

# **DIRECTIONS FOR LAND MANAGEMENT IN RURAL AREAS**

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**Published by:**  
**Croatian Information Technology Society, GIS Forum**  
**10 000 Zagreb, Ilica 191e, Croatia**  
**University of Warmia and Mazury in Olsztyn**  
**10-719 Olsztyn, Oczapowskiego 2, Poland**  
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**Number of copies: 100**

**ISBN 978-953-6129-40-9 Nacionalna knjižnica, Zagreb, Croatia**

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# INTRODUCTION

The monograph presents directions and trends of real estate management in the rural areas in Poland and in Norway. Changes and transformation of the spatial structure of agricultural farms have been intensively developed since the Polish accession to the European Union. Real estate management in rural areas covers technical, procedural and legal aspects resulting from attempts aiming at solution of current problems. The amending legal regulations and the rules concerning the real estate transactions force the changes of the real estate management in its wide sense. The new trends of management of real estates of the State Treasury and the procedure of privatisation of those lands is a long-term process. Section 1 of the monograph presents the possibilities to perform real estate transactions and the assessment of impacts of activities performed by the State Treasury Real Estate Agency on the real estate market and on the level of transaction prices achieved in the period of 2009 -2013. Purchase of real estate is still of high interest in Poland since those lands are much cheaper than real estates dedicated for building purposes.

Modification of consideration of some issues is often forced by the current situation; this may be confirmed by the series of summer floods which occurred in Poland in recent years, or by the necessity to intensify works related with the programme of construction of motorways. As it has been proved by performed research works, the attention should be paid to such phenomena which are important for the specified areas and focused on adaptation to those phenomena instead of consideration of all possible variants of those phenomena. Information concerning the intensity of particular phenomena, complemented by spatial data about their distribution, are the excellent tools which may support decision making processes concerning rural areas. These aspects have been presented in Section 2.

Surveying works, which support the process of structural changes in rural areas, concern land consolidation processes. The monograph presents, which types of land consolidation works should be performed in specified conditions in Polish rural areas. Examples of the scope of designed and implemented land consolidation works have been presented in Section 3, which is a compendium of knowledge concerning the land consolidation process. Specifics of land consolidation works in the case of linear or flood protection investments, as well as methods of utilisation and management of flood areas require that activities are undertaken at the physical planning level, as well as that many studies are performed. Land consolidation projects, which concern structural land consolidation, should follow those provisions.

In Poland the issue of management within problem areas of agriculture is very important. It is necessary to balance the chances of development of farms within environmentally less favourable areas, which are characterised by the low soil productivity and which are hazarded by degradation. Section 4 of the monograph presents the analysis of criteria, which are applied for delineation of areas, as well as their spatial extension. As a result of land consolidation works management of the agriculture problem areas should emerge from destination of a given area for playing specified functions, as well as it should be compliant with legal regulations. Diversification and complexity of issues which occur within rural areas force the decision makers to specify areas where land consolidation works will be performed. Section 5 describes the methodology of specification of urgency to commence land consolidation and exchange using the example of cadastral districts in one of the administrative units (powiats) in Poland.

The last section presents solutions applied in real estate management in rural areas, which are performed in Norway. Organisational structures of the norwegian "consolidation courts" (Jordskifteretten) - the units which are responsible, among others, for implementation of many procedures of real estate management - have been discussed. Particular attention has been paid to detailed presentation of the way of organisation of the court and its obligations in the field of implementation of real estate procedures. Solutions which have been developed and are currently applied in the Norwegian legislation have been explained and justified.

The presented monograph discusses only some aspects related to real estate management issues in rural areas with consideration of the works of surveyors. The multi-issue nature of the

monograph stresses the difficulties which are faced by surveyors in the course of implementation of land consolidation works, which must be accepted by the society, efficient and which must protect the natural environment.

**Scientific Editor**  
**Katarzyna Sobolewska-Mikulska**

# 1. Advantages and limitations of the management of agricultural property

Management of real estate situated on farmland brings many benefits, the main ones are payments arising out of the ownership, preferential tax rates, and simplified rules of division of the property and its buildings. The biggest limitation is Treasury supervision of these areas, the monopoly of Agricultural Real Estate Agency in their sales. Even the purchase is often carried out by the agency which performs on behalf of the Treasury and has liquidated estates of former state farms. The same agency may cancel the sale of such property if the transaction omitted its right to first refusal. Interest in purchasing such property does not decline, because these lands are much cheaper than property held even for construction purposes, and the process of transformation of zoning is an administrative decision and do not create many difficulties. The main objective of the study was to assess the impact of the Agency for the land market by examining the distribution of all land area being under its management. The authors presented a way to transfer the land to other entities and assessed the timeframe for the further privatization activities of the Agency. This chapter presents the advantage of advantages to restrictions, because the latter is actually very little. In addition, note the definition of the farmer, which carries a divergence between different legal regulations.

Polish accession to the European Union resulted in large changes in many areas of the economy. One of them is agriculture. Agriculture is one of the most protected and subsidized sectors of the economy. It is also supported for many years by a facilitated procedure for the building of agricultural land, the so-called plot habitat or by charging lower taxes on agricultural property and lower insurance premiums.

Agricultural real estate (agricultural land) according to the Civil Code (ACT 1964) are properties that are or may be used to conduct manufacturing activities in agriculture in terms of plant and animal production, including the production of horticultural, orchard and fish. From the definition of agricultural property is closely related to the definition of the farm, the farmer and agricultural activities.

As farm Civil Code recognizes agricultural land, including forest land, buildings or their parts, equipment and inventory, if they present or may present an organized economic unit, and the rights associated with running a farm. Act on shaping the agricultural system (ACT 2003) adds to these requirements the requirement of the area, at least 1 ha of agricultural land.

Farm by (ACT 1990) are each holding for agricultural activity. Regulation (Regulation 2009) extends this definition recognizing that the holding means all the production units managed by a farmer situated within the territory of that Member State. Act (ACT 1984) considers the farm land area, with a total area exceeding 1 ha or 1 ha conversion, owned or held by a natural person, legal person or an organizational unit, including companies without legal personality.

Definition of farmer is itself an equally problematic and ambiguous as the definition of a farm. Farmer definitions shown in Table 1.

**Table 1:** Definition of farmer.

No	Rule of law	Definition of farmer
1	REGULATION No 73/2009 of 19 January 2009 establishing common rules for direct support schemes for farmers under the common agricultural policy and establishing certain support schemes for farmers, amending Regulation No 1290/2005, 247/2006, No. 378 / 2007 and repealing Regulation No 1782/2003	Natural or legal person or group of natural or legal persons, whatever legal status is granted to the group and its members by national law, whose holding is situated on Polish territory and who exercises an agricultural activity.
2	The Act of 20 December 1990 on social insurance for farmers. (Journal of Laws 1991, No. 7, item. 24)	Adult natural person residing and running on Polish territory, in person and the self-employed, agricultural activity remaining in the possession of the farm, including within the group of agricultural producers, as well as the person who allocated land held by them to the farm afforestation.
3	The Act of 11 April 2003 on the agricultural system (Journal of Laws No. 64, item. 592)	A natural person who owns, perpetual usufructuary, sole owner or lessee of agricultural property, the total area of agricultural land does not exceed 300 acres, having agricultural skills and at least 5 years living in the community, in an area where it is located one of the agricultural property belonging to the farm and led personally by this time the farm (individual farmer).
4	The Act of 15 November 1984 on the agricultural tax (Journal of Laws No. 52, item. 268)	Natural persons, legal entities, including companies, unincorporated being: <ul style="list-style-type: none"> <li>• land owners, perpetual users or spontaneous owners of land;</li> <li>• holders of land owned by the State or local government if their having: <ul style="list-style-type: none"> <li>○ results from an agreement with the owner of the Agricultural Property Agency of the State Treasury or other legal title,</li> <li>○ is without legal title, with the exception of land belonging to the Agricultural Property Stock of the State Treasury or in the management of the National Forests; in this case the taxpayers are respectively units of the Agricultural Property Agency of the State Treasury and State Forests.</li> </ul> </li> </ul>

**Resource:** Regulation No 73/2009 of 19 January 2009, Regulation No 1290/2005, 247/2006, No. 378 / 2007 and repealing Regulation No 1782/2003, Act of 20 December 1990, Act of 11 April 2003, Act of 15 November 1984.

For listed in Table 1, the definition could be added to the definition of the agricultural producer. However, they overlap to a large extent with the referenced definitions.

Assuming a definition in accordance with the Act (ACT 2003) (Lp.3) should be determined what is meant by the terms personal farm management, agricultural qualifications and seniority. By this act the farmer personally conducts a farm if:

- works in the farm,
- take all decisions relating to agricultural activities in the farm.

On the other hand, have the appropriate qualifications means that the farmer has:

- agricultural education vocational, secondary or higher or
- title of the qualification or professional degree or professional degree master in the profession suitable for agricultural activities and have at least 3 years work experience in agriculture, or
- higher education other than agricultural, and have at least 3 years work experience in agriculture or higher education other than agricultural and completed postgraduate studies in the field related to agriculture, or secondary education other than agricultural, and have at least 3 years work experience in agriculture, or
- primary, secondary or vocational school, other than agricultural, and has at least 5 years work experience in agriculture (what is meant by seniority defined in the Act).

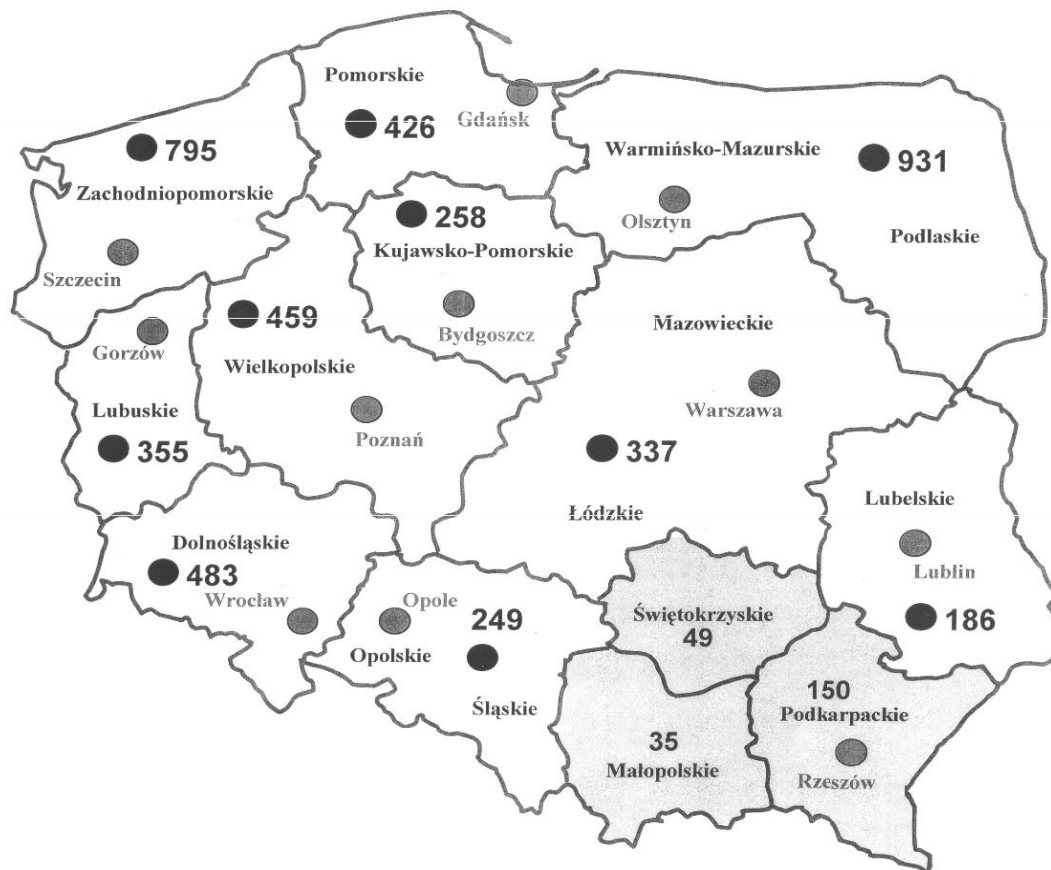
Agricultural activity by (Regulation 2009) means the production, rearing or growing of agricultural products including harvesting, milking, breeding animals and keeping animals for farming purposes, or maintaining the land in good agricultural and environmental condition. According to (ACT 1990) agricultural activity means an activity in the production of plant or animal, including gardening, fruit growing, beekeeping and fish. According to (ACT 1984) for an agricultural activity is considered to be plant and animal production, including seed production, nursery, breeding and reproduction, production Vegetable, ornamental plants, fungi crops, horticulture, livestock and production of breeding material of animals, birds and insects utility, the type of industrial livestock production and fish breeding and farming.

As you can see, each of these terms is referred to several times depending on the context and purpose of the act for the measure. It is cumbersome and difficult to read. In addition, this state of affairs raises many doubts, thus allowing a multitude of different interpretations. This makes it difficult to present a significant benefit agricultural activities.

### **1.1. The activities of the Agricultural Property Agency**

The Agency has a significant impact on the market of land (JASIŃSKA & PREWEDA, 2012). The possibilities of this institution can be proved by the fact that out of 18.87 million hectares of agricultural land in Poland at the beginning of its activities until it managed 4.7 million hectares, an area that has been taken over from the former Agricultural Property Stock of the State Treasury.





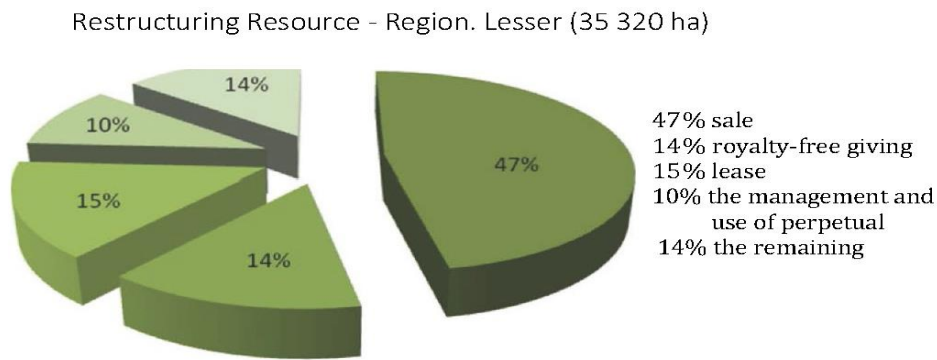
**Figure 1.** Resource acquired by the Agency in the various provinces in thousands. ha.  
**Resource:** Krakow branch of the Agency.

Pictured above (Figure 1) the extent to which the Agricultural Property Agency participated in the market in different regions, which are close to the provincial administrative division. Characteristic is quite a large amount of assets held in the western part of the country. The District analyzed the Field Rzeszow, which includes the provinces: Lesser Poland, Podkarpackie and Swietokrzyskie total area of the acquired assets reached 235,000 hectares.

One of the main tasks of the Agency is the restructuring of the former property of the Agricultural Property of the Treasury. It aims, among other things:

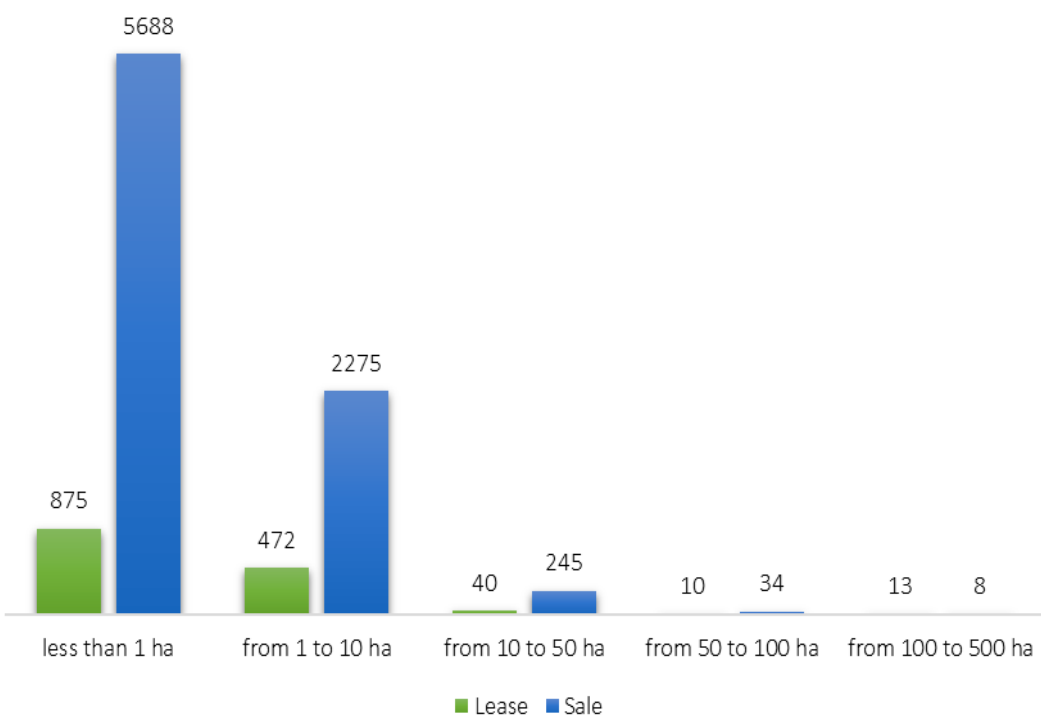
- reducing irrational land concentration, larger farms,
- the exclusion of land for investment purposes,
- and the protection of nature.

The idea of privatization of the state sector in agriculture, is intended to create the right conditions for effective management. With the right tools, the legal property of the State Treasury may be distributed in several ways. We distinguish here forms such as sales, free delivery, leasing and management of sustainable and perpetual usufruct. Of course, as already was mentioned are also a variety of methods of distribution of assets (bidding mode, no-biding mode, free transfer), as well as those involved in the transaction (farmers and former employees of state farms, companies with foreign capital). In the Figure 2 percentage breakdown was included due to the form of distribution of the assets of the Treasury in the Malopolska province.



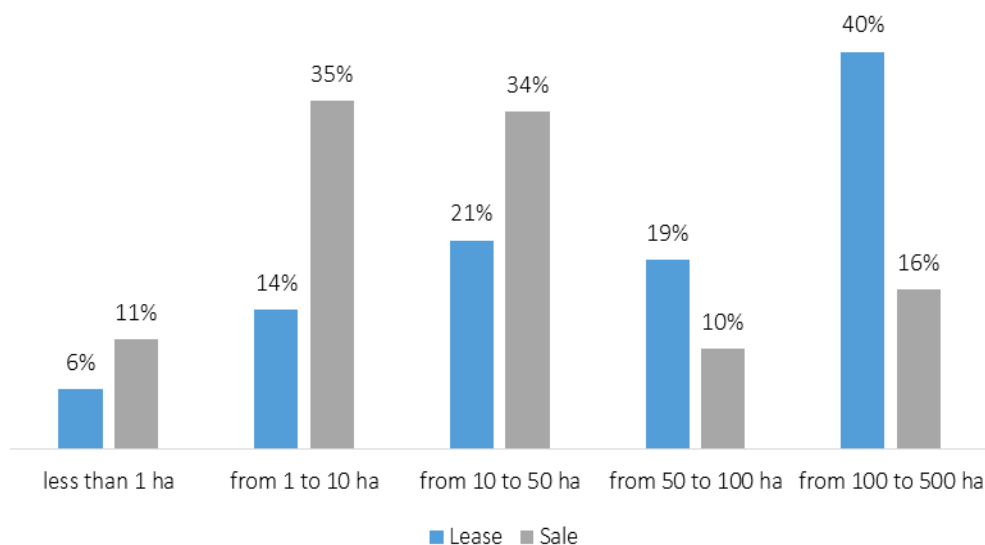
**Figure 2.** Restructuring Resource - Region. Lesser.  
**Resource:** Krakow branch of the Agency.

Particularly noteworthy is the structure of the contracts of sale and lease. The vast majority of transactions are for very small plots (Figure 3). This is due to a fragmentation of areas, as well as enlarging the surface of a solid family farms with a relatively small manufacturing capabilities.



**Figure 3.** Quantitative structure of contracts of sale and lease.  
**Resource:** Krakow branch of the Agency.

In Figure 4 is shown the area structure of these agreements. Individual compartments are in this case more even. You can see exactly that in spite of relatively few large-scale plots of transactions they are the dominant faction in the economic landscape of the region.



**Figure 4.** Area structure of contracts of sale and lease.  
**Resource:** Krakow branch of the Agency.

## 1.2. The benefits of agricultural property management

Benefits of agricultural real estate management can be broadly divided into those arising from:

- EU subsidies for agricultural production (direct payments, the Rural Development Programme 2007-2013),
- preferential rates of tax on agricultural property,
- preferential rates of social insurance of farmers,
- simplified location of the new building is necessary for the performance of agricultural production.

Direct payments, awarded every year to persons conducting agricultural activities for at least 1 ha of agricultural land (by ARMA every year is claiming payment of about 1,4 million farmers).

By 2014, farmers can apply for:

- the single area payment (JPO)
- supplementary payments, including:
  - a supplementary payment to the cultivation of hops, to which the payment is granted a supplementary
  - to the cultivation of hops for 2006 (payment unrelated to production),
  - additional payment for producers of raw tobacco (non payment to tobacco),
  - a supplementary payment for potato production of starch (non payment for starch),
- separate fruit and vegetables payment (payment of tomatoes),
- a separate payment for soft fruit,
- sugar payment,
- payment for raw tobacco (tobacco payments),
- payment for cows and sheep,
- special area payment to the area under pulses and legumes, fine-seed.

Rural development programme 2007-2013 is the continuation of a similar program from years 2004-2006.

Under the PROW was implemented many tasks, and the most important of them are:

- the structural pension,
- afforestation of agricultural land and land for non-agricultural,
- a group of agricultural producers,
- modernisation of agricultural holdings,
- creation and development of micro-enterprises,
- improving and developing infrastructure related to the development and adaptation of agriculture and forestry,
- implementation of local development strategies,
- restoring forestry production potential damaged by natural disasters and introducing prevention,
- implementation of cooperation projects,
- support,
- other listed in ([www.prow.umww.pl](http://www.prow.umww.pl)).

Undoubtedly, a great advantage for people leading agricultural activities have been used for many years, the preferential tax rate of agricultural property. The tax base is agricultural tax (ACT 1984):

- for land holdings - the number of conversion hectares determined on the basis of surface types and classes of agricultural land resulting from land and buildings, and credit to the county tax,
- for other land - the number of hectares resulting from the land and buildings.

**Table 2:** The list of utilized agricultural area.

Types of agricultural land	Arable land				Meadows and pastures			
	I	II	III	IV	I	II	III	IV
Circles tax								
Class of farmland	Conversions							
I	1,95	1,80	1,65	1,45	1,75	1,60	1,45	1,35
II	1,80	1,65	1,50	1,35	1,45	1,35	1,25	1,10
IIIa	1,65	1,50	1,40	1,25				
III					1,25	1,15	1,05	0,95
IIIb	1,35	1,25	1,15	1,00				
IVa	1,10	1,00	0,90	0,80				
IV					0,75	0,70	0,60	0,55
IVb	0,80	0,75	0,65	0,60				
V	0,35	0,30	0,25	0,20	0,20	0,20	0,15	0,15
VI	0,20	0,15	0,10	0,05	0,15	0,15	0,10	0,05

**Resource:** Act, 1984.

Agricultural Tax Act (ACT 1984) establishes four tax districts. Assessment of the city or municipality for a specific tax district should occur as a result of the assessment of the economic and production conditions. Credit to a particular area of a circle by the Minister of Finance in a regulation, it is currently the disposal (ACT 1984), for example, Krakow and Krakow district is a district tax II, Warsaw is a district and a district Bieszczady - District IV. However, in special circumstances, both voivodship parliament and the Municipal Council may change the tax district as defined in Regulation (ACT 1984).

Agricultural tax for the tax year from 1 ha of land conversion, is equivalent to a cash of 2.5 quintals of rye, and from 1 ha of other land is equivalent to a cash 5 quintals of rye. Rye prices are calculated at the average purchase price of rye for 11 quarters preceding the quarter preceding tax year. It is worth noting that local councils are entitled to a reduction in purchase prices taken as the basis for calculating the agricultural tax within the municipality.

### **1.3. Change of use of agricultural real estate**

In times of high demand and rising prices of building plots became popular change of designated use in the local plan and shutdown of production agricultural land, which are even several times cheaper, particularly those found in urban and suburban areas. Despite the lack of accurate quantitative data about the scale of such trafficking must definitely say that it is a profitable investment, though not entirely simple and requiring the investor a sizeable quantity of time.

It should also be noted that agricultural land have specific regulations regarding their division. You can share it without following the procedure laid down in the Act on real estate, it should be remembered that as a result of the operation created a plot of at least 0.3 hectares (ACT 1997). The division into smaller parts is possible only in accordance with the provisions of the local zoning plan or the moment of decision on building conditions.

The procedure for use of agricultural land for non-agricultural purposes consists of two stages: its reassignment recognized in the local development plan and the exclusion of agricultural production.

Proceedings transformations differs depending on whether the land which is the subject is located within the administrative boundaries of the city. Pursuant to the Law on the protection of agricultural and forest land on 1 January 2009 (ACT 2009) for agricultural land which land located in the cities of non-agricultural buildings is possible without changing the destination, or off from agricultural production. The basis can be a zoning plan, or zoning decision, not requiring the agriculture consent.

Different results have stand at non-urban areas. If the area designed to change the destination is larger than 0.5 hectares is to be taken into account this change in the zoning plan, and obtain the consent of the Marshal and Minister responsible for agriculture (ACT 2009). This procedure applies only to agricultural land classes I to III. The transformation of the remaining land (class IV-VI, including the land, organic and inorganic) may be based on zoning subject to the other guidelines, for example, the principle of good neighborliness.

The second step on the way to the use of non-agricultural land in rural areas is to disable it from agricultural production, through Edition by the Mayor's decision. This is necessary before obtaining building permits. The decision to require the sites generated with all the soil types that belong to classes I, II and III and agricultural classes IV-VI from organic soils (the decision is declaratory) (ACT 2009). Exemption shall not be required for soils of classes IV-VI of mineral origin. In the latter case, a building permit shall be issued without the need for any decision to exclude land from agricultural production.

If it is necessary to issue a decision in respect of the exclusion applicable one-time fee (Table 3) and annual fees, which depend on the class of land, productivity per hectare and in force in that year, the price of one ton of rye, as well as from the ground surface to exempt agricultural production (ACT 2009).

**Table 3:** The costs of exclusion from the agricultural production of 1 ha of land

Arable land and orchards, under the buildings and devices on the farms and under the mid-field shelterbelts, including under anti-windy lanes and anti-erosion devices		Permanent meadows and pastures, under buildings and units in farms and under shelterbelts and intra-field bushes, including under anti-windy lanes and anti-erosion devices	
Category	Charge (PLN)	Class	Charge (PLN)
Created with soil mineral and organic origin			
I	437 175	Ł and Ps I	437 175
II	378 885	Ł and Ps II	361 398
IIIa	320 595	Ł and Ps III	291 450
IIIb	262 305		
Produced from soil organic			
IVa	204 015	Ł and Ps IV	174 870
IVb	145 725	Ł V	145 725
V	116 580	Ps V	116 580
VI	87 435	Ł and Ps VI	87 435

**Resource:** Act, 2009.

The obligation to pay does not apply to off land for housing construction:

- smaller than 0.02 hectares per dwelling for multi-family dwellings,
- smaller than 0.05 ha in the case of single-family building.

To analyze the changes in value of the property after the change function in the local development plans data from the registry of real estate prices and values of the district office in Krakow was derived. Analysis of property prices covered the period 2003 to XI.2013 for the municipality Michałowice. Municipal Council adopted the percentages for determining planning fee, which amounted to:

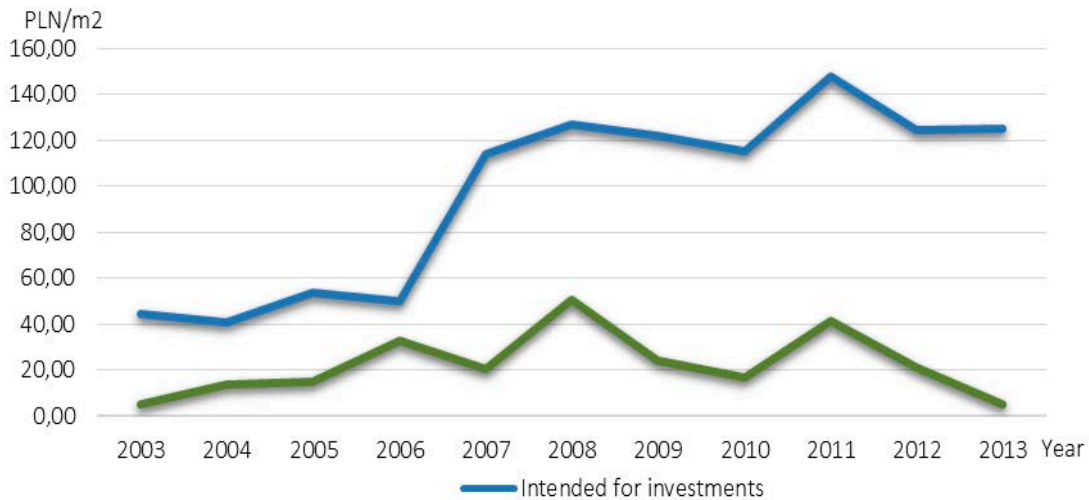
- for land for housing -10%,
- for others - 7%.

Analysis of the data from the register of prices and real estate values in different localities and years allowed for notice certain trends in real estate values in the area covered by the survey. Taking into account the above-mentioned analysis can conclude that real estate prices decrease, depending on the functions that are given in local development plans. Following are the features that these prices range from the most expensive:

1. sites of multi-family housing,
2. sites of a single-family housing,
3. service area-residential,
4. recreational area,
5. green areas,
6. agricultural areas.

Average prices of real estate using for investing (in the Unitary Development Plan for the function and single-family housing) over the analyzed area were significantly increased after the adoption of the local development plan in 2006. Visible in Figure 5 almost 3 - fold increase in real estate prices of construction in 2006-2007 confirms the findings of the impact of the plan on the real estate market. The value of agricultural land in the surveyed 10 years has not changed significantly and the impact of price fluctuations were other factors such as general market conditions , the amount of purchase-sale transaction and the one in which the city was the transaction completed . The adoption of the local plan for the valley Dłubnia in 2009 did not affect the price of real estate construction and agricultural equipment. This was due to the fact that it

covered a small number of parcels that would be subject to sales and in many villages, none of the plots of land sold was not located within the plan.



**Figure 5.** Average prices for real estate investment and agricultural land in the period 2003-2013.

**Resource:** JASIŃSKA E., PREWEDA E. - study based on registry of prices and real estate values.

In the complex Wilczkowie it is possible to find a few examples of direct changes in real estate prices due to changes in the real estate destination. The first case is a plot No. 389, which was sold in 2003 and 2010. Its price in this period increased from 40000 to 179000 PLN. Undoubtedly influenced by the fact that state changes the function of the plot, which changed the destiny of agriculture on purpose for farm-family housing. On fact such a significant change in the price was also certainly influence of time and differences in average prices on the real estate market. In turn, plot no 338/2 in 2007, was intended for agriculture and was sold for 23000 PLN, and the Unitary Development Plan introduced its transfer to the protected green nature. Price of the property has increased significantly and in 2010 as a result of the sale of its price was 185000 PLN. Another example is the plot of the number 14, which in 2004 reached the value of the sale of 7000 PLN. When the surface of 5600 m<sup>2</sup> gives a price of 1,24 PLN per 1 m<sup>2</sup>.

After a partial change in the destination of agricultural farm buildings and single-family housing price you achieved with the sale of the property in 2006, was 50000 PLN (8,83 per m<sup>2</sup>). As you can see this is a more than 7-fold increase in value.

#### 1.4. Conclusions

Agricultural property is a special property of the entity, which allows the use of multiple privileges, provided the status of the farmer. In this way, recent years have seen a significant increase of just such landlords. Undoubtedly, various grants, both from the State, and how the European Union, favor the development of this sector, which the cyclical changes requires very specific assistance. Plays an important role in this process, the Agricultural Property Agency, which supervises the marketing of these lands and allocation of land remaining after the huge state farms. Pre-emption is a powerful tool, as well as the constraints of minimum area created when dividing the property, all it takes to failure to see the excessive fragmentation of the land. It should be noted, however, that agricultural property mainly due to their low prices, are a tasty morsel for investors, not frightened even by charges associated with the transformation of the property at exceeding a specified area. As long as differences in prices between the property for construction purposes and for agricultural purposes will be several hundred percent, it will be profitable to be converted, regardless of the administrative procedure related charges.

## 2. Spatial hazards conditions used in rural space management

The climate of the Earth has already changed many times during its history. There are some groups of mechanisms responsible for climate changes that are as follows:

- fluctuations in solar radiation (activity of the Sun, e.g. defined by the indicator of the number of sunspots),
- changes in the parameters of the orbit of Earth movement around the Sun (in timescale tens of thousands of years, so they have no noticeable influence on the current warming),
- oscillation in the ocean-atmosphere system, i.e. the phenomenon of quasi-periodic change in the heat exchange processes between the atmosphere and the ocean,
- changes in the Earth atmosphere composition (greenhouse gases – water steam, carbon dioxide, methane, nitrogen monoxide, dust aerosols),
- changes in the Earth surface characteristics (reflection coefficient, water retention, surface permeability, land use, vegetation) (STARKEL & KUNDZEWICZ, 2008, KUNDZEWICZ, 2012).

Consequences of gradual climate changes and extreme weather phenomena during the recent years influence the food safety significantly. They also have negative influence on the development of areas. Economic sectors that are dependent to a large extent on the weather conditions such as agriculture and fisheries are exposed more and more to the climate change consequences (PACHAURI & REISINGER, 2009, KARFAKIS et al. 2013). Table 4 presents the percentage share of losses caused by extreme phenomena worldwide (FAO data). The largest losses were caused by floods and tropical storms. In the Polish conditions we deal only with the first of those phenomena.

**Table 4:** Losses caused by extreme natural phenomena.

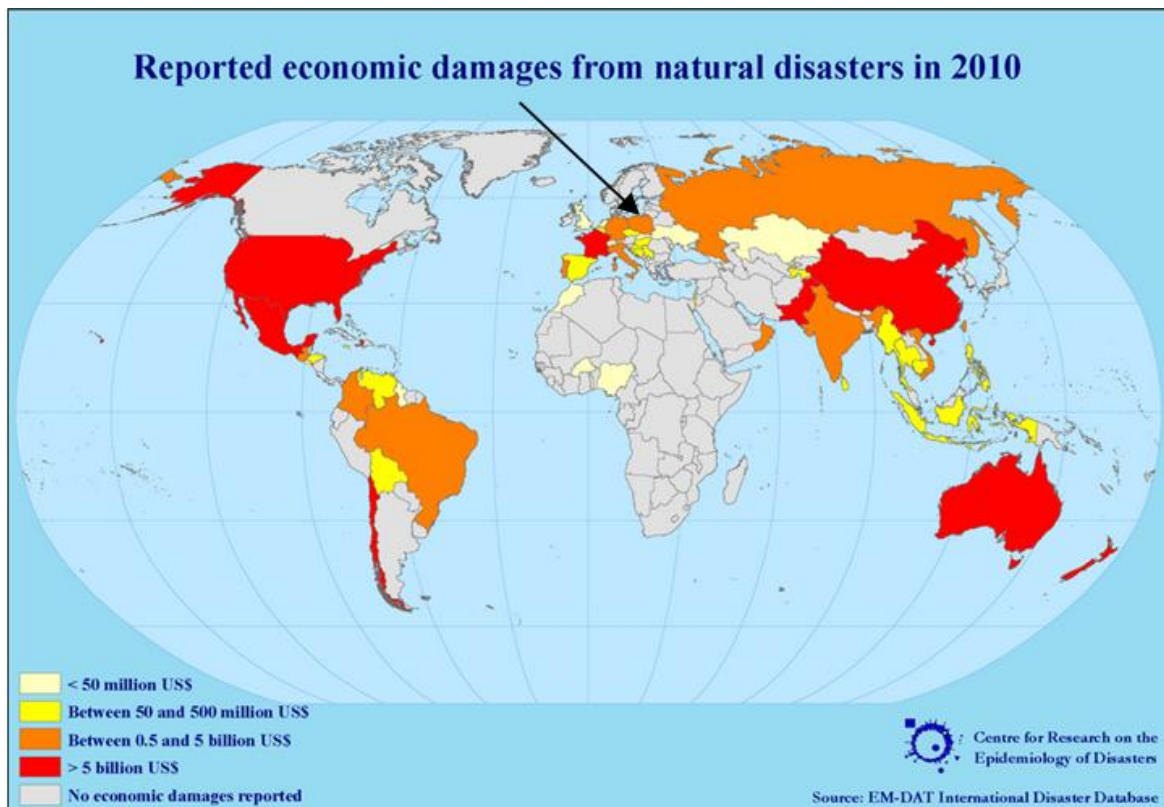
Extreme Phenomena	percentage share of losses (%)		
	Important damage	Losses in colonization	Mortality
Tropical storms	30	20	19
floods	32	32	26
earthquake	10	4	13
drought	22	33	3
other natural disasters	6	11	9
together	100	100	100

**Resource:** DUDZIŃSKA M., KOCUR-BERA K. - work based on the data by MIODUSZEWSKI W., 2012.

Figure 6 presents economic losses caused by extreme phenomena in 2010 worldwide. During that time, Poland was also in the zone of economic losses ranging within 0.5-5 billion dollars.

Climate changes in the area of Poland indicate that numerous threats exist in all the sectors of human activities. The sectors of agriculture, biodiversity and water resources are threatened by floods, hurricanes, droughts, negative consequences of wintering, ground frost, rain storms and hail. The sector of forestry is threatened by floods, strong winds, droughts, minor flooding and landslides, snow formation on tree branches, intensive snowfall, thunder, hail and heat waves. The sector of health and local communities are threatened by heat waves, cold waves, extreme phenomena causing mental-social damages, health damage and life loss, landslides and droughts. Infrastructure is threatened by floods, flooding, hurricanes, atmospheric discharges, hail, landslides, rime and snowfalls as well as icing (MINISTERSTWO ŚRODOWISKA, 2012).





**Figure 6.** Economic losses caused by extreme phenomena in 2010 worldwide.  
**Resource:** <http://www.emdat.be/world-map>.

Space management process with consideration for the threats consists of a number of activities at the stage of planning (during the phase prior to the phenomenon) as well as those that aim at mitigating the losses in the population and property (during the phenomenon) and after occurrence of the phenomenon (works aiming at valuation of the losses, cleaning the space, introduction of protective elements, etc.). Integration of all those processes is necessary. Precise and current forecasting of dangerous phenomenon may save human life but it can mitigate only to a minor extent the economic losses or social disturbances. This, however, may be accomplished by measures implemented already earlier. The concept of limiting disasters contains the fundamental assumption that the influence of the disaster may be limited if we expect such a situation during planning of investments, development of space and real property. Mitigating the consequences of disasters results in decreasing susceptibility to risk factors and modifies the propensity for risks. Preparation for the consequences of extreme phenomena applies to the individual sectors (spatial planning, water management, agriculture and livestock production, forestry, public health, power sector, transport, construction and infrastructure, tourism, the financial sector, etc.). Adaptation at the national level requires improvement of the systems of protection against natural disasters (rain storms, floods, landslides, heat waves, droughts, plagues of, e.g. insects, fires, epidemics) consisting of the systems of forecasting, prevention, response and getting out of crisis. Considering the risk of flood in spatial planning, adjustment of the existing construction regulations assuring that the infrastructure with long planned life will be resistant to climate change, strengthening the strategy of protection against natural disasters as well as improving the systems of early warning against flood and forest fires are required in Poland (KUNDZEWICZ, 2012). Mitigating measures should be considered at the regional level (in spatial planning, study of conditions and directions of development of communes, in economic analyses, in systems of support to decisions concerning space development) and at the national level by the statutory requirement of contracting insurance (at the areas susceptible the most to such phenomena) including state subsidy to such insurance (by applying the appropriate legal solutions).

Any activities undertaken in space should take place with support of the geographic information system (GIS), which serves input, collection, processing and visualisation of geographic data (LONGLEY et al., 2012). Spatial information is the information on location (coordinates in the assumed reference system), geometric characteristics, and spatial relations of objects that are the subject of interest of the system and can be identified in relation to the Earth. Enriching it with additional data, Geoinformation on the phenomenon positioned in space supports one of the more important GIS functions, i.e. supporting the decision-taking process in relation to the object, land lot or space.

The present section is based on the authors research on the identification of extreme phenomena occurring within the studied non-urban area of Warmia and Mazury, analysis of losses resulting from occurrence of such phenomena and indicating the adaptation measures that could influence mitigating the consequences of extreme phenomena within the studied rural areas. The following methods were applied: analysis and synthesis of Polish and foreign scientific literature, quantitative analysis of occurrence of extreme phenomena and analysis of financial losses within the area studied, spatial analysis of extreme phenomena occurrence with indication of communes susceptible the most to occurrence of such phenomena.

The issue is another challenge for management instruments space and land consolidations.

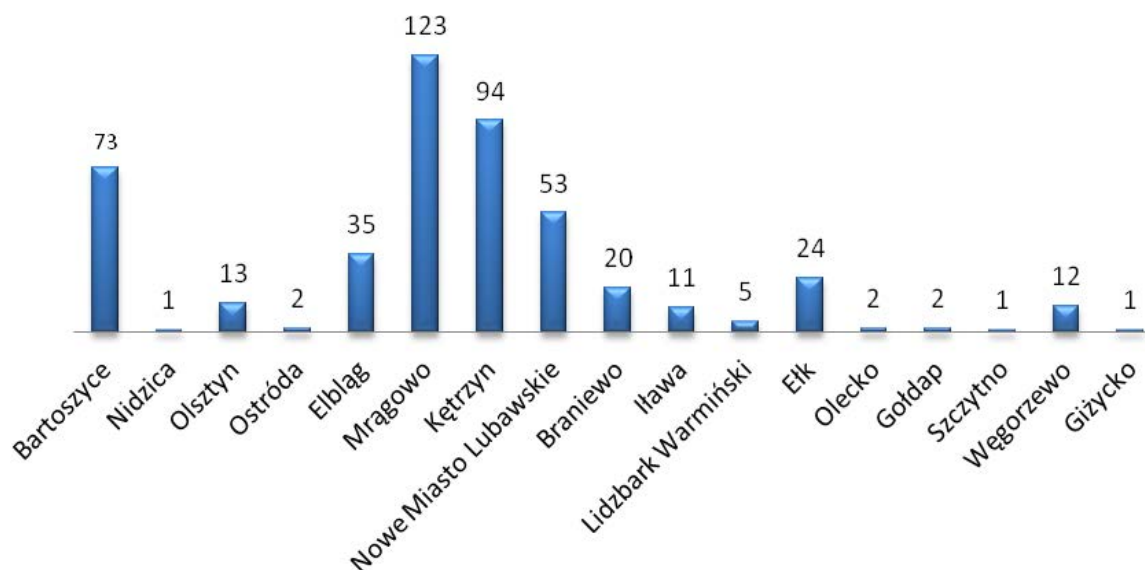
## **2.1. Results and discussion**

Analytic-financial studies were conducted for the rural areas of Warmińsko-Mazurskie voivodship. There are a number of rural areas definitions. The simplest one has been formulated by the Central Statistical Office stating that rural areas are the areas situated outside administrative limits of towns (CSO 2014). The wider definition takes into account both the physical aspects such as low density of population and buildings, landscape with domination of open green areas and "surface" economic activity with the domination of the agricultural and forestry functions, as well as lifestyle of residents defined by membership in a small community, identity and looks of people saturated with specific peasant culture. Similar characteristics are given by BAŃSKI and (STOLA, 2012) based on the attempts at defining the rural areas (BAŃSKI & STOLA, 2012). Those definitions indicate that the rural area is characterised by complexity of characteristics that form it. Depending on the level of relations between them the given area can be considered rural to a different level. The characteristics listed above influence development of rural areas. Values of the landscape and culture generate revenues from tourism while focus on agricultural, forestry or fishery production generates the income (KOCUR-BERA, 2011).

The area of Warmińsko-Mazurskie voivodship was the subject of quantitative analyses. The region is situated in the northern part of Poland. To the north it borders with Russia (Kaliningrad District), to the west with Pomorskie voivodship, to the south with Kujawsko-Pomorskie and Mazowieckie voivodships and to the east with Podlaskie voivodship. The voivodship has the area of 241.73 km<sup>2</sup>, i.e. 7.7% of the area of Poland. The population density is 59 persons/km<sup>2</sup>; 40.1% of the population live in the rural areas while employment in agriculture is 15.9 %. 96% of the voivodship area are non-urban areas of which 54% are agricultural land, 32.7% forests and forest use lands, 5.7% are lands under waters, 0.1% lands under organic use, 3.1% wastelands and 0,3% other areas (CSO 2014). The remaining areas are built up and urbanised areas.

The voivodship is characterised by large diversity of the landscape and richness of the natural environment. There are more than 3000 lakes, 8 landscape parks, 96 sanctuaries of the nature and more than 2,000 monuments of the nature within the area of the voivodship. The total area covered by legal protection of the nature represents 46.1% of the voivodship area.

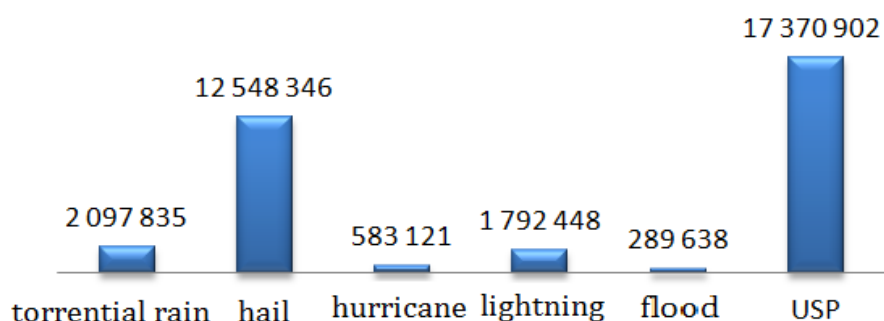
The first stage of the studies covered quantitative analysis of extreme phenomena occurrence in Warmińsko-Mazurskie voivodship and analysis of financial losses caused within that area. Figure 7 presents the number of extreme phenomena that occurred within the area studied in 2012. The evident domination of the communes of Mrągowo, Kętrzyn, Bartoszyce and Nowe Miasto Lubawskie is visible.



**Figure 7.** Number of extreme phenomena that occurred in Warmińsko-Mazurskie voivodship in 2012 by rural communes.

**Resource:** DUDZIŃSKA M., KOCUR-BERA K. - work based on the data from the Agricultural Extension Service Centre in Olsztyn.

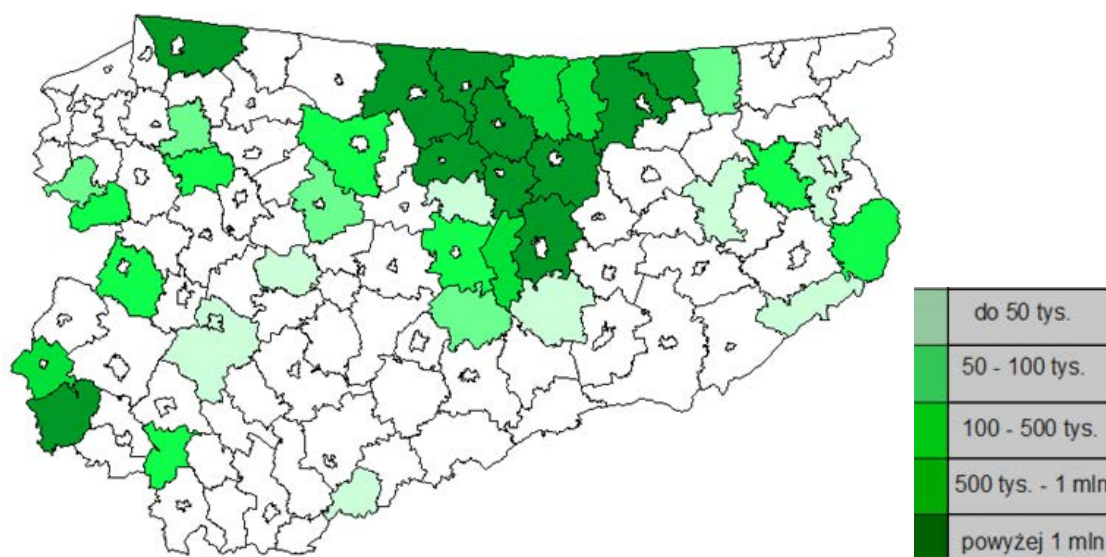
Figure 8 presents the level of damages within the studied area in 2012. The largest damages in rural areas (losses in the urbanised and built up areas were not included) are caused by the negative consequences of wintering. Sudden ground frosts during the late autumn, winter without snow, strong solar radiation during the day and low temperature at night as well as high air humidity coming from water reservoirs are the main causes for such high losses. Hail is the second most arduous extreme phenomenon that in most cases damages crops by hitting them strongly. Plants that are already in the mature stage of growth have little chance for recovery and as a consequence of that phenomenon they are wasted and no full ripening of, e.g. the heads takes place.



