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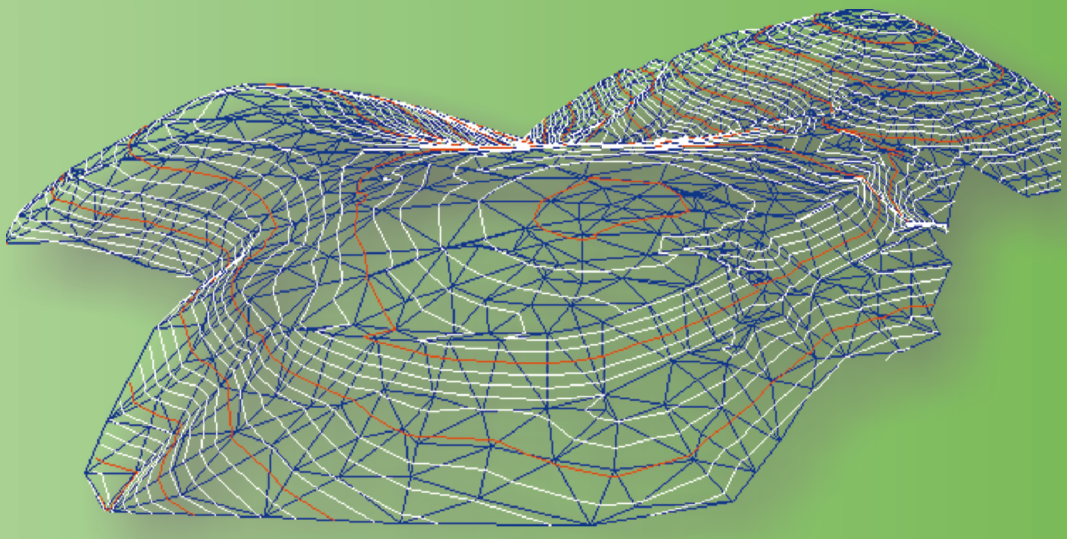
Jakub Sikora



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MODELLING PRODUCTION SPACE IN THE PRODUCER GROUPS AND COMPARATIVE INDIVIDUAL FARMS

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List of abbreviations and symbols:

$\mathbf{\Phi_1}$ – space of the level of the machinery park potential,
$\mathbf{\Phi_2}$ – space of agricultural production efficiency,
$\mathbf{\Phi_3}$ – space of financial external support for agricultural farms,
$\mathbf{\Omega}$ – set of objects,
$\mathbf{\Omega_G}$ – set of farms associated in the agricultural producer groups,
$\mathbf{\Omega_I}$ – set of individual farms,
$\mathbf{\Omega_{GM}}$ – farms associated in the milk producer group,
$\mathbf{\Omega_{GT}}$ – farms associated in the pig producer group,
$\mathbf{\Omega_{GO}}$ – farms associated in the horticultural producer groups,
$\mathbf{\Omega_{GW}}$ – farms associated in the producer groups oriented to horticultural production,
$\mathbf{\Omega_{GE}}$ – farms associated in the producer group oriented to organic production**,**
$\mathbf{\Omega_{IM}}$ – individual milk farms,
$\mathbf{\Omega_{IT}}$ – individual pig farms,
$\mathbf{\Omega_{IO}}$ – individual horticultural farms,
$\mathbf{\Omega_{IW}}$ – individual vegetable farms,
$\mathbf{\Omega_{IM}}$ – individual organic farms,
$\boldsymbol{1Z_1}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of tractors,
$\boldsymbol{1Z_2}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of transport means,
$\boldsymbol{1Z_3}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of loaders,
$\boldsymbol{1Z_4}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of cultivation machines,
$\boldsymbol{1Z_5}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of fertilization machines,
$\boldsymbol{1Z_6}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of sowing machines,
$\boldsymbol{1Z_7}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of plant protection machines,
$\boldsymbol{1Z_8}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of machines and tools for treatment of interrows,
$\boldsymbol{1Z_9}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of green forage harvesting machines,
$\boldsymbol{1Z_{10}}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of combine harvesters,
$\boldsymbol{1Z_{11}}$ – normalized diagnostic variable describing Φ_1 – gross replacement value of root crops harvesters,
$\boldsymbol{1Z_{12}}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of milking machines,
$\boldsymbol{1Z_{13}}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of fodder preparing machines,

$1Z_{14}$ – normalized diagnostic variable describing space Φ_1 – of the gross replacement value of delivery trucks,
$2Z_1$ – normalized diagnostic variable describing space Φ_2 – gross final production,
$2Z_2$ – normalized diagnostic variable describing space Φ_2 – direct inputs on production,
$2Z_3$ – normalized diagnostic variable describing space Φ_2 – ESU – European Size Unit of farms,
$2Z_4$ – normalized diagnostic variable describing space Φ_2 – work inputs,
$2Z_5$ – normalized diagnostic value describing space Φ_2 – WT – utilities index,
$1Z_6$ – normalized diagnostic value describing space Φ_2 – Wpśt– fixed assets productivity index,
$3Z_1$ – normalized diagnostic variable describing space Φ_2 – direct subsidies,
$3Z_2$ – normalized diagnostic variable describing space Φ_2 – WRD – compensation index of inputs with the obtained subsidies,
$3Z_3$ – normalized diagnostic variable describing space Φ_2 – WDN – index of subsidies participation in the gross standard margin value,
$3Z_4$ – normalized diagnostic variable describing space Φ_2 – value of investment in technical back,
$3Z_5$ – normalized diagnostic variable describing space Φ_2 – WRD – compensation index of inputs with the obtained subsidies,
$\mathbf{M_{1-n}}$ – a farm associated in the milk producer group,
$\mathbf{T_{1-n}}$ – a farm associated in the pig producer group,
$\mathbf{O_{1-n}}$ – a farm associated in the horticultural producer group,
$\mathbf{W_{1-n}}$ – a farm associated in the vegetable producer group,
$\mathbf{E_{1-n}}$ – a farm associated in the organic producer group,
$\mathbf{IM_{1-n}}$ – individual milk farm,
$\mathbf{IT_{1-n}}$ – individual pig farm,
$\mathbf{IO_{1-n}}$ – individual horticultural farm,
$\mathbf{IW_{1-n}}$ – individual vegetable farm,
$\mathbf{IE_{1-n}}$ – individual organic farm,
JPO – uniform area payment,
UPO – supplementary area payment,
ONW – area with unfavourable farming conditions.

1. INTRODUCTION

Social acceptance for speeding up restructuring and modernization of rural areas before accession of Poland to the European Union was not supported with increased budget inputs or other external grants for investments related to the development of rural areas and agriculture (Wójcicki, 2000). Various cases which differ from analogy may be justified with a forty-year stagnation period of the Polish agriculture. This period according to Dyka (1991) corresponded to a great part of farmers, as it ensured a suitable existence and stabilization of management (of course at considerable, rather low work efficiency, soil productivity, effectiveness of management, etc.). Inefficiency of management, weak development and other failures accompanied rural areas and agriculture within this period, as in the entire state economy. Undoubtedly, this statement can be discussed, because some elements of production space were developed within this period and sometimes over contemporary needs. Unfortunately, many of these elements have not survived present transformation to the market economy, and they are depreciated at other elements. Efficiency of production space management depends greatly on the use of effective IT methods. These are: computerized system designing methods, data bases models and also effective implementation of a long-standing development plan. Development and implementation of these methods is a basis for suitable cooperation of advisory services with agricultural producers and paying agencies which carry out the mentioned development plan (Szeptycki and Wójcicki, 2003). These operations must however base on credible source information, which constitute a basis for knowledge, which is a significant factor in the fight for a client and in achieving a competitive domination. Having knowledge on the produced goods one may entirely use the production space, thus increase productive efficiency of the possessed technologies. Professional knowledge is also a crucial factor in functioning of agricultural producer groups. Having suitable knowledge itself or in the form of human capital, particular owners may gain notable effects from exchange within the group (Szeląg-Sikora and Oleksy-Gębczyk, 2013). Sharing with experience and technologies they save time, vain work and capital. They may also generate joint solutions which are the most optional for the production space they have.

In Poland, agriculture is an economic sector which is significant and decisively influences the socio-economic situation of rural areas citizens. It also affects the condition of the environment, landscape structure and biological variety of the country. Presently, Polish agriculture undergoes a widely understood modernization process due to the raise in requirements for agriculture and its closest surrounding. According to Wójcicki (2003), modernization is an economic activity which aims at replacing production potential with a new one, which ensures higher work efficiency and production effectiveness of higher quality at lowering nuisances of the hardest works which have been performed so far. Modernization of a farm consists in such a selection of plant and animal production technology and such selection of the machines, buildings and structures set at which efficiency of a farm func-

tioning increases and the production space in this dimension, positively affects the increase of Polish farms competitiveness.

Rural areas are highly varied and next to richer, more developed there are poor areas also called problematic areas (Duczkowska-Małysz, 2003). However, in Poland we also have numerous regions and single farms, where the achieved production effects are at the highest global level. There, the newest scientific achievements are applied, introducing progress in all forms: biological, chemical, technical and organizational (Michałek, 2002; Wójcicki, 2002). One may expect that still development of Polish agriculture will be accompanied by implementation of instruments of common agricultural policy and direct financial support as well as restricted grants which constitute an integral part of the Rural Areas Development Plan (Polish PROW). Available subsidies for agriculture have become an impulse which increases its participation in the agricultural space development (Sikora, 2011; Woźniak and Sikora, 2006).

Creating proper production space in agriculture allows obtaining high production efficiency. As a result it relatively causes a drop of food prices for consumers and despite this, the level of incomes obtained by producers of these food products ensures a suitable life standard (Cewra, 1994). Impact of production space, and in particular internal infrastructure has an undoubted impact on technical progress (Wójcicki and Michałek, 2002; Machowski, 1998). According to Daelemans (1992) good equipment with machines is not the only solution to the work mechanization problem, because the size of a farm plays a significant role.

Further development of the agricultural sector should be designed according to the principles of the sustainable development, which characterizes:

- rational use of agricultural production space and maintenance of production potential of soil,
- ensuring food self-sufficiency of the country (net),
- safe food production,
- production of materials with desired, expected quality parameters, expected by consumers and industry,
- limitation or elimination of threats for environment and care for maintaining biodiversity,
- obtaining incomes in agriculture which allow comparable with other economy branches, payment for work and ensuring financial means for modernization and development (Kukuła and Krasowicz, 2006).

The features which have been mentioned reflect various aspects of balance in agriculture in the country's scale, compared to environmental and economic and organizational preconditions.

One of manners of securing farmers' interests in the division of income generated in the food chain is processing of produce by producer groups and then their sale. Participation in privatization of processing plants is another possibility of obtaining control over enterprises by farmers. A cooperative form, which associates active members and carries out their economic purposes, allows greater participation of agricultural producers in control of processing operations and sale of food products (Łukasik, 2011).

Overcoming barriers in the development of the rural areas citizens' entrepreneurship is a long-lasting and difficult process. Therefore, in the beginning of the 21st century there is a need to take up versatile activities concerning modern system of creating and implement-

ing innovativeness within widely understood agricultural production space. This system, with regard to agriculture, should serve structural changes by development of local initiatives concerning entrepreneurship activities and promotion and implementation of new agro-food technologies. The idea of appointing a producer group has been known for many years. However, it has gained a new meaning in the recent few years, since the need to integrate farmers has its source in the need of the moment influenced by present market mechanism, when the farmers must take economic decisions including the situation on the market. Undoubtedly, the law of supply and demand and great competition that is factors deciding on the position of agricultural farmers on the present marketing outlets plays a significant role. In Poland only a little bit over one percent of farmers are grouped in agricultural producer groups. Comparing with the Western Europe, producer groups are very popular. They are controlling approximately 60% of turnover with agricultural articles. In Poland, this coefficient amounts from a fraction of a percent to few percent, which depends on the business. Disadvantageous agrarian structure of the Polish farms (especially in the Southern Poland) translates not only into their low competitiveness but also determines their efficiency of farming by too slow modernization process of the technical back and by this to also low labor efficiency and high production costs. Moreover, full mechanization is the most frequently economically unjustified in small farms. The only way for its introduction is a common purchase of specialist equipment at a considerable participation of the EU funds in its funding. The next factor determining profitability of the production is availability of the marketing outlets. Distance separating farmers from those markets and guarantees of merchandising should be included. Agricultural farmers which have land resources within 1 to 10 ha in majority of cases are not perceived by recipients of produce as partners who are worth attention because of the small scale and because they often diverge from the accepted quality standards of the commodities produced by them. Thus, association of individual farms in the producer groups influences strengthening of the market position of small agricultural producers through possibility of supplying recipients with commodities (raw materials) in bigger batches in suitable terms and of a required quality. Modest Polish experiences in functioning of producer groups and experiences of the west European countries prove that a producer group takes over from their members numerous tasks and works to be performed in order to increase efficiency of their farms.

2. PRECONDITIONS FOR EFFECTIVENESS OF MANAGEMENT OF FARMS GROUPED IN PRODUCER GROUPS

2.1. Space of the level of technical back equipment

In order to face changing conditions of management, agriculture needs to apply the newest technical, technological and organizational achievements. Nature and power of relations between agriculture and the surrounding, including agricultural services market, plays a significant role in its development (Poczta and Mrówczyńska-Kamińska, 2004). The level of development of the production forces, including production means and labor force (work) decides on the level of production of each farm. On account of origin, production means are divided most frequently into biological, chemical and technical means (Michałek et al., 1998). Providing that the first two groups of means directly influence the increase of the obtained production value, then technical means influence mainly optimal conditions which favor high-efficiency plant and animal production (Sikora, 2009b; Kowalski and Tabor, 1996). The condition for strengthening the position on the market, improvement of economic effectiveness of management and adjusting production to the requirements of clients is a quality and scale of supplying products which come from joint operation of individual farms. Agricultural production efficiency depends on many factors. However, it mainly depends on the production trend and technical back of a farm. Having modern machines and technical devices enables agricultural producers to apply new technologies and production techniques, which affect the increase of work performance, improvement of the quality and increase in the production scale (Gołębiewska, 2010).

Modernization of potentially developmental agricultural farms may be carried out by improving the current technologies of plant and animal production. Too slow progress of technical back modernization in Poland is related to unfavorable agrarian structure of Polish farms, which influences low competitiveness and management efficiency. As a result it leads to low work performance and high production costs (Szeląg-Sikora, 2010). In case of resources majority, an agricultural farm distinguishes in comparison to other economic subjects since it should have technical means, which many times it cannot rationally use on account of the level and nature of production. Proportionally low investment ability of agricultural farms, which results from the relation of purchase prices of technical means and merchandising prices of agricultural products is a significant issue in the resources majority. It is especially significant in conditions of fragmented Polish agriculture, characterized with low investment abilities, and on the other hand with the lack of opportunity for intensive use of machines on the limited area of particular farms. In these conditions proper management of the machinery and tractor park is of particular significance (Muzalewski, 2010). Small and individual farms have more difficulties in remaining on the European market since incomes from the agricultural activity cannot cover the costs of

purchase of modern equipment or modernization of an old technical base (Szeląg-Sikora and Kowalski, 2010). Not always "desire translates into ability" therefore development of agricultural mechanization depends on both demands as well as possibility of their fulfilment (Muzalewski, 2000). Shift from traditional farming to the modern one relates to the increase of the capital participation in the production factors resources (Kowalczyk, 2013). According to Johnson (2002) along with the economic development of the country, land as a factor of agricultural production loses its significance for the benefit of capital and material inputs. Moreover, proper management gains more significance. Efficient and effective functioning of farms is not possible without investing in fixed production means. It includes:

– purchase, mounting and repairs of machines, devices and tools for agricultural production, preservation and storing,
– construction or renovation of outhouses.

Prompt completion and quality of works depends on the equipment and condition of fixed assets and as a consequence - efficiency of the course of the entire production process in a farm (Kowalczyk, 2011).

Developmental and competitive farms thus need modern and efficient machines, and these need efficient and reliable tractors, while the age of a statistical tractor used in agriculture was 21 years in 2002 and its power was 32 kW (Muzalewski, 2004). Proceeding economic changes in the 90's affected restrictions with regard to purchase of tractors and agricultural machines. In those years, within the period of sudden economic changes, investments in agriculture dropped to the zero level. Then, they were gradually rising. However, according to estimates made by agricultural technique market analysts still the level of purchase is low and it does not ensure reconstruction of existing resources of possessed technical means. Admittedly, the trend is upward, because in 2001 in Poland 4,523 tractors were purchased in 2002 – 4,473, in 2003 – 7,491 and in 2006 – 8,017, but in comparison to the number of used tractors (approximately 1,300 thousand pieces), it proves depreciation of the used fixed assets (Lorencowicz, 2004; Rynek środków produkcji..., 2005). However, it should be emphasized that farmers buy bigger machines so the exchange is not equivalent. For example, power of the basic tractor purchased for a farm is 60-70 kW, which means that one new tractor replaces more than one old, due to better parameters. Besides, the existing market of used tractors and machines will satisfy the needs of many farmers who do not have enough cash (Lorencowicz, 2006).

According to the results of the Agricultural Census (2010) in farms there were:

– 1,471 tractors, i.e. by 9.9% more than in 2002,
– 152 thousand combine harvesters, i.e. by 23.6% more than in 2002.
– 28 thousand beetroot harvesters i.e. by 14.2% less than in 2002.
– 80 thousand potato harvesters i.e. by 1.7% less than 2002.
– 12 thousand forage harvesters i.e. by 9.4% less than in 2002.
– 496 thousand field sprayers i.e. by 5.1% more than in 2002.
– 52 thousand orchard sprayers i.e. by 14.0% more than in 2002.

In 2010 in the entire agriculture, 1,471 thousand tractors were recorded, i.e. by 9.9% more than in 2002, including in individual farms – 1,448 thousand pieces, i.e. more by 10.1%. Majority of tractors (1,394 thousand items, i.e. 94.8% in total) was in individual farms of the area above 1 ha of agricultural land. At a lowered number of farms and simul-

taneous decrease of the area of agricultural land, average area per 1 tractor decreased in relation to the results of the agricultural census and was 10.6 ha of agricultural land in comparison to 12.6 ha in 2002. In the group of farms up to 15 ha of AL the number of farms increased proportionally to the increase of the area of used land. The highest number of tractors was in the group of farms of the area of 10-15 ha AL – 220 thousand pieces, i.e. 14.9% of the total number of tractors.

At the further increase of acreage and simultaneous considerable decrease of the number of farms, the number of tractors decreased. In particular groups of farms up to 7 ha of AL, at the average less than one tractor was used in farm. In the group of farms of the area up to 5 ha per 100 farms there were 28.4 tractors at the average and in the 5-7 ha group, there were 90.5 pieces. In the farms above 7 ha, participation of which in the total number of farms was approximately 22.9%, more than one tractor was per one farm at the average. Number of farms increased from 1.1 pieces in the group of farms within 7-10 ha of AL to 4.7 pieces in the group above 100 ha of agricultural land. In 2010 farms, where more than one tractor was used, used approximately 78% of the total area of agricultural land, including 82% of the total area under crop. Acreage of grains cultivation in those farms was approximately 81% in the national area seeded with grains, respectively industrial crops - approx. 95% of fodder crops – approx. 88% and potatoes – approx. 65%. Within 8 years between agricultural censuses small changes in the tractor power structure were reported. Similarly to 2002, tractors with power from 15 to 25 kW and from 25 to 40 kW prevailed. Together they constituted in the total number of tractors 65.3% (in 2002 – 59.1%). Participation of tractors with average power 40-60 kW decreased from 27.6% in 2002 to 19.6% in 2010. Equipment of farms with tractors of great power, above 60 kW, increased slightly. They constituted 11.9% in the total number of tractors in comparison to 9.1% in 2002. Results of the 2002 Agricultural Census show great diversity of the equipment in farm tractors with regard to territory. The greatest number of tractors was listed in Mazowieckie Voivodeship (214 thousand pieces), Lubelskie Voivodeship (174 thousand pieces) and Wielkopolskie Vopivodeship (153 thousand pieces), which on account of the number of farms were on the 2nd, 4th and 7th position. Percentage share of agricultural lands in the above-mentioned voivodeships in the total area of agricultural land was also very high and was respectively: 12.9%, 9.1% and 11.6%. Simultaneously, headage of cattle and pigs in these parts of the country was at a very high level. Results of the census show at the same time, that in Kujawsko-Pomorskie Voivodeship, Podlaskie and Wielkopolskie Voivodeship, almost in each farm, at the average one tractor was listed. Per 100 farms in the above mentioned voivodeships, respectively 100.8, 98.4 and 94.3 tractors were recorded. A considerably lower level of equipment of farms in tractors was reported in Śląskie, Małopolskie and Podkarpackie Voivodeships. In those voivodeships, respectively 31.9, 41.4 and 41.9 tractors were at the average per 100 farms. Since 2002, changes in the structure of the cultivation area of main crops and progressing process of modernization in agriculture, influenced inter alia, the present state of equipment of farms in machines and agricultural devices. In comparison to the results of the previous agricultural census, at the maintaining domination of grains in the structure of area under crop and simultaneous considerable increase of the cultivation area of rapeseed, number of harvesters increased (by 23.6%). The downward trend of the area of sugar beet and potatoes influenced reduction of combines for crops harvesting, respectively by 14.2% and 1.7%. Moreover, the number of

fodder harvesters decreased by 9.4%. The highest number of combine harvesters, potato and fodder harvesters was recorded in the group of farms of the area 10-50 ha of AL and the constituted respectively 64.2%, 76.7%, 64.5% and 69.8% in the total number of each type of machines. In comparison to the results of the 2002 census, the increase in the farm equipment in field tractor sprayers was reported (by 5.1%). Majority of these machines (81.0%) was reported in total in the group of farms with the area within 3-30 ha of agricultural land. Considerable increase of the area of orchards by 33.7% in comparison to 2002 influenced the increase in the number of orchard sprayers – by 14.0%. At the same time, at so high increase of the area, the number of sprayers per 100 ha of orchards decreased to 14.3 in comparison to 16.8 in 2002. The highest number of sprayers (67.3%) due to specificity of production was reported in farms with the area of agricultural land within 3-15 ha. The area of orchards in these farms was over a half of the area of orchards in the country. In the list there is also a total number of sprayers, which may include not only machines used in plant protection (sprayers in use) but also for fertilization, irrigation and other farming purposes (Powszechny Spis Rolny, 2014).

Rising expectations of consumers and the agri-food industry, stronger competition on the agricultural market (at the over-production of food), place higher requirements for agricultural producers. They concern both the improvement of the quality of products as well as the rising need for the production volume. Only farms, which increase their area and introduce new technical and technological solutions will be able to meet those requirements. On one hand, high quality agricultural equipment decides on the increase of work efficiency, on the other hand rising precision of performance of particular elements of the technological process influences the quality of products to a high degree (Sosnowska, 2000). In this situation, one should expect that the changes which take place in the organizational and ownership structure will evaluate towards the number of farms which are able to execute these assumptions and in a given moment they will determine demand for modern agricultural mechanization means (Niewiadomski, 2012).

2.2. Space of agricultural production effectiveness

Agriculture is a significant sector of Polish agriculture, which is proved by the structure of use of land and structure of employment. Furthermore, it plays a significant role in the social and economic development of rural areas. These areas occupy over a half of the area of the country thus affecting shaping of the environment, determination of the land use trend and relations in occurring plant and animal species. In present times, we may observe modernization and specialization of agricultural production in Poland. Modern industrial methods applied in agriculture bring bigger economic advantages than traditional agriculture. However, many threats are negative for these methods. Therefore, effective agricultural production without losses on original areas and satisfaction of basic needs of future generations of producers and consumers is the aim (Znaczenie rolnictwa w gospodarce Polski, on-line, 2014).

Efficiency is a widely understood definition; however, it reflects quantity or quality effects of determined phenomena and depends on certain conditions and situations. Since 2004, direct subsidies have a crucial share in agricultural incomes in Poland thus efficiency

indexes were based on incomes. The aim of effectiveness of relations of agricultural farms with the surrounding is an assessment of the transfer scope of the surplus developed in agriculture. It is considered as means for development of farms. The concept of alternative costs which is applied in the assessment of effectiveness of farms relations with the surrounding causes difficulties in determination of alternative costs of unpaid work resources. The index of covering alternative costs of a farm by agricultural incomes allows assessment of competitive position of farms. Their income situation influences shaping of the level of this index. Additionally, direct subsidies influence the index, average level of payment and percentage rates, which decide on alternative costs of home equity (Grzelak, 2008).

Decrease of real agricultural incomes was caused by a strengthening role of market relations of farms. It led to weakening of the farms' position in the mechanism of market division; however, if farms had not undertaken activities aiming at the increase of economic activity it would have caused even greater decrease of incomes. These phenomena may indicate transfers of the added value developed in agriculture to its surrounding, i.e. non-agricultural sectors of consumers and budget (Woś, 2011).

Agrarian fragmentation of a country is a serious problem of the Polish agriculture. It directly or indirectly influences farmers' low incomes, low production efficiency, low crops, weak quality of products or setting – aside. Such organization of producers is a weak point of agriculture. Farmers, who generate produce, which are mainly of high quality, are forced to sell them to agents who dominate on the market. Products are also sold by farmers to processing plants or trade companies in a non-organized manner. Farmers, who have small batches of goods, which very often are not adjusted to the requirements of consignees sell them favorably. The Polish market in comparison to the EU countries, where producer groups constitute the main cell, is not well organized. Farmers in those countries due to association in groups may supply themselves with cheaper production means and sell their products for higher prices (Chlebicka et al., 2008). Present situation has been included in the common agricultural policy, which greatly influenced transformations of the agriculture structure. Grants to prices and technological innovations were supposed to increased productivity and production (Dick, 2003). On account of generation transformations and trend education of agricultural producers, one should assume that presently a considerable increase in innovativeness in agricultural sector, which is observed, results, inter alia, from the changes which take place within this scope.

Innovation is a process, in which a farm introduces a new or considerably better product or methods of its production and distribution. Innovation does not have to be a groundbreaking invention. Innovation depends more frequently on accumulating small progresses than on a greater technological turning point. Introduction of innovation in Polish farms is very important due to shaping of their competitiveness; it also confirms opinion that a given farm has capacity for development. Among innovations we may distinguish: technological innovations – they include new products and processes and considerable technological changes in products and processes; product innovations – it means production of high quality products; process innovations – it means implementation of new or considerably improved production methods or distribution of products; it may relate to changes of equipment, human resources, methods of work or combination of these changes; organizational innovations – they include many activities concerning organization of farms – organization of processes or manner of sale organization, distribution, storing, cooperation with

other economic subjects, etc. marketing innovations – it means that introduction of a new method, including considerable changes in the product image or its packaging, positioning of a product, promotion and price strategy. Marketing innovations aim at better satisfaction of clients' needs, entering new markets including the increase of farm incomes.

In agriculture, factors of innovativeness increase include the use of modern cultivation technologies based inter alia on the non-plough system, the use of simplified cultivation. It takes place, inter alia, through withdrawing inactive tools, which are replaced with active machines (or automatic) many times multi-task (in one crossing cultivation, fertilization, sowing). Changes of equipment within this scope concern both plant and animal production. Thus, we observe implementation of technological-process innovations. In case of product innovations in intensive agriculture high-yielding plant varieties and animal species of genetics, which allow achieving high unit production, (milk, livestock) are introduced. Implementation of precise agriculture based on aiming at optimization of crop at rational dosing of nutritious and fertilization components and plant protection is a significant element of innovativeness in intensive agriculture. Whereas in case of animal production, elements of innovative solutions of precise agriculture may be observed inter alia at rational - automatic dosing of fodder. In realities of Polish organic agriculture, where farms of unfavorable agrarian structure and multi-trend prevail, presently we mainly observe introduction of product innovations in the form of cultivation of plants resistant to pathogens. Observed changes concerning distribution of products may be considered as a success from the point of view of implementation of innovative solutions. In scientific works from this scope we find results, which confirm, that we deal with the management method of the organic food production chain based on local distribution of food. The observed development of organic farms allows assumptions that in near future the innovativeness process of this group of farms will speed up. Human capital may play here a significant role, because carrying out organic production requires high professional qualifications. Having appropriate knowledge will allow introduction of inter alia systems which support management in the form of computer applications and modern technical solutions, including precise agriculture elements. Undoubtedly, it would influence the increase in management efficiency and the decrease of nuisance of particular cultivation treatments (treatments – elimination of manual weeding). Looking with perspective in the present, new accession period 2014-2020 Common Agricultural Policy in the developed RADP project which is performed, indicates "Facilitation of the knowledge and innovation transfer in agriculture, forestry and rural areas". Therefore, RADP 2014-2020 assumes that supporting and coordinating units will be founded, i.e. Innovation, Networks Broker for innovation in agriculture and rural areas and Groups for innovation.

In the European Union, groups of agricultural producers play a significant role on the economic market. Groups through their activity influence improvement of agrarian structure, they construct market of specific products, influence concentration of supply of produce and cut off from the wholesalers monopoly. All these activities affect the drop in product prices and limit consumer's costs. Except for fragmentation of farms, having lands in few plots is a great disadvantage. It is estimated that it concerns approximately 5 million ha that is over 1/4 of the total area of agricultural land. At the average a family farm in Poland is composed of 6-7 plots, each of average area of 0.6-1.0 ha. Fragmented distribution of a farm, composed of few or even a dozen or so plots, frequently located far from

buildings, makes it difficult to properly develop technical means and mineral fertilizers (Struktura agrarna polskiej wsi, on-line, 2014). A popular problem of fragmentation of agricultural farms occurs mainly in the sector of individual farms. Majority of them does not produce for the market and the entire production serves for self-supply or designates more for supply than it sells. However, also in case of fragmentation of agricultural farms, a downward trend is reported. After 1990, the number of agricultural farms has systematically decreased. Among individual farms, the polarization process of individual farms, consisting in the increase of the number of the smallest and the biggest farms at the expense of the average ones, takes place. A constant process of increasing agricultural farms is visible. However, the pace of changes is still too small.

Area structure is one of the most important determinants of economic situation of farms. Old technologies are mainly used in small farms, where relations between labor resources and capital or labor and land are incorrect. As a consequence it leads to low quality of products, high costs and low incomes (Poczta and Wysocki, 2001). Efficiency of management according to Pawlak (1995) and other specialists of agricultural engineering depends on the organizational-economic situation on the supply and sale market of agricultural products. Instability of the market and prices fluctuations offered to producers cause unfavorable changes in the farms' production structure and scale. Purchase of specialist machines in this case is questioned although these machines increase the quantity of production and improve its quality.

Improvement of the market competitiveness of agricultural farms may indicate the increase of the index of covering alternative costs incurred by a farm. For agriculture it is below 1, which means that these are more effective ways of using production resources in comparison to agricultural activity. Improvement of effectiveness in farms was caused by decrease of inflation, the increase of the number of farms and small changes in alternative labor costs. Farms, which are better managed and better used, are in general agricultural farms, where hired labor resources are practiced (industrial form). Grzelak (2008) claims that market competitiveness may be limited with regard to development through increase of the payment level on the market. A synthetic index of effectiveness of agricultural farms relations with the surrounding, allows assessment of income effect of a farm on account of intensity of relations with the surrounding for a long-term period. This intensity is expressed in monetary units and describes the quality of generated processes. The lower this index is the higher are the chances to receive economic surplus transfer. Quoting production, which decreases export potential and caused consumer prices fluctuations shapes production stabilization in the conditions where supply is higher than demand. Global, state and regional conditions influence development of agriculture. It is related to a fast increase of demand for agricultural products and development of urban centers, which favor intensive agriculture (Wigier, 2010).

When comparing EU countries and their effectiveness in farms with reference to the surrounding, despite decrease of the effectiveness index in 1990-2006 changes in agricultural incomes did not differ significantly from economic activity of farms. According to this, one may assume that Polish farms are on the lower stage of production intensification. Improvement of market competitiveness of farm follows from rising average costs and in case of alternative costs with an alternative increase of income. Polish farms obtained a higher level of the above index since they obtained a lower level of remuneration. After

1995, effectiveness of agricultural farms related to the surrounding deteriorated considerably and it became notable. Price scissors index (improper level and prices relations) is considered to be the basic agent of the existing situation. The improvement took place due to alternative costs of agricultural farms through lowering capital costs. Following the Poland's integration with the EU, the situation with regard to farms effectiveness improved due to direct payments, in particular in bigger and specialist farms, where production resources were better used.

2.3. Space of financial external support

After our country entered the EU, Polish producers gained access to the European market, which was a positive outcome. Therefore, merchandising and competitiveness has risen. Moreover, structural funds and financial operational programmes from the European Union budget improve competitiveness of the Polish food production and modernization of farms and enterprises which adjust to present market conditions (Wigier, 2010). In the elaboration of applications for funding, suitability of machines for requirements concerning agricultural production technologies used in a farm is verified. Moreover, verification concerns adjustment of the tractor power or the machine performance to the scale and intensity of agricultural activity which is carried out (Zasady doboru maszyn rolniczych…, 2008). Meeting these criteria proves the rational selection of the machinery park for the farm needs and introduction of new equipment affects improvement of work organization, promptness of field treatments, the quality of mechanization works which are carried out as well as improvement of conditions and farmers; work safety (Kurek, 2007).

When comparing Poland with the EU countries on account of equipment with agricultural machines, Poland comes out better, when we consider the area of arable land per one machine, whereas on account of using the power per 1 ha our country is far behind since farmers use tractors with low power frequently dozen or so or even several dozen years old.

The role of union funds in shaping the present image of Poland cannot be overestimated. Polish farmers were included into a simplified system of direct payments which consisted in granting a financial support proportionally to the area of a farm and selected crops. Direct subsidies have a nature of annual payments for which the European Commission determines financial thresholds, within which payments may be carried out. Direct payments are granted to farmers, who have an identification number given by ARiMR (Agency for Restructuring and Modernization of Agriculture) (entry to the registry of producers) and have applied for payment. Application is filed every year to the 15^{th} day of May in district offices of ARiMR competent for the place of residence. Filing an application after a time limit results in the lowering of the amount, to which a farmer was entitled by 1% for each working day. If a delay is over 25 calendar days, the application is considered to be not accepted.

Also, in the context of funding technical back, union funds constitute a significant factor which determines investment capability of Polish farms. New perspective of subsidizing agricultural sector was determined mainly in the project of the Rural Areas Development Plan (PROW) which is divided into 16 activities and dozen or so sub-activities. In this program a particular pressure was placed on two areas: area related to investments and

construing competitive agriculture and the area related to ecology. Activities which are typically investment in nature are: "Modernization of agricultural farms" – with a budget over Euro 2.8 billion, "Restructuring of small farms" – almost Euro 750 million, "Bonuses for young farmers" – almost Euro 585 million, "Payment for farmers who transfer small farms" - over Euro 130 million and "Development of agricultural services" – almost Euro 65 million. The obtained financial means can be designated inter alia for:

– construction or modernization of buildings or structures which are used for carrying out agricultural activity or for preparing for sale agricultural products which are produced in a farm;
– purchase, including also installation of new machines, devices, including IT equipment along with software for running agricultural activity or for preparing for sale agricultural products produced in a farm;
– purchase, including installation or construction of elements of technical infrastructure directly influencing the conditions of running agricultural activity and preparing for sale agricultural products produced in a farm;

As a part of particular activities, maximum amount of aid, level of funding and necessity of meeting the so-called border values of economic sizes of farms is varied. For example in the measure "Modernization of agricultural holdings" the maximum amount of aid will be PLN 1,500 thousand or PLN 500 thousand, the level of funding up to 60% of costs of qualified operations in case of young farmers and group investments or to 50% of qualified costs in case of remaining operations. However, a farm has to achieve the economic size of at least the equivalence of Euro 6 thousand but not higher than Euro 250 thousand in order to apply for such type of subsidies. Maximum amount of aid granted to one beneficiary and per one farm, including realization of team projects as a part of sub-measure cannot exceed: PLN 900,000 – in case of the operation performed within the objective – development of piglets production, PLN 500,000 – in case of the remaining objectives, whereas, for investments not related directly to the construction, modernization of inventory buildings or adaptation of other buildings existing in a farm into livestock buildings or construction or modernization of fodder storehouses in farms, where animal production is carried out, cannot exceed PLN 200 thousand.

The measure "Bonus for young farmers" is the next example which in previous editions of RADP was very popular. It is an activity which is granted in the form of a bonus in the amount of PLN 100 thousand with 100% funding level. In this edition it is burdened with an economic size of a farm, i.e. it may not be lower than Euro 10 thousand and not higher than Euro 100 thousand.

When analyzing perspectives and possibility of funding technical back of a farm in a new subsidizing perspective within 2014-2020 one should emphasize that the discussed RADP program for the present term presently is in a project form and undergoes the last phase of public discussion, thus guideline which it includes may be modified.

The process of structural changes of agriculture and the surroundings of agriculture which has taken place after Poland's accession to the EU, has a decisive influence on the nature and directions of evolution of all segments of the agribusiness zone market in Poland, including the agriculture machines market, many times very modern and specialist. From a deficit market it transformed into a saturated market and the mechanism of its func-

tioning has features of the sustainable market, i.e. a market on which mutually related adjusting processes of demand, supply and prices shaping take place quite freely (Szeląg-Sikora, 2011). Factors which stimulate the increase of the demand for agricultural equipment are on one hand the necessity of reproduction of the used mechanization means resources and on the other hand - gradual increase of using financial means as a part of the Common Agricultural Policy of the European Union. The mechanization degree in the Polish agriculture however is still lower than in the developed countries of the Western Europe. Modernization of the machinery park and its rational use is essential because it will limit agricultural production costs and thus it will allow maintenance of the Polish agriculture competitiveness and of the entire food sector. Therefore, the agricultural machines market in Poland is perceived as prospective. The majority of the equipment requires to be replaced due to its wear and tear, and the European Union programs for agriculture development support favor investments in new machines. As a part of which, one may obtain funding for the purchase on the level of approx. 50% of the machine value. Companies which deal with the sale of agricultural machines as a part of sale, many times offer aid at obtaining European Union funds and after the purchase they guarantee the repair of equipment. It is estimated that the state demand in 2010 was approx. 200% higher than in 2000. In the first period of Poland's accession to the EU, in particular tractors were purchased and further the so-called accompanying machines or self-propelled machines. Presently, the trend has changed and sale of tractors is at the level of approx. 20%. Available data (Main Statistical Office, Agency for Restructuring and Modernization of Agriculture) indicate that approx. 30% of the purchased machines were funded by the European Union funds. Mainly farms, which carry out production at the level of 40 ESU (1ESU -Euro 1,200) of the economic viability, benefited from the subsidy. Dynamics of the increase of machine sale in Poland does not go hand in hand with the rise of the national production of machines, quite oppositely, it is estimated that the national production dropped by approximately 50% because it was displaced by foreign production. When analyzing the state market of agricultural machines, one should also pay attention to the process of shaping their prices. Within this scope 2004-2005 were crucial, when 22% VAT tax was introduced, before that purchase of machines was not taxed. It caused a dramatic increase in prices. However, availability of the European Union funds to a great scale allows compensation of this situation which is unfavorable for agricultural producers (Pawlak, 2012).

Rural areas are subject to the processes of constant changes caused by global and regional processes. Such management of changes is necessary which would make the citizens of rural areas beneficiaries of these processes and not their victims.

In order to do so, first of all we have to fully use developmental chances, which we have through the access to the European Union politics, both to the Common Agricultural Policy as well as structural policy. Founders of the Common Agricultural Policy aimed at creating a system which would stimulate food production at maintaining a proper level of life of agricultural producers and maintaining acceptable prices.

2.4. Dynamics of development of producer groups in Poland

As a result of system transformation, successive governments were not much interested in the aid for farmers in arranging common channels of agricultural products distribution. Moreover, they did not care for creating economic units grouping farmers, who deal with the same production branches. Excessive "protectiveness" of the state in the communist system and its complete lack in the post-communist system became the main reason for weak condition of agricultural producers' organization, which translated into the lack of non-competitiveness of the Polish agriculture on local and international markets (Szeląg-Sikora and Sikora, 2014). Farmers, producing on a small scale are on the lost position in advance. Usually, they sell produce to agents (rarely to processing plants or trading companies) for prices, which frequently fluctuate on the border of production profitability. If farmers want to carry out direct sale they have difficulties in the sale of produced goods. Although these products are of good quality, their small amounts and non-adjustment to clients' expectations create very unfavorable prices relations (Martynowski, 2010).

The system of organizations which associate farmers (called agricultural producers), food-processors and traders functions in the European Union. Effective management joins them and thus they may compete on global markets. Legal issues which regulate the problems of producer groups in the EU are included in the resolution no. 952/97. Polish provisions which regulate organization and functioning of the producer groups are modelled on solutions accepted by the EU and they are set forth in the act of 15th September 2000 on agricultural producer groups and their relations and in the amendments to other acts. The act defines that the following parties may organize in the agricultural producer groups: "Natural persons, who run a farm pursuant to the provisions on the agricultural tax and legal persons who run agricultural business activity relating to special branches of agricultural production (Journal of Laws, No. 88, item 983). Since 1st January 2007, also cooperatives have the possibility to run business activity as an agricultural producer group.

Creating an initiative of agricultural producer group aimed mainly at strengthening the institutional structure as the base of agriculture that is in the phase of agricultural production. These activities were designed to encourage farmers to adjust their manufacturing work to the standards dictated by the market, developing common production as well as later introduction of the manufactured articles to trade through demand concentration. These treatments should be preceded by common preparation of products for sale, creating the system of supply to wholesale consignees and also by creating common norms which refer to the information on products. These accomplishments were to facilitate functioning in new market realities and to influence natural environment protection (Journal of Laws No. 88, item 983).

Acknowledging a producer group as a form of economic organization is an essential and basic element of the market structure. A lower degree of perceiving a group as a legal form for the benefit of the economic organization form, may decide on its proper functioning. A good group organization, concerning cooperation of farmers and careful presentation of common economic undertaking is significant (Witosław, 2002). Undertaking cooperation by economic subjects is an example of integration.

In agricultural farms it is a horizontal integration, that is, creation of agricultural producer groups, which considerably improves their incomes (Łukasik, 2011). Cooperation of

farmers may constitute the basis for vertical integration and may improve the quality and efficiency of agricultural production (Krzyżanowska, 2011). Vertical integration consists in merging own business activity with other cells of a chain.

According to Małysz (1996) horizontal integration of farms, except for sale carries with it the following advantages: easier access to the market and scientific information, better bidding power on the market, carrying out common investments and simplified access to external sources of financing. A property component which leads to achieving profits from investments constitutes a common property of farmers, which is separated from individual properties, thus members still maintain economic independence. In our country, farmers' integration in the form of producer groups is still far from expectations of the Polish agriculture. A limited production potential and too low capital are problems of the majority of organized producer groups. An impeded access to external funding sources forces the groups to cooperate and to formalize the associations which were formed (Boguta and Siekierski, 2001). After Poland's accession to the EU, granting aid for newly formed agricultural producers groups has improved. Amendment to the act on agricultural producer groups and their associations of 18th June 2004 enabled membership in the group not only for natural persons but also for legal persons and organizational units, which do not have legal capacity (Journal of Laws 2004, No. 162, item 1694).

Requirements for a producer group to run business activity as an entrepreneur with a legal capacity are as follows:

- formed by minimum 5 producers,
- acting based on a memorandum of association,
- reaching a minimum size of annual goods production defined in the ordinance of the Ministry of Agriculture and Rural Development,
- revenues from the sale of a given product manufactured in member farms of a group, must constitute more than a half of revenues from the products sale (Journal of Laws of 2008, No. 72, item 424).

The minimum size of commodity production for this group is not the only reason of weak organization of producers with a small and medium potential of agricultural production. Also factors of awareness, economic, legal and organizational and counselling nature affect this. Farmers' team activities are a good way for improvement of agricultural production effectiveness in conditions of market competition. Farmers' cooperation causes structural changes in rural areas and concentration of production and capital. It leads to the necessity of creating and maintaining a producers' group by few members, since only this way producers may start to be important on the market. During the process of forming producer groups they need financial support and educational and advisory aid (Krzyżanowska, 2011). One of manners of securing farmers' interests in the division of income generated in the food chain is processing of produce by producer groups and then their sale. Participation in privatization of processing plants is another possibility of obtaining control over enterprises by farmers. A cooperative form, which associates active members and carries out their economic purposes, allows greater participation of agricultural producers in control of processing operations and sale of food products (Łukasik, 2011).

Producer groups develop in a varied pace in particular in the European Union countries. Participation of groups in the agricultural products purchase fluctuates within 25-80% and contribution in the supply of production means is 35-75%. The Community in particular

helps groups, which function on areas with a weakly developed agriculture and where farmers are weakly organized. The European Union suggests the producer groups the use of various forms of support such as:

– emergency dispositions, which consist in handing over not sold products to charity organization, the EU offers then guaranteed prices to producers,
– operating fund, which consists in collecting fees from producers, defined based on the amount of sold agricultural products,
– technical aid designated for the market research or training of farmers (Chlebicka, et al. 2008).

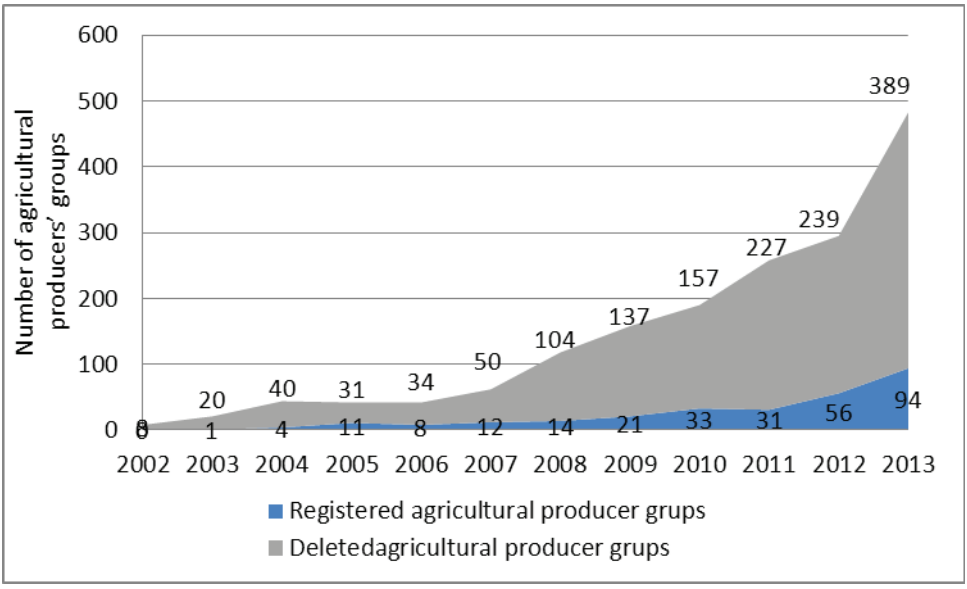
In order to stop farmers going out of cooperatives, many initiatives, inter alia creating new economic structures based on the commercial code, cooperative law, are initialized. Operation, the aim of which is to support grouped agricultural producers is a formation of producer groups, which consists in taking over a part of commercial margin (increasing incomes of agricultural producers). Organizing agricultural producers has also formal significance, because a part of instruments of market intervention within the framework of CAP is based on producer groups (Szumski, 2007).

In 2013 in the registries of Marshal Offices, 1,436 agricultural producer groups were entered, out of which 65% groups carried out business activity as limited liability companies, 31% in the form of a cooperative, 3% as associations, and only 1% in the form of society. Number of registered groups still raises. In 2010 157 groups were registered, in 2011 227 groups and in 2012 239. Over the last 10 years 2003-2013, the number of producer groups raised very dynamically – from 20 to 1,408 (fig. 2.1.).

Development of the number of agricultural producer groups is very regionally diverse. Despite expectations the highest number of groups in voivodeships with unfavorable agrarian structure (South Poland Region), was not reported, where formation of groups was therefore recommended. The highest number of agricultural producers was formed in the following voivodeships: Wielkopolskie (385 groups), Kujawsko-Pomorskie (127 groups) and Dolnośląskie (120). Agricultural producers' organization is the weakest in Świętokrzyskie and Małopolskie Voivodeship, where the number of groups is the lowest (fig. 2.2).

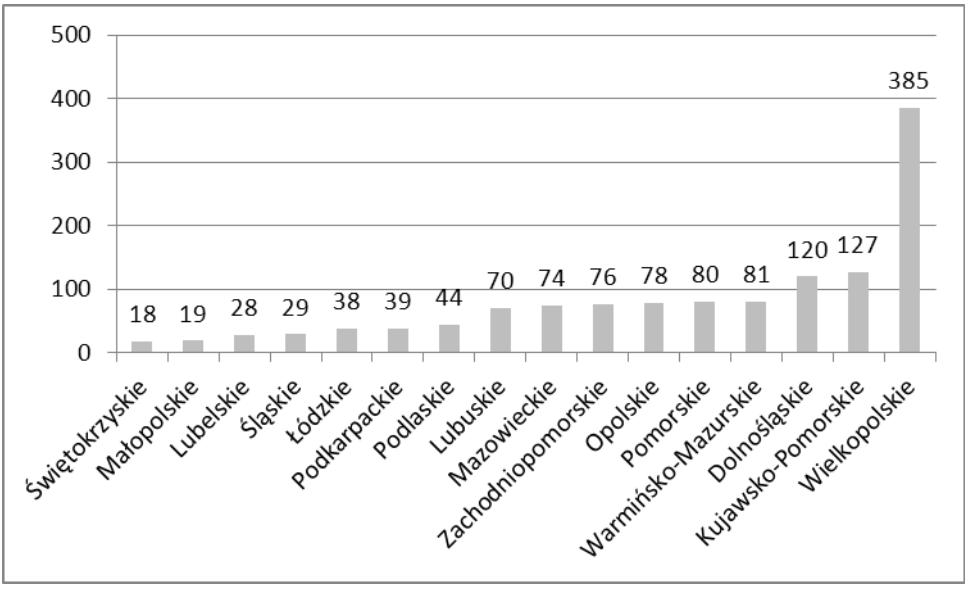
Agricultural producers groups are the most frequently founded by wheat grain producers and oil plants seeds producers, pig and poultry producers. Pig producers were organized in 295 groups, grain seed producers and oil plants seeds in 303 groups, poultry producers in 268 groups. Milk producers formed 102 groups; in the remaining branches the number of groups did not exceed 100 and many times even 10.

The highest number of members is grouped in the tobacco producer groups (11,122 members), pig producer groups (5,038), milk producer groups (4,187), grain seeds and oil plant seed producer groups (2,729) and poultry producer groups (1,535). In total in all agricultural farms in Poland there is 28,089 members (Grupy producentów rolnych. KSOW, on-line, 2014).



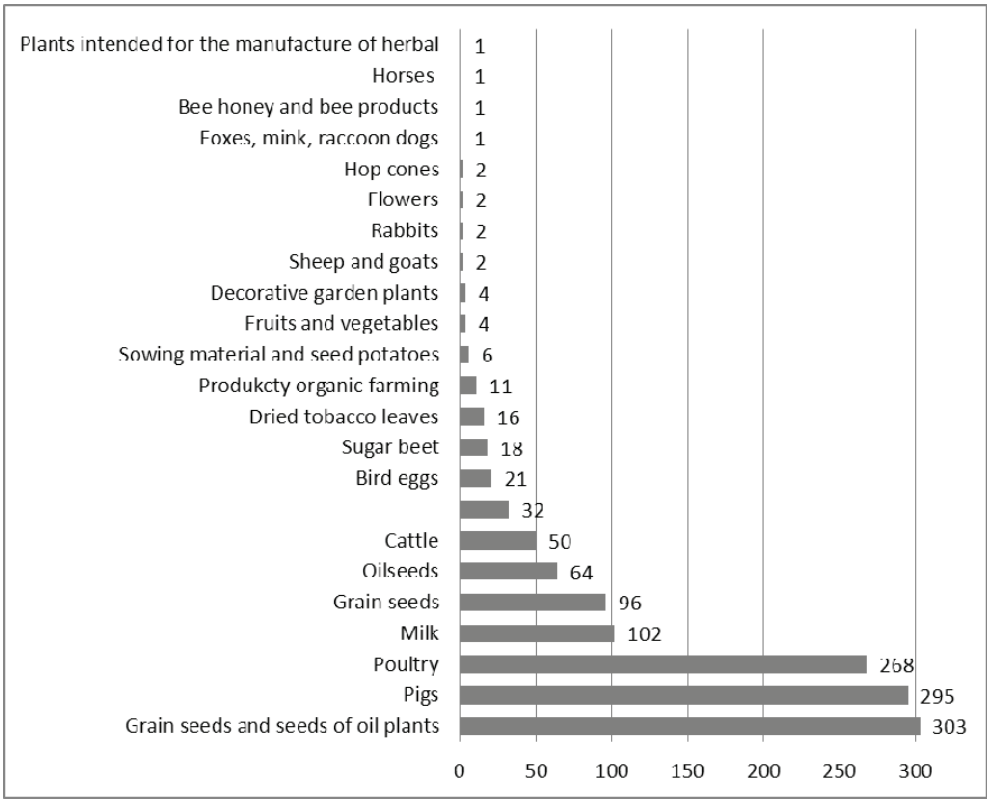
Source: author's own study based on: Agricultural producer groups. KSOW, 2014

Figure 2.1. Number of agricultural producers; groups provided by registries carried out by voivodeship/ Marshall offices



Source: author's own study based on: Agricultural producers' groups. KSOW, 2014

Figure 2.2. Number of agricultural producer group in particular voivodeships in 2013



Source: author's own study based on: Agricultural producers' groups. KSOW, 2014

Figure 2.3. Number of groups of agricultural producers divided into branches in 2013

Concluding the discussion on the legitimacy of agricultural producers' associations, one should say that the favorable sale of products, manufactured by its members for the processing company or directly to the outlet, is the most significant aim of the producer group. Market benefit includes higher amounts of long-term contracts concluded by producers for the supply of goods. Principles, which influence efficiency and endurance of the appointed group, are as follows: freedom of association, common operation aim, mutual trust and honesty. European Union, through financial aid, which it offers to its members, has become an alternative for development of Polish production space and it is a favorable factor – an external one.

3. ASSUMPTIONS AND OBJECT OF THE RESEARCH

This paper is a result of execution of the last stage of the research project N313759040 titled "Technical modernization of agricultural farms supported with European Union funds as a precondition for development of producer groups". Through detailed research in facilities accepted for the research, their effects and production resources as well as the level of absorbed funds were determined. The scope of the research included economic and strategic issues left from the past, obtained from farms of the Southern Poland, where, as in the entire country, the organization process in groups of agricultural producers is slow. The number of the grouped producers in comparison to the total number of farmers who produce for the market is still low; however, it increases every year. Moreover, not many groups fully use the possibilities of financial aid from the state and European Union funds. The most significant obstacle for undertaking a team activity is a tradition of single operation and no trust to any type of companies and weakly developed market information system. Small farms, and such prevail in the Southern Poland, have no possibilities, at such great competition, to enter the EU market with their agricultural products. Joint operation gives them such chance. Belonging to a group, also influences the increase of incomes of particular farmers. Group members will sell the products which they manufacture for a higher price. They may purchase means for a cheaper price. They also have an easier access to preferential credits. Belonging to a group facilitates farmers in the access to technological progress and market information (Cupiał, 2005; 2006). In future, the EU funds will be offered in majority to the agricultural producer groups and not to small single producers. Moreover, access to professional information, in case of producer groups seems to be easier. According to Wiener (1960) information in the most general meaning means any content taken from the external world. In 1999 Kotler widened definition of information as "knowledge gained any way". The term information is both used in a narrow and wide meaning. In the first case, it may be treated equally to data. We often think about information that it is each entry in the form of a number. Information differs from the data with a certain degree of selection and organization and preparation for interpretation. Preparation of information is an expensive process, however, in the next stages it is easily copied and spread e.g. bases of the space data of a certain area.

Following this path of understanding, this paper attempts to develop a model production space in the producer groups and comparative individual farms. Due to variability of factors, which characterize preconditions of functioning of producer groups and individual farms, one of the elements of the applied methodology was taxonomic analysis, based on which widely understood comparative analysis was carried out. Comparative research allowed recognition of the condition of the researched individual farms and producer groups as a group of objects. The applied course of calculation allowed comparison of the group units with the determined pattern unit, developed with the use of this method. The applied

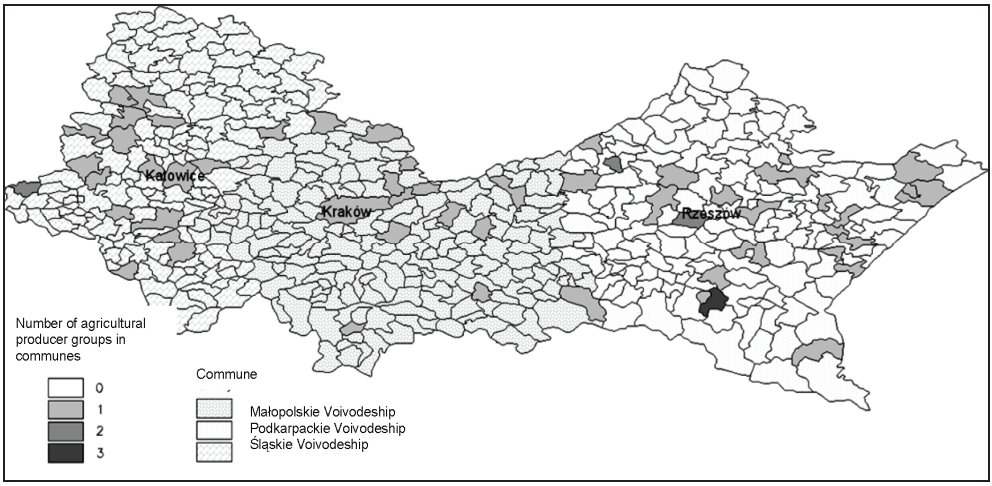
taxonomic method considerably enabled to objectivize evaluation and enabled to compare the discussed multi-feature objects on account of various criteria. Introduction of taxonomic measures allowed grouping the investigated facilities in the so-called typological groups and looking at the researched group from the point of view of similarities and differences. The basic concept accepted in taxonomy is a unit subject to classification, the so-called the object of research described by the set of features (factors) which characterize the object. Features which characterize the object are called diagnostic features, whereas the group of these features is called the set of diagnostic features. The paper includes selection of features and sets of diagnostic features, which were described with detail in the chapter 4 Methodology of work. For indexation and determination of optimal features of farms grouped in producer groups and farms acting individually a synthetic measure of development assumed after Hellig was applied. A synthetic measure is applied for aggregation of the group of input features for the common vector defined as the so-called index of total size.

The research defining model solutions of the producer group with reference to the production trend took place in the following stages:

- defining a data matrix,
- grouping features in groups
- checking conditions of positive correlation between features which form the group of features.
- standardization of features,
- calculation of indexes for the whole matrix and particular group of features,
- analysis of the obtained information,
- designation of optimal value for each group of features,
- designation of the optimal area of operation and the direction of preconditions of activity in the agricultural space of producer groups and individual farms.

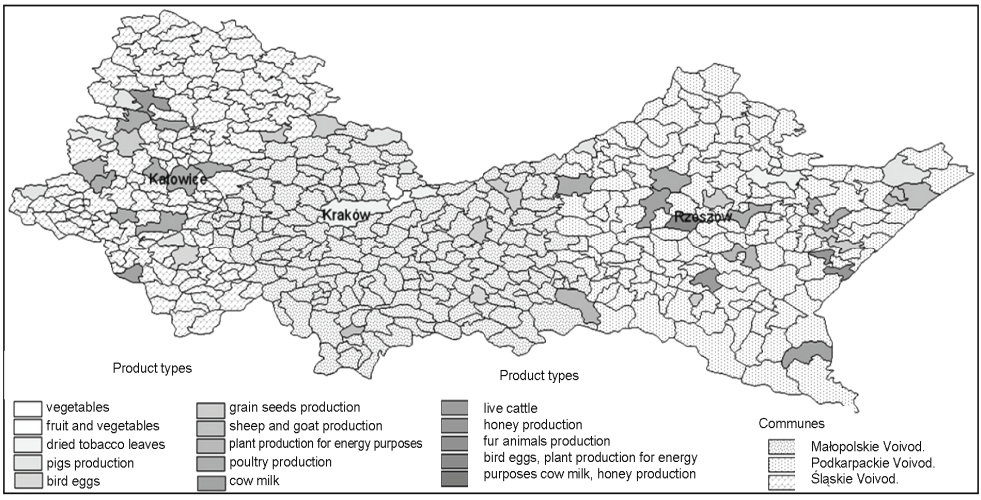
According to the accepted design assumptions of the executed grant N313 759040, a macro-region of the Southern Poland was included in the research area, where the selected producer groups and individual farms were located (accepted for the research as a comparative group). It is a problematic region on account of high agrarian fragmentation of operating farms. The space distribution of localization in the macro-region of the functioning producer groups also indicated that within this scope there is a need to improve activities aiming at intensification of the formation process of organized forms of agricultural producers cooperation (fig. 3.1.) Spatial distribution of agricultural producers groups in relation to the production type was presented in fig. 3.2.

In total 5 producer groups were covered by research. They were varied on account of the production trend and the number of members (farms) of particular groups. According to the accepted assumptions for comparative purposes, a comparative group of individual farms was selected, pursuant to the principle that each producer group responds to the "group" of individual farms. When selecting facilities for the research from the comparative group, they tried to qualify facilities which had similar management conditions. The same production trend and in a possible scope, also possessing comparable land resources, was accepted as the output criterion. Including the agrarian structure as a factor determining that particular farms are accepted for research was to emphasize the problem of agricultural fragmentation in the Southern Poland region.



Source: Szeląg-Sikora, 2013

Figure 3.1. Spatial distribution of the agricultural producers groups on the commune level



Source: Szeląg-Sikora, 2013

Figure 3.2. Spatial distribution of agricultural producer groups in relation to the production type

However, as early as during qualification of particular facilities, it occurred that this criterion not always can be satisfied, due to which, in some cases it was not taken into consideration (this remark relates to vegetable farms). However, taking into account the accepted calculation methodology and particularly – the manner of presentation of the obtained results, which assumes consideration of unit values, i.e. referred to a given calculation unit

and after the variables standardization, which was carried out – intensity of the investigated variable was provided. Based on the indicated intensity of diagnostic variables, a synthetic measure was constructed for comparison of farms divided on account of production trend and the manner of operation form. Thus, failure to meet the criteria of having such area of agricultural land by farms from producer groups and the comparative group of individual farms did not influence negatively the execution of the accepted research aims and gave an opportunity for diligent conclusion.

Division of the researched facilities into two groups, i.e., producer groups and individual farms was accepted as a main grouping factor. The mentioned groups were divided into communities on account of production trend. 95 farms in total were covered by the research.

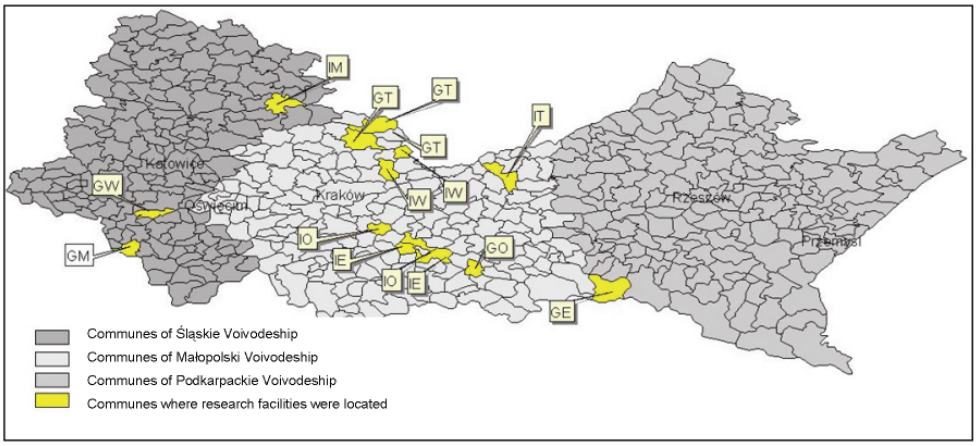
42 farms in total were grouped in the researched 5 producer groups. A given number of facilities, constituted each group; in relation to the production trend these were:

- milk production (M_{1-n}) – 6 farms,
- pig production (T_{1-n}) – 10 farms,
- fruit production (O_{1-n}) – 6 farms,
- vegetable production (W_{1-n}) – 5 farms,
- organic system production (E_{1-n}) – 15 farms.

In case of a comparative group of individual farms, division was as follows:

- milk production (IM_{1-n}) – 10 farms,
- pig production (IT_{1-n}) – 10 farms,
- fruit production (IO_{1-n}) – 10 farms,
- vegetable production (IW_{1-n}) – 10 farms,
- organic system production (IE_{1-n}) – 13 farms.

Figure 3.3 presents location of the researched facilities acc. to assignation to communes within which the researched farms were located. Distribution of facilities proves that this is the Southern Poland macro-region.



Source: Szeląg-Sikora, 2013

Figure 3.3. Location of the research facilities

Due to a small number of existing producer groups in this region of Poland, particularly in Małopolskie Voivodeship, there was no possibility to select a comparative group which is located directly next to producer groups included in the research. However, on account of the similar conditions of management in the whole region of the Southern Poland, described above, it was accepted that such a selection of facilities is admissible and methodologically correct. According to the source data obtained during the guided survey, farmers do not limit their markets and supply only to the local commercial space, thereby, they must be competitive not only in their own production space but also outside administrative borders of a commune, province and even a voivodeship. In some cases, the necessity of competing at the foreign markets was also pointed out.

Facilities, accepted for research, were varied on account of the possessed land resources. Within the producer groups, average area of the investigated farm was 42.54 ha AL and was two times higher than the average for a comparative group of individual farms (tab.3.1). Comparing the average area of AL of farms in particular groups within the production trends the biggest difference was in case of vegetable farms. Since, it was proved that the average area of a farm associated in the producer group was higher by 116.13 ha AL in comparison to the average area in the comparative group of individual farms. Only in case of the pig producer group, the average area of a farm was lower than in case of non-associated farms, the difference was 13.27 ha. The remaining comparisons proved that the producer groups associated farms of higher land resources. Only in case of the fruit producer group, the average area i.e. 9.66 was similar to the present average area of a farm in the country, in the remaining it was higher by few times and in case of vegetable production group it was 10 times higher.

Table 3.1. Average area of agricultural lands, soil and crops of the researched farms (ha)

Specification	Producer groups						Individual farms					
	Average	M	T	O	W	E	Average	IM	IT	IO	IW	IE
Arable land including:	24.96	19.12	29.98	-	123.50	1.09	15.21	22.84	40.02	-	7.56	8.38
Grains	13.34	6.08	26.23	-	49.50	0.93	11.83	17.39	37.14	-	2.48	4.92
Root crops	3.27	0.03	1.65	-	23.70	0.15	1.01	0.20	1.93	-	0.36	2.10
Industrial crops	0.81	-	1.50	-	3.80	-	0.19	0.05	0.95	-	-	-
Vegetables	5.54	-	-	-	46.50	-	1.24	-	-	-	5.18	1.08
Fodder crops	2.00	13.00	0.60	-	-	-	1.04	5.20	-	-	-	0.29
Grasslands	16.19	38.08	0.82	-	0.20	29.48	4.84	9.97	3.80	-	-	8.82
Orchards and plantations	1.39	0.07	-	9.67	-	-	1.49	0.05	0.26	7.71	-	0.03
Agricultural land	42.54	57.27	30.80	9.67	123.70	30.57	21.54	32.86	44.08	7.71	7.56	17.23

The owned land resources are the basic resource indispensable for carrying out agricultural production both plant and animal. In case of animal production farms, in the researched facilities, agricultural land constituted mainly the production area of the fodder back for the possessed livestock. In case of the livestock at the average for both comparative groups, twofold livestock was reported in facilities belonging to producer groups (table 3.2.) They included milk producer group, where the value of the discussed index exceeded 1 LSU·ha^{-1}AL. In farms with this production trend from comparative groups of farms operating individually, this value was at the level of only 0.64 LSU·ha^{-1}AL. For headage of pigs the index value was similar in both cases whereas in farms with an organic production system, it was almost identical.

Table 3.2. Livestock (LSU·ha^{-1} AL)

Specification	Producer groups						Individual farms					
	Average	M	T	O	W	E	Average	IM	IT	IO	IW	IE
Cattle	0.36	1.12	0.03	-	-	0.54	0.12	0.62	0.01	-	-	0.51
Pigs	0.12	-	0.71	-	-		0.09	0.01	0.54	-	-	0.02
Poultry	0.002	0.001	0.003	-	-	0.004	0.001	0.005	0.002	-	-	0.001
Total	0.482	1.121	0.753	-	-	0.544	0.211	0.645	0.562	-	-	0.551

A suitably equipped machinery park in a farm is an indispensable element for efficient execution of production processes in the agricultural sector.

In case of the investigated objects in each mentioned group, a farm tractor was reported in the machinery park. When comparing average values for associated farms and individual farms, the number of farms was similar and was approx. 2.25 items·farms^{-1} (table 3.3). Cultivation machines occurred in great number in each compared group, except for farms belonging to the fruit producer group where only 0.17 items·farm^{-1} of a plough was reported. Whereas, in a similar comparative group of farms acting individually, the situation was almost opposite. These facilities were equipped with cultivation machines such as ploughs, cultivators, cultivation aggregates, although the cultivation structure would suggest that such type of machines and devices is unnecessary. With regard to the remaining elements of the machinery park, in majority their presence in particular objects was compatible with the production trend.

The next index which characterizes the possessed elements of space of the technical back equipment is a gross replacement value of the machinery park.

The results presented in table 3.4. indicate that individual farms were characterized by a higher unit level of capital-intensiveness of the possessed machinery park. This remark relates in particular to vegetable farms, where per one hectare of agricultural land there was as much as PLN 43.02 thousand, for comparison in associated facilities it was only PLN 7.31 thousand. In the value structure of the mentioned index, tractors prevailed, except for fruit farms, where in both comparative groups delivery trucks played a significant role. According to information obtained during collection of source data, farmers from these

farms declared that presently it is a basic, indispensable transport mean. It relates both to the internal as well as external transport.

Table 3.3. Quantity of equipment of the machinery park in the investigated facilities (items·farm^{-1})

Specification	Producer groups						Individual farms					
	Ave-rage	M	T	O	W	E	Ave-rage	IM	IT	IO	IW	IE
Farm tractors	2.27	3.67	2.50	1.83	1.80	1.53	2.24	3.40	2.50	1.60	1.60	2.14
Delivery trucks	0.40	0.50	-	1.17	-	0.47	0.52	0.10	0.40	0.90	0.50	0.64
Trailers	1.48	1.33	1.90	1.00	2.00	1.27	1.67	2.40	2.00	1.20	1.00	1.71
Ploughs	0.93	1.00	1.30	0.17	0.80	1.00	1.02	1.20	1.30	0.70	1.10	0.86
Harrows	0.74	0.83	1.00	-	0.40	0.93	1.28	1.80	1.40	-	1.80	1.36
Cultivators	0.14	0.17	0.10	-	0.80	-	0.33	0.50	0.30	0.30	0.40	0.21
Cultivation aggregates	0.48	0.33	1.00	-	0.60	0.33	0.70	0.80	0.70	0.70	1.00	0.43
Manure spreaders	0.55	1.00	1.10	-	-	0.40	0.61	1.20	0.50	0.10	0.80	0.50
Fertilizer distributors	0.60	1.00	1.00	1.00	0.60	-	0.67	0.70	0.60	0.20	0.90	0.86
Waste removal vehicles	0.43	0.83	0.40	-	-	0.60	0.24	0.40	0.30	-	0.30	0.21
Manure loaders	0.48	1.00	0.90	-	-	0.33	0.46	0.90	0.40	-	0.30	0.64
Manure removal device	0.02	0.17	-	-	-	-	-	-	-	-	-	-
Grain drills	0.38	0.83	1.00	-	0.20	-	0.67	1.00	1.00	-	0.60	0.71
Single-seed drill	0.14	0.33	0.10	-	0.60	-	0.30	0.90	0.10	-	0.40	0.14
Automatic planting machines	0.14	-	0.50	-	-	0.07	0.48	0.10	-	0.80	1.00	0.50
Root plants harvesting combines	0.60		0.60		0.60	1.07	0.65	1.00	0.70		1.00	0.57
Sprayers	0.64	0.67	1.20	1.00	1.00	-	1.06	1.00	0.90	1.90	1.00	0.64
Firmer	0.31	-	0.60	-	1.20	0.07	0.28	0.80	0.10	0.10		0.36
Mowers	0.76	1.00	0.50	1.00	-	1.00	0.52	1.00	0.30	0.40	0.20	0.64
Tedders	0.45	1.00	0.10	-	-	0.80	0.65	1.70	0.60	-	-	0.86
Combine harvesters	0.29	0.33	1.00	-	-	-	0.31	0.80	0.40	-	-	0.36
Collecting presses	0.29	0.83	0.70	-	-	-	0.37	1.50	0.40	-	-	0.07
Self-collecting trailer	0.10	0.33	-	-	-	0.13	0.04	0.20	-	-	-	
Green forage cutters	0.05	0.33	-	-	-	-	0.06			-	0.20	0.07
Feed grinder	0.10	0.50	0.10	-	-	-	0.31	0.50	0.80	-		0.29
Sorter	0.10	-	0.40	-	-	-	0.11	0.20		-	0.10	0.21
Fodder mixer	0.19	-	0.80	-	-	-	-			-		
Milking machines	0.55	1.17	0.10	-	-	1.00	0.44	0.90	0.30	-	-	0.86
Coolers and cool storages	0.14	1.00		-	-		0.46	1.10	-	-	-	1.00

Table 3.4. Replacement value of the machinery park in the investigated objects (thousand PLN·ha^{-1}AL)

Specification	Producer groups						Individual farms					
	Average	M	T	O	W	E	Average	IM	IT	IO	IW	IE
Vehicles	0,71	0.67	-	8.19	-	1.22	1.88	0.26	0.71	9.54	5.62	2.59
Tractors	2.59	4.15	4.27	2.84	1.94	1.13	4.27	2.37	3.96	6.39	9.97	4.98
Self-driven	1.77	0.23	1.36	0.60	4.24	-	0.89	0.85	0.32	4.54	0.46	0.95
Remaining	5.30	6.26	9.20	4.49	1.13	7.70	10.37	12.53	4.73	8.03	26.97	13.29
TOTAL	10.37	11.31	14.83	16.12	7.31	10.05	17.41	16.00	9.72	28.50	43.02	21.81

Each business activity tends to generate profit, it also concerns agricultural production. However, efficiency of management in case of farms may be very varied despite similar conditions of management. In a unit view, an average higher value (i.e. 26.30 thousand PLN·ha^{-1}AL) was obtained by farms which are a producer group member, this value was over two times higher than in non-associated farms (table 3.5).

Table 3.5. Characteristic of the efficiency of farming in the researched facilities

Specification	Producer groups						Individual farms					
	Average	M	T	O	W	E	Average	IM	IT	IO	IW	IE
	(thousand PLN·ha^{-1}AL)											
Gross final production	26.30	9.54	14.46	34.40	55.33	6.62	12.39	8.76	10.58	28.37	36.61	7.96
Direct inputs	4.53	3.06	6.50	3.00	7.06	1.09	3.99	2.76	5.23	5.53	5.10	2.55
	(-)											
ESU	183,71	73.54	48.66	60.23	1184.65	33.54	35.94	39.13	46.80	34.92	47.29	18.52
	(man-hour·ha^{-1}AL)											
Work inputs	197.99	64.93	187.27	460.18	347.16	103.76	297.39	131.79	151.11	535.02	652.62	96.67
	(thousand PLN·man-hour^{-1})											
Index of technical back	0.12	0.20	0.13	0.04	0.04	0.15	0.15	0.18	0.13	0.07	0.11	0.25
	(-)											
Productivity index of fixed assets	2.80	1.00	1.07	2.34	8.90	0.66	0.90	0.59	1.11	1.05	0.97	0.81

Within compared groups according to the production trend, the highest value of this index was obtained by vegetable production facilities. As a result, in the producer group with this trend, the ESU number was obtained at the level of 1,184.65. Here it should be mentioned that this group is the biggest carrot producer in Poland and one of the most important in Europe. Maintaining agricultural production means incurring expenses, including work inputs. The highest level of work inputs with reference to vegetable production was reported in individual farms and with reference to horticultural production – in the associ-

ated farms. The result of farming is the value of the obtained technical back index and fixed assets productivity. In case of the technical back index, we can see how the capital invested in the machinery park translates into the incurred work inputs, whereas the index of productivity of fixed assets pictures relations between the value of the final production and the gross replacement value of the machinery park (table 3.5).

When describing objects included in the research, on account of the management specificity, of which presently the basic part are instruments of the executed Common Agricultural Policy, one should also include subsidizing of agriculture in the management space. The results presented in table 3.6. indicate that in many cases direct subsidies played their function, that is, they significantly compensated the incurred direct inputs at the average level of approx. 22-26%. Obviously, organic farms, where the value of the obtained subsidies exceeded the value of incurred costs diverge from this threshold, as it was in case of the producer group with this production system. The index of subsidies participation in the total value of standard gross margin explicitly proves that they played a more significant role in individual farms.

Table 3.6. The role of EU subsidies in the researched facilities.

Specification	Producer groups						Individual farms					
	Average	M	T	O	W	E	Average	IM	IT	IO	IW	IE
	(thousand PLN·ha^{-1}AL)											
Direct subsidies	1.00	1.01	0.93	0.73	0.82	1.31	1.02	0.97	0.94	0.73	0.79	1.39
	(%)											
Inputs compensation index	22.03	32.86	14.34	24.39	11.67	119.47	25.57	35.13	18.00	13.24	15.46	54.70
Index of subsidies participation in the standard gross margin	4.59	15.55	11.71	2.33	1.71	23.62	12.13	16.18	17.59	3.20	2.50	25.72
	(thousand PLN·ha^{-1}AL)											
Investment value in technical back	10.78	10.04	15.24	21.39	2.93	6.48	6.02	1.75	1.94	15.95	9.41	2.46
EU funds value	6.78	5.52	9.56	14.44	1.96	3.97	3.81	1.34	1.35	9.00	6.33	1.83

Next to direct subsidies, farms also use investment funds; in the investigated farms the subsidy mainly concerned purchase of a machine and tools. In the associated farms, it was at the average approx. 60% of total value of investment i.e. 10.78 PLN thousand·ha^{-1}AL (tab. 3.6). In the unit aspect, non-associated farms reached for almost two times lower subsidy to the purchase of the machinery park. Undoubtedly, it resulted from their lower investment capability, which translated into the amount of the required own input.

4. METHODOLOGY OF WORK

A key issue for solving the research problem is selection of diagnostic features and manner of their aggregation. In papers devoted to synthetic measures many times one may meet the demand of independence of variables finally used to create a synthetic index. However, on the other hand, the rules of statistic reporting provide a limited set of data accepted for the research in the scale of individual farms and in the agricultural producer groups. Thus, due to the costs of research, one should look for indirect solutions, that is, to look for a compromise between technical and statistical approach (Dąbkowski, 1998). The object of the research – the space of many variables of the technical back equipment, space of production efficiency and the space of the financial external support for agricultural farms – limits a formal criterion for the benefit of the technical one. From among the set of features, which describe individual agricultural farms and in the group of agricultural producers, which characterize the accepted taxonomic spaces, the set of diagnostic variables was selected, which constitute the basis of classification of the equipment level of technical back, production efficiency, financial external aid of agricultural farms aggregated to the level of the production trend. The selected level of objects results from the criteria of the Common Agricultural Policy, which explicitly determine the principles of the producer group on account of the same production trend of the associated individual farms.

The classification object (Ω) is a set of 95 objects located on the territory of three voivodeships of the Southern Poland and South-East Poland. Classification was carried out on the set Ω of objects from the entire research area, but also classification was carried out within particular classes of objects (individual farm and farms associated in the agricultural producer groups, without taking the production trend into consideration). In farm operating within the agricultural producer groups, the set (Ω_G) composed of 42 facilities was classified and in individual farm the set (Ω_I) was composed of 53 facilities.

For better understanding of phenomena, analysis was carried out on sets which referred to the production trend. Set of objects Ω_G was divided into set of objects in relation to the production trend, i.e.

- Ω_{GM} – farms associated in the milk producer group,
- Ω_{GT} – farms associated in the pig producer group,
- Ω_{GO} – farms associated in the horticultural producer group,
- Ω_{GW} – farms associated in the vegetable producer group,
- Ω_{GE} – farms associated in the organic producer group.

From the research point of view, organic farms are valuable comparative facilities due to great dynamics of development of organic production in Poland. Individual farms Ω_I were divided into set of objects in relation to the production trend, i.e.

- Ω_{IM} – individual milk farms,

– Ω_{IT} – individual pig farms,
– Ω_{IO} – individual horticultural farms,
– Ω_{IW} – individual vegetable farms,
– Ω_{IE} – individual organic farms.

The classification space of diagnostic variables (Φ) was selected as follows: the space of the level of equipment of technical back (Φ_1), space of agricultural production efficiency (Φ_2), space of financial external aid for agricultural farms (Φ_3).

From among the set of features defining the equipment level of technical back, 14 diagnostic variables were selected, which were presented in table 4.1. These variables allow fully and objectively picturing the analyzed facilities in the ownership space (Φ_1). Features were selected from the set so that the list of variables which represents them has the following properties:
– variables were weakly correlated between themselves,
– they were strongly correlated with rejected variables,
– the same significance was accepted for each variable.

Table 4.1. Diagnostic variables accepted for the research describing the space of the machinery park potential expressed with indexes of the gross replacement value of the machinery park (Φ_1)

X_j	Diagnostic variable	Dimensions of a feature
X_1	Tractors	(thousand PLN·farm^{-1})
X_2	Transport means	(thousand PLN·farm^{-1})
X_3	Loaders	(thousand PLN·farm^{-1})
X_4	Cultivating machines	(thousand PLN·farm^{-1})
X_5	Fertilization machines	(thousand PLN·farm^{-1})
X_6	Sowing machines	(thousand PLN·farm^{-1})
X_7	Machines for plant protection	(thousand PLN·farm^{-1})
X_8	Machines for interrows treatment	(thousand PLN·farm^{-1})
X_9	Green forage harvesting machines	(thousand PLN·farm^{-1})
X_{10}	Combine harvesters	(thousand PLN·farm^{-1})
X_{11}	Root plants harvesting combines	(thousand PLN·farm^{-1})
X_{12}	Milking machines	(thousand PLN·farm^{-1})
X_{13}	Machines for fodder preparation	(thousand PLN·farm^{-1})
X_{14}	Delivery trucks	(thousand PLN·farm^{-1})

The accepted diagnostic variables describing the space of the machinery park potential were calculated as **replacement value of the machinery park** (thousand PLN·ha^{-1}AL). A current value of new or of similar operational properties machines without including

their degree of physical and economic wear was accepted as their replacement value (Kowalski et al. 2002).

Further, from among the set of features defining the space of agricultural production efficiency 6 diagnostic variables were selected, which were presented in table 4.2. Detailed variables characterize the accepted space, indicating the production value in a particular year and the amount of expenses generated by the production process, which was carried out. Including the ESU index aimed at presentation of final effect of the conducted agricultural production. Accepting three subsequent variables, i.e. work inputs, index of technical back, index of fixed assets productivity, aimed at imaging the effectiveness of management through the lens of the incurred work inputs with reference to the level of equipment of the machinery park. These variables allow fully and objectively picture the analyzed objects in the ownership space (Φ_2). As previously, features were selected from the set so that the list, which represents them, met the border conditions i.e.:

– variables were weakly correlated between themselves,
– they were strongly correlated with rejected variables,
– the same significance was accepted for each variable.

Table 4.2. Diagnostic variables accepted in the research which describe the agricultural production efficiency (Φ_2)

X_j	Diagnostic variable	Dimensions of a feature
X_1	Gross final production (PK)	(thousand PLN·ha^{-1}AL)
X_2	Direct inputs on production (NB)	(thousand PLN·ha^{-1}AL)
X_3	European Size Unit of an agricultural farm (ESU)	(-)
X_4	Work inputs (NP)	(man-hour·ha^{-1}AL)
X_5	Technical back index (WT)	(thousand PLN·man-hour^{-1})
X_6	Index of fixed assets productivity ($W_{pśt}$)	(-)

Variables from the space which describes the space of agricultural production efficiency (Φ_2) were calculated according to the following methodology (Augustyńska-Grzybek et al., 1999):

Gross final production – calculated as a sum of the obtained plant and animal production value. It consists in: the main product value, side product value (only in case it was the object of market exchange), internal use value, subsidies to the product or to its cultivation area. Value of production in case of particular activities of plant production was calculated for 1 ha of AL of cultivation.

Direct inputs on production – included materials, raw materials and components used in the production process, which directly can be linked to a given production. Inter alia sowing material and planting material, purchased fertilizers, plant protection substances, growth regulators, insurance concerning directly a particular activity, specialistic costs can be included in the direct costs of plant production. The direct costs of animal production included: animals in particular types of activity, in order to replace a herd, fodder from outside the farm and own fodder, medicines and means as well as veterinary services.

Particular components of costs coming from outside the farm were calculated according to the purchase prices, whereas components of the costs generated in a farm (sowing material) according to the sale process "loco farm". The cost of planting material in case of perennial plantations is an exception (in case of plant production). For determination of this cost, the value of planting material was divided into the assumed number of production use of plantation. Own fodders from non-commodity products, which were estimated according to the direct costs incurred for their production constitute a next exception (in animal production).

Economic Size Unit of an agricultural farm was determined as a sum of gross margins of all activities occurring in the agricultural farm and expressed with the European Size Unit (ESU). This unit constitutes an equivalent of Euro 1200 (accepted mid-year currency exchange rate: Euro 1=PLN 4.2), (Augustyńska-Grzybek et al., 1999).

Work inputs *(NP)* – through work consumption of plant production should be understood as number of man – hour (mhr) necessary for 1 ha of crop during the entire production cycle. Labour consumption in farm animals husbandry is expressed with demand on man-hour per 1 item of animals of one species during a year (Fereniec, 1999).

Technical back index *(WT)*

$$WT = \frac{SP_T}{NP} \text{ (thousand PLN·man-hour}^{-1}\text{)} \tag{4.1}$$

where:

SP_T – value of technical production means (thousand PLN),

LI (NP) – labour force inputs (mhr).

Index of technical devices is a meter of live labor substitution with objectified labor and constitutes the relation of technical means of production value to the labor force inputs. Index of technical devices is higher if the production process is more capital-intensive and less labor-consumptive. Replacement value of the machinery park and mechanization services costs are included in the composition of technical production means (Kowalski et al., 2002).

Index of fixed assets productivity ***(Wpśt)****,* non-denominated index determines, what production value is per 1 unit of fixed assets value (Szeląg-Sikora, 2013).

$$Wp\text{śt} = \frac{PK}{SR} \tag{4.2}$$

where:

PK – gross final production value (thousand PLN·ha^{-1}AL),

SR – fixed assets value (thousand PLN·ha^{-1}AL).

Available EU subsidies determine present functioning of farms. Both these targeted and direct subsidies as well as investments i.e. operational, are the most frequently designated for purchase of agricultural machines and tools or construction or modernization of farm buildings. These presumptions induced the author to select a third space which defines the aspect of financial external aid for agricultural farms (Φ_3). In this space, direct subsidies

and their relation to incurred direct inputs were included, i.e. compensation index of inputs with obtained subsidies. This index pictures execution of the main statute aim of subsidies which is the degree of incurring direct costs generated by the performed production processes. The index of subsidies participation in the value of direct surplus is also significant because it indicates the nature of the researched facilities, i.e. whether these are farms informally called "only subsidized farms" or whether they are characterized by high potential of commodity production. In this space also the second type of subsidies was included, which aims at strengthening investment potential with fixed means (X_4, X_5). From among the set of features defining the space of external aid for agricultural farms 5 diagnostic variables were selected, which were presented in table 4.3. These variables allow fully and objectively picturing the analyzed facilities in the ownership space (Φ_3). Features were selected from the set so that the list of variables which represents them has the following properties:

– variables were weakly correlated between themselves,
– they were strongly correlated with rejected variables,
– the same significance was accepted for each variable.

Table 4.3. Diagnostic variables accepted in the research describing the space of financial external support for agricultural farms

X_j	Diagnostic variable	Dimensions of a feature
X_1	Direct subsidies (DB)	(thousand PLN·ha^{-1}AL)
X_2	Index of inputs compensation with obtained subsidies (%)	(%)
X_3	Subsidies share index in the value of direct surplus (%)	(%)
X_4	Investment value in technical back	(thousand PLN·ha^{-1}AL)
X_5	Funding investment from EU funds	(thousand PLN·ha^{-1}AL)

Subsequent three indexes were calculated according to the methodology (Szeląg-Sikora, 2013):

Index of direct inputs compensation with the obtained direct subsidies from the European funds *(WRD):*

$$WRD = \frac{DB}{KB} \cdot 100 \quad (\%) \tag{4.3}$$

where:

DB – direct subsidies (PLN thousand·ha^{-1}AL),
DB – direct inputs (PLN thousand·ha^{-1}AL),

Index of direct subsidies share from the European funds in the value of direct surplus (*WDN*):

$$WDN = \frac{DB}{NB} \cdot 100 \quad (\%) \tag{4.4}$$

where:
DB – direct subsidies (thousand PLN·ha^{-1}AL),
NB – direct surplus (thousand PLN·ha^{-1}AL).

Index of funding from the European funds of the executed investments concerning technical back modernization

$$FIEU = \frac{\text{Value of subisdy}}{total\ value\ of\ the\ investment} \cdot 100 \tag{4.5}$$

Direct subsidies, value of the investment in the machinery park and the amount of the obtained subsidizing for this purpose were accepted as values declared by respondents.

In the geometrical interpretation Ω is a set of apexes of vectors in *k* dimensional space of ownership Φ. These points should be divided into certain, determined in advance, number of groups of facilities which are similar to each other (homogeneous, uniform) units which belong to the remaining groups. The starting point for determination of potential of the investigated farms in the ownership spaces, described with the matrix of observation Φ(*X*) (1). For farms associated in agricultural producer groups in the ownership space Φ_1 this matrix will have dimensions 42×14 (42 farms, 14 variables), individual farms 53x14. Moreover, analysis on sets divided on account of the production trend in three spaces of ownership, schematic representation of analysis was presented in table 4.4.

Table 4.4. Schematic representation of interpolation of sets in the ownership space

Sets facilities	Ownership spaces		
	Φ_1	Φ_2	Φ_3
Farms acting in producer groups			
Ω_G	42x14	42x6	42x5
Ω_{GM}	6x14	6x6	6x5
Ω_{GT}	10x14	10x6	10x5
Ω_{GO}	6x14	6x6	6x5
Ω_{GW}	5x14	5x6	5x5
Ω_{GE}	15x14	15x6	15x5
Individual farms			
Ω_I	53x14	53x6	53x5
Ω_{IM}	10x14	10x6	10x5
Ω_{IT}	10x14	10x6	10x5
Ω_{IO}	10x14	10x6	10x5
Ω_{IW}	10x14	10x6	10x5
Ω_{IE}	13x14	13x6	13x5
Ω	95x14	95x6	95x5

$$X_{[nxk]} = \begin{bmatrix} x_{1,1} & x_{1,2} & x_{1,3} & \dots & x_{1,k} \\ x_{2,1} & x_{2,2} & x_{2,3} & \dots & x_{2,k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{n,1} & x_{n,2} & x_{n,3} & \dots & x_{n,k} \end{bmatrix} \tag{4.6}$$

Coefficient of variation *Vj,* calculated according to the following formula (4.7.) was assumed as a formal criterion of assessment of diagnostic features:

$$V_j = \frac{s_j}{\bar{x}_j} \geq \varepsilon \tag{4.7}$$

where:

V_j – coefficient of variation,
s_j – standard deviation *j* of this variable,
$\bar{x}_j$ – average *j* of this variation.

Construing synthetic measures requires the selected features to have higher variability than the arbitrary required number ε (in general ε=0.1 is accepted) (Woźniak, 2001).

Normalization of diagnostic variables

The problem of classification of farms due to many features and indexes, which can be used for description of the level of equipment and the production level is a typical problem of a multidimensional comparative analysis. The concept of taxonomic structure as a configuration of multi-dimensional space points, which is a set of objects characterized by various features. Determination of similarities between objects requires firstly bringing diagnostic features to comparativeness. It may be carried out through a typical procedure of variables normalization. Method of comparative analysis requires the use of variables expressed with the same measure units and of similar sizes (Kukuła, 2000). Following normalization of diagnostic variables which describe taxonomic space intensity of a given phenomenon within the set is compared, based on this the assumption that each variable is equally significant in the researched space has been accepted.

Normalization of variables is the most frequently carried out according to the formula (Grabiński, 1992; Borys, 1982; Kukuła, 2000):

$$z_{ij} = \left(\frac{x_{ij} - A}{B} \right)^p \qquad (i = 1,2...,n;\ j = 1,2...,m;) \tag{4.8}$$

where:

z_{ij} – normalized value of variable x_j for *i*-object,
xij – output value of *j*- variable,
n – number of observation,
m – number of variables,
A, B and p – parameters, which in relation to the manner of normalization, may assume various values.

Constant B in the formula, plays a function of a scaling factor, whereas constant A is a reference point, with the use of which, values of properties are shifted to the contractual zero. In the subject literature one may notice many ways of normalization transformations (Nowak, 1990; Sobczyk, 1995; Strahl et al., 1997). Selection of a normalization formula may influence the final results of conducted analyses.

The purpose of this treatment is removal of original name of features and bringing the scope of variability to similar dimensions. Further stage consisting in determination of synthetic index in the researched spaces of ownership requires such a normalization transformation. In the set of the accepted diagnostic variables, all were qualified as stimulants (their higher values allow qualification of a given object as a better one on account of the analyzed feature).

Standardization of diagnostic features was carried out by a certain modification of a formula (4.9), through replacing parameters *A* and *B* respectively with arithmetic mean and standard deviation (at the value p=1):

$$Z_{ij} = \frac{x_{ij} - \bar{x}_j}{S_j} \tag{4.9}$$

where:

i – number of an object,
j – number of a diagnostic feature,
S_j – standard deviation of a feature j,
x_{ij} – realization of j feature in the object i.

According to the standardization formula (4.9) variables were presented in tables from 10.1 to 10.30. The standardization which was carried out led to unification of all variables on account of their variability and location. Matrix of normalized input variables x_{ij} of dimensions $n \times m$ was obtained depending on the size of the set Ω and the size of space Φ.

$$Z_{[nxk]} = \begin{bmatrix} z_{1,1} & z_{1,2} & z_{1,3} & \cdots & z_{1,k} \\ z_{2,1} & z_{2,2} & z_{2,3} & \cdots & z_{2,k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ z_{n,1} & z_{n,2} & z_{n,3} & \cdots & z_{n,k} \end{bmatrix} \tag{4.10}$$

Precious property of transformed variables, which form matrix *Z,* is standardization of all its elements within the scope of $-\infty < Z_{ij} < +\infty$ and removal of input variable names. Multiplicity of standardization methods and existing formulas of normalization of diagnostic features in many cases may cause problems in selection of the most appropriate. Some authors, e.g. Borys (1980) and Grabiński (1984) suggest combining selection of the normalization formula with the selection of the aggregation formula (Woźniak, 2000).

As it was mentioned before, the aim of the research is to carry out classification which consists in linear ordering of the set of elements Ω with the synthetic measure

developed on the ownership set Θ; that is on determination of the linear hierarchy in this set on account of accepted criterion by diagnostic features. On this basis, for each pair of objects one may find, which of them is "better" from the point of view of a general criterion.

Synthetic measure of development as a criterion of linear ordering

The presented form of a synthetic measure of development is based on a general concept of distance, which may be defined as a distance of two points η_l and η_k in space *m*-dimensional in the determined system of positive weights (Woźniak, 2001; Sikora, 2009a).

It was accepted in the research that weights are the same for all variables, which gives us the same meaning for each synthetic variable. In the research, the form of synthetic measure of development was accepted after Hellwig as a square function of a general form:

$$q_i = 1 - \frac{d_{i(1)}}{d_{(0),(1)}} = -\frac{\left[\sum_{j=1}^{m} \alpha_j (z_{ij} - z_{(1),j})^2\right]^{\frac{1}{2}}}{\left[\sum_{j=1}^{m} \alpha_j (z_{(0),j} - z_{(1),j})^2\right]^{\frac{1}{2}}} \tag{4.11}$$

where:

$d_{i(1)} = d_(\eta_i$ i $\eta_{(1))}$ – distance between a disaggregated level of development of *i*-object η_i and disaggregated pattern of the level of development $\eta_{(1)}$,

$d_{(0)\,(1)} = d_(\eta_{(0)}\ \eta_{(1))}$ – distance between a disaggregated zero level of development $\eta_{(0)}$ and a disaggregated pattern of the development level $\eta_{(1),}$

α_j – weighting factor of a feature x_j.

Assuming in the research that α_j=1, giving each diagnostic variable the same weight, finally aggregated measure of development was determined according to the formula:

$$q_i = \left[\sum_{j=1}^{m} (z_{ij} - z_{(1),j})^2\right]^{\frac{1}{2}} \tag{4.12}$$

The accepted model of synthetization of features meets demands of measure standardized to <0.1> and linearly orders objects from the worst to the best with regard to the accepted criteria. Value of metrics $d_{i(1)}$, decides on the function values, i.e. distances of point η_i from the pattern level of development $\eta_{(1).}$ Increase of this distance causes decrease of the global result of assessment. Calculations of a synthetic measure after Hellwig were collectively presented in tables from 10.1 to 10.30 in column q_i.

The presented method of searching a synthetic measure based on the development pattern allows assessment of a taxonomic structure of a set of farms as a configuration of facilities in the multi-feature space of their ownership. Structure of facilities in the space classification of objects allows ordering objects which are closer or further to the accepted

pattern of development. Measure of development q_i determined for each object i forms a vector of aggregates in the form of a one-column matrix:

$$P_{[1xn]} = \begin{bmatrix} q_1 \\ q_2 \\ \dots \\ q_n \end{bmatrix} \tag{4.13}$$

Vector $P_{[1xn]}$ is a synthetic measure of a development which enables classification, with one number, multi-feature phenomenon, which is a potential of agricultural farms.

5. FARMS RANKING IN THE SPACE OF MACHINERY PARK POTENTIAL

5.1. Classification of farms associated in the producer groups in the space of machinery park potential

Construing a synthetic measure of development solved the comparability problem and the problem of ordering the researched objects on account of the level of phenomena, which seem to be unmeasurable. Apparent immeasurability results from the lack of possibility of measuring them with one measure. A phenomenon which is multi-dimensional in nature, and may be described only with the set of certain significant properties (features), is the level of farming potential of farms. The development measure developed by Hellwig allowed combining various information from the group of features and to assign them to the mentioned phenomenon aggregated with one synthetic measure. Indication of the synthetic index allowed preparation of the ranking of objects associated in the groups of agricultural producers, based on which, it was determined, which farms have a machinery park, which has the highest value of the investigated features from the space of ownership Φ_1.

The constructed Hellwig's measure assumes values from the range of <0:1>. For the analyzed entire set (Ω_G) in the space of diagnostic features, the potential of the machinery park (Φ_1), value of Hellwig's measure (q_i) was within qi ϵ <0.052-0.317>. If the value q_i aims at uniformity, gets closer to the pattern object, then the object from the collection (Ω_G) is more equipped on account of the level of multi-dimensional phenomenon. Values of development measures ordered according to the obtained sizes were presented in table 5.1.

Based on the developed ranking (table 5.1.) a pig farm from a producer group T_8 (q_i=max) proved to be the best object. This farm obtained the value of the development measure at the level of 0.317 and in comparison to the object which is second in the row (with the same production trend) this value was higher by 0.04. Object (T_8), which was on the first place in the investigated sample of 42 farms, which belong to farms associated in the agricultural producer groups may be considered as a leader for this set in the space of ownership (Φ_1). According to the accepted assumption, that an optimal mathematical formula aims at uniformity, one may assume that the object, which was at the first place in the global view is far from being perfect. Because it diverged from the mathematical formula, which assumes a synthetic measure at the level equal to 1. Its value of a synthetic index is lower by 0.683 from the accepted perfect mathematical pattern object.

Table 5.1. Ordered objects within the investigated producer groups based on the synthetic measure q_i for the space of ownership which defines the potential ofthe machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T_8	0.380	0.184	0.609	0.348	0.610	0.178	0.067	0.333	0.439	0.029	0.534	0.000	1.000	0.000	0.317
T_{10}	0.829	0.143	0.609	0.414	0.470	0.178	0.067	0.333	0.020	0.029	0.534	0.000	1.000	0.000	0.313
T_9	0.070	0.052	0.630	0.341	0.610	0.178	0.067	0.333	0.020	0.029	0.466	0.000	1.000	0.000	0.272
T_4	0.397	0.026	0.609	0.379	0.225	0.178	0.133	0.333	0.299	0.029	0.534	0.000	0.719	0.000	0.261
M_2	0.452	0.164	0.141	0.056	0.250	1.000	0.278	0.000	0.409	0.029	0.000	1.000	0.090	0.394	0.259
T_3	0.091	0.031	0.609	0.383	1.000	0.178	0.133	0.333	0.299	0.017	0.466	0.000	0.401	0.000	0.251
M_6	0.567	0.319	0.761	0.308	0.280	0.038	0.278	0.000	1.000	0.000	0.000	0.862	0.000	0.000	0.245
W_2	0.384	1.000	0.000	0.308	0.014	0.556	0.133	1.000	0.000	0.000	0.000	0.000	0.000	0.121	0.245
M_4	0.428	0.000	0.022	0.301	0.800	0.444	0.000	0.000	0.978	0.000	0.000	0.437	0.000	1.000	0.238
W_3	0.360	0.937	0.000	0.188	0.035	0.556	0.067	0.667	0.000	0.000	0.534	0.000	0.000	0.194	0.228
M_1	0.478	0.158	1.000	0.014	0.814	0.000	0.278	0.000	0.479	0.000	0.000	0.345	0.090	0.000	0.221
T_6	0.176	0.618	0.609	0.406	0.800	0.178	0.067	0.000	0.259	0.029	0.000	0.000	0.281	0.000	0.214
T_5	0.167	0.079	0.000	1.000	0.415	0.733	0.067	0.000	0.259	0.029	0.000	0.000	0.563	0.000	0.208
M_5	0.512	0.142	0.326	0.406	0.800	0.178	0.067	0.000	0.535	0.017	0.000	0.747	0.000	0.000	0.200
T_7	0.045	0.230	0.000	0.867	0.660	0.178	0.067	0.333	0.259	0.017	0.466	0.000	0.281	0.000	0.200
W_5	0.033	0.000	0.000	0.124	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.186
W_1	1.000	0.976	0.000	0.211	0.014	0.444	0.133	0.000	0.000	0.000	0.000	0.000	0.000	0.152	0.173
T_2	0.141	0.052	0.609	0.431	0.390	0.178	0.067	0.000	0.327	0.017	0.000	0.460	0.000	0.000	0.153
E6	0.088	0.545	0.000	0.214	0.220	0.000	0.000	0.000	0.248	0.000	0.534	0.402	0.000	0.485	0.142
E4	0.068	0.031	0.000	0.218	0.000	0.000	0.000	0.333	0.263	0.000	0.534	0.402	0.000	0.485	0.129
O5	0.037	0.048	0.000	0.376	0.035	0.000	1.000	0.000	0.020	0.000	0.000	0.000	0.000	0.394	0.126
W4	0.384	0.000	0.000	0.034	0.000	0.027	0.000	0.333	0.000	0.400	0.000	0.000	0.000	0.000	0.125

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
O1	0.068	0.214	0.000	0.000	0.035	0.000	1.000	0.000	0.020	0.000	0.000	0.000	0.000	0.394	0.122
E9	0.088	0.128	0.022	0.308	0.190	0.000	0.000	0.000	0.866	0.000	0.534	0.402	0.000	0.000	0.121
E2	0.088	0.047	0.000	0.130	0.000	0.000	0.000	0.000	0.267	0.000	1.000	0.402	0.000	0.485	0.118
E8	0.017	0.240	0.000	0.469	0.000	0.000	0.000	0.000	0.204	0.000	0.534	0.402	0.000	0.485	0.117
O3	0.037	0.048	0.000	0.000	0.060	0.000	1.000	0.000	0.020	0.000	0.000	0.000	0.000	0.394	0.112
O4	0.068	0.016	0.000	0.000	0.060	0.000	1.000	0.000	0.020	0.000	0.000	0.000	0.000	0.394	0.111
O2	0.020	0.016	0.000	0.000	0.035	0.000	1.000	0.000	0.020	0.000	0.000	0.000	0.000	0.394	0.107
E15	0.088	0.026	0.022	0.308	0.220	0.000	0.000	0.000	0.663	0.000	0.534	0.402	0.000	0.000	0.106
E11	0.088	0.256	0.000	0.022	0.000	0.000	0.000	0.000	0.226	0.000	0.534	0.402	0.000	0.485	0.104
T1	0.074	0.016	0.609	0.323	0.280	0.178	0.067	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.099
E7	0.088	0.026	0.022	0.218	0.000	0.000	0.000	0.000	0.160	0.000	0.534	0.402	0.000	0.485	0.096
E14	0.020	0.262	0.000	0.211	0.220	0.000	0.000	0.000	0.208	0.000	0.534	0.402	0.000	0.000	0.090
E12	0.085	0.240	0.022	0.022	0.220	0.000	0.000	0.000	0.212	0.000	0.534	0.402	0.000	0.000	0.086
E3	0.020	0.031	0.000	0.026	0.000	0.000	0.000	0.000	0.204	0.000	0.534	0.402	0.000	0.485	0.086
E13	0.088	0.219	0.022	0.022	0.190	0.000	0.000	0.000	0.090	0.000	0.534	0.402	0.000	0.000	0.078
M3	0.134	0.133	0.022	0.017	0.115	0.178	0.000	0.000	0.152	0.000	0.000	0.437	0.120	0.000	0.076
E10	0.068	0.026	0.000	0.211	0.000	0.000	0.000	0.000	0.168	0.000	0.534	0.402	0.000	0.000	0.064
E5	0.020	0.026	0.000	0.117	0.000	0.000	0.000	0.000	0.204	0.000	0.534	0.402	0.000	0.000	0.060
E1	0.020	0.016	0.000	0.022	0.000	0.000	0.000	0.000	0.204	0.000	0.534	0.402	0.000	0.000	0.055

Equipment of the technical back of farms associated in producer groups did not allow obtaining even half of the value of the development measure, not exceeding the value of 0.5. Objects, which were at four first places belong to the same group as groups of farms divided on account of the production trend and belong to a group of pig producers. On account of the order of places taken by particular farms, it was proved that the first five places were dominated by pig production farms and one farm from milk producer group (T_8, T_{10}, T_9, T_4, M_2). Thus, the level of technical back equipment in pig farms differs from facilities from the remaining sets. Next positions were taken in turn by objects from the set of pig, vegetables and milk producer group (T_3, M_6, W_2, M_4, W_3). The last positions taken by facilities belonging to the organic producer group result, inter alia, from considerably lower technical equipment of agricultural farms in comparison to the facilities from the remaining groups (table 5.1).

In order to compare changes of the development measure index q_i in the ownership space which describes the machinery park equipment of farms of the investigated groups of agricultural producers, the analysis was carried out on collections divided on account of the production trend (ranking within each producer group was carried out). Tables with detailed results were presented in the Annex (table 10. 1-5). In the investigated groups, the biggest difference of the synthetic measure (at the level of 0.665) was reported in the set of farms associated in the group of organic agricultural producers (Ω_{GE}), it proves the biggest variability of facilities in this group in the space Φ_1. Objects from the group of farms from the producer groups oriented to pig production (Ω_{GT}) were the least varied (at the level of 0.370). It proves that in this group, a comparable level of invested funds of the investigated features occurred. For example, in the milk producer group, the value of the discussed index was within 0.180-0.623 whereas in the fruit producer group it was on the comparable level i.e. within 0.120-0.692. In each analyzed group, one can notice a leader that is a farm, which in comparison to other farms from a given group, has decisively higher synthetic index. For example, in the vegetable producer group, the leader reached the value of the synthetic index at the level of 0.710 and the second farm – 0.522. A similar relation occurred with reference to the lowest values of the synthetic index in the space of the potential of the machinery park equipment. In the discussed vegetable group, a farm W_4 occurred, which decisively diverged from the average level of saturation with the machinery park potential, because its value of the synthetic index was only 0.125.

Further, calculations determining similarity of the investigated objects on axes in the ownership space Φ_1 (figure 5.1) were carried out. In the set of farms associated in the milk producer group, such machines were absent: machine tools for treatment of interrows ($1Z_8$) and root plants harvesters ($1Z_{11}$). It proves that farms of this group, which purposefully did not maintain machines, which cannot be used in fodder production or directly in milk, have become specialized. These farms considerably were based on roughage. The fact, that all objects from this collection have a high class milking machines and cooling machines for storing milk, also proves specialization ($1Z_{12}$). On this axis objects head to the pattern, that is to uniformity. Variable describing farm tractors, which reflects the level of capital invested in this type of technical means was the least varied. Within a collection of milk producers from six objects, five farms invested similar values of financial resources in farm tractors ($1Z_1$). Farm M_6 had a field chaff-cutter which renders services for the remaining farms of the producer group thus it was the most favorable on the axis of machines for green forage harvesting ($1Z_9$) Furthermore, this farm had invested the highest funds in farm tractors ($1Z_1$) and transport means ($1Z_2$).

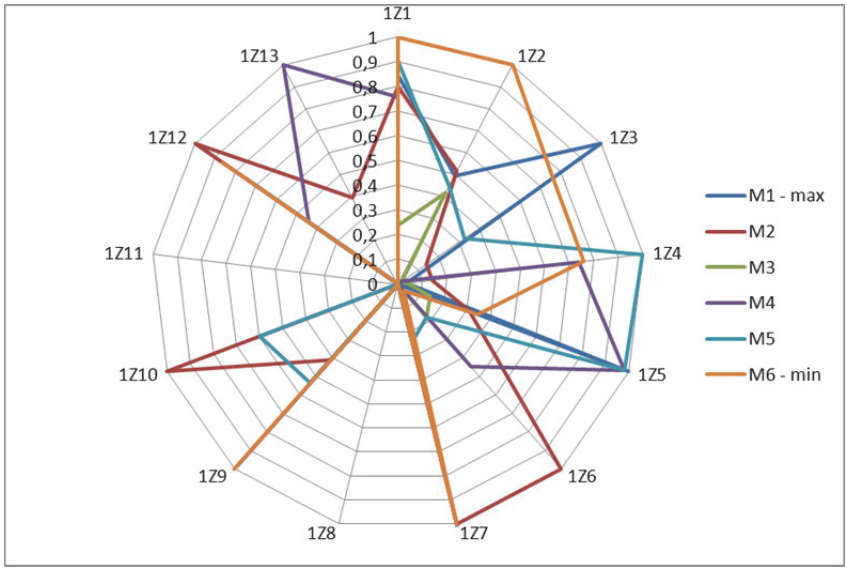


Figure 5.1. Positions of farms from the milk producer group (Ω_{GM}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

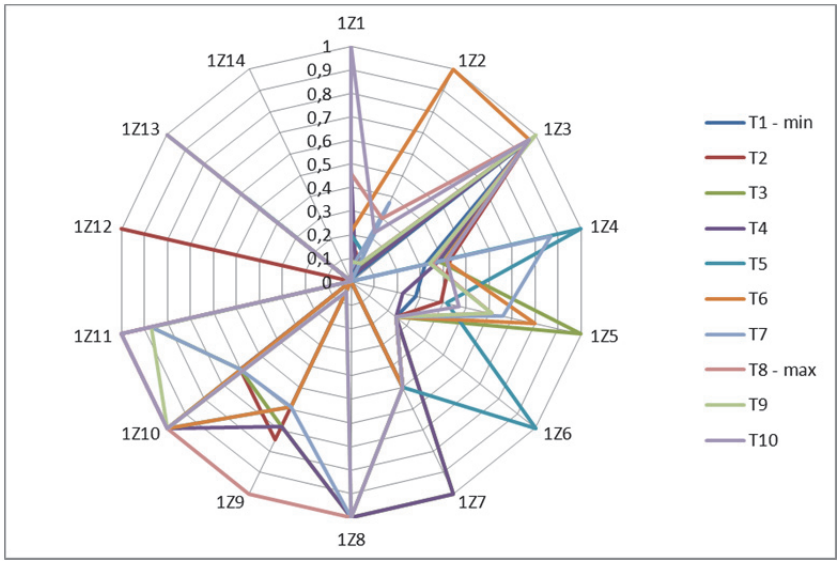


Figure 5.2. *Positions of farms from the pig producer group (Ω_{GT})* according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

In the investigated set of farms associated in the agricultural producer group, which are oriented to pig production, all facilities in the space of ownership of the machinery park potential proved a similar level of investing funds in the machinery park (figure 5.2). Suitable technical back equipment of agricultural farms constitutes the basic element of proper farming. In this collection, no invested funds in delivery trucks were reported ($1Z_{14}$). It seems to be justified because in the production process of pigs it is not a key technical mean, which considerably determines time limit and correctness of performing particular elements of the production process. Direct declarations made by beneficiaries show that the producer group uses services of transport companies at the sale of porkers. Two farms of the investigated group do not have machines for preparing fodder ($1Z_{14}$). It proves that these farms (T_1 i T_2) buy ready - made fodders for animals. Such approach seems to be justified because the producer group tends to buy ready-made fodders since as a one enterprise it has an opportunity to negotiate best prices. The smallest diversity was reported in the investigated group for a variable of loaders ($1Z_3$) while the biggest for a variable of a fertilization machine ($1Z_5$).

One of the weaknesses of Polish agriculture is a low level of use of the possessed machinery park and its unsatisfactory technical condition. One of the aspects of cooperation of the associated farms is common use of the possessed technical back, many times purchased in the form of co-ownership of particular group members. In many cases producer groups prove that the machinery park is selected rationally to the production trend. In case of the analyzed agricultural producer group Ω_{GO}, in space $\Phi_{1,}$ we observe a situation, when a machinery park is directly related only to the horticultural production (figure 5.3). Almost in each associated farm, the highest capital was invested in farm tractors ($1Z_1$). Delivery trucks ($1Z_{14}$) and other transport means ($1Z_2$) were also significant components of the machinery park from the point of view of their replacement value. Results presented in figure 5.3. indicate that in the analyzed group, farm O_6 was a leader on account of the amount of invested funds in particular components of the machinery park. In case of this facility, the level of the gross replacement value of particular elements, i.e. of farm tractors ($1Z_1$), machines for green forage harvesting ($1Z_9$) – used for treatment of interrows and delivery trucks ($1Z_{14}$) was the highest. Thus, it constituted a pattern for reference for the remaining farms from the collection $\Omega_{GO.}$

In case of the set of farms associated in the vegetable producer group (Ω_{GW}) we can see comparable features of the technical back with the previously analyzed horticultural producer group i.e. funds invested in the machinery park are directly related to the production trend of the association (figure 5.4). All farms of the set (Ω_{GW}) have similar machinery parks in the discussed space $\Phi_{1,}$ and mainly designated for production of root vegetables ($1Z_1$, $1Z_2$, $1Z_4$, $1Z_5$, $1Z_6$, $1Z_7$, $1Z_8$).

In one of farms from the analyzed group (W_3) the highest gross replacement value of root plants harvesting machines was reported. According to the source data collected during the guided survey this object had a self-driven combine for root plants harvesting (carrot) in its technical back. It was used for harvesting in each farm from the group, because its technical parameters (performance) enabled to carry out the harvesting process on time with maintaining high quality of the process. In case of farm W_5, presence of a combine harvester ($1Z_{10}$) was reported, which may seem to be opposite to the vegetable production trend of the group. However, it should be mentioned here, that cultivation of vegetables requires the use of proper rotation including grain cultivation.

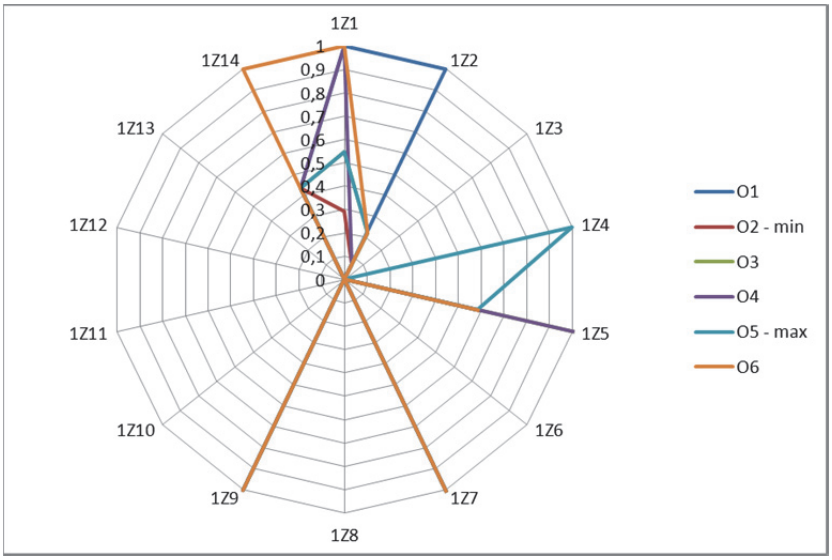


Figure 5.3. Positions of farms from the horticultural producer group (Ω_{GO}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

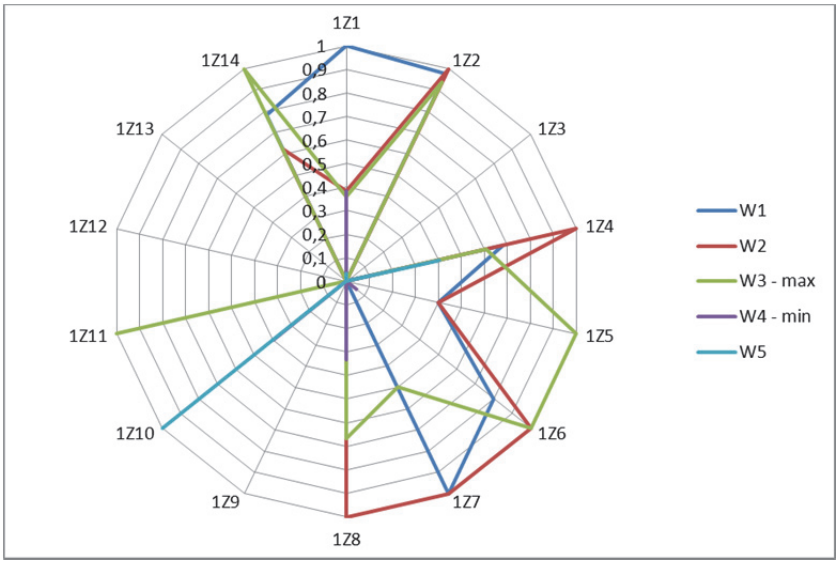


Figure 5.4. Positions of farms from the horticultural producer group (Ω_{GW}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

The use of grain crops, in the farmers' opinion prevents excessive development of harmful soil pathogens in root vegetables cultivation. At the total area of agricultural land in the investigated producer group 618.50 ha, having own machine for harvesting of grains seems to be justified, because it gives an opportunity for its rational use.

The analysis of the position of farms from the vegetable producer group (Ω_{GW}) according to variables in the ownership space describing the level of the machinery park equipment Φ_1 proves that the equipment of the investigated facilities complies with the production trend.

In case of the set of farms associated in the organic producer group, equipment of the machinery park is varied. It is typical of organic farms that do not have sprayers ($1Z_7$) (figure 5.5). Moreover, no devices for preparing fodder ($1Z_{13}$) were reported, although these were milk production farms. However, it follows from the accepted production system, in which according to organic farming principles, mainly roughage was used (green forage and hay). During summer season, cattle grazing dominated and in winter season hay was used as fodder. Low participation of grains in the disposition of crops (at the average the area they occupied was 0.93 ha at the average total area of agricultural land at the level of 30.57 ha) eliminated the necessity of having combine harvesters ($1Z_{10}$). Thus, using services was the best solution, this remark also relates to sowing machines ($1Z_6$). Organic farming is an agricultural production system, which is based on the use of natural processes which takes place within a farm. Therefore, a machinery park must be selected typically for the crops cultivated in a farm. One may notice that modernization of a machinery park in producer groups aims at rational use of a park.

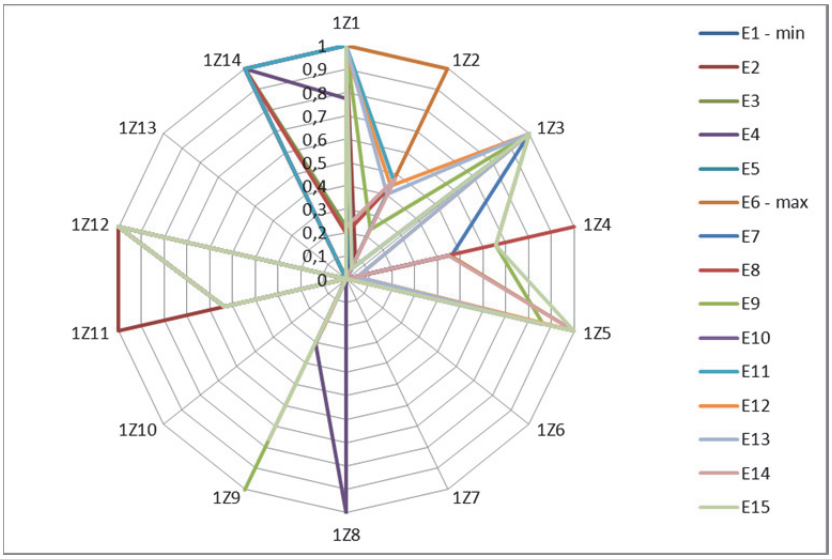


Figure 5.5. Positions of farms from the organic producer group (Ω_{GE}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

5.2. Classification of individual farms in the space of machinery park potential

According to table 5.2., milk production individual farm proved to be the best facility (q_i=max). Farm IM_5, obtained the value of the development measure at the level of 0.590 and in comparison to the object which is second in the row it obtained the development measure higher by 0.067. A facility, which was at the first place among the investigated sample of 53 individual farms, may be considered to be a leader for this set of individual farms in the space of ownership (Φ_1). According to the accepted assumption, that an optimal mathematical formula aims at uniformity, one may assume that the discussed object, which was at the first position in the global view is far from being perfect. Technical back equipment of farms from the set Ω_I did not allow obtaining the value of the development measure close to unity because the best facilities from this set did not exceed the value of 0.6. Taking into consideration the order of taken positions by particular farms, it proved that milk farms prevailed in the first ten positions (IM_5, IM_{10}, IM_9, IM_2, IM_8, IM_6, IM_7, IM_4) and two organic farms (IE_7,IE_6) and they reached the value of the synthetic index of q_i <0.322-0.590>. The subsequent positions were taken in turn by objects from the collection of pig farms, vegetable and horticultural farms. Thus, the conclusion arises that equipment of the technical back of individual farms oriented to milk production, is characterized with a higher level of investment of funds in its particular elements.

The fact that horticultural farms are on the last positions result inter alia from considerably lower quantity of the technical back in comparison to the facilities with other production trends of individual farms. It results from the adaptation of the park, with which objects are equipped, which many times remained after the previous manner of farming (non-trend farming). Thus, in these farms, there are machines and devices, which presently are not used but they generate costs of their maintenance. Individual organic farms took central positions in the ranking in the discussed space of ownership Φ_1. When comparing these objects with their equivalents from the organic producer group, they are more favorably in the surrounding of the remaining facilities Ω_G and Ω_I. Except the first ten positions with almost all facilities of milk individual farms, the next positions are taken by facilities with various production trends and one may not explicitly state, that any group takes the final or central position in the set (table 5.2).

In order to compare changes of the development measure index q_i in the ownership space which describes the machinery park equipment of individual farms the analysis was carried out on sets divided on account of the production trend . Due to the size of tables they were included in the Annex (table 10. 6-10). Value of aggregate measure referred to the entire set of individual farms was higher and was within the range of $q_i \in$ <0.144-0.903>. In the investigated groups of individual farms divided according to the production trend, the biggest difference of the synthetic measure (0.712) was reported in the collection of individual farms with horticultural production trend (Ω_{IO}) which proves the biggest diversity in this group. Objects from the group of individual farms were the most varied (Ω_{IW}). Thus we may conclude that the level of the machinery park equipment in these farms was at a similar level. In each group of individual farms divided according to the production trend, except for milk producing objects, there is a leader. For example, in the horticultural group of farms, the leader O_3, had the value of the synthetic index at the level of 0.857, whereas farms subsequent in the hierarchy of this group obtained the value of the discussed index at the level of only 0.381.

Table 5.2. Ordered objects within the investigated individual farms based on the synthetic measure q_i for the space of ownership which defines the potential of the equipment of the machinery park

Farm name	Normalized variables describing the level of the technical back equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IM_5	0.241	0.450	0.938	0.989	0.284	0.027	0.063	1.000	0.901	0.600	0.534	0.563	1.000	0.000	0.590
IE_7	0.610	0.894	0.000	0.338	0.443	0.622	0.260	1.000	0.133	1.000	1.000	0.475	0.107	1.000	0.523
IM_{10}	0.126	0.105	0.406	0.088	0.256	0.038	0.063	1.000	0.306	0.600	0.534	0.563	1.000	0.000	0.430
IM_9	0.204	0.426	0.406	0.345	1.000	0.011	0.063	0.000	1.000	1.000	0.534	0.688	0.143	0.000	0.418
IM_2	0.160	0.395	0.406	0.419	0.477	0.038	0.260	1.000	0.438	0.600	0.534	0.563	0.143	0.000	0.395
IM_8	0.102	0.136	0.938	0.352	0.250	0.038	0.063	1.000	0.445	0.600	0.534	0.563	0.000	0.000	0.388
IM_6	0.129	0.112	0.063	0.360	0.256	0.038	0.063	1.000	0.476	1.000	0.534	1.000	0.000	0.000	0.374
IM_7	0.105	0.024	0.000	0.342	0.290	0.567	0.260	1.000	0.234	0.600	0.466	0.438	0.143	0.000	0.336
IM_4	0.479	0.411	0.063	0.371	0.307	0.744	0.063	1.000	0.324	0.000	0.534	0.563	0.000	0.000	0.333
IE_6	0.045	0.024	0.406	0.610	0.477	0.011	0.000	1.000	0.040	1.000	0.000	0.475	0.107	0.000	0.322
IT_4	0.479	0.073	0.406	0.470	0.284	0.444	0.063	1.000	0.064	0.000	0.534	0.000	0.143	0.567	0.318
IM_3	0.099	0.379	0.063	0.342	0.477	0.038	0.063	1.000	0.327	0.600	0.534	0.563	0.000	0.000	0.316
IT_1	1.000	0.378	0.406	1.000	0.232	0.444	0.063	0.000	0.206	0.600	0.534	0.000	0.143	0.000	0.316
IE_5	0.073	0.065	0.000	0.451	0.000	0.456	0.260	1.000	0.152	0.000	0.534	0.000	0.857	0.000	0.308
IE_{12}	0.147	1.000	0.406	0.153	0.290	0.178	0.063	0.000	0.055	1.000	0.534	0.350	0.000	0.433	0.298
IE_{10}	0.188	0.385	1.000	0.101	0.040	0.000	0.260	1.000	0.006	0.000	0.000	0.350	0.000	0.567	0.294
IT_7	0.142	0.385	0.000	0.090	0.068	0.444	0.063	0.000	0.212	1.000	0.534	0.438	0.143	0.567	0.286
IE_2	0.103	0.411	0.000	0.141	0.040	0.204	0.260	0.000	0.000	0.000	0.534	0.475	0.857	0.433	0.246
IE_1	0.101	0.337	0.469	0.126	0.040	0.000	0.260	1.000	0.006	0.000	0.000	0.475	0.000	0.433	0.238
IW_5	0.586	0.048	0.063	0.878	0.909	0.027	0.260	0.000	0.000	0.000	1.000	0.000	0.000	0.567	0.230
IE_3	0.166	0.443	0.063	0.570	0.477	0.000	0.063	0.000	0.018	0.600	0.534	0.475	0.000	0.433	0.225
IW_4	0.065	0.180	0.000	0.766	0.977	0.733	0.063	0.000	0.052	0.000	0.466	0.000	0.000	0.567	0.222
IE_9	0.078	0.385	0.406	0.622	0.232	0.000	0.000	0.000	0.024	1.000	0.000	0.475	0.000	0.000	0.217
IE_4	0.103	0.411	0.000	0.143	0.040	0.204	0.260	0.000	0.000	0.000	0.534	0.000	0.857	0.433	0.214
IT_5	0.516	0.220	0.406	0.760	0.284	0.444	0.063	0.000	0.091	0.000	0.534	0.000	0.143	0.000	0.212
IT_2	0.435	0.081	0.406	0.406	0.216	0.444	0.063	0.000	0.000	0.000	0.000	0.438	0.143	0.533	0.211

Farm name	Normalized variables describing the level of the technical back equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IE_8	0.479	0.443	0.000	0.336	0.056	0.000	0.938	0.000	0.040	0.000	0.534	0.475	0.000	0.433	0.208
IT_6	0.459	0.385	0.000	0.084	0.318	1.000	0.063	0.000	0.000	0.000	0.534	0.438	0.000	0.000	0.205
IE_{11}	0.496	0.655	0.406	0.032	0.284	0.178	0.000	0.000	0.095	0.000	0.000	0.788	0.143	0.000	0.204
IW_{10}	0.102	0.024	0.000	0.467	0.949	0.038	0.938	0.000	0.000	0.000	0.466	0.000	0.000	0.567	0.200
IW_3	0.045	0.040	0.000	0.307	0.977	0.000	0.063	0.000	0.000	0.000	0.466	0.000	0.857	0.000	0.200
IT_3	0.479	0.399	0.000	0.466	0.068	0.444	0.063	0.000	0.263	0.600	0.000	0.000	0.143	0.000	0.198
IM_1	0.045	0.088	0.063	0.576	0.477	0.038	0.063	0.000	0.306	0.000	0.534	0.563	0.000	0.567	0.196
IO_3	0.082	0.281	0.000	0.021	0.227	0.000	0.260	1.000	0.062	0.000	0.000	0.000	0.000	0.567	0.179
IW_2	0.147	0.437	0.000	0.715	0.227	0.011	0.063	0.000	0.052	0.000	1.000	0.000	0.000	0.567	0.158
IT_{10}	0.093	0.433	0.000	0.034	0.000	0.444	0.000	0.000	0.113	0.600	0.534	0.000	0.000	0.000	0.150
IW_7	0.021	0.378	0.063	0.677	0.977	0.038	0.260	0.000	0.024	0.000	0.466	0.000	0.000	0.000	0.150
IW_8	0.516	0.048	0.000	0.462	0.949	0.011	0.260	0.000	0.000	0.000	0.466	0.000	0.000	0.000	0.146
IO_6	0.142	0.281	0.000	0.491	0.000	0.000	1.000	0.000	0.024	0.000	0.000	0.000	0.000	0.533	0.134
IT_9	0.110	0.459	0.000	0.342	0.000	0.444	0.063	0.000	0.054	0.000	0.534	0.000	0.143	0.000	0.125
IT_8	0.078	0.411	0.000	0.544	0.000	0.444	0.063	0.000	0.000	0.000	0.000	0.000	0.143	0.433	0.122
IW_6	0.075	0.048	0.063	0.168	0.949	0.011	0.260	0.000	0.024	0.000	0.466	0.000	0.000	0.000	0.119
IE_{13}	0.024	0.395	0.000	0.552	0.216	0.178	0.000	0.000	0.044	0.000	0.000	0.350	0.143	0.000	0.108
IO_4	0.123	0.281	0.000	0.480	0.227	0.000	0.260	0.000	0.000	0.000	0.000	0.000	0.000	0.567	0.099
IW_1	0.021	0.073	0.000	0.697	0.977	0.000	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.091
IO_9	0.064	0.281	0.000	0.480	0.091	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.567	0.091
IO_2	0.126	0.281	0.000	0.491	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.567	0.090
IO_7	0.102	0.281	0.000	0.480	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.567	0.088
IO_5	0.102	0.281	0.000	0.491	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.533	0.086
IW_9	0.061	0.024	0.000	0.708	0.068	0.000	0.260	0.000	0.000	0.000	0.000	0.000	0.000	0.567	0.083
IO_8	0.123	0.281	0.000	0.021	0.000	0.000	0.323	0.000	0.062	0.000	0.000	0.000	0.000	0.567	0.079
IO_{10}	0.123	0.428	0.000	0.480	0.000	0.000	0.385	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.065
IO_1	0.082	0.281	0.000	0.021	0.000	0.000	0.323	0.000	0.024	0.000	0.000	0.000	0.000	0.433	0.065

In the discussed set Ω_{IM}, where the synthetic index was the least varied, in the first farm in the ranking, its value was 0.724 whereas in the following facilities this value was at the level of 0.490. The described positioning of particular farms of the discussed group pictures the range within which the value of synthetic measure is located, i.e. inter alia 0.170 to maximum 0.724. The biggest differences were reported between leader – M_5, and the second farm in the ranking of this group – M_4. In more detail, 8 of 10 farms were within 0.490-0.248 and the average difference between the positions taken by these farms was at the average only 0.030.

All farms of the set (Ω_{IM}) have a similar machinery park of wide designation (figure 5.6.). The smallest diversity in the researched set (Ω_{IM}) was reported for the variable which describes transport means ($1Z_2$). One farm IM_2 has half more funds invested in farm tractors ($1Z_1$) whereas only one (IM_5) farm was equipped with a delivery car. The analysis of the machinery park of individual milk farms allows stating that the equipment of the researched facilities is non-oriented. These are machinery parks, which were adapted to the production trend. Many of these machines are obviously not used at the normative level. Having a full machinery park by a farm, many times is not justified and does not comply to the present trends in the developed countries which tend to diverge from possessing expensive specialist machines (i.e. field chaff cutters, combine harvesters) for the benefit of using mechanization services of external subjects. Thus, limitation of own mechanization costs for the benefit of costs from the purchase of mechanization services, takes place. Farmers' access to modern technical solutions which condition higher quality of cultivation technology is a significant, favorable element, which as a result translates into size and the quality of the product.

Individual pig farms like a set of milk farms have a machinery park of a wide designation. Oppositely to the set of farms associated in the pig producer group where farms only had a technical back related to the production trend. According to figure 5.7. for transport means dominated ($1Z_2$) loaders ($1Z_2$), cultivation machines ($1Z_3$) and fertilization machines ($1Z_4$). No delivery trucks ($1Z_{14}$) were reported in any farm. Modernization of farms requires verification of farm models in order to determine dependencies, which may be used in agricultural practice, in the production intensification processes and rationalization of technical means exploitation, in various groups of objects oriented on account of the performed production.

In case of the set of farms associated in the horticultural producer group, we can see comparable features of the technical back with the horticultural production i.e. funds invested in the machinery park are directly related to the production trend of objects. In the discussed case, it particularly concerns three elements i.e. farm tractors ($1Z_1$), transport means (inter alia trailers, forklift trucks) ($1Z_2$) and delivery trucks ($1Z_14$), figure 5.8. All farms of the set (Ω_{IO}) have a similar machinery park, in majority designated for horticultural production. No machines for traditional grain cultivation or root crops, were reported, therefore one may assume that like in case of the previously discussed fruit producer group also in individual fruit farm we deal with a rational selection of technical back. The analysis of equipment with the machinery park with horticultural production trend allows determination that the equipment of the researched objects is in accordance with the production trend. Thus, the presumption that farms where agricultural production is limited to the plant production branch are usually better equipped has been confirmed.

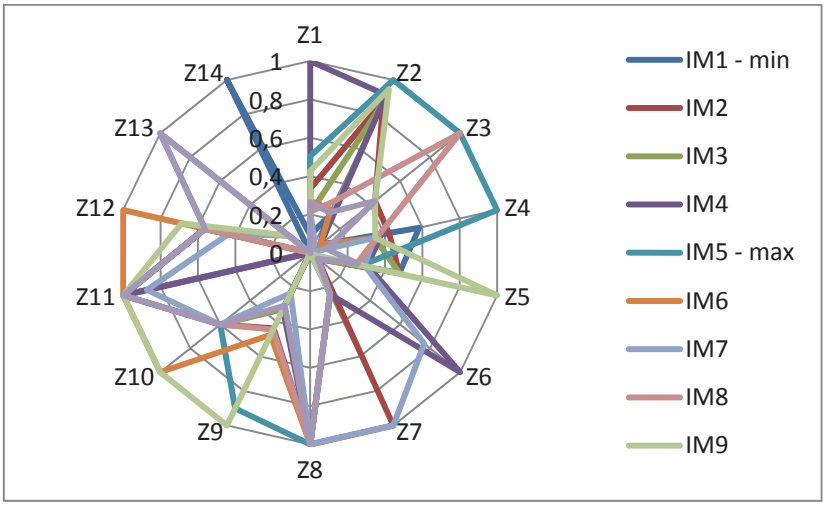


Figure 5.6. Positions of individuals milk farms (Ω_{IM}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

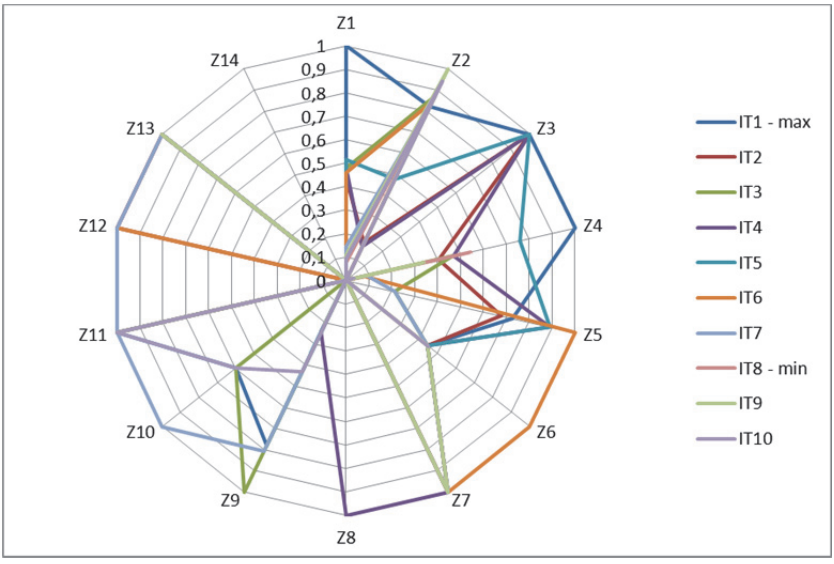


Figure 5.7. Positions of individual pig farms (Ω_{IT}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

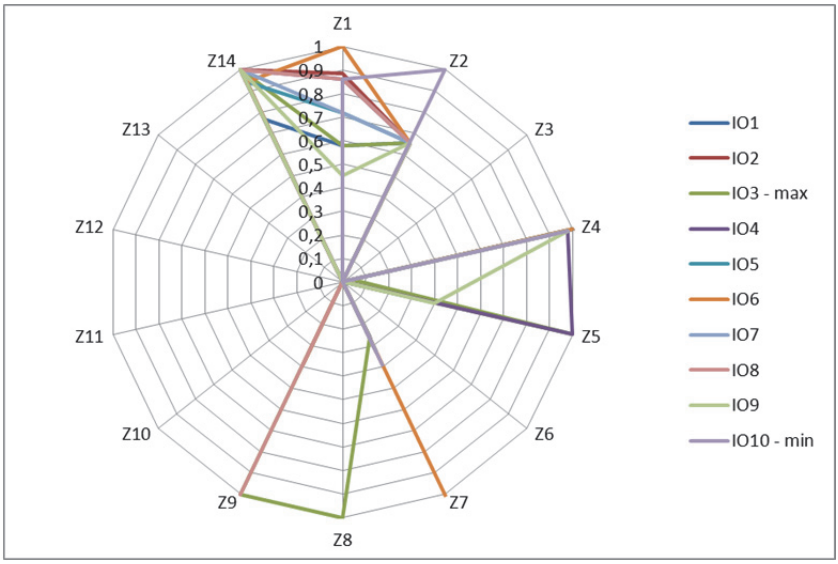


Figure 5.8. Positions of individual horticultural farms (Ω_{IO}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

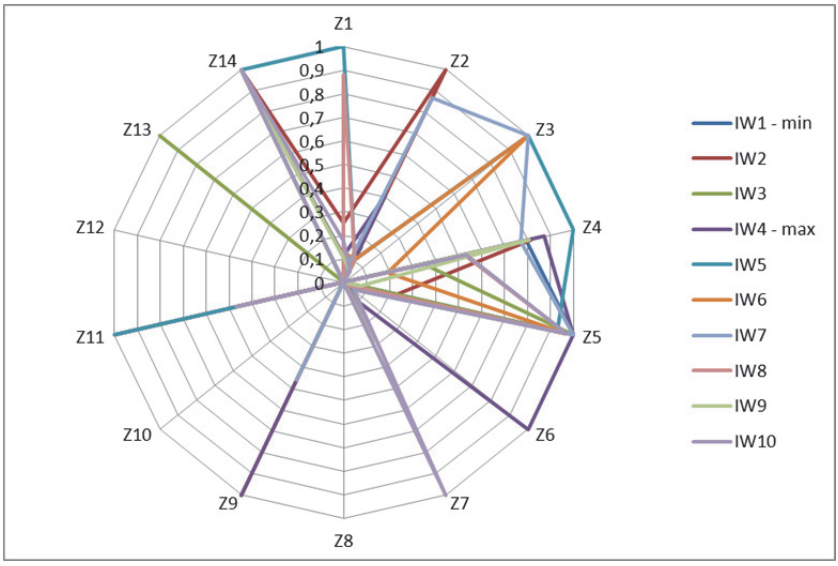


Figure 5.9. Positions of individual vegetable farms (Ω_{IO}) according to variables in the space of ownership describing the level of the machinery park equipment Φ_1

When analyzing results presented in figure 5.9., one may notice that in the accepted comparative group of individual vegetable farms, the replacement value of the machinery

park is mainly composed of the same group of machines, that is farm tractors ($1Z_1$), transport means ($1Z_2$), loaders ($1Z_3$), cultivation machines ($1Z_4$), fertilization machines ($1Z_5$) and delivery trucks ($1Z_{14}$). At the same time, it should be emphasized that the level of invested funds in the above mentioned elements of the machinery park was different in particular farms. A farm, which can be ascribed the role of a leader according to the positions it takes (equal to 1 or close to 1) was a facility IW_{10}. When comparing the investigated facilities with an identical vegetable producer group, existence of delivery trucks in the machinery park is a significant difference. It follows mainly from the fact that individual farms carried themselves transport of products to the outlet, both for individual as well wholesale clients. Contrary, in the producer group, clients dealt with delivery of products not the group members. All farms from the set (Ω_{IW}) have a machinery park, which is multi-trend and has wide designation, which may prove that farms are in the production specialization phase and the machinery park is adapted to vegetable cultivation technologies.

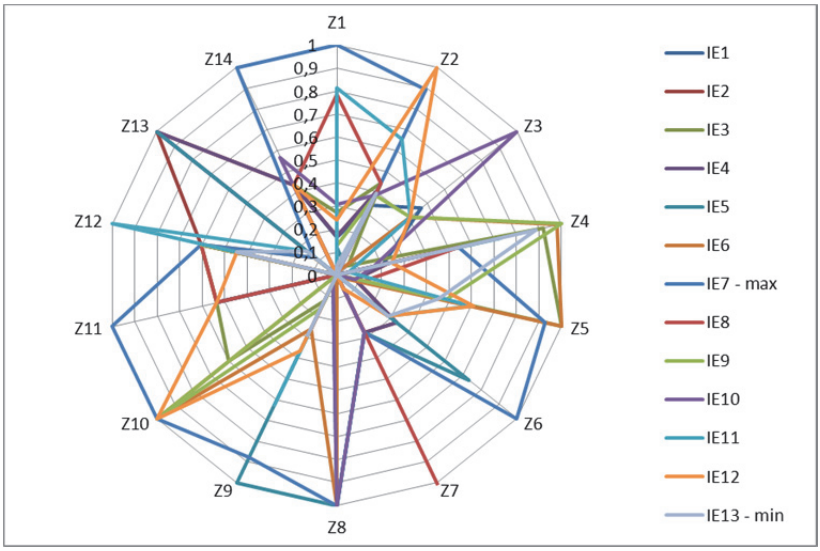


Figure 5.10. Positions of individual organic farms (Ω_{IE}) according to the variables in the space of ownership describing the level of equipment of the machinery park Φ_1

Individual organic farms like a set of milk and pig farms have a machinery park of a wide designation. The investigated individual organic farms are most often multi-trend farms, which has been confirmed by results presented in figure 5.10. Where as we see, any variable 1Zn of the space of ownership describing the level of equipment of the machinery park is not distinguished with multi-occurrence in particular objects. In the hierarchy of the entire set of individual farms, they take distant positions, which proves, that they have low-capital machines (table 5.2). It is also difficult to point out to the leading farm from among the analyzed group of objects. Low investment capacity of organic farms causes that the modernization process is too slow in comparison to competitive farms from the remaining researched groups.

5.3. Classification of all farms in the space of machinery park potential

The set was classified according to Woźniak and Sikora (2005) in the comparable analyses between farm facilities associated in the producer groups and individual farms. It was assumed that objects of these collections will be divided into five groups, which focus farms with similar synthetic development measure values: Division criterion was presented in table 5.3.

Table 5.3. Characteristics of facilities classification on account of the synthetic value of the development measure

Group	Group characteristic	The scope of the group variability
I	Facilities with very low development measure values	$0 \le q_i \le \min\{q_i\} + 0.2R$
II	Facilities with low development measure values	$\min\{q_i\} + 0.2R \le q_i \le \min\{q_i\} + 0.4R$
III	Facilities with average development measure values	$\min\{q_i\} + 0.4R \le q_i \le \min\{q_i\} + 0.6R$
IV	Facilities with high development measure values	$\min\{q_i\} + 0.6R \le q_i \le \min\{q_i\} + 0.8R$
V	Facilities with very high development measure values	$\min\{q_i\} + 0.8R \le q_i \le 1$

Source: Woźniak and Sikora, 2005

where:

q_i – synthetic measure value determined for *i*-facility

R – value range of synthetic development measure.

The comparative analysis of facilities associated in the agricultural producer groups and comparable individual farms allowed determination of the farm equipment level referred to the farming system. The obtained results (table 5.4.) allow noticing that the first positions in the ranking are taken by farms associated in the agricultural producer groups, thus have been qualified to group V with very high values of development measure (q_i = 0.263-0.302). This group has 5 facilities, including 3 from the pig production group. In the next group IV with high values of development measure only 5 out of 11 facilities were individual farms, out of which 4 were milk production oriented. Thus, one may assume that facilities which operate in the agricultural producer groups independently from the production trend have their own machinery park with higher gross replacement value of its particular elements (variable Z_{n-1}).

III group includes mainly facilities which belong to the set of individual farms, because they constituted as much as 75% of total group size. Farms from the III group obtained the development measure value based on the space of ownership describing the machinery park potential from the range of 0.201 to 0.154. This state of affairs proves that individual farms have machinery parks which have lower capital value. One of the reasons is a limited ability which results from smaller opportunity of application by the European Union investment funds in comparison to farms from producer groups. The mentioned investment ability results inter alia from smaller opportunity within bringing the so-called own contribution, which many times, is necessary at applying for the EU subsidy.

Table 5.4. Ordered facilities within the entire population of individual farms and agricultural producers' groups based on the synthetic measure q_i for the space of ownership which defines the potential of the machinery park equipment

Farm name	Normalized variables describing the level of the technical back equipment														q_i	Group
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
T_8	0.380	0.184	0.609	0.348	0.610	0.178	0.063	0.333	0.312	0.029	0.534	0.000	1.000	0.000	0.302	
M_2	0.200	0.292	0.326	0.697	0.250	0.027	0.063	0.333	0.901	0.017	0.534	0.517	0.838	0.000	0.302	
T_{10}	0.829	0.143	0.609	0.414	0.470	0.178	0.063	0.333	0.014	0.029	0.534	0.000	1.000	0.000	0.299	**V**
W_5	0.505	0.580	0.000	0.238	0.390	0.622	0.260	0.333	0.133	0.029	1.000	0.437	0.090	0.909	0.294	
T_9	0.070	0.052	0.630	0.341	0.610	0.178	0.063	0.333	0.014	0.029	0.466	0.000	1.000	0.000	0.263	
T_4	0.397	0.026	0.609	0.379	0.225	0.178	0.125	0.333	0.212	0.029	0.534	0.000	0.719	0.000	0.250	
IM_5	0.452	0.164	0.141	0.056	0.250	1.000	0.260	0.000	0.290	0.029	0.000	1.000	0.090	0.394	0.240	
T_3	0.091	0.031	0.609	0.383	1.000	0.178	0.125	0.333	0.212	0.017	0.466	0.000	0.401	0.000	0.239	
M_6	0.567	0.319	0.761	0.308	0.280	0.038	0.260	0.000	0.709	0.000	0.000	0.862	0.000	0.000	0.236	
IE_7	0.033	0.000	0.000	0.124	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.229	
IM_9	0.169	0.276	0.141	0.243	0.880	0.011	0.063	0.000	1.000	0.029	0.534	0.632	0.120	0.000	0.219	**IV**
M_1	0.478	0.158	1.000	0.014	0.814	0.000	0.260	0.000	0.340	0.000	0.000	0.345	0.090	0.000	0.219	
M4	0.428	0.000	0.022	0.301	0.800	0.444	0.000	0.000	0.694	0.000	0.000	0.437	0.000	1.000	0.215	
$IM1_0$	0.105	0.068	0.141	0.062	0.225	0.038	0.063	0.333	0.306	0.017	0.534	0.517	0.838	0.000	0.214	
W_2	0.384	1.000	0.000	0.308	0.014	0.556	0.125	1.000	0.000	0.000	0.000	0.000	0.000	0.121	0.207	
IM_4	0.397	0.267	0.022	0.262	0.270	0.744	0.063	0.333	0.324	0.000	0.534	0.517	0.000	0.000	0.202	
T_6	0.176	0.618	0.609	0.406	0.800	0.178	0.063	0.000	0.184	0.029	0.000	0.000	0.281	0.000	0.201	
IM_2	0.132	0.256	0.141	0.295	0.420	0.038	0.260	0.333	0.438	0.017	0.534	0.517	0.120	0.000	0.195	
W_3	0.360	0.937	0.000	0.188	0.035	0.556	0.063	0.667	0.000	0.000	0.534	0.000	0.000	0.194	0.194	
M_5	0.512	0.142	0.326	0.406	0.800	0.178	0.063	0.000	0.379	0.017	0.000	0.747	0.000	0.000	0.191	**III**
T_5	0.167	0.079	0.000	1.000	0.415	0.733	0.063	0.000	0.184	0.029	0.000	0.000	0.563	0.000	0.186	
IE_5	0.060	0.042	0.000	0.318	0.000	0.456	0.260	0.333	0.152	0.000	0.534	0.000	0.719	0.000	0.186	

Farm name	Normalized variables describing the level of the technical back equipment														q_i	Group
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
IE_2	0.085	0.267	0.000	0.099	0.035	0.204	0.260	0.000	0.000	0.000	0.534	0.437	0.719	0.394	0.181	
IT_4	0.397	0.048	0.141	0.331	0.250	0.444	0.063	0.333	0.064	0.000	0.534	0.000	0.120	0.515	0.180	
IT_1	0.829	0.245	0.141	0.705	0.204	0.444	0.063	0.000	0.206	0.017	0.534	0.000	0.120	0.000	0.178	
T_7	0.045	0.230	0.000	0.867	0.660	0.178	0.063	0.333	0.184	0.017	0.466	0.000	0.281	0.000	0.176	
IM_7	0.087	0.016	0.000	0.241	0.255	0.567	0.260	0.333	0.234	0.017	0.466	0.402	0.120	0.000	0.174	
IW_5	0.486	0.031	0.022	0.619	0.800	0.027	0.260	0.000	0.000	0.000	1.000	0.000	0.000	0.515	0.171	
IW_4	0.054	0.117	0.000	0.540	0.860	0.733	0.063	0.000	0.052	0.000	0.466	0.000	0.000	0.515	0.169	
IM_8	0.085	0.088	0.326	0.248	0.220	0.038	0.063	0.333	0.445	0.017	0.534	0.517	0.000	0.000	0.167	
IE_8	0.397	0.288	0.000	0.236	0.049	0.000	0.938	0.000	0.040	0.000	0.534	0.437	0.000	0.394	0.167	
IM_6	0.107	0.073	0.022	0.253	0.225	0.038	0.063	0.333	0.476	0.029	0.534	0.920	0.000	0.000	0.166	
IW_{10}	0.085	0.016	0.000	0.329	0.835	0.038	0.938	0.000	0.000	0.000	0.466	0.000	0.000	0.515	0.162	
IE_4	0.085	0.267	0.000	0.101	0.035	0.204	0.260	0.000	0.000	0.000	0.534	0.000	0.719	0.394	0.159	
IT_6	0.380	0.250	0.000	0.059	0.280	1.000	0.063	0.000	0.000	0.000	0.534	0.402	0.000	0.000	0.157	
IT_7	0.118	0.250	0.000	0.063	0.060	0.444	0.063	0.000	0.212	0.029	0.534	0.402	0.120	0.515	0.154	
T_2	0.141	0.052	0.609	0.431	0.390	0.178	0.063	0.000	0.232	0.017	0.000	0.460	0.000	0.000	0.152	
IM_3	0.082	0.246	0.022	0.241	0.420	0.038	0.063	0.333	0.327	0.017	0.534	0.517	0.000	0.000	0.150	
IE_{12}	0.122	0.649	0.141	0.108	0.255	0.178	0.063	0.000	0.055	0.029	0.534	0.322	0.000	0.394	0.147	
W_1	1.000	0.976	0.000	0.211	0.014	0.444	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.152	0.145	
IW_3	0.037	0.026	0.000	0.217	0.860	0.000	0.063	0.000	0.000	0.000	0.466	0.000	0.719	0.000	0.141	
IT_5	0.428	0.143	0.141	0.535	0.250	0.444	0.063	0.000	0.091	0.000	0.534	0.000	0.120	0.000	0.141	
IT_2	0.360	0.052	0.141	0.286	0.190	0.444	0.063	0.000	0.000	0.000	0.000	0.402	0.120	0.485	0.140	**II**
IE_{10}	0.156	0.250	0.348	0.071	0.035	0.000	0.260	0.333	0.006	0.000	0.000	0.322	0.000	0.515	0.139	
IM_1	0.037	0.057	0.022	0.406	0.420	0.038	0.063	0.000	0.306	0.000	0.534	0.517	0.000	0.515	0.139	
W_4	0.384	0.000	0.000	0.034	0.000	0.027	0.000	0.333	0.000	0.400	0.000	0.000	0.000	0.000	0.137	
IE_{11}	0.411	0.425	0.141	0.023	0.250	0.178	0.000	0.000	0.095	0.000	0.000	0.724	0.120	0.000	0.129	
IE_3	0.138	0.288	0.022	0.402	0.420	0.000	0.063	0.000	0.018	0.017	0.534	0.437	0.000	0.394	0.128	
E_6	0.088	0.545	0.000	0.214	0.220	0.000	0.000	0.000	0.176	0.000	0.534	0.402	0.000	0.485	0.124	

Farm name	Normalized variables describing the level of the technical back equipment														q_i	Group
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
IW_2	0.122	0.283	0.000	0.504	0.200	0.011	0.063	0.000	0.052	0.000	1.000	0.000	0.000	0.515	0.120	
IE_1	0.083	0.219	0.163	0.089	0.035	0.000	0.260	0.333	0.006	0.000	0.000	0.437	0.000	0.394	0.118	
E_4	0.068	0.031	0.000	0.218	0.000	0.000	0.000	0.333	0.187	0.000	0.534	0.402	0.000	0.485	0.117	
IE_6	0.037	0.016	0.141	0.430	0.420	0.011	0.000	0.333	0.040	0.029	0.000	0.437	0.090	0.000	0.116	
IO_6	0.118	0.182	0.000	0.346	0.000	0.000	1.000	0.000	0.024	0.000	0.000	0.000	0.000	0.485	0.114	
O_6	0.068	0.048	0.000	0.000	0.035	0.000	0.938	0.000	0.014	0.000	0.000	0.000	0.000	0.909	0.113	
IW_7	0.017	0.245	0.022	0.477	0.860	0.038	0.260	0.000	0.024	0.000	0.466	0.000	0.000	0.000	0.111	
E_9	0.088	0.128	0.022	0.308	0.190	0.000	0.000	0.000	0.615	0.000	0.534	0.402	0.000	0.000	0.110	
IW_8	0.428	0.031	0.000	0.326	0.835	0.011	0.260	0.000	0.000	0.000	0.466	0.000	0.000	0.000	0.109	
IT_3	0.397	0.259	0.000	0.329	0.060	0.444	0.063	0.000	0.263	0.017	0.000	0.000	0.120	0.000	0.108	
E_2	0.088	0.047	0.000	0.130	0.000	0.000	0.000	0.000	0.190	0.000	1.000	0.402	0.000	0.485	0.108	
E_8	0.017	0.240	0.000	0.469	0.000	0.000	0.000	0.000	0.144	0.000	0.534	0.402	0.000	0.485	0.103	
T_1	0.074	0.016	0.609	0.323	0.280	0.178	0.063	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.101	
E_{15}	0.088	0.026	0.022	0.308	0.220	0.000	0.000	0.000	0.470	0.000	0.534	0.402	0.000	0.000	0.098	
O_5	0.037	0.048	0.000	0.376	0.035	0.000	0.938	0.000	0.014	0.000	0.000	0.000	0.000	0.394	0.097	
IT_9	0.091	0.298	0.000	0.241	0.000	0.444	0.063	0.000	0.054	0.000	0.534	0.000	0.120	0.000	0.095	
IO_3	0.068	0.182	0.000	0.015	0.200	0.000	0.260	0.333	0.062	0.000	0.000	0.000	0.000	0.515	0.095	
O_1	0.068	0.214	0.000	0.000	0.035	0.000	0.938	0.000	0.014	0.000	0.000	0.000	0.000	0.394	0.094	
E_{11}	0.088	0.256	0.000	0.022	0.000	0.000	0.000	0.000	0.160	0.000	0.534	0.402	0.000	0.485	0.093	**I**
IT_8	0.065	0.267	0.000	0.383	0.000	0.444	0.063	0.000	0.000	0.000	0.000	0.000	0.120	0.394	0.092	
IW_6	0.062	0.031	0.022	0.118	0.835	0.011	0.260	0.000	0.024	0.000	0.466	0.000	0.000	0.000	0.088	
E_7	0.088	0.026	0.022	0.218	0.000	0.000	0.000	0.000	0.113	0.000	0.534	0.402	0.000	0.485	0.088	
O_4	0.068	0.016	0.000	0.000	0.060	0.000	0.938	0.000	0.014	0.000	0.000	0.000	0.000	0.394	0.086	
O_3	0.037	0.048	0.000	0.000	0.060	0.000	0.938	0.000	0.014	0.000	0.000	0.000	0.000	0.394	0.086	
O_2	0.020	0.016	0.000	0.000	0.035	0.000	0.938	0.000	0.014	0.000	0.000	0.000	0.000	0.394	0.083	
E_{14}	0.020	0.262	0.000	0.211	0.220	0.000	0.000	0.000	0.147	0.000	0.534	0.402	0.000	0.000	0.081	

Farm name	Normalized variables describing the level of the technical back equipment														q_i	Group
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
IE_9	0.065	0.250	0.141	0.438	0.204	0.000	0.000	0.000	0.024	0.029	0.000	0.437	0.000	0.000	0.081	
E_{12}	0.085	0.240	0.022	0.022	0.220	0.000	0.000	0.000	0.150	0.000	0.534	0.402	0.000	0.000	0.079	
IT_{10}	0.077	0.281	0.000	0.024	0.000	0.444	0.000	0.000	0.113	0.017	0.534	0.000	0.000	0.000	0.079	
E_3	0.020	0.031	0.000	0.026	0.000	0.000	0.000	0.000	0.144	0.000	0.534	0.402	0.000	0.485	0.079	
IO_4	0.102	0.182	0.000	0.338	0.200	0.000	0.260	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.077	
IE_{13}	0.020	0.257	0.000	0.389	0.190	0.178	0.000	0.000	0.044	0.000	0.000	0.322	0.120	0.000	0.076	
IO_9	0.053	0.182	0.000	0.338	0.080	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.072	
E_{13}	0.088	0.219	0.022	0.022	0.190	0.000	0.000	0.000	0.064	0.000	0.534	0.402	0.000	0.000	0.072	
M_3	0.134	0.133	0.022	0.017	0.115	0.178	0.000	0.000	0.108	0.000	0.000	0.437	0.120	0.000	0.072	
IO_2	0.105	0.182	0.000	0.346	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.071	
IO_7	0.085	0.182	0.000	0.338	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.070	
IO_5	0.085	0.182	0.000	0.346	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.485	0.069	
IW_1	0.017	0.048	0.000	0.491	0.860	0.000	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.065	
IW_9	0.050	0.016	0.000	0.498	0.060	0.000	0.260	0.000	0.000	0.000	0.000	0.000	0.000	0.515	0.065	
IO_8	0.102	0.182	0.000	0.015	0.000	0.000	0.323	0.000	0.062	0.000	0.000	0.000	0.000	0.515	0.064	**I**
E_{10}	0.068	0.026	0.000	0.211	0.000	0.000	0.000	0.000	0.119	0.000	0.534	0.402	0.000	0.000	0.060	
E_5	0.020	0.026	0.000	0.117	0.000	0.000	0.000	0.000	0.144	0.000	0.534	0.402	0.000	0.000	0.056	
IO_1	0.068	0.182	0.000	0.015	0.000	0.000	0.323	0.000	0.024	0.000	0.000	0.000	0.000	0.394	0.054	
E_1	0.020	0.016	0.000	0.022	0.000	0.000	0.000	0.000	0.144	0.000	0.534	0.402	0.000	0.000	0.053	
IO_{10}	0.102	0.278	0.000	0.338	0.000	0.000	0.385	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	

The next group II, according to classification of facilities, on account of the value of the synthetic development measure, included 24 farms, out of which 8 belonged to the producer groups covered by the research, among them 4 were from the producer groups which had organic production system. In the mentioned II group, aggregate measure was within 0.152-0.108. The fact that farms belonging to the organic producer group are within this group proves the previous detailed analysis of the space of the machinery park equipment potential, which unanimously showed that from among the 5 producer groups accepted for the research, facilities producing organic food products had the machinery park with the lowest gross replacement value of its particular elements. The analysis of the synthetic index shows that the group of facilities which had the lowest degree of development of the machinery park potential (I group, table 5.4), where the aggregate measure was within the first range q_i 0.053-0.103, was the most numerous. This group contains 35 facilities, i.e. 37% of the entire sets (in total individual farms and farms from producer groups). From among 35 facilities individual farms constituted 48.6% (17 facilities) and farms associated in the agricultural producer groups the remaining 51.4% (18 facilities). Organic farms were the most numerous set in the II group, and they constituted in total 40% of population. The fact that organic farms take far positions than the accepted pattern results from the lack of production specialization, which carries with it the necessity of having numerous machinery park, and at the low unit productivity of the organic agricultural production system, many times these facilities lack investment abilities. The possessed park in these facilities is mainly adapted from the period of operation of farms before changing into organic production, therefore there is no specialist machines for this production system.

When analyzing the composition of group I, one should also pay attention to the presence of facilities which belong to the producer group; this remark does not relate to the mentioned case of organic farms. As it proved, 5 out of 6 farms from fruit producer group were in this group. It results from the structure of the machinery park, which these facilities possessed, where no machines and tools related to the production trend were reported. The possessed technical equipment was not numerous and it was mainly composed of farm tractors and delivery trucks, the remaining elements were less capital consuming than e.g. combine harvesters or other harvesting machines.

6. RANKING OF FARMS IN THE SPACE OF AGRICULTURAL PRODUCTION EFFICIENCY

6.1. Classification of farms associated in the producer groups in the space of describing agricultural production efficiency

Economic efficiency results from the business activity which follows from the relation of the obtained effects with incurred inputs. In a wider meaning the term "efficiency" means the best results in production. Efficiency of farming in agriculture is defined as one of the manners of assessment of farms functioning - relation of effects with the used means (Józwiak, 1998). Such approach allows measuring the efficiency with fractional synthetic indexes of productivity of using resources. However, these indexes do not precisely express neither efficiency of particular production factors nor efficiency of various fields in a farm, or efficiency of farm functioning as a whole. It follows from the fact that effects of economic activity are multi-aspect: direct and indirect, positive and negative, desired and non-desired (Bórawski and Pawlewicz, 2006). According to Juchniewicz (1999) the basis for discussion on the efficiency is rational action, showing in maximization of effects and minimization of the incurred inputs. It results directly from the aim of farming, that is, maximization of income (Kierul, 1986). The basic aim of determination of synthetic measures in the space of ownership based on efficiency of production is ordering facilities on account of the level of multi-feature phenomenon. It allowed ordering the investigated objects on account of the level of phenomena, which cannot be measured with one measure e.g. efficiency of agricultural production. The development measure synthesizes information from the row of diagnostic variables and orders aggregated one measure to the analyzed phenomenon on the basis on which we can order facilities in the investigated space.

The determined ranking of the collection of farms associated in the agricultural producer group (table 6.1.) proves that two farms from the vegetable group (W_5 where q_i=0.626 and W_1 q_i=0.539), which took first positions exceeded half of the distance to the space pattern (equal to 1). Also the remaining vegetable farms of the investigated group of agricultural farmers did not take high positions in the space of the machinery park potential, whereas in the economic space, there were on first five positions. The index of synthetic measure q_i for all farms in the discussed producer group was within 0.629-0.241. Vegetable crops are characterized as a rule with a higher unit (from a hectare) production efficiency in comparison to traditional crops e.g. grains. Nonetheless, in case of the analyzed producer group, analysis of the input values – before standardization, explicitly proved that farms carry out high commodity production (table 3.1, 3.5, 3.6).

Further positions were taken by farms from horticultural and pig groups; their average synthetic measure was lower than vegetable farms by 0.396. Such difference proves great

disproportion between the investigated facilities of the set in the space of ownership describing agricultural production efficiency.

Farms from organic producer group took the last positions and they differed with the best farm by as much as 0.459 of synthetic measure. In comparison to the remaining farms in this space of ownership, organic farming system differs a lot from the remaining facilities. Out of 15 members of the organic agricultural producer group as much as 14 farms took the last positions according to the value of the development measure and the reported minimum value q_i for this facilities was 0.042 (E_9). When analyzing this situation, one should remember that it results from the farming system accepted by these facilities, since the organic agricultural production on account of problematic farming criteria within its scope, is characterized by the so-called production extensiveness. Limitations within the scope of using chemical production means and regulations concerning the level of fertilization directly influence lower unit performance both of plant and animal production. Available EU subsidies, which in case of this production system have to not only compensate the incurred inputs but also equalize income difference which occurred as a result of the lower production profitability, are an element which levels lower competitiveness of organic farms in comparison to the traditional agricultural production.

Farms from milk producer group in the space of ownership which describes the agricultural production efficiency take central positions in the set of facilities. Oppositely to the space describing the machinery park potential they took leading positions. Thus, one may assume that the funds invested in the machinery park did not translate directly into indexes which characterize the farming efficiency. A similar situation was reported in case of facilities from the pig producer group.

Further, calculations determining similarity of the investigated objects on axes in the ownership space Φ_2 were carried out. In the set of farms associated in the milk producer group a similar distribution of facilities on ownership axes occurred, except for farm M_6. It proves a levelled level of production efficiency of agricultural producers who are oriented to milk production. An axis which describes the final production ($2Z_1$) reflecting the level of production efficiency was the least varied. The mentioned sixth farm (M_6), took the maximum values in the investigated set on three axis; whereas in the population of all facilities associated in the agricultural producer groups in the discussed space of ownership, took only the 19th position (tab.6.1). Thus, one may assume, that even the best farms which produce milk, find it hard to compete with vegetable and fruit producers on account of production efficiency.

Within the analyzed set of milk producers (Ω_{GM}) farm M_3 in all mentioned variables which characterize the space Φ_2 was unfavorable, similarly to the space Φ_1.

In the investigated set of farms associated in the agricultural producer group, which are oriented to pig production, all facilities within the space of ownership which describes the production efficiency proved a varied level of work inputs ($2Z_4$), technical back index ($2Z_5$) and the index of fixed assets productivity ($2Z_6$). Direct inputs for production in the investigated collection were the least varied, which may prove similar production technology and similarity of facilities. However, despite the comparable level of direct inputs, farms differed within the index of European Size Unit ($2Z_3$ – ESU). The position within the axes of the mentioned variable $2Z_3$ is reflected in positioning of the investigated facilities on the axis of variable $2Z_1$. In the analyzed group of pig producer group (Ω_{GT}) farm T_{10} has features of a leader, since it had on four axes ($2Z_1$, $2Z_2$, $2Z_3$, $2Z_4$) maximum values and in the

entire population, it is on the sixth position (table 6.1). Proper economic force of farms associated in the agricultural producer groups causes that these facilities have bigger investment ability. Farms from this group of facilities in the space of ownership of the machinery park potential took high positions which reflects the production efficiency. It proves that the investigated group of agricultural producers carried out highly specialist pig production.

Table 6.1. Ordered facilities within the investigated producer group based on the synthetic measure q_i for the space of ownership which defines the potential of the equipment of the machinery park

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
W5	0.786	0.825	0.225	0.481	0.004	1.000	0.629
W1	0.984	1.000	1.000	0.872	0.050	0.060	0.539
W2	0.620	0.628	0.489	0.380	0.069	0.063	0.298
W3	1.000	0.929	0.083	0.505	0.213	0.025	0.243
W4	0.561	0.671	0.192	0.419	0.026	0.139	0.241
T10	0.318	0.902	0.029	1.000	0.107	0.008	0.193
O6	0.524	0.566	0.015	0.850	0.159	0.010	0.178
O3	0.524	0.321	0.024	0.841	0.060	0.028	0.163
O1	0.460	0.363	0.015	0.702	0.131	0.013	0.145
O5	0.501	0.363	0.023	0.597	0.110	0.020	0.143
T4	0.173	0.665	0.008	0.143	0.871	0.004	0.142
T3	0.278	0.878	0.017	0.367	0.223	0.009	0.139
O2	0.480	0.237	0.024	0.646	0.060	0.033	0.139
T8	0.179	0.670	0.009	0.180	0.735	0.004	0.136
O4	0.460	0.316	0.020	0.590	0.096	0.022	0.134
T6	0.238	0.870	0.028	0.280	0.170	0.013	0.128
T9	0.237	0.732	0.011	0.277	0.300	0.008	0.122
E8	0.137	0.283	0.006	0.127	1.000	0.003	0.122
M6	0.162	0.494	0.037	0.072	0.623	0.010	0.115
T7	0.155	0.765	0.012	0.133	0.313	0.010	0.106
T5	0.195	0.657	0.027	0.236	0.158	0.014	0.106
M4	0.124	0.259	0.026	0.076	0.774	0.006	0.104
M1	0.140	0.406	0.012	0.151	0.579	0.004	0.102
T2	0.162	0.569	0.013	0.129	0.410	0.008	0.101
M2	0.156	0.380	0.028	0.102	0.550	0.007	0.101
T1	0.161	0.766	0.011	0.122	0.180	0.020	0.100
M5	0.112	0.216	0.027	0.074	0.608	0.007	0.088
E7	0.172	0.197	0.011	0.155	0.525	0.006	0.087
E2	0.108	0.195	0.006	0.190	0.551	0.003	0.084

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
E1	0.114	0.136	0.002	0.218	0.567	0.002	0.083
E5	0.159	0.252	0.006	0.237	0.338	0.005	0.081
E10	0.152	0.287	0.011	0.114	0.406	0.009	0.080
E4	0.132	0.193	0.008	0.181	0.460	0.004	0.079
E3	0.125	0.179	0.007	0.163	0.452	0.004	0.076
E14	0.078	0.068	0.009	0.059	0.667	0.005	0.073
M3	0.120	0.372	0.020	0.122	0.128	0.021	0.069
E12	0.151	0.197	0.017	0.187	0.217	0.010	0.068
E13	0.142	0.197	0.016	0.274	0.129	0.011	0.068
E15	0.109	0.152	0.018	0.142	0.273	0.008	0.061
E11	0.091	0.138	0.016	0.160	0.196	0.008	0.054
E6	0.071	0.118	0.015	0.125	0.264	0.006	0.052
E9	0.039	0.007	0.021	0.050	0.332	0.006	0.042

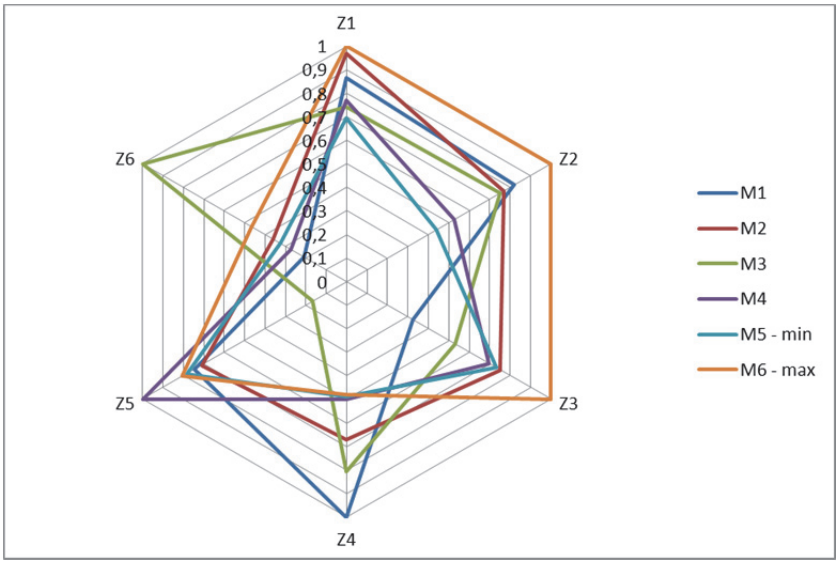


Figure 6.1. Positions of farms from the pig producer group (Ω_{GM}) according to variables in the space of ownership describing the level of agricultural production efficiency Φ_2

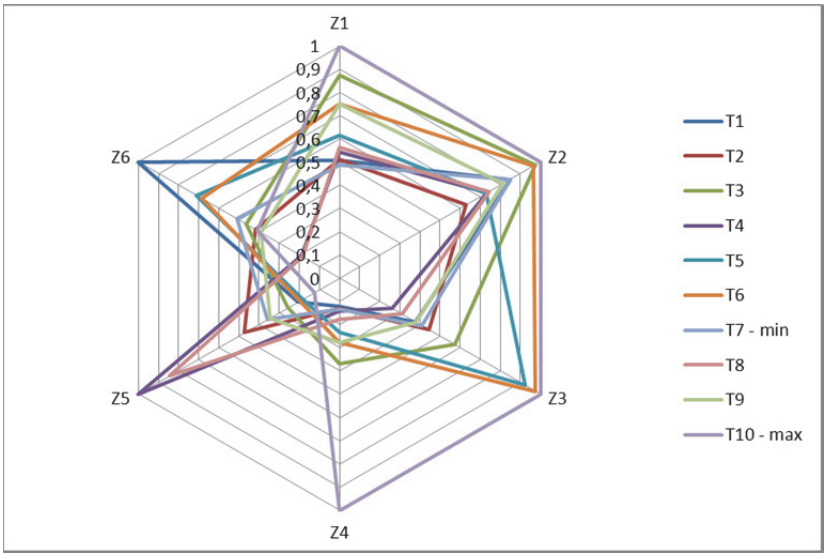


Figure 6.2. Positions of farms from the pig producer group (Ω_{GT}) according to variables in the space of ownership describing the level of agricultural production efficiency Φ_2

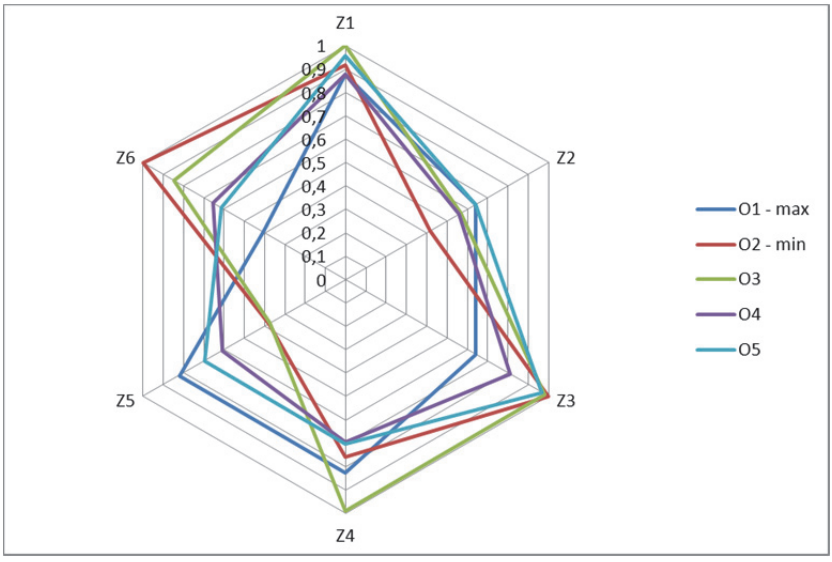


Figure 6.3. Positions of farms from the horticultural producer group (Ω_{GT}) according to variables in the space of ownership describing the level of agricultural production efficiency Φ_2

High variety of production intensity and thus many times a variable quality of a product is one of the weaknesses of the Polish agriculture. Producer groups aim at the same level of production in a given agricultural producer group and the obtained crop was on the comparable level of quality. In case of the analyzed agricultural producer group Ω_{GO} all farms obtained the value of final production on the comparable level and in the ranking of positioning (figure 6.3.) they were focused around the pattern that is value 1, which at a similar level of incurred direct inputs, directly ($2Z_2$) translated into the positioning of particular farm with reference to the variable $2Z_3$ (ESU).

The highest diversity in the investigated group was reported for the variable which describes the productivity index of fixed assets, which expresses relation between the value of the obtained gross final production and the gross replacement value of the machinery park. Farm from the set Ω_{GO} in the entire population of facilities of the agricultural producer groups were on high positions (table 6.1.) as it shows from the information obtained during the guided survey in case of this producer group, one of the aspects of cooperation of the associated farms is common management over production and obtaining higher production efficiency.

In case of the set of farms associated in the agricultural producer group which are oriented to the vegetable production (Ω_{GW}) production efficiency is varied. This group contains farms, which have high values at all axes (W_1). And these farms in the hierarchy of the entire set took two first positions and exceeded half of the distance to the space pattern (W_3, W_5). All farms of the set Ω_W are unrivalled in this space of ownership Φ_2 and take all leading positions (table 6.1.). It proves that these farms are specialized and they carry out production within the producer group with high degree of farming efficiency.

Farms belonging to the organic producer group show very high diversity of production efficiency. Facilities from this set in the entire population of farms associated in the agricultural producer groups were on the last positions (table 6.1.). It proves low production efficiency in these farms. Organic farms must be subsidized because low unit productivity, as it results from the hierarchy of facilities of this set, will not allow competing with other production systems. Organic agricultural production with the specific nature requires various machines, which can be observed in the previously analyzed figures 5.5. and 5.9., which generates additional costs. Specificity of the Polish organic production especially in the region of the Southern Poland reflects positioning of the investigated facilities according to variable $2Z_2$ (direct inputs). Providing that in case of remaining producer groups this variable was the least variable within farms from particular producer group, we have a reverse situation in case of organic farms from the analyzed set Ω_E. Simultaneously one should remember that farms which were joining the producer group had to have oriented production (in this case milk production oriented) thus it did not result from the lack of specialization but accepted production technologies. Since, as it follows from the information obtained during a guided survey, in farms direct inputs were generated mainly by the feeding system which was varied. In some farms it was based mainly on roughage (less capital consuming) such as green forage, hay, whereas in the remaining facilities also more expensive substantial fodders played a significant role.

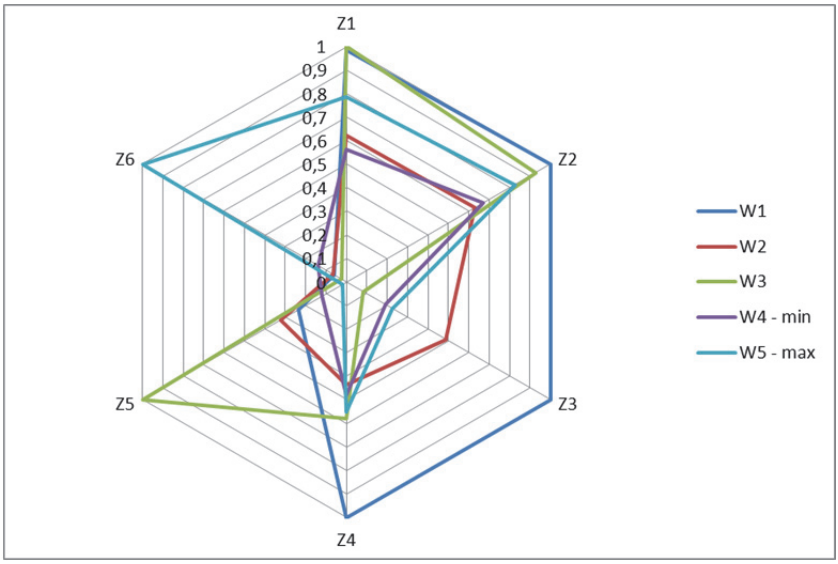


Figure 6.4. Positions of farms from vegetable producer group (Ω_{GW}) according to variables in the space of ownership describing agricultural production efficiency Φ_2

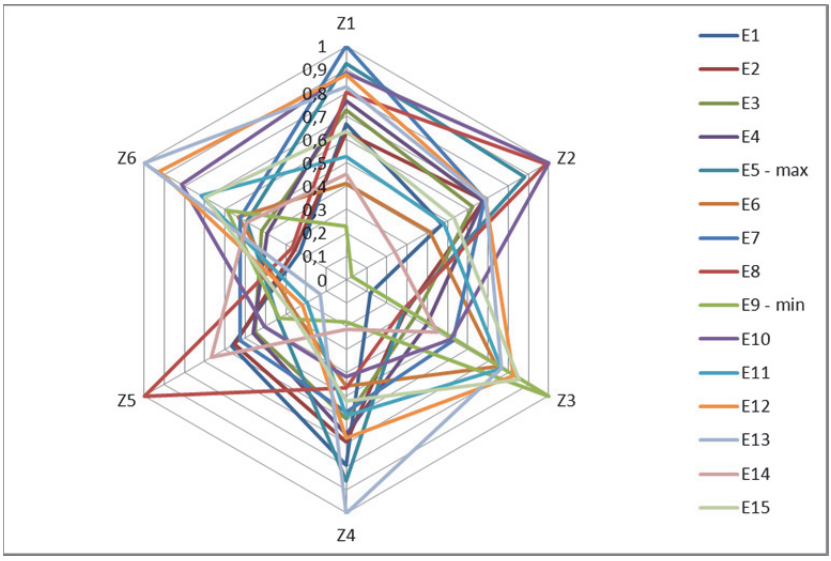


Figure 6.5. Positions of farms from organic producer group (Ω_E) according to variables in the space of ownership describing the agricultural production efficiency Φ_2

6.2. Classification of individual farms in the space of agricultural production efficiency

Ordering facilities which belong to the set of individual farms on account of the level of multi-feature phenomenon which is production efficiency, allowed assessment of the most effective farming among farms. The ranking of the set of individual farms images the taken positions in the entire population of these facilities divided on account of the production trend (table 6.2). The ranking shows that one vegetable farm (IW_2) was at the first position and exceeded half of the distance (i.e. 0.539) to the space pattern equal to 1. Similarly as in farms associated in the agricultural producer groups, leading positions are taken by facilities of vegetable and horticultural production trend. Subsequent positions were taken by pig farms; their average synthetic measure was lower than vegetable farms by 0.127. Such difference proves slight disproportion between the investigated facilities of the set in the space of ownership describing agricultural production efficiency. In the hierarchy, organic food producer farms were on positions at the end of the table 6.2 and the difference to the best farm IW_2 was 0.400 of synthetic measure. Farms from milk producer group in the space of ownership describing agricultural production efficiency are located throughout the whole table of the investigated set of facilities.

Table 6.2. Ordered facilities within the investigated producer group based on the synthetic measure q_i for the space of ownership which defines the agricultural production efficiency

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IW_2	0.923	1.000	0.611	0.452	0.110	0.327	0.539
IO_{10}	0.416	0.312	0.907	0.350	0.021	1.000	0.461
IW_{10}	1.000	0.276	0.716	0.287	0.162	0.379	0.451
IW_3	0.567	0.199	0.410	0.910	0.030	0.363	0.429
IT_5	0.356	0.549	0.933	0.305	0.039	0.528	0.412
IT_3	0.287	0.449	1.000	0.241	0.036	0.584	0.390
IW_1	0.329	0.201	0.302	1.000	0.017	0.339	0.388
IW_9	0.683	0.241	0.323	0.543	0.074	0.299	0.364
IW_4	0.529	0.204	0.518	0.580	0.068	0.235	0.358
IO_8	0.457	0.331	0.451	0.368	0.051	0.430	0.334
IW_8	0.566	0.245	0.515	0.372	0.120	0.222	0.334
IW_7	0.597	0.198	0.357	0.211	0.215	0.231	0.298
IO_5	0.404	0.313	0.243	0.511	0.063	0.222	0.296
IO_9	0.362	0.246	0.389	0.408	0.043	0.362	0.295
IE_1	0.397	0.051	0.501	0.050	0.433	0.322	0.288
IO_6	0.448	0.302	0.287	0.337	0.108	0.216	0.280
IE_4	0.135	0.070	0.142	0.027	1.000	0.088	0.273
IW_6	0.412	0.184	0.434	0.190	0.097	0.393	0.271
IO_1	0.421	0.333	0.126	0.379	0.120	0.163	0.261

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IE_5	0.148	0.088	0.209	0.021	0.818	0.150	0.258
IO_2	0.399	0.316	0.155	0.368	0.144	0.133	0.257
IO_7	0.320	0.265	0.222	0.447	0.065	0.194	0.256
IO_3	0.421	0.303	0.197	0.293	0.139	0.182	0.255
IO_4	0.383	0.321	0.173	0.361	0.132	0.141	0.255
IM_5	0.109	0.172	0.255	0.031	0.694	0.090	0.237
IT_7	0.163	0.353	0.449	0.095	0.082	0.367	0.227
IM_{10}	0.131	0.118	0.558	0.031	0.234	0.314	0.215
IE_8	0.146	0.072	0.213	0.058	0.600	0.073	0.208
IT_4	0.214	0.318	0.270	0.160	0.161	0.145	0.204
IT_1	0.066	0.129	0.513	0.017	0.327	0.210	0.200
IM_9	0.114	0.138	0.414	0.046	0.360	0.122	0.195
IT_6	0.114	0.144	0.317	0.029	0.398	0.176	0.195
IT_2	0.137	0.293	0.313	0.066	0.132	0.278	0.187
IE_7	0.099	0.111	0.140	0.094	0.538	0.035	0.185
IM_1	0.173	0.212	0.304	0.121	0.152	0.165	0.180
IT_8	0.139	0.351	0.165	0.062	0.116	0.342	0.180
IM_2	0.157	0.263	0.293	0.134	0.126	0.163	0.180
IM_7	0.129	0.113	0.430	0.085	0.103	0.258	0.173
IM_3	0.143	0.151	0.376	0.125	0.103	0.195	0.172
IE_3	0.101	0.058	0.151	0.056	0.513	0.062	0.171
IE_{11}	0.140	0.373	0.079	0.149	0.191	0.086	0.168
IT_9	0.123	0.329	0.140	0.056	0.125	0.311	0.167
IM_4	0.125	0.131	0.340	0.118	0.149	0.124	0.159
IW_5	0.089	0.126	0.081	0.117	0.409	0.033	0.156
IT_{10}	0.108	0.297	0.123	0.050	0.135	0.282	0.155
IE_2	0.090	0.136	0.075	0.066	0.401	0.060	0.148
IM_6	0.102	0.112	0.307	0.087	0.148	0.139	0.143
IE_{12}	0.087	0.166	0.138	0.061	0.290	0.087	0.140
IE_9	0.122	0.173	0.173	0.132	0.111	0.146	0.139
IE_6	0.109	0.197	0.119	0.066	0.214	0.136	0.138
IM_8	0.091	0.157	0.229	0.103	0.101	0.155	0.133
IE_{13}	0.066	0.132	0.141	0.051	0.106	0.214	0.112
IE_{10}	0.048	0.054	0.088	0.051	0.269	0.062	0.102

Dispersion of individual farms in the space $\Phi_{2,}$ proves a levelled level of farming intensity regardless the production trend. It was proved that in individual farms, the border of production efficiency could not have been determined in relation to the production trend.

All farms from the set Ω_{IM} have varied production efficiency, thus it is hard to indicate a leader in this group. The best individual milk farm was only on the 25th position in the entire population (table 6.2). Farms which maintain small cow herds, low-commodity cannot compete with vegetable, horticultural and pig farms on account of production efficiency. The investigated set was characterized with high diversity on all axes of space which describes potential of agricultural production efficiency. Poland's accession to the European Union caused considerable decrease of the number of milk farms and the increase of milk production concentration. It caused that around big farms, milk producer groups are formed and these farms prosper very well, whereas single farms with small concentration carry out non-effective production.

In the researched set of individual pig farms, all facilities in the space of ownership describing production efficiency proved a varied level of all variables. Facilities which belong to the set Ω_T cannot be explicitly characterized. It includes farms, which are on high positions in the entire population and facilities, which are on very low positions on account of synthetic measure. Farms IT_5 and IT_3 may be an exception, which except for variable $2Z_5$ (technical back index) in the highest possible degree obtained values similar to unity (fig. 6.7).

In the investigated set of individual horticultural farms, all facilities within the space of ownership which describes the production efficiency proved a varied level of technical back index ($2Z_4$), technical back index (2Z5) and the index of fixed assets productivity ($2Z_6$). In the researched set, the least varied variables are final gross production ($2Z_1$) and direct inputs ($2Z_2$). The fact that horticultural farms took high positions in the hierarchy of entire population proves the real economic force of these farms (table 6.2). It proves that the researched individual farms carried out high commodity horticultural production in comparison to facilities with different production trends. Farms from this group of facilities in the space of ownership of the potential achieved synthetic measure of development at the average level of 0.461.

In case of the set of individual vegetable farms Ω_{IW} positions of particular facilities within the range of particular variables, which characterize the space of production efficiency $\Phi_{2,}$ is varied. Farms from this set took very high positions in the entire population (table 6.2). All farms of the set Ω_{IW} take high positions in the entire population similarly to farms from the vegetable group, which were unrivalled in its set of individual facilities. This group includes a farm, which was at the first position and exceeded half of the distance to the space pattern (IW_2). When analyzing positioning of facilities according to particular variable we see that in case of variable $2Z_2$ only the mentioned farm $IW_{2,}$ was able to optimize the amount of incurred direct inputs, which in case of this production trend are the main determinant of production profitability.

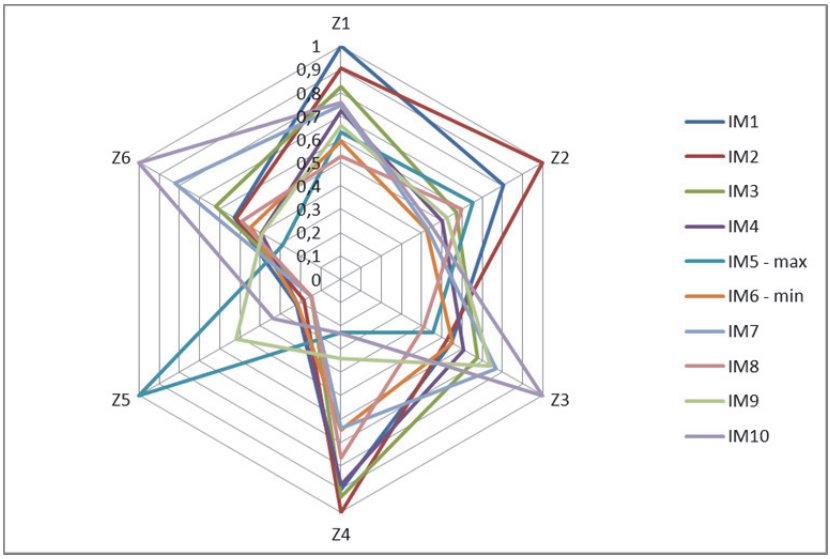


Figure 6.6. Positions of individual farms milk production oriented (Ω_{IM}) according to variables in the space of ownership describing agricultural production efficiency Φ_2

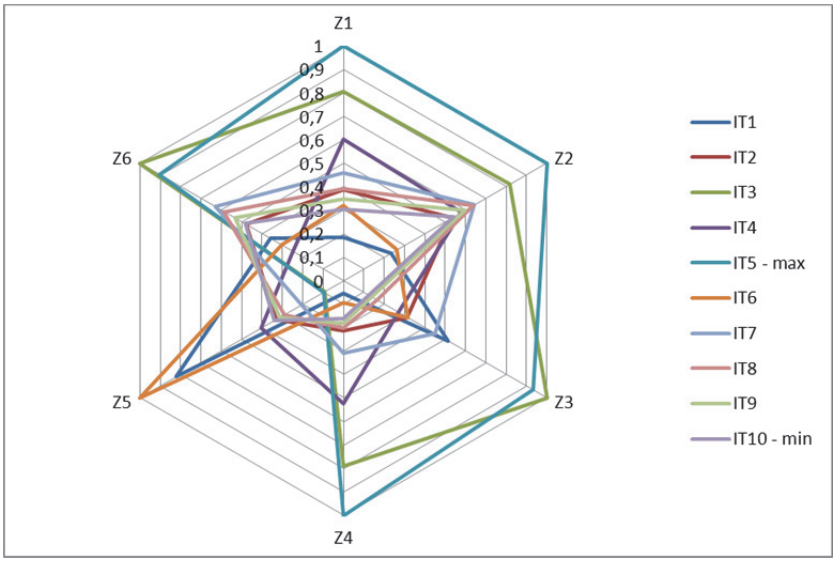


Figure 6.7. Positions of individual farms pig production oriented (ΩIT) according to variables in the space of ownership describing agricultural production efficiency Φ_2

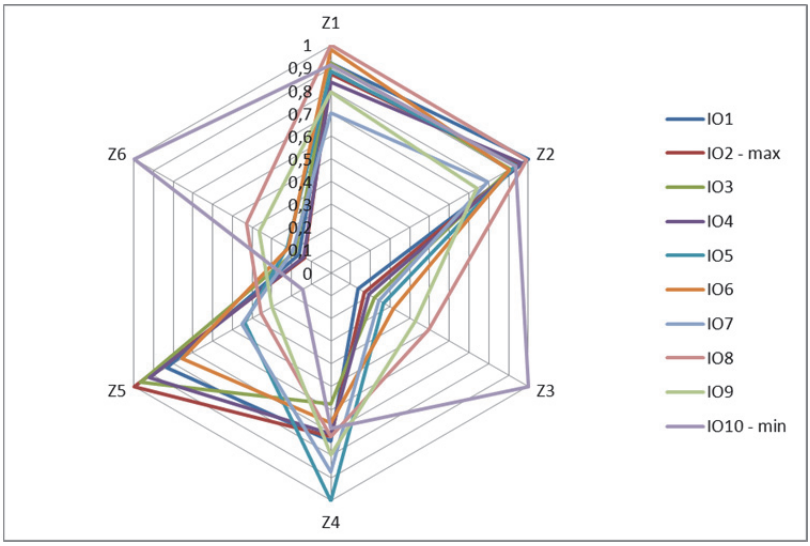


Figure 6.8. Positions of individual farms horticultural production oriented (Ω_{IO}) according to variables in the space of ownership describing agricultural production efficiency Φ_2

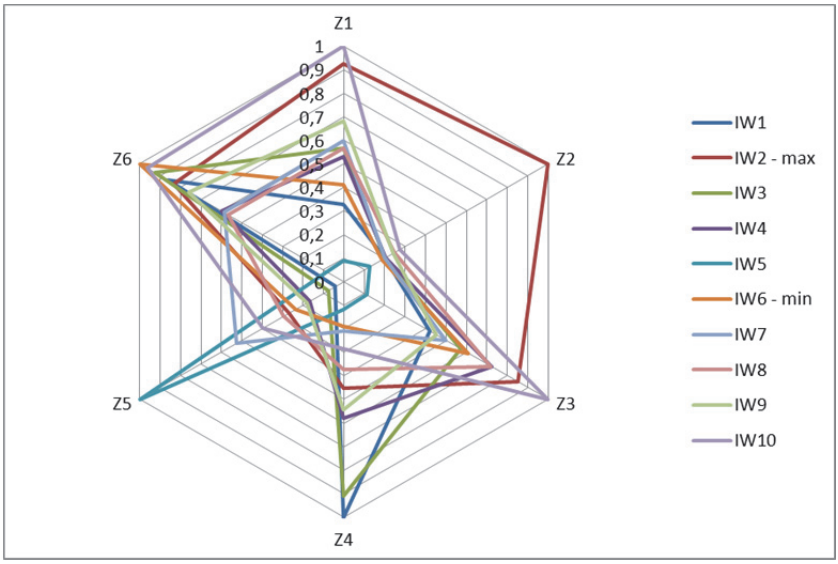


Figure 6.9. Positions of individual farms vegetable production oriented (ΩIW) according to variables in the space of ownership describing agricultural production efficiency Φ_2

Results presented in figure 6.10 indicate weakness of individual organic farms within the agricultural production efficiency. Almost each farm, included in the research achieved low positions within listed variables. This remark relates not only to the surrounding of the set to individual organic farms but also the remaining facilities which act individually (table 6.2). A farm which singles out in comparison to organic farms is a facility IE_1, in which in case of three variables ($2Z_1$, $2Z_3$, $2Z_6$) a pattern value of the index of synthetic measure of development was achieved. Very high variability of production efficiency of individual farms which can be observed in figure 6.10 proves that these were multi-trend facilities. Despite the dynamic increase of the number of organic farms in Poland recently, still an average level of intensity and productivity, which can be reported in identical facilities in the remaining European Union Countries has not been achieved.

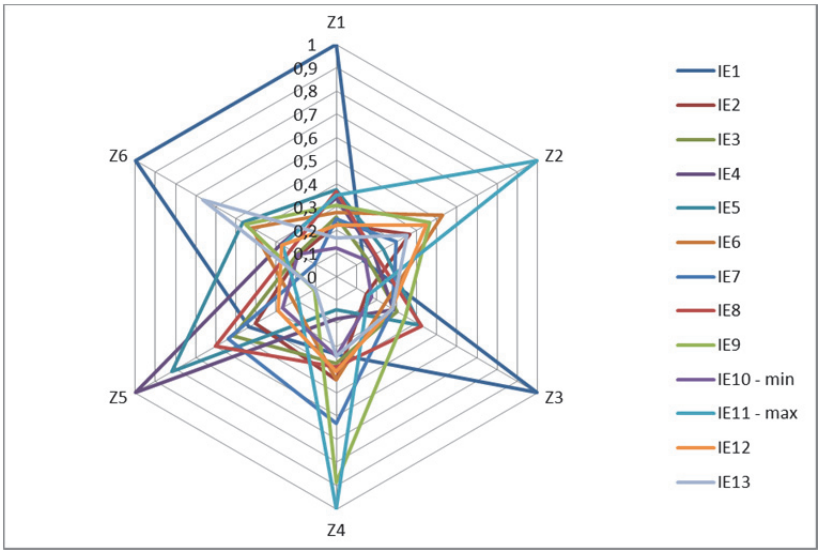


Figure 6.10. Positions of individual organic farms (Ω_{IW}) according to variables in the space of ownership describing agricultural production efficiency Φ_2

6.3. Classification of all farms in the space of agricultural production efficiency

The comparative analysis which was carried out in the entire set of facilities associated in agricultural producer groups and individual farms in the space of ownership which describes the level of production efficiency allowed determination of the systematics of facilities with reference to the farming system and production trend. The obtained results (table 6.3) show that the first positions in the ranking are taken by farms associated in the agricultural producer groups of vegetable production trend. In group V of very high values of the

development measure (q_i=0.450-0.476) there were only two farms and these are facilities from the vegetable producer group. In the next group which had high values of development measure there were only three vegetable farms. It proves that facilities with vegetable production trend are unraveled with other farms on account of production efficiency. Profitability of vegetable production is observed also in case of individual farms, which were close behind identical facilities associated in the 3rd group on account of the index size $q_{i.}$ Nonetheless, the mentioned example of vegetable farms simultaneously indicates higher production efficiency of facilities associated in comparison to those which act individually. Doubtlessly, it is related to higher production potential, ability to reduce the incurred direct inputs which as a result translates into better financial results. More favorable production preconditions, such as access to better technical equipment, lower work inputs many times determine higher competitiveness of associated farms.

Table 6.3. Ordered objects within the entire population of individual farms and agricultural producers groups based on the development measure q_i for the space of ownership which defines the potential of production efficiency

Farm name	Normalized variables describing agricultural production efficiency						q_i	Group
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$		
1	2	3	4	5	6	7	8	9
W_5	0.785	0.390	0.225	0.225	0.002	1.000	0.576	**V**
W_1	0.983	0.472	1.000	0.407	0.022	0.060	0.450	
W_2	0.619	0.296	0.489	0.177	0.030	0.063	0.247	
W_4	0.560	0.317	0.192	0.196	0.011	0.139	0.189	**IV**
IW_2	0.923	1.000	0.023	0.452	0.110	0.010	0.180	
W_3	0.999	0.439	0.083	0.236	0.093	0.025	0.158	
IW_3	0.567	0.199	0.015	0.910	0.030	0.011	0.142	
IW_{10}	1.000	0.276	0.027	0.287	0.162	0.012	0.137	**III**
IW_1	0.329	0.201	0.011	1.000	0.017	0.011	0.130	
IW_9	0.683	0.241	0.012	0.543	0.074	0.009	0.122	
IW_4	0.529	0.204	0.019	0.580	0.068	0.007	0.113	
IW_8	0.566	0.245	0.019	0.372	0.120	0.007	0.104	
IT_5	0.356	0.549	0.035	0.305	0.039	0.016	0.102	
T_{10}	0.317	0.426	0.029	0.467	0.047	0.008	0.102	**II**
IO_{10}	0.416	0.312	0.034	0.350	0.021	0.031	0.102	
IO_5	0.404	0.313	0.009	0.511	0.063	0.007	0.101	
O_6	0.524	0.267	0.015	0.397	0.070	0.010	0.101	
O_3	0.524	0.152	0.024	0.392	0.026	0.028	0.100	
IE_4	0.135	0.070	0.005	0.027	1.000	0.003	0.100	
IO_8	0.457	0.331	0.017	0.368	0.051	0.013	0.097	
IW_7	0.597	0.198	0.013	0.211	0.215	0.007	0.096	**I**
IO_1	0.421	0.333	0.005	0.379	0.120	0.005	0.095	
IO_2	0.399	0.316	0.006	0.368	0.144	0.004	0.093	
IO_6	0.448	0.302	0.011	0.337	0.108	0.007	0.093	
IO_4	0.383	0.321	0.006	0.361	0.132	0.004	0.091	

Farm name	Normalized variables describing agricultural production efficiency						q_i	Group
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$		
1	2	3	4	5	6	7	8	9
O_2	0.479	0.112	0.024	0.302	0.026	0.033	0.089	
O_5	0.500	0.171	0.023	0.279	0.048	0.020	0.088	
IE_5	0.148	0.088	0.008	0.021	0.818	0.005	0.088	
IO_3	0.421	0.303	0.007	0.293	0.139	0.006	0.088	
IT_3	0.287	0.449	0.037	0.241	0.036	0.018	0.088	
IO_9	0.362	0.246	0.014	0.408	0.043	0.011	0.087	
IO_7	0.320	0.265	0.008	0.447	0.065	0.006	0.086	
O_1	0.459	0.171	0.015	0.328	0.057	0.013	0.085	
O_4	0.459	0.149	0.020	0.275	0.042	0.022	0.083	
IM_5	0.109	0.172	0.009	0.031	0.694	0.003	0.081	
IE_1	0.397	0.051	0.019	0.050	0.433	0.010	0.080	
T_3	0.277	0.415	0.017	0.171	0.098	0.009	0.074	
IW_6	0.412	0.184	0.016	0.190	0.097	0.012	0.074	
IE_8	0.146	0.072	0.008	0.058	0.600	0.002	0.072	
T_6	0.238	0.410	0.028	0.130	0.075	0.013	0.071	
T_4	0.172	0.314	0.008	0.067	0.381	0.004	0.070	
T_8	0.179	0.316	0.009	0.084	0.322	0.004	0.068	
IE_7	0.099	0.111	0.005	0.094	0.538	0.001	0.067	
IT_4	0.214	0.318	0.010	0.160	0.161	0.005	0.065	
T_9	0.237	0.346	0.011	0.129	0.131	0.008	0.064	
M_6	0.162	0.233	0.037	0.034	0.273	0.010	0.064	
IE_{11}	0.140	0.373	0.003	0.149	0.191	0.003	0.061	
E_8	0.137	0.134	0.006	0.059	0.438	0.003	0.061	
T_5	0.195	0.310	0.027	0.110	0.069	0.014	0.060	
IE_3	0.101	0.058	0.006	0.056	0.513	0.002	0.060	
IW_5	0.089	0.126	0.003	0.117	0.409	0.001	0.058	**I**
IT_6	0.114	0.144	0.012	0.029	0.398	0.005	0.057	
M_4	0.124	0.122	0.026	0.035	0.339	0.006	0.056	
M_2	0.156	0.179	0.028	0.047	0.241	0.007	0.056	
IT_7	0.163	0.353	0.017	0.095	0.082	0.011	0.056	
IM_9	0.114	0.138	0.015	0.046	0.360	0.004	0.055	
T_7	0.154	0.361	0.012	0.062	0.137	0.010	0.055	
T_1	0.161	0.361	0.011	0.057	0.079	0.020	0.054	
IE_2	0.090	0.136	0.003	0.066	0.401	0.002	0.054	
T_2	0.162	0.269	0.013	0.060	0.180	0.008	0.053	
IM_2	0.157	0.263	0.011	0.134	0.126	0.005	0.053	
M_1	0.140	0.192	0.012	0.070	0.253	0.004	0.053	
IM_1	0.173	0.212	0.011	0.121	0.152	0.005	0.052	
IT_8	0.139	0.351	0.006	0.062	0.116	0.011	0.050	
IT_2	0.137	0.293	0.012	0.066	0.132	0.009	0.049	
M_5	0.112	0.102	0.027	0.034	0.266	0.007	0.049	

Farm name	Normalized variables describing agricultural production efficiency						q_i	Group
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$		
1	2	3	4	5	6	7	8	9
IT_1	0.066	0.129	0.019	0.017	0.327	0.007	0.048	
E_7	0.172	0.093	0.011	0.072	0.230	0.006	0.048	
IM_{10}	0.131	0.118	0.021	0.031	0.234	0.010	0.048	
IT_9	0.123	0.329	0.005	0.056	0.125	0.010	0.048	
IE_{12}	0.087	0.166	0.005	0.061	0.290	0.003	0.047	
IE_6	0.109	0.197	0.004	0.066	0.214	0.004	0.045	
IT_{10}	0.108	0.297	0.005	0.050	0.135	0.009	0.045	
IM_3	0.143	0.151	0.014	0.125	0.103	0.006	0.044	
E_{10}	0.152	0.135	0.011	0.053	0.178	0.009	0.044	
IM_4	0.125	0.131	0.013	0.118	0.149	0.004	0.044	
E_5	0.159	0.119	0.006	0.110	0.148	0.005	0.043	
E_2	0.108	0.092	0.006	0.089	0.241	0.003	0.043	
E_1	0.114	0.064	0.002	0.102	0.248	0.002	0.043	
IE_9	0.122	0.173	0.006	0.132	0.111	0.005	0.042	
E_4	0.132	0.091	0.008	0.085	0.201	0.004	0.042	
M_3	0.120	0.176	0.020	0.057	0.056	0.021	0.042	**I**
E_{12}	0.151	0.093	0.017	0.087	0.095	0.010	0.040	
E_3	0.125	0.085	0.007	0.076	0.198	0.004	0.040	
E_{13}	0.142	0.093	0.016	0.128	0.056	0.011	0.040	
IM_7	0.129	0.113	0.016	0.085	0.103	0.008	0.039	
E_{14}	0.077	0.032	0.009	0.027	0.292	0.005	0.038	
IM_6	0.102	0.112	0.011	0.087	0.148	0.004	0.038	
IM_8	0.091	0.157	0.009	0.103	0.101	0.005	0.037	
E_{15}	0.109	0.072	0.018	0.066	0.119	0.008	0.036	
IE_{10}	0.048	0.054	0.003	0.051	0.269	0.002	0.035	
E_{11}	0.091	0.065	0.016	0.075	0.086	0.008	0.031	
E_6	0.071	0.056	0.015	0.058	0.115	0.006	0.029	
IE_{13}	0.066	0.132	0.005	0.051	0.106	0.007	0.029	
E_9	0.039	0.003	0.021	0.023	0.146	0.006	0.026	

Analysis of the synthetic index (tab. 6.3) shows that the group of facilities with the lowest degree of development of the production efficiency, where the aggregate measure was within the first range q_i 0.026-0.100 was the most numerous (I group). This group included in total 78 facilities, i.e. 82% of the entire set. Such picture shows disproportion between vegetable farms and other production trends. From among the last 22 facilities individual farms oriented to milk production and organic farms had equal participation, their aggregate measure did not exceed q_i 0.050. The fact that milk production farms were at distant positions than the accepted pattern results from low unit productivity of the possessed livestock in case of milk farms. In facilities with organic production system such a low production efficiency results from the lack of production concentration, high human and objectified work inputs which in a total balance of profitableness determined unfavorable positions in the hierarchy of the entire population.

7. RANKING OF FARMS IN THE SPACE OF FINANCIAL EXTERNAL SUPPORT OF AGRICULTURAL FARMS

7.1. Classification of farms associated in the producer groups in the space describing financial external support for agricultural farms

Poland joined the European Union on 1st May 2014 then majority of farmers was unwilling and afraid of belonging to this organization. Presently, this social group belongs to its biggest followers. It results from the advantages which they obtain after accession. The most important advantages are "increase of transfer of funds for support of agriculture, thanks to which farmers' incomes increased (Starzyński, 2009), obtaining favourable balance of turnover of agri-food products, due to belonging to the Uniform European Union (Czyżewski and Stępień, 2010), increase of purchase prices of majority of produce, increase of transfer of funds for infrastructural investments and those which modernize development of rural areas, increase of produce export, raising the quality of manufactured products and stabilization of agricultural policy (Kania, 2008). The European Union strongly supports development and modernization of agriculture which influences positive attitude of farmers. This sector absorbs greater part of its budget, presently it is 34% of the total amount. Thus, as early as in 1957 Common Agricultural Policy started its operation Then, its main task was to counteract shortage of food as well as maintaining farmers' incomes. Presently, the basic aims of this institution include: increase of agricultural production, financial support of farmers' incomes, stabilization of agricultural markets, co-financing projects, the main objective of which is development and modernization of rural areas, ensuring regular food supplies, creating rational level of prices (Gaździcki, 2002).

Ordering facilities which belong to the collection of agricultural producer group on account of the level of multi-feature phenomenon which is financial external support of agricultural production, allowed assessment of the most aided farm. The ranking of the set of agricultural producer groups images the taken positions in the entire population of facilities also divided on account of the production trend (table 7.1).

According to the ranking, farms belonging to the milk producer group and organic producer group are on the leading positions in the ranking. A farm from the milk production group (M_4) was at the first position and decisively overtakes the remaining farms achieving the development measure at the level of q_i=0.639. Except for the mentioned facility, only one farm E_{12} exceeded half of the distance to the accepted space pattern. Further positions as far as to the 8th, were taken by farms also belonging to the milk and organic group, their average synthetic measure was at the level of q_i=0.476. The ranking which was carried out is a confirmation of the need of the agricultural production support. The previous analyses (chapter 6) shows that organic and milk group farms have the lowest production efficiency.

Table 7.1. Ordered facilities within the investigated producer group farms based on the synthetic measure q_i for the space of ownership which defines the financial external support for agricultural farms

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
M_4	0.762	0.204	0.326	1.000	1.000	0.639
E_{12}	0.974	0.930	1.000	0.002	0.005	0.506
M_6	0.742	0.104	0.290	0.697	0.685	0.457
E_6	1.000	0.589	0.701	0.225	0.170	0.450
W_2	0.646	0.071	0.047	0.738	0.870	0.447
E_{11}	0.974	0.489	0.521	0.363	0.274	0.443
E_{14}	0.981	1.000	0.559	0.005	0.009	0.441
M_2	0.747	0.137	0.269	0.623	0.616	0.427
T_5	0.710	0.075	0.245	0.631	0.656	0.415
T_1	0.708	0.064	0.417	0.500	0.560	0.391
E_9	0.974	0.343	0.302	0.403	0.304	0.378
T_2	0.709	0.086	0.304	0.512	0.544	0.375
T_7	0.692	0.063	0.454	0.459	0.471	0.367
T_{10}	0.681	0.052	0.130	0.562	0.572	0.349
M_5	0.766	0.246	0.352	0.287	0.426	0.348
T_6	0.708	0.057	0.213	0.476	0.487	0.327
E_1	0.995	0.510	0.401	0.066	0.110	0.316
E_{10}	0.983	0.238	0.331	0.287	0.221	0.308
E_2	0.986	0.352	0.462	0.088	0.163	0.302
E_{15}	0.974	0.445	0.423	0.022	0.041	0.275
W_1	0.597	0.041	0.027	0.410	0.514	0.270
E_7	0.974	0.344	0.260	0.123	0.114	0.257
E_8	0.988	0.243	0.380	0.092	0.137	0.251
E_{13}	0.974	0.342	0.327	0.047	0.088	0.245
T_4	0.694	0.073	0.302	0.213	0.316	0.244
E_3	0.980	0.380	0.376	0.002	0.004	0.235
E_4	0.982	0.353	0.358	0.020	0.027	0.234
T_8	0.696	0.072	0.285	0.189	0.259	0.222
M_1	0.754	0.129	0.330	0.165	0.147	0.217
O_1	0.549	0.105	0.052	0.266	0.342	0.215
W_4	0.615	0.064	0.051	0.266	0.373	0.214
M_3	0.759	0.141	0.404	0.115	0.107	0.214
E_5	0.974	0.268	0.301	0.023	0.037	0.202
T_9	0.678	0.064	0.182	0.184	0.267	0.199
W_5	0.613	0.052	0.035	0.242	0.281	0.181
T_3	0.685	0.054	0.159	0.172	0.213	0.177
O_6	0.549	0.067	0.048	0.225	0.266	0.176
O_2	0.549	0.161	0.048	0.164	0.213	0.174
O_3	0.549	0.119	0.045	0.164	0.213	0.162
O_4	0.549	0.121	0.051	0.098	0.122	0.127
O_5	0.549	0.105	0.047	0.000	0.000	0.070
W_3	0.628	0.047	0.028	0.000	0.000	0.055

The ranking which was carried out in the space of ownership describing external support for agricultural production, one may assume that low production efficiency is compensated by subsidies for agricultural production. Farms from vegetable and fruit producer group, which in the space of production efficiency took high positions in the ranking of obtaining non-production funds take last positions. It is related to the fact that these farms obtain only basic subsidies because presently there is no supplementing support for fruit and vegetable production. Fruit and vegetable producer groups may file for support for founding a group and its functioning with regard to administration. These facilities also have possibility of obtaining investment subsidies, however, with no possibility of direct support for agricultural production.

In the hierarchy, farms from the pig producer group took central positions in table 7.1. and the difference in comparison to the best farm was 0.224 of the synthetic measure. Farms from this group the most frequently benefited from direct subsidies for plant cultivation areas.

Determined similarity of the investigated facilities on axes in the space of ownership Φ_3 which describes the potential of financial external support for agricultural farms, allowed defining disproportion in particular diagnostic variables. In the analyzed collection of farms associated in the milk producer group, a similar distribution of facilities on the axis $3Z_1$, which describes the size of direct subsidies, occurred. It proves the balance level of subsidies for agricultural production, which directly depended on a similar use structure, seeding (Single Area Payments, Supplementary Area Payments) and farming conditions e.g. carrying out agricultural activity on areas with unfavorable farming conditions (less-favored areas LFA). Differences on other axes of this space of ownership result from the level of incurred inputs, obtained direct surplus, the size of investment in technical back and the level of the obtained subsidy for the executed investment. Axis 3Z5, which describes the index of subsidy for executed investments in technical back modernization was the most variable. It reflects the level of the obtained subsidies for execution of investments by the investigated facilities of the milk producer group. Farm M_4, which in the analysis of space of ownership describing machinery park potential (fig. 5.1) took the first position was the most favorable in the area of this variable (table 7.1). Thus, it proves that this farm is active on account of searching for means investment in the machinery park. The mentioned farm M_4 took on three axes maximum values in the research ($3Z_1$, $3Z_4$, $3Z_5$). Within the set of milk producers the third farm looks unfavorably in all analyses of variables. This facility also obtained the lowest positions in previously described space Φ_1 and Φ_2.

In the investigated collection of farms associated in the agricultural producer group oriented to pig production all facilities in the space of ownership describing financial external support proved a varied level of the compensation index of inputs with the obtained subsidies ($3Z_2$), participation index of subsidies in the direct surplus value ($3Z_3$), value of investment in technical back ($3Z_4$) and aiding investment from EU funds UE ($3Z_5$). In the analyzed collection of farms similarly to the milk producer group occurred a similar distribution of facilities on the axis $3Z_1$, which describes the size of direct subsidies. It proves a levelled level of subsidies for agricultural production. The greatest diversity of facilities occurred on the axis $3Z_3$, which describes the index of participation of subsidies in the direct subsidy value, it indicates a significant impact of EU subsidies on the obtained farming efficiency in associated farms pig production oriented. Farm T_5, which on three axes ($3Z_1$, $3Z_4$, $3Z_5$) in the space of ownership describing potential of external financial support for agricultural production was in the first positions was only at the 10th position in the entire population of producer group farms (table 7.1).

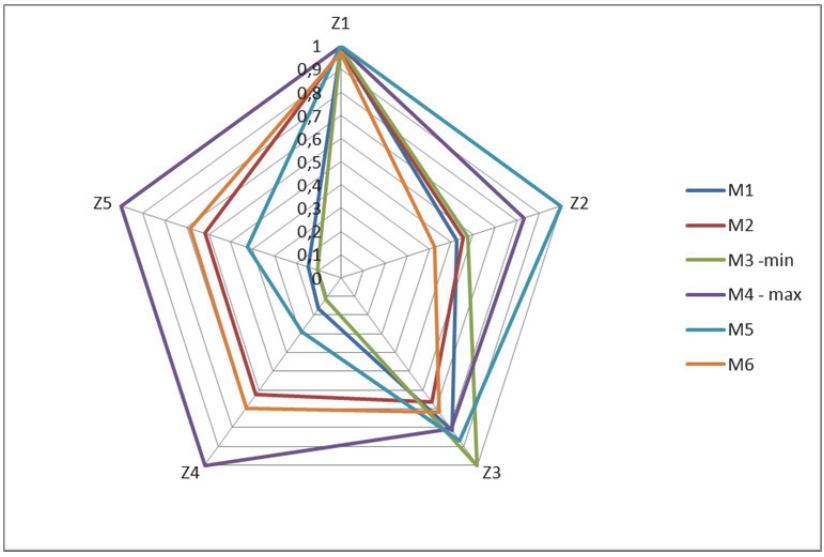


Figure 7.1. Positions of farms from the milk producer group (Ω_{GM}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

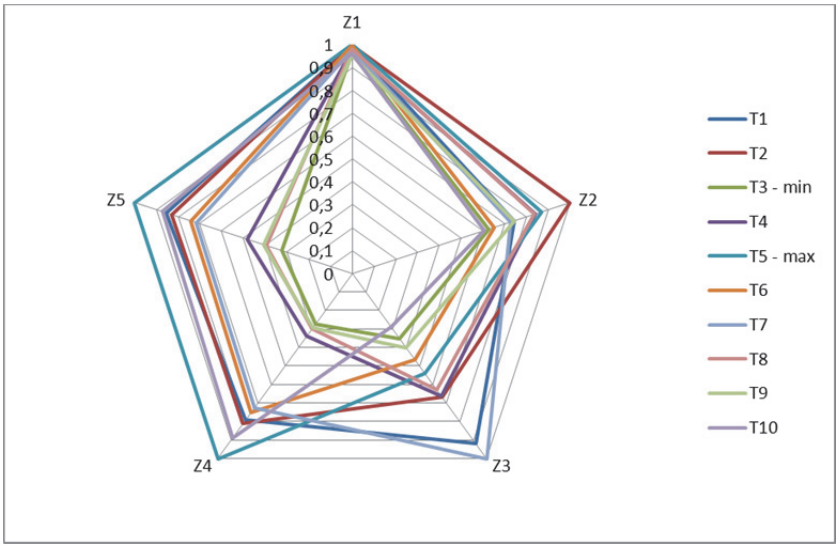


Figure 7.2. Positions of farms from the pig producer group (Ω_{GT}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

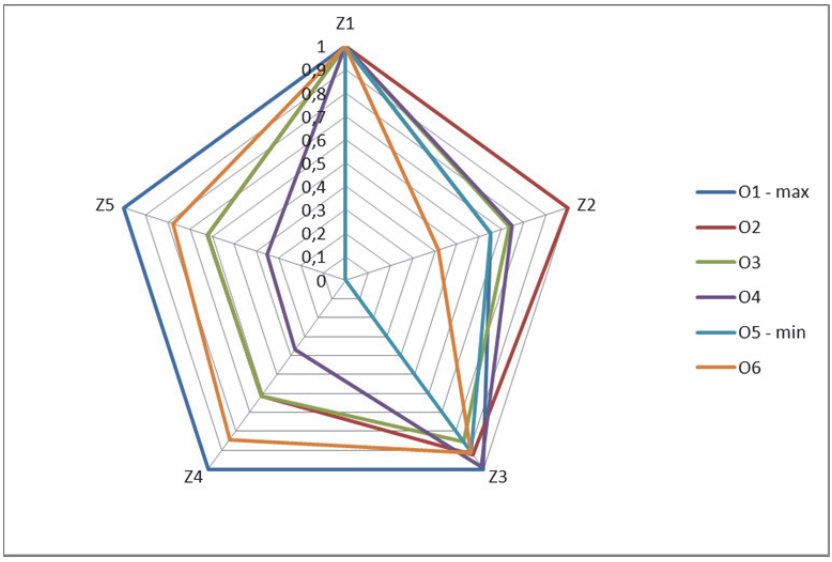


Figure 7.3. Positions of farms from the milk producer group (Ω_{GO}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

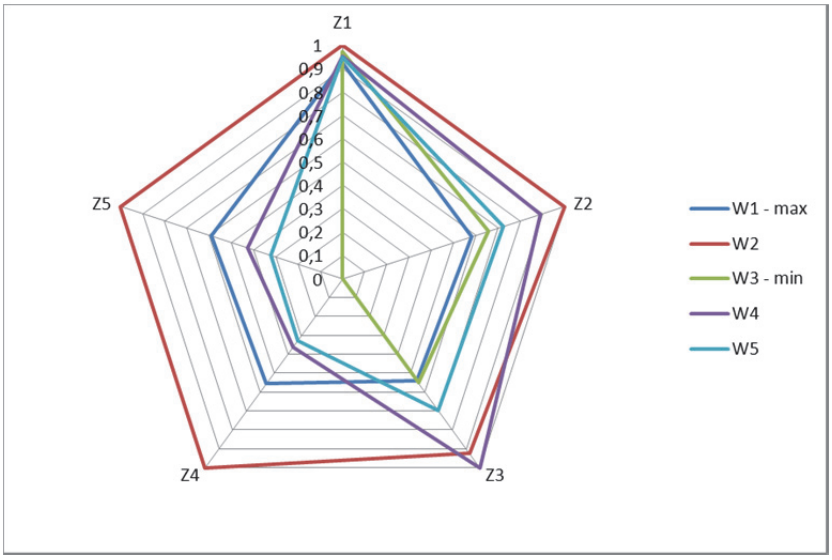


Figure 7.4. Positions of farms from the milk producer group (Ω_{GW}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

In case of the set of farms from the agricultural producer group oriented to horticultural production in the space of ownership Φ_3 similarly to other sets of farms from producer groups, the axis which described direct subsidies ($3Z_1$) was the least variable, as well as axis ($3Z_3$). It results from the fact that all farms from the set (Ω_{GO}) have a similar participation of subsidies in the direct surplus. Axis $3Z_5$, which describes the index of subsidy for executed investments in technical back modernization was the most variable. It reflects the level of the obtained subsidies for execution of investments by the investigated facilities of the fruit producer group. Farm O_1, which in the analysis of all farms from producer groups, was only at the 30th positions was the most favorable in the area of this variable (table 7.1). Farms of the group oriented to horticultural production in the space of ownership Φ_3 are unfavorable in comparison to other farms of agricultural producer groups. Such a situation follows from a low support of fruit producers in comparison to other production trends.

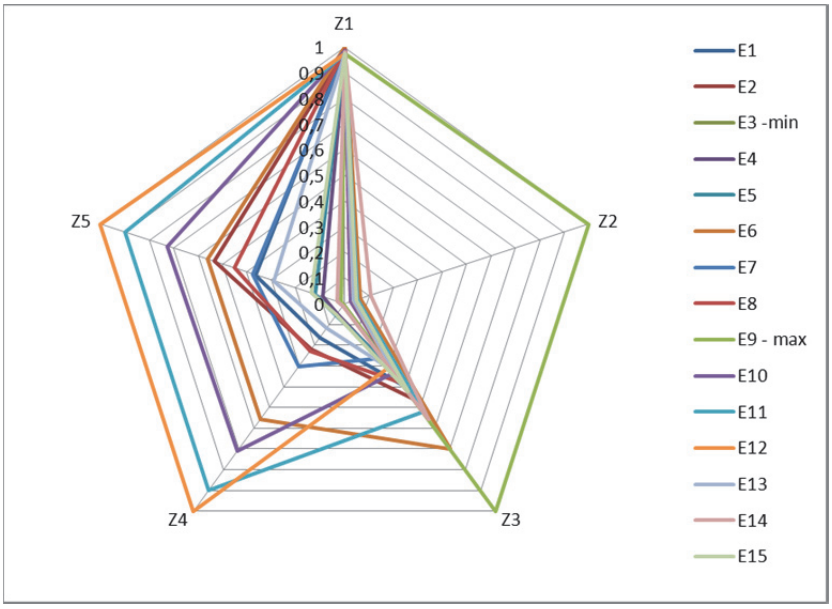


Figure 7.5. Positions of organic group farms (Ω_{GE}) according to variables in the space of ownership which describes financial external support for agricultural farms Φ_3

When analyzing the set of the agricultural producer group oriented to vegetable production Ω_{GW} in the space of ownership Φ_3 it was reported that a difference on the axis describing direct subsidies ($3Z_1$) occurred. It results from the fact that in farms of this group, a difference in the disposition of crops and in farming conditions occurred. Axis $3Z_5$, which describes the index of subsidy for executed investments in technical back modernization was the most variable. It reflects the level of the obtained subsidies for execution of investments by the investigated, the same similarity occurs in the group of milk and fruit producers. The essential fact of the analysis is that the farm W_2 was at the first positions on all axes of space and is the group leader. In the ranking of farms of agricultural producers,

the facility W_2 was at a very high position (5th position, table 7.1). The most favorable in this collection was farm W_3, which for two variables ($3Z_4$, $3Z_5$) achieved the lowest values and in the set of agricultural farms associated in the producer groups, was at the last position. It results from the fact that this farm did not obtain funds for investment in the machinery park.

In organic group farms Ω_{GE} a disturbed spatial order on all axes of the space of ownership occurred Φ_3. All facilities from the analyzed set only in case of axis, which describes direct subsidies, achieved a similar level ($3Z_1$). In the set Ω_{GE} one may not explicitly determine a spatial leader of ownership Φ_3. When analyzing particular space axes one may only notice that two farms (E_{12} and E_{11}) on axes $3Z_4$ and $3Z_5$ obtained the highest values, which ranks them as leading farms in the described group. Here, one should notice that two organic farms (E_{12} i E_{11}), which in two previously analyzed spaces were less favorable in case of space Φ_3 in the ranking of all farms from the producer group were on high positions i.e. 2nd and 6th position (table 7.1). It proves their high activity within the scope of obtained external funding. This activity in many cases was restricted only to obtaining the so-called guaranteed funds i.e. single area aid, supplementary area aid, subsidies according to variants for organic production - as a part of the environmental management scheme.

7.2. Classification of individual farms in the space describing financial external support for agricultural farms

The basic assumption of the Common Agricultural Policy is that a family farm is a fundamental production unit in agriculture. It has to guarantee self-sufficiency of the European Union within the scope of agri-products. Moreover, agriculture requires regulations in the European Union policy. Basic principles of the Common Agricultural Policy includes: the principle of preference (priority in purchase on the EU market belongs to products manufactured by farmers from the member states, furthermore these products should be protected against cheaper imported products), principle of uniform market (free flow of agricultural products on the EU territory), the principle of financial solidarity (costs are funded from money of all countries of the community). Undoubtedly, execution of common agricultural policy is based however on subsidizing agriculture on its particular stages of activity, both investment as well as directly productive.

Table 7.2. Ordered facilities within the set of individual farms based on the synthetic measure q_i for the space of ownership which defines the financial external support for agricultural farms

Name farms	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IW_5	0.585	0.269	0.369	0.859	1.000	0.606
IE_{10}	0.851	0.913	0.884	0.146	0.213	0.579
IE_3	1.000	0.996	0.413	0.337	0.245	0.545
IE_{13}	0.879	0.385	1.000	0.244	0.333	0.525
IW_{10}	0.526	0.110	0.020	1.000	0.993	0.508
IE_1	0.876	1.000	0.081	0.439	0.319	0.497

Name farms	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IT_9	0.612	0.107	0.587	0.780	0.493	0.492
IT_1	0.633	0.285	0.705	0.351	0.461	0.464
IE_8	0.972	0.776	0.273	0.244	0.355	0.458
IT_8	0.618	0.102	0.469	0.541	0.709	0.456
IE_{12}	0.897	0.312	0.726	0.390	0.221	0.450
IE_5	0.990	0.654	0.280	0.220	0.319	0.418
IM_4	0.611	0.269	0.241	0.634	0.461	0.409
IT_{10}	0.626	0.122	0.726	0.327	0.342	0.396
IT_2	0.618	0.122	0.362	0.454	0.603	0.393
IM_8	0.613	0.226	0.436	0.488	0.355	0.389
IE_{11}	0.867	0.134	0.733	0.220	0.319	0.389
IM_1	0.622	0.170	0.187	0.585	0.550	0.381
IE_9	0.936	0.313	0.436	0.244	0.355	0.380
IM_3	0.619	0.237	0.213	0.483	0.457	0.361
IE_4	0.993	0.819	0.304	0.000	0.000	0.346
IO_4	0.480	0.086	0.057	0.683	0.567	0.344
IO_3	0.480	0.091	0.050	0.683	0.567	0.344
IE_2	0.944	0.402	0.615	0.000	0.000	0.314
IO_{10}	0.480	0.089	0.051	0.634	0.461	0.309
IM_9	0.617	0.259	0.282	0.244	0.355	0.307
IO_1	0.480	0.083	0.051	0.566	0.482	0.297
IM_5	0.610	0.205	0.337	0.220	0.319	0.293
IW_2	0.480	0.028	0.026	0.537	0.570	0.290
IM_7	0.598	0.306	0.215	0.220	0.319	0.288
IO_2	0.480	0.088	0.054	0.537	0.461	0.288
IE_7	0.873	0.454	0.441	0.000	0.000	0.280
IE_6	0.934	0.274	0.579	0.010	0.011	0.277
IT_6	0.605	0.243	0.282	0.200	0.213	0.261
IO_9	0.480	0.112	0.057	0.488	0.355	0.261
IO_6	0.480	0.092	0.046	0.488	0.355	0.253
IT_5	0.618	0.065	0.104	0.332	0.411	0.248
IW_1	0.480	0.138	0.062	0.390	0.284	0.231
IM_6	0.614	0.318	0.300	0.000	0.000	0.194
IT_7	0.576	0.094	0.288	0.103	0.057	0.168
IM_{10}	0.603	0.295	0.214	0.000	0.000	0.167
IW_7	0.513	0.150	0.033	0.171	0.199	0.162
IT_3	0.618	0.080	0.130	0.119	0.106	0.144
IT_4	0.617	0.112	0.168	0.081	0.053	0.141
IW_9	0.513	0.123	0.029	0.171	0.124	0.138
IM_2	0.602	0.132	0.244	0.000	0.000	0.133
IW_8	0.520	0.123	0.037	0.146	0.106	0.131
IW_4	0.490	0.139	0.037	0.098	0.071	0.115
IW_6	0.542	0.170	0.053	0.000	0.000	0.093
IW_3	0.480	0.139	0.033	0.000	0.000	0.076
IO_7	0.480	0.105	0.068	0.000	0.000	0.076
IO_5	0.480	0.089	0.053	0.000	0.000	0.068
IO_8	0.480	0.084	0.046	0.000	0.000	0.065

The determined ranking of individual farms Ω_I in the space of ownership which defines financial external support for agricultural farms (Φ_3) reflects the obtained external funds for conducting agricultural activity. The ranking shows that farms with extensive nature of production, that is, facilities with the organic system of farming may obtain higher funds than farms with other production trends. In the ranking, the first ten positions were taken by five farms from the set of organic facilities, i.e. IE_{10}, IE_3, IE_{13}, IE_1 and IE_5 (tab. 7.2). Whereas, synthetic measure qi in facilities from the first tenth of the ranking was within 0.456 to 0.606 and was higher than the facilities from the first tenth of the ranking of farms belonging to the agricultural producer groups by 0.051 (table 7.1). High level of obtaining external means of support for agricultural production by individual farms is proved by the fact that as much as five facilities of this set exceeded half of the distance to the accepted spatial pattern. These were facilities of only two sets, two facilities oriented to vegetable production and three facilities from the set of organic farms (IW_5, IE_{10}, IE_3, IE_{13}, IW_{10}). The next relation of the ranking is a great disproportion between facilities of one set, the highest disproportion can be noticed in facilities oriented to vegetable production, since as much as seven facilities (IW_1, IW_7, IW_9, IW_8, IW_4, IW_6, IW_3) of this set takes positions in the end of the ranking. Whereas, the firs facility in the ranking comes from the same group and achieved the synthetic measure *qi* at the level of 0.606.

The determined ranking of individual farms is a confirmation of the need of agricultural production support. Since high positions taken by farms with low productivity in the space of ownership Φ_3 are a compensation for low positions in the ranking of space of production efficiency Φ_2. Individual farms from the set of fruit producer group, which in the space of production efficiency took high positions, in the ranking of obtaining non-production funds (direct subsidies) take last positions. A similar situation occurred in the set of agricultural producer group farms. It is related to the fact that these farms obtain only basic subsidies because presently there is no supplementary aid for fruit production (supplementary area payments).

Farms from pig and milk producer group took central positions in the ranking table 7.2. A difference to the best farm of the facility oriented to pig production was 0.114 of the synthetic measure, whereas in farms oriented to milk production this difference was higher and it was 0.196. Individual farms oriented to milk and pigs production the most frequently use direct subsidies for the area of cultivated plants.

Determined similarity of facilities of the set of individual farms oriented to milk production (Ω_{IM}) on axes in the space of ownership Φ_3 which describes the potential of financial external support for agricultural farm, allowed determination of disproportion between facilities. In the analyzed set (Ω_{IM}) of farms oriented to milk production, occurred a similar distribution of facilities on axis $3Z_1$, which describes the amount of direct subsidies, a similar situation was reported in the set of facilities associated to the milk producer group (Ω_M). Lack of variability on this axis proves that farms had a similar cultivation and seeding structure and consequently they obtained subsidies at a similar level. Differences on the axis $3Z_2$ result from the level of compensation of inputs incurred on agricultural production. Farm IM_2 had the lowest value of the discussed index in this set and the farm IM_6 obtained the highest compensation of incurred inputs. On the next axis $3Z_3$, farms achieved values from the range 0.4 to 0.7; only one farm IM_8 dominated the entire set with the size of ESU index ($3Z_3$). Three farms (IM_2, IM_6, IM_{10}) in the investigated period did not invest in the technical back and obtained zero value on axes $3Z_4$ and $3Z_5$.

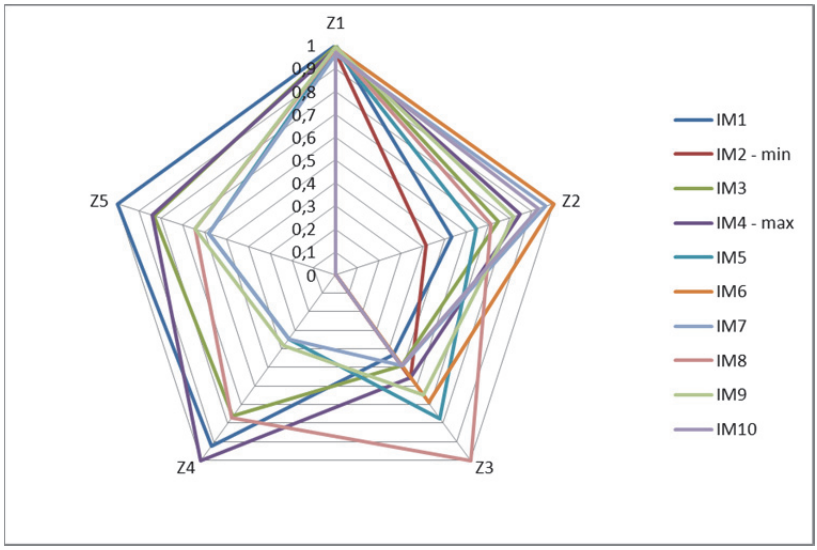


Figure 7.6. Positions of individual farms oriented to milk production (Ω_{IM}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

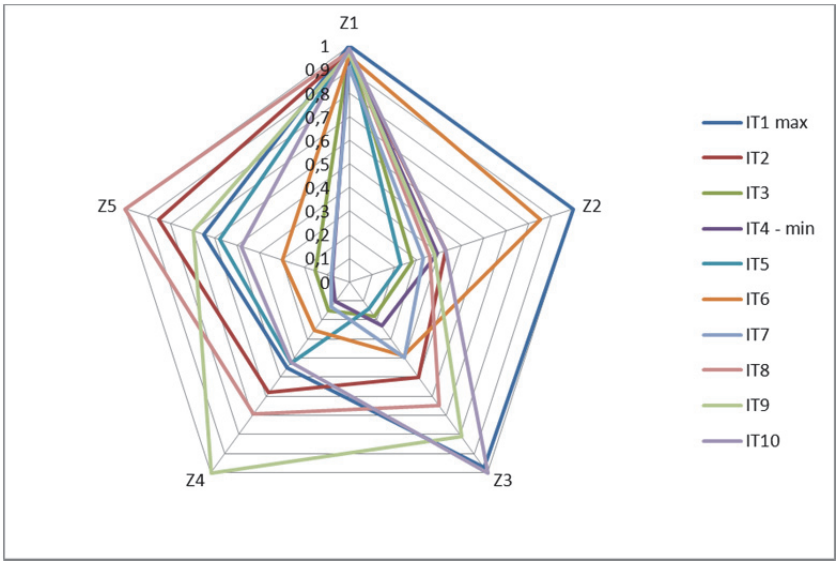


Figure 7.7. Positions of individual farms oriented to pig production (Ω_{IT}) according to variables in the space of ownership which defines financial external support for agricultural farms Φ_3

In the set of individual farms milk production oriented, the highest variability was on axes which define the value of investment in technical back ($3Z_4$) and presenting the index of funding of conducted investments from the scope of modernization of technical back ($3Z_5$). Farm IM_1, which in the analysis of the space of ownership which defines potential of the machinery park (figure 5.6) is on the second position was the most favorable for variable presenting the index of subsidizing the executed investments, which proves that the farm was active on account of obtaining funds for investments in the machinery park. The fourth farm (IM_4) had high values on all axes and is a leader in the investigated set, whereas in the population of individual farms, it took 13 positions (table 7.2). It proves that milk producers are less active in looking for external aids for investments. Within the set of individual farms oriented to milk production in the space of ownership Φ_3 farm IM_2 was unfavorable. Whereas in the analyzed other spaces of ownership (Φ_1, Φ_2) this farm was on the leading positions. It results from the fact that this farm was not a beneficiary of investment funds.

In the analyzed set of individual farms oriented to pig production, all facilities in the space of ownership which defines financial external support for agricultural farms, they showed a varied level of investment in technical back, because there are the biggest differences on axes $3Z_4$ and $3Z_5$ An axis which defines the index of subsidies participation in the value of direct surplus ($3Z_3$) is also varied. Facilities of the set ($3Z_3$) form two centers within the maximum value, these are facilities IT_1, IT_6, and the remaining farm within 0.2 to 0.5. In the analyzed set similarly to individual farms oriented to milk production occurred a similar distribution of facilities on the axis $3Z_1$, which describes the size of direct subsidies. It proves a levelled level of subsidies to agricultural production. Farm IT_1 which on three axes ($3Z_1$, $3Z_2$, $3Z_3$) in the space of ownership describing potential of external financial support of agricultural production was in the first position, is a leader of this set.

In case of the set of farms oriented to horticultural production in the space of ownership Φ_3 an equal distribution on all axes can be reported. As in previous analyses, the least variable was the axis which describes direct subsidies $3Z_1$. In this set of individual farms, also axis $3Z_3$ was less variable. It shows that all farms from collection Ω_{IG} have a similar index of inputs compensation. At the mentioned level of obtained direct subsidies, producers from these farms incurred direct inputs similar in values. Three farms: IO_5, IO_7, IO_8 in the investigated period did not incur costs related to investments in the machinery park and on two axes $3Z_4$ i $3Z_5$ of this space achieved a zero value. Taking into consideration the remaining farms from the set, the most variable was the axis which described the index of subsidy of the executed investments related to the machinery park. Farms O_3 i O_4 were the most favourable for this variable. They were on 21st and 22nd position in the analysis of all individual farms (table 7.2). These farms are undoubtedly leaders of the defined set. They obtained the value of the synthetic measure at the level of 0.987. It shows that these facilities actively apply for support for agricultural producers at the level of set of individual farms oriented to horticultural production.

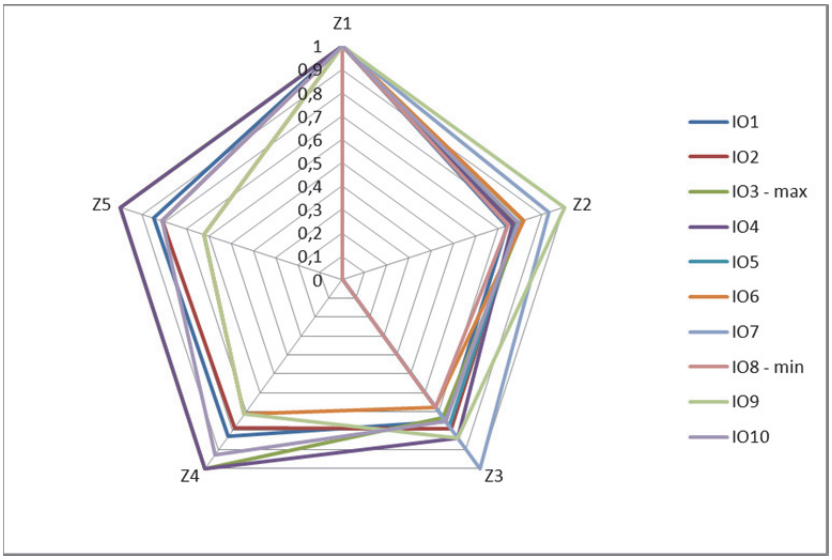


Figure 7.8. Positions of individual farms oriented to horticultural production (Ω_{IO}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

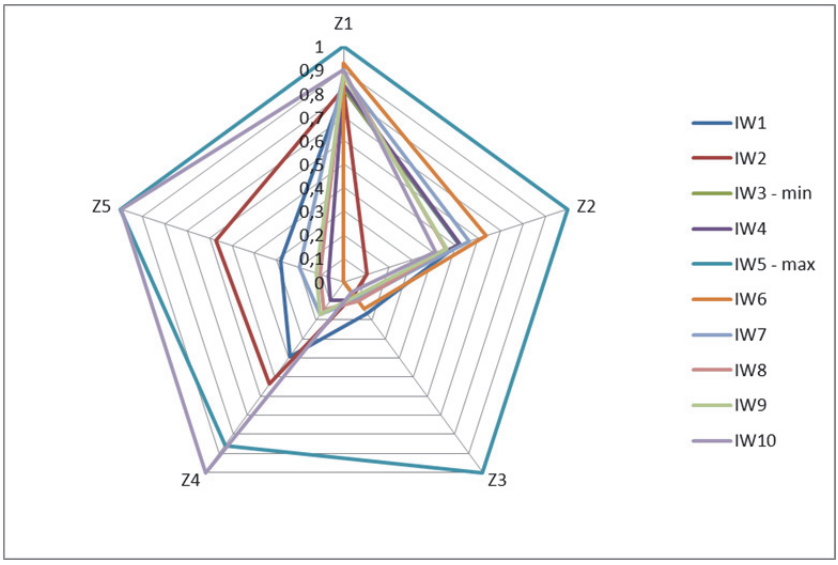


Figure 7.9. Positions of individual farms oriented to vegetable production (Ω_{IW}) according to variables in the space of ownership describing the financial external support for agricultural farms Φ_3

In the determined spatial distribution of ownership Φ_3 in the set composed of individual farms oriented to vegetable production, one may notice variability on the axis which describes direct subsidies ($3Z_1$). According to the above, facilities had a varied disposition of crops and carried out agricultural activity in various farming conditions (e.g. from LFA). Diversity on the axis $3Z_1$ undoubtedly results from the varied structure of use. Since, according to source information, obtained during the guided survey, in the farm IW_5, grains played an essential role in the disposition of crops. The remaining axes had similar diversity (great range of the obtained values). Facilities on axis $3Z_2$ in the range of values within 0.4 to 0.7 were the most similar. Farm IW_5 is a leader. On four axes $3Z_1$, $3Z_2$, $3Z_3$, $3Z_5$ of the space of ownership Φ_3 it took first positions; it should be mentioned that in the entire population of individual facilities it is also a leader (table 7.2). Farm IW_3 was the most favourable in this set. For all variables it obtained low values and in the hierarchy of the entire set it was only at the 50th position.

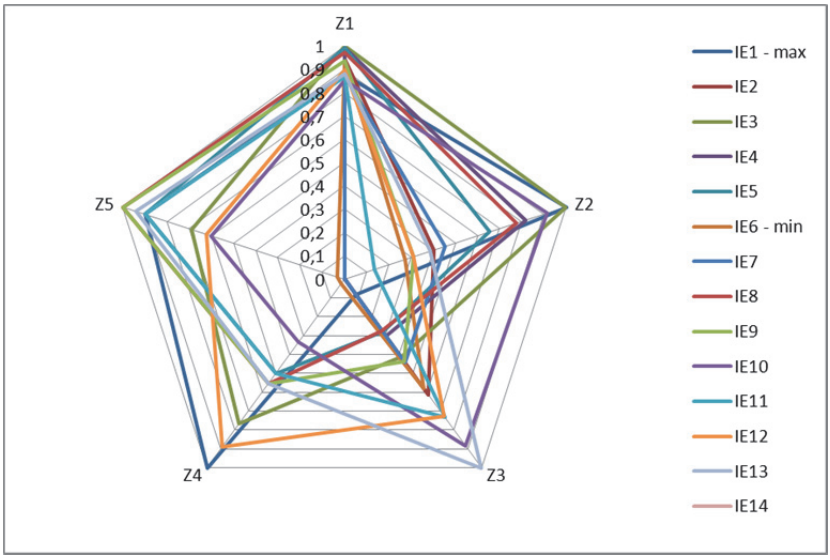


Figure 7.10. Positions of individual organic farms (Ω_{IE}) according to variables in the space of ownership which describes financial external support for agricultural farms Φ_3

In the last set of individual organic farms (Ω_{IE}) a disturbed spatial order occurred on the axes $3Z_2$ and $3Z_3$ of the space of ownership Φ_3. Obvious spatial order may be observed only on the axis $3Z_1$, because in this case all facilities focus around high values. In the set Ω_{IE} one may not explicitly indicate one spatial leader of ownership, which describes financial external support for agricultural farms. The three farms i.e. IE_1, IE_3 i IE_{12} came out the most favorably. In the hierarchy of all individual farms facilities from the organic set take high positions in majority in the first ten positions of the ranking. However, it results from obtaining high direct subsidies and special subsidies to organic production. But, this set also included such farms as IE_4, IE_6, IE_7, which to a slight degree invest in technical back and thus do not obtain subsidies for modernization of technical back.

7.3. Classification of all farms in the space, which defines financial external support for agricultural farms

At the beginning of its existence Common Agricultural Policy greatly influenced the shape and the situation of the European Agriculture. As it were, the so-called European model of agriculture is its product. Two basic stages can be distinguished in its entire history. The first one is a period of pro-supply policy, which lasted from the beginning of the 90's of the 20th century. Consequently, the European Union obtained a considerable level of food self-sufficiency. The second stage was clearly pro-demand. It started in 1992 with the moment of implementing Mac Sharr's reform, which resulted from pressures of the World Trade Organization. As its results, compensation payments for farmers were introduced, due to which institutional prices were gradually reduced. It allowed creation of the internal and external demand for products manufactured in member states at the simultaneous limitation of the production increase. Its main element was determination of production limits (for lowering of grains production, obligation to lie fallow was introduced) and lowering intervention prices (e.g. pork price dropped by 15%).

The ranking of farms in the entire population, that is of the combined set of individual farms and farms belonging to agricultural producer groups in the space of ownership describing financial external support of agricultural farms allowed determination of the possibility of obtaining means for support for agricultural production (table 7.3).

The ranking explicitly proves that farms associated in the agricultural producer groups are more active in applying for aid for agricultural production. In the determined ranges of ranking, in relation to the range of synthetic index, in the fifth group which includes facilities with very high values of the development measure and the fourth group which includes facilities with very high values of measure, only two farms, which belong to the group of agricultural producers, took places. The fifth group with very high measurement values included farms from producer groups such as vegetable farms (W_2), milk farms (M_6, M_2, M_4), pig farms (T_5, T_1, T_2, T_{10}) and organic farming system farms (E_{11}). In this ranking group, pig farms were represented the most strongly. In space Φ_3 a vegetable farm (W_2) associated in the agricultural producer group is a model. It obtained the synthetic index value at the level of $qi = 0.560$. It obtained such value mainly through gaining aid for investments in the technical back. Places in the last group (I) which includes farms, which obtained very low values of development measure were taken in majority by farms from the set of individual facilities Ω_I. It proves the fact that individual farms have greater opportunities for obtaining aid for agricultural production. However, this group does not include any farm with organic farming system. This state of affairs follows from the fact that organic farms obtain considerable funds for direct production means not for investment means, as it was in case of facilities associated in producer groups. Present system of subsidizing the agriculture at a present structure and intensity of production causes that the level of obtained subsidies many times exceeds the level of the incurred inputs. Thus, many times farms with organic production system are non-commodity farms, which produce for the so-called own demand, seeing advantage not in aiming at production intensification but obtaining subsidies. Many times the obtained subsidies are designated for satisfaction of living demand of the entire family and not inputs for agricultural production.

Table 7.3. Ordered facilities within the entire population of individual farms and agricultural producer groups based on the development measure q_i for the space of ownership which defines the financial external support for agricultural farms

Farm name	Normalized variables describing the level of external support of agricultural production					q_i	Group	Farm name	Normalized variables describing the level of external support of agricultural production					q_i	Group
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$				$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$		
1	2	3	4	5	6	8	9	1	2	3	4	5	6	8	9
W_2	0.564	0.071	0.037	1.000	0.870	0.560		IT_9	0.612	0.070	0.587	0.178	0.106	0.235	
M_6	0.649	0.104	0.229	0.944	0.685	0.543		E_7	0.851	0.344	0.205	0.167	0.114	0.234	
M_2	0.652	0.137	0.212	0.844	0.616	0.501		IE_{11}	0.867	0.087	0.733	0.050	0.068	0.234	
T_5	0.621	0.075	0.194	0.856	0.656	0.496		T_8	0.608	0.072	0.225	0.256	0.259	0.230	
T_1	0.618	0.064	0.330	0.678	0.560	0.445	V	IE_5	0.990	0.424	0.280	0.050	0.068	0.229	
E_{11}	0.851	0.489	0.412	0.492	0.274	0.437		IT_{10}	0.626	0.079	0.726	0.075	0.073	0.226	
T_2	0.619	0.086	0.240	0.694	0.544	0.433		E_8	0.864	0.243	0.300	0.124	0.137	0.225	
M_4	0.666	0.204	0.257	0.136	1.000	0.433		IE_4	0.993	0.532	0.304	0.000	0.000	0.225	
T_{10}	0.595	0.052	0.103	0.761	0.572	0.425		E_{15}	0.851	0.445	0.335	0.030	0.041	0.223	
T_7	0.605	0.063	0.358	0.622	0.471	0.410		IE_2	0.944	0.261	0.615	0.000	0.000	0.222	
E_6	0.874	0.589	0.554	0.306	0.170	0.407		M_1	0.659	0.129	0.261	0.223	0.147	0.212	
E_9	0.851	0.932	0.790	0.003	0.005	0.397		T_9	0.592	0.064	0.143	0.250	0.267	0.212	
E_{12}	0.851	0.343	0.239	0.547	0.304	0.396		IE_9	0.936	0.203	0.436	0.056	0.076	0.211	
T_6	0.618	0.057	0.168	0.644	0.487	0.384	IV	W_5	0.536	0.052	0.028	0.328	0.281	0.210	
M_5	0.670	0.246	0.278	0.389	0.426	0.362		IT_8	0.618	0.066	0.469	0.123	0.152	0.209	
E_1	0.851	0.592	0.884	0.033	0.046	0.360		E_{13}	0.851	0.342	0.258	0.064	0.088	0.209	II
E_{14}	0.857	1.000	0.442	0.007	0.009	0.349		O_6	0.480	0.067	0.038	0.306	0.266	0.202	
W_1	0.522	0.041	0.022	0.556	0.514	0.331		IE_6	0.934	0.178	0.579	0.002	0.002	0.198	
IE_{13}	0.879	0.250	1.000	0.056	0.072	0.322		M_3	0.663	0.141	0.319	0.156	0.107	0.197	
E_{10}	0.859	0.238	0.262	0.389	0.221	0.312	III	IM_8	0.613	0.146	0.436	0.111	0.076	0.197	
IE_3	1.000	0.646	0.413	0.077	0.052	0.306		IE_7	0.873	0.294	0.441	0.000	0.000	0.193	
IE_{10}	0.870	0.510	0.317	0.089	0.110	0.270		E_4	0.858	0.353	0.283	0.027	0.027	0.190	
E_2	0.862	0.352	0.365	0.119	0.163	0.267		T_3	0.598	0.054	0.126	0.233	0.213	0.188	
IE_{12}	0.897	0.202	0.726	0.089	0.047	0.264		O_2	0.480	0.161	0.038	0.222	0.213	0.186	
T_4	0.607	0.073	0.238	0.289	0.316	0.257		E_3	0.857	0.380	0.297	0.003	0.004	0.185	
IT_1	0.633	0.185	0.705	0.080	0.099	0.254		IM_4	0.611	0.175	0.241	0.144	0.099	0.182	
IW_5	0.585	0.174	0.369	0.196	0.215	0.249		IT_2	0.618	0.079	0.362	0.103	0.129	0.181	
W_4	0.538	0.064	0.040	0.361	0.373	0.249		O_3	0.480	0.119	0.035	0.222	0.213	0.176	
IE_1	0.876	0.649	0.081	0.100	0.068	0.248	II	IW_{10}	0.526	0.071	0.020	0.228	0.213	0.167	
IE_8	0.972	0.504	0.273	0.056	0.076	0.247		E_5	0.851	0.268	0.238	0.031	0.037	0.166	
O_1	0.480	0.105	0.041	0.361	0.342	0.247		IM_3	0.619	0.154	0.213	0.110	0.098	0.163	
IM_1	0.622	0.110	0.187	0.133	0.118	0.160		IO_6	0.480	0.060	0.046	0.111	0.076	0.098	
IM_9	0.617	0.168	0.282	0.056	0.076	0.158		IW_1	0.480	0.089	0.062	0.089	0.061	0.097	
IM_5	0.610	0.133	0.337	0.050	0.068	0.156		IM_2	0.602	0.086	0.244	0.000	0.000	0.096	
IM_7	0.598	0.199	0.215	0.050	0.068	0.147		IT_4	0.617	0.073	0.168	0.019	0.011	0.088	
IT_6	0.605	0.157	0.282	0.045	0.046	0.144	II	IT_3	0.618	0.052	0.130	0.027	0.023	0.082	
IM_6	0.614	0.206	0.300	0.000	0.000	0.133		IW_7	0.513	0.097	0.033	0.039	0.043	0.077	
O_4	0.480	0.121	0.041	0.133	0.122	0.128		IW_9	0.513	0.080	0.029	0.039	0.027	0.068	
IO_4	0.480	0.056	0.057	0.156	0.122	0.124		IW_8	0.520	0.079	0.037	0.033	0.023	0.067	
IO_3	0.480	0.059	0.050	0.156	0.122	0.123		IW_6	0.542	0.110	0.053	0.000	0.000	0.063	I
IO_{10}	0.480	0.058	0.051	0.144	0.099	0.114		IW_4	0.490	0.090	0.037	0.022	0.015	0.063	
IM_{10}	0.603	0.191	0.214	0.000	0.000	0.113		O_5	0.480	0.105	0.037	0.000	0.000	0.055	
IO_1	0.480	0.054	0.051	0.129	0.103	0.110		IO_7	0.480	0.068	0.068	0.000	0.000	0.053	
IO_2	0.480	0.057	0.054	0.122	0.099	0.108	I	IW_3	0.480	0.090	0.033	0.000	0.000	0.051	
IT_7	0.576	0.061	0.288	0.024	0.012	0.107		IO_5	0.480	0.057	0.053	0.000	0.000	0.048	
IT_5	0.618	0.042	0.104	0.076	0.088	0.106		IO_8	0.480	0.054	0.046	0.000	0.000	0.046	
IO_9	0.480	0.073	0.057	0.111	0.076	0.103		W_3	0.549	0.047	0.022	0.000	0.000	0.043	
IW_2	0.480	0.018	0.026	0.122	0.122	0.100									

In the ranking, which was carried out, the group II, which included farms with low values of the development measure, is the most numerous in the ranking. This group included as much as 48% of farms, which obtained the index within (q_i) from 0.124 to 0.257. It proves that half of farms from the entire population are active to a small degree in obtaining external subsidies for investment and limit to applying for direct subsidies for agricultural production.

8. SUMMARY AND CONCLUSIONS

The analysis of relations in spaces of ownership which was conducted included three types of information: concerning potential of the machinery park (Φ_1), efficiency of agricultural production (Φ_2) and financial external aid for agricultural farms (Φ_3). Degree of intensification of the investigated phenomenon in the facilities was determined with the use of the synthetic index of the development measure. The synthetic index was constructed based on variables which characterize spaces of ownership Φ. Structure of index is presented by means of formula 4.12. Assumptions presented in the paper were executed and verified by carrying out firstly field research in 95 farms, out of which 43 farms were associated in groups of agricultural producers whereas 52 facilities were individual farms.

The determined ranking based on the accepted synthetic index explicitly allowed determination of pattern facilities in a given set and in the entire population of farms. Based on the synthetic index the level of saturation of the investigated facilities with multi-feature phenomena which were accepted in the research assumptions of the paper, were determined. The obtained results presented in the paper in the form of the numerical data allowed carrying out the following analyses:

determination of the ranking of farms belonging to agricultural producer groups in collections: Ω_G, Ω_{GM}, Ω_{GT}, Ω_{GO}, Ω_{GW}, Ω_{GE} in multi-feature space of ownership which describes the potential of the machinery park, efficiency of agricultural production and potential of financial external aid for agricultural farms,

determination of the ranking of individual farms in sets: Ω_I, Ω_M, Ω_T, Ω_O, Ω_W, Ω_E in multi-feature space of ownership which describes the potential of the machinery park, efficiency of agricultural production and potential of financial external aid for agricultural farms,

determination of the hierarchy in facilities of agricultural producer groups and individual farms in the set Ω in multi-feature space of ownership which describes potential of the machinery park, efficiency of agricultural production and financial external aid for agricultural farms.

The rankings, which were carried out, explicitly prove that, the groups of agricultural producers form around one farm, which in the analyzed spaces of ownership was a leader, thus they have features of model solutions. Results confirm accepted assumptions that farms from agricultural producer groups prevail considerably in spaces Φ_1 i Φ_2. They own higher means invested in the machinery park and carry out more effective agricultural production than individual farms. Reverse situation is observed in space Φ_3 where individual farms prevail, which proves the compensation of low-commodity production with subsidies. The same situation was within farms divided on account of production trend where high commodity vegetable farms and fruit farms took high positions in the space of ownership which describes production efficiency and low positions in the ranking determined based on variables which describe external aid for agricultural production. Analysis of

space of the financial aid of the investigated facilities explicitly shows that farms from the production groups in its balance of production efficiency base to a lower degree on the obtained direct subsidies contrary to individual farms. However, these associated facilities carry out more effective agricultural production, have higher investment ability, thus more invest in technical back using EU subsidies for this purpose. This makes them more developmental and more competitive in comparison to individual farms, which in many cases were characterized with stagnation of operation. Following the analysis of organic farms, both associated as well as individual, one may state unanimously that a farm model, whose functioning is determined by EU subsidies for agricultural production is forming. Very low activity of these farms within the scope of modernization of technical back is alarming; Obviously, it influences the increase of the distance to farms which produce in the conventional or integrated system.

Enlargement of the European Community by new member states in 2004 (including Poland) and considerable variety of the level of development of rural areas of particular member states and their regions forced on the community level to start reforms which aimed at ensuring sustainable technical, economic and social progress for underdeveloped member states. The applied instruments in all states within Common Agricultural Policy are not able to lead to equal development of all agricultural farms. Free-market economy imposes even higher qualities and quantities of supplied products on agricultural producers. Individual small agricultural producers have difficulties to meet those requirements. In the collision with big distributive networks, which presently are recipients of agricultural producers, individual - small producers usually lose. Common operation allows strengthening of their position in the surrounding production spaces, improvement of economic farming efficiency and adjusting production to clients' requirements. However, the condition, except for scale and continuity of supplying to the market their products, is their proper quality. It may be secured only by appropriate technologies fitted with modern and efficient machines and devices.

9. REFERENCES

Augustyńska-Grzybek, I. i in. (1999). *Metodyka liczenia nadwyżki bezpośredniej dla działalności produkcji rolniczej*. IERiGR. Warszawa, ISBