fed into the system.

Energy (production, distribution)				ENERGY
System 4			Contact / Expert Name	
Description of Evaluation: Criteria: land cover class, slope, direction, New projects: Build photovoltaic solar plants. Kamu Buyuk çatılı binalar belirlenerek bu alanlara gunes enerji santrali yapılabilir.				
Feasible	Suitable	Capable	Not Appropriate	Existing
and cover class = settlements OR step, slope = between 3 % - 15 %, Aspect = South, Southeast, Soutthwest	Land cover class = all other classes, slope = between 15 % - 25 %, Aspect = South, Southeast, Soutthwest	and cover class = all other classes, slope = between 25 % - 35 %, Aspect = South, Southeast, Soutthwest	land cover class = , slope = between 0 % - 3 %, Aspect = South, Southeast, Soutthwest	land cover class = 'Archaeological sitel' OR '"imarsiz settlement' OR 'main road' OR 'forest', slope = higher than 35 %, Aspect = North, Northeast, Northwest , East and West

Figure 5: Criteria and evaluation classes for the system energy

The evaluation maps were imported into GDH, a web-based Geodesign software. These maps served as a background, on which the area of new projects for the 10 systems like housing projects, light train lines or solar energy plants could be drawn using the user-friendly tools of GDH. In a second step, the impact of such new projects like housing could be investigated not only on its own system (housing lower density) but, also on any of the other 9 systems e.g. green infrastructure. Using this instant feedback, suggested projects could be revised on the spot until an optimal solution was found.

As GDH tries to simulate a real planning process it provides tools that enable several teams to come up with their own development designs. In this case, two teams were formed: a municipality team, which focused on new urban development, and at the core team, consisting of academics that had a more environment focused approach. Both teams created a total of 69 projects, which were combined in 3 different designs representing planning alternatives for Sanliurfa. All the details of the work flow using GDH are not explained in detail here. They can be found in Ballal, H. (2015).

During this first workshop in cooperation with the municipality of Sanliurfa, the only scenario used for the placement of new projects was the "early-adopter" one. This was due to time constraints and the fact that this most optimistic option left much more freedom for the selection of new projects. As one of the focal points of discussion was the further development of the Southern district of the city, 3D models for three different scenarios for one quarter of this district (high-rise apartment buildings with 30 floors, apartment buildings with 10 floors, and a "new urbanism" model) had been constructed and converted to a virtual reality environment. It could be experienced by the workshop participants using computer connected VR glasses (see figure 6).

Figure 6: Presentation of a future scenario by means of VR glasses to workshop participants

At the end of the workshop, participants were requested to fill in a questionnaire with questions concerning technical matters and the overall satisfaction with the workshop and its underlying methodology.

3.RESULTS

During this research, the expert group created three different scenarios for the future of Sanliurfa as required by the IGC project. They were presented to staff of different sub organizations of the Municipality of the Metropolitan area of Sanliurfa for further discussion and more detailed elaboration.

The first scenario was a continuation of "business as usual" without any major change of current development trends. An uncontrolled development of the research area will continue and, instead of solving existing problems they will be enlarged. As none of the Syrian refugees will return to their home country population will increase at high rates. Failing to create the required job opportunities will lead to increasing poverty and criminality. Environmental problems like air pollution caused by individual traffic and heating, noise pollution, increasing temperature within urban settlements and missing open space will lead to living conditions that cannot longer be called "human". This was illustrated by showing the entrance scene of the movie "Elysium" directed by Neill Blomkamp during the workshop. Whereas in the South of the city uncontrolled construction of houses and commercial buildings will be accelerated, in the North, new urban development projects will continue to create unhealthy living conditions characterized by high-rise buildings without enough open spaces. Unsuitable agricultural practices will extend the area of infertile lands due to salinization. In combination with expected water shortcomings caused by climate change the overall agricultural production will decrease hindering the further development of a food processing industry.

