Renewable Energy Resources and their impact on Rural Landscape

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Abstract: - This paper analyzes the evolution of land use in Italy in particular about the impact of the renewable energy plants on the rural land. The study area is the Molise Region in the South of Italy, which contains the greatest number of plants in relation to the whole national territory. This paper describes an ongoing collaboration between our University of Molise, the Molise Region and the Regional Protection Heritage Office of Molise: in fact the l.a.co.s.t.a. Laboratory (Director prof. D. Cialdea) of the University of Molise was engaged for the realization of the "New Regional Landscape Plan of Molise", through an agreement with the Molise Region, for the verification of existing tools, analyzing in particular the restrictions resulting from the identification of rural areas of visual and productive interest. Our study analyzes technical norms and proposes a new methodology that could support Local Authorities decisions, especially in relation to the definition of landscape quality aims, that the new Regional Landscape Plan must provide.

Keywords: Rural Land, Renewable Energy, Landscape, Geographical Information System, landscape quality

1 Introduction

This paper aims to analyze the evolution of land use especially in relation to the renewable energy infrastructures: wind power and ground–mounted photovoltaic plants, which have the most impact on land use in rural areas, were carefully observed.

The paper provide therefore useful tools for spatial planning choices, taking care to implement a methodology aimed at the recognition of the scenic and historic values according to the "landscape quality aims".

In European Union, rural areas have undergone a process of transformation rather intense from three points of view: social, economic and environmental [13], [24], [28].

The literature shows that, in terms of social and economic development, there are *dynamic* and *marginal* areas. Moreover there is a strong presence of areas in marginal conditions [22], which comes mainly from intrinsic peculiarities of the territory, such as the morphological conditions that involve structural weaknesses in the networks of transportation and communication, disfavouring the settlement and development of productive activities. These are usually located far from major urban areas in zones with a low population density, which have a level of economic and social development not comparable to the territorial context that surrounds them [15].

In Italy, these marginal areas coincide with the zones with rural development problems [21], which include the predominantly rural areas of mountain, hill areas predominantly rural and significantly rural mountain areas. In these areas, the structural changes and the increasing role of agriculture in recent years have taken on renewable energy profoundly affect land use [3], [6].

Energy is the prime mover of economic growth that depends on the long-term availability of energy from renewable sources [26], that are affordable, accessible and environmentally friendly [27]. Thanks to the petroleum prices, the renewable resources can be seen as possible, economically acceptable alternative, as by more intense utilization of renewable resources the costs of renewable energy fall [23].

Renewable energy technologies utilization is indicated as an appropriate alternative for providing a considerable portion of future energy demand.

Renewable energy has the potential to play an important role in providing energy with sustainability to the vast populations in developing countries who as yet have no access to clean energy [16].

During the last few decades all Countries started to increase their focus on clean and renewable energy sources [7]. Moreover energy infrastructures are relevant for some species and for the aesthetic quality of the landscape [12].

2 Landscape and Renewable Energy

The landscape was born “inside“ and “from“ the territory, and therefore, every landscape is the expression of specific territorial dynamics [2].

The landscape is the result of a process of the natural environment creation and modification. The uniqueness of the landscape consists of in its close relationship with social system and local context. Landscape constantly requires attention in order to its sustainable conservation [8]. Landscape is a factor of reorganization and territorial competitiveness [10] which creates ecological, environmental, cultural, social and economic values, through which it is possible to recognize and recover the identity of places [1] and, in this way, it represents a tool to design a model of integrated and sustainable territorial development.

The landscape quality is the necessary basis for productive activities, such as agriculture and tourism. Rural tourism, for example, is an inherently territorial activity, really connected to the specific territory, in terms of environmental diversity, architectural texture, cultural and social wealth.

Renewable energy supply requires large tracts of land, food production necessitates arable and pasture land with suitable soils, and land is also needed for urban-industrial purposes, transport, resource extraction, refuse deposition, and recreation, i.e. all of them compete for land.

As a consequence, mankind's growing demands for renewable energy, food, and land cannot be circumvented by any form of adaptation. “These growing demands the three major ecological traps that threaten mankind probably more severely than any other environmental problem. If endeavours for promoting sustainable development disregard these three ecological traps, they will inevitably miss their goals. As a consequence of these growing demands, the remaining unfragmented areas are under an enormous pressure. Therefore, much higher efforts are now required to conserve unfragmented landscapes.” [18]

The impact on the landscape of renewable energy requires an approach designed to make the deployment of systems compatible with the landscape and with agricultural production. It needs therefore considered the visual impact of the energy infrastructures, caused by the large size of the area occupied and - particularly in agricultural soils - the consequences that the installation of the equipment on the ground could result, if prolonged, on the fertility of the land and, consequently, on their land value. This paper presents the situation of power plants in the Region Molise (Figure 1) with reference to the two main types of plants installed in rural areas: wind farms and ground-mounted photovoltaic plants. The study area although it was affected by significant demographical and economical changes [19] preserves environmental situations worthy of preservation, evidenced by the presence of Sites of Community Importance identified under the Habitats Directive, containing their habitat and riparian wetlands, coastal and gullies, as well as a number of animal species and two plant species of priority interest [11].