**Figure 8.** Magnitude of losses from extreme weather phenomena in Warmińsko-Mazurskie voivodship in 2012 (USP – negative consequences of wintering).

**Resource:** DUDZIŃSKA M., KOCUR-BERA K. - study based on the data from the Agricultural Extension Service Centre in Olsztyn.

The second stage of studies concerned spatial analysis of occurrences of the extreme phenomena. Figure 9 presents the overall spatial distribution of losses resulting from occurrence of extreme weather phenomena in Warmińsko-Mazurskie voivodship in 2012 by commune.

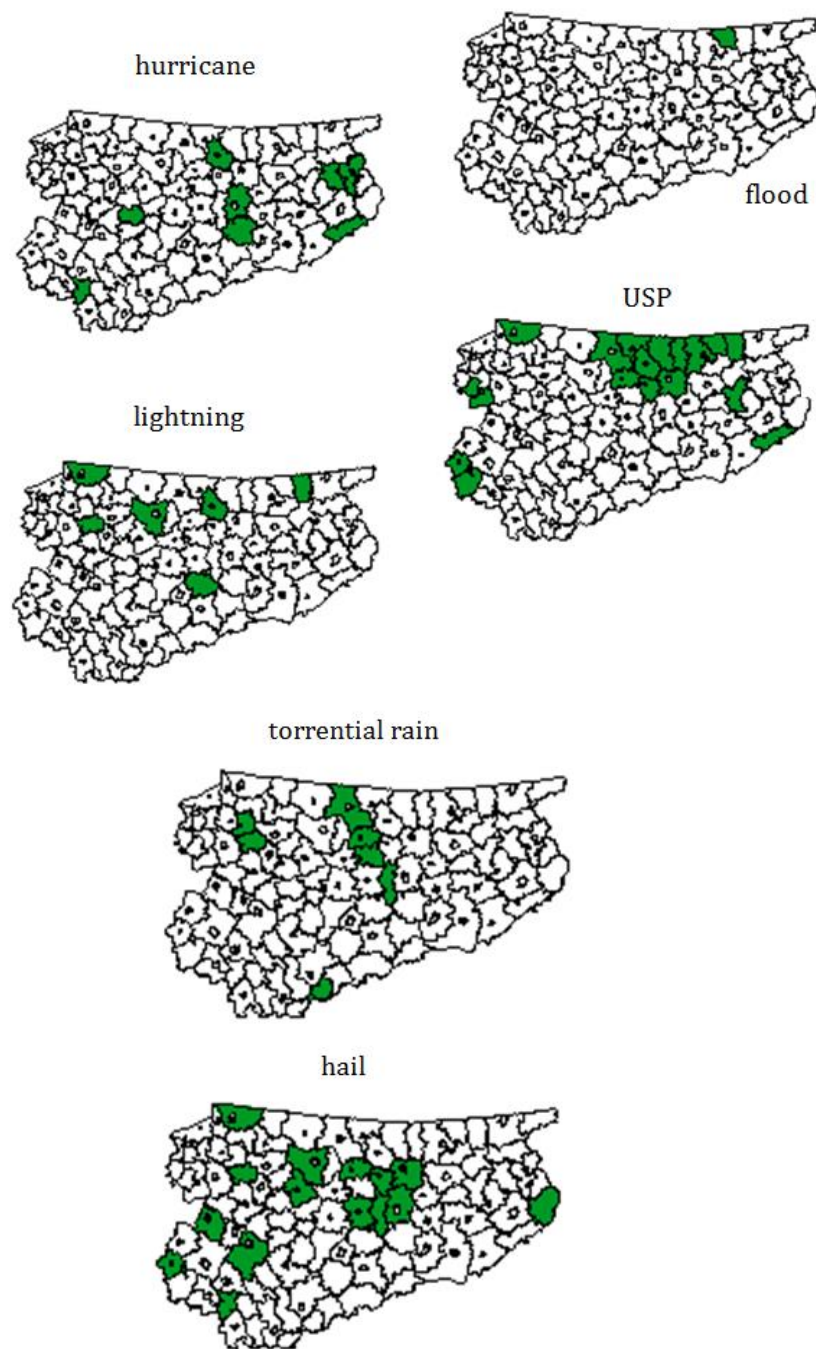


**Figure 9.** Summary spatial distribution of losses in Warmińsko-Mazurskie voivodship in 2012 (in PLN, 1 Euro = 4,4 PLN).

**Resource:** DUDZIŃSKA M., KOCUR-BERA K.

The tendency for occurrence of the highest losses caused by extreme phenomena in the central-eastern part of the covered area is clearly visible. That area covers the communes of Budry, Reszel, Węgorzewo, Kętrzyn, Sępólno, Biskupiec Pomorski, Mrągowo, Braniewo, Bartoszyce, Korsze and Bisztynek.

Figure 10 presents the distribution of losses resulting from the individual types of extreme phenomena. In the central-eastern part of the voivodship the phenomena such as rain storm, hail, hurricane and ground frost are the most frequent. The other phenomena occur without a clear trend for cumulating in the studied area.

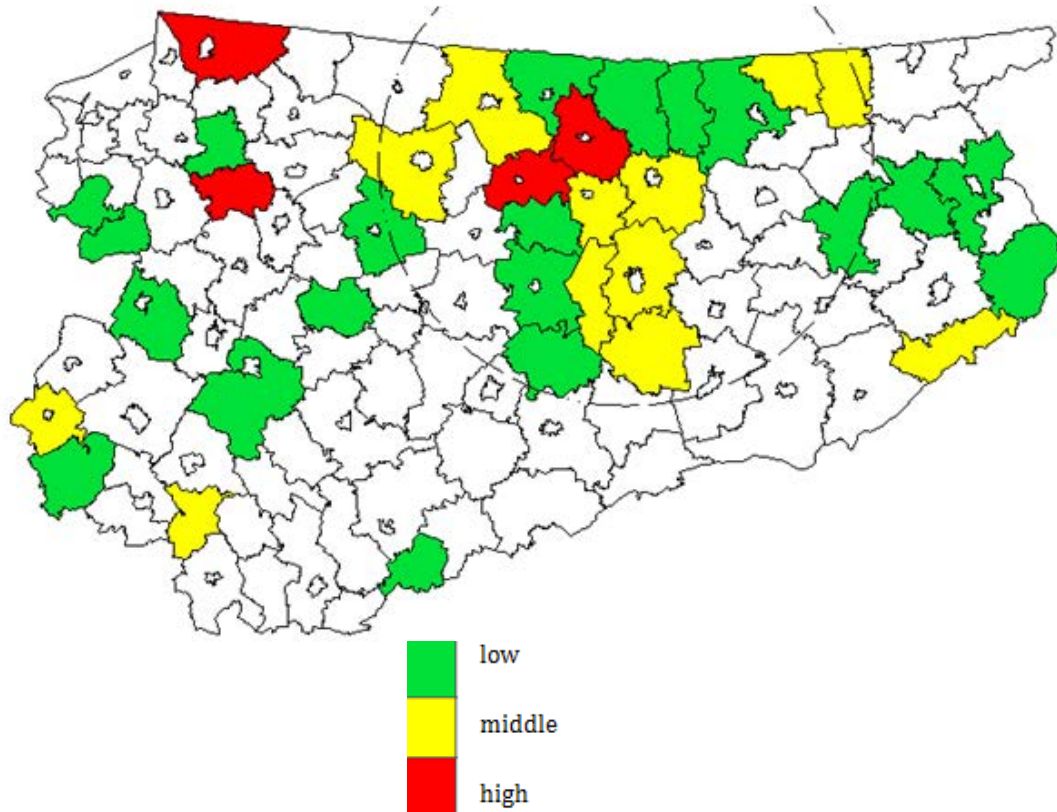


**Figure 10.** Spatial distribution of losses resulting from the individual types of extreme phenomena by commune of Warmińsko-Mazurskie voivodship (USP – negative consequences of wintering).

**Resource:** DUDZIŃSKA M., KOCUR-BERA K. - study based on the data from the Agricultural Extension Service Centre in Olsztyn.

Next, the susceptibility of the terrain for occurrence of an extreme phenomenon was investigated. It was established based on the analysis of the number of occurrences of such phenomena in the given commune of the studied voivodship. The following classification was assumed: low susceptibility (1 occurrence), moderate susceptibility (2 occurrences) and high susceptibility (3 and more occurrences). High susceptibility was determined for the communes of Bisztynek, Braniewo, Godkowo and Korsze. Three of them also recorded the highest financial losses. Figure 11 presents the susceptibility of communes to extreme phenomena.





**Figure 11.** Susceptibility of communes in Warmińsko-Mazurskie voivodship to extreme weather phenomena in 2012 (by commune).

**Resource:** DUDZIŃSKA M., KOCUR-BERA K.

The analysis of Polish and foreign literature on the consequences of extreme phenomena in rural areas and possibilities of adaptation to those consequences was the next stage of the study. The analysed literature showed that climate changes influence both vegetable and animal production.

Consequences of the extreme phenomena occurrence manifest mainly in the:

- soil compacting,
- increasing water deficit during the summer,
- loss of soil carbon and its mineralisation,
- thermal stress for plants and animals,
- influence on availability of pastures, changes in availability of plants for forage and the quality of those plants (SMIT, 1996),
- influence on the development, productivity and reproduction of animals (SIMM, 2010),
- influence of agriculture on the environment (e.g. increasing erosion, degradation of organic matter in soil) (OLESEN et al, 2011),
- change in productivity of crops (PORTER & SEMENOW, 2005; GORNALL et al, 2010; TRNKA et al, 2011),
- increased risk of pests and diseases (TUBIELLO et al, 2007),
- losses caused by ground frost and other extreme phenomena.

Management of agricultural activity at the level of agricultural farm taking into account the extreme phenomena and climate change involves application of adaptive activities such as:

- replacement of cultivars of the crops with those better adapted to changing climate that are resistant to high temperature and drought and pests, applying faster or slower

ripening crops and cultivation of mixed crops (ALCAMO et al, 2007; MORIONDO et al, 2010; SZWED et al, 2010),

- choice of the simplified cultivation method,
- application of walls in orchards,
- mulching with better use of post-harvest residues,
- popularisation of agroforestry,
- appropriate shifting of sowing/planting date without significant turning the calendar upside down (OLESEN & BINDI, 2002),
- plants watering increased by additional doses,
- optimisation of volume and methods for applying agricultural chemical substances by changes in the volumes of fertilisers applied and adjustment of application dates,
- optimisation of animals grazing conditions,
- adjustment of the plants composition in permanent and alternating green lands,
- optimisation of organic fertilisers storage and use,
- restoring usable values of degraded soils,
- application of midfield woods and maintenance of baulks,
- increasing the area of energetic crops,
- introduction of new crops and water saving techniques,
- adaptation of farm buildings,
- monitoring of spread of the pests and diseases and development of agricultural technique methods for controlling them (e.g. rotation of crops or resignation from monocultures) (SADOWSKI et al, 2008),
- incentives for diversification of farm incomes by cultivation of a number instead of one market crops (REIDSMA & EWERT, 2008),
- insurance against consequences of extreme phenomena occurrence.

Rural areas are not areas of vegetable and animal agricultural production only. They are also areas of human residence, forests, protected and protecting areas, etc. That is why, next to the adaptive activities in vegetable and animal agricultural production the system of protections such as, e.g. strengthening the dykes, relocation of ports industry and entire villages and towns from low coastal areas and flooded planes, power sector investments in case of insufficient operation of water power plants during droughts must be included in the spatial planning.

Water management requires retention increasing but with the permanently flooded area limited to minimum (increased polder type area) and withdrawing settlements and infrastructure from areas that are subject to flooding near to riverbeds as well as steep slopes threatened by landslides, construction of retention reservoirs, including water retention polders (also for securing water supply during periods of low water levels and droughts).

Reconstruction of forest standing timber and building multispecies forests will allow protection against wind breakages and pests (STARKWEL & KUNDZEWICZ, 2008).

Construction should be adjusted to frequent occurrence of strong winds and extremely hot weather while the road network (culverts, bridges, etc.) and sewers should be adjusted to occurrence of high intensity precipitations.

Revision of tourism development programmes and adjusting them to the scenarios of the future snow conditions projecting poor snow coverage of lower and southern slopes is required (KUNDZEWICZ, 2012).

## **2.2. Conclusions**

Identification of extreme phenomena in non-urban area, analysis of financial losses and indicating the adaptation actions in areas used for agricultural purposes were the main objectives of the study. Those tasks can be carried out at different levels of management – of the country, region and of the individual agricultural farm. Such actions will be considered if the authorities start noticing the problem.

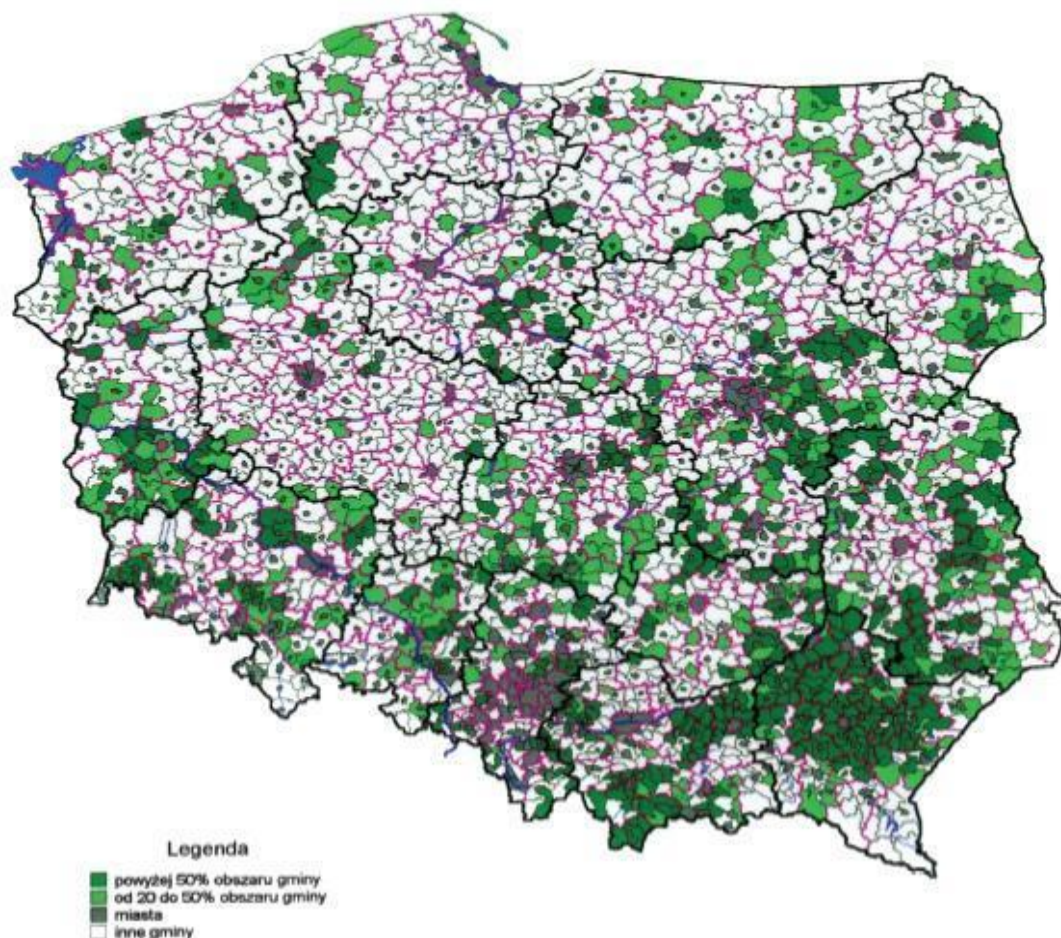
Rural areas management in the aspect of extreme phenomena is not an easy task. The tasks should be adjusted to the actually occurring phenomena and the activities dominating within the

given area. Studies of susceptibility to phenomena show that tsunami type phenomena should not occur in Poland but rapid ground frost that cause losses in wintering of plants represent the phenomenon that is so important that appropriate measures should be undertaken for adaptation of agricultural production. Increasing the awareness of people concerning the risks related to extreme phenomena and methods of mitigating their consequences is another important task.



### 3. Investigation of the scope of various types of land consolidation projects in Poland

The history of surveying works concerning land consolidation has been very long; these works have been modified through the years. The first act on land consolidation of 1923 promoted land consolidation works which were performed in order to increase the profitability of farms only. At present, such land consolidation works are called „classical”. Demands for such operations are still high and, following data from the Ministry of Agriculture and Development of Rural Areas it has been estimated as about 2,0 million hectares. Tests performed by the Agricultural University in Wrocław specified even higher demands for such works, equal to approximately 3,4 million hectares. The level of demands for land consolidation works in Poland, by particular municipalities, is presented in Figure 12.



Legend  
above 50% of the municipality area  
between 20% and 50% of the municipality area  
towns  
other municipalities

**Figure 12.** Demands for land consolidation works by municipalities.

**Resource:** SIUTA J., ŻUKOWSKI B. Development and potential hazards of agro-ecosystems, Part IV. Hazards of Agro-ecosystems, 2010.

Intensive development of the country, which took place after the year 2004, when Poland became the European Union member, resulted in the necessity to perform land consolidation works in their wider extension. Changing spatial conditions in rural areas, connected with

development of linear infrastructure, and, in particular, with growing development of construction of motorways and expressways, as well as with modernisation of railway lines, resulted in negative impacts on the agricultural space and on conditions of farming. Corrections of the spatial structure of farms, which are crossed by transport networks, are performed in Poland within the frames of land consolidation works, they so-called, infrastructural land consolidation. The scope of works covers then only parts of rural register districts, located within the direct neighbourhood of roads.

In 2010 the extended flood swept through Poland what resulted in large devastations of flooded areas. Realisation of repeatability of such phenomena resulted in commencement of works in the field of legal, technical and organisational regulations, aiming at minimisation of negative effects of floods. The necessity to construct flood banks, canals and water retention sites results in consideration of agricultural and forested areas as places for implementation of such investments. Although the final objective is flood protection, designing solutions and their implementation may result in inconveniences of farming, which mainly concern elongation of access roads to arable fields or the lack of access to public roads. In the case of implementation of flood protection investments, specific features of land consolidation operations, as well as methods of use and administration of flood areas require that physical planning activities and study works are undertaken. Land consolidation plans should be included in such operations at the level of register units, since they are also a kind of infrastructural land consolidation works. The above introduction shows the wide spectrum of solutions, which might be applied for rural areas and particular farms, which are implemented in the process of land consolidation works.

The objective of the paper is to characterise and compare land consolidation works, which are known as „classical”, infrastructural and maintained in order to protect against floods. Legal bases, technical procedures, objectives and results of implemented land consolidation works have been considered in the analysis. Additionally, in the case of „classical” and infrastructural land consolidation, performed analyses were based on representative objects.

For the needs of the presented works, land consolidation documents, cadastral information included in the WMS Geoportal and documentation of works concerning flood hazards, have been used. Methods of descriptive-and-comparative analysis and deductive reasoning were used for the needs of the presented research works.

### **3.1. Types of land consolidation works performed in Poland**

Land consolidation may be defined as agricultural engineering operations, aiming at transformation of the spatial configuration of lands located in rural areas in such a way that more favourable conditions of farming are created, as a result of improvements of the spatial structure of farms, rational setting of extension of farms and adaptation of real estate borders to the system of water melioration installations, roads and to the terrain relief. The legal basis for these operations is the Act of 26 March 1982 on land consolidation and exchange of lands (Journal of Laws 2013, item. 1157).

Due to the complexity of issues, which are solved within the agricultural-and-engineering works the following types of land consolidation works may be distinguished:

- 1) „classical” - aiming at creation of the more favourable farming conditions basing on, among others, elimination of inconvenient patchwork of field boundaries and improvement of shapes of expanse of farms, as well as construction of required technical infrastructure together with multifunctional development of rural areas.
- 2) infrastructural – implemented, first of all, due to disorganisation of the existing spatial structure of farms/villages and disturbances of the system of agricultural transport roads, resulting from construction of a motorway, i.e. technical, linear investment of large territorial extent.
- 3) performed in connection with implementation of investments, which prevent against floods - in such cases land consolidation works is one of the method of acquisition of real estates for the needs of construction of flood protection installations. Such works should be performed after detailed analysis of areas specified in flood hazard maps and flood risk maps, developed according to resolution of the Flood Directive of 2007.

- 4) „secondary” – resulting from the secondary fragmentation of the structure of farms within the areas, where land consolidation works were already performed in the past. Secondary land consolidation works may be also necessary due to demands resulting from the possibility to liquidation of land cooperatives, consolidation of forest lands or prevention against erosion. Such purposes may have not been considered during the „primary” land consolidation works, or they did not occur at that time.

Procedural-and-technical stages of all types of land consolidation works are the same and they directly result from resolutions of the act on land consolidation and exchange.

Re: 1. Land consolidation proceedings, as well as post-consolidation management are performed by the starost (the head of the district) as one of the governmental administration tasks. The proceedings may be instituted following an application of the majority of owners of farms, located within the area of planned land consolidation works or following an application of owners of lands, the total size of which exceeds the half of the area of the planned area of land consolidation. Such operations may be also routinely initiated, according to the rules assumed in the act. The procedure covers the lands located in one or several villages or in their parts. Costs of land consolidation works and post-consolidation management are covered, first of all, from the state budget.

The basic objectives of land consolidation works and post-consolidation management include (MALINA & KOWALCZYK, 2009):

- liquidation of the patchwork of fields and improvement of shapes of expanse of particular farms and liquidation of land usufruct,
- introduction of changes in the size of possession and use of lands of individual, state or cooperative farms,
- verification of the number of farms and their size,
- adaptation of farm expanse to works protecting against erosion,
- amendment, reconstruction and development of the components of the environment and landscape,
- correction of agricultural-and-forest boundaries through liquidation of inconvenient patchwork of agricultural-and-forest lands and enclaves in forests,
- improvement of the spatial, technical and aesthetic conditions concerning built-up areas.

The secondary purposes include:

- corrections of the transportation system and built-up areas,
- amendments of components of the natural environment,
- construction of passages and crossings with barriers,
- corrections of the water supply system and other components of the technical infrastructure,
- introduction of recreation facilities.

The above legal foundations, objectives and the mode of operations concern the „classical” and infrastructural land consolidation works, as well as activities, which are connected with implementation of investments related to flood protection.

Implementation of the above objectives of land consolidation works should allow for achieving calculable effects, which include:

- a) spatial effects, i.e. such effects, which concern the changes of the status of spatial-and-structural factors,
- b) economic effects, i.e. financial benefits resulting from the increase of incomes of farmers,
- c) social effects, i.e. improvement of living conditions, development of family and social relations,
- d) environmental-and-landscape effects, i.e. benefits which result from the increase of landscape, environmental and ecological values,
- e) organisational-and-legal effects, i.e. the settlement of legal status of lands, updating the soil classification of lands, creation of the updated, digital cadastral map.

Re: 2. Undoubtedly, construction of a motorway disorganises the spatial structure of the village. One of the ways which may minimise such inconvenient effects is to perform land consolidation works. Infrastructural land consolidation comprises agricultural-and-engineering operations, which settles the space adjacent to the motorway construction sites and, according to (KOZŁOWSKI, 2012) it is initiated in order to acquire real estates for motorway right-of-ways, as well other lands related to the motorway construction. Besides, such operations decrease the costs of investments, since it rationalises the widths of lanes and acquisition of only those lands which are necessary for the motorway construction. Infrastructural land consolidation works allow for distribution of losses of lands onto the greater number of owners; therefore such losses do not become threats for the existence of particular farms, which intend to continue agricultural activities. It is also possible to perform infrastructural land consolidation works, which are initiated before, in the course of or after completion of the motorway construction. In the latter case, the process of land acquisition for the needs of the performed investment, should be excluded from land consolidation works. Infrastructural land consolidation works may also include the assumptions of the complete or limited „classical” approach. In both cases, when new parcels are designed, their location with respect to homestead areas should be considered, in order to ensure location of all parcels from a farm on the same side of the motorway - on the same side where the homestead area is located. Besides, the construction of the motorway and accompanying objects, such as technical installations, fences, protective screens or development of insulating green areas, result in the necessity to move away the areas of agricultural production from the zones of impacts. Thus, the most important benefits resulting from the performed infrastructural works, include:

- ordering the space,
- improvement of the farm expanse,
- location of all parcels from one farm on the same side of the motorway - on the same side, where the homestead area is located,
- adaptation of location of boundaries of parcels to the investment delimiting lines and to modernised agricultural roads, water melioration installations and ditches,
- prevention against creation of parcels which size does not allow for effective farming,
- creation of the new system of roads for agricultural transport, which ensure the access to all parcels in a farm,
- creation of buffer zones, in order to minimise the extension of impact of investments on the surrounding agricultural space.

Besides, the difference between the infrastructural and „classical” land consolidation works concerns the source of funding (costs of land consolidation and post-consolidation land management are covered by the General Directorate for National Roads and Motorways) and the way they are instituted - the infrastructural works must be initiated routinely.

Re: 3. Land consolidation works which are performed in connection with flood protection investments, i.e. construction of flood protection structures (canals, flood protection polders, barrages and retention reservoirs which contain flood retention, dry flood protection reservoirs, flood banks, anti-storm gates, flood gates, switches in river estuaries and structures which protect against sea floods), are one of the methods of real estate acquisition, according to the Act of 8 July 2010 on particular regulations concerning preparation of investments in the field of flood protection structures.

The National Water Management Board, following the provisions of the Directive 2007/60/EE of the European Parliament and the European Council of 23 October 2007 on the assessment and management of flood risks and basing on the Act of 18 July 2001, The Water Law (Journal of Laws 2012, item. 145 with amendments), as well as the Resolution of the Minister for Environment, the Minister of Transport, Building Industry and Sea Economy, the Minister of Administration and Digitisation and the Minister of Internal Affairs of 21 December 2012 on development of flood hazard maps and flood risk maps (Journal of Laws 2013, item. 104), has developed and published the following maps:

- a) flood hazard maps, which were produced for flood hazarded areas, pointed by the first assessment of the flood risk,
- b) flood risk maps, which amend the flood hazard maps, and which determine the values of possible flood losses and which present objects hazarded by flood in the case of flood characterised by the specified probability of occurrence.

Both types of maps are the bases for strategic physical planning within the areas which are hazarded by floods and they aim at limitation the negative impacts of floods. Land consolidation works performed during implementation of flood protection investments is one of the instruments which allow the investor for acquisition of lands, which are required for construction of flood protection structures. Besides, such works are amended by the objectives of the „classical” land consolidation and allows for elimination of negative impacts of performed investments and contributes to the improvement of spatial structure of farms, of their expanse and allows for creation of the required technical infrastructure. Such land consolidation may be performed before the construction of flood protection structure or, at the time, when the investment is performed. Land consolidation works are routinely instituted.

Re: 4. „Secondary” land consolidation works, following this term are performed for the areas, where land consolidation works were already performed in the past. The need for secondary land consolidation works may result from the secondary fragmentation of farms or it may follow the demands resulting from the system regulations of specified types of real estates, such as the possibility to liquidate land cooperatives, consolidation of forests and forest lands. Such purposes may also result from ecological demands or it may cover the erosion protection actions. The legal basis, stages and objectives of this type of engineering-and-agricultural works are identical with the case of „classical” land consolidation.

**Table 5:** Comparison of the „classical”, infrastructural and flood protecting land consolidation works.

	<b>„Classical” land consolidation</b>	<b>Infrastructural land consolidation</b>	<b>Land consolidation works performed as implementation of investments protecting against flood</b>
Legal and methodological foundations	1. Act on land consolidation and exchange of 26 March 1982. 2. Instruction No.1 of the Minister of Agriculture and Food Economy on land consolidation of 29 March 1983. 3. Polish Standard PN-R-04151:1997.	1. Act on land consolidation and exchange of 26 March 1982. 2. Instruction No.1 of the Minister of Agriculture and Food Economy on land consolidation of 29 March 1983. 3 Polish Standard PN-R-04151:1997.	1. Act on land consolidation and exchange of 26 March 1982. 2. Instruction No.1 of the Minister of Agriculture and Food Economy on land consolidation of 29 March 1983. 3. Polish Standard PN-R-04151:1997. 4. Act of 8 July 2010 on particular regulations concerning preparation of investments in the field of flood protection structures. 5. Directive 2007/60/WE of 23 October 2007 on the assessment and management of flood risks.
The mode of instituting land consolidation operations	1. Following the application 2. Routinely, after the specified conditions, determined in the Act, are met.	Routinely	Routinely

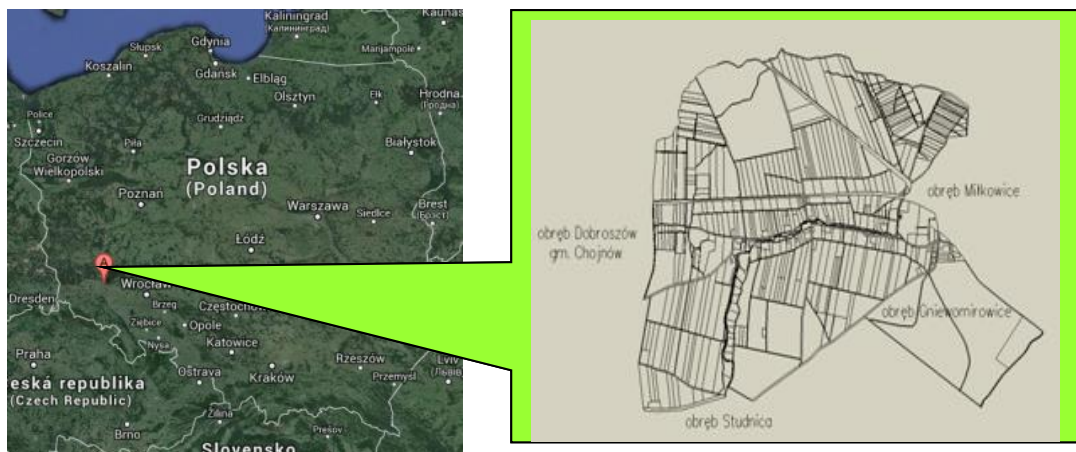
Stages of land consolidation works	Following the provisions of the Act on land consolidation and exchange of 26 March 1982.	Following the provisions of the Act on land consolidation and exchange of 26 March 1982.	Following the provisions of the Act on land consolidation and exchange of 26 March 1982.
Sources of funds	1. The State Treasury (possibly, supported by the participant of land consolidation or/and the EU funds). 2. In the case of routine instituting of proceedings: - the investor, or - the body responsible for the natural protection.	The General Directorate for Construction of Roads and Motorways.	Investor: - the regional water management board, - the maritime office, - voivodeship (province), - powiat (district), - gmina (municipality), - private partner.
Main reasons of land consolidation	Inconvenient structure of farms, irrational arrangements of expanse, real estate boundaries not adapted to the system of water melioration, roads and the terrain relief.	In connection with the motorway construction: 1. Disturbances of the agricultural transport road network: - elongation of access roads from households to parcels, - losses of access to agricultural transport roads from selected parcels. 2. Creation of parcels of the size which does not allow for effective farming. The possibility to acquire real estates for motorway lanes, as well as lands connected with the motorway constructions.	The possibility to acquire real estates by the investor due to implementation of a flood protection investment.
Period of implementation of land consolidation	When the circumstances specified in the act of 1982 occur.	1. Before construction of the motorway. 2. Together with the implementation of investments concerning the motorway construction. 3. After construction of the motorway.	1. Before construction of flood protection structures. 2. Together with the implementation of investments concerning the construction of the flood protection structures.

**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

### 3.2. Examples of the „classical” and infrastructural land consolidation

I. An example of the „classical” approach to land consolidation works concerns works performed within the area of the Siedliska village and in the part of the Gniewomirowice village (Miłkowice municipality, Legnica district, Lower Silesian province). A part of the lands of the Gniewomirowice district were included in the land consolidation areas, due to the demands concerning liquidation of the co-ownership of twelve farmers, living in the Siedliska village.





**Figure 13.** The area of land consolidation covering the Siedliska village and the part of the Gniewomirowice village.

**Resource:** <https://maps.google.pl>, SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

The basic objective of land consolidation was to improve farming through liquidation of the inconvenient fragmentation of farms, as well as to regulate the legal status of some real estates under the construction of the agricultural transport roads and to regulate the Brochotka water stream. Land consolidation works were initiated following the decision of the starost in October 2000, according to the application presented by the majority of the owners of farms located within the area of land consolidation. The works were completed by the decision of the starost which confirmed the completion of land consolidation works in March 2003.

The land consolidation works covered: the improvement of the spatial structure of farms, regulation of the Brochotka water stream, reconstruction of the system of the agricultural transport roads and ditches. Assumptions of the land consolidation works included reconstruction of the water feature and building the sports field.

**Table 6:** Selected values, which characterise the reviewed area of land consolidation.

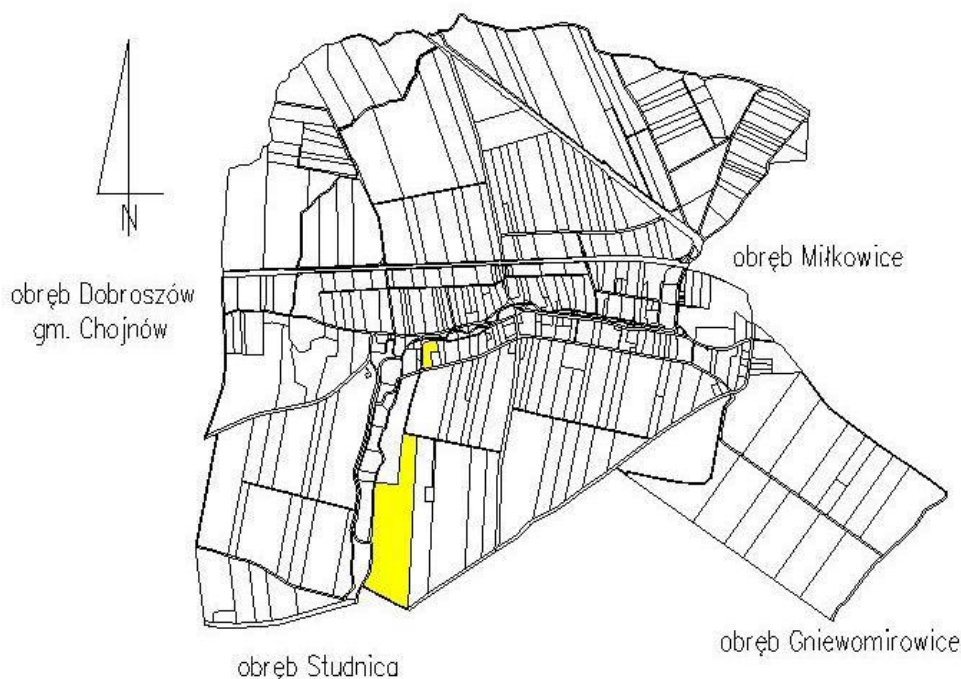
	Area of land consolidation	
	Before land consolidation	After land consolidation
Number of parcels	921	516
Average parcel size [ha]	0.7821	1.3962
Number of land register units	237	183
Average size of the register unit [ha]	2.7311	3.9368

**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K. - study based on data from the Lower Silesian Office for Geodesy and Agricultural Areas in Wrocław.

Below the location of cadastral parcels of the selected register unit - before and after the land consolidation works in the Siedliska village - is presented (Fig. 14 and 15).



**Figure 14.** Location of cadastral parcels of the register unit 108 – before land consolidation.  
**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

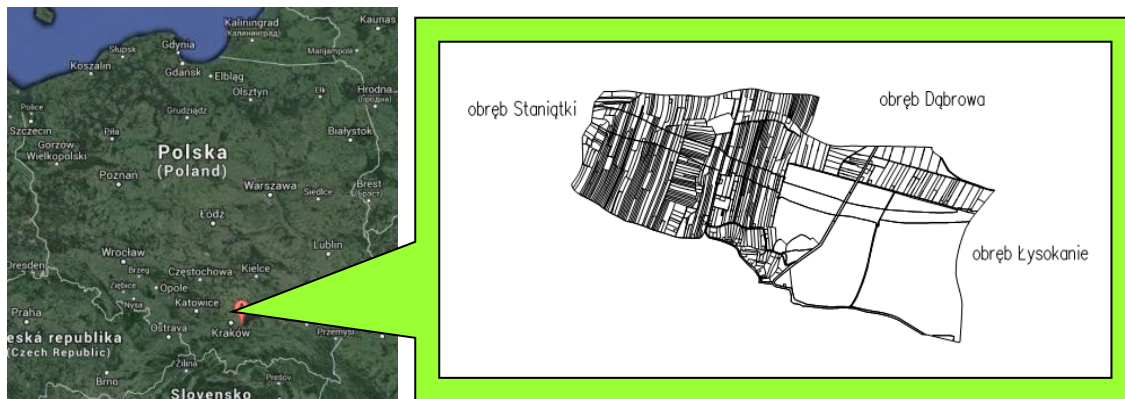


**Figure 15.** Location of cadastral parcels of the register unit 100 – after land consolidation works (the corresponding unit to the unit 108 – before land consolidation).  
**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

II. The example of the infrastructural land consolidation works concern the part of the Brzezcie village (Kłaj municipality, Wieliczka district, Małopolska Province), performed in connection with the construction of the A-4 motorway. The final extent of the area which was to be covered by the land consolidation works was determined basing on the work performed by the Krakow Office for Geodesy and Rural Areas in 1995, „The assessment of the impact of the



A-4 motorway on agricultural and forest lands”, which was successively updated in 2005, after the field inventory and development of the document „The schedule of land consolidation works connected with the construction of the A-4 motorway for the village of Brzezie, Kłaj municipality, Wieliczka district”. Finally, the area of works covered almost half of the village, i.e. the area of 332 hectare, including the Brzezie soletsvo (about 297 hectares) and the Gruszki soletsvo (about 35 hectares).



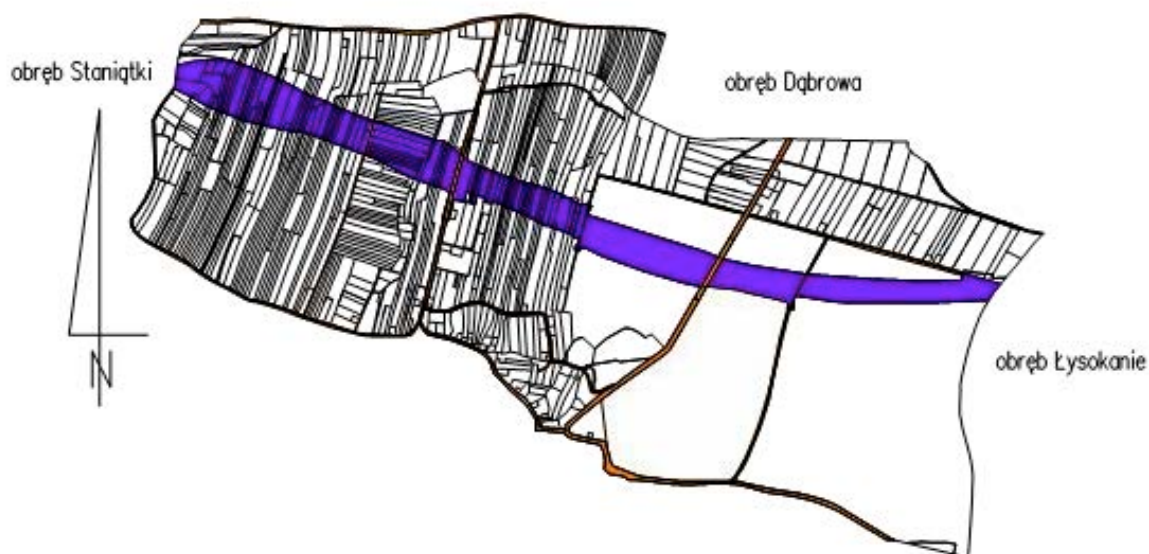
**Figure 16.** Area of land consolidation works covering the part of the Brzezie village.

**Resource:** <https://maps.google.pl>, SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

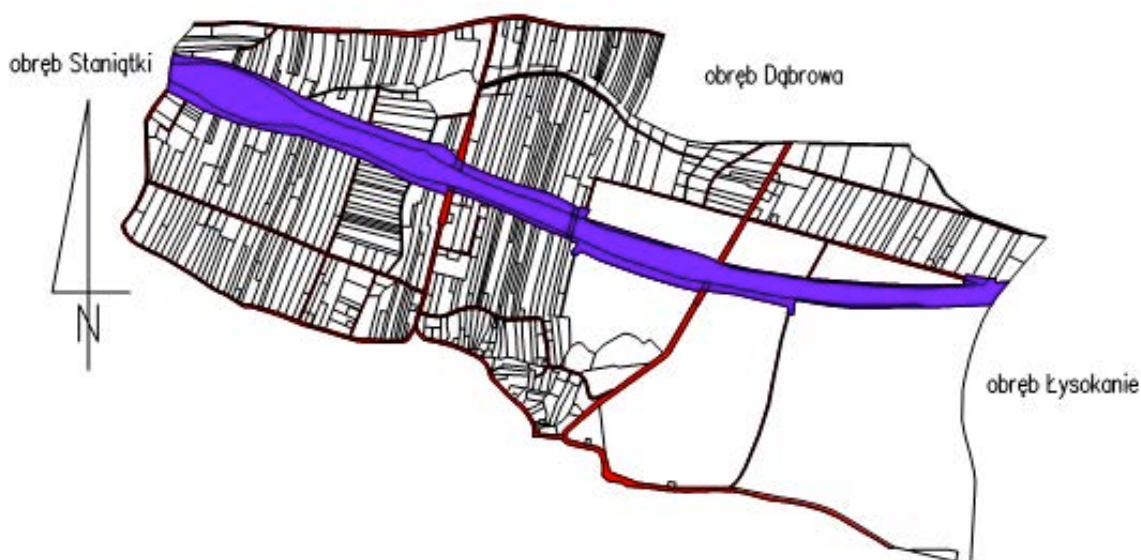
The basic objective of land consolidation works was to reduce the negative impacts of the motorway on the adjacent land, as well as to reduce inconveniences related to the access to parcels which are crossed or cut off by the motorway. Land consolidation works were initiated by the decision of the starost in September 2006 and completed by the decision of the starost, which confirmed the completion of land consolidation works in September 2009.

The location of the motorway, which is located almost in the centre of the area of land consolidation works, resulted in disorganisation of the existing transportation system, which became insufficient to ensure the convenient access to the great number of parcels, cut off by the motorway. Although the agricultural (collective) roads were designed along the motorway, together with motorway viaducts in lines of the basic local roads, such operations did not eliminate transportation difficulties within the village. Thus, the most important and prioritised objectives of land consolidation works, included: improvement of the expanse of farms crossed and cut off by the motorway, liquidation of the, so-called, „conflict parcels” by transferring them to the appropriate side of the motorway with respect to households, changes of shapes and configuration of parcels with respect to the necessity to change land use methods within the zones of negative impacts of the motorway, modernisation of the existing agricultural transport roads and designing, setting and arrangements of new sections of roads, which consider the changes in shapes and configuration of newly designed parcels, in order to ensure the access to public roads for every parcel.

Below the comparison of the agricultural transport roads before and after land consolidation works is presented (Fig. 17 and 18).



**Figure 17.** The road network of agricultural transport before land consolidation.  
**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.



**Figure 18.** The road network of agricultural transport after land consolidation.  
**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

Besides, land consolidation works also covered the pure „classical” works, which included: the improvement of the spatial structure of farms, modernisation of water melioration installations, reduction of the number of parcels of inconvenient shapes and regulations concerning the legal status of real estates.

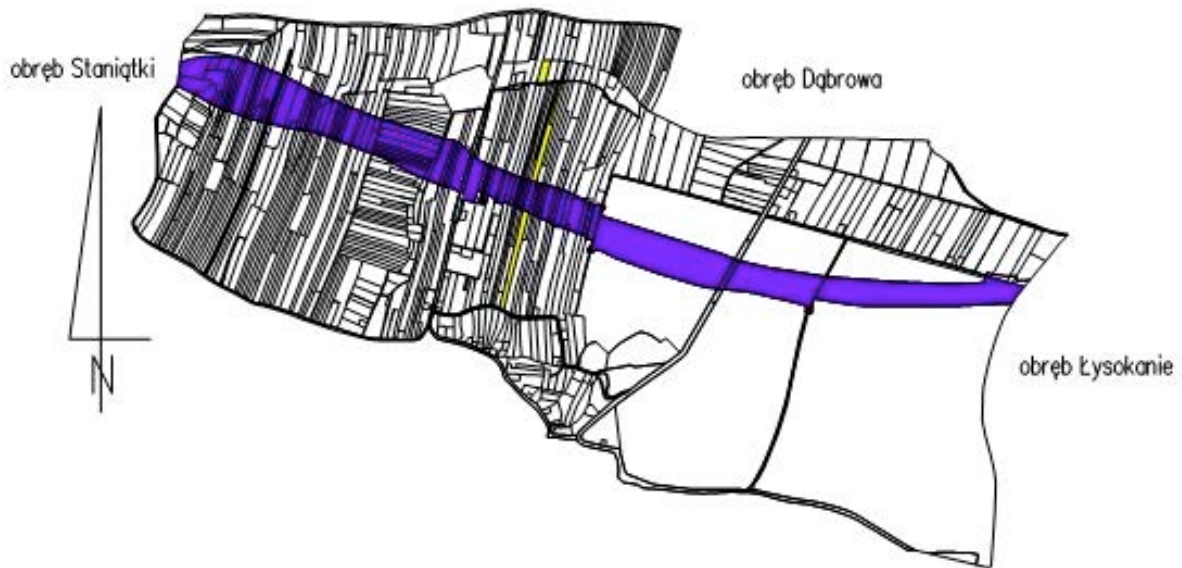
The relatively high number of parcels, of the so-called, „difference holders”, was a very inconvenient element. The „difference holders” were the owners and independent possessors of lands, whose parcels with households were located in neighbouring or in other, remote locations. Such lands comprised about 18% of the total area and they were located within the inconvenient patchwork of fields together with parcels of the owners who lived in the analysed area. One of the basic objectives of land consolidation works was also to „transfer” such parcels to their natural locations.

**Table 7:** Selected values which characterise the analysed area of land consolidation.

	Area of land consolidation	
	Before land consolidation	After land consolidation
Number of parcels	715	539
Average parcel size [ha]	0.3946	0.6154
Number of land register units	315	316
Average size of the register unit [ha]	0.8958	1.0496

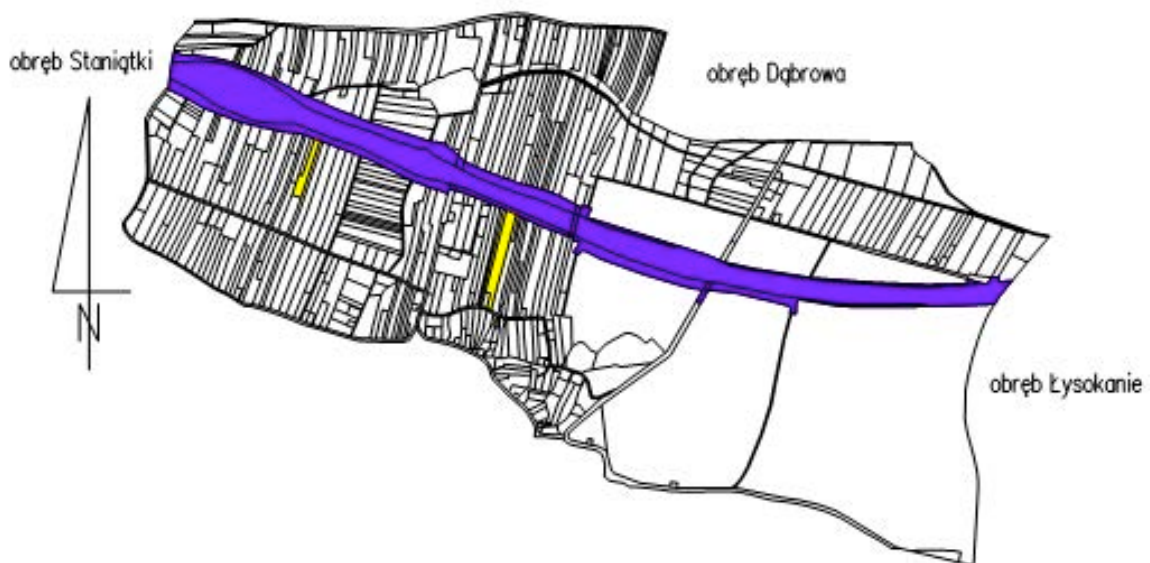
**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K. - study based on data from the Kraków Office for Geodesy and Agricultural Areas.

Below the location of cadastral parcels of the selected register unit in the Siedliska village - before and after the land consolidation works - is presented (Fig. 19 and 20).



**Figure 19.** Location of cadastral parcels of the register unit 140 – before land consolidation.

**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.



**Figure 20.** Location of cadastral parcels of the register unit 140 – after land consolidation.

**Resource:** SAJNÓG N., SOBOLEWSKA-MIKULSKA K.

### **3.3. Conclusions**

The basic legal act, which regulates issues related to land consolidation, in the „classical”, infrastructural approaches, as well as performed for the needs of protection against floods, is the Act dated March 26,1982 on land consolidation and exchange. In all cases, this process may be divided onto the same stages of operations. The appearing differences concern the mode of the possible instituting the proceedings (following the application or routinely) and the way of financing land consolidation works and post-consolidation land management (the State Treasury, possibly owners of consolidated lands, EU funds, investors, the General Directorate of National Roads and Motorways).

The basic objectives of infrastructural land consolidation is to minimise the disorganising impacts of motorways on surrounding areas. Such operations are connected, first of all, with reconstruction of the roads of the agricultural transport, elimination of the, so-called, conflict parcels by transferring them onto the appropriate side of the motorway, with respect to homestead areas and with the necessity to modify ways of use of some lands, which are located within the zone of negative impacts of the motorway.

At present, land consolidation works performed as an investment, which is to protect against flood is, first of all, the instrument which allows the investor for acquisition of lands which are required for construction of flood protection structures.

The land consolidation operations described above should be amended with assumptions of the „classical” land consolidation (elimination of inconvenient patchwork of fields, improvement in the expanse of farms). In the case of infrastructural land consolidation works, as well as in the case of land consolidation which is performed in relation to flood protection investments, the ideal solution would be to cover entire villages with land consolidation works, and not to include only parts of villages, hazarded by impacts of investments, by such operations, as it mostly happens. Such assumptions would allow for consideration of the improvement of the structure of areas of farms in the entire village, as the condition which should be met by any land consolidation operation. Such approach would also enable to meet the assumptions of the multifunctional development of rural areas (SOBOLEWSKA-MIKULSKA, 2012).

## **4. Criteria for separation of the problematic agricultural areas in the process of land consolidation in Poland**

One of the basic priorities of the Common Agricultural Policy (CAP) of the European Union and the Rural Areas Development Program is sustainable development of rural areas. On the other hand, the important objective is to balance the chances of development and to maintain agricultural characteristics of areas located in inconvenient natural and landscape conditions (which are hazarded by depopulation and danger processes of environmental degradation), in less favoured farming conditions (LFA), with consideration of the general quality of agro-ecological conditions, with the use of the index of valorisation of the agricultural production space, as well as the agricultural problem areas.

Land consolidation was the first instrument which served for the development of the rural areas and the agriculture, mainly through the improvement of the spatial structure of farms.

At present, the objective of land consolidation works is to create more favoured conditions for farming and forestry. It includes the set of designing and technical operations, which should result in the improvement of living conditions in rural areas. Investments concerning renovation of rural areas, together with development of elements of technical and social infrastructure, as well as environmental protection actions and efforts to maintain the natural foundations of life, including landscape, are also important. The importance of land consolidation connected with construction and modernisation of a network of access roads to agricultural lands should also be stressed. Another important aspect is the reduction of production costs in agriculture and forestry, which results from the decrease of labour inputs and elimination of structural barriers.

Abiotic factors are particularly important for agriculture; they include the terrain relief, types of soils, atmospheric precipitation - water, the air temperature, winds. The development of rural areas is also determined by demographic, economic, natural-and-landscape aspects, as well as aspects related to public interests.

As it turns out from performed research works (BALAWAJDER et al., 2014), important criteria concerning delineation of agricultural problem areas during land consolidation works in Poland include: soil conditions (the terrain relief), location, social-and-economic conditions and natural-and-landscape values.

### **4.1. The essence of land consolidation works in Poland**

Accession of Poland to the European Union in 2004 initiated the implementation of the Common Agricultural Policy (CAP) and also created the new opportunities to balance the chances of development and to increase the competitiveness of farms, which operate in difficult conditions. , and, therefore, it started the important process of restructuring of rural areas, which is based on land consolidation and exchange works.

The land consolidation is defined by the Polish Standard PN-R-04151:1997, as a set of designing and technical operations, which aim at creation of better farming conditions through: improvement of the spatial structure of farms, rational arrangement of expanse of farms, adaptation of real estate boundaries to the water melioration system, roads and the terrain relief. The similar definition is quoted by Art.1 of the Act on land consolidation and exchange of 1982. The Sectoral Operational Programme "Restructuring and modernisation of the food sector and development of rural areas" considers land consolidation works as the most important operations performed in rural areas. A document, which is connected with transformation of the Polish villages is "The strategy of development of rural areas in the period 2007-2013, prepared by the Ministry of Agriculture and Development of Rural Areas, which - in sections related to multifunctional development of rural areas - includes provisions concerning:

- economic development, which supports the attractiveness of rural areas,
- balancing the economic development, with consideration of principles of maintenance of sustainable development of the natural environment, the cultural heritage, as well as management of marginal lands.



The commonly applied principles of land management in rural areas, which are compliant with the European models, include (SOBOLEWSKA-MIKULSKA, 2009) :

- reduction of negative impacts of the agriculture on the natural environment and protection of rural areas against negative impacts of the industry,
- promotion of ecological agriculture methods, in particular, in the areas of high natural and landscape values,
- increase of areas of forests through afforestation of arable fields.

The performed land consolidation projects should cover the wide range of issues, in order to allow to meet the above purposes within the land consolidation process.

The scope of assumptions of the land consolidation project has been determined as an action which transforms the configuration of fragmented parcels, as well as extensively elongated parcels, into a system of regular parcels, which meets the requirements of rational farming. The following components of the land consolidation process may be mentioned: systematisation of boundaries, delineation of lands for the future building activities, functional designed of the transportation system and effective arrangements of the farms expanse, with consideration of the increased size of farms, as well as liquidation of enclaves and semi-enclaves. Every land consolidation project should consider and specify the following components:

- local issues related to arrangements and improvement of organisation of farms,
- time and terms of implementation of investments assumed in post-land consolidation actions,
- entities, which are responsible for implementation of the planned investments.

Results included in the design of the land consolidation must be in agreement with the study of conditions and directions of land management and with local plans of the municipality.

The design of land consolidation, developed after the stage of consultancy and after determination of demands of all participants of the land consolidation process, should consider proposals related to disposal of lands:

- changes of lands in the structure of arable lands and other lands, which are planned for afforestation, in order to create wind protection zones and anti-erosion protection facilities,
- criteria concerning maintenance and protection of trees and bushes,
- size of lands excluded from land consolidation,
- proposal concerning recultivation and melioration works.

The above elements of the design consider aspects resulting from the environmental protection needs, referring to earlier trends on the field of regional policy. From the perspective of the current objectives such statements are insufficient. Therefore, agricultural-and-environmental projects are a supplement of those statements, which contain the term "buffer zones" (elongated zones of vegetation created in order to limit water pollution or protect against erosion and increase the level of biodiversity of arable lands). The objective of these structure in the agricultural space is to separate arable lands from edges of escarpments, ditches, water streams, valuable habitats and peat bogs (The National Agricultural-and-Environmental Programme for the period 2007-2013). Such structures increase the, so-called, the terrain roughness and protect against phenomena of water and wind erosion.

#### **4.2. Criteria for delineation of the agricultural problem areas in Poland**

Poland is situated in the central Europe, on the Baltic Sea. It covers the area of 312 685 sq. km. It is characterised by convenient natural conditions, such as the terrain relief, flat plains and moderate uplands. In Poland we experience the low erosion hazard, both wind and water erosion of soils, 28% of all arable lands are hazarded by erosion. Relatively high diversification of natural conditions may be mentioned; therefore it is possible to highly diversify the structure of crops.

The basic factors, which slows down the development of agriculture in Poland is the influence of contraction in agriculture. It results in the decrease of profitability of the agricultural production. Besides, many agricultural areas are successively swallowed up by dynamically growing large cities. The process threatens the agricultural and forest complexes, which finally may be occupied by investments. Additionally, the low profitability means the lack of possibility to perform modernisation and restructuring of farms.

Next factors include high fragmentation of private farms, as well as the high number of small farms. This situation mainly occurs in the south-eastern Poland (Małopolskie, Podkarpackie, Podlaskie, Lubelskie voivodships). A good example is the Podkarpackie Voivodship, where 198,100 farms of the size exceeding 1 hectare exist; 83,3% of those farms are small and their size does not exceed 5 hectares. In Poland the similar situation concerns 58,6% of farms, which use 393,200 hectares of arable lands (51,9%). At the same time, approximately 122 thousand agricultural real estates exist in the same voivodship; they totally occupy 53,200 hectares of arable lands. On the other hand, bigger farms, of the size of more than 20 hectares, belong to the small group of only 0,6% of the total number of farms (5,9% in Poland); and they occupy about 132,000 hectares, i.e. 17,1% of the total area of arable lands. (LEŃ, 2010). The high fragmentation of farms is highly inconvenient for the development of agriculture, since it limits the possibilities to increase the goods assortment of the agricultural production.

Criteria of delineation of areas of less favoured farming conditions (LFA) applied in Poland (JADCZYSZYN et al., 2010) consider, first of all, the general quality of agro-ecological conditions and are based on the factor of valorisation of the agricultural production space. In the case of mountainous areas the basic factor of classification of areas is the elevation of arable lands above the sea. However, such approach to the definition of the LFA areas does not reflect all limitations in the agricultural land use, such as degradation of the natural environment, fragmentation of the structure of farms, or man-made transformations.

Works performed within the delineation of the LFA areas were the basis for continuation, by the Institute of Soil Science and Plant Cultivation (IUNG), the State Research Institute, of the analysis of rural areas in Poland, within the long-term PIB 2006-2010 Programme. The discussed works were performed with respect to identification of the additional factors, which limit the production and contribute to the environmental degradation (JADCZYSZYN et al., 2010).

Basing on the reviewed publications, criteria of delineation of the agricultural problem areas within rural, as well as rural-and-urban municipalities, were developed. It was stated that 38% of municipalities and 32% of arable lands were included in the agricultural problem areas.

Following the guidelines of the Resolution of the Council of Europe EC1257/99, the agricultural problem areas operate in less favoured conditions due to environmental limitations; they are practically hazarded by possible termination of land use. On such areas it is necessary to protect the landscape and to maintain the vitality of rural societies; related programmes are supported by the financial means (from the EU at present). An important criterion used for delineation of analysed areas in Poland is the level of the soil productivity. The measure of the soil productivity is the index of valorisation of the agricultural production space, being the basis for the assessment of the production conditions. In Poland, three following categories of the terrain relief may be distinguished within the less favoured areas (LFA) (JADCZYSZYN et al., 2010):

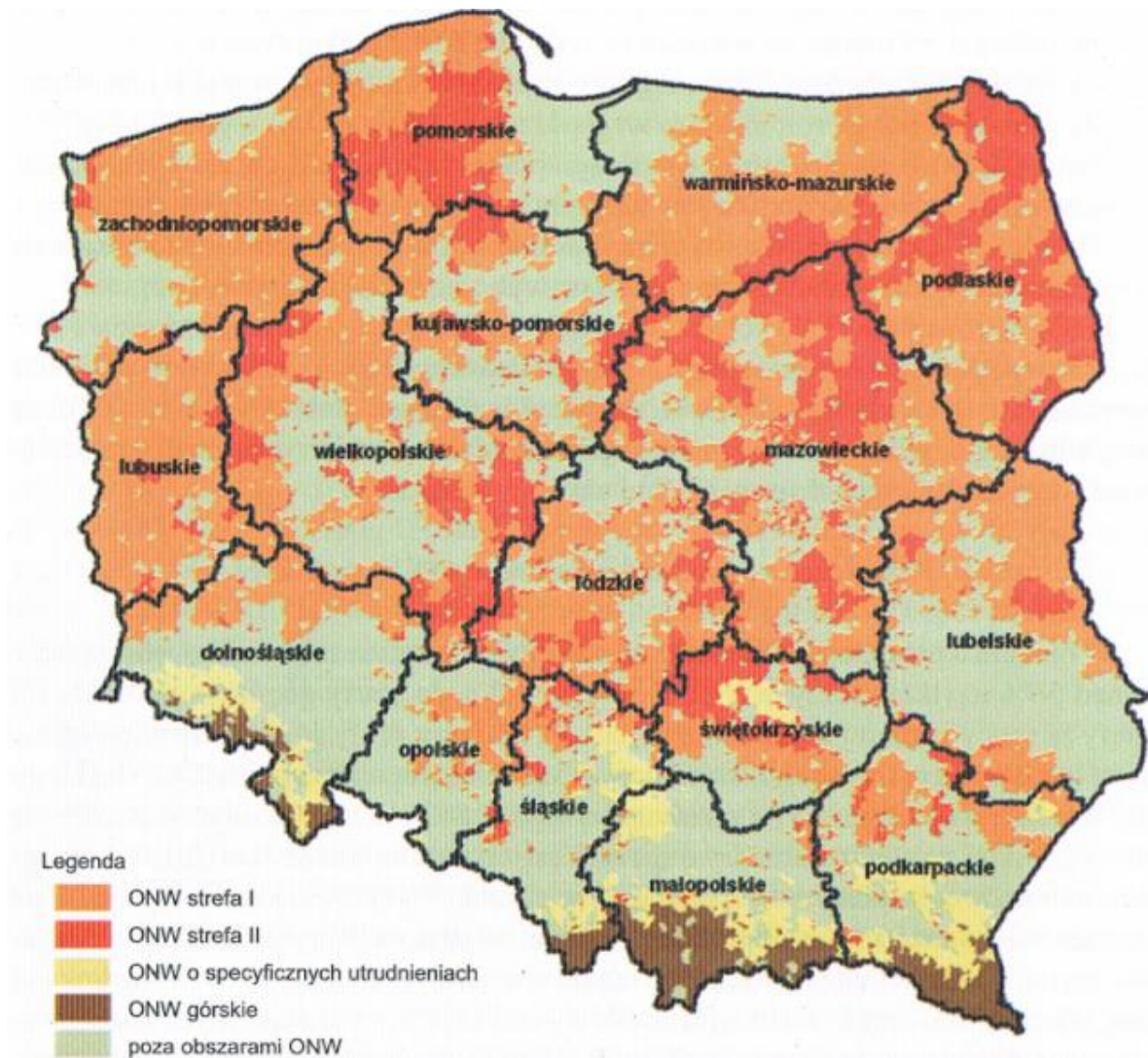
- mountainous areas, which are characterised by the high limits of the possibility to maintain the land use and the high costs of labour (observed difficult climatic conditions, as well as the shortened vegetation period and high values of the slopes of the terrain), are qualified in the agricultural production only, following the criterion concerning the location at elevation which exceeds 500 m above the sea level,

- areas of specific difficulties, located within the upland zone, where climatic limitations also occur, where organisation of production is difficult due to the terrain relief, water erosion hazards; in more than 25% of farms the agricultural production has been terminated. Fragmentation of the agricultural structure of farms exists, the average size of a farm is smaller than 7.5 ha. Municipalities where at least 50% of arable fields are located within the zone of 350-500 m above the sea level, were classified in this category.
- lowland areas, located within the zones which are almost flat, elevation above the sea level - up to 200 m, the slope angle < 2°. The agricultural production in lowlands in Poland was limited due to the low quality of soils, inconvenient climatic and water conditions, inconvenient terrain relief, as well as due to the demographic index and participants of the society connected with the agriculture.

The basis for delineation of the agricultural problem areas is spatial and statistical data, which characterises the agricultural production space: results collected within the programme of monitoring of the chemical composition of soils in Poland, the metric soil-and-agricultural map, the numerical map of possible water erosion, the map of the LFA areas. statistical data from the agricultural census.

Basing on the assumed criteria (Fig.21) above 56% of arable lands were classified as the LFA areas, including 2.3% in the mountainous zone and 3,2 % to the zone with specific difficulties. The areas of the mountainous zone are located in four southern voivodships: Małopolskie (19,2%), Silesian (6,7%), Lower Silesian (4.5%) and Podkarpackie (2,8%). Areas of specific difficulties in agriculture are located within the direct neighbourhood of the mountainous zone, with two additional areas in the Silesian-and-Krakow Upland, at the border zone between the Małopolskie and Silesian voivodships and in the Kielce Upland. The percentage of arable lands classified as the areas of the extremely inconvenient farming conditions - in the Lowland Zone II equals to 11.2% and their highest concentration occurs in the Podlasie (40,0%), Pomerania (30,6%) and Mazovia (22,9%) voivodships. The areas of this zone do not occur in the Lower Silesian, Opole and Małopolskie voivodships. The biggest size (34,2%) within the LFA areas is occupied by the Lowland Zone I. Those areas are concentrated in the north-eastern part of Poland, in Podlasie (57,1%) and Warmia-and-Mazurian voivodships (63%), in the north-western Poland, in the West Pomerania (62,5%) and Lubuskie (83,8%) voivodships. The relatively high percentage of areas of the Lowland Zone I occurs also in the central Poland, in Łódź (47,8%) and Mazovia (40,7%) voivodships.

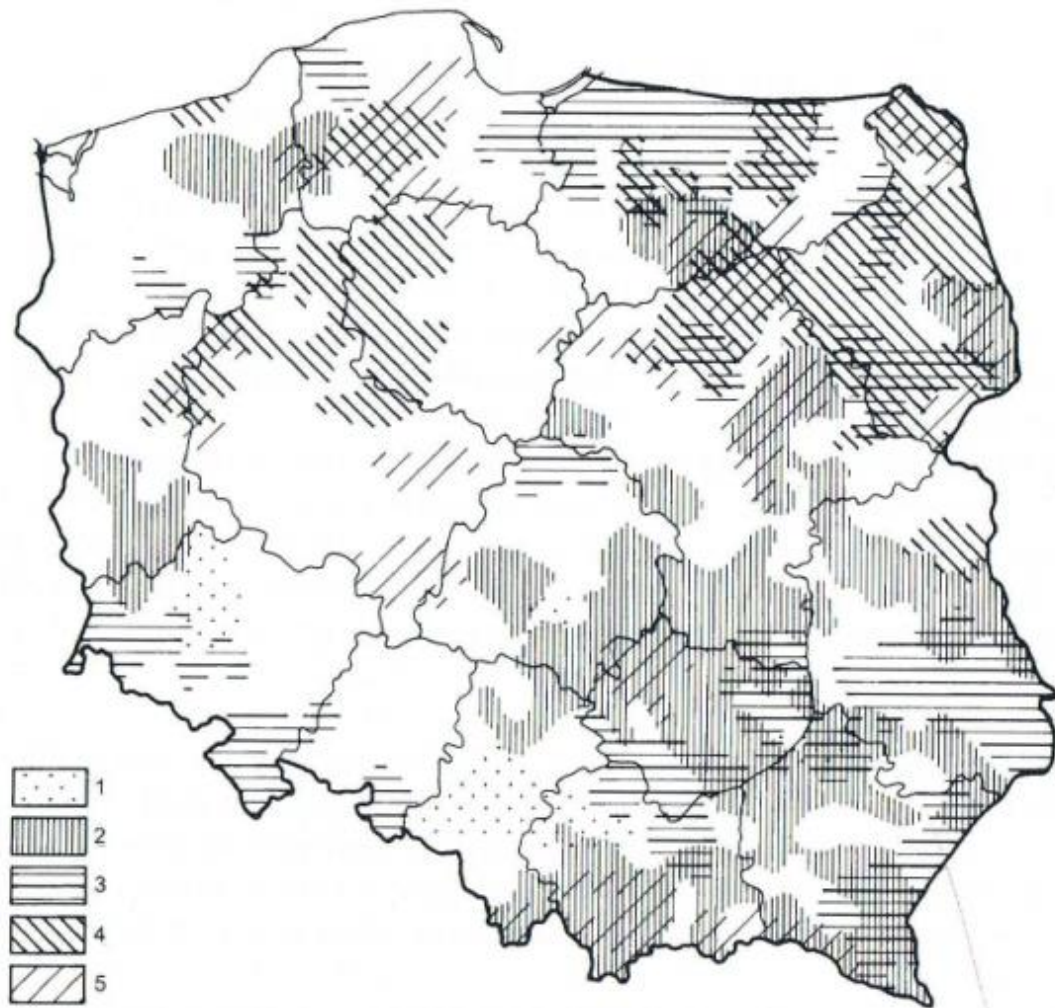




**Figure 21.** Area of less favoured areas (LFA) in Poland.

**Resource:** STACZYŃSKI et al., (2003, p. 8).

Figure 22, which presents agricultural problem areas in Poland (KOŁODZIEJSKI, 1997) also presents regions where such areas occur, with the division into: areas of degraded agricultural production space, areas of delayed development, areas of the natural production reserves, areas of the economic production reserves and areas of the low quality of the agricultural production space.



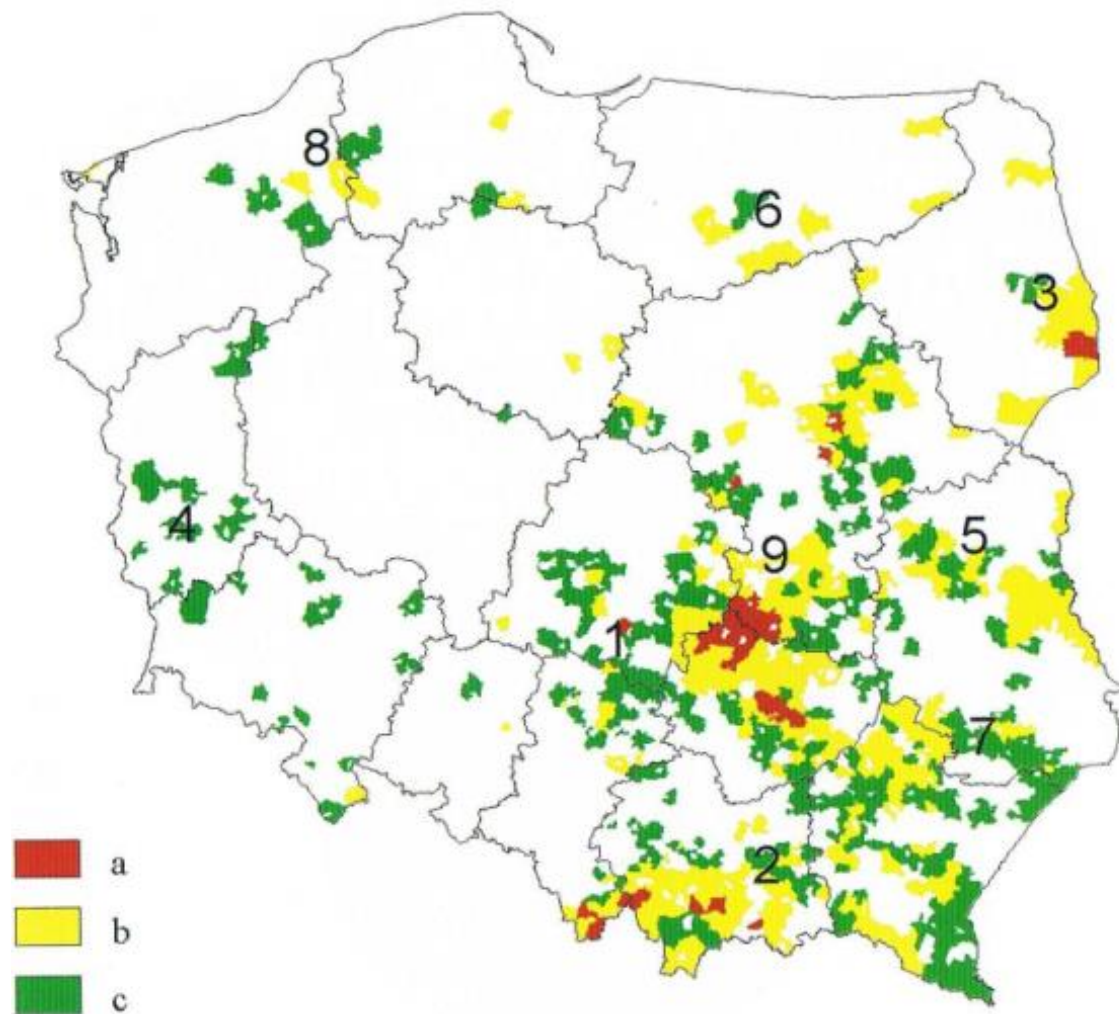
**Figure 22.** Agricultural problem areas in Poland

1 - areas of degraded production space, 2 - areas of delayed development, 3 - areas of natural production reserves, 4 - areas of economic production reserves, 5 - areas the low quality of the agricultural production space.

**Resource:** KOŁODZIEJSKI J. (1997, p.107).

Bański, who performed research works in this field, has sorted agricultural areas of delayed development according to three basic groups (Fig. 23), as the indices of ordering rural areas in particular voivodships:

- pathological areas which are characterised by the lowest agricultural development in the country (they reach the lowest values). They are also characterised by the deep delays in development, what results in the lack of chances of development for farms, which incomes are generated by agriculture only; such farms are doomed to failure. The only way to rescue such areas is to introduce other economic functions, e.g. tourism and recreation or forestry, as well as creation of new job opportunities in sectors other than agriculture (Świętokrzyskie, Mazovia, Carpathian, Kraków-Częstochowa, Podlaskie areas).
- critical areas - adjoin the pathological areas. In the case of the lack of the external economic support for the agriculture, such areas are doomed to failure. Only a few, strong farms may remain on the market. Therefore, it is recommended to develop such areas in directions other than agriculture, what would allow to increase the employment in rural areas.
- threshold areas - such areas, which have the chance for the agricultural development, as a result of the rational restructuring of agriculture, what may lead to the average level of development.



**Figure 23.** Agricultural areas of delayed development

1- The Kraków-Częstochowa Upland, 2-Carpathian area, 3-Knyszyn-Białowieża area, 4-Lubuskie area, 5-Mazowsze-Polesie area, 6-Olsztyn area, 7-Sandomierz-Roztocze area, 8-Middle Pomerania, 9-Świętokrzyskie area, a-pathological areas, b-critical areas, c-threshold areas.

**Resource:** BAŃSKI J. (1999, p.61).

The development of agriculture is supported by subsidies for farmers, which are established in the European Union. The majority of farmers, when they meet specified requirements, may receive funds for modernisation, purchase of new machinery, what results in improvements of the effectiveness of farming and increase of the agricultural production. Another, important incentive for the agricultural development is the increase of interests in the natural food produced by the Polish agricultural and breeding farms, without the use of artificial fertilisers. The widely popularised model of the healthy food also supports the increase of the agricultural production. It is often connected with the new way of development of rural areas - agrotourism (reception of guests in rural farms), which also contributes to the support of the rural areas.

Basing on the analysis presented by the author it should be emphasized that land consolidation contributes to creation of more favoured management conditions in the agriculture and forestry. Land consolidation works have positive influence on improvement of living conditions in rural areas. Together with all operations concerning land consolidation and management, natural, landscape, ecological, social and economic aspects should be considered.

Following the Instruction No.1 of the Minister of Agriculture and Food Economy on land consolidation of March 29,1983, such lands may also be used for (SAJNÓG & WÓJCIK, 2013):



- playing functions of forests, i.e. afforestation,
- purposes other than forestry and agriculture, e.g. the future built-up areas, transportation networks, agro-tourist operations, for recreation etc.,
- transformation into ecological fields,  
as well as:
- cultivation of energy crops (WÓJCIK, 2013),
- creation of hunting plots.

#### **4.3. Conclusions**

Conditions of the agricultural production space in Poland reflect the historical-and-legal, as well as social-and-economic and demographic processes. At present, economically poor and fragmented agriculture creates an important problem; without deep restructuring it will not be able to play production functions (production of agricultural goods in highly competitive conditions) or other functions (such as increasing the landscape values, protection of the natural environment). The high diversification of natural-and-soil conditions results in the situation where the agricultural production is performed in favoured, as well as less favoured climatic conditions, in lowlands, as well as in piedmont and mountainous areas, where farming is highly inconvenient.

Criteria of delineation of the less favoured areas (LFA) are based on the factor of valuation of the agricultural production space. One of the processes which improve the spatial structure of rural areas and allow for effective farming is consolidation of lands. It allows for correct delineation of the LFA areas and, during the post - consolidation process - for more convenient and effective land management. However, it is very important that the state would take care of the interests of the Polish farmers and support them in order to increase the effectiveness and profitability of their work.

## 5. Methods for identifying the need for consolidation and interexchange of plots of land on an example of the rural district Brzozow

Agricultural land in the Podkarpackie Province is characterized by considerable fragmentation, small dimensions and irregular shapes of specific plots of land. Additionally the network of roads designed for direct operation of fields, dating from the time the local villages were established, does not provide access to the land from settlements. Due to their technical condition it difficult or at times impossible for agricultural machines to access the fields. If we also take into account the obligatory road easement, we can see the spatial structure of agriculture in the Podkarpackie Province. In such conditions, agricultural production is burdened with excessive costs and development of farming estates is hindered (LEŃ, 2013).

The existing defects in the spatial structure of rural areas may be reduced by consolidation and interchange of plots of land. Such projects are mainly designed to eliminate fragmentation and dispersion of land, modernize and build road networks for direct operation of fields as well as develop other technical infrastructures. It is also necessary to re-cultivate soil and prevent phenomena of erosion.

All these efforts are designed to improve farmers' living and working conditions through minimizing costs of farming production and reducing workload. From the moment Poland joined the European Union, priority assumptions for projects aimed at consolidation and interchange of plots are related to economic growth enhancing attractiveness of rural areas for their residents and to ensuring sustainable development of agricultural sector and balance in the natural environment.

Given the above, the present study focused on determining the priorities and needs for works aimed at consolidation and interchange of land in 44 villages in the District of Brzozów in the Podkarpackie Province.

### 5.1. Methodology for delimitation of the area in question

#### 5.1.1. Characteristics of adopted factors

In order to classify villages in Brzozów District, and identify groups with similar spatial structure of agricultural land, the authors defined and calculated 32 factors, as illustrated in Table 8.

**Table 8:** List of factors describing the area in question.

1. Use of land	2. Administration of land	3. Fragmentation of land	4. Natural conditions	5. Fragmentation and dispersion of plots of land	6. Demographic rates
x <sub>1</sub> - % share of arable land	x <sub>9</sub> - % share of the Agricultural Property Agency of the State Treasury	x <sub>17</sub> - number of plots owned by individuals	x <sub>21</sub> -productivity rate for grasslands	x <sub>25</sub> -number of fragmented plots in the village owned by non-residents	x <sub>31</sub> - number of residents per 1km <sup>2</sup>
x <sub>2</sub> - % share of orchards	x <sub>10</sub> - % share of State Forests	x <sub>18</sub> - total number of plots in a village	x <sub>22</sub> -productivity rate for arable land	x <sub>26</sub> - area of fragmented plots in the village owned by non-residents	x <sub>32</sub> -number of residents per 100ha/AL
x <sub>3</sub> - % share of meadowland	x <sub>11</sub> - % share of land owned by commune	x <sub>19</sub> - plot dispersion rate	x <sub>23</sub> - highest altitude in the village	x <sub>27</sub> -number of non-resident owners of fragmented plots	

x <sub>4</sub> - % share of pastures	x <sub>12</sub> - % share of land owned by district	x <sub>20</sub> - mean area of plots owned by individuals	x <sub>24</sub> -lowest altitude in the village	x <sub>28</sub> - number of fragmented plots in the village owned by local residents	
x <sub>5</sub> - % share of forests	x <sub>13</sub> - % share of land owned by province			x <sub>29</sub> - area of fragmented plots in the village owned by local residents	
x <sub>6</sub> - % share of farming and building land	x <sub>14</sub> - % share of land owned by individual farms			x <sub>30</sub> - number of local residents, owners of fragmented plots	
x <sub>7</sub> - % share of areas designated for transport infrastructure	x <sub>15</sub> - % share of land owned by Farming Cooperatives				
x <sub>8</sub> - % share of land under water	x <sub>16</sub> - % share of land owned by churches				

**Resource:** LEŃ P.

The table shows the factors represent six aspects. The first two groups related to land use and administration are represented by eight factors each. These were calculated taking into account data from the Land and Property Register and represent percentage in the total area of a given village (data based on 2010 Land Register).

The third group related to land fragmentation and included four factors. Two factors: x<sub>17</sub> (number of plots owned by individuals), and x<sub>18</sub> (total number of plots in village) were based on Land and Property Register. Another factor was the mean area of plots owned by individuals (x<sub>20</sub>), yet mean area of plot is an excessive generalization, because as it was shown in a study (LEŃ & NOGA, 2010) small size plots, up to 0,10ha and up to 0,30ha in the region in question account for no less than 76,5% of their overall area. Due to this the present study applied rate (x<sub>19</sub>) proposed elsewhere (LEŃ & NOGA, 2010).

In the fourth group, factors (x<sub>22</sub>, x<sub>21</sub>) relate to productivity rates for arable land and grasslands. Dimensions of specific classes of land were acquired from Land and Property Register. The assumed productivity rate (x<sub>4</sub>, x<sub>5</sub>) for each village is based on the previous study (LEŃ, 2010). Productivity rate was calculated separately for arable land ( $W_{wg}$ ) and grassland ( $W_{wu}$ ) because they cannot be calculated jointly due to the differences in soil valuation classes resulting from the achieved productive effectiveness. The subsequent factors in this group (x<sub>23</sub>, x<sub>24</sub>) provide information about the highest and lowest altitudes in the villages; these were based on map in 1:25000 scale.

Method of patchwork tables (NOGA, 1977) was used to determine the sizes of fragmented plots owned by local residents and by non-residents (x<sub>25</sub>, x<sub>26</sub>, x<sub>27</sub>, x<sub>28</sub>, x<sub>29</sub>, x<sub>30</sub>).

The final group focuses on demographic conditions in the villages: x<sub>31</sub> - number of residents per 1km<sup>2</sup> and x<sub>32</sub>- number of residents per 100ha/AL. Population data were collected in the communes of the District of Brzozów, and the remaining information was acquired in Geodesy Department of the District Office in Brzozów.

### 5.1.2. Method of delimitation of the area

Analysis of correlation coefficients and variables was used in order to select diagnostic characteristics. Method of correlation coefficients made it possible to eliminate those variables which were strongly correlated between each other and analysis of variance coefficients allowed for eliminating characteristics strongly correlated with low variance coefficient.

Based on factor analysis the number of variables was reduced to 7 factors which carry nearly 80% of the information contained in the initial 32 variables. Hence, loss of information is only at

the level of approx. 20%. Table 9 shows the so-called factor loads, which provide grounds for practical characterization of each factor. The factors were subjected to rotation in order to achieve maximum diversity.

**Table 9:** List of calculated factors.

Characteristic	Factor loading for specific factors						
	1	2	3	4	5	6	7
x <sub>1</sub> - Percentage of arable land	-0,24	0,18	0,78**	-0,32	-0,04	0,2	0,19
x <sub>2</sub> - Percentage of orchards	0,13	-0,13	0,12	-0,74**	-0,03	-0,1	0,19
x <sub>3</sub> - Percentage of meadowland	-0,1	-0,81**	0,39	-0,09	0,12	0,04	-0,02
x <sub>4</sub> - Percentage of pastures	0,19	-0,14	0,38	0,24	0,08	0,09	-0,65*
x <sub>5</sub> - Percentage of forests	0,15	0,13	-0,91**	0,2	0,09	-0,2	0,07
x <sub>6</sub> - Percentage of farming and building land	0,18	-0,17	0,68*	0,24	-0,24	-0,2	-0,13
x <sub>7</sub> - Percentage of areas designated for transport infrastructure	-0,1	0,16	0,76**	0,12	-0,01	0,38	-0,15
x <sub>8</sub> - Percentage of land under water	0,09	-0,03	-0,17	-0,21	-0,79**	0,28	0,01
x <sub>9</sub> - Percentage of land owned by APAST	-0,15	0,17	0,03	-0,08	-0,12	0,06	-0,70*
x <sub>10</sub> - Percentage of State Forests	0,19	-0,02	-0,92**	0,15	0,03	-0,17	0,18
x <sub>11</sub> - Percentage of land owned by commune	0,21	0,13	0,12	0,1	0,09	0,66*	-0,45
x <sub>12</sub> - Percentage of land owned by district	0,03	-0,27	0,03	0,04	-0,06	0,88**	0,02
x <sub>13</sub> - Percentage of land owned by province	0,15	-0,08	0,37	0,11	-0,66	-0,36	0,15
x <sub>14</sub> - Percentage of land owned by individuals	-0,23	0	0,91**	-0,14	0,07	0,01	0,02
x <sub>15</sub> - Percentage of land owned by F.Cs.	0,12	-0,64*	0,16	-0,05	0,06	0,37	0,2
x <sub>16</sub> - Percentage of land owned by churches	-0,25	0,05	0,42	0,44	0,05	0,13	0,17
x <sub>17</sub> - Number of plots owned by individuals	-0,84**	0,03	0,39	0,22	0,11	-0,08	-0,02
x <sub>18</sub> - Total number of plots in a village	-0,85**	0,04	0,38	0,21	0,11	-0,07	-0,05
x <sub>19</sub> - Plot dispersion rate	0,47	0,09	-0,72**	-0,05	-0,17	0,21	-0,02
x <sub>20</sub> - Mean area of plots owned by individuals	0,16	-0,03	-0,9**	0,06	0,02	0,01	0,14
x <sub>21</sub> - Productivity rate for grasslands	0,02	-0,9**	-0,03	0,05	-0,07	-0,11	0,07
x <sub>22</sub> - Productivity rate for arable land	0,06	-0,82**	-0,15	-0,09	-0,19	0,04	0,03
x <sub>23</sub> - Highest altitude in the village	-0,21	0,56*	-0,1	0,07	0,46	-0,02	0,26
x <sub>24</sub> - Lowest altitude in the village	0,32	0,37	0,02	-0,1	0,64*	0,15	0,26
x <sub>25</sub> - Number of fragmented plots owned by non-residents	-0,9**	0,12	0,29	0,01	0,04	0,04	-0,06
x <sub>26</sub> - Area of fragmented plots owned by non-residents	-0,81**	0	-0,04	-0,12	-0,16	0,06	0,01
x <sub>27</sub> - Number of non-resident owners of fragmented plots	-0,81**	-0,02	0,4	-0,03	0,01	-0,01	-0,02
x <sub>28</sub> - Number of fragmented plots owned by local residents	-0,61*	0,08	0,53	0,47	0,06	-0,13	0,13
x <sub>29</sub> - Area of fragmented plots owned by local residents	-0,4	0,07	0,46	0,47	0	-0,15	0,28
x <sub>30</sub> - Number of local residents, owners of fragmented plots	-0,48	0	0,54*	0,51*	0,08	-0,23	0,13
x <sub>31</sub> - Population density 1km <sup>2</sup>	0,04	-0,36	0,75**	0,28	0,07	-0,38	0,09
x <sub>32</sub> - Population per 100 ha AL	0,09	-0,26	0,66*	0,37	0,06	-0,46	0,03
Relevant variance	5,18	3,51	8,5	2,19	1,95	2,44	1,64
% share in the totality of relevant variance	16,0	11,0	27,0	7,0	6,0	8,0	5,0

$r_{XY} = 0$  no correlation between variables,  $0 < r_{XY} < 0,1$  low correlation,  $0,1 = r_{XY} < 0,3$  mild correlation,  $0,3 = r_{XY} < 0,5$  average correlation,  $0,5 = r_{XY} < 0,7$  high correlation\*,  $0,7 = r_{XY} < 0,9$  very high correlation\*\*,  $0,9 = r_{XY} < 1$  almost full correlation\*\*\*

**Resource:** LEŇ P.

## 5.2. Determining groups of villages by means of Ward's Method

Based on values of the 7 distinguished factors (Table 9), analysis of clusters was performed using Ward's method. This method belongs to the group of agglomerative methods. It uses analysis of variances to estimate distances between clusters. Distances of a new cluster from all of the remaining clusters are determined using Euclidean distance. Calculations were performed using Statistica PI software, cluster analysis module.

Factor values were not standardized (values for each factor are constructed in such a way that their mean equals 0 and standard deviation equals 1, hence, in fact, they are standardized), each factor was treated equally in the analysis (no weighing system was applied). The following dendrogram (Fig. 24) was obtained based on the analysis. Cut-off level was defined in an arbitrary way taking into account practical reasons.

As a result of this cut-off, the dendrogram shows 6 groups and 5 subgroups of villages with similar spatial conditions (Fig.24).

The respective groups and their subgroups are significantly varied in terms of the number of villages, total area and density of population. The spatial distribution of the identified groups and subgroups of villages is illustrated by Figure 25.

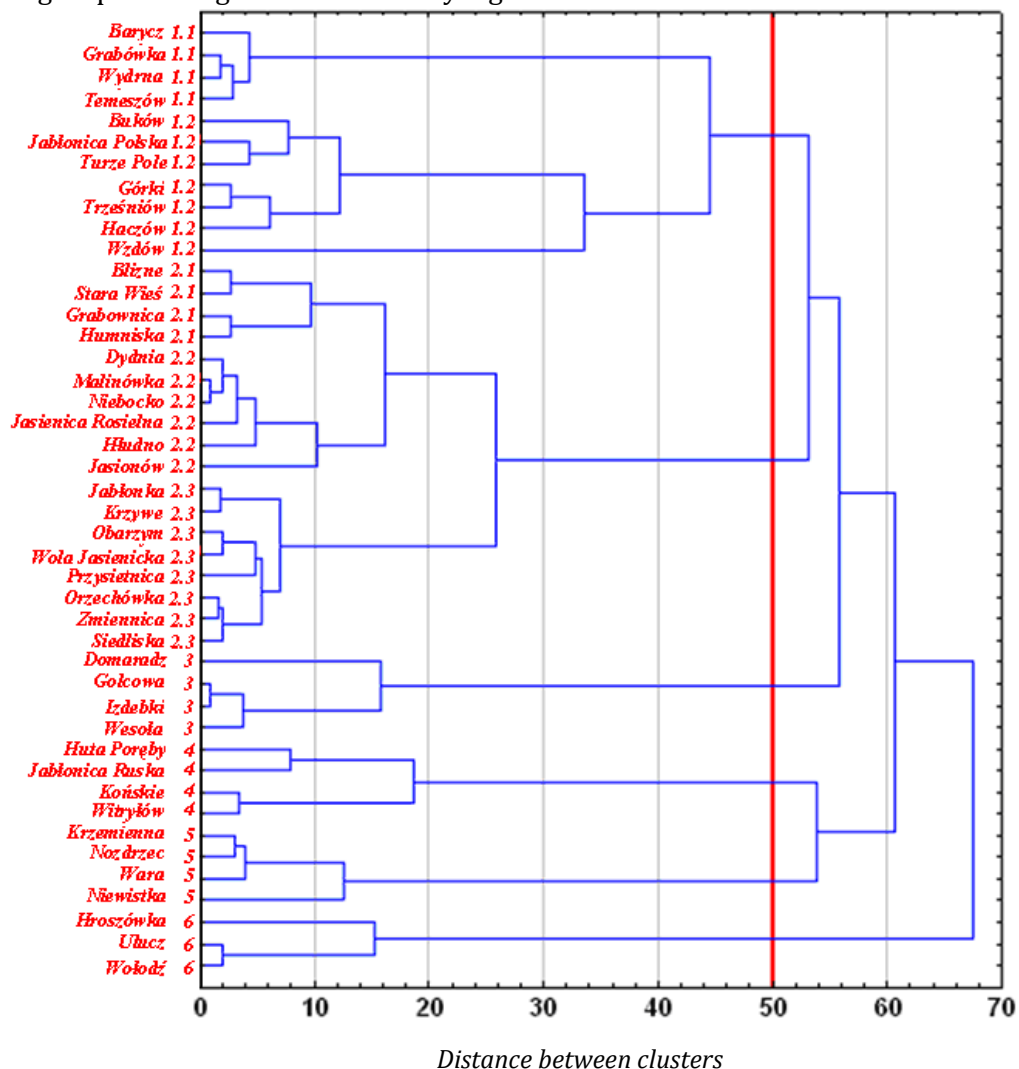


Figure 24. Dendrogram.  
Resource: LEŃ P.





Legal and ownership status of the land in the first group of villages differs from that in the second group. Plots owned by individuals comprise area of 15146,1ha, which constitutes 70,3% of the group's area. The relevant rate in the subgroups ranges from 63,6% (subgroup 2.3) to 75,7% of the total agricultural land (subgroup 2.2). The lowest percentage of individually owned land in the third subgroup results from the fact that as much as 28,5% of the land in that area is owned by the State Treasury (State Forests). The lowest percentage of land owned by individual farmers was found in the villages of Group 6, which is a consequence of historical factors: these villages were depopulated as a result of Operation Vistula.

### **5.3. Determining the sequence of works aimed at consolidating and interchanging plots in the villages of the region**

Typology of spatial and economic phenomena is used in numerous sciences (economy, geography, agriculture). Additionally, a number of previous studies and publications have proposed methods for selecting diagnostic features in order to classify agricultural and forest areas taking into account recognized criteria (KOZŁOWSKI 1972, HOPFER 1974, MROZOWICKI 1975, GAJDEROWICZ & HOPFER 1977, NOGA 1988b, 2001).

Previous studies of spatial and agricultural issues have developed a number of methods for delimiting areas of land (FAJFEREK 1964, ISARD 1965, KOPEĆ 1996, DOMAŃSKI 1969, MŁYNARCZYK 1970). Most frequently applied for distinguishing macro-scale spatial agricultural zones, taxonomy and score-based methods make it possible to distinguish areas with similar features. Additionally, the need for typology of villages and farms occurs in projects aimed at planning and transforming defective spatial arrangements of plots. Such projects involve transposition of methods for reduction of multivariate space, most frequently used as taxonomic methods (MŁYNARCZYK 1970, KOZŁOWSKI 1972, MROZOWICKI 1975, NOGA 1977, 1985b, 2001).

Investigation of spatial and agricultural issues by means of taxonomic methods (relative deviations) was first undertaken in Poland by Ernst (1934). Then taxonomic methods were developed and used to identify agricultural zones by Fierich and his students (FIERICH, 1957). Further improvements were introduced by other authors who also expanded the scope of spatial phenomena covered by research (GŁUGIEWICZ 1961, KOZŁOWSKI 1972, KRÓL 1969, LICZKOWSKI 1972, MROZOWICKI 1975, JASIŃSKI 1982).

The first study of methods related to defining zones for the purposes related to agricultural development was discussed by Hopfer (1974). The author focused on defining zones and hierarchies of farming units from the viewpoint of their maturity for transformation of the spatial arrangement of land through legal and technical procedures aimed at development of agriculture. Grouping of areas was conducted by that author in three stages: in macro-, mezo- and micro-scale. The choice of characteristics was varied, and adjusted to the specificity of the relevant area units (NOGA, 2001).

Ward's Method leads to achieving small clusters and is considered to be very effective (GRABIŃSKI & SOKOŁOWSKI, 1984). Analysis allows for obtaining a dendrogram, which is a graphic interpretation of the observed effects. Depending on the assumptions of the study, including in particular the accepted taxonomic distance between objects resulting from the proposed set of characteristics, we can distinguish larger or smaller clusters of villages taking into account similarities and differences between their spatial structures.

It seemed Ward's method would be one of the most effective tools for distinguishing small clusters of villages with similar spatial structure of plots. The obtained classification of 44 villages into 6 groups and 5 subgroups of roughly uniform villages in terms of the relevant features did not provide grounds for determining the sequence of works aimed at consolidation and interchange of plots.

Therefore, in order to specifically determine the level of urgency for works aimed at consolidation in the relevant area the authors applied multidimensional analysis for creating ratings taking into account the pool of characteristics assumed for delimitation by means of Ward's method. Zero unitarisation method was used to determine the sequence for works aimed at consolidation and interchange of plots.

The initial analysis focused on general characteristics of value distribution for specific variables, presented in the form of descriptive statistics (Table 10). Each variable was defined as either a stimulating or deterrent factor from the viewpoint of the need to conduct the consolidation process. 20 qualities were classified as stimulating factors, and 12 features were recognized as deterrent factors.

**Table 10:** Adopted characteristics as stimulating and deterrent factors for qualities subject to analysis.

Selected characteristics	Stimulating factors	$\bar{x}$	Me	min	max	V
x <sub>1</sub> - Percentage of arable land	↑	44,8	44,3	2,1	71,9	32.6
x <sub>2</sub> - Percentage of orchards	↑	0,19	0,05	0	1,17	158.3
x <sub>3</sub> - Percentage of meadowland	↑	4,8	2,7	0	24,2	113.7
x <sub>4</sub> - Percentage of pastures	↑	10,4	10,5	2,1	17,4	39.4
x <sub>6</sub> - Percentage of farming and building land	↑	3	2,7	0	7,3	54,0
x <sub>7</sub> - Percentage of areas designated for transport infrastructure	↑	2,7	2,7	0,2	4,5	33.8
x <sub>11</sub> - Percentage of land owned by commune	↑	3,6	3,2	0,1	14,1	72.9
x <sub>14</sub> - Percentage of land owned by individuals	↑	64,7	69,9	2,7	92,9	30.0
x <sub>17</sub> - Number of plots owned by individuals	↑	3 233	1 786	5	11 171	99.6
x <sub>18</sub> - Total number of plots in a village	↑	3 734	2 029	43	14 205	100.4
x <sub>21</sub> - Productivity rate for grasslands	↑	44,7	44	31	61	18.6
x <sub>22</sub> - Productivity rate for arable land	↑	55,5	54	39	75	15.5
x <sub>25</sub> - Number of fragmented plots owned by non-residents	↑	185,8	134	0	616	86.6
x <sub>26</sub> - Area of fragmented plots owned by non-residents	↑	61,4	49,7	0	261	79.3
x <sub>27</sub> - Number of non-resident owners of fragmented plots	↑	84	79,5	0	249	71.9
x <sub>28</sub> - Number of fragmented plots owned by local residents	↑	185,8	158,5	0	603	86.6
x <sub>29</sub> - Area of fragmented plots owned by local residents	↑	61,4	46,7	0	254,8	92.2
x <sub>30</sub> - Number of local residents, owners of fragmented plots in a village	↑	84	78	0	234	77.2
x <sub>31</sub> - Population density 1km <sup>2</sup>	↑	107,3	102,9	0	301	61.4
x <sub>32</sub> - Population per 100 ha AL	↑	160,5	145,4	0	492,1	59.4
	Deterrent factors					
x <sub>5</sub> - Percentage of forests	↓	30,4	26,7	5,9	95,1	60.8
x <sub>8</sub> - Percentage of land under water	↓	1,22	0,52	0,04	5,39	121.9
x <sub>9</sub> - Percentage of land owned by APAST	↓	3,93	2,38	0	22,35	123.3
x <sub>10</sub> - Percentage of State Forests	↓	23	19,4	0	97,1	89.2
x <sub>12</sub> - Percentage of land owned by district	↓	0,55	0,54	0	2,28	78.1
x <sub>13</sub> - Percentage of land owned by province	↓	0,26	0	0	1,47	139.0
x <sub>15</sub> - Percentage of land owned by F.Cs	↓	0,33	0,01	0	6,51	361.3
x <sub>16</sub> - Percentage of land owned by churches	↓	0,71	0,59	0	2,66	96.9
x <sub>19</sub> - Plot dispersion rate	↓	4,22	4,19	2,55	5,96	20.2
x <sub>20</sub> - Mean area of plots owned by individuals	↓	0,47	0,32	0,14	2,56	102.2
x <sub>23</sub> - Highest altitude in the village	↓	394,1	394,5	311,7	510,7	11.1
x <sub>24</sub> - Lowest altitude in the village	↓	300,6	295,3	243,5	411	13.5

Resource: LEŇ P.

Before elaborating synthetic rating based on baseline values for the diagnostic qualities, it was necessary to perform initial selection of the latter. The most common criteria are related to:

1. disregarding variables with low level of variability (it is frequently assumed that these are qualities for which variability coefficient  $V$  is lower than 20%);
2. eliminating qualities highly correlating to each other (due to the fact that they carry similar information about the hierarchy of respective objects).

For the needs of taxonomic analyses it is assumed that the primary criterion for the diagnostic value of a given quality is its specific level of variability. For this purpose the value of variability coefficient ( $V$ ) is usually applied.

Data in Table 10 show that the criterion of variability coefficient is not met by  $x_{22}$  - productivity rate for arable land for which  $V = 15,5\%$  and by  $x_{21}$  - productivity rate for grasslands, where  $V = 18,6\%$ . Additionally,  $x_{23}$  - highest altitude in the village (11,1%) and  $x_{24}$  - lowest altitude in the village (13,5%). The above list shows that four qualities are characterized by relatively low variability. However, the substance related analysis of their significance and the range of the potentially assumed values allow for a conclusion that the low level of variability does not mean these qualities insufficiently differentiate the villages in question. This is because a difference of a few dozen metres above sea level or a few per cent in the case of productivity rate for arable land or grasslands may signify considerable qualitative difference. And the low value of variability coefficient results from the fact that the distribution of these four qualities has limited range which is a consequence of the substantive importance of these qualities.

Reduction of diagnostic variables was performed using the method of information capacity analysis (ICA). This is one of the methods of reducing the number of diagnostic qualities by excluding those which highly correlate with each other, and therefore carry similar information about the hierarchy of relevant objects. Analysis designed to create a rating takes into account positive correlations between variables of the same nature (hence within the category of stimulating or deterrent factors) and negative correlations between qualities of different types (between stimulating and deterring factors). ICA procedure is described with the following recurrence algorithm:

- 1) Correlation matrix is calculated for a given set of diagnostic qualities;
- 2) It is necessary to find quality  $X_i$ , which most strongly correlates with the other qualities (that is checked by adequately summing up absolute values of correlation coefficients for each variable against the others);
- 3) It is necessary to find all qualities  $X_j$ , whose strength of correlation (i.e. absolute value of correlation coefficient) with quality  $X_i$  exceeds a certain threshold value  $R^*$ ;
- 4) Quality  $X_i$  is defined as central (or isolated if no satellite qualities were matched for it) and qualities  $X_j$  are its satellite qualities; at this point the latter are temporarily disregarded in the analysis, and the whole procedure goes back to step 1.
- 5) The algorithm "ends" when all qualities have been classified as central, isolated or satellite.

Satellite qualities have been excluded from the set of diagnostic qualities.

The choice of threshold value  $R^*$  is also an important matter. Frequently recommended is the value of 0,5 or such level of correlation coefficient which is statistically significant at the level of 0,05. Because these criteria lead to excluding a very high number of qualities, the analyses assumed a very high threshold value of  $R^* = 0,70$ . This is justified in two ways:

- according to many sources, correlation higher than 0,70 is defined as "strong";
- coefficient of determination for  $R^* = 0,70$  (calculated as squared correlation coefficient) is approx. 50%, which means that half of the variables for one quality can be explained with values pertaining to the other quality.

Due to the non-linear nature of relation between some qualities and because outliers occur among some of these, calculations in accordance with ICA method were based on the values of Spearman's rank correlation coefficient.

The variable which most strongly correlated with other characteristics was  $x_{18}$  - total number of plots in a village, and it resulted in excluding as many as 10 of the initial variables from

further analysis. The other central variables were  $x_3$  - percentage of meadowland,  $x_5$  - percentage of forests and  $x_{21}$  - productivity rate for grasslands.

The final places in the table are occupied by isolated variables, i.e. those which did not correlate with the other variables at a level higher than  $R = 0,70$ . These variables contain such information about hierarchies of the villages which cannot be replaced with information related to other variables, therefore they participate in further analysis. 14 qualities were excluded from further analysis.

#### 5.4. Determining the sequence of works aimed at consolidating and interchanging plots in the villages of the region Urgency rating for the need to consolidate and interchange plots of land

In order to achieve urgency rating for the need to consolidate and interchange plots of land the authors applied zero unitarization method (KUKUŁA, 2000). The method involves cross-referencing the value of a given quality to the level of minimum and maximum values in such a way that the "optimum" score in a given set takes the value of 100% and the "poorest" score assumes the value of 0%. Calculations in accordance with zero unitarization method took into account 18 diagnostic qualities and were performed following the formula:

$$- \text{ for stimulating factors related to the phenomenon } x_i^U = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \quad (1)$$

$$- \text{ for deterrent factors related to the phenomenon } x_i^U = \frac{x_{\max} - x_i}{x_{\max} - x_{\min}} \quad (2)$$

where:

$x_i^U$  – unitarized value of i-element of the variable,

$x_i$  – non-unitarized value of i-element of the variable,

$x_{\max}$  – maximum value of the variable,

$x_{\min}$  – minimum value of the variable.

Calculations carried out in this manner allowed for identifying synthetic indicators for all villages in the area. The indicator is in the range from 35,0 for the village of Hroszówka, too 72,4 for Buków. The value of this indicator shows the urgency of works aimed at consolidation and interchange of plots. Lower values of the indicator show a decrease in the needs for consolidation, even though the relevant villages still should not be excluded from such projects. The classification of needs for consolidation works, in sequence from the most to the least urgent, is shown in Table 11.

**Table 11:** Rating of villages according to the calculated synthetic indicator.

No.	Village	Synthetic measure	Position in the rating	No.	Village	Synthetic measure	Position in the rating
1	Buków	72,4	1	23	Grabówka	54	23
2	Humniska	65,4	2	24	Zmiennica	53,5	24
3	Górki	64	3	25	Wesoła	53	25
4	Domaradz	63,7	4	26	Nozdrzec	52,9	26
5	Blizne	63,5	5	27	Wydrna	52,7	27
6	Stara Wieś	63,5	6	28	Wola Jasienicka	52,5	28
7	Haczów	62,5	7	29	Malinówka	51,9	29
8	Jasienica Rosielna	60,9	8	30	Krzemienna	51,3	30
9	Przysietnica	60,3	9	31	Barycz	51,2	31
10	Orzechówka	59,8	10	32	Siedliska	50	32
11	Grabownica	59,3	11	33	Witryłów	49,5	33
12	Jabłonica Polska	57,7	12	34	Dydnia	49,5	34

13	Trześniów	57,6	13	35	Jabłonka	48,6	35
14	Jasionów	56,9	14	36	Wara	48,4	36
15	Wzdów	56,8	15	37	Krzywe	48,4	37
16	Turze Pole	56,6	16	38	Ulucz	48,1	38
17	Golcowa	56,5	17	39	Jabłonica Ruska	47,6	39
18	Izdebki	55,9	18	40	Końskie	47,2	40
19	Niebocko	55,3	19	41	Niewistka	46,2	41
20	Hłudno	55,3	20	42	Wołodź	43,2	42
21	Obarzym	55	21	43	Temeszów	43,1	43
22	Huta Poręby	54,6	22	44	Hroszówka	35	44

Resource: LEŃ P.

Location of villages is shown in Figure 26; groups of villages represent the same indicator range of 5 points.

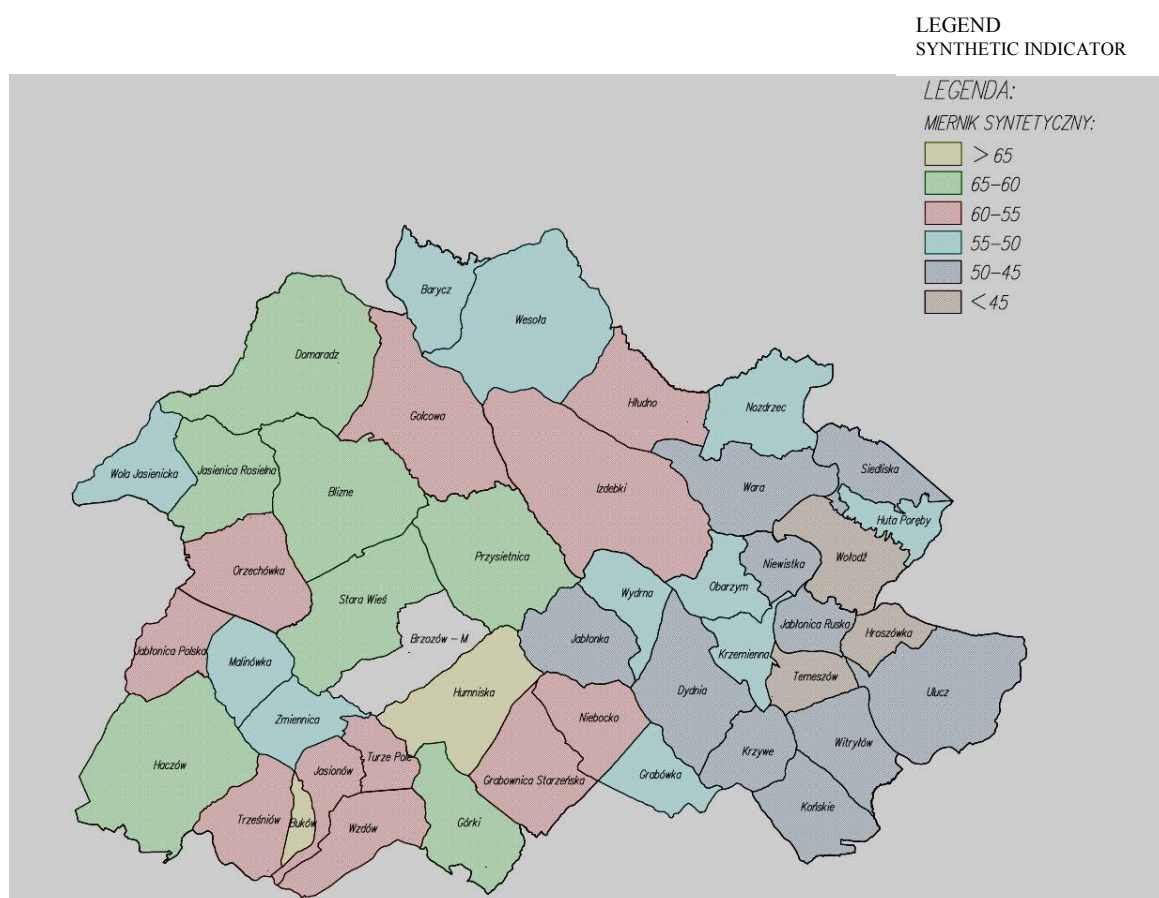


Figure 26. Spatial distribution of villages and the urgency of works aimed at consolidation and interchange of plots.

Resource: LEŃ P.

The findings suggest that consolidation and interchange of plots of land should, in the first place, be carried out in the village of Buków, where the value of synthetic indicator reached the level of 72,4 points and in the village of Humniska (65,4 points). The next group of villages (65-60) includes: Górki, Domaradz, Blizne, Stara Wieś, Haczów, Jasionica Rosielna and Przysietnica. In accordance with the findings, works aimed at consolidation and interchange of plots should most urgently be carried out in villages with high population rates. These villages are varied in terms of terrain which affects the type of patchwork of fields (ribbon and ladder type). These villages are considerably affected by the District town of Brzozów as well as the cities of:

Rzeszów, Krosno, Sanok and other places of significance in the commune, i.e. Domaradz, Haczów and Jasienica Rosielna. Plots of land in these villages are greatly fragmented and scattered. A decrease in the synthetic indicator coincides with lower population density in the villages.

## 5.5. Conclusions

Projects designed to remove inadequacies in the spatial structure of agricultural land include consolidation and interchange of plots. In Poland such defective agricultural structures are estimated to comprise the total area of approx. 3 million hectares. Therefore, despite the subsidies from the EU it is impossible to perform such works in large areas, due to financial and personnel related limitation. In order to ensure rational allocation of funds for the aforementioned purposes, it is necessary to identify the urgency and sequence of works aimed at consolidation and interchange of plots, and this was the purpose of the present study.

The study was designed to identify urgency of works aimed at consolidation and interchange of plots and its findings suggest the following conclusions:

1. The main factor which impacted the defective spatial structure of agricultural land was the high rate of population growth in rural areas.
2. The existing patchwork of fields resulted from fair division of farming estates. The patchwork is characterized by extremely fragmented parcels, where plots with an area up to 0,10ha constitute 32,0% of the total number of plots owned by individuals, and the plots with an area up to 0,30ha account for 75,5% of their overall number and comprise the total of 109,181 parcels. As a result of this within the area in question there is no road access to over 40,0% of the plots.
3. In addition to the fragmentation of agricultural land in the region, there is also significant external plot patchwork comprising as much as 26,8% of the total land owned by individuals. It can be assumed that by eliminating this patchwork it will be possible to bring farming lands closer to settlements.
4. The identified defects were taken into account in determining urgency of consolidation and interchange of plots. For this purpose, Ward's statistical method was applied in order to delineate areas with uniform spatial structure. Yet these did not provide grounds for clearly sequencing the necessary works aimed at consolidation and interchange of plots.
5. Therefore, in order to supplement Ward's method and to precisely determine the urgency of works aimed at consolidation and interchange of plots the authors additionally performed a multidimensional analysis for creating ratings, by means of zero unitarization method. This procedure made it possible to determine the sequence of necessary works aimed at consolidation and interchange of plots in the villages of the District of Brzozów.

## **6. Norwegian land consolidation court – responsibilities, structure and particular solutions worked out in the field of land management**

Land consolidation which can be considered as "a sequence of operations designed to reorganize land parcels in an area, regrouping them into consolidated holdings of more regular form and with improved access [ ... ], which is intended to provide a more rational distribution of land to improve the efficiency of farming" (FAO 2003) has been a direct or indirect subject of many detailed scientific analysis worldwide (CELLMER, 2013) (RADZEWICZ, 2013) (LONG, 2014) (HIIRONENA & NIUKKANEN, 2014) (DEMETRIOU et al., 2013) (UYAN et al., 2013) (MARTÍNEZA et al., 2013).

The standard meaning of land consolidation is that it is a broad reallocation process in a rural area that "suffers" from fragmentation of agricultural or forest holdings or their parts. The legally defined aims of the land consolidation procedure vary from country to country, but the general objective is, however, to improve land holdings and to promote efficient and appropriate use of the real estates.

The objective is pursued by consolidating land plots through land exchanges, to form plots that are better adapted to their proper use. In addition to actual land exchanges, improvement of the road and drainage networks and other infrastructures are usually parts of the scheme. Landscaping, environmental management and conservation projects may be implemented, and/or at least taken into consideration in a land consolidation process.

The official name of the land consolidation activities in Norway is Jordskifte. This concept is normally translated into "land consolidation" in English. A more precise translation would be "reallocation of holdings by pooling and redistribution".

The execution and decision-making body on land consolidation in Norway is organized as a special kind of court, called "The Land Consolidation Court". This body has become a permanent public institution, within the framework of the judicial system (FERNANDEZ & SUAREZ, 2008).

Forms of land consolidation existed as agreement based or organized by local seniors. When formalized land consolidation activities started in Norway, in the 19th century -it started in 1821, but it took off from 1859-; it had the narrow, classic land consolidation objectives: to solve, once and for all, the problems related with land fragmentation and to develop proper joint infrastructures and the like. However, the Land Consolidation Court has gradually developed into a permanent institutionalized body, handling a lot of other, related issues as well. Nowadays these activities cover a wide range of problems related to land use and property conditions, in rural, urban and semi urban settings; and even in remote mountainous areas. The tools for solving these diversified problems have been developed. In addition to the reallocation of holdings, the land consolidation court activities include actions as, for example:

- clarification of boundaries and rights
- new layout of properties and rights, through dissolving joint ownership, division of properties, new layout of properties, prescribing rules relating to joint use - like the use and maintenance of common private roads- or organizing owners of waterfalls for hydro-electric plant development, elimination of rights of use, etc.
- rearrangement of properties, as a "compensation" for damages done by the construction of public infrastructure like highways, etc.
- assessment of compensation for expropriation and for restrictions imposed on the use of property, caused by public infrastructures like roads, etc.

### **6.1. Land consolidation; an institutional approach**

Land fragmentation, i.e. non-contiguous landholdings, represents an important problem in agricultural activity in many regions. It may cause production loss, but the main problem is that it increases production costs due to high supervision costs and increased time requirement. Fragmentation can occur in several ways:

- as a fragmented farm, i.e. a farm that comprises a number of parcels located some distance from one another.



- as fragmented ownership, i.e. a farmer's holding that includes land owned by the farmer as well as land leased from others. The leased land (or not cultivated parcels) may be owned by a neighboring farmer or it may involve a case of "absentee ownership" with the owner living in a distant city.

As an attempt to solve this situation, farmers can try to improve the structure of their holdings by means of transactions with land, but they could find difficulties in the process. It would require negotiating with numerous small landowners; and the restrictions on the access to information and/or the non-transparency conditions of the land markets are other circumstances which may have influence on the process. These factors leads to high transaction costs, which, in many cases, will not permit to achieve final agreements when these costs are higher than the value of the land which is going to be transferred

The access to reliable information is in many cases the main handicap which conditions the operation of the land markets. The cadastre and the legal register system are the two main information sources about the real estates concerning their registry, their description and their property situation. The quantity and quality of the data of these two sources, but also their accessibility to the general public, are key factors which influence the achievement of land exchanges.

Besides that, it can be noticed that these exchanges are produced within a complex institutional framework which conditions them. Institutions, both in the form of laws (public control systems of rural land transactions and in the form of social norms (traditional private (law) discrimination of no-family buyers), etc. provide the structure for these exchanges, and the importance of the institutional framework in the process is generally acknowledged.

Taking the previous into account, land consolidation in the institutional context arises as an instrument which permits the achievement of "agreements" in land exchanges in which many parties are involved, by means of the reduction of the transaction costs. The land consolidation process is a very complex one, because there are numerous actors involved, and each one has his particular features, requirements and wishes about the real estates that are going to be rearranged; so these conditions have to be considered as much as possible to get a final solution which benefit the most part of -presumably all- the actors involved (FERNANDEZ & SUAREZ, 2008).

Institutions are the structure and the mechanisms of the social order among the human beings, and provide the framework for the social and economic interaction. Economic transactions and the transaction costs associated to them (information, negotiation, decision costs, etc.) are defined by the institutional context. Within an institutional approach, land consolidation is a way to come about transaction costs; and, to a large extent, it is a part of the institutional set up in a society. In some sort of conclusion to this chapter, the organization of institutions and transaction costs are one basic factor to understand land consolidation in a country. The other basic factor is the property conditions; which will be studied in the following chapter.

## **6.2. Land Consolidation in Norway: System and Legal Framework**

### **6.2.1. Land Consolidation in Norway: Jordskifte**

To give a reasonable overview on land consolidation in Norway is not an easy task, simply because this institution has evolved successively and pragmatically from the middle of the 19th century until present time. In the course of time new tasks have come into being as needs arose, without always paying too much attention to the creation of a logical system in this matter. The present legislation regarding land consolidation, which dates from 1979, has been modified many times since then to adapt it to the current changes and tasks which arose in the course of time, shaping a complex legal framework nowadays.

The official name of the land consolidation court and its activities in Norway is Jordskifte, which is normally translated as "land consolidation" in English. A more precise translation would be "reallocation of holdings by pooling and redistribution". This more accurate translation would express the fact that many holdings are pooled or put together, and from this

"pool" the same number of holdings emerges in a new physical and legally-recognizable shape. At the same time these new holdings should retain or exceed their old relative values, broadly conceived. This pareto principle of "no loss" for any involved party/holding, and the principle (in most cases) that it is enough with one party demanding a case, are basic preconditions for Norwegian Land Consolidation.

This is the "classic" conception of jordskifte, but as we shall see, the present activities has moved a long way from this, both with regards to objectives and tools. Other situations when Land Consolidation is used are, for instance the buying and selling of land; expropriations; extensive planning of land use; investments for land improvement both in private and public sectors (roads, drainage) and organizing joint tenure; monumentation of boundaries; mapping and surveying; cadastral works; etc. have developed, too.

Land consolidation is so far mostly applied in rural areas, to all type of land; agriculture, forestry, residential, etc. It should be noted, however, that at least in some countries it is not legally restricted to rural areas. In Norway all sorts of land and holdings, both rural and urban can be subject to consolidation from a strictly legal point of view, but in the practice the land consolidation actions are focused on rural areas. However, residential land, land for recreation (recreational homes), land for extraction of sand and gravel, and so on, quite often will be included; but most cases are still initiated by the needs in typical "rural" land use (FERNANDÉZ & SUARÉZ, 2008).

### **6.2.2. History**

Official interest in land reallocation development in Norway started towards the end of the 18th century. The background was, as in many other European countries that the successive subdivision practices of farmland produced fragmentation of the farms, with an extensive intermixture of plots and strips. It also produced various forms of joint ownership (common tenure), usufructs and annual rotation of plots. In many districts this was also connected with a nucleated settlement, the farms constituted a cluster of intermixed buildings with low level of collective structures. In other European countries this was the agriculture villages, in Norway the clusters were generally too small, normally from 3-4 up to 20 farms, to be called a village.

In the outfields the ownership often was connected to defined functions or uses of land- so that one farmer possessed rights to the trees (or even to certain types of trees), another farmer the hay-harvesting rights, while the grazing and ground itself could be held in joint ownership (JONES, 1980). The mountain areas were (and still largely are) held in common (private) ownership by the farms or as common public land belonging to the Crown (State), which certain rights like hunting, fishing and grazing belonging to the local community.

The first legislation on land consolidation in the "modern" sense (reallocation of plots) dates from 1821. "It relied on the existing legal apparatus to supervise and if necessary conduct the reallocation" (JONES, 1980).

Later on, financial and professional support was given by the government by the 1857 Act. In 1859 the Land Consolidation Service was established, followed by professional officials employed and paid by the government. This, in addition to financial aid to the farmers to remove farm houses from clustered settlements, triggered off an extensive reallocation activity. From this time to 1920, large parts of the countryside were restructured by consolidation. This may be called the first period of consolidation in Norway.

The attitude and philosophy behind land consolidation at the very beginning in the 18th century came close to that of a land reform. The idea was to "individualize" the holdings once and for all, both with regard to legal rights and the physical structure (lay-out). The ideal was the enclosed holding consisting of one piece of agricultural land with the farmyard in the centre, as independent of others as possible. Dispersal of clustered farms was even motivated by poor health conditions within these dense and hardly planned settlements. This ideal was, however, not easy to carry out, given the nature of Norwegian terrain, soils, etc.

It also quite soon became apparent that the whole idea of regarding this type of work as a land reform, that could be done once and for all, had to be adjusted to the dynamics of the society. Gradually it gave way to the notion of land consolidation as more of a continuous

process, constantly readjusting the ownership structure to changing economies, technology and patterns of land use. This demanded a wider variety of means, the concept of land consolidation became more diversified, and it became a permanent institution in society.

Beside the power to decide upon land reallocation, it was practical and efficient to give the same tribunal power to pass judgment in disputes concerning ownership, boundaries, etc., that had to be settled before a reallocation case could be finally concluded. Another reason why Land consolidation in Norway was organized as a court in the early 19th century was probably the lack of other bodies with sufficient skills and integrity within the setup of the young nation. The judicial aspects, of the land consolidation service has gradually been extended, and is in fact since 1934 to some extent detached from the proper consolidation work. According to an amendment that year, disputes concerning boundaries in general could be taken to the land consolidation court, and in the 1979 Act this legal power was considerably extended, more or less to land ownership disputes in general. Thus the original "tribunal" has become a specialized court for many aspects of disputes concerning boundaries and landed ownership (SEVATDAL, 1986, KAIN & BAIGENT, 1992, SEVATDAL 1999, SEVATDAL 2007).

### **6.2.3. Executive Organization**

According to the 1857 Act the decision-making body on land consolidation issues was organized as a special kind of court, which means that it has the power of a court, but only in certain specific stated issues. This institution, the land consolidation court (LCC) has developed into a permanent public institution within the framework of the judicial system.

The body has court power, extensive planning capacity and competence, and is encouraged to mediate decisions. Norway seems to be the only country with an integrated institution that combines court power, planning and mediation in dealing with land disputes (ROGNES & SKY, 1998).

Norway is divided into 41 land consolidation court districts and 5 land consolidation court of appeal districts; adding a total of 275 employees. The staff can be divided into three main groups: land consolidation judges, engineers, and administrative staff.

In some counties there is only one land consolidation court and in other counties there are several courts. The workload varies between the different parts of the country and from case to case. The extent of a case can, in terms of area, vary from a few square meters to several hundred hectares - in terms of boundary length from a few meters to several kilometres. In workload the cases can last from a couple of days to several years. Each year the land consolidation courts handles approximately 1000 cases and 1400 kilometres of property boundaries.

Each of the land consolidation offices is headed by a professional "surveyor", called Land Consolidation Judge. To serve as a land consolidation judge one must have a specific masters degree. Until 2013 this degree was only accepted given by the University of Life Sciences (before known as Agricultural University of Norway). The course comprises a variety of relevant subjects, including surveying, mapping, cadastre, law, economics, valuation, land use planning and land consolidation. It is also expected that a prospective candidate for a judgeship in the land consolidation court will have gained some practical experience as a surveyor before appointment. The King of Norway formally appoints the land consolidation judges.

The land consolidation court, for each of the cases, is normally staffed by one land consolidation judge and two lay judges. In routine cases the court can be overseen by a land consolidation judge only; and in very complex cases the parties can demand that the court be staffed with four lay judges. In every municipality the municipal council will have elected a number of lay judges, and the land consolidation judge picks lay judges from this selection for each case. They are normally farmers or have other types of background, according to the nature of problems in the individual case. The lay judges' task is to participate in the decisions regarding land use and render verdicts in disputes. All decisions are made by all members of the land consolidation court, taken by simple voting in this body. The lay judges and the professional judge have equal voting rights (DYRVIK, 1997)

Until 2013 cases can be appealed to the ordinary courts of appeal or the land consolidation court of appeal depending on the grounds of appeal (Land Consolidation Act, § 61, 1979). The Land Consolidation Court of Appeal is normally composed of one land consolidation appellate judge and four lay judges. In cases where the land consolidation court has been headed by the judge only, the land consolidation court of appeal can be comprised of two lay judges. From 2016 all appeals will be handled by the ordinary Court of Appeal, supplied with a Land Consolidation Judge if necessary.

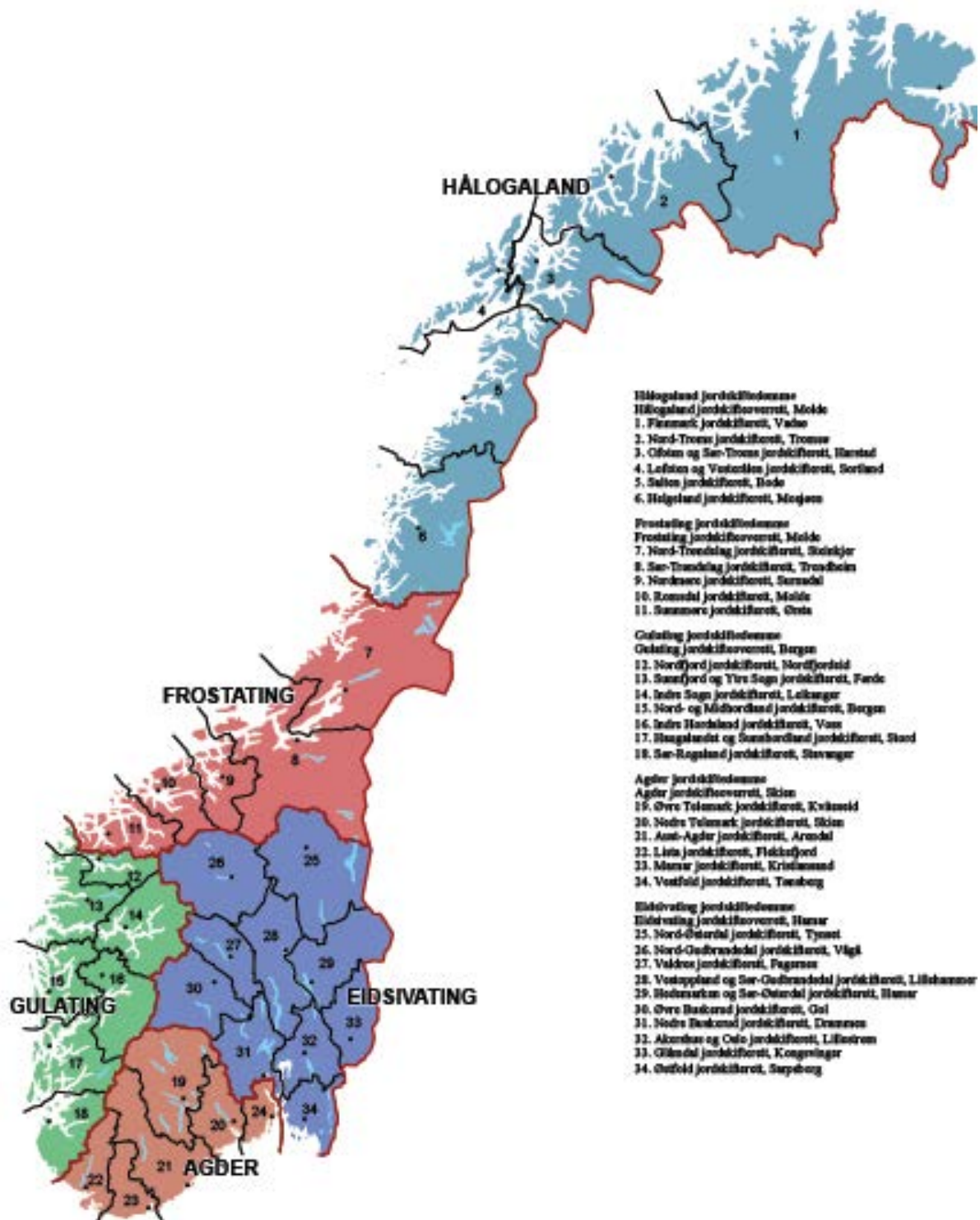


Figure 27. The division into land consolidation court districts.  
Resource: Norges Domstoler.

#### 6.2.4. Legal Principles

The present act on land consolidation in Norway dates from 1979, but it has suffered many changes from this date by means of consecutive amendments, the last on 1st of January of 2007. The aims and means have, of course, changed during this period, but the basic principles are the same:

1. The land consolidation process is intended to restructure outdated or unsatisfactory property patterns; so any landed property that is considered difficult to utilize efficiently under existing circumstances may be subjected to land consolidation under the terms of the Land Consolidation Act. Land consolidation might be initiated both by existing situation, but also by the situation that will come into being.

2. The initiation of land consolidation is mainly left to individual landowners or persons that enjoy permanent easements. A request from one landowner or owner of usufruct rights in an area is enough. The others can be opposed to land consolidation, but if the court finds the request justified and that none of the parties will suffer losses -in economic terms- because of land consolidation, the case proceeds.

3. The decision-making body is independent of the administration, it is a first instance court, and has the authority of a court of law. As an independent court, and like other courts, it can not be instructed by the governmental administration; the influence has to be exercised by general legislation (SEVATDAL, 1986).

The organization and relationships between the LCC and the different official authorities at national, regional and local levels has to be defined, then. Broadly speaking the LCC has to base its work on decisions and regulations made by the administrative authorities- if such decisions exist. The importance of this relationship is most obvious in issues like land use planning and land policies, but also when it comes to planning and implementation of public infrastructures (roads, railway, etc), environmental and conservation issues and so on.

In principle the power of the LCC is limited to what the parties themselves had decided, if they agreed among themselves. This principle holds true in the relationship both with the parties and with the public administration. It is also important to note that proper authorities can request land consolidation to promote their interests (building of public roads, railways, land use planning, conservation plans, etc), and such request is treated in the same way as requests from private persons.

4. Both the aims and the activities of land consolidation in Norway can be structured in two broad groups; on the one hand clarification of property right issues, on the other hand, rearrangement.

The clarification process could take various forms; mediation in disputes resulting in agreements between the parties, or legal court procedures resulting in formal judgements. The rearrangement could take many forms, according to the nature of the problems that are in the agenda. It could be "classic" physical consolidation of fragmented land and holdings, adjustment of boundaries, implementation of joint infrastructure, dissolving commons, subdivision of property units and so on. But the "rearrangement" takes altogether a different form; instead of rearrangement of the physical structure one may arrange the legal structure, i.e. introduce or rearrange the rights and duties concerning the use and the behavioural patterns amongst the parties. Most often this will end up in some sort of organization pattern, for example the creation of a local organization of owners, with a body with executive authority.

Finally there are other activities that do not fit well under the headlines of "rearrangement" or "clarification"; the main ones are the assessment of compensations and the buying and selling of land. The assessment of compensations is carried out in certain situations. Most typically it would be assessment of compensation in cases of expropriation, for instance of land for public infrastructure.

Regarding the buying and selling of the land; the LCC mediate in the process to facilitate the achievement of agreements between the parties.

5. The formal power of the land consolidation court to make legal binding decisions lies in the relationships between the parties; being them rearrangement, clarification or assessment of

compensations. This principle means that issues defined as the sole power of individual owners are outside the formal decision making power of the LCC. Most typical this will include transactions with land, like buying/selling and renting/leasing of land. Such transactions do however play a very important role in the land consolidation. The role of the LCC is then to initiate and especially to mediate/help in negotiations; and finally to give legal/technical assistance in the transactions (settings up contracts and deeds, surveying and the cadastral works, subdivisions, etc).

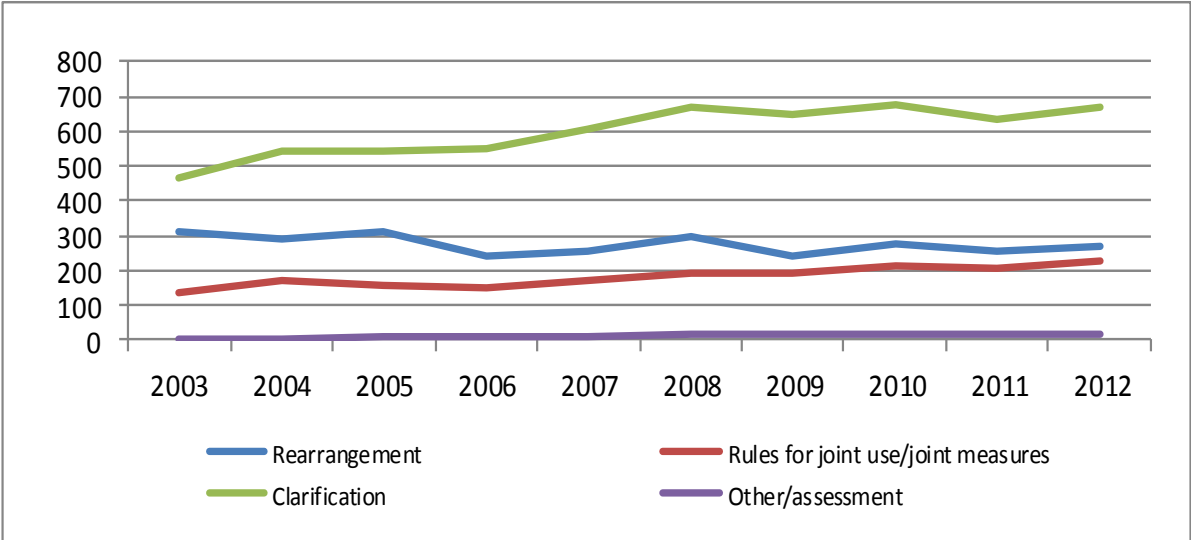
6. All in all, the working of the LCC can be understood in a context of conflict resolution and transaction costs. Most of its work, decisions and transactions could have been done by the parties themselves, if they had had the means and will to agree on negotiated solutions. There are multitude of reasons because of they do not agree, but the main reason why they apply for LCC can be summarized in one concept: the transaction costs. In an institutional theoretical sense, the sole justification of the LCC is that it reduces the transaction costs.

**6.3. Norwegian land consolidation court in figures**

In 2012 the Land consolidation courts concluded 1176 cases (1,114 in 2011). This is almost on par with the peak year of 2010. In view of the difficult recruitment situation one is up in, the result is very good. Result indicators show that 1272 (959) disputes were settled, while the number of rights clarifications were 4623 (3697). The area of the cases was 894,642 ha (587,978). Rules relating to joint use were done for an area of 1542 km<sup>2</sup> (809). Number of parties was 10,246 (10,373). Marked and surveyed border length was 2548 km Borders (2092), while the number of surveyed boundary points was 19059 (19661). Land consolidation courts have handled 287 km of road (427), while fee income was 17,7 million (16,0 million).

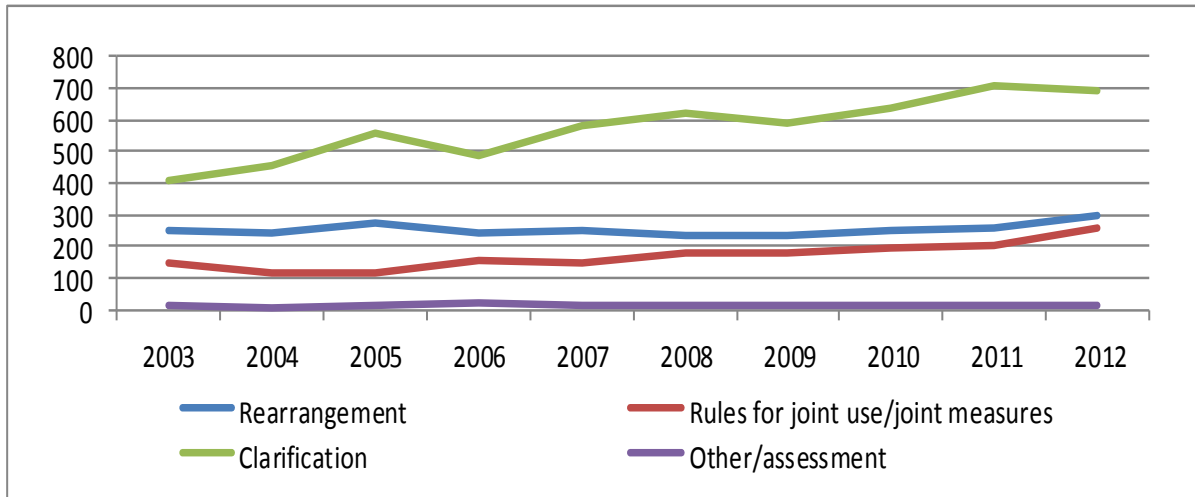
The supply of new cases increased significantly in 2012. 1262 new cases were applied for. For comparison 1,179 were applied for in 2011. This is by far the highest number of new cases land consolidation courts have registered since the early 1980s. Up by one third on each of the main instruments used scheme, rearrangement, and clarification of rights.

The new cases divided by approx. 24% (22) rearrangement, 20 % (17) joint use rules, 55% (60) clarification of rights and 1% (1) assessment.



**Figure 28.** The number of closed cases in Norwegian land consolidation courts in 2011. **Resource:** Norwegian LC Court, annual reports.

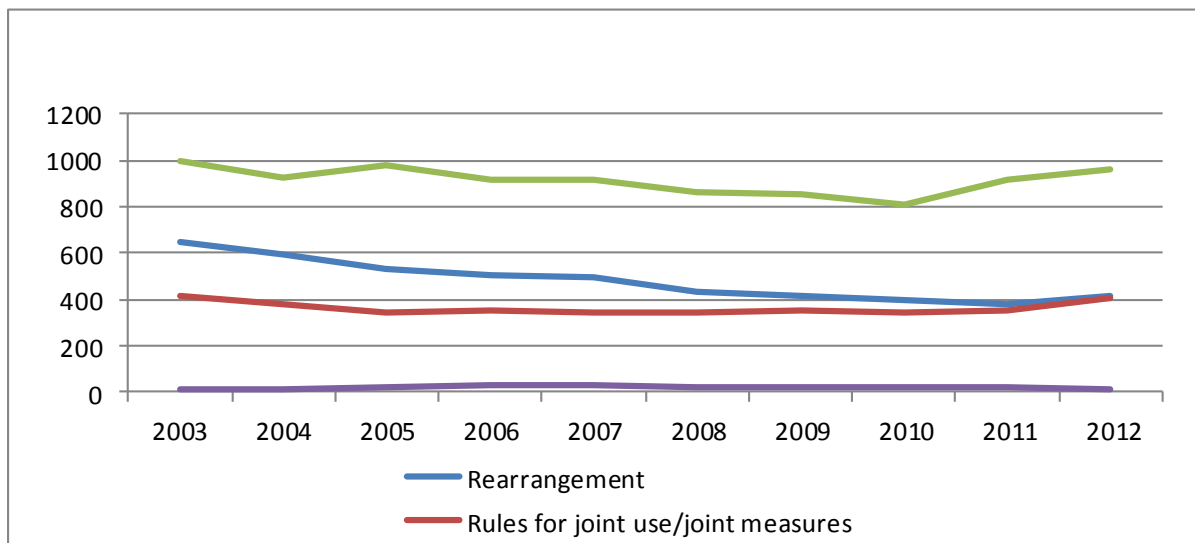
The distribution between the types of cases has varied considerably. The last 10 years there has been a significant increase in the number of clarification cases. But now these seem to decline again. The number of cases involving rearrangement and rules for joint use increases sharply. The number of new cases involving joint use is more than doubled in the last 5-6 years. The use of private roads makes up a large proportion of these cases.



**Figure 29.** The number of new cases in Norwegian land consolidation courts.  
**Resource:** Norwegian LC Court, annual reports.

The Land consolidation courts have reduced their backlog over a long continuous period. In 1983 the number of ongoing cases was 3919; in 1999 the number was reduced to 2558, and in 2010 to 1567.

In 2011 this positive development was reversed. Backlog increased by 102 cases. The increase continued in 2012, as the backlog increased by 122 cases, resulting in a total increase of 224 cases, or 17 % over the past two years.



**Figure 30.** The number of new cases at hand in Norwegian land consolidation courts.  
**Resource:** Norwegian LC Court, annual reports.

#### 6.4. Conclusions

The Norwegian land consolidation court can be defined as a specialized court on land disputes, a body which combines skills in diverse fields: law, mapping, surveying, agronomy, economy, etc., and which has court power, and is encouraged to mediate decisions.

A very long list of problems related with land issues between owners/right holders can be handled and "solved" through land consolidation. They have been grouped in physical, legal and organizational rearrangements, and clarification of rights. In addition there is a miscellaneous group comprising assessments of compensations, buying and selling of land, etc.



"Multifunctionality" is an attribute which can describe the land consolidation activities since the establishment of the Land Consolidation Service in 1860, but which really took off in 1936 with the introduction of clarification of boundaries as a task in itself.

More activities were included in the jurisdiction of the land consolidation courts according to the enactment from 1979, and since then, new amendments in the law were made, the last one in January 2007. All the successive modifications gave rise to a complex and sometimes confuse legal framework, even for the experts in the matter.

Anyway, the changes in the law are the response to the new circumstances and tasks which the land consolidation court has to deal with, stating the dynamism regarding land uses.

What can be observed through the passing of time is the decrease in the number of cases handled by the land consolidation courts from the previous decades to the present times. This fact is related with the decrease of the importance of the agricultural activities.

Nowadays, the most part of the cases carried out in the land consolidation courts are related with the clarifying of boundaries and rights. Mistakes or imprecisions in the cadastral information can partly explain this fact. In spite of the regression produced in the agricultural sector, the rearrangement of plots is still one important activity developed by the land consolidation courts.

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*This work is financed from funds for science realized at AGH University of Science and Technology, allocated for the year 2014*



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