In contrast, the "early-adapter" scenario required a bundle of economic, social and political measures to be taken from now on. New subsidizing and taxing policies would favor environmentally friendly and sustainable technologies. In addition, it was assumed that most of the Syrian refugees will return to their home country. For urban development, the central military area will be converted to apartment building for about 80,000 persons. A mixed-use including workplaces in the service sector will be preferred. Urban conversion for the Southern part of the city will be implemented according to the "New Urbanism" concept. It will prevent that poorer people will be forced to move out and start to occupy fertile land to erect again "Gecekondu" s. In agriculture, unsuitable practices like uncontrolled irrigation will be replaced by precision farming. According to the overall goals of the Development Plan of Southeastern Project (GAP) planting of pistachio and almonds trees will be encouraged by means of changed subsidies and water prices. Improved techniques will increase the low productivity of pistachios gardens. On much more land organic farming will be practiced achieving higher income by exporting goods to Western countries. Tourism based on archaeology and religion will become the backbone of the service sector due to the region's history reaching back to 10,000 years BCE in case of Göbeklitepe. Due to favorable climatic conditions, availability of land and the local university's solar energy research facility (GAPYENEV) Şanlıurfa will become a center for the development and production of solar energy. The "late-adopter" scenario lies somehow between the two above described ones. However, options will be much more reduced because in the time period up to 2035, irreversible developments will have taken place. Among them, increase urban sprawl, construction of high-rise apartment buildings and increased salinization of fertile lands must be mentioned.

The used web-based software GDH enabled the users to create new projects and evaluate them immediately during the workshop. For example, several new installations of solar energy plants were suggested. Suitable locations were outlined by using the evaluation map for the system "Energy" as a background (see fig. 7). During the impact analysis phase, such projects were evaluated thoroughly. While for the project no. 2 the system impact meaning how well the project was selected according to suitability criteria for the "Energy" system showed results favorable for the selected location (fig. 8), a cross systems impact meaning how the project might affect any of the other nine systems showed a very different picture. In this example, in half of the project area very negative impacts on the system "Agriculture" were to be expected (see fig. 9).

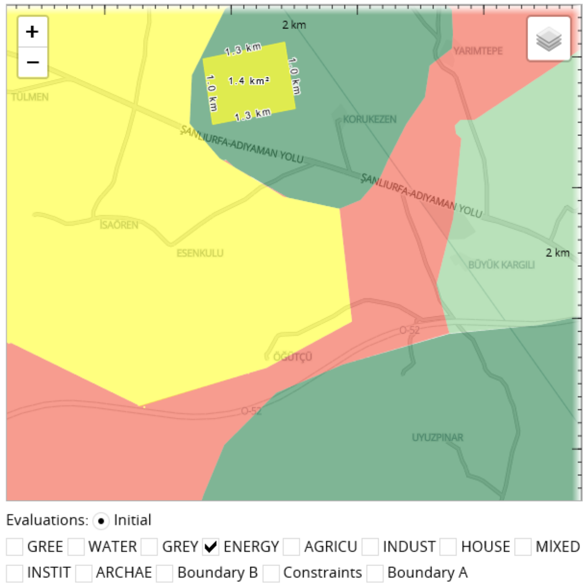

Figure 7: Newly created project for a PV solar plant (yellow rectangle in upper part of the map) against the background of the suitability map for this system.

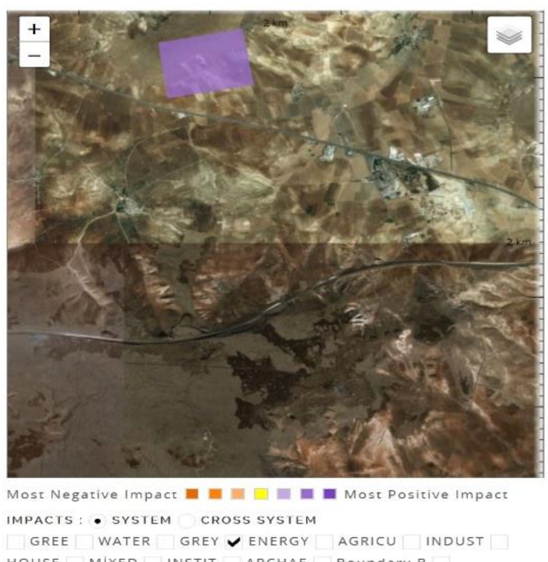

Figure 8: Same project against the background of a satellite image and analyzed according to suitability criteria for the system "Energy" only.

