TOOLS FOR A NEW URBAN AGENDA

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Summary:
Urban Authorities, civil society, businesses and knowledge institutions are the main drivers in shaping sustainable development. The aim of enhancing the environmental, economic, social and cultural progress of urban areas is a cross-cutting issue of the Urban Agenda for the EU, the New Urban Agenda and the Sustainable Development Goals (SDGs, 2030 Agenda on Sustainable Development). The Urban Agenda for the EU represents a shared vision for a better and more sustainable future and it focuses on a more effective and coherent implementation of existing EU policies, legislation and instruments.

Among the tools able to be utilized to reach this ambitious goal we find GIS methodology and related technology. The layered based knowledge, with the possibilities of deepening our awareness in each of the layers composing the territorial complexity is the key component together with the ability to integrate data modeling online. Therefore what is important now is to use data to guide a management model for the control of urban development to respond to the Agenda.

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Introduction

The development of Urban Areas according to Eurostat, JRC and European Commission Directorate-General for Regional Policy will have a major impact on the future sustainable development (economic, environmental, and social) of the European Union and its citizens. Today, more than 70% of Europe's citizens lives in an Urban Area and the intergovernmental Organization of United Nations projects that by 2050 this percentage will reach 80%. Land use changes occur mainly in agricultural, natural and semi-natural areas where there is more economic potential associated with a transformation.

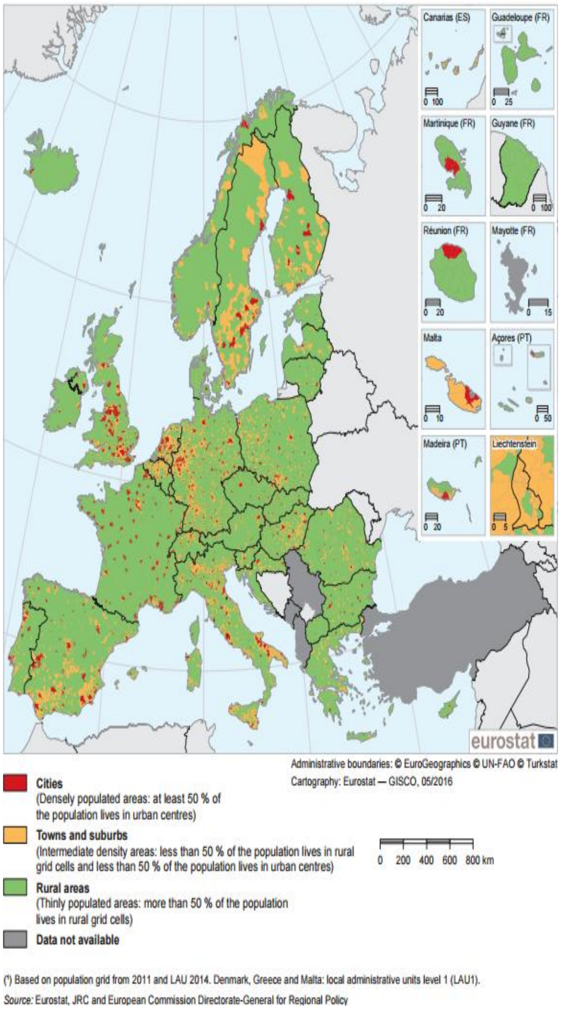

Fig. 1) Degree of urbanization for local administrative units level 2 (LAU2) based on population grid from 2011 and LAU 2014 (Eurostat, JRC and European Commission Directorate-General for Regional Policy)

On 30 May 2016, in Amsterdam, the Netherlands, upon the invitation by the Netherlands Presidency of the Council of the European Union (EU), the Informal Meeting of EU Ministers responsible for Urban Matters was held. At the Informal Meeting the EU Ministers Responsible for Urban Matters Agreed on the 'Pact of Amsterdam'. The Pact defines Urban Areas as all forms and sizes of urban settlement and their citizens. The Urban Agenda for the EU strives to involve Urban Authorities in achieving Better Regulation, Better Funding and Better Knowledge. The Urban Agenda for the EU will contribute to the implementation of the UN 2030 Agenda for Sustainable Development, notably Goal 11 'Make cities inclusive, safe, resilient and sustainable' and the global 'New Urban Agenda' as part of the Habitat III process.
Several Sustainable Development Goals (SDGs) were adopted in September 2015 by world leaders to mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change over the next fifteen years.

