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FIELDWORK APPROACH TO DETERMINING THE EXTENT OF AGRICULTURAL LAND ABANDONMENT – CASE STUDY

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Summary

Agricultural land abandonment is an elusive phenomenon, as yet not fully defined. Even though it is common in Polish landscape, there are no measures to date that could quantify the phenomenon. Neither the data from the Central Statistical Office, nor the data from land registers include information on land abandonment. Therefore, there is a need for a systematic approach that could quantify and determine the extent of land abandonment.
A fieldwork approach was designed for the purpose, and research was conducted on a test area of Okocim village in Małopolska region. Vegetation cover that could indicate the existence of land abandonment on the agricultural areas – such as trees, brushwood, and grass cover – was examined using a representative sample of 145 test fields.
The fieldwork approach revealed that the extent of land abandonment in the test area is 37% of all areas officially classified as agricultural, which shows that the scale of the phenomenon is significant, and that there is a need to develop an approach to provide a more detailed picture of the distribution of land abandonment.

Keywords

agricultural land abandonment • fieldwork approach • land use

1. Introduction

Agricultural land abandonment – sometimes called a "new wilderness" [Höchtl, Lehringer, and Konold 2005] – has been present in scientific research for many decades. The phenomena, however, is new in the context of Poland's landscapes, and new to Polish research – until 26 years ago (when a socioeconomic transition took place), each piece of land was supposed to be cultivated and to give crops [Woś 1992]. However, with the reality of market economy, there is no need to fully use all agricultural areas, as it is not viable [Orłowski and Nowak 2004]. Therefore, many areas officially classified as agricultural land are in fact abandoned. With land abandonment, we lose the mosaic of fields, a traditional feature of southern Poland's landscape.

Even though the phenomenon is visible in the landscape of rural areas, as yet there is no widely accepted definition of agricultural land abandonment [Rico and Maseda 2008; Terres, Nisini, and Anguiano 2013]. Each paper presents a slightly different definition, therefore, for the purpose of this paper and the pertinent research, the following definition has been adopted: Agricultural land abandonment occurs if trees and brushwood are present on a plot officially classified as agricultural land, which indicates that there is no agricultural activity therein.

There is no data available on agricultural land abandonment. The existing official control system of the European Union for the verification of subsidies does not collect the data on the areas, which are not covered by the subsidies. Therefore, there is a need to apply methods that can give reliable results for all rural areas, such as the fieldwork method. The paper aims to present the results of fieldwork approach to determining land abandonment in a chosen research area.

1.1. Agricultural land abandonment in census data

Some official data sources include partial information on land abandonment. Census data is an indirect source of information on agricultural land abandonment as it includes the surface area of fallow land and set-asides, which in long term could turn into agricultural land abandonment. Therefore, they can be perceived as areas prone to becoming abandoned. Census data is a source, which shows the potential size of the phenomenon.

Niewęgłowska [2010] states that the surface area excluded from agricultural production (i.e. the areas, which are not cultivated) changed very dynamically between 2002 and 2007. It dropped from 2.3 million hectares in 2002 to 1 million hectares in 2005, to reach the level of 413.1 thousand hectares in 2007. Data from the Central Statistical Office shows that surface area of idle and fallow land has remained at the level of approx. 0.5 million hectares since 2005, and in 2014 it was at the level of 475.2 thousands hectares [Central Statistical Office 2015]. The surface area of idle and fallow land has been slowly but constantly increasing since 2005.

The data quoted above indicates that the surface area of fallow land and set-asides has been dynamic (especially between 2002 and 2007), which should not be the case for land abandonment. Re-establishing agricultural use in cases of advanced agricultural land abandonment is difficult. Therefore such dynamics is astonishing, and cannot be explained by natural processes only.

However, this puzzling dynamics can be explained by the change in the official land cover classification. The place of set-asides and fallow land changed in the classification due to the fact that, after 2004, upon becoming a new Member State of the EU, Poland needed to adjust land cover classes to the Community requirements, and to the so-called Good Agricultural and Environmental Conditions (GAEC) [Lebiecka et al. 2007]. Therefore, in the new classification, set-asides and fallow land, which do not provide good agricultural and environmental conditions, became part of the category classified as 'remaining land'. This categorisation makes it even more difficult to extract the infor-

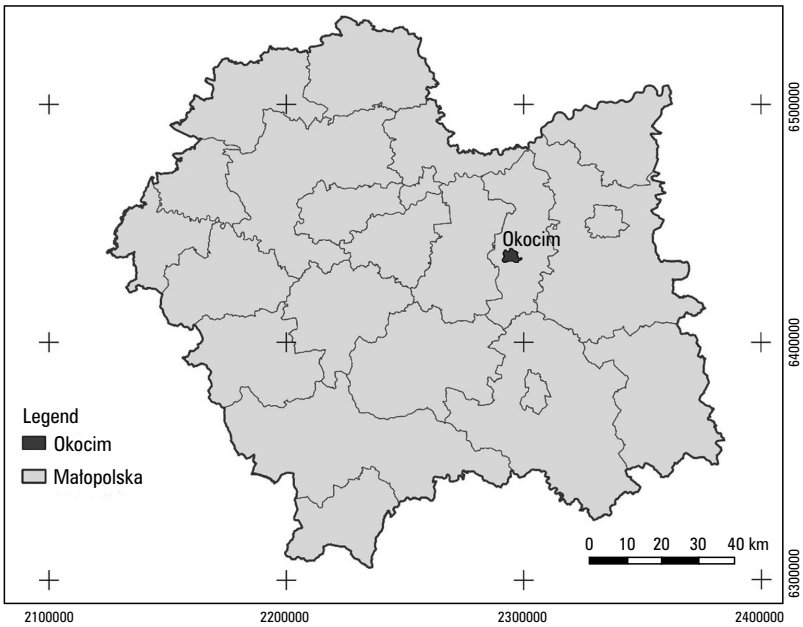
mation on the area of agricultural land abandonment from the census data, as it places agricultural land abandonment in the same class with e.g. parks, gardens, waters, and ditches. Another class that may contain agricultural land abandonment is the "remaining agricultural areas" category, which includes areas without good agricultural and environmental conditions as well as unused agricultural areas [Central Statistical Office 201].

It follows that census data does not constitute a reliable source of information on land abandonment. Land classification in census data neither distinguishes agricultural land abandonment, nor does it show the real extent and spatial distribution of agricultural land abandonment.

2. Materials and methods

2.1. Research area

Fieldwork studies were conducted on a sample area of Okocim (Figure 1), a village in southern Poland. The area of Okocim includes 638.67 ha of agricultural land, featuring 78.82 ha of meadows, 118.7 ha of pastures and 441.15 ha of arable land. There are certain factors listed below that make Okocim a fairly advantageous area for agriculture, within the region of Małopolska. Its most frequent soil class, indicating good agricultural fitness of the area, is that of mountain soil suitable for growing wheat.



Source: authors' study

Fig. 1. Location of the research area

The size of the plots in the studied region is larger (0.74 ha) than the average plot size in Małopolska (0.46 ha) [Szafrańska 2012]. All the above factors, combined with the relatively mild climate compared to some mountainous areas further south, make Okocim suitable for agriculture.

2.2. Fieldwork approach

Data used in the research includes land registry data, data obtained from the Polish geoportal [Geoportal 2015] with a Web Feature Service (WFS), and digital data obtained from county offices in Brzesko.

Plots tend not to be used exclusively in one way; sometimes there is more than one usage within a given plot. Therefore, the study had to be more detailed than a binary classification on the level of a plot, categorising each plot as either abandoned or not abandoned.

The chosen test field is a square, which measures 14 m on a side, with a surface area of 196 m^2. Originally the side of a test field was 10 m, however, taking in consideration the accuracy of the handheld GPS receiver (± 2 m), the surface area was increased in order to increase the probability of taking the correct measurement.

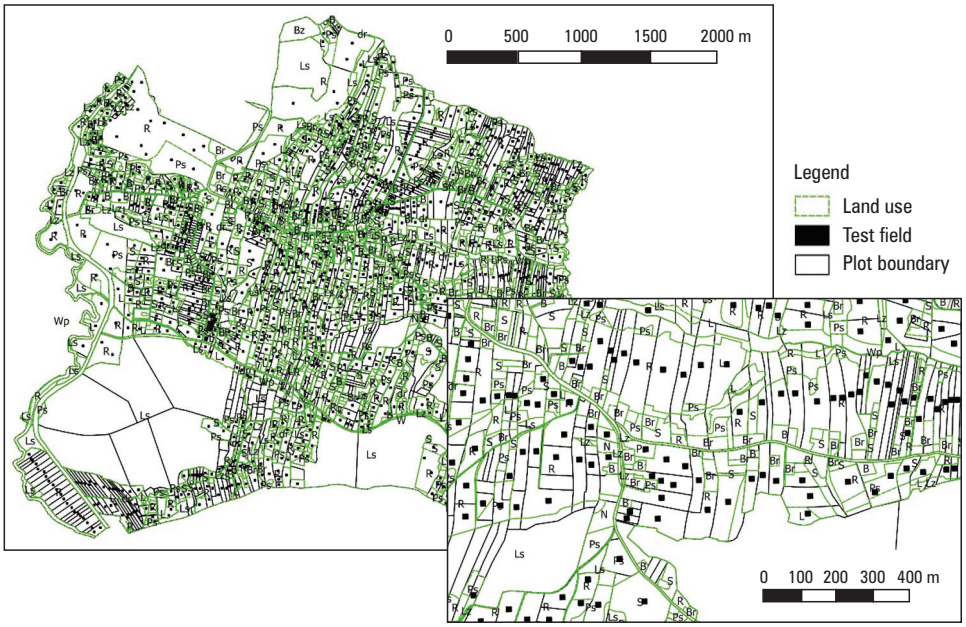
Test fields were located on the plots according to the following criteria:

- they should be of agricultural use,
- they should be as close to the centre of the plot and the centre of land use as possible,
- they should be evenly distributed (on each 0.5 h, there should be at least one test field) (Figure 2).

The region of Małopolska is characterised by high fragmentation of the plots, therefore, plots that were too small to accommodate a test field were not considered. Only 79 test fields out of 1164 were excluded from the analyses because of insufficient surface area of a plot.

The prerequisite for agricultural land abandonment is the cover of brushwood and trees on the area officially classified as agricultural land. Therefore, each test field was allocated the following attributes:

- number of trees,
- tree cover (1–10 scale, 1 = 10%, 10 = 100%),
- tree girth,
- tree height,
- brushwood cover (1–10 scale, 1 = 10%, 10 = 100%),
- brushwood height,
- grass cover (1–10 scale, 1 = 10%, 10 = 100%),
- grass height,
- arable land (yes/no),
- additional comments.



Source: authors' study

Fig. 2. Test fields in Okocim

The first test field was chosen randomly; then the next closest test field was measured (Figure 3).

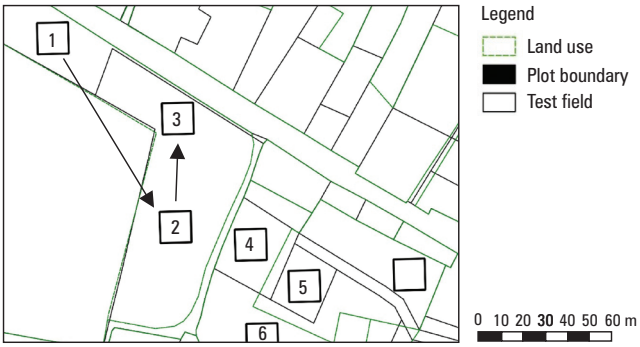


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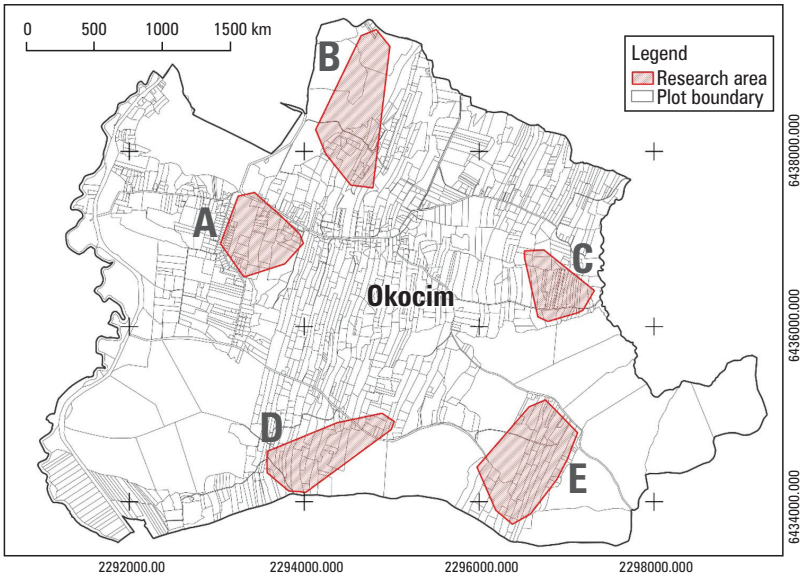
Fig. 3. Test field measurement

The first measurement covered 27 test fields. The measurement process was labour-intensive and time-consuming. Therefore, on the basis of the first sample and the t-test results, the number of a representative sample of test field was calculated.

T-test results on a significance level of 0.05 demonstrated that a representative test sample should include at least 100 test fields. In order to increase reliability of the results, the measurement was conducted on as many as 145 test fields. Test fields were located in five areas (A–E) (Figure 4).



Source: authors' study

Fig. 4. Location of randomly chosen test fields in Okocim in five areas (A–E)

The actual cover of land officially classified as agricultural area sometimes included park spaces, forests or orchards. Therefore, the following categories were identified within the test fields:

- abandoned,
- at risk,
- arable (actual agricultural use),
- other.

Land abandonment was identified if a test field was covered with trees or brushwood. It was the type of plants and not their height that decided of the plot's classification as "abandoned."

Apart from land abandonment, there were plots that were identified as "at risk" of land abandonment. Those were the plots that were covered with high grass (over 150 cm, such as *calamagrostis epigejos* (L.) Roth) or where goldenrod (*solidago* species) was observed. Goldenrod indicates that plant succession has already started, and that with no further care, the plot will be soon abandoned [Rola and Rola 2010; Włodek

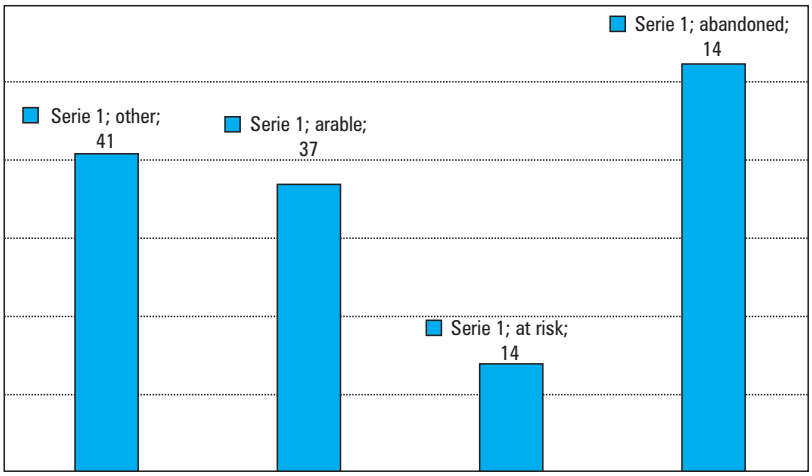
et al. 2014]. High grass of over 150 cm can hide wooden stems of small shrubbery; therefore, it can be also the sign of the risk of land abandonment.

Test fields were chosen randomly from the areas classified by land register as meadows, pastures or arable land. Some of those plots – even though they are used differently from their official classification – are not abandoned and, therefore, there was a need for another class, which would cover areas such as gardens, car parks or land used according to the official classification as "other".

Another category included plots classified as "arable": actually used as arable land, not at risk of land abandonment. Those were the plots that were cultivated during the fieldwork study. Plots were identified as arable when the value of "arable" field was positive.

3. Results

The results of the fieldwork study demonstrate that land abandonment occurs within the tested area. Out of the 145 measured test fields, 53 were classified as abandoned (Figure 5). 14 test fields were deemed at risk of being abandoned, which indicates that there are already signs of plant succession, which however can still be stopped at this point. Arable land was identified on 37 test fields. 41 test fields were classified as "other".



Source: authors' study

Fig. 5. Number of test fields that were classified as: abandoned, at risk, arable, and other

The chart (Figure 4) shows number of test fields that belong to each of the four categories. 37% of the fields were classified as abandoned (out of all measured fields), and that constitutes the largest category among the test fields. As the sample was representative, we may assume that the ratio will be similar for the whole population.

Table 1. Basic statistics of the attributes

	Confidence interval	Range	Skewness
Tree cover	1.30 ± 0.40	10	2.00
Tree height	2.84 ± 0.73	20	1.82
Tree girth	11.55 ± 3.20	80	1.55
Number of trees	3.33 ± 1.32	60	3.85
Brushwood cover	0.89 ± 0.40	10	2.52
Brushwood height	0.71 ± 0.22	6	1.96
Grass cover	7.26 ± 0.72	10	–1.03
Grass height	76.69 ± 12.97	250	0.51

Source: authors' study

Basic statistics of eight attributes are presented in the table above (Table 1). They show that the scattering of the results around the mean, i.e. the confidence interval (significance interval of 0.5) does not exceed 30%. The only exception is grass cover. Skewness is positive, which indicates that the mean is higher than the mode and the median. Grass cover is again an exception.

Table 2. Correlation coefficient between features measured on the whole area. Significant correlation coefficient highlighted in red

145	1	2	3	4	5	6	7	8
Tree cover 1	1.00	0.83	0.70	0.86	0.61	0.61	0.24	0.26
Tree height 2	0.83	1.00	0.87	0.77	0.59	0.66	0.27	0.34
Tree girth 3	0.70	0.87	1.00	0.55	0.52	0.57	0.31	0.29
Number of trees 4	0.86	0.77	0.55	1.00	0.43	0.45	0.12	0.20
Brushwood cover 5	0.61	0.59	0.52	0.43	1.00	0.75	0.27	0.44
Brushwood height 6	0.61	0.66	0.57	0.45	0.75	1.00	0.32	0.48
Grass cover 7	0.24	0.27	0.31	0.12	0.27	0.32	1.00	0.58
Grass height 8	0.26	0.34	0.29	0.20	0.44	0.48	0.58	1.00

Source: authors' study

Correlation is nearly always positive and nearly always statistically significant (Table 2). The only exception is the correlation between the number of trees and the grass cover, which may suggest that a forest may not encourage the increase of grass cover but neither does it influence the height of the grass.

The study was conducted in five research areas (A–E), in which comparable numbers of test fields were analysed. Therefore, it was necessary to check whether the

coefficients calculated from the observations in various areas differ from each other. The results show that correlation coefficients for each particular research area do not differ significantly from the coefficients calculated for all observations. The only exception is the correlation between the trees and brushwood (height and cover) in one of the areas. This shows that the choice of five test areas (A–E) does not affect the results. Test of significance has demonstrated that test fields from one area do not statistically differ from test fields in other areas.

4. Conclusions

Fieldwork studies are necessary in order to determine the surface area of agricultural land abandonment. Existing data sources are not sufficient for the determination of spatial distribution and extent of land abandonment. Therefore, there is a need for another approach that could shed some light on the surface area of land abandonment. Fieldwork is not an ideal solution as it is time consuming and, therefore, only a small sample area could be examined.

The research conducted on a sample area shows that the majority (37%) of test fields were identified as abandoned. It is a very important finding, as all the plots were officially classified as agricultural. The fact that most of the plots already demonstrated long-term changes in their cover structure is of utmost importance. This fact also illustrates insufficient effectiveness of the current system used for official classification, as those changes should have been detected earlier, so an action could have been taken if desired. 14 further test fields were detected as "at risk", making a total of 67 (46%). This indicates that almost half of the test fields were not used according to their original purpose, and showed at least some predisposition or signs of abandonment. Those results demonstrate the importance of the land abandonment phenomenon, and point to the fact that we need more effective tools for detecting it. The study showed that there is a need for further research, conducted using modern technologies, which would be less time and labour consuming and which could give a better idea on the spatial distribution of agricultural land abandonment in Polish villages.

41 test fields (28%) were classified as 'other'. This finding is also significant as it indicates that these plots were still in use at the time of the study, even though in some of the plots, that use was not as stated in the original classification, for example car parks. Therefore, the study shows that there is a need to keep an updated database of land use.

Arable land was only identified on 37 (25%) test fields. Together with test fields classified as "other", this adds up to 78 (53%) test fields that are actually used. It is a surprising result, since all of the test fields had been officially classified as "of agricultural use", while only just over a half of them are actually used in this way. It is difficult to keep the data updated, however the study showed substantial discrepancies between theoretical data and field data. There is a need to develop less time and labour-consuming methods for classifying land use, such as a remote sensing approach, in order to know the actual usage and this will be a focus for the future research.

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