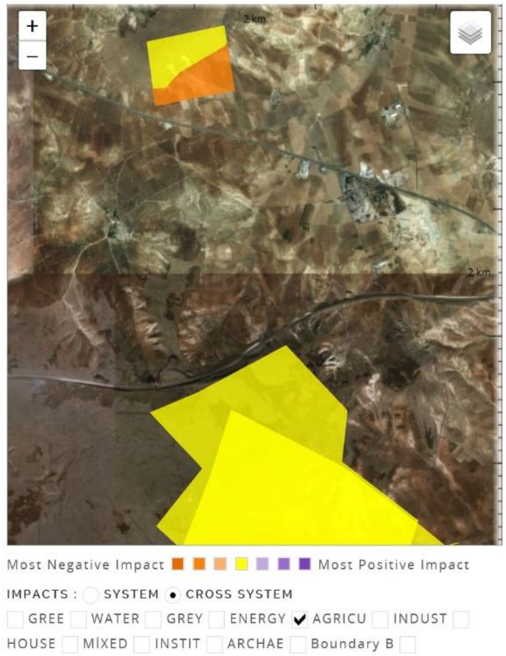

Figure 1 Same project against the background of a satellite image and analyzed according to suitability criteria for the system "Agriculture" (cross systems impact).

The most important outcome of this project concerning rural areas was the conflict potential that exists between the systems green infrastructure, energy and agriculture. Although the suitability criteria for these three systems are slightly different in the end, marginal lands with south facing slopes and shallow soils would favor land uses both for pistachio plantation and solar energy plants. At the same time, they might constitute range lands that should be conserved due to endemic animals like Urfa Gazelle (Gazella subgutturosa) and Anatolian Waran (Varanus griseus) Currently, a FAO funded project is aiming for protecting range lands in this region (FAO/GEF, 2016). On the other side, for urban areas it became evident that a huge development potential for squatter settlements in the south of the city adjacent to the historical city center exists. Although most of the houses have a private ownership the land belongs to the municipality thus, permitting it to set direction for a more sustainable development. The municipality already started with a new development project along a major transportation axis according to the concept of New Urbanism. However, implementing such projects on a bigger scale will be difficult due to the poverty of home owners and the low interest of investors in this area. Therefore, the representatives of the municipalities welcomed a future cooperation on this subject to elaborate new solutions. As participants of the workshop pointed out, the above explained potential for conflict cannot be solved by means of regional planning alone and without the engagement of the central government. Investment in both solar energy and pistachios plantation requires financial resources that might not be available in this poor region. Out of 22 participants from municipalities and related companies only 10 filled in the questionnaires. This amount was not enough to carry out a statistical analysis of the results. In general, it can be concluded that most of the participants found the methodology based on Geodesign very helpful for their work. They expressed their interest in continuing such a cooperation. For such future events they requested a framework allowing to explore opportunities in more detail than it was the case during this first workshop. They were very impressed how 2D maps could be converted into a real experience using VR technology. They asked to extent this technology to greater areas in order to become operational for their planning work.

4.DISCUSSION

With this research, Geodesign methodology with an anticipatory approach has been implemented in Turkey for the first time. While a few Geodesign projects had been conducted until now, they were restricted to an academic environment. When reading the definition of participatory planning given by Fisher (2001a, b) carefully it becomes clear that in this research the involvement of stakeholders has been quite limited. During the preparing and holding of the Geodesign workshop, teaching and administrative staff from the local university on the one side and representatives of Municipality of the Metropolitan area of Şanlıurfa city, depending municipalities and related municipal enterprises on the other side were involved. However, non-governmental organizations were totally excluded. This can be attributed to the political culture in Turkey, in which the top-down decision-making process is prevailing. This is even more the case in the southeastern part of Turkey. Surely, the presence of social media makes the participation of the broader public possible everywhere and anytime if access to the necessary PPGIS tools are given.

That leads to the question whether GDH would qualify for such a tool. The answer to this question is a clear No. A special knowledge of GIS or CAD is not required to use GDH. The fact that the participants of the workshop came up with a relatively high number of projects within a short time of half a day proved the steep learning curve due to the user-friendly graphical user interface (GUI) and overall concept of the used software GDH for planners and decision-makers. However, without at least a basic understanding of mapping and planning this online tool cannot be deployed in a meaningful way. While it is one thing to collect comments of citizens on a map and categorize them for further processing it is a totally different one to go through the whole planning process starting with the collection of data and the creation of suitability maps. Still, a workable solution could be to involve more stakeholders during upcoming workshops.

This NO does not mean that the involvement of the general public is not possible at all using GDH. On the contrary, we consider this as an interesting field for further research.

The API offered by GDH makes the integration of existing software or newly developed one straightforward. Therefore, it should be further investigated how tools that allow for instant online registration of comments or proposals on planned urban development projects could be linked to the part of GDH where new projects are created. It is also clear that it would be impossible to accomplish a planning involving the general public within a one-day workshop only. For this, more time and the willingness of all stakeholders to invest in such an extended amount of time would be needed.