World leaders recognize that ending poverty must go hand-in-hand with strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.

Fig. 2) Sustainable Development Goals (SDGs) of the UN 2030 Agenda for Sustainable Development

The New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016. The 2016 UN Habitat III conference in Quito, identified the Urban Agenda for the EU as the main delivery mechanism in the EU for the UN's New Urban Agenda, a roadmap for global sustainable urban development. In particular the Quito Implementation Plan for the new Urban Agenda addresses, among other challenging topics, “transformative commitments for sustainable urban development” such as “sustainable and inclusive urban prosperity and opportunities for all” (see Annexes from the New Urban Agenda for details).

The New Urban Agenda intends to:

- promote sustainable management and use of natural resources and land,
- promote the development of urban spatial frameworks, including urban planning and design instruments that support sustainable management and use of natural resources and land,
- encourage spatial development strategies in preventing urban sprawl.

Furthermore it addresses “Environmentally sustainable and resilient urban development” where it is shown the commitment to spatial development practices that incorporate integrated water resources planning and management, considering the urban-rural continuum on the local and territorial scales. The New Urban Agenda in relation to environmentally sustainable and resilient urban development intends to:

- strengthen the resilience of cities and human settlements, including through the development of quality infrastructure and spatial planning, by adopting and implementing ecosystem-based approaches,
- support a more proactive risk-based promoting ex-ante investments to prevent risks and awareness of new risks into future planning.

Moreover it addresses “Planning and managing urban spatial development” with the aim to implement integrated planning to balance short-term needs with the long term desired outcomes of sustainable environment.

The New Urban Agenda in relation to “Means of implementation” farther addresses to:

- promote the development of national information and communications technology e-government strategies fostering responsible governance, as well as increasing efficiency,

- Encourage the use of digital platforms and tools, including geospatial information systems to improve long-term integrated urban and territorial planning and design, land administration and management,
- support science-policy interfaces in urban and territorial planning and policy formulation and institutionalized mechanisms for sharing and exchanging information, knowledge and expertise, including the collection, analysis, standardization and dissemination of geographically based, community-collected, high-quality, timely and reliable data,
- promoting evidence-based governance, building on a shared knowledge base using both globally comparable as well as locally generated data,
- foster the creation, promotion and enhancement of open, user-friendly and participatory data platforms using technological tools available to transfer and share knowledge among national, sub national and local governments and relevant stakeholders, including non-State actors and people,
- enhance effective urban planning and management, efficiency and transparency through e-governance, approaches assisted by information and communications technologies, and geospatial information management.

Material and Methods

In an era condensed with social challenges and environmental treats it is globally recognized the need to harvest data and information. According to the big data phenomenon is of primarily importance the capacity to acquire, store and access data. To contrast these challenges scientists have strengthened the use of Model to understand the global trends. Model is concerned with how the world looks, can also be a representation of some real-world process and is concerned with how the world works.

A model, as Michael F. Goodchild describes (Longley et al., 2001), is a representation of something real, or a representation of a real process (social or physical) operating on the Earth's surface or a representation of design process conceived by a human used to search for the best alternative. In particular, according to Michael F. Goodchild (Longley et al., 2001), A spatial model is a model of some process operating in space (and time) where there is variation across the space (and through time) and where location is considered an important issue to be taken into account. Location in fact must be known and the results of modeling changes when locations change.

The meaning of territorial modeling (Longley and Batty, 1997):

- To support some design process
- To allow the user to experiment with a replica
- To investigate *what-if* scenarios
- To understand change and dynamics
- To test sensitivity and confidence

According to Michael F. Goodchild evaluations (Longley et al., 2001) the difference between Analysis and Modeling can be summarized in the following table.

