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[F] PhD Extended Abstract Form

Changing territories, Territorial planning, land management and environmental threats.

Agro-energy districts as chances for sustainable development

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Extended Abstract

The PhD activity focused on the analysis of different contexts of Mediterranean Europe. The choice to work on these contexts is since they are very similar and comparable contexts, but with peculiar characteristics linked to their history, culture, society and economy. The research activity benefited from the collaboration of several universities and research institutions, e.g. CREA, which co-financed the research project. The strong multidisciplinary was also guaranteed through the collaboration with numerous researchers of different universities and research centers in Italy and around the world, proposing original approaches to provide innovative tools managing and proposing sustainable development scenarios in rural contexts and publishing the works in international journals. The research project has made it possible to emerge:

1. Recent territorial configuration between demographic, socio-economic and landscape changes

Several territorial contexts of Mediterranean Europe have considerably transformed over the last decades. These changes can be detected in demographic, socio-economic, environmental politic and landscape variations. Especially the widespread land-use transformations in the European Mediterranean areas depended not only on urbanization, industrialization and agricultural mechanization but also on depopulation, economic marginalization and land abandonment of rural areas, at times accompanied by local processes of soil erosion. Monitoring land-use changes is relevant since it offers useful information for urban planners and policy makers for the management of peri-urban and rural areas. The work during the PhD period explored several Mediterranean contexts, e.g. Barcelona and Valencia in Spain, Rome and Viterbo in Italy and Athens in Greece. Comparative analysis of land-use and urbanization patterns and processes may spell out urban transformations and socioeconomic configurations. All these urban changes directly affect the local landscape and specifically the natural, agricultural and forest contexts. An integrated framework, involving quantitative analysis, evidenced the complexity in land-use transformations, proposing detailed solutions for sustainable land management concerning social cohesion, environmental sustainability and local competitiveness.

2. Evolving threats to the agricultural sector and the peri-urban landscape

Peri-urban landscape is also linked to economic factors that can affect the welfare condition of farmers (e.g. increase of farmer's income, decline in mechanization investments). From this point of view, the mechanization of some crop operations, especially harvesting, contributes to the achievement of the objective of environmental sustainability and economic viability of farms, e.g. specialized in olive cultivation.

Focusing also on current land quality in agricultural districts, land sensitivity to degradation resulted influenced by spatial heterogeneity in the environmental conditions. Agricultural districts in Italy with spatially-homogeneous environmental situations brought about to be more visible to land degradation in recent decades in respect to the time-period immediately following the World War II. Cropland confirmed to be mainly prone to environmental conditions leading to land degradation when the spatial structure of agro-forest districts (e.g. crop mosaic and landscape fragmentation) has been compromised.

3. Environmental threats and soil consumption

In past decades, widespread land-use transformations in European Mediterranean areas also accompanied by e.g. industrialization, agricultural mechanization, land abandonment of rural areas caused relevant environmental diseases and local soil erosion and degradation processes, which are emerging environmental issues and include unpredictable events, e.g. wildfires. The latter were studied in Viterbo and during the research period in Valencia, expressing how the need for appropriate approaches, strategies and plans can be useful to prevent fires, manage sensitive areas and potentially avoid the loss of valuable land.

4. Smart contexts Towards Sustainability

To make it easier to promote more sustainable territorial contexts, new technologies can be useful. The need to define “smart” tools, strategies and suitable policies is essential familiarizing with new technology and offering innovative job opportunities.

5. Exploring contemporary context with GIS technologies

Using GIS technologies made it possible to recognize which realities can offer new development opportunities in rural and peri-urban landscape. For instance, strengthening the activities related to agricultural mechanization and proposing strategies and optimizing mechanization systems through geo-spatial technologies.

Geo-spatial technologies were used also with network RTK in GNSS, which was applied to hilly areas in Viterbo following an approach based on criteria of precision farming.

New technologies also helped to identify where the major critical issues concern recent job accidents in the primary sector in Italy. The study exposed that the number of injuries reduced over time, likely influenced by a thorough supply of educational courses dealing with safety at work and which kind of agricultural machines was used.

6. Identifying, planning and designing agro-energy districts

The most relevant strength point of the thesis is the interdisciplinarity with which agricultural mechanization has been encountered during the research. It started with an analysis of today's territorial transformation and then moved on to solutions of sustainability. The study of local realities (districts) in Italy and in Europe (e.g. Spain and Greece) were analyzed to offer development scenarios to improve the three components of sustainability: social (more work, attention to the safety of workers), economic (new income opportunities and strengthening the local economy by enhancing the value of local agricultural and forestry products) and environmental (attention to recent impacts and phenomena related to climate change as predisposition to desertification and soil erosion). In addition to the three classic components of sustainability development, the research has found a fourth: energy. The main issue of the research work emerges with the results offered on the study of agro-energy districts. Agro-energy districts have been examined in different Italian contexts, showing their local opportunities but also their implementation limits. Establishing agro-energetic districts represents a real chance for local realities, which are rich of natural and agricultural resources, with the determination of strengthening their socio-economic structures with more technological innovation and environmental quality, reducing potential waste. Through the agro-energy districts, a territorial study was carried out in which also agricultural mechanization was linked with other disciplines. Proposing strategies and optimizing mechanization systems through geo-spatial technologies, the work suggests a potential reality based on the circular economy with the purpose of re-using agricultural residues for energy purposes. In this way, scenarios of circular economy and enhancement of local contexts are made possible and discussed highlighting their points of opportunity and threats.

Thorough investigations in Sicily and Viterbo, GIS processing let to recognize the most appropriate areas for the cultivation (and collection) of hazelnuts, since this kind of agriculture is not recommended on the steep slopes and can cause invasive environmental processes e.g. soil erosion. The analysis focused also in e.g. topography, morphology, land-use changes and slopes, which are useful to then reflect on which agrarian and mechanization systems apply to avoid possible accidents at work, especially during hazelnut harvesting.

Agro-energy districts were not only intended as an area dedicated to agriculture, but also with the presence of greenhouse plants and the possibility of applying photovoltaic systems. Results specified that the recent expansion of solar systems in Italy was mainly concentrated on both traditional and intensive agricultural districts in flat and hilly areas with optimal or sub-optimal conditions for cropping. Their spreading derived also from heterogeneous (and possibly poorly effective) planning measures regulating the spatial development of rural areas traditionally devoted to intensive agriculture. From this highlight, greenhouse systems represented a conceivable structure in which to install photovoltaic systems in agricultural contexts. Favoring photovoltaic systems installed on the roof of constructions than those on the ground, the thesis explored a tunnel greenhouse in Viterbo, studying the most suitable photovoltaic installation on the roofs of greenhouses, and a greenhouse in Sanremo, detecting the shading effects of photovoltaic system on some flowers growth.

The research study ends with a context dedicated to vineyards. Especially, the research work focuses on the three concepts of sustainability, which should also include a fourth component: energy. In this sense, also through energy, it is possible to create a system (or agricultural districts as studied) based on a circular economy that respects the environment, offers work to the local society and stimulates competitive economic processes, recycling everything that is produced avoiding waste. By integrating the four dimensions (energy, economy, society and environment) that can lead to greater sustainable

development, agro-energy districts applied to realities e.g. the wine-producing ones may be a developing phenomenon that provides a new scenario of rural areas in the evolution towards a sustainable (energy) future.

Final remarks concerning the competition benchmarks and strength points

Due to the multidisciplinary nature of this thesis, agricultural mechanization was encountered with different disciplines. Rural realities were investigated reflecting on their sustainability development and revealing potential scenarios with distinctive opportunities and threats. The strong multidisciplinary was guaranteed through the collaboration with numerous researchers around the world, offering innovative results and publishing the works in international journals.