Regional and urban planning cannot be performed without considering the political conditions. Although this workshop had been organized together with the mayor's office of the Municipality of Metropolitan area of Şanlıurfa and planned for much time ahead early selection of mayors in Turkey resulted in the absence of the higher management of this Municipality. Consequently, preparation works for repeating this workshop with the participation of the new mayor have already started. Even though in our case the planning process had been prolonged, usually this process can be very much accelerated using GDH. This is an important factor for regions that have a much higher developing speed as compared with Western countries. In the above-mentioned case of Madinah (Ernst, 2016), the planning process for the Metropolitan area of Madinah that initially was not based on Geodesign took more than 5 years to be finalized. During this period the city had already changed to such a degree that the comprehensive plan had become obsolete.

To use the anticipatory change model for such an ambitious model does not come without risks. Steinitz (2012) himself pointed out that it is less likely to succeed "when the design problem is large, complicated, less well defined". Without having a strong vision of the future of a place such an approach cannot be applied successfully. And, having one vision about the future seems to be something impossible when politics – and be it only at the local level – become involved. Interestingly, all participants, independent which organization they were working for, mentioned the lack of a vision as the main reason for the different negative aspects of current development trends in the region. All major development projects that had been realized in the last years were seen as the result of mere ad-hoc decisions rather than part of a long-term strategy. The further integration of Virtual Reality technology in the Geodesign process could offer a practical solution to this dilemma. Often, the lack of a vision is caused by the difficulty to imagine a future state of life, an environment or an urban setting. Virtual Reality is the ultimate tool that enable us not only to "see" but also to "live" such a future. Here, we are not talking about walking in a fantasy environment of a 3D game. Instead, now it is technically possible to make a sketch of a major development project in form of a digital drawing and walk through this project in real-time using VR glasses. Thus, in our case, the difference between the absence of a vision resulting in further encroachment of fertile lands by uncontrolled squatter settlements and high-rise apartment buildings and the vision to follow a development according to the New

Urbanism concept would be become so distinct that the whole decision process could be lifted to a new level.

The last step in the Geodesign methodology comprises decision models. Due to time constraints and the fact, that local elections had been scheduled shortly after the workshop it was decided to skip this step and conduct other workshops afterwards. While the inclusion of Virtual Reality technology into decision models could change dramatically the way how decisions are taking in our region, much work must be done to implement such a process successfully. Ernst et al. (2019) have already shown that the conversion of 2D maps into a virtual environment on-the-fly is possible. Currently, this can only be achieved by producing models without a high level of detail for the produced virtual environment. That means that the emphasis is on the “virtual” part and not on the “reality” part. For this, much more research in the field is required.

5.CONCLUSIONS

Geographic Information Systems (GIS) have been an integral part in the process of urban and regional planning since decades. While classical GIS require a considerable amount of hardware and human resources to be operated successfully, nowadays light GIS versions are available as well. They can serve the purposes of public participation geographic information systems (PPGIS) that address the needs for participation of many stakeholders in the planning process. The methodology of Geodesign that has its origins in landscape architecture makes usage of such PPGIS tools. Going beyond these tools it offers mechanisms that can accelerate the planning process and enhance the quality of the achieved results. Most distinctively, it gives an instant feedback of the different impacts of proposed new projects, it supports the integration of values of different stakeholder groups and it emphasizes innovative visualization tools like VR that makes the results of planning understandable for the non-expert. The latter can be a huge benefit for Turkish local administrations where positions in the middle and higher management are often assigned to non-experts.

We presented and discussed an approach based on the Geodesign methodology to address major challenges for the infrastructure of the Şanlıurfa region in Southeastern Anatolia. This research has been carried out in the framework of the International Geodesign Cooperation project. The main goal was to set up different development scenarios for the time period between 2020 and 2050. As an essential part of this study, a workshop was organized in cooperation with the local administration. By applying this methodology tangible results could be produced in a very short time even with the participation of non-experts.

The shortening of the planning process when implemented on an operational basis would be very beneficial for a region where half of the population is under the age of 20 and urgent actions that will have a long-term positive impact are needed. In order to communicate these impacts to decision-makers and the general public and to avoid the repetition of past wrong developments strong visualization tools like VR must be integrated in the planning process. This could already be realized during our first workshop. However, more research on designing a more interactive workflow that delivers much more realistic visualization is required. The gap between having a vision and sharing it by means of advanced visualization technologies has still to be bridged.

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