The invasion of the coastal area by ground-mounted photovoltaic plants and by the large number of wind farms situated along the ridges in the pre-coastal area is very clear, especially in the eastern part of the province of Campobasso, along the ridge located between the Biferno Valley and the Fortore Valley.

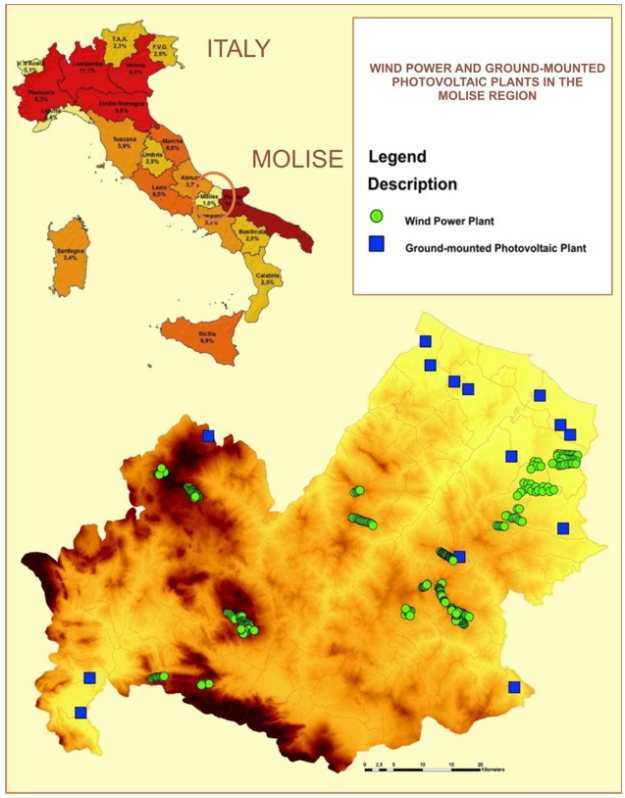

Fig. 1 Wind power and Ground-mounted Photovoltaic Plants in Molise (Source: Molise Region, our elaboration)

As is known, the production of electrical energy underwent a great change in the 90's [5]: in fact, the two laws of 1991 opened a new scenario because from that time onwards the power production was no longer just the prerogative of ENEL (National Agency for Electricity), and the Regions were delegated to identify suitable areas within their territory for the exploitation of renewable energy sources.

In Italy, the contribution of renewable energy sources grew by 32% in the decade 1990-2000; in particular, excluding hydroelectric, the increase is 72% [17].

It is particularly significant because the Italian energy system is characterized by a strong dependence from other countries.

The supply data show that - in the period 1980-2010 - the national primary energy imports the 80% of total consumption; in particular in 2000, resources from foreign countries reached a share of 84%.

Therefore Italy is one of the last places in Europe for energy self-sufficiency. Taking into account the energy production trend in Italy from 2000 to 2012, the energy production from renewable sources increased over the years (Figure 2).

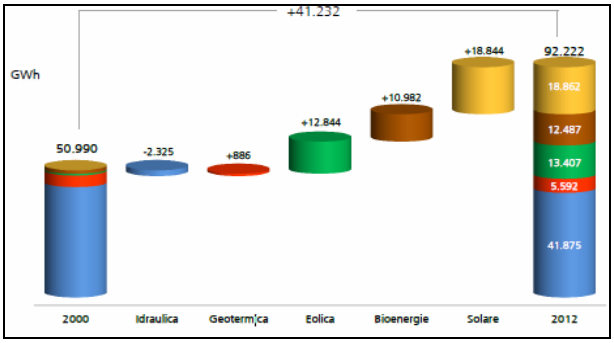

Fig. 2 Energy Production from renewable sources in Italy (GWh). Comparison 2000-2012 (Source: GSE, Rapporti Statistici, 2012)

From 2008 to 2011, the number of PV systems has more than doubled, although the growth in 2012 was less significant (about 44%), compared to previous years. With regard to power, from 87 MW in 2007 has come down to 16.420 MW in 2012, representing 28.5% more than in 2011.

The power has grown more than proportionally to the number, as it came into operation plants larger; This phenomenon is particularly evident until 2011. At the regional level, the installed capacity is concentrated to 43.5% in the North, 37.5% in the South and 18.9% in the center.

3 Material and Methods

Our methodology is intended to fit into the structure of the *New Regional Landscape Plan* – in processing for the Molise Region - through the identification of conservation measures connotative character of the landscape, the determination of the recovery and rehabilitation of areas significantly compromised or degraded, the identification of the measures necessary for the proper insertion of the interventions of land transformation in the landscape, with particular reference to systems for wind power and ground–mounted photovoltaic plants.

3.1 Renewable Energy Production Norms in Italy

In Italy the National Code of Cultural Heritage and Landscape was issued in 2004; following this enactment and its subsequent amendments also the Molise Region must adapt its previous landscape planning and identify the landscape quality aims for each identity-area. Therefore, the landscape planning should not only interested in the preservation and conservation of the constituent elements of those parts of the territory are deemed exceptional but should be able to define lines of development and landscape quality aims for the entire territory. Objective of the plan will therefore also the identification of measures for the rehabilitation of areas affected and degraded and the identification of the lines of urban development and construction, on the basis of their compatibility with the landscape values recognized and protected, with particular attention to the protection of rural landscapes and sites inscribed on the world Heritage List of UNESCO.

In 1999, to implement Directive 96/92/EC (common rules for the internal electricity market), the Legislative Decree no. 79/99 was issued which promotes the production of electricity from renewable sources. This obliged producers of energy from fossil fuels to introduce green energy into the electricity market by 2001 or, alternatively, as determined by the Ministerial Decree of 11 November 1999, to purchase of "green certificates". The reform of the Title V of the Italian Constitution (Constitutional Law no. 3/2001) assigned legislative power over energy production to the Regions. Afterwards new Guidelines for the authorization of renewable energy, plants were implemented by the National Decree in 2010: they will be analyzed in this paper. In 2006, the Molise Region adopted the Regional Environmental Energy Plan with the goal of optimizing and encouraging energy conservation, and enhancing green energy sources with particular attention to hydroelectric and wind power. The Plan highlights the potential of the Molise territory for the production of wind energy and suggests a target scenario for 2015 in which the installation of wind turbines exceeds 1,700 MW. In addition, the plan identifies areas within the river Biferno basin as sites of great interest for wind energy. The 2015 target scenario does not take into account the

contribution of PV integrated into buildings, neither does it considered the construction of ground-mounted photovoltaic plants.

The Plan also lays down the guidelines for the evaluation of projects and the impacts of wind farms to be implemented by future regional laws.

In 2008, the Molise Region issued its own regional law governing the installation of wind and photovoltaic plants in the area. This law and the subsequent guidelines, identified a number of areas unsuitable for the installation of wind and photovoltaic plants, in particular the areas of regional parks and nature reserves, the "zone 1" of national parks, areas of "protection and integrated conservation" of the Vast Area Landscape Environmental Plans, the SPAs (Special Protection Areas), SCI (Sites of Community Interest) and the area of the Tammaro Valley and the surrounding hills. Additional changes and additions to the Law of 2009 were made by Regional Law no. 23/2010. This law reinserted the Tammaro Valley and surrounding hills in the list of areas unsuited to the realization of wind farms and photovoltaic installations, because it is one of the Region's most important archaeological contexts.

Subsequently, a Council of Ministers Ruling declared this Regional law to be unconstitutional because of the above-mentioned Legislative Decree no. 387/2003 which states that Regions can proceed with the identification of unsuitable areas, but in accordance with National Guidelines.

In fact, according to D.M. of 10th September 2010 (National Guidelines for the authorization of plants powered by renewable sources) unsuitable zones could be identified with regard to specific sites after the completion of a thorough investigation that would identify particularly sensitive or vulnerable areas.

3.2 Spatial analyses

We therefore developed a method of territory analysis available for the control of the new infrastructures involving rural areas, creating new forms of landscape impact.

Our research on regional territory as embodied in the L.a.co.s.t.a. Laboratory, through the use of GIS software for spatial analysis, wants to reconstruct the main changes in the geography of the rural zone such as changes of the costal and pre-coastal zone, which remains imprinted on a matrix rural, but suffering from marginalization phenomena. The GIS started initially as a desire for the "mechanization of the process of map production" and so its aim was to substitute cartography on paper with a database that would be both flexible and easy to update. This system has been since perfected, so that it can now offer the possibility of superimposing the various themes that have been dealt with in a way that it would be useful for a better understanding and study of territorial analysis. The possibility of using GIS for information, both in raster format as well as in vector format or a combination of both, has extended the capacity of the system as well as the number of its potential uses. This data processing tool upon which the territorial information system is based has, therefore, the task of being an archive of information which will also allow its elaboration and analysis, as well as to be able to give a spatial representation of it. The architecture of the GIS, as well as being a system which will allow the memorization, filing, manipulation, and analysis of data, should be organized with the aim of optimizing the possibility of comparison between data. It should also be used, according to the purposes of the system, for the creation of representations, and for the visualization and analysis of geographical data itself [4].

GIS is a powerful tool for analyzing spatial data and establishing a process for decision support [20, 29]. However, it is a very useful method for assessment of changes and development of ecosystems in the landscape [25].

Geoinformation technologies are specific information technologies used for processing of geodata and geoinformation. A Geographic Information System integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. A GIS helped us answer questions and solve problems by looking at ourdata in a way that is quickly understood and easily shared.

The analysis of marginality and economic dynamics was carried out in order to focus on the changes which have been recorded in our sample-area. It wants to investigate major changes due to the settlement of the territory along the coast especially in relation to economic factors. In this regard, the investigated dimensions are the following: I) population; II) agriculture; III) industry and services.

The information sources used for the statistical elaborations are mainly based on data by ISTAT (Central Institute of Statistics) and they are basically census data. The analytical system concerned, first

of all, the construction of “integrated signs”, that is the main changes occurred between the first and the last reference year (year 2010), in relation to the investigated phenomena. In this case, the adopted methodologies are the usual ones for the analysis of structural changes and they don’t require specific explanations. The evolution of land use in the Molise Region in order to renewable energy installations is evaluated by taking two representations of the territory fifty years apart. We used data from the vegetation map of the Molise Region drafted after World War II (indicative reference year: 1954) and data from the Corine Land Cover 2006. To do this analysis the keys were standardized and then a comparative vector informative layer was used [4]. In the analysis of the evolution of land use we wanted particularly to highlight the great territorial evolution related to changes in agricultural zones and in urbanized areas.

4 Results

Our application for the Molise Region foresees a comparison between variations in soil use with the evolution of the environmental characteristics of the area under study.

In the definition of the characteristics which a territorial information system of aid to our project should have, there have first of all been established the parameters for the collection of data and for the reordering of the information which was already in our possession. Another necessary step has been that of revising and coordinating the existing sources, keeping in mind that the final purpose of the system is to define the objective landscape qualities, we find ourselves having to face the problem of combining, and consequently confronting between themselves, information coming from different sources. The first step, therefore, has been to create the pre-supposition for the creation of an archive of the information available. The archive should be uniform and comparable, the aim being to render effective the system of correlation and utilization, which must become an element of support for the final evaluations to which the GIS is destined. In particular, as far as the territory of Molise is concerned, a technical regional cartography or map is available, which has been produced by the Centre for Cartographical Research of the Region of Molise since the beginning of the nineties. The map is a numbered map with a scale of 1:5,000 and it covers the entire regional territory. Furthermore, we have a series of photogrammatric filming which has been carried out with a certain regularity - (1957, 1987, 1992, 1997-1998, 2002, 2012) - and which can be used for a reading of territorial transformation through time. In the cartographical inventory of the Region are also available some thematic maps, such as those dealing with vegetation, or the geomorphology or the use of the soil, examined also in their temporary evolution [4].

4.1 Marginality and Changes in Economic Settlement

The geographical area’s marginality comes from a large number of demographic, social and economic causes, but it takes many configurations depending on the methodological approach.

From the demographic point of view, the Molise Region is characterized by the presence of small size municipalities with fewer than 5,000 inhabitants (125 out of 136 municipalities), which cover 82% of the total area with the middle of the regional population: 105 towns have less than 2,000 inhabitants and extends over approximately 65% of the region, with almost 30% of the total population, while 88 municipalities that have less than 5,000 inhabitants and population density of less than 50 inhabitants/km² appear in strong condition of depopulation (Figure 3).

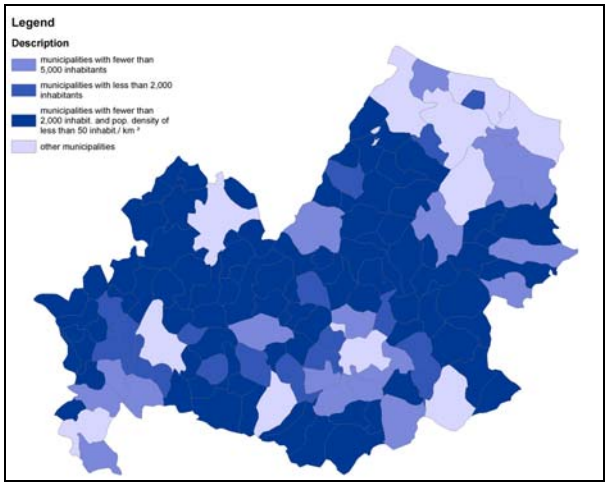

Fig. 3 Demographic Map of the Molise Region ((Source: ISTAT 2011, our elaboration))

In the “Molise Regional Rural Development Plan” (2007), two different typologies are identified: they are "Urban Centers" and "Rural Areas with Development Problems", which are divided into: a) Hilly Irrigated Areas; b) Hilly Rural Areas; c) Mountain Areas. "Urban Centers" correspond to the most dynamic areas of the region with a good amount of services and good level of well-being; they are attributable to the two capitals of Campobasso and Isernia.

"Hilly Irrigated Areas" include the coastal strip and the inland plain: despite their characterization by elements of fragility, they have some characters that are fundamentally different compared to other rural areas with development problems, particularly with regard to their competitiveness of the agricultural activities. "Hilly Rural Areas" differ from the first one in relation to the reduced incidence of irrigated areas; this situation, also with their geo-morphological conditions, affects their agricultural production and, more generally, on their economic balance. Moreover, they are characterized by strong elements of rurality, associated with lack of infrastructures and services that distinguish them significantly from other hilly areas. "Mountain Areas" correspond to the most marginal and peripheral areas of the region, in which geographic morphological and climatic features, influence in a negative way business decisions and consequently the levels of development of the territory.

It is precisely in these areas - identified as predominantly rural from regional investigations - that in recent years were made the most renewable energy installations. Our attention turns particularly to installations which have a more significant impact on the landscape – and inevitably affect the agricultural activities that take place on it - or wind power and ground-mounted photovoltaic plants.

In the coastal area, as data in Fig. 4 highlight, a framework of strong population growth between 1951 and 2010: the number of residents is, in fact, almost doubled. The greatest increase occurred between 1961 and 1991: in this phase, the population has grown from 32,043 units to 47,058 units (up 47%). This is particularly important because the growth is due solely to the change in net migration that, in the past, depleted the area of active forces low Molise. In the following decades, the increase was substantially lower (5%), but always interesting. Considering the urban-rural dichotomy between 1961 and 2010, a clear process of centralization of population in urban areas (41%), while the number of rural residents was basically cut in half. This is due, above all, to population growth overall, but is also explained by the population movements from rural to urban areas. Therefore, a "socio-territorial dualism" in which a large part of the population of the area tends to centralize in Termoli and more common in the next, where are located the most important industrial activities and services. E 'to be considered, however, that the increase of internal mobility has given rise to a process of urbanization different from that already experienced in major Italian cities, which have, meanwhile, initiated and / or completed almost all the phase described congestion.

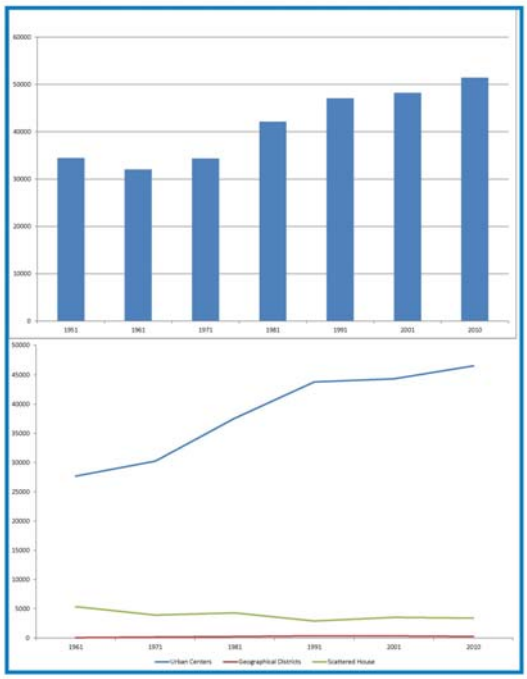

Fig. 4 Demographic Trend in the Molise Region (Source: ISTAT 2011, our elaboration)

Industrial activities and services play an important role in the town of Termoli. This condition is significant also in the industrial Map of Italian Localism. In the industrial area of Termoli, that reaches the top of specialization with the participation of the mechanical industry, diversification of production grew up in the direction of agro-food and chemical industries. Starting in '60's, there was a significant increase in local units of industry and services. In 1961 there were just 1,681 local units, while in 2010, local units amount to about 50,000. Really there are significant differences between different National Census. In fact, over the past few decades the increase of local units had a lower intensity compared to the period 1971-1991. The result is, therefore, a framework that emphasizes a clear outsourcing of the production system.

Agriculture suffers a drastic restructuring and tends to specialization and intensification. The farms number increased slightly, except in Montecilfone, Petacciato and San Giacomo. In contrast, the Total farms Land and the Agricultural Land are greatly reduced in each Municipality, except in Campomarino Montenero di Bisaccia and San Martino in Pensilis. Consequently, the average size corporate decreased significantly. This

condition is to be read in relation to the actions of land reclamation.

The land structure does not detect phenomena of sputtering but since the 90s in almost all areas there were a decline in the share of the Agricultural Land of farms with over 50 hectares.

Irrigation played a very important role for the development of this area, where rainfall is scarce and poorly distributed over the course of the agricultural year. Irrigation developed in the 80s, thanks to the use of water resources of the Guardialfiera Lake, which has a usable capacity of about 137 million cubic meters of water. In 2010, irrigated areas totals more than 5,000 hectares and affect significantly all the municipalities in the area: it is a phenomenon that must be carefully assessed in terms of farming but also the environmental impact.

Data relating to farms indicate a widespread presence and extensive use of irrigation. More than half of farms use irrigation for a coverage of more than 70% of their irrigable area.

The percentage of irrigated area in the Total Agricultural Land takes significant values in Campomarino, Guglionesi, Petacciato, Porto-cannone and Termoli. Irrigation affects mainly horticultural crops, industrial plants (sugar beet) and fruit trees. Great importance have dynamics of the production structure of the area: in 2010, the production scenario appears to be more varied than in the 50s. Data reveal, however, a clear decrease of arable land and permanent grassland. In contrast, permanent crops showed a significant increase. Moreover the forest increase appears smaller. The weight of the arable land unchanged, the incidence of meadows and pastures reduced, while there is a significant increase in permanent crops. The so-called "other land" almost disappeared. With particular reference to wine production, it is appropriate to emphasize the special vocation of agriculture in the area and the importance of the production of quality.

The livestock farming is marginal in the context of this area, although in recent years there were a slight increase in the number of farms in Campomarino, San Martino in Pensilis and Petacciato. The spread of organic farming in the study area is relatively low: farms that adopted organic production amounted to just 108 units.

The Total farms Biological Land is 512.35 hectares, while the Agricultural Biological Land covers an area of 291.68 hectares.

At the municipal level, the analysis shows that Petacciato is the Municipality with the majority of biological land, which represents the 44.2% in terms of Agricultural Land and 49.8% in terms of Total farms Land. In Guglionesi the biological surface amounts to 91.49 hectares and 74.38 hectares of Agricultural Land (25.5% of Agricultural Land and 17.9% of Total farms Land). In Campomarino the Total farms Land and Agricultural biological Land amounted to, respectively, 29.89 and 18.6 hectares. In Termoli, the Total farms Land and the Agricultural Land correspond, respectively, to 6.01 and 3.94 hectares (1.4% of the Total Agricultural Land and 1.2% of the total farms land). The result is a framework that emphasizes a clear process of specialization and intensification of agriculture, which created environmental problems and simplification of the landscape.

Therefore, the most significant changes in the demographic structure and employment are formed by the increase of the population, especially those living in urban areas, compared to the depopulation of the countryside. The result is a strong framework of "centralization" of the population, which tends to be arranged on the territory along lines of force that reflects the focus of the most remarkable susceptibility productive, clashing with the traditional urban structure, characterized by an extreme dispersion of the settlements. However our sample area undergone a significant transformation that has also affected the landscape and the natural topography. This is a source of some problems that concern not so much the abandonment of marginal land, as the isolation of the villages and little inner served by the network of connections. In lowlands or in the valley, however, several productive activities created problems of adaptation and, at times, competition for land use.

In agriculture a restructuring process took place, with repercussions on production, work organization, business activities, rural territories and landscape. The main transformations involved the intensification of agricultural land-labor because of agriculture exodus, mechanization operations, new cultivation guidelines. The contraction of employees in agriculture contributes to widening the gap between demand and supply of work, and, therefore, could give rise to the phenomena of cessation of business activities or "simplification" of production systems, with consequences on the landscape.

4.2 Changes in Land Use and Renewable Energy Settlement

In our sample area, significant remediation of wetlands was made from the late 50s, which have changed the aspect and the land use of most of the coastal and pre-coastal zone [9]. The coastal area is

covered by the Landscape Plan No. 1 Coastal Area, for a total of 48 434 hectares1, and it is, of course, never returned to any Mountain Community.

Moreover, in the last fifty years there were considerable changes in land use [9] , [4].

First of all, there was a net decrease in areas with shrubs and bushes that it turns into an agricultural area.

Only in few circumstances, where agriculture activities appeared uncomfortable because of the area's topography, agricultural zones were abandoned: consequently these areas have slowly naturalized (this is the case of the wooded areas along the Tecchio River, near Petacciato, which before were devoted to agricultural uses). A Campomarino, however, we see the opposite phenomenon: in Ramitelli locality, forest areas disappeared to take place for agricultural use.

Another growing problem is the disappearance of the dune system: on the coast of Molise today do not have that few residual areas, often remained only by chance.

This ecosystem degradation began with the early works of reclamation of the Adriatic coast, but in more recent times it had a large increase. In fact, the coastal building development, which was spontaneous, chaotic and deregulated, pushed the anthropic presence more and more close to the shoreline, destroying the sparse vegetation typical of the dunes and levelling the dunes themselves for their own purposes. All along the coast, therefore, there is an increase in number and size of urban areas. This phenomenon is particularly concentrated around the town of Termoli (already in the 90s, there was a consistency of urban areas equal to 10 times that of forty years earlier).

The analysis carried out for the definition of the land use (Figure 5) bring out the clear vocation to agricultural production: in particular, land valley and irrigated areas along the hillside are considered as exceptional value, both for their geo-pedological asset and for their cultural attitudes.

Areas along the Biferno and Trigno Rivers, and in general all coastal areas, are considered by the plan of exceptional natural interest: there are, in fact, areas that were then proposed as Sites of Community Importance, reflecting the presence of flora and fauna as important to highlight the need to protect their biodiversity.

These are: the dune habitat in Campomarino, rare flora in the coastal area near the Saccione River; the wetland biotope in the district of Salcete in Guglionesi on the left side of the Biferno River; the habitat suitable for aquatic species along the Tamburro River (it is currently the only wetland remaining in the stretch from the Liscione dam to the Biferno's mouth) which is characterized by the presence of holmoak Mediterranean forests.

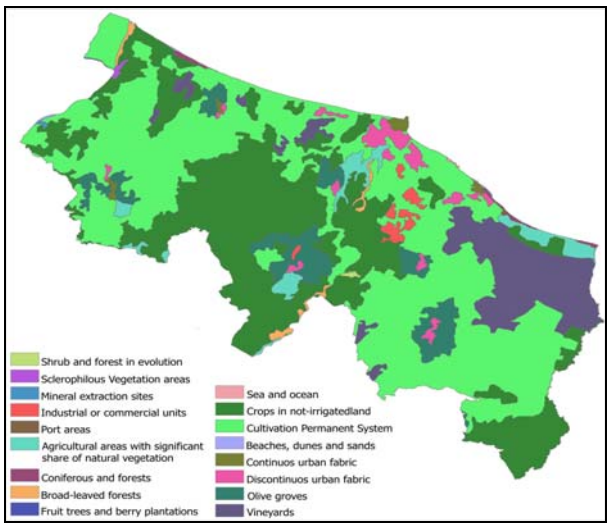

Fig. 5 Land use analysis in the coastal area (Source: CLC 2006, our elaboration)

Worth less, but similarly important elements in this area, are the coastal wetland typical of the Mediterranean basin located near the mouth of the Biferno River- and therefore in an area subject to intense human activity - and the forest named Fantine in Campomarino, currently extremely devastated by the presence of activities, including a dump, but potentially recoverable thanks to the remains of holm oak survivors. Moreover, in the actual Landscape Plan, there are different areas characterized by the visual interest such as peak lines and hilly performances. It is necessary to underline the exceptional importance of the so-called headland of Campomarino, that put Campomarino in a panoramic location.

Elements of geological hazard have been identified in Petacciato landslides, in Montenero di Bisaccia and Guglionesi landfall and also in Montenero di Bisaccia along the right side of the Trigno River. In essence, the coastal zone is certainly the part of the region with the major transformations, in the area which is also highly exposed to anthropogenic pressures, especially those linked to the increase in tourism. Of course, also the creation of reservoirs and the abundant mining activity contributed to the actual condition of the landscape feature, particularly in the coastal area, where the already mentioned urbanization occurred rapidly and without effective checks both for the settlement of industrial settlement and for urban increase. Moreover the coastal area could be divided into two sub-areas. The demarcation is essentially

signed by the Biferno River. In its right side there is the area with the higher soil fertility and where farming activity is more developed, also as a result of the past land reclamation. In the left side of the Biferno River there are the greater phenomena related to the human activity, to the expansion of the urban area of Termoli and especially to the presence of the industrial area.

The Figure 6 shows the situation in the Coastal Zone of the Region and shows the number of wind farms and ground-mounted photovoltaic plants in each municipality territory. The installations are subdivided in three project typologies:

- Approved projects by Environmental Impact Assessment (EIA): wind or photovoltaic projects for which have been required the EIA act in accord to the Regional Law no. 21/200010. The EIA procedure has been positive issue;
- Approved projects only by Screening Act: projects that have been subjected to screening process and for which it isn't necessary the EIA procedure;
- Ongoing projects – EIA in progress: projects that have benne subjected to screening process and for which is necessary realize the EIA procedure. The data refers to the procedures for environmental impact assessment (EIA) and environmental assessment (VA) used for screening wind farms and photovoltaic plants from 2000 to 2014, taken from the Molise Region's institutional website11. Plants already on maps, that are those greater than 1 MW, have not be considered. Most of the cases submitted to the opinion of the Regional Authority, about 90%, are concentrated in three years (2009-2012). In some years (2000 - 2001 - 2003 - 2004 - 2006), no plant was submitted for evaluation by the Molise Region. The data shows that in the coastal areas (Montenero di Bisaccia, Campomarino, Petacciato) there is a substantial and exclusive concentration of photovoltaic plants, while in the pre-coastal territories there is a higher concentration of wind farms (Acquaviva Collecroce, Santa Croce di Magliano, Bonefro, Ururi, Montecilfone). Projects submitted to verification in order to determine whether they should undergo environmental impact assessment (commonly called "Screening") represent 97% of all evaluations. The procedure is intended to determine whether the proposed project may have a significant environmental impact and therefore should be subject to further EIA procedures, or not.

There are three wind power plants in the Region subject to environmental impact assessment (EIA) localized in Campomarino, Portocannone and San Martino in Pensilis, and two photovoltaic plants localized in Campomarino-Portocannone and Montenero di Bisaccia.

