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ASSESSMENT OF AGRICULTURAL LAND FRAGMENTATION IN ROMANIA, A CASE STUDY: IZVOARELE COMMUNE, OLT COUNTY

OCENA RAZDROBLJENOSTI KMETIJSKIH ZEMLJIŠČ V ROMUNIJI, ŠTUDIJA NA PRIMERU OBČINE IZVOARELE V OKROŽJU OLT

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Agricultural land fragmentation in the Wallachian Plain.
Razdrobljenost kmetijskih zemljišč v Vlaški nižini.

Assessment of agricultural land fragmentation in Romania, a case study: Izvoarele commune, Olt county

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ABSTRACT: Agricultural land fragmentation is a common phenomenon in developing countries in general and for Romanian agriculture in particular. The aim of this study was to analyze the degree of fragmentation of Romania's agricultural land, which is considered a major obstacle in the development of a modern agriculture. The analysis undertaken has shown that the degree of land fragmentation is high in the study area; the most fragmented are the big farms, while the small ones are more compact. At the same time, due to the scattered distribution of plots and the long distances between holdings, many fields have been turned into fallow land and consequently productivity has dropped. Under the circumstances, half of the owners are against the proposed process of merging plots because they are afraid of losing their properties again, as occurred during the communist regime.

KEYWORDS: geography, rural geography, land fragmentation, fragmentation index, participatory mapping, orthophotoplans, GIS, Izvoarele Commune, Romania

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1 Introduction

Land fragmentation, a feature that many countries have in common (Van Hung, MacAulay and Sally 2007), is regarded as an obstacle to the efficient management of rural land.

Agricultural land fragmentation, also known as pulverization (Clout 1972), parcelization (Roche 1956), or land scattering (Farmer 1960), is a type of agricultural property distribution where »… *a single farm consists of numerous discrete plots often scattered over a wide area* …« (Binns 1950).

The causes of agricultural land fragmentation are manifold and complex, controlled by socio-cultural, economic, physical-geographical, political, and operational factors (King and Burton 1985).

Socio-cultural factors have a strong influence on agricultural land degradation. The most important in this respect are inheritance laws that grant equal access by all the heirs to the assets left behind by the deceased. This principle has significant consequences when the agricultural lands subject to partition have different land uses (vineyards, arable land) or different fertility (Simion 2008). Once the fragmentation process has started, it continues in geometrical progression with each generation that inherits the land. Generally, in developing countries, land fragmentation is due particularly to the inheritance process (Jabarin and Eplin 1994; Ram et al. 1999; Niroula and Thapa 2005, quoted by Di Falco et al. 2009). Furthermore, Thapa and Niroula (2008; cited by Di Falco et al. 2009), reveal the existence of a steady decreasing trend in farm size and an increase of the number of plots caused by the tradition of dividing parental property among the heirs, which is influenced in turn by the strong affective bond with the land.

Economic factors become important from the moment a farm experiences economic or technological changes. For instance, a farmer driven by the desire to expand his farm can buy plots of land that are not adjacent to his property, thus raising further the degree of fragmentation of agricultural land (Simion 2008). An example occurred in France between 1955 and 1967 when a group of farmers trying to meet the increasing demand for fruit and vegetables bought many plots of land on the outskirts of Paris, thus increasing the fragmentation of their farms.

Physical-geographical factors control the fragmentation of agricultural land particularly through the sliding or slipping of slopes and climate conditions. Among operational factors, we can mention various interventions such as the installation of a fence or the building of railroads, highways, and canals that can split consolidated land into several plots (Simion 2008).

Many times, political decisions play a very important part in land fragmentation. For instance, the Turkish government has decided that every member of a village community should be given a small plot from the communal land. In Greece, the successive distribution of state-owned land, generally made available through multiple expropriations from large landowners has generated situations where farmers have come to possess between four and eighteen very small plots. Another example may be derived from Chinese state policies regarding the fair distribution of land. Tan, Heerink, and Qu (2006; quoted by Di Falco et al. 2009), have reported that in China the agricultural land of every village was divided into several classes according to soil fertility. Subsequently, each household received plots of land from each of these classes based on the decisions taken at the local level.

In Eastern Europe, the aim of agrarian reforms initiated by the state has been the restitution of land to those who had owned it in 1947 (Kopeva, Mishew, and Howe 1994; quoted by Di Falco et al. 2009). The post-communist changes consisted of the transfer to the private sector the property of former state agricultural enterprises and agricultural production cooperatives. In this process, the land was given back to those who had owned it previously (or to their direct heirs), who often already had small and scattered plots, or who resided in distant cities and had no skills whatsoever to work the land. Moreover, the privatization of state-owned farms was not followed by specific rules regarding the use of the land and productivity. Consequently, the agricultural exploitation of the land was significantly altered by the elimination of agricultural production cooperatives as well as by the increase of the number of private farms (Kopeva, Mishew, and Howe 1994).

2 Agricultural land fragmentation in Romania

The excessive fragmentation of Romania's land is seen as a consequence of the agrarian reforms accomplished after 1989. The laws issued for these reforms led to the restitution of agricultural lands to the former

owners who had been forced to join agricultural production cooperatives or to donate their plots to the state. Many of them, however, had passed away in the meantime and their estates were split among their heirs in accordance with the tradition observed in rural areas, where all heirs get equal shares of the land and then engage in agricultural activities on their own (Rusu et. al. 2002).

The most important reform took place in 1991 with the enforcement of Land Law No. 18 (Legea Fondului Funciar 18 … 1991) when former owners were given back their estates. The agricultural production cooperatives were divided into many holdings, and each of these was further split into plots.

The establishment of ownership rights over the land relied on restoring the old boundaries as well as on the fair distribution of land taking into account the fertility of the soil. Because each person was entitled to get at least 0.5 ha but no more than 10 ha per family, the agrarian reform led to enormous land fragmentation (Rusu et al. 2002).

According to the Agricultural Census of 2002, there were 4.3 million individual farms in Romania that all together held 14.3 million plots. The average size of a farm was 1.7 ha, the mean number of plots per farm was 3.3, and the mean size of a plot was 0.5 ha.

Relative to the degree of fragmentation of individual farms, which is expressed by the number of plots that comprise an estate, farms with moderate fragmentation (2–3 plots) are dominant (36%). They are followed by single plot farms (30%), which are more compact, and farms consisting of 4–6 plots (18%) showing a higher degree of fragmentation. The last position is occupied by farms with excessive fragmentation made up of more than 6 plots, which account for 16% of the total number (Rusu et al. 2002).

According to the Structural Survey in Agriculture, the number of individual farms dropped by 12% in 2007 compared with the situation shown by the Agricultural Census of 2002; in 2007, Romania had 3.9 million individual farms compared to 4.3 million individual farms in 2002. In the same year, the average area of cultivated land was 2.3 ha per individual farm compared to 1.7 ha in 2002. Although the survey of 2007 did not take into account the number of plots that belonged to each farm, it was estimated that the number continued to be high (National Statistical Institute 2004).

More than 25% of Romania's agricultural land is exploited by subsistence farms that are not eligible to receive European Union funds since the money is earmarked for those holdings exceeding one hectare. Nearly 70% of the total number of Romanian farmers are consequently left without any financial support. However, these funds could eventually be accessed by individual farmers, provided they join their forces and plots; otherwise, they will continue to lag behind the other countries of the European Union.

Land fragmentation, the inheritance system, and the non-intervention policy adopted by the government have sometimes led farmers to leave their plots fallow (Rusu et al. 2002) or, even worse, to abandon them completely (Sikor, Müller, and Stahl 2009). Usually, fallow plots come into existence when individual farmers fail to join together to work the land. According to the official estimates, Romania has between 1.5 and 2.5 million hectares of fallow land or at least 20% of the country's agricultural land (National Statistical Institute 2008). Sadly, from this point of view Romania comes first in the European Union. This happens because local taxes and duties on land fail to differentiate between cultivated and fallow land.

In Romania, the fragmentation of agricultural estates is very high, which explains the regression from mechanized to manual production or in other words from commercial agriculture to subsistence farming. Similarly, one can see that small agricultural holdings are prevalent and individual farms include more than 70% of Romania's agricultural land. Most of these properties lie in the southern part of the country (the Wallachian or Romanian Plain), where their mean surface area is less than 1.5 ha.

Another obstacle in the development of the agricultural sector is the aging rural population. Statistics show that 40% of Romania's farmers are older than 65, while less than 9% are younger than 35 (National Statistical Institute 2006).

The high percentage of aging population in rural areas and the multitude of small farms are major obstacles in the development of this branch of the economy.

The most optimistic estimates suggest that Romanian agriculture needs at least thirty years to catch up with the other member states of the European Union.

The trend in recent years in European Union countries has been to reduce the number of small farms and to increase the efficiency of agricultural holdings, which is reflected by the fact that a smaller number of farmers are growing more crops on larger areas.

3 Materials and methods

The main investigation methods employed were the observation method, the survey method, statistic-mathematical methods, participatory mapping, the cartographic method and diagnostic analysis tools. Because on the commune scale there were some inconsistencies between the number of agricultural parcels provided by the commune's administration and the number reported by the National Statistical Institute, and observing that some parameters were missing from the records, the authors chose to base their study only on the data collected from the questionnaires given to the local farmers.

The field research was carried out in the spring and summer of 2010 and consisted of direct observations, interviews with local farmers and decision-making officials, filling in of questionnaires, and the application of a participatory mapping method using orthophotoplans.

The questionnaire used for data collection included closed and open questions and was given to 644 individual farmers. The sample was selected at random from a list of individual farmers provided by the local authorities.

The questionnaire items covered the following aspects: the farmer's age; the way the farmers took possession of their agricultural land after 1990 (restitution, inheritance, donation, purchasing); the size of the farm; the number of plots; the size of individual plots; the farmer's opinion on the degree of fragmentation; the perception of land productivity; the farmers' future intentions regarding their estates (leasing, partnerships with other farmers, exchange of plots between owners to increase the farm's contiguity, keeping the status quo). The relevant answers were processed using SPSS *v17*, applying the T test and One-Way ANOVA.

The degree of fragmentation of agricultural land was assessed based on the computation of specific indexes and by using the participatory mapping toolbox techniques in the exploitation of orthophotoplans.

In order to get a general and as accurate as possible picture of agricultural fragmentation, the following parameters must necessarily be taken into account: farm size, the number, size, shape, and spatial distribution of plots, and the distribution of plots with various sizes (King and Burton 1985; Bentley 1987; Simmons 1988).

Apart from these aspects, the study also relies on the analysis of the following synthetic indexes: the Januszewski index, the Simpson index, and the Igbozurike index.

The Januszewski consolidation index (Januszewski 1968), which takes into account the number of plots per farm and the size distribution of plots, can be computed according to the formula:

$$K = \frac{\sqrt{\sum_{a=1}^{n} a_i}}{\sum_{a=1}^{n} \sqrt{a_i}} \quad (1)$$

where K is the Januszewski index, n is the number of plots, and a_1 is the area of each plot. The index is expressed as the ratio of the square root of the total farm area to the sum of the square roots of the plot sizes.

This index ranges from 0 to 1. The higher values point to the better consolidation of a farm, while those closer to 0 highlight an increase in fragmentation. According to Melmed-Sanjak, Bloch, and Hanson (1998), the index shows three important aspects: i) the degree of fragmentation of the farm increases with the number of plots; ii) the fragmentation is high in the case of small-size plots; and iii) the fragmentation is lower when large plots are more prevalent than small ones.

The Simpson index is similar to a certain extent to the Januszewski index and can be defined according to the formula:

$$SI = 1 - \frac{\sum_{i=1}^{n} a_i^2}{A^2} \quad (2)$$

where SI is the Simpson index; a_i is the area of the *i*-th plot; and A, which can be rewritten as Σa_i, is the farm size. Thus, the zero value indicates a complete land consolidation. The value of the Simpson index is also determined by the number of plots, the average plot size, and the plot size distribution. Unfortunately, this index does not take into account some other parameters such as farm size, distance, and plot shape (Hristov 2009).

The Igbozurike index is another way of expressing agricultural land fragmentation (King and Burton 1982). Unlike the previous indexes that refer to the »number of plots per farm« and ignore the distance between them, the Igbozurike index uses the mean area of the plots (the ratio between the total area of the farm and the number of plots) as well as the distance covered by the farmer in order to visit his plots. The index can be computed according to the formula (Igbozurike 1974):

$$P_i = \frac{Dt \cdot 100}{\overline{s}} \tag{3}$$

where P_i is the fragmentation index; $\overline{S}$ is the mean area of the plots; and Dt is the distance covered by the farmer in order to visit all his plots. In practice, the Igbozurike index is not so widespread because the computation methodology is rather obscure. This happens because the definition mentions the total distance covered by the farmer in a tour during which he visits all his plots whereas the exemplifications use the sum of the legs to each plot and back. Furthermore, it is not clear how the measurements were made, in a beeline or along the roads. However, the most important criticism refers to the fact that it emphasizes too much the distance to the detriment of the number of plots.

In analyzing these synthetic indexes, one can note that none of them takes into account all the six parameters mentioned by King and Burton (1985) for the analysis of agricultural land fragmentation. Consequently, it is necessary that they be used in a complementary way.

The participatory mapping technique was used with the purpose of employing the distance parameter as well in the analysis of land fragmentation. Thus, the computation of the Igbozurike index highlights fragmentation as a relationship between the mean size of the plots and the distance covered by the farmer to visit all his plots.

The intention was to see to what extent the inclusion of the distance parameter in the fragmentation analysis alters the fragmentation hierarchy resulting from the computation of Januszewski and Simpson indexes. At the same time, we tried to establish if the distance analysis was absolutely necessary for all the farms in the commune.

Another reason for employing participatory mapping derives from the fact that this method helps to raise the awareness of community members about characteristics of the local environment and the processes and phenomena that affect it. At the same time, it allows the development within the community of the desire to support the initiatives based on these analyses.

The process of participatory mapping consisted of the recognition and delimitation on a transparency overlapped on the orthophotoplans by each farmer who received a symbol ($P_1 = Farmer_1$) of his or her plots, which were marked with corresponding numbers (1.1, 1.2 etc.).

After the fieldwork, the data was entered into the ArcGIS(c) program. In order to georeference the transparencies, we employed the ImageWarp extension that allows the acquisition of the projection system and the coordination of points in the .shp (shapefile) image or vector format already georeferenced (in our case a satellite image). Each polygon that was introduced in a shapefile theme was assigned a unique ID number corresponding to the farmer and the plot. Additional attributes were introduced by adding new fields (field sites) in the table of attributes. By georeferencing the orthophotoplans, we determined the distances, applying the »distance« tool of the ArcGIS 9.3. software. Once these actions were completed, various statistical indicators were calculated for the case study.

The participatory mapping using photomaps proposed by Müller and Wode (2003) together with the GIS techniques provided accurate data concerning the size and spatial structure of the farms in the selected geographical sample.

The case study relies on twelve average-size farms whose plots the landowners were able to identify on orthophotoplans. These were used to create a spatial model using the Igbozurike index and the GIS techniques.

4 Case study

4.1 The study area

The Izvoarele Commune lies in the southern part of Romania, more exactly in the Wallachian (Romanian) Plain, and belongs administratively to Olt County. We focused on this territory because it stretches into the plain area that has been the most affected by the fragmentation of agricultural land. However, due to its favourable soil and bioclimatic conditions and to relatively modern agro-technical improvements (irrigation systems, storage facilities), the area has a huge potential for a rapid increase of productivity, provided that this undesirable phenomenon is eliminated or at least mitigated.

The Izvoarele Commune is made up of two villages: Izvoarele and Alimănesti. During the population census of 2002, it had a population of 3,860 inhabitants, of whom 24% were over 60 years of age. At that time, a significant proportion of people were working in agriculture, respectively 83.4% (National Statistical Institute 2002).

4.2 Data acquisition

This paper relies both on data collected by the authors themselves from March to August 2010 from questionnaires that were given to local farmers and on statistical information provided by the Izvoarele mayoralty, the National Statistical Institute, and the Ministry of Agriculture, Forests, and Rural Development. The cartographic materials used for this study included orthophotoplans purchased in 2009 from the National Agency for Survey and Real Estate Advertising (aerial photos of 1 : 5000 scale; georeferenced in the Stereo Projection 1970, the Krasovski ellipsoid – Piscului Hill datum).

4.3 Analysis, results and discussions

According to the data provided by the Izvoarele commune's administration, in 2010 the agricultural area of 4,286 ha was divided into 1,355 holdings, of which 1,354 were individual farms (on the commune scale there was a single agricultural association that covered 24.57 ha). According to our calculations, the mean area of an agricultural holding was 3.16 ha (as compared to the national average of 2.3 ha in 2007).

The answers given by the farmers during the survey gave us a partial and momentary picture both of the use of the land and of its distribution at the level of the individual farms of the Izvoarele Commune (Figure 1).

From the data collected by the 644 questionnaires given to the local farmers in 2010 we were able to see that the individual farms within the sample accounted for 2,659 agricultural plots. The calculations showed that the mean area of a farm was 3.38 ha (a value close to that of 3.16 ha provided by the com-

Table 1: Degree of fragmentation of individual farms depending on the number of parcels per farm.

Mean size of the farms	Share of the total number of farms (%)	Degree of fragmentation							
		Compact (1 parcel)		Moderate (2–3 parcels)		High (4–6 parcels)		Excessive (>6 parcels)	
		%	% of the farms	%	% of the farms	%	% of the farms	%	% of the farms
<2 ha	29.9	21.2	6.3	66.3	19.9	12.5	3.7	–	–
2–4 ha	44.3	5.6	2.5	35.1	15.5	54.7	24.3	4.6	2
4–6 ha	15.4	2	0.3	17.2	2.6	59.6	9.2	21.2	3.3
>6 ha	10.4	1.5	0.2	3	0.4	28.4	2.9	67.1	6.9
TOTAL	100.0	–	9.3	–	38.4	–	40.1	–	12.2

Source: Authors' calculations using data collected from questionnaires given to the farmers in 2010.

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Figure 1: Izvoarele Commune – a detail of land use fragmentation.

mune's administration for the entire commune), the mean area of a parcel was 0.82 ha (as compared to the national average of 0.5 ha in 2002), and the mean number of parcels per farm was 4.12.

The analysis of the degree of fragmentation, expressed as the ratio of the number of plots to the mean areas of the farms (Table 1), reveals the farms in the Izvoarele Commune are highly or excessively fragmented (52.3%). Only the very small farms (owning less than 2 ha) hold a significant percentage of compact land (6.3%).

In general, the agricultural landowners are over 60 years of age because most of them (96%) took possession of their lands after 1990 through restitution, while the rest were allocated plots through Land Law No. 18 (Legea fondului … 1991), but no more than 0.5 ha per person. At present, people get possession of agricultural lands mainly through inheritance (95%), while cases in which the land is purchased are irrelevant (5%) and donations are absent.

Answering the question »*What is your opinion on the degree of fragmentation of agricultural land,*« 76% of the farmers stated the land was too scattered. During the survey, we discovered that the interviewed farmers perceived in different ways the consequences of land fragmentation, insisting on saying there were both advantages and disadvantages. Some of the farmers (34.7%) considered it beneficial to have many different crops on various parcels in order to avoid losing all their crops in the unwanted event of a calamity. Most of them (65.3%), however, thought the fragmentation was a negative phenomenon because the efficiency of using the land was low and the use of the best technologies was hindered. These people also believed that measures were needed to encourage the merging of land.

In order to test the hypothesis that there are differences among individuals concerning the declared productivity and the future intentions, we applied the T test by SPPS v17 soft, which demonstrated that there are indeed significant differences. The test of materiality value was less than 0.05, so the probability was 95% in both cases (tables 2 and 3).

Table 2: One-Sample Test (Declared productivity).