• Analysis: – static, one point in time – searching for patterns, anomalies – generating ideas and hypotheses – evaluating	VS	• Modeling: – may be dynamic, multiple points in time – implementing ideas and hypotheses • to compare to the real world – experimenting with scenarios

Table 1) The difference between Analysis and Modeling

The integration with modeling and GIS provides that inputs are taken from the map and the outputs are represented in map form. Nevertheless the integration provides the possibility to re-utilize that spatial knowledge with other GIS operations assuring the re-use of data, information and software resources. Accurate data production effort can therefore be conserved in several analyses.

The Steinitz framework according to Michael F. Goodchild models at various stages of the decision-making or problem-solving process (Longley et al., 2001).

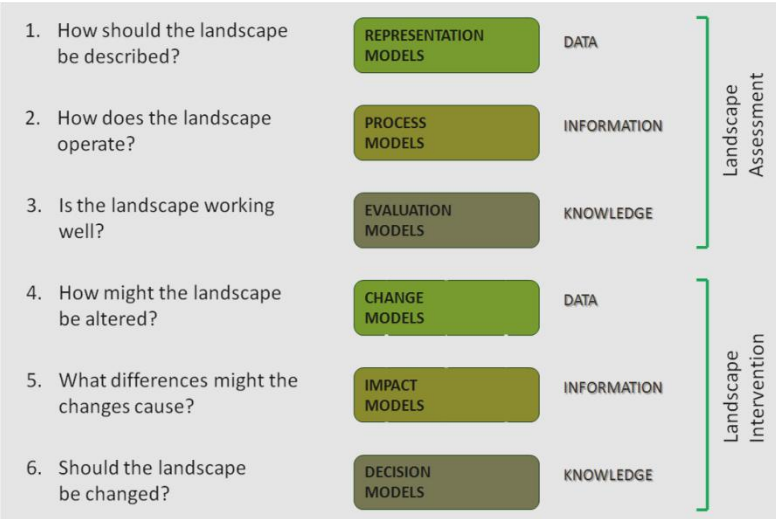

Fig. 3) Landscape Change Model by Carl Steinitz

Results

The new settlement developments should be designed to minimize impacts on the environment. According to Pistocchi (2001) only on the correct representation and prediction of natural resources and their processes can derive practices and environmental policies rational foundation.

Geographic Information System (GIS) technology, which was born in the United States around 1960, is one of the ICT - Information and Communications Technology tools globally used for territorial analysis due to the GIS abilities to inform about location, characteristics, trends of the studied phenomena. The GIS is therefore configured as a decision support tool, Decision Support System (DSS), for spatial analysis and for human impacts assessment, as it facilitates proper operational decision based on a correct interpretation of reality and allows:

- Shared geodatabase provision,
- Common cartographic base endowment,
- Information dissemination between different bodies,
- Real time data dissemination,
- Information continuous updating tools,
- Phenomena analysis tools,
- Different levels and sectors training,
- Procedures potential optimization,
- Resources optimization.

Geographic Information Systems provide the ability to perform spatial analysis and permit to graphically highlight the results of queries on the data related to the map.

This technology allows the capture, storage, analysis, visualization, and the return of information from geographic data. In other words, an interactive mapping system is a tool that allows to analyze the relationships between objects located on the territory. Therefore a Geographic Information Systems provide several opportunities:

- High level of control over estimates
- Time consuming multi-step process
- Direct Estimate
- Intuitive interpretation of results

Moreover Geographic Information Systems guarantee the knowledge of:

- Spatial location: positioning information of space objects

- Spatial distribution: the similar spatial object groups positioning information, including distribution, trends, contrast etc..
- Spatial form: the geometric shape of the spatial objects
- Spatial space: the space objects' approaching degree
- Spatial relationship: relationship between spatial objects, including topological, orientation, similarity, etc..

The added value of this technology is that the data, stored properly, systemized and localized cartographically, can be viewed simultaneously by multiple technicians on the network through the cloud. The GIS structure is organized with several layers each containing a single theme. This structure enables knowledge integration through a multi-sectorial and multi-scale approach.

The resulting challenge is to bring together GIS tools and assessment models in a network environment implementing them to the online interoperability. Implementing GIS technology towards online interoperability, through Web-GIS, permits to answer to the challenge of bringing together GIS tools and assessment models in a network environment. The Web-GIS are established, precisely to connect all public servers and the information available to manage the map information on the web.

The Web-GIS solutions improved with specialized tools boost Web-GIS technology as a SAAS - Software As A Service approach that helps make information available anytime and anywhere to the different stakeholders in the network building a common and accessible tool able to guide decision-making power on a science-based approach.

In the nineties, the Relational Data Base Management System, RDBMS, was the innovation in the use of “intelligent” maps, with the connection of CAD elements with the external tables DB, Microsoft Excels or Access, to arrive to SQL and Oracle.

Today the geodatabase, a sort of Geo RDBMS, such as SDE of Esri Inc., or the Spatial Cartage of Oracle Inc. allows the on-line map user to perform relational database query on spatially selected elements to boost the power both of SQL analysis and the potential on the geospatial investigations to work together, adding the intelligence of thematic modelling.

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In the following two examples how to integrate data modeling online are shown, evolving Web-GIS as a DSS and a SAAS application:

1) Modeling hydraulic calculations

2) Modeling land use changes impact on runoff.

HYDRAULIC MODELING ON LINE

The first web application shown allows calculating the hydraulic parameters of the network starting from diameter, material and pressure at the water tank. The application shows online the part of the trunk line that has pressure/velocity not suitable with the network design. This innovative visual methodology simplifies the management approach of major projects.

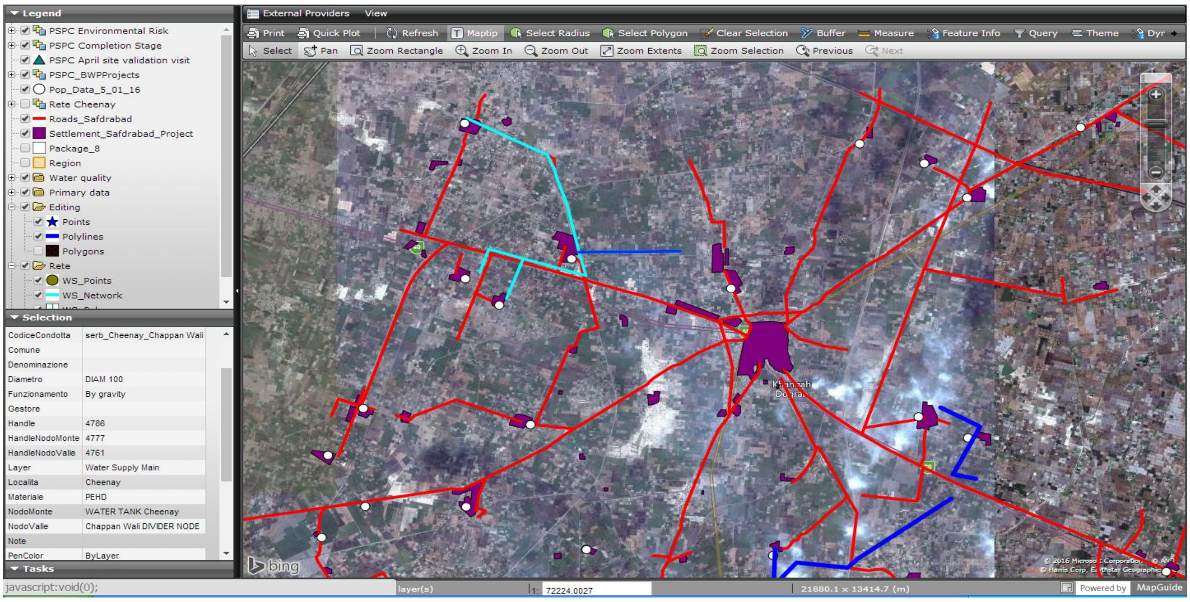

Fig. 4) Hydraulic calculations modeling WEBGIS with the selected water network in light blue

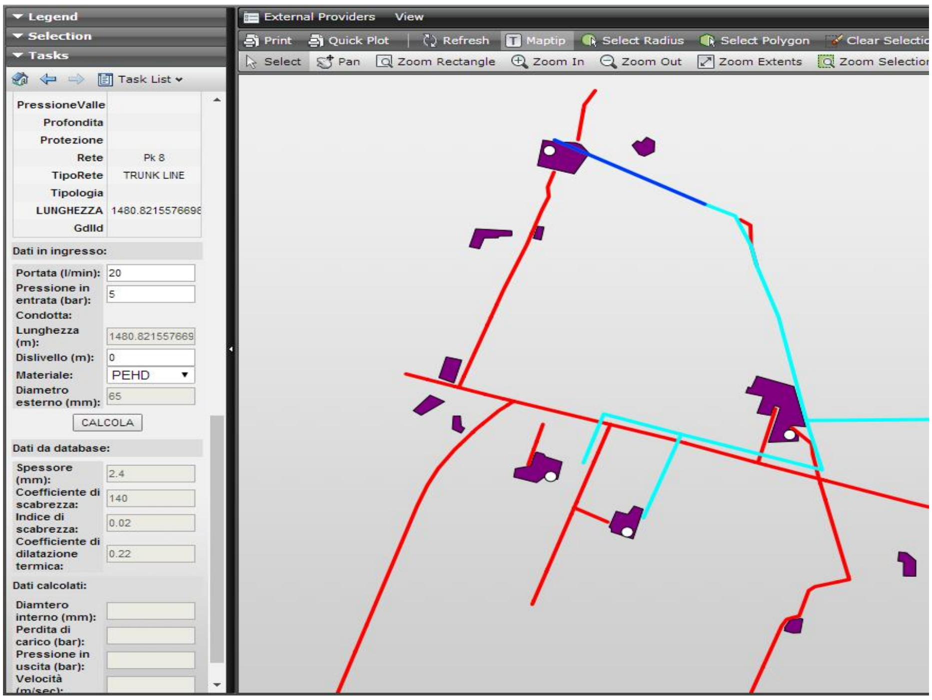

Fig. 5) The WEBGIS tasks panel on the left with the Hydraulic calculations

MODELING LAND USE CHANGES ONLINE

The second web application shown allows calculating the land use changes impact on runoff evaluating a parameter changes from an ex-ante situation to an ex-post situation proposed by a project.

The work illustrates the development of methodologies and technologies for the creation of support tools for the planning and evaluation of anthropic impacts in marginal areas. It is proposed to develop a decision support system through the adoption and implementation of GIS Geographic Information Systems online technology. The chosen methodology allows addressing the current topics of the prevention of the impacts of surface run-off and of land use changes control. The main theme is to allow the design of land uses, assisted by appropriate tools, based on considerations on environmental risks that waterproofing produces. In fact, waterproofing or soil sealing is the phenomenon that compromises the ability of soils to provide ecosystem services. Periurban areas (mixed urban and agricultural areas) are the main object of study since they represent the part of the territory most affected by changes in land use and where environmental protection should be more severe.

The web application acts as a support system for territorial decisions making it possible for stakeholders, to perform complex operations such as spatial analysis. Specific tools for spatial analysis are proposed therefore to guide users towards the adoption of risk mitigation measures through the use of best water management practices or Best Management Practice. The methodology intends to extend and implement the Geographic Information System technology towards online interoperability with the integration of this in the framework of the application of the Soil Conservation Service Curve Number method developed by the USA Department of Agriculture in 1972.
The implementation of the geographic information system would allow the designer and public authorities to use the tool to study the impacts of the project on the environment and water runoff and verify them before the authorization is issued.

The second web application includes the development of a database linked to the designed object to have information about the area, Curve Number CN, land use, surfaces description of the part of land subjected to change.

The Client can insert values, directly in this data structure, with the underlying cartography, and these values will be stored in the map server to constitute the database of the transformation. The new design situation can be edited on a working layer called “Editing” (Figure 6).

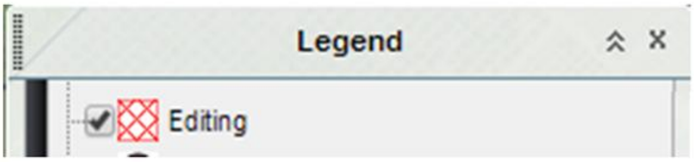

Fig. 6) The drawing layer on which new objects are stored

New surfaces representing the different kind of land use can as a result be designed having identified a project area. New characteristics of permeability can be assigned, according to what will be built in those areas, for each type of land use and therefore for each surface.

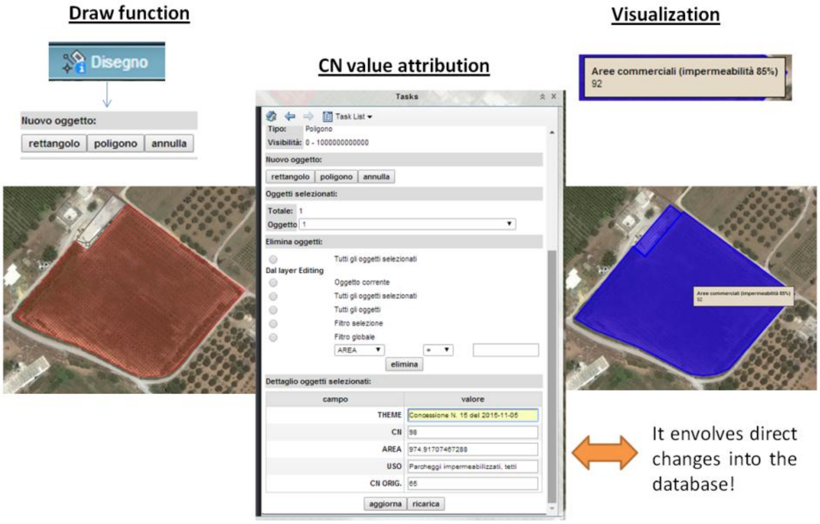

Fig. 7) The flow of procedures provided by the developed web application.

Future development of this technological approach concerns the possibility of integrating other data that can be used for modeling on the some web applications.

For example, referring to what can be called "Agriculture 4.0", other data that can be used for modeling are related to the Normalized Difference Vegetation Index (NDVI) to assess whether the target being observed contains live green vegetation or not.

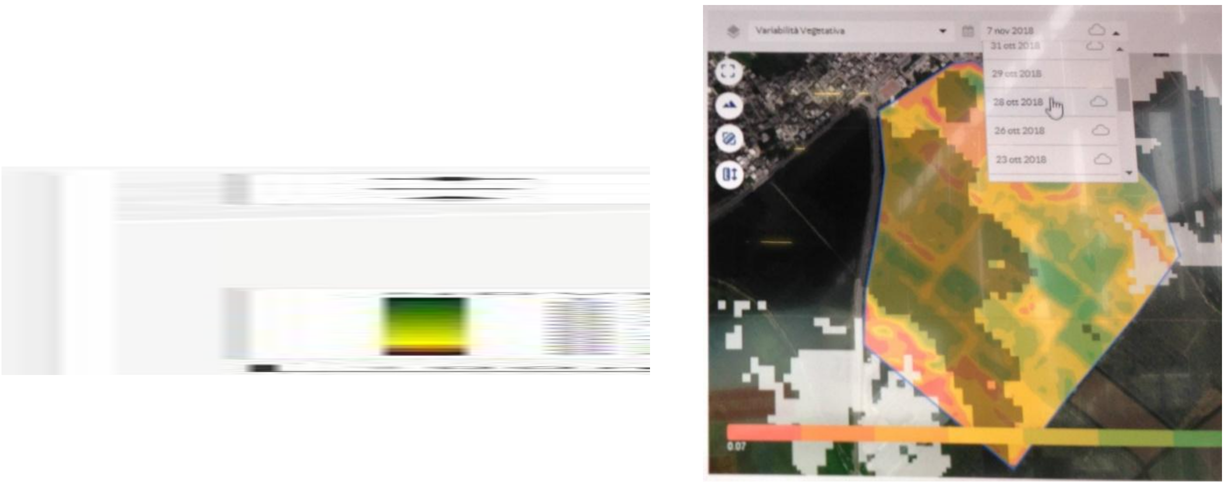

Fig. 8) Example of evaluation using the Normalized Difference Vegetation Index (NDVI)

