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CONSEQUENCES OF SETTING UP PHOTOVOLTAIC PARKS - RELATED LAND USE/LAND COVER CHANGES IN GIURGIU COUNTY RURAL AREA (ROMANIA)

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Abstract: The conceptual framework of sustainable development relies commonly on three main pillars, completed over the past years with a forth one, namely the institutional pillar. Aiming at environmentally sustainable growth, Romania has a suitable location for the installation of photovoltaic systems. The country experiences a very dynamic development in photovoltaic energy production, including photovoltaic industry, and both at central and local government level. The study herein makes an analysis of the territorial effects of implementing and operating photovoltaic parks in the rural area of Giurgiu County in terms of land use changes. The case-studies discussed in this paper reflect the land use/land cover changes of building and operating the six solar parks in the three Giurgiu County rural local territorial units (Izvoarele, Stăneşti and Malu). The analysis on the land use changes induced by the photovoltaic park implantation valorises the information revealed by the interviews applied to the local authorities during the field investigation.

Keywords: photovoltaic park, rural space, land use changes, Giurgiu County, Romania

1. INTRODUCTION

In Romania, the sustainable development represents a new challenge, in the context of critical state of the environment, unsustainable used of natural resources and population poverty (Cămăşoiu et al., 2009). Some of recent worldwide investigations on the consequences of solar park implantation in rural areas refer to: the role of renewable energies, including solar energy for the local development (Mezei, 2008; Pelin et al., 2014). The setting up a photovoltaic park implies positive and negative consequences on environment in terms of land use/land cover, landscape effects, visual pollution of the environment, visibility in terms of the local landscape and natural heritage, greenhouse gas emissions, water and soil pollution, energy consumption etc. (Tsoutsos et al., 2005). In the context of the growth rate of atmospheric carbon dioxides due to the burning and use of fossil fuels and the large scale deforestation (Le Quéré, 2009), the photovoltaic parks registered some positive effects on environment. The photovoltaic energy uses the solar resource, which is virtually unlimited compared to any conceivable demand for energy (Morton, 2006), and it has a positive role in reducing the carbon-dioxide emissions. In parallel with this opportunity, there are problems focusing on the fact that solar PV systems affect the environment and it involves the use of land resources. In this context, the risks linked to the use of an intensified renewable energy source are adequately taken into consideration in any planning process (Sliz-Szkliniarz, 2013). Also, the identification of land cover classes affiliated with high solar potential (Janke, 2010), represents a topical research trend.

The objective of this paper is to analyse the local and regional consequences on the sustainable development process of photovoltaic parks implantation in terms of the land use and land cover changes in three rural local administrative units (Izvoarele, Malu and Stăneşti) in Giurgiu County.

The Giurgiu County is located in the south of Romania, in the Romanian Plain, also known as the Lower Danube Plain (Niculescu et al., 2006) (Fig. 1).

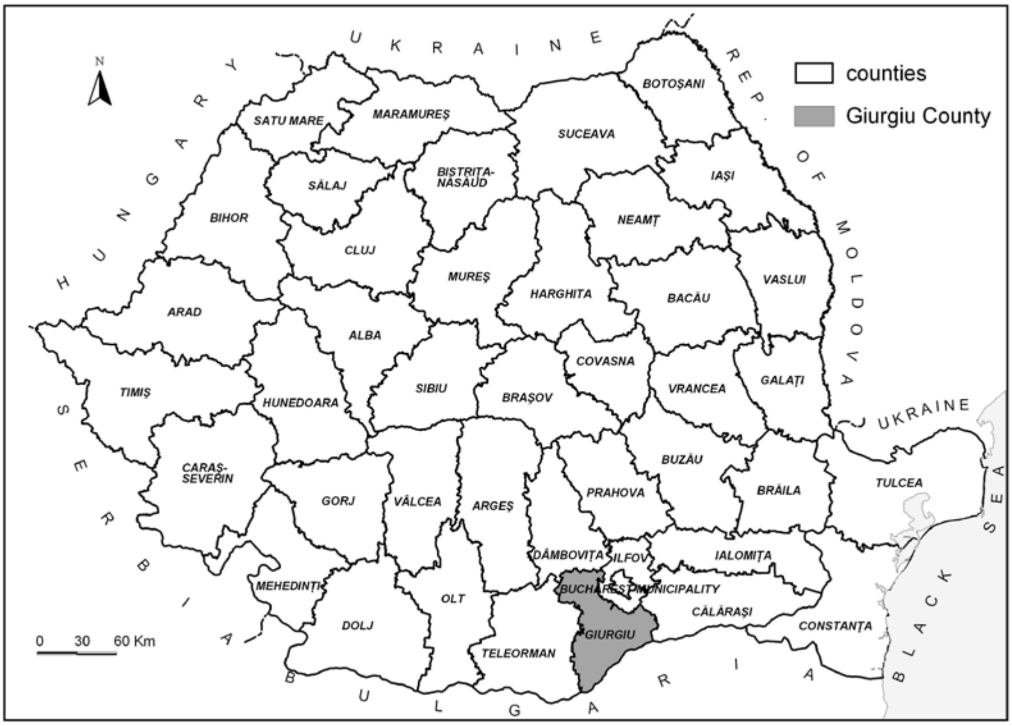

Figure 1. Geographical location of the Giurgiu County

In terms of administrative-territorial features, Giurgiu County includes: Giurgiu Municipality (the county-seat, an urban pole with regional development); two urban poles with local influence (Bolintin Vale and Mihăileşti); and 51 rural Local Administrative Units (LAU2) with 167 villages (Giurgiu County Statistics Office, 2012). Whatever the limits of the projected Bucharest Metropolitan Area (Iordan, 1973; Iordan, 1998; Săgeată, 2004; Ianoş et al., 2010), some local administrative units (LAU2), belonging to Giurgiu County, fall inside this metropolitan area, which acts as an urban-rural structure organised into one-core city (Bucharest) and both urban and rural LAU2 (Grigorescu, 2010). Giurgiu Municipality has a peri-urban area which comprises seven rural local administrative units, also including the three case-studies discussed in this paper (Izvoarele, Malu and Stăneşti).

2. KEY DRIVING FORCES OF LAND USE CHANGES

Regional land change patterns are the combined result of changes at much finer scale, that are driven by complex forces natural (Lambin & Meyfroidt, 2010; Verburg et al., 2009, quoted by Munteanu et al., 2014).

The natural factors, such as the sunshine duration and the solar energy potential, may favour or restrict certain land use/land cover categories. The Giurgiu County being located in the south of the Romanian Plain, it is recipient of the annual average sunshine duration over 2 100-2 200 hours (National Administration of Meteorology, 2008). Also, the geographical distribution of solar energy potential shows that Romania lies within an area with a good solar potential consisting of a global horizontal irradiation between 1,000 kWh/m^2 and 1,400 kWh/m^2. The most important solar regions in Romania are the Black Sea Coast, Dobrogea and the South of the Romanian Plain (where is situated the Giurgiu County), with an average annual sum of 1 400 kWh/m^2. The land cover classes affiliated with high solar potential are cultivated areas regularly ploughed and generally under a rotation system (Fig. 2).

The legal status of the land covered by a solar project has a strong influence on the dynamics of the photovoltaic energy industry and on land-use changes. Until 2013, legal provisions offered the possibility for the area covered by photovoltaic parks to be exempted from agricultural use/circuit, on condition that some taxes are being paid (many examples of irregularities and circumvention of land-use legal provisions were published in the local newspapers). Beginning with 2014, the legislation predicted the decreasing of the number of green certificates accredited to energy producers, investors not being eligible to the support scheme if the photovoltaic park is located on cultivable agricultural land (Emergency Government Ordinance No. 79/2013, Monitorul Oficial, I, No. 390/June 2013).

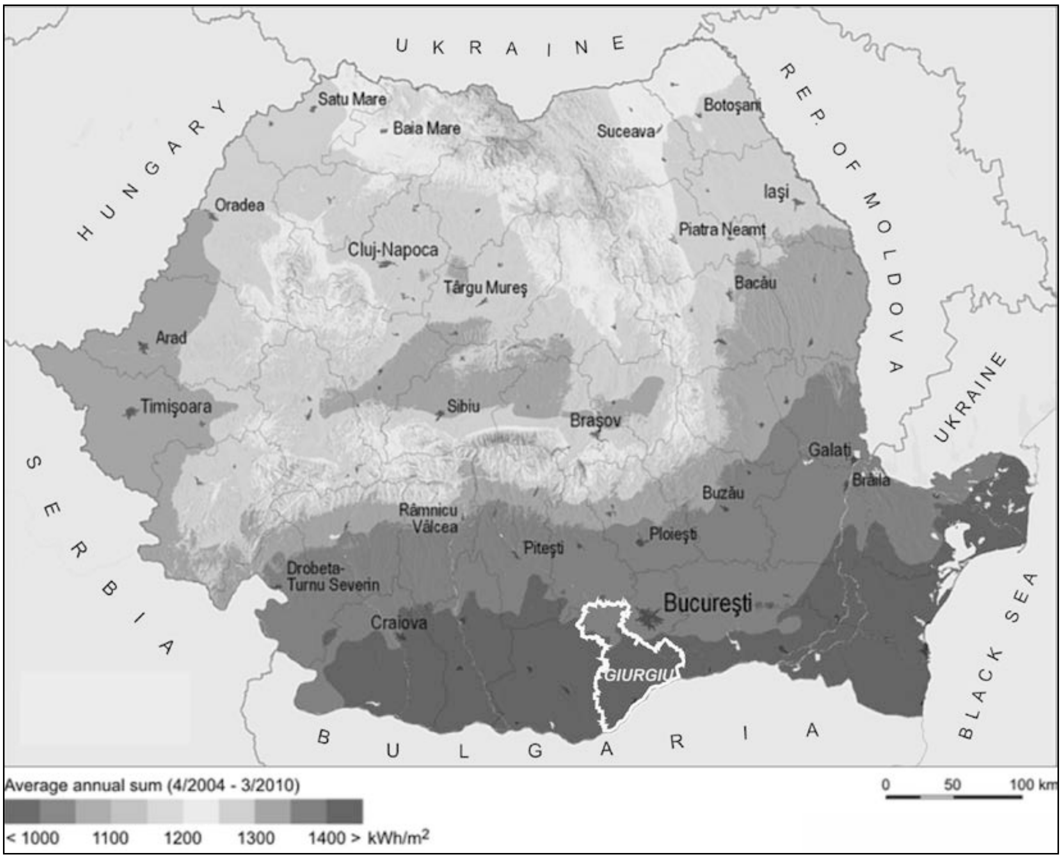

Figure 2. Global horizontal irradiation. Source: Solargis, GeoModel Solar, 2011

3. MATERIAL, SOURCES AND METHODS

In order to trace the main local territorial effects of some photovoltaic parks implantation in the rural area, the present approach relies on some relevant statistical indicators. The territorial effects of a solar project investment discussed in the present study in terms of land use and land cover change are reflected by the following statistical indicators: the number of photovoltaic energy producers; the percentage of farm land covered with photovoltaic parks per total agricultural surface. Thus, specific statistical data were used to assess the size of each solar park implanted in the rural area of Giurgiu County and its local impact. In this sense, Giurgiu County for Environment Protection and the National Regulatory Authority for Energy offered detailed information about the installed power (MW) and the surface covered by the solar panels (ha).

In this paper, the statistical data were selected for the local territorial administrative units of the Giurgiu County, in order to provide comprehensive information on the identification of key development issues of solar park implantation.

The statistical data were completed with the results of the field investigation and interviews applied to the local authorities (mayor and/or councillors) of Stăneşti, Malu and Izvoarele rural local administrative units, where six photovoltaic parks had been implanted.

4. RESULTS

In Giurgiu County, a number of 25 photovoltaic energy producers are operating in 19 rural local administrative units and in Giurgiu Municipality. In Giurgiu County are registered 37 photovoltaic parks (National Regulatory Authority for Energy and InDeSen Project). The numerous photovoltaic parks are in Bucşani, Colibaşi (6 photovoltaic parks each), in Bulbucata (4 photovoltaic parks) and Izvoarele rural local administrative units (Fig. 3).

According to CORINE Land Cover data (2006), in Giurgiu County agricultural areas are the main land use, representing 65.9% of total land fund (23346.5 ha). Forest and semi-natural areas cover 37554 ha (10.6% of total land fund) and artificial surfaces represent 5.2% of total land fund (1830.5 ha). In the three case-studies (Izvoarele, Malu and Stăneşti), agriculture is the main land use (75%-90%). The main land cover category is represented by cultivated areas regularly ploughed and generally under a rotation system (Fig. 4).

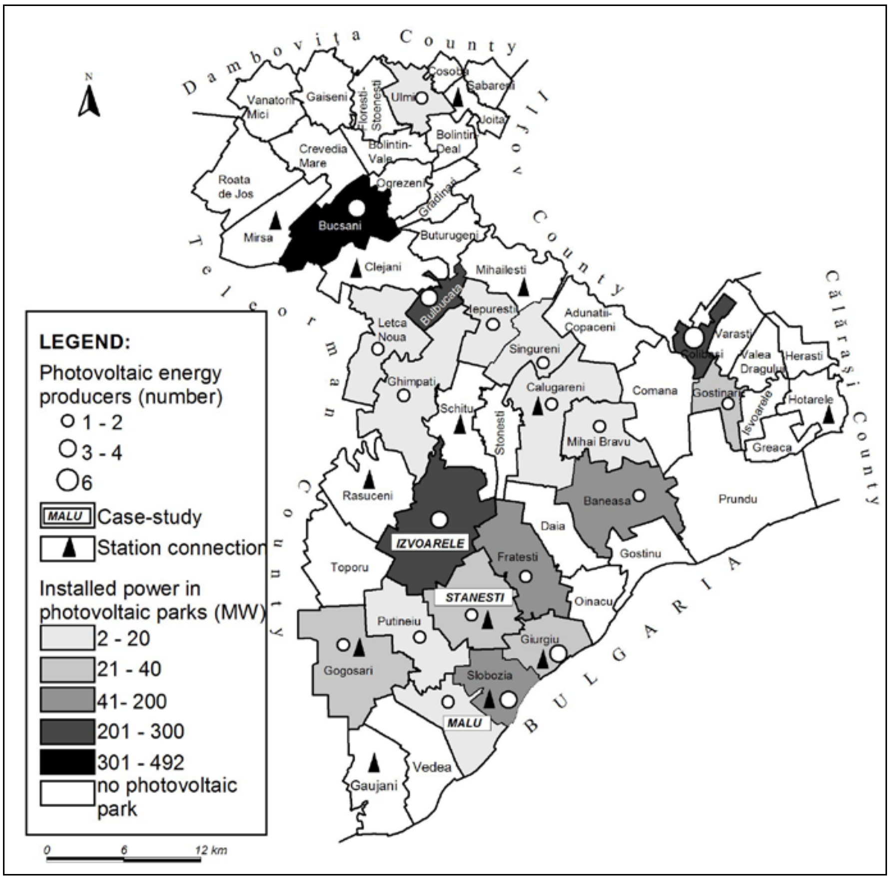

Figure 3. The photovoltaic energy producers in Giurgiu County

Source: National Regulatory Authority for Energy and InDeSen Project data-base processed and mapped, 2012

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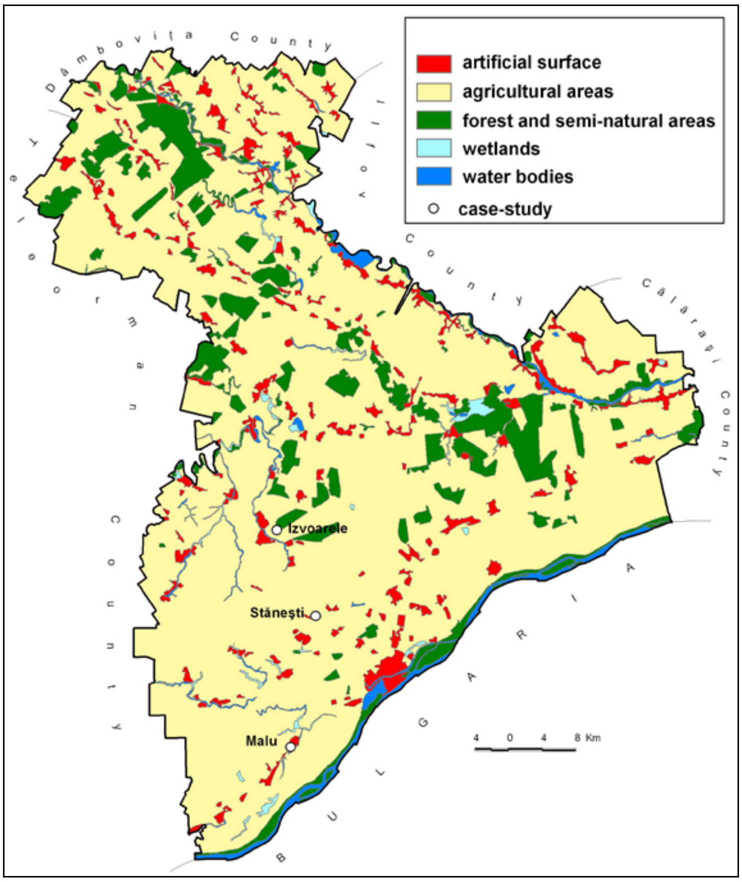

Figure 4. Distribution of the land use and land cover categories. Source: CORINE Land Cover, 2006

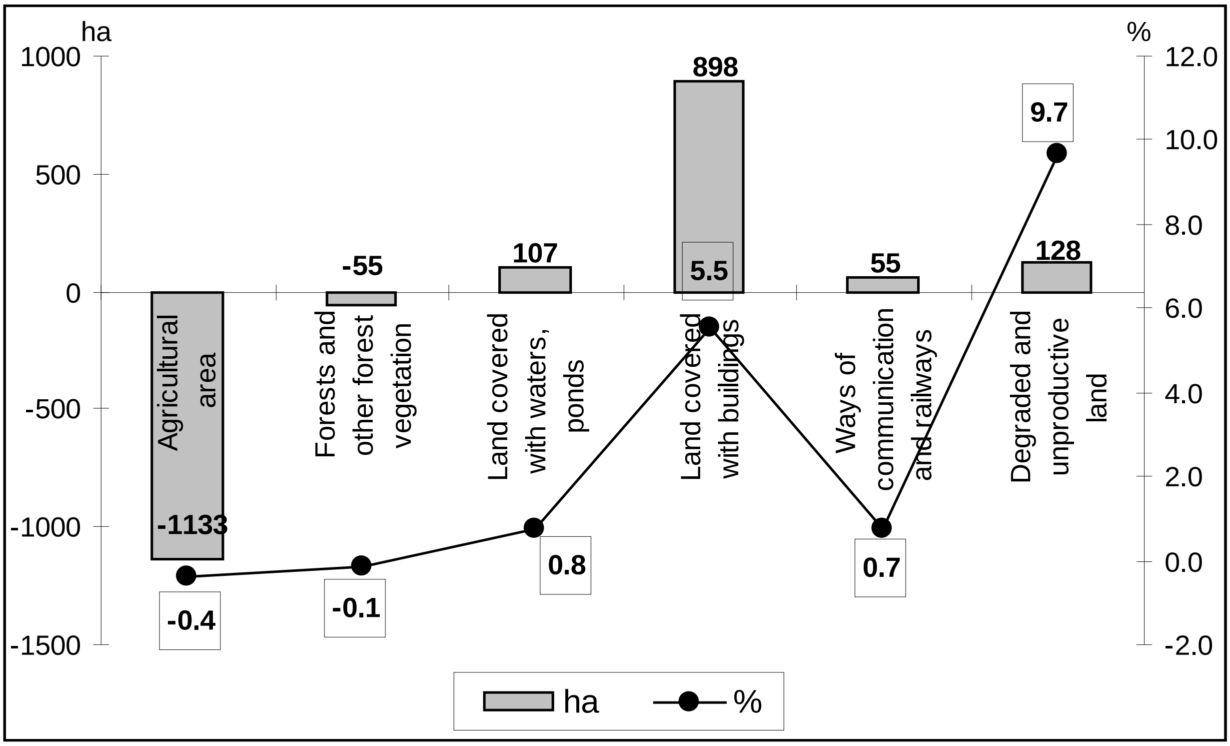

Fig. 5. Land use changes in Giurgiu County (2008 – 2012)
Source: National Institute of Statistics, TempOnline data-base processed, 2008-2012

The loss of agricultural area was reflected in the land covered with buildings, which increased with 898 ha (5.5%). Therefore, they are not under the effects of the law revoking the support scheme for investors if the solar park is located on farming land use. In the specific situation of our case-studies (Izvoarele, Malu and Stăneşti), the solar projects contributed to the growth of the local, farming-dominated anthropic activities, giving them a multi-functional feature.

The installed power in photovoltaic parks is related with the surface of land covered by the photovoltaic panels (for 1 MW installed power, 2.4 ha are covered by photovoltaic panels). In terms of land use and land cover, the studied solar parks are positioned on very valuable arable land – chernozem soil with a degree of fertility I and II (Buza, 2006), the three photovoltaic parks at Izvoarele occupying 240 ha farm land with almost 470 000 solar panels. Compared with this large photovoltaic park, the two Stăneşti parks cumulate only 30 ha farm land covered with solar panels; the photovoltaic park at Malu is built on 9.6 ha of non-agricultural land (19,000 solar panels). The field investigation revealed that farm-land areas used for the construction of solar parks were bought from local farmers.

The loss of farm land associated with the construction of solar projects and their related activities (access roads, electrical installations, special buildings, etc.) is revealed by the percentage of farm land covered with photovoltaic parks per total agricultural surface in certain rural communes. In the Giurgiu County communes hosting photovoltaic parks, solar parks cover 123,520 ha (1.6%) of the overall farming area, with highest percentages in Colibaşi (13.08%), Bulbucata (9.80%) and Bucşani (6.80%). Our case-study photovoltaic parks occupy small farming land at Stăneşti (0.47%) and Izvoarele (2.16%) (the field investigation shows that the Malu commune solar park extends on non-farming land) (Fig. 6).

The loss of farm land represents a negative effect of solar project implantations in the rural area. This reality presents a research potential from the perspective of the evaluation of primary eco-energies, which is based on the direct relationship between the land use and the quantity of primary eco-energies (Ianoş et al., 2011). The loss of farm land is related with the damage of biodiversity and soil. In terms of land-use and land-cover changes, the construction of solar facilities on large areas of land have as results the soil compaction and also can adversely affect native vegetation and wildlife, including loss of habitat. When a photovoltaic park is installed, the aboveground vegetation is cleared and soils typically graded, and regionally by landscape fragmentation that create barriers to the movement of species (Saunders et al., 1991, Cameron et al., 2012).

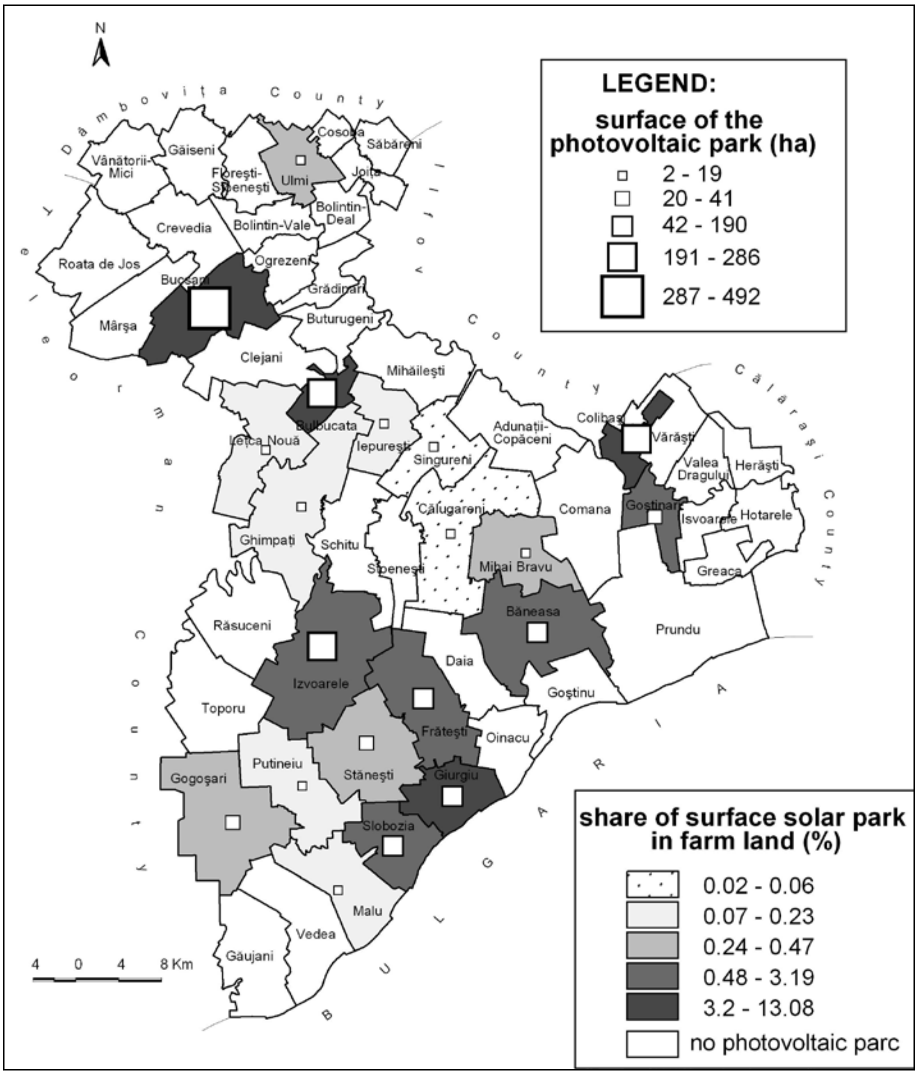

Fig. 6. The farm land covered by photovoltaic parks in Giurgiu County, 2012
Source: National Regulatory Authority for Energy and InDeSen Project data-base processed and mapped

The majority of solar parks in Giurgiu County, the three case studies included, are too extended, versus the local consumption potential. An average household demand is of 16 to 20 sq.m solar panels (Fthenakis et al., 2008). Differences in the case of Giurgiu rural area (where the county average is 800 sq.m/household) are being quite significant, the values ranking between 22 sq.m/household and 3,785 sq. m/household. Only two solar parks (in Călugăreni and Singureni) fit into the standard needs. In our case studies, the situation looks as follows: Malu – 107 sq.m/household; Stăneşti – 340 sq.m/household; and Izvoarele – 1,528 sq.m/household.

5. CONCLUSION

The general opinion on the implantation of photovoltaic parks in the three rural local administrative units studied (Izvoarele, Stăneşti and Malu) is a very good one. The negative effect (loss of farm land) was not mentioned by the local authorities simply because their impact was not being perceived. The local authorities, mentioned in some case-studies reported in the literature (Pelin et al., 2014; Şerban & Baroiu, 2011) having a positive role in community development, are very satisfied with the investment and the locals were content with their jobs, even if temporary; the local population is very poor and any additional income is welcome. The taxes and duties levied on farm land transactions have a positive impact only if consistently paid annually, during solar park lifetime. But, in some cases, irregularities and the circumvention of legal tax provisions concerning the elimination from agricultural use of farm land targeted for solar projects became a topic of the local media. In Giurgiu County, especially in the three settlements, the loss of farm land is very much present. According to the Ministry of Economy, solar parks are oversized compared to the transport capacity of the national energy system. It is obvious that the majority of solar parks in Giurgiu County, the three case studies included, are too extended, versus the local consumption potential.

The development of the photovoltaic energy industry in Giurgiu County was, and still is, part of the national direction towards the renewable energy industry. However, the way in which a new type of power industry has been conceived raises the question of sustainability: are large-sized solar parks the best solution for integrating renewable energy sources into the local development and in the green economy, in general? The analyses made for this study led us to the conclusions that this is not really the sustainable solution, a conclusion which obviously can and should be assessed in each particular case. We have in view the big photovoltaic parks built on arable, fertile land of priceless value. The ideal solution would be to have them replaced at the end of their lifetime (25-30 years on average, or shorter according to some authors – Fthenakis et al., 2008) by smaller such systems for individual or clusters of households (McKay, 2010) and small rural communities (Chaurey et al., 2004; Zahnd et al., 2006; Palit, 2013). For this type of energy to be more environmentally friendly and more sustainable (Pelin et al., 2014), the energy of solar installations should be produced and consumed locally.

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