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Declared productivity	64.215	641	.002	3.45171	3.3462	3.5573

Table 3: One-Sample Test (Future intentions).

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Future intentions	59.595	641	.003	3.12773	3.0247	3.2308

Furthermore, the Oneway ANOVA test shows that future intentions are influenced both by the size of the farms held, a claim supported by a 95% confidence interval, which corresponds to a value of $0.05 > 0.03$, and by the number of parcels, a statement which can be justified by a rate of 0.09, corresponding to a 90% confidence interval (Table 4).

Table 4: ANOVA test for future intentions.

Future intentions					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	691.559	358	1.932	1.237	.030
Within Groups	441.967	283	1.562		
Total	1133.526	641			

Future intentions					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	48.940	19	2.576	1.477	.087
Within Groups	1084.586	622	1.744		
Total	1133.526	641			

To test the hypothesis that productivity affects the future intentions stated, we also applied the ANOVA test by SPSS v17.

Table 5: ANOVA test for the influence of productivity upon the future intentions.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.333	4	5.083	2.909	.021
Within Groups	1113.194	637	1.748		
Total	1133.526	641			

Analyzing Table 5, we can say with a probability of 0.05 corresponding to 95% of confidence level that declared productivity influences future intentions for the chosen sample.

On the whole, 50% of the farmers consider fragmentation responsible for the decrease of productivity, but their future intentions are mostly to keep the plots scattered as they are now. These facts can be correlated with an aged population having fresh memories of the communist cooperativization policies, unprepared to make changes, and believing strongly in traditional farming focused mainly on subsistence

practices. Against this background, local decision makers should take specific measures to solve the local community farming issues in a sustainable way, which, however, is not a topic of this paper.

The second part of the study focused on analyzing the selected farm samples (Table 6) that were included in the participatory mapping process using three land fragmentation indexes (Januszewski, Simpson, and Igbozurike). The main parameters used to assess the degree of fragmentation were *the size of the farm* and *the number and size of the plots*. Another significant parameter, the *distance between the parcels*, was employed only for the sample of individual farms that were studied based on the participatory mapping technique.

Table 6: Agricultural land fragmentation – examples of individual farms.

Farm	Plot 1 (ha)	Plot 2 (ha)	Plot 3 (ha)	Plot 4 (ha)	Plot 5 (ha)	Plot 6 (ha)	Plot 7 (ha)	Plot 8 (ha)	Plots per farm	Farm area (ha)	Distance covered by the farmer to visit his plots (km)
1	0.14	0.77	0.48	–	–	–	–	–	3	1.39	6.46
2	0.15	1.98	–	–	–	–	–	–	2	2.13	7.19
3	0.28	0.86	0.13	0.34	–	–	–	–	4	1.61	9.28
4	0.41	0.12	0.19	0.57	0.78	0.96	–	–	6	3.03	11.19
5	0.35	3.61	–	–	–	–	–	–	2	3.96	2.99
6	0.30	0.25	0.29	0.40	0.55	0.63	1.00	1.50	8	4.92	11.77
7	0.10	0.52	0.70	0.19	0.18	0.54	–	–	6	2.23	11.07
8	0.43	0.70	–	–	–	–	–	–	2	1.13	4.41
9	1.55	1.58	–	–	–	–	–	–	2	3.13	7.36
10	0.70	0.12	0.14	0.33	0.68	2.26	–	–	6	4.23	13.18
11	2.71	0.13	1.22	2.50					4	6.56	9.82
12	0.50	2.09	0.12	1.53	0.30	0.80	0.70	0.50	8	6.54	13.59

Source: Questionnaires given to farmers in 2010.

Likewise, two synthetic indexes were computed (Januszewski and Simpson) that highlighted the fact (Table 7) that, irrespective of their size, all the farms had a high degree of fragmentation, partly explained by the very small farms (74.2% owning less than 4 ha).

According to the results, these holdings can be grouped into three categories: farms with *high fragmentation*, farms with *moderate fragmentation*, and farms with *low fragmentation*. The comparative analysis of the datasets generated by each index was meant to highlight the influence of the investigated parameters (farm size, distance and number of plots, size and distribution of plots) on the final results.

Table 7: The degree of fragmentation of individual farms.

Mean size of the farms	Share of the total number of farms (%)	Mean area of the parcels (ha)	Mean number of parcels per farm	Mean value of Januszewski index	Mean value of Simpson index
<2 ha	29.9	0.62	2.36	0.73	0.41
2–4 ha	44.3	0.73	3.85	0.59	0.69
4–6 ha	15.4	0.96	5.07	0.42	0.76
>6 ha	10.4	0.99	9.0	0.34	0.81

Source: Authors' calculations using data collected from questionnaires given to farmers in 2010.

Despite the common preconception that small farms have a high degree of fragmentation, the analysis showed that in fact the highest degree of fragmentation is attributed to farms exceeding 6 ha. It can also be stated that farms which exceed 6 ha are more split into plots than those smaller than 2 ha. Large farms are therefore more fragmented than small ones. The land consolidation phenomenon, emphasized by the increase of the mean size of the parcels up to 0.99 ha, was counterbalanced by the increase of more than 300% of the mean number of parcels per farm (from 2.36 to 9.0).

Comparing the values of the Januszewski and Simpson indexes (Table 8), one can see the former has a tendency to mitigate the degree of fragmentation. For instance, farms number 3, 4, 10, and 11, which

Table 8: Degree of fragmentation of individual farms – case study

Farm	Januszewski index		Simpson index		Igbozurike index	
	Value	Category	Value	Category	Value	Category
1	0.60	moderate	0.57	moderate	1404	high
2	0.81	low	0.14	low	678	low
3	0.52	moderate	0.65	high	2320	high
4	0.43	moderate	0.78	high	2238	high
5	0.79	low	0.17	low	151	low
6	0.37	high	0.83	high	1929	high
7	0.43	moderate	0.78	high	2991	high
8	0.71	low	0.48	moderate	787	low
9	0.70	low	0.51	moderate	471	low
10	0.46	moderate	0.66	high	1882	high
11	0.54	moderate	0.65	high	598	low
12	0.38	high	0.81	high	1677	high

Source: Authors' calculations using data collected from questionnaires given to farmers in 2010.

according to the Simpson index fall in the category of high fragmentation, fall according to the Januszewski index in the category of moderate fragmentation. Likewise, farms number 8 and 9 pass from the moderate category to the low fragmentation category.

It is apparent, however, that despite this fact most of the farms in the case study rank in the upper category of fragmentation according to both indexes. This result is consistent with the information collected from the questionnaires (Table 6).

Regarding the Igbozurike index, its values have a low practical applicability because they do not have a precise variation range. It is therefore very difficult to define the moderate fragmentation category.

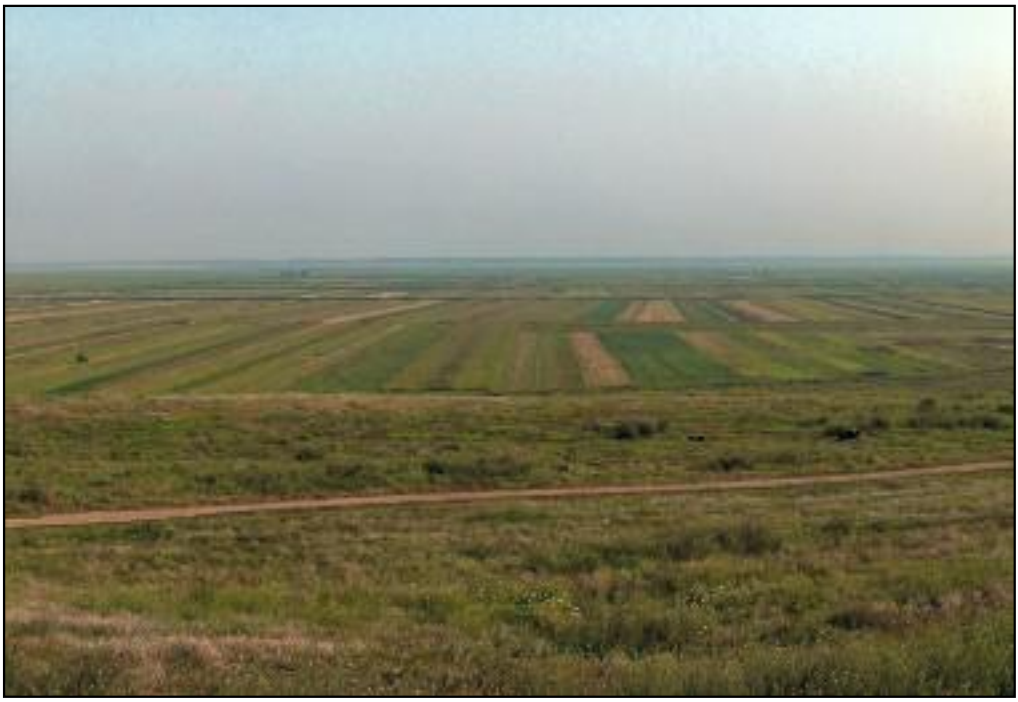

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Figure 2: Strong stripping plots.

Consequently, the index can only be used in combination with the other two indexes to reveal the changes introduced by the distance parameter in the land fragmentation analysis (Table 8).

From this point of view, one can note significant departures from the hierarchy generated by the Januszewski and Simpson indexes only in the case of farms number 1 and 11, which have obvious specific features (great variations in parcel size relative to the distance covered by the farmer in order to visit them).

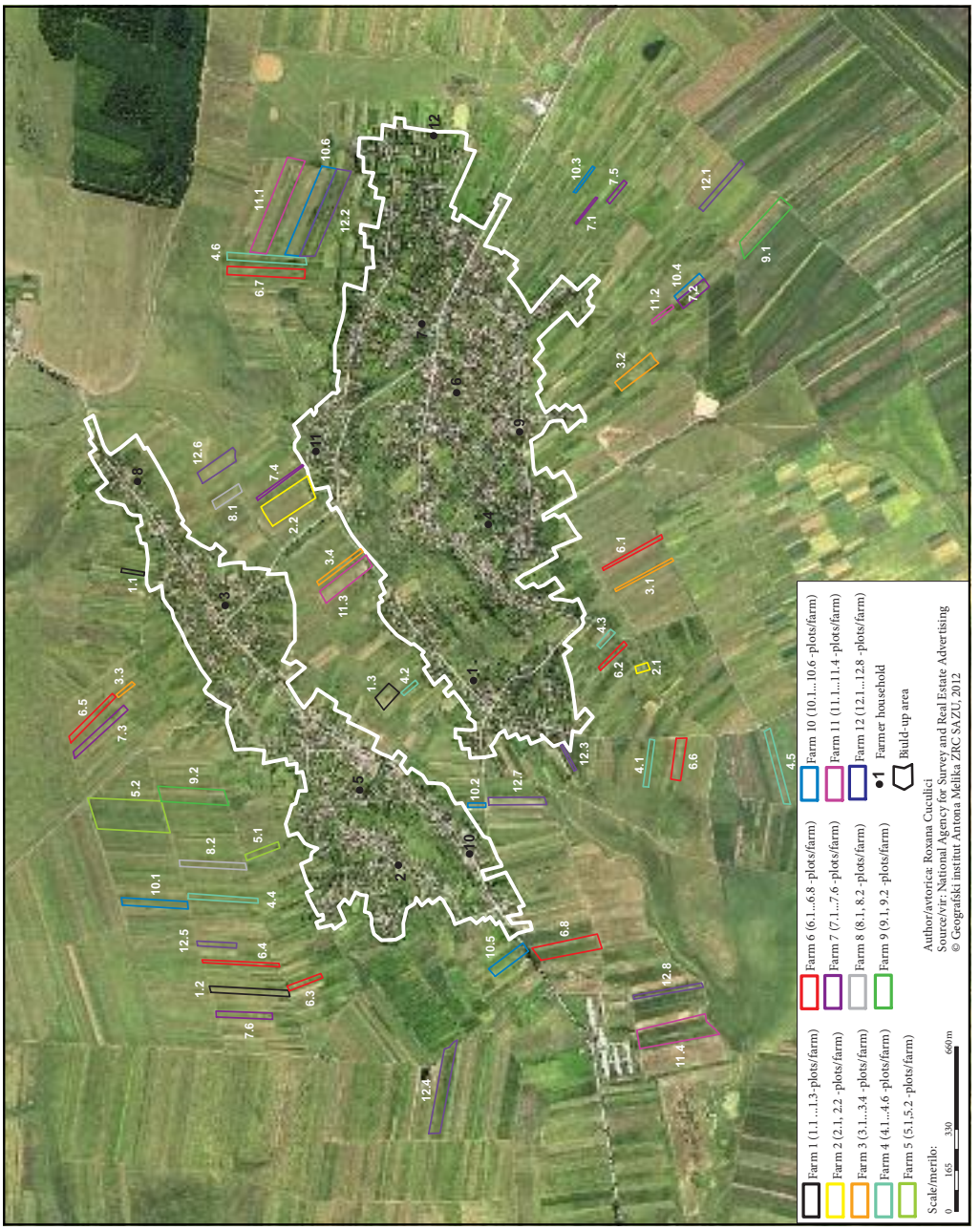

Figure 3: Degree of fragmentation of agricultural land in the Izvoarele Commune, Olt County.

In the case of the Izvoarele Commune, the analysis of the distance parameter did not bring any profit to the study. This is explained by the way the farms were set up following the enforcement of Land Law No. 18 (Legea fondului … 1991) through which the authorities tried to restore the old estates without giving up the equity principle. Therefore, local commissions charged with the enforcement of this law allocated plots in various parts of the commune in an effort to give everyone land with relatively similar production potential, thus generating the fragmentation of the farm land.

The participatory mapping ultimately led to the development of the agricultural land fragmentation map (Figure 3). This has emphasized once again that the agricultural holdings in the Izvoarele Commune are highly fragmented. Taking into account that none of the fragmentation indexes deals with the shape of the parcels, this parameter was analyzed separately for the farms in the case study sample. Although a rectangular shape dominates, the ratio between the width and the length has, with few exceptions, high values (mean ratio 1 : 9), which highlights a strong »stripping.«

Comparing the final results with other studies in Romania (Simion 2008; Rusu et al. 2002) or abroad, we have come to the conclusion that land fragmentation has a number of advantages, for example, the reduced risk of crop damage and the diversification of production in accordance with natural conditions and market demands (Simmons 1987). However, there are also disadvantages, among which we can mention low productivity (MacPhearson 1982), the limited possibilities for mechanization, difficulties in using irrigation networks, and the impossibility of land reclamation projects. Under such circumstances, the plots are likely to be abandoned, which is even more likely if the distances between plots prevent their efficient management.

5 Conclusion

The present study shows that land fragmentation is a serious problem affecting the plains that are the most fertile areas of Romania.

The fragmentation of agricultural land dates back to the early periods of property evolution, but following the communist merging and the subsequent restitutions made after 1989, the land suffered even greater fragmentation than in the past.

The farmers' perception of the effects of plot scattering clearly shows that these people are aware of the low productivity and the increasing risk of abandonment. More than half of the farmers are against the proposals for changing the management practices, although half of them also admit the need to develop their holdings through strategies meant to consolidate agricultural activities.

The Januszewski and Simpson indices show that the land fragmentation phenomenon allows us to speak about small farms with a low degree of fragmentation, medium farms, and farms with scattered plots totaling more than 6 ha.

The model created based on the selected samples using the Igbozurike index and the ArcGIS 9.3. Software together with the results obtained by the participatory map show a high level of fragmentation of land situated at various distances around the settlements.

The farmers are faced with difficulties in managing their holdings since land scattering leads to inefficient exploitation. It is therefore inevitable that scattered plots raise issues regarding their cultivation and the use of agricultural machinery.

The proportion of local people working in the agricultural sector is still very high (83.4%), and this has a negative impact both on agricultural productivity and on rural people's income. The excessive fragmentation of agricultural holdings has led to the development of subsistence and semi-subsistence agriculture.

At the same time, land scattering is a major cause of plot abandonment because more often than not the farmers of the Izvoarele Commune choose to work only those plots of land that either lie close to the settlements or have the highest productive potential. Such behaviour derives from the lack of financial resources and the use of primitive technologies. Under the circumstances, it is no wonder that some plots have been left fallow.

In order to increase agricultural competitiveness, Romania's decision makers will have to focus on mitigating the main causes that lead to land fragmentation by creating an appropriate legal framework and by implementing adequate development policies. The consolidation of scattered lands is a necessary condition for a productivity increase in the agricultural sector.

6 Acknowledgements

The authors wish to extend their special thanks to the local authorities of the Izvoarele Commune for their support throughout the research and especially for persuading the local farmers to engage in the participatory mapping process. Likewise, we express our gratitude to Dr. Gabriel Simion, Bucharest University, for providing us with useful information.

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Ocena razdrobljenosti kmetijskih zemljišč v Romuniji – študija na primeru občine Izvoarele v okrožju Olt

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POVZETEK: Razdrobljenost kmetijskih zemljišč je pogost pojav v deželah v razvoju na splošno, še posebej pa to velja za Romunijo. Namen te študije je analizirati stopnjo razdrobljenosti romunskih kmetijskih zemljišč, saj predstavlja veliko oviro za razvoj modernega kmetijstva. Opravljena analiza je na območju raziskave pokazala visoko stopnjo razdrobljenosti zemljišč; velike kmetije so bolj prizadete, manjše pa so enotnejše. Istočasno so se zaradi razpršenosti parcel in velikih razdalj med posestmi kmetijska zemljišča začela spreminjati v prahe, zaradi česar se je zmanjšala tudi njihova produktivnost. Zaradi teh okoliščin je polovica lastnikov nerada sprejela predlog o združevanju parcel, saj so se bali, da se bo ponovila praksa iz komunističnega režima, ko so kmetje na ta način izgubljali svojo zemljo.

KLJUČNE BESEDE: geografija, geografija podeželja, razdrobljenost zemljišč, indeks razdrobljenosti, participativno kartiranje, ortofoto načrti, GIS, občina Izvoarele v Romuniji

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Vsebina

1 Uvod

Razdrobljenost zemljišč, ki je značilna za številne države (Van Hung, MacAulay in Sally 2007) predstavlja oviro pri uvajanju učinkovitega upravljanja z zemljišči na podeželju.

Razdrobljenost kmetijskih zemljišč, druga imena zanjo so tudi pulverizacija (Clout 1972), parcelizacija (Roche 1956) ali razpršenost zemljišč (Farmer 1960), je vrsta razpršenosti kmetijskih posesti, kjer »… *posamezno kmetijo sestavljajo številna zemljišča, razkropljena po širši okolici* …« (Binns 1950).

Razlogi za razpršenost kmetijskih zemljišč so raznoliki in kompleksni, odvisni pa so od socio-kulturnih, gospodarskih, fizično-geografskih, političnih in operativnih dejavnikov (King in Burton 1985).

Socio-kulturni dejavniki imajo močan vpliv na degradacijo kmetijskih zemljišč. V tem pogledu so najpomembnejši zakoni o dedovanju, ki jamčijo vsem dedičem enakopraven dostop do premoženja umrle osebe. To načelo ima pomembne posledice v primerih, ko se kmetijska zemljišča, ki so predmet delitve, razlikujejo glede na rabo tal (vinogradi, njive) ali rodnost (Simion 2008). Ko se proces drobljenja zemljišč enkrat začne, se potem z vsako generacijo, ki podeduje zemljo, nadaljuje v geometrijskem zaporedju. Gledano na splošno je ta proces v deželah v razvoju predvsem posledica procesov dedovanja (Jabarin in Eplin 1994; Ram in ostali 1999; Niroula in Thapa 2005; cititrano po Di Falco in ostali 2009). Še več, Thapa in Niroula (2008; citirano po Di Falco in ostali 2009) razkrivata obstoj tendence, po kateri se zaradi navezanosti na tradicijo, da starši svojo zemljo razdelijo med več dedičev, zmanjšuje velikost kmetij, narašča pa število parcel. Gospodarski dejavniki postanejo pomembni takoj, ko se na kmetiji odločijo za gospodarske ali tehnološke spremembe. Če želi kmet svojo kmetijo povečati, kupuje druga zemljišča, ki pa ne mejijo na njegovo, in s tem dodatno povečuje razdrobljenost kmetijskih zemljišč (Simion 2008). Podoben primer se je zgodil v Franciji, kjer je med 1955 in 1967 skupina kmetov zaradi povečanega povpraševanja po sadju in zelenjavi poskušala kupiti več parcel v predmestju Pariza, s čimer so samo pospešili drobitev svojih kmetij.

Fizičnogeografski dejavniki obvladujejo drobljenje kmetijskih zemljišč še posebej zaradi prekinjanja pobočij in podnebnih razmer. Med vplivnimi dejavniki naj omenimo različna dela, npr. postavitev ograje ali gradnjo železnice, avtocest ali kanalov, ki lahko razdelijo sicer strnjeno zemljišče na več parcel (Simion 2008).

Velikokrat imajo pri drobljenju zemljišč pomembno vlogo tudi politične odločitve. Turška vlada se je na primer odločila, da bo vsak član vaške skupnosti dobil majhno parcelo dotedanje občinske zemlje. V Grčiji je postopno razdeljevanje državnih zemljišč, ki so jih navadno pridobili z večkratnim razlastninjenjem velikih zemljiških posestnikov, pripeljalo do tega, da so kmetje postali lastniki od štiri do osemnajst zelo majhnih parcel. Naslednji primer izvira iz kitajske državne politike in zadeva pravično razdelitev kmetijskih zemljišč. Tan, Heerink in Qu (2006; citirano po Di Falco in ostali 2009) so ugotovili, da so na Kitajskem kmetijska zemljišča v vsaki vasi razdelili v več razredov glede na rodovitnost zemlje. Tako je po odločitvi lokalnih veljakov vsako gospodinjstvo dobilo po nekaj parcel iz vsakega razreda.

V Vzhodni Evropi je država uvedla agrarne reforme z namenom, da se povrne zemljo tistim, ki so bili njeni lastniki leta 1947 (Kopeva, Mishew in Howe 1994; citirano po Di Falco in ostali 2009). Post-komunistične spremembe so prinesle prenos lastnine državnih kmetijskih podjetij in kmetijskih proizvodnih kooperativ v zasebno lastnino. V tem procesu so zemljo vrnili prejšnjim lastnikom ali njihovim neposrednim dedičem, ki so pogosto že bili lastniki manjših in razdrobljenih parcel, ali pa so prebivali daleč stran in sploh niso znali obdelovati zemlje. Privatizacija državnih kmetij ni upoštevala pravil o rabi tal in produktivnosti. Zaradi ukinitve kmetijskih proizvodnih kooperativ in povečanja deleža zasebnih kmetij se je bistveno spremenilo kmetijsko izkoriščanje zemljišč (Kopeva, Mishew in Howe 1994).

2 Razdrobljenost kmetijskih zemljišč v Romuniji

Čezmerno povečana razdrobljenost zemljišč v Romuniji je posledica agrarne reforme iz leta 1989. Zakoni, ki so bili sprejeti, da bi uredili to tematiko, so pripeljali do vračila kmetijskih zemljišč bivšim lastnikom, ki so se bili takrat prisiljeni pridružiti kmetijskim proizvodnim kooperativam ali pa podariti svoje parcele državi. Medtem pa jih je mnogo že umrlo in njihove posesti so po tradiciji, ki velja na podeželju, razdelili med dediče. Ti so dobili enake deleže in na teh parcelah sami po svoje kmetovali (Rusu in ostali 2002).

Najpomembnejša reforma je potekala leta 1991, ko je v veljavo stopil Zemljiški zakon št. 18 (Legea fondului funciar 18/1991), po katerem so bivšim lastnikom vrnili njihova posestva. Kmetijske proizvodne kooperative so razdelili na številne posesti, vsako od teh pa še naprej v parcele.

Vzpostavitev lastninskih pravic nad zemljišči se je opirala na ponovno vzpostavitev starih meja in na pravično razdelitev zemlje, saj so upoštevali tudi njeno rodovitnost. Vsaka oseba je lahko dobila najmanj 0,5 ha zemlje, vendar ne več kot 10 ha na družino, kar je privedlo do velike razdrobljenosti zemljišč (Rusu in ostali 2002).

Po kmetijskem popisu iz 2002 je bilo v Romuniji 4,3 milijona zasebnih kmetij, ki so skupaj obsegala 14,3 milijona parcel. Povprečna kmetija je tako merila 1,7 ha, povprečno število parcel na kmetijo je bilo 3,3, povprečna velikost parcele pa je bila 0,5 ha (Nacionalni statistični inštitut 2004).

Glede na stopnjo razdrobljenosti zemljišč na posameznih kmetijah, razvidno iz števila parcel na posestvo, prevladujejo (36 %) kmetije z zmerno razdrobljenostjo (2–3 parcele). Sledijo jim kmetije s po eno parcelo (30 %), ki so tudi bolj enotne, in kmetije, ki jih sestavlja 4–6 parcel (18 %), kar kaže na večjo stopnjo razdrobljenosti. Na zadnjem mestu so kmetije z prekomerno razdrobljenostjo, sestavljene iz več kot 6 parcel, obsegajo pa 16 % celotnega števila kmetij (Rusu in ostali 2002).

Po strukturni anketi v kmetijstvu iz leta 2007 je število posameznih kmetij padlo za 12 % glede na stanje iz kmetijskega popisa iz leta 2002; tako je imela Romunija leta 2007 še 3,9 milijona posameznih kmetij. Tega leta je povprečna površina obdelane zemlje znašala 2,3 ha na kmetijo, leta 2002 pa 1,7 ha. Čeprav anketa iz 2007 ni upoštevala števila parcel na posamezno kmetijo, ocenjujejo, da je to število še vedno visoko (Nacionalni statistični inštitut 2008).

V Romuniji več kot četrtina kmetijskih zemljišč pripada kmetijam, kjer hrano pridelujejo za lastno porabo, te pa niso upravičene do sredstev Evropske unije, saj so ta sredstva rezervirana za kmetijska gospodarstva, ki so večja od enega hektara. Skoraj 70 % vseh romunskih kmetov tako ni upravičenih do kakršne koli finančne pomoči. Edini način, da taki kmetje le pridejo do sredstev je v tem, da se organizirajo in združijo svoje majhne parcele v večje enote, saj bodo sicer še naprej zaostajali za državami Evropske unije. Razdrobljenost zemljišč, sistem dedovanja in vladna politika neposredovanja silita kmete, da ne obdelujejo svojih parcel, ki se tako spreminjajo v prahe (Rusu ostali 2002), ali pa, kar je še slabše, svojo zemljo popolnoma opustijo (Sikor, Müller in Stahl 2009). Prahe navadno nastanejo takrat, ko se kmetje ne uspejo združiti in skupaj obdelovati svojih zemljišč. Uradne ocene navajajo, da je v Romuniji med 1,5 in 2,5 milijona hektarov ledin, kar predstavlja najmanj petino vseh kmetijskih zemljišč (Nacionalni statistični inštitut 2008). Žal to Romunijo uvršča na prvo mesto v Evropski uniji. K temu pripomorejo tudi lokalni davki in dajatve na zemljo, ki ne ločujejo med obdelano zemljo in praho.

V Romuniji je razdrobljenost kmetijskih posestev zelo velika, kar pojasnjuje, zakaj je mehansko proizvodnjo nadomestila ročna, oziroma zakaj je proizvodnjo za komercialne namene nadomestila tista za lastne potrebe. Prevladujejo majhne kmetijske posesti, posamezne kmetije pa obsegajo več kot 70 % romunskih kmetijskih zemljišč. Večina teh posesti leži v južnem delu dežele (Vlaška ali Romunska nižina), kjer njihova povprečna velikost ne presega 1,5 ha.

Naslednja ovira pri razvoju kmetijskega sektorja je starajoče se prebivalstvo, ki živi na podeželju. Statistike navajajo, da je 40 % kmetov starejših od 65 let, mlajših od 35 let pa je manj kot 9 % (Nacionalni statistični inštitut 2006). Veliko število starajočega se prebivalstva na podeželju in množica majhnih kmetij predstavljata veliko oviro pri razvoju te gospodarske panoge. Po optimistični oceni bo Romunija potrebovala vsaj 30 let, da bo na tem področju dohitela ostale članice Evropske unije. Zadnjih nekaj let moderni trendi v Evropski uniji kažejo potrebo po znižanju števila majhnih kmetij in povečanju učinkovitosti kmetijskih gospodarstev, saj na ta način manj kmetov lahko goji pridelke na večjih površinah.

3 Gradiva in metode

Glavne uporabljene preiskovalne metode so bile: metoda opazovanja, metoda popisa, statistično-matematične metode, participativno kartiranje, kartografska metoda, orodje za diagnostični analizo.

Ker so se na občinski ravni pojavila neskladja med številom kmetijskih parcel, ki jih je podala občina in številom iz poročila Nacionalnega statističnega inštituta, in ker smo opazili, da je manjkalo nekaj parametrov iz poročil, smo se avtorji odločili, da bo naša študija temeljila le na podatkih, zbranih s pomočjo vprašalnika, naslovljenega na lokalne kmete.

Terensko raziskavo smo izvedli spomladi in poleti 2010, sestavljali so jo neposredna opazovanja, pogovori z lokalnimi kmeti in organi odločanja, izpolnjevanje vprašalnika in izvajanje metode participativnega kartiranja z uporabo ortofoto načrtov.

Vprašalnik, ki smo ga uporabili za zbiranje podatkov, je vseboval odprta in zaprta vprašanja, izpolnjevalo pa ga je 644 kmetovalcev. Vzorec smo izbrali naključno s seznama kmetov, ki so ga posredovale lokalne oblasti.

Vprašanja iz vprašalnika so se nanašale na naslednje vidike: starost kmetov, kako so prišli do lastništva zemljišč po letu 1990 (povračilo, dedovanje, donacija, nakup); velikost kmetij; število parcel; velikost posameznih parcel; kmetovo mnenje o stopnji razdrobljenosti; produktivnost zemljišč; načrti kmetov glede njihovih posesti v bodočnosti (lizing, partnerstvo z drugimi kmeti, izmenjava parcel med lastniki z namenom povečanja kontinuiranosti kmetij, ohranjanja statusa quo). Ustrezni odgovori so bili obdelani s programom *SPSS v. 17* z uporabo T testa in One-Way ANOVA.

Stopnja razdrobljenosti kmetijskih zemljišč se je ocenjevala glede na izračunavanje specifičnih kazalcev, pa tudi z uporabo orodja tehnik participativnega kartiranja in ortofoto načrtov.

Da bi dobili splošno in čim natančnejšo sliko kmetijske razdrobljenosti, je treba upoštevati naslednje parametre: velikost kmetij, število, velikost, obliko in prostorsko razporeditev parcel, kot tudi razporeditev parcel različnih velikosti (King in Burton 1985; Bentley 1987; Simmons 1988).

Poleg teh vidikov se študija opira tudi na analizo naslednjih sintetičnih indeksov: Januszewskijev indeks, Simpsonov indeks in Igbozurikejev indeks.

Januszewskijev konsolidacijski indeks, ki upošteva število parcel na kmetjo in velikost parcel, lahko izračunamo po naslednji formuli (Januszewski 1968):

$$K = \frac{\sqrt{\sum_{a=1}^{n} a_i}}{\sum_{a=1}^{n} \sqrt{a_i}} \tag{1}$$

kjer je *K* Januszewskijev indeks, *n* število parcel in a_i površina posameznih parcel. Ta indeks je izražen kot razmerje kvadratnega korena celotne površine kmetije in vsote kvadratnih korenov velikosti parcel. Razpon indeksa je med 0 in 1. Višje vrednosti pomenijo boljšo konsolidacijo kmetije, vrednosti bližje ničli pa poudarjajo naraščanje razdrobljenosti. Melmed-Sanjak, Bloch in Hanson (1998) menijo, da ta indeks kaže na tri vidike: i) stopnja razdrobljenosti kmetije narašča s številom parcel; ii) razdrobljenost je visoka, če so parcele majhne; iii) razdrobljenost je nižja takrat, ko je število večjih parcel večje od števila majhnih.

Simpsonov indeks je do določene mere podoben Januszewskijevemu indeksu in ga lahko določimo z naslednjo formulo:

$$SI = 1 - \frac{\sum_{i=1}^{n} a_i^2}{A^2} \tag{2}$$

kjer je *SI* Simpsonov indeks, a_i površina *i*-števila parcel, *A,* ki ga lahko zapišemo tudi kot $Sa_{i,}$ pa je velikost kmetij. Tako vrednost nič pomeni popolno konsolidacijo zemljišča. Vrednost Simpsonovega indeksa je določena s številom parcel, povprečno velikostjo parcel in razporeditvijo parcel. Žal ta indeks ne upošteva nekaterih drugih parametrov, kot so velikost kmetij, oddaljenosti in oblika parcele (Hristov 2009).

Igbozurikejev indeks predstavlja drug način izražanja razdrobljenosti kmetijskih zemljišč (King in Burton 1982). Za razliko od zgornjih dveh indeksov, ki se nanašata na »število parcel na kmetijo« in ne upoštevata razdalje med njimi, Igbozurikejev indeks upošteva povprečno površino parcel (razmerje med skupno površino kmetij in število parcel) in potjo, ki jo opravi kmet, da obišče vse svoje parcele. Indeks izračunamo po formuli (Igbozurike 1974):

$$P_i = \frac{Dt \cdot 100}{\overline{s}} \tag{3}$$

kjer je P_i razdrobitveni indeks; $\overline{S}$ povprečna površina parcel in *Dt* pot, ki jo mora opraviti kmet, da obišče vse svoje parcele. V praksi Igbozurikejev indeks ni tako široko razširjen, ker je metoda računanja

precej težko razumljiva. Definicija namreč omenja skupno pot, ki jo opravi kmet, da obišče vse svoje parcele, medtem ko eksemplifikacija uporablja vsoto posameznih poti do parcel in nazaj. Po drugi strani pa ni jasno, kako so bile meritve opravljene: po zračni liniji, ali po cestah. Največja kritika pa leti na dejstvo, da ta indeks na škodo razdalje preveč poudarja število parcel.

Z analizo teh sintetičnih indeksov lahko ugotovimo, da nobeden od njih ne upošteva vseh šestih parametrov, ki jih omenjata King in Burton (1985) za analizo razdrobljenosti kmetijskih zemljišč. Zaradi tega jih je treba uporabiti na komplementaren način.

Tehniko participativnega kartiranja smo uporabili z namenom, da bi pri analizi razdrobljenosti zemljišč uporabili tudi parameter razdalje. Računanje Igbozurikejevega indeksa poudarja razdrobljenost kot razmerje med povprečno velikostjo parcel in potjo, ki jo opravi kmet, da obišče vse svoje parcele.

Na ta način želimo ugotoviti, do katere mere vključitev parametra razdalje pri analizi razdrobljenosti spremeni hierarhijo razdrobljenosti, ki izhaja iz računanja Januszewskijevega in Simpsonovega indeksa. Istočasno smo ugotavljali, če je analiza razdalje absolutno potrebna za vse kmetije v občini.

Naslednji razlog za uporabo participativnega kartiranja izvira iz dejstva, da ta metoda pomaga članom skupnosti pri dvigu zavedanja o značilnostih lokalnega okolja ter procesov in pojavov, ki nanj vplivajo. Istočasno pa znotraj skupnosti dovoljuje razvoj želje po podpori pobudam, ki temeljijo na teh analizah.

Proces participativnega kartiranja za vsakega kmeta, ki je prejel oznako (P_1 – $kmetovalec_1$) za svojo parcelo z odgovarjajaočo številko (1.1, 1.2 itd.), vsebuje identifikacijo in razmejitev na prosojnici, ki prekriva ortofoto načrt.

Po delu na terenu smo podatke vnesli v ArcGIS(c). Za georeferiranje prosojnic smo uporabili ImageWarp, ki omogoča pridobitev projekcijskega sistema in koordinacijo točk na sliki ali vektorskem formatu .shp (shapefile), ki je že georeferiran (v našem primeru satelitska slika). Vsak mnogokotnik, ki smo ga vnesli v format shapefile, je dobil svojo edinstveno identifikacijsko številko, ki je ustrezala posameznemu kmetu in parceli. Dodatne atribute smo vnesli z dodajanjem novih polj v preglednice z atributi. Z georeferenciranjem ortofoto načrtov smo določili razdalje in uporabili orodje za »razdalje« pri programski opremi *ArcGIS 9.3*. Ko so bile te aktivnosti zaključene, smo izračunali različne pokazatelje za študijo primera.

Participativno kartiranje z uporabo fotokart, ki sta jo predlagala Müller in Wode (2003), skupaj z GIS tehnikami zagotavlja točne podatke o velikosti in prostorski strukturi kmetij na izbranem geografskem vzorcu.

Študija primera se nanaša na dvanajst povprečno velikih kmetij, parcele katerih so lastniki lahko identificirali na ortoforo načrtu. Uporabili so jih pri ustvarjanju prostorskega modela z Igbozurikejevim indeksom in GIS tehnikami.

4 Študija primera

4.1 Predstavitev območja

Občina Izvoarele leži v južnem delu Romunije, oziroma natančneje v Vlaški (Romunski) nižini, administrativno pa je del okrožja Olt. Na to ozemlje smo se osredotočili zato, ker se razteza v ravninsko območje, ki ga je razdrobljenost kmetijskih zermljišč najbolj prizadela. Vendar pa ima to območje zaradi ugodne strukture zemlje in bioklimatskih razmer ter relativno modernih kmetijsko-tehničnih izboljšav (namakalni sistem, skladiščni objekti) velike možnosti za hitro povečanje produktivnosti, če bi le odpravili ali vsaj omilili ta nezaželen pojav.

Občino Izvoarele sestavljata dve vasi: Izvoarele in Alimănesti. Med popisom prebivalstva iz 2002 je občina štela 3.860 prebivalcev, od the je bilo 24 % starejših od 60 let. V tem času je bil pomenljiv delež ljudi zaposlenih v kmetijstvu (83,4 %; Nacionalni statistični inštitut 2002).

4.2 Pridobivanje podatkov

To delo se zanaša na podatke, ki so jih zbrali avtorji sami med marcem in avgustom 2010 s pomočjo vprašalnikov, ki so jih razdelili lokalnim kmetovalcem, ter na statisične podatke, ki jih je posredovala administracija občine Izvoarele, Nacionalni statistični inštitut in Ministrstvo za kmetijstvo, gozdove in razvoj podeželja. Kartografsko gradivo, uporabljeno v tej študiji, obsega ortofoto načrte, ki smo jih 2009 nabavili pri

Državni agenciji za nadzor in oglaševanje nepremičnin (letalski posnetki v merilu 1 : 5000, georeferencirani v stereoprojekciji 1970 z uporabo elipsoida Krasovski – Piscului Hill datum).

4.3 Analize, rezultati in razprave

Glede na podatke, ki jih je zagotovila administracija občine Izvoarele 2010, je bilo 4.286 hektarov zemljišč razdeljenih med 1.355 posesti, od katerih je bilo 1.354 kmetij (na občinski ravni je obstajalo samo eno kmetijsko združenje, ki je merilo 24,57 ha). Po naših izračunih je povprečna kmetijska posest merila 3,16 ha (v primerjavi z nacionalnim povprečjem, ki je 2007 znašalo 2,3 ha).

Iz odgovorov kmetov med anketo smo si ustvarili delno in trenutno sliko o rabi tal in razporeditvi na ravni kmetij občine Izvoarele (slika 1).

Slika 1: Občina Izvoarele – detajl razdrobljenosti zemljišč.
Glej angleški del prispevka.

Po podatkih, zbranih s pomočjo 644 vprašalnikov, ki smo jih kmetom razdelili leta 2010, smo ugotovili, da so kmetije vzorca obsegale 2.659 kmetijskih parcel. Izračuni so pokazali, da je povprečna površina kmetij znašala 3,38 ha (ta vrednost je blizu vrednosti 3,16 ha, ki jo je posredovala občinska administracija za celotno občino), povprečna površina parcele je bila 0,82 ha (v primerjavi z nacionalnim povprečjem 0,5 ha v letu 2002), povprečno število parcel na kmetijo pa je bilo 4,12.

Analiza stopnje razdrobljenosti, izražene z razmerjem med številom parcel in povprečno površino kmetij (preglednica 1) razkriva, da so kmetije v občini Izvoarele visoko oziroma prekomerno razdrobljene (52,3 %). Samo zelo majhne kmetije (ki merijo manj kot 2 ha) so uspele zadržati pomemben delež strnjenih zemljišč (6,3 %).

Na splošno so lastniki zemljišč starejši od 60 let, saj je večina (96 %) prišla do svoje zemlje po letu 1990 s pomočjo povračil, ostalim pa je bila zemlja dodeljena po Zemljiškem zakonu št. 18 (Legea Fondului Funciar 18/1991), in sicer ne več kot 0,5 ha na osebo. V današnjem času ljudje pridejo do svoje zemlje največkrat z dedovanjem (95 %), primeri nakupa zemlje so zanemarljivi (5 %), donacij ni.

Na vprašanje *»Kakšno je vaše mnenje o stopnji razdrobljenosti kmetijskih zemljišč«* je 76 % kmetov odgovorilo, da so zemljišča preveč razdrobljena. Med anketo smo ugotovili, da so kmetje dojemali posledice razdrobljenosti na različne načine in vztrajali pri tem, da so le te tako ugodne kot neugodne. Nekateri kmetje (34,7 %) so menili, da je veliko število različnih pridelkov na različnih parcelah celo koristno, saj se na ta način izognejo izgubi celotnega pridelka ob naravni nesreči ali neželjenem dogodku. Večina (65,3 %) pa je vendarle menila, da je razdrobljenost negativen pojav, saj je izkoristek zemlje nizek, uporaba najboljših tehnologij pa otežena. Ti ljudje so tudi mislili, da bi bilo potrebno uvesti določene ukrepe, ki bi spodbudili združevanje zemljišč.

Da bi preverili hipotezo, po kateri obstajajo razlike med posamezniki glede produktivnosti in namerah v prihodnosti, smo uporabili test T s *SPPS v. 17* soft, ki je pokazal, da precejšnje razlike res obstajajo. Test pomembnosti vrednosti je bil manj kot 0,05, in verjetnost 95 % v obeh primerih (preglednici 2 in 3).

Tabela 1: Stopnja razdrobljenosti kmetij glede na število parcel na kmetijo.

povprečna velikost kmetij	delež glede na skupno število kmetij (%)	stopnja razdrobljenosti							
		strnjena (1 parcela)		zmerna (2–3 parcele)		visoka (4–6 parcel)		prekomerna (>6 parcel)	
		%	% kmetij	%	% kmetij	%	% kmetij	%	% kmetij
<2 ha	29,9	21,2	6,3	66,3	19,9	12,5	3,7	–	–
2–4 ha	44,3	5,6	2,5	35,1	15,5	54,7	24,3	4,6	2
4–6 ha	15,4	2	0,3	17,2	2,6	59,6	9,2	21,2	3,3
>6 ha	10,4	1,5	0,2	3	0,4	28,4	2,9	67,1	6,9
SKUPAJ	100	–	9,3	–	38,4	–	40,1	–	12,2

Vir: Izračuni avtorjev ob uporabi podatkov zbranih iz vprašalnikov, razdeljenih kmetom leta 2010.

Preglednica 2: Test enega vzorca (napovedana produktivnost).

	Testna vrednost = 0					
	t	SP	Stopnja znač. (2-stranska)	Povprečna razlika	95% stopnja natančnosti razlike	
					spodnja	zgornja
napovedana produktivnost	64,215	641	,002	3,45171	3,3462	3,5573

Preglednica 3: Test enega vzorca (Namere v prihodnosti).

	Testna vrednost = 0					
	t	SP	Stopnja znač. (2-stranska)	Povprečna razlika	95% stopnja natančnosti razlike	
					spodnja	zgornja
Namere v prihodnosti	59,595	641	,003	3,12773	3,0247	3,2308

Nadalje, Oneway ANOVA test kaže, da na namere v prihodnosti vplivata tako velikost kmetij, ki jo podpira 95 % stopnja natančnosti, kar odgovarja vrednosti 0,05 > 0,03, kot tudi število parcel; to ugotovitev se da upravičiti s stopnjo 0,09, kar odgovarja 90% stopnji natančnosti (preglednica 4).

Preglednica 4: ANOVA test za namere v prihodnosti.

Namere v prihodnosti					
	Vsota kvadratov	SP	Povprečni kvadrat	F	Stopnja znač.
Med skupinami	691,559	358	1,932	1,237	,030
Znotraj skupin	441,967	283	1,562		
Skupaj	1133,526	641			

Namere v prihodnosti					
	Vsota kvadratov	SP	Povprečni kvadrat	F	Stopnja znač.
Med skupinami	48,940	19	2,576	1,477	,087
Znotraj skupin	1084,586	622	1,744		
Skupaj	1133,526	641			

Za testiranje hipoteze, da produktivnost vpliva na navedene namere v prihodnosti, smo uporabili tudi SPSS-ov test ANOVA.

Preglednica 5: ANOVA test za ugotavljanje vpliva produktivnosti na namere v prihodnosti.

	Vsota kvadratov	SP	Povprečni kvadrat	F	Stopnja znač.
Med skupinami	20,333	4	5,083	2,909	,021
Znotraj skupin	1113,194	637	1,748		
Skupaj	1133,526	641			

Ko analiziramo podatke v preglednici 5, lahko z verjetnostjo 0,05, ki odgovarja 95 % stopnji natančnosti ugotovimo, da navedena produktivnost vpliva na namere v prihodnosti za izbran vzorec.

Na splošno lahko rečemo, da polovica kmetovovalcev meni, da je razdrobljenost kriva za zmanjšanje produktivnosti, njihove namere v prihodnosti pa so največkrat samo to, da parcele še naprej ostanejo razdrobljene. Ta dejstva se skladajo z mnenjem starajočega se prebivalstva, ki se še spominja komunistične

zadružne politike in ni pripravljeno na spremembe, saj zelo verjame v tradicionalno kmetovanje, ki temelji na praksi samooskrbe. Da bi to spremenili, bi morali lokalni organi odločanja sprejeti posebne ukrepe, ki bi rešili ta občinski problem pri kmetovanju na trajnosten način, vendar to ni stvar te študije.

Drugi del študije je bil osredotočen na analiziranje izbranih vzorcev kmetij (preglednica 6), vključenih v process participativnega kartiranja z uporabo treh indeksov razdrobljenosti kmetijskih zemljišč (Januszewski, Simpson in Igbozurike). Glavna kazalnika, ki smo jih uporabili za oceno stopnje razdrobljenosti, sta bila *velikost kmetij* in *število in velikost parcel.* Naslednji pomemben parameter, *razdaljo med parcelami*, smo uporabili samo pri vzorcu posameznih kmetij, ki smo jih preučevali ob upoštevanju tehnike participativnega kartiranja.

Preglednica 6: Razdrobljenost kmetijskih zemljišč – primeri posameznih kmetij.

kmetija	parcela 1 (ha)	parcela 2 (ha)	parcela 3 (ha)	parcela 4 (ha)	parcela 5 (ha)	parcela 6 (ha)	parcela 7 (ha)	parcela 8 (ha)	parcel na kmetijo	površina kmetij (ha)	pot, ki jo opravi kmet, da obišče vse svoje parcele (km)
1	0,14	0,77	0,48	–	–	–	–	–	3	1,39	6,46
2	0,15	1,98	–	–	–	–	–	–	2	2,13	7,19
3	0,28	0,86	0,13	0,34	–	–	–	–	4	1,61	9,28
4	0,41	0,12	0,19	0,57	0,78	0,96	–	–	6	3,03	11,19
5	0,35	3,61	–	–	–	–	–	–	2	3,96	2,99
6	0,30	0,25	0,29	0,40	0,55	0,63	1,00	1,50	8	4,92	11,77
7	0,10	0,52	0,70	0,19	0,18	0,54	–	–	6	2,23	11,07
8	0,43	0,70	–	–	–	–	–	–	2	1,13	4,41
9	1,55	1,58	–	–	–	–	–	–	2	3,13	7,36
10	0,70	0,12	0,14	0,33	0,68	2,26	–	–	6	4,23	13,18
11	2,71	0,13	1,22	2,50					4	6,56	9,82
12	0,50	2,09	0,12	1,53	0,30	0,80	0,70	0,50	8	6,54	13,59

Vir: Vprašalniki, ki so jih prejeli kmetje leta 2010.

Podobno smo izračunali dva sintetična indeksa (Januszewski in Simpson), ki sta poudarila dejstvo (preglednica 7), da so imele vse kmetije ne glede na velikost visoko stopnjo razdrobljenosti, kar lahko delno razložimo z zelo majhnimi kmetijami (74,2 % jih meri manj kot 4 ha).

Glede na rezultate lahko te posesti razdelimo v tri kategorije: kmetije z *visoko razdrobljenostjo*, kmetije z *zmerno razdrobljenostjo*, in kmetije z *nizko razdrobljenostjo*. Namen primerjalne analize podatkovnih nizov, ki so jih ustvarili posameznimi indeksi, je bil, da se poudari vpliv preučevanih parametrov (velikost kmetij, oddaljenost in število parcel, velikost in razporeditev parcel) na končne rezultate.

Preglednica 7: Stopnja razdrobljenosti posameznih kmetij.

povprečna velikost kmetij	delež skupnega števila kmetij (%)	povprečna površina parcel (ha)	povprečno število parcel na kmetijo	povprečna vrednost januszewskijevega indeksa	povprečna vrednost simpsonovega indeksa
< 2 ha	29,9	0,62	2,36	0,73	0,41
2–4 ha	44,3	0,73	3,85	0,59	0,69
4–6 ha	15,4	0,96	5,07	0,42	0,76
> 6 ha	10,4	0,99	9,0	0,34	0,81

Vir: Izračuni avtorjev z uporabo podatkov, zbranih s pomočjo vprašalnikov, razdeljenih kmetom leta 2010.

Navkljub prevladujočemu prepričanju, da imajo majhne kmetije visok indeks razdrobljenosti, je analiza pokazala, da imajo najvišjo stopnjo razdrobljenosti pravzaprav kmetije, katerih velikost presega 6 ha. Lahko tudi rečemo, da so kmetije, večje od 6 ha, bolj razdeljene na parcele kot tiste, ki so manjše od 2 ha; velike kmetije so torej bolj razdrobljene kot majhne. Pojem združevanja zemljišč, ki ga izpostavlja naraščanje povprečne velikosti parcel do 0,99 ha, je protiutež naraščanju povprečnega števila parcel na kmetijo, ki se je povečala za 300 % (s 2,36 na 9,0).

Preglednica 8: Stopnja razdrobljensoti posameznih kmetij – študija primera.

kmetija	Januszewskijev indeks		Simpsonov indeks		Igbozurikejev indeks	
	vrednost	kategorija	vrednost	kategorija	vrednost	kategorija
1	0,60	zmerna	0,57	zmerna	1404	visoka
2	0,81	nizka	0,14	nizka	678	nizka
3	0,52	zmerna	0,65	visoka	2320	visoka
4	0,43	zmerna	0,78	visoka	2238	visoka
5	0,79	nizka	0,17	nizka	151	nizka
6	0,37	visoka	0,83	visoka	1929	visoka
7	0,43	zmerna	0,78	visoka	2991	visoka
8	0,71	nizka	0,48	zmerna	787	nizka
9	0,70	nizka	0,51	zmerna	471	nizka
10	0,46	zmerna	0,66	visoka	1882	visoka
11	0,54	zmerna	0,65	visoka	598	nizka
12	0,38	visoka	0,81	visoka	1677	visoka

Vir: Izračuni avtorjev z uporabo podatkov, zbranih s pomočjo vprašalnikov, razdeljenih kmetom leta 2010.

S primerjavo vrednosti Januszewskijevega in Simpsonovega indeksa (preglednica 8) lahko vidimo, da se pri prvem kaže tendenca zmanjševanja stopnje razdrobljenosti. Na primer: kmetije številka 3, 4, 10, in 11, ki po Simpsonovem indeksu spadajo v kategorijo visoke razdrobljenosti, se po Januszewskijevem indeksu uvrščajo v kategorijo zmerne razdrobljenosti. Na podoben način kmetiji številka 8 in 9 preideta iz zmerne v kategorijo nizke razdrobljenosti.

Kljub temu pa je očitno, da navkljub temu dejstvu večina kmetij iz študije primerov sodi v zgornjo kategorijo razdrobljenosti po obeh indeksih. Ta rezultat se ujema tudi s podatki, zbranimi iz vprašalnikov (preglednica 6).

Glede na Igbozurikejev indeks imajo te vrednosti majhno praktično uporabnost, saj jim manjka natančen razpon različic. Zato je zmerno kategorijo razdrobljenosti zelo težko opredeliti. Če želimo odkriti spremembe, ki smo jih v analizi razdrobljenosti zemljišč uvedli s parametrom razdalje, lahko ta indeks uporabljamo samo v kombinaciji z drugima dvema indeksoma (preglednica 8).

S tega stališča lahko opazimo pomembna odstopanja v hierarhiji Januszewskijevega in Simpsonovega indeksa samo v primeru kmetij številka 1 in 11, ki imata očitne specifične značilnosti (velika odstopanja v velikosti parcel glede na pot, ki jo opravi kmet, da obišče vse svoje parcele).

V primeru Občine Izvoarele analiza parametra razdalje študiji ni prinesla nikakršne koristi. To lahko razložimo z načinom ureditve kmetij glede na uveljavitev Zemljiškega zakona št. 18 (Legea fondului … 1991), s pomočjo katerega so oblasti poskušale ponovno vzpostaviti prejšnje posesti, ne da bi se pri tem odpovedale načelu enakosti. Zato so lokalne komisije z uveljavljavitvijo tega zakona dodeljevale občinske parcele iz različnih delov občine z namenom da bi vsakdo dobil kos zemlje z relativno podobnim proizvodnim potencialom, s tem pa so ustvarile razdrobljenost kmetijskih zemljišč.

Participativno kartiranje je končno privedlo do zemljevida razdrobljenosti kmetijskih zemljišč (slika 2). To je ponovno potrdilo, da so kmetijska zemljišča v občini Izvoarele zelo razdrobljena. Ob upoštevanju, da nobeden od indeksov razdrobljenosti ne upošteva oblik parcel, smo v študiji primerov ta parameter analizirali za vsako kmetijo posebej. Pravokotna oblika sicer prevladuje, razmerje med širino in dolžino pa, razen v redkih izjemah, dosega visoke vrednosti (povprečno razmerje 1 : 9), kar kaže, da prevladuje zemljiška razdelitev v proge.

Slika 2: Parcele trakastih oblik.
Glej angleški del prispevka.

Slika 3: Stopnja razdrobljensoti kmetijskih zemljišč v občini Izvoarele, okrožje Olt.
Glej angleški del prispevka.

Ko smo primerjali končne rezultate drugih študij (Simion 2008; Rusu in ostali 2002) smo ugotovili, da ima razdrobljenost kmetijskih zemljišč številne prednosti, na primer zmanjšano tveganje škode na pridelkih

in raznolikost proizvodnje glede na naravne pogoje in povpraševanje na trgu (Simmons 1987). Obenem pa pomeni tudi pomanjkljivosti, med katerimi naj omenimo nizko produktivnost (MacPhearson 1982), omejene možnosti za mehanizacijo, težave pri uporabi namakalne mreže in nezmožnost udeležbe v melioracijskih projektih. V teh razmerah je velika verjetnost, da bodo te parcele ostale zapuščene, še posebej, če velika razdalja do parcel onemogoča učinkovito upravljanje.

5 Sklep

Ta študija je pokazala, da razdrobljenost kmetijskih zemljišč predstavlja resen problem, ki vpliva na kmetovanje na ravninah, ki so najrodovitnejša področja v Romuniji.

Razdrobljenost kmetijskih zemljišč izvira iz zgodnjega obdobja razvoja nepremičnin, ki sta mu sledila združevanje v času komunizma in kasneje povračila po letu 1989, kar je razdrobljenost le še povečalo.

Opažanja kmetov glede učinkov razpršenosti parcel kažejo na to, da se zavedajo nizke produktivnosti in naraščajočega tveganja opustitve. Več kot polovica kmetov nasprotuje predlogom za spremembo prakse upravljanja, druga polovica pa priznava potrebo po razvoju svojih posesti s pomočjo strategij, ki bodo utrdile kmetijske aktivnosti.

Januszewskijev in Simpsonov indeks kažeta na to, da nam pojem razdrobljenost kmetijskih zemljišč omogoča, da govorimo o majhnih kmetijah z nizko stopnjo razdrobljenosti, srednje velikih kmetijah in kmetijah z razpršenimi parcelami, katerih skupna površina presega 6 ha.

Model, ki smo ga ustvarili na podlagi izbranih primerov z uporabo Igbozurikejevega indeksa in programsko opremo *ArcGIS 9.3* skupaj z rezultati, pridobljenimi s participativno karto, kaže visoko stopnjo razdrobljenosti zemljišč, ki ležijo v različni oddaljenosti od naselij.

Kmetovalci se soočajo s težavami pri upravljanju svojih posesti, saj razpršenost zemljišč vodi v neučinkovito izkoriščanje tal. Neizogibno je, da razpršene parcele povzročajo težave pri obdelovanju in uporabi kmetijske mehanizacije.

Delež lokalnega prebivalstva, ki je zaposlen v kmetijskem sektorju je še vedno precej visok (83,4 %), kar negativno vpliva tako na produktivnost, kot na dohodek podeželskega prebivalstva. Nadpovprečna razdrobljenost kmetijskih posesti je pripeljala do razvoja samooskrbnega in pol-samooskrbnega kmetijstva.

Istočasno pa razpršenost zemljišč predstavlja velik razlog za opuščanje parcel, saj kmetje v občini Izvoarele navadno obdelujejo samo tiste parcele, ki ležijo blizu naselij, ali pa imajo visok produktivnostni potencial. Tako vedenje izhaja iz pomanjkanja virov financiranja in uporabe primitivnih kmetijskih tehnologij. Zaradi teh okoliščin torej ni nič čudnega, da se nekatere parcele prehajajo v praho.

Če želimo povečati kmetijsko konkurenčnost, se bodo morali organi odločanja v Romuniji osredotočiti na zmanjševanje glavnih vzrokov, ki so privedli do razdrobljenosti zemljišč in ustvariti primeren zakonski okvir, ter uvesti ustrezno razvojno politiko. Konsolidacija razpršenih zemljišč je nujen pogoj za povečanje produktivnosti v kmetijskem sektorju.

6 Zahvala

Avtorji želimo izraziti posebno zahvalo lokalnim oblastem občine Izvoarele za njihovo podporo med izvajanjem študije, še posebej za to, da so prepričali lokalne kmete v sodelovanje pri procesu participativnega kartiranja. Prav tako se zahvaljujemo Dr. Gabrielu Simionu z Univerze v Bukarešti za koristne podatke.

7 Literatura

Glej angleški del prispevka.