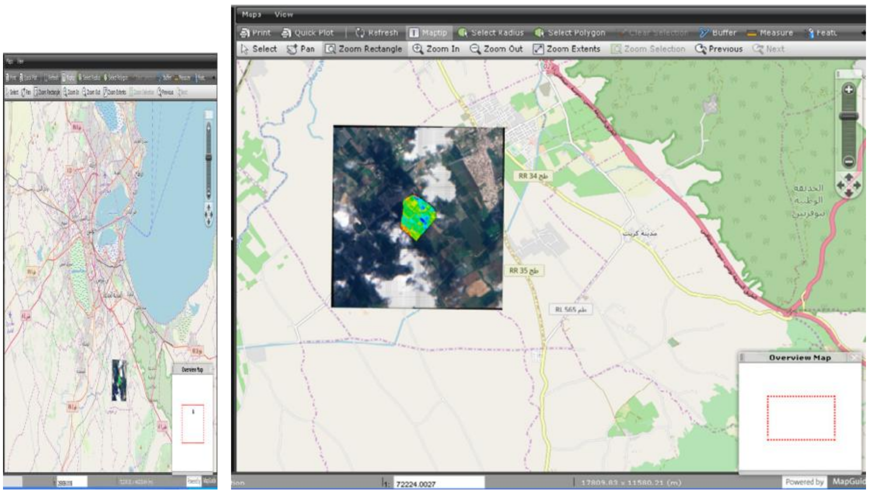

Fig. 9) Example of integration of the NDVI evaluation into the WEBGIS application

Discussion

The shown methodology extends and implements Geographic Information System technology towards online interoperability. The development of Information and Communication Technology ICT solutions integrated with spatial data knowledge can guide planners, and more in general stakeholders who act directly on land such as public authorities and private professionals, towards strategic, reliable and shared decisions in the environmental sector. One of the recent trend in the geo-space technology is to provide economic satellite images and guarantee public use of satellite investments and technology, therefore future development is linked to real time data and satellite images. As the urban environment is becoming increasingly complex to be managed by a single person also due to the heterogeneity of sensors and data sources (as in the case of satellite data) it is necessary to break down reality into systems and models (as layered based components) that can increasingly be integrated with each other. The challenge is now to face the aspects of communication to stakeholders about the integration of new technologies to improve land management. The need to set in place "user friendly" tools for end users is for that reason becoming evident as highlighted by the New Urban Agenda and its policy implications. The definition of scenarios as key components underlying the political decisions (Di Giacomo, 2016) is permitted by implementing GIS technology that enhances the comprehension of interactions between the existing multiple aspects, the environmental processes simulation and the impacts analysis of land management activities on natural resources can permit. The added value is that integration and interaction take place on the cloud as a sharing technology where it is possible to update the information layers and the modeling at the same time for all the stakeholders worldwide.

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Annexes from the New Urban Agenda by the United Nations (2017)

Transformative commitments for sustainable urban development.

Sustainable and inclusive urban prosperity and opportunities for all

49. We commit ourselves to supporting territorial systems that integrate urban and rural functions into the national and sub national spatial frameworks and the systems of cities and human settlements, thus promoting sustainable management and use of natural resources and land, ensuring reliable supply and value chains that connect urban and rural supply and demand to foster equitable regional development across the urban-rural continuum and fill social, economic and territorial gaps.

51. We commit ourselves to promoting the development of urban spatial frameworks, including urban planning and design instruments that support sustainable management and use of natural resources and land, appropriate compactness and density, polycentrism and mixed uses, through infill or planned urban extension strategies, as applicable, to trigger economies of scale and agglomeration, strengthen food system planning and enhance resource efficiency, urban resilience and environmental sustainability

52. We encourage spatial development strategies that take into account, as appropriate, the need to guide urban extension, prioritizing urban renewal by planning for the provision of accessible and well-connected infrastructure and services, sustainable population densities and compact design and integration of new neighbourhoods into the urban fabric, preventing urban sprawl and marginalization.