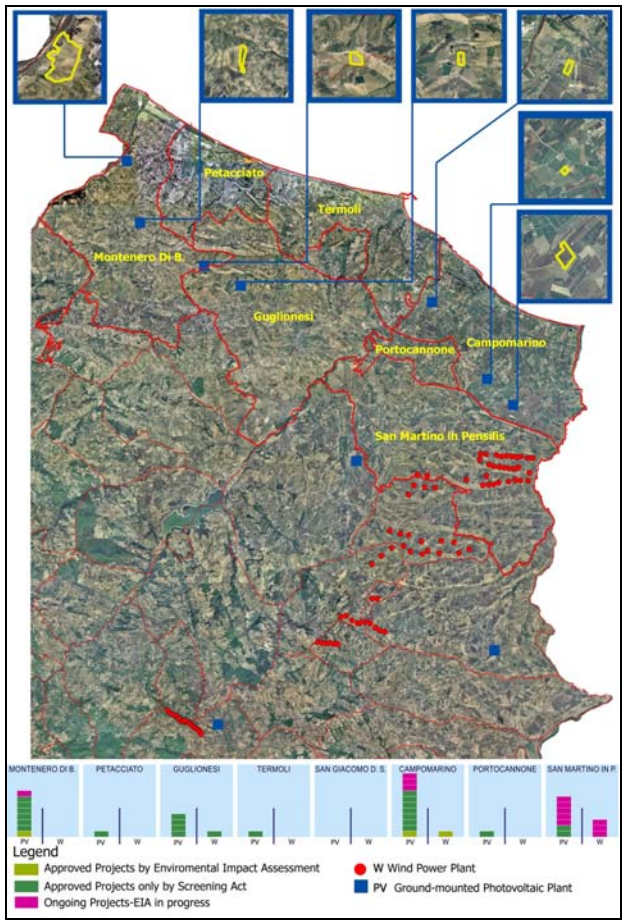

Fig. 6 Wind power and Dround-mounted Photovoltaic Plants in Coastal Zone (Source: Molise Region, our elaboration)

4 Conclusion

The aim of this paper was to identify a methodology of territory analysis available for the control of these new infrastructures involving rural areas, creating new forms of landscape impact [14]. Moreover it is important verify the current land use. Also we wanted to assess how the current landscape plans, drawn up in the early 90s, provided to safeguard their territories, starting from the identification of their elements of interest. The spirit of the enforcement of the Galasso law, in fact, was to establish the area's transformability by dividing the area of each plans. In fact, as known in the Molise Region the landscape plan did not cover the all regional territory. Therefore, the analysis of the Transformability Map of the Plan no.1, which covers the coastal area, has highlighted the mode of transformations prescribed by the plan.

The actual Landscape Plans are created from documentation referred to by Art. 6 of the Regional Law no. 24 of December 1, 1989, which regulates the Legislation regarding Territorial Landscape Plans. Therefore, the project tables containing, among other things, the indications of the degree of landscape and environmental transformability of the area and the methods of protection and enhancement (according to Art. 4 of the same Act) are an integral part of the plans. These indications have been reported for all eight plans drawn up for the Region, in the Transformability Map of the area, scale 1:25,000. The Map of Coastal Zone, shown in Figure 7, defines the main characteristics of the area analyzed by dividing it into different fields of interest or risk.

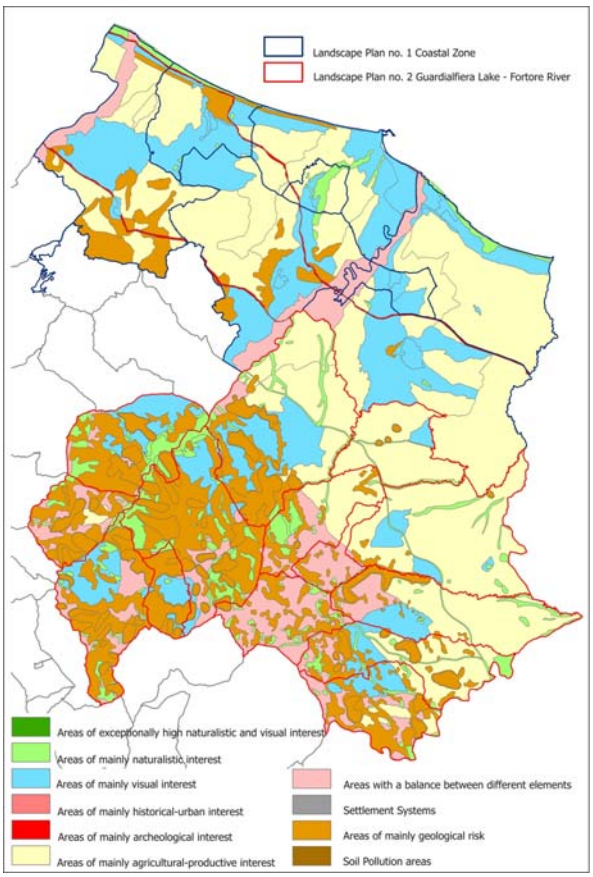

Fig. 7 The Transformability Map of the Coastal Vast Area Landscape Plans (Source: Molise Region, our elaboration)

For each of these areas, depending on the prevailing interest, was shown a mode of transformation and the resulting land use regulations through the definition of eligible interventions by identifying the areas to be protected. In order to gain a complete picture of the transformability of the Region, all the Transformability Maps of the eight landscape plans in force have been analyzed. The problem arose in the interpretation of the keys to the plans because, having been drafted by eight different workgroups, they do not present a uniform reading of the territory even though they used the same general guidelines. The keys have been simplified so that they can be standardized.

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