Environmentally sustainable and resilient urban development

72. We commit ourselves to long-term urban and territorial planning processes and spatial development practices that incorporate integrated water resources planning and management, considering the urban-rural continuum on the local and territorial scales and including the participation of relevant stakeholders and communities.

77. We commit ourselves to strengthening the resilience of cities and human settlements, including through the development of quality infrastructure and spatial planning, by adopting and implementing integrated, age- and gender-responsive policies and plans and ecosystem-based approaches in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 and by mainstreaming holistic and data-informed disaster risk reduction and management at all levels to reduce vulnerabilities and risk, especially in risk-prone areas of formal and informal settlements, including slums, and to enable households, communities, institutions and services to prepare for, respond to, adapt to and rapidly recover from the effects of hazards, including shocks or latent stresses. We will promote the development of infrastructure that is resilient and

resource efficient and will reduce the risks and impact of disasters, including the rehabilitation and upgrading of slums and informal settlements. We will also promote measures for strengthening and retrofitting all risky housing stock, including in slums and informal settlements, to make it resilient to disasters, in coordination with local authorities and stakeholders.

78. We commit ourselves to supporting moving from reactive to more proactive risk-based, all hazards and all-of-society approaches, such as raising public awareness of risks and promoting ex-ante investments to prevent risks and build resilience, while also ensuring timely and effective local responses to address the immediate needs of inhabitants affected by natural and human-made disasters and conflicts. This should include the integration of the “build back better” principles into the post-disaster recovery process to integrate resilience-building, environmental and spatial measures and lessons from past disasters, as well as awareness of new risks, into future planning.

Planning and managing urban spatial development

94. We will implement integrated planning that aims to balance short-term needs with the longterm desired outcomes of a competitive economy, high quality of life and sustainable environment. We will also strive to build flexibility into our plans in order to adjust to changing social and economic conditions over time. We will implement and systematically evaluate these plans, while making efforts to leverage innovations in technology and to produce a better living environment.

Means of implementation

156. We will promote the development of national information and communications technology policies and e-government strategies, as well as citizen-centric digital governance tools, tapping into technological innovations, including capacity-development programmes, in order to make information and communications technologies accessible to the public, including women and girls, children and youth, persons with disabilities, older persons and persons in vulnerable situations, to enable them to develop and exercise civic responsibility, broadening participation and fostering responsible governance, as well as increasing efficiency. The use of digital platforms and tools, including geospatial information systems, will be encouraged to improve long-term integrated urban and territorial planning and design, land administration and management, and access to urban and metropolitan services.

157. We will support science, research and innovation, including a focus on social, technological, digital and nature-based innovation, robust science-policy interfaces in urban and territorial planning and policy formulation and institutionalized mechanisms for sharing and exchanging information, knowledge and expertise, including the collection, analysis, standardization and dissemination of geographically based,

community-collected, high-quality, timely and reliable data disaggregated by income, sex, age, race, ethnicity, migration status, disability, geographic location and other characteristics relevant in national, sub-national and local contexts.

159. We will support the role and enhanced capacity of national, sub-national and local governments in data collection, mapping, analysis and dissemination and in promoting evidence-based governance, building on a shared knowledge base using both globally comparable as well as locally generated data, including through censuses, household surveys, population registers, community-based monitoring processes and other relevant sources, disaggregated by income, sex, age, race, ethnicity, migration status, disability, geographic location and other characteristics relevant in national, subnational and local contexts.

160. We will foster the creation, promotion and enhancement of open, user-friendly and participatory data platforms using technological and social tools available to transfer and share knowledge among national, sub national and local governments and relevant stakeholders, including non-State actors and people, to enhance effective urban planning and management, efficiency and transparency through e-governance, approaches assisted by information and communications technologies, and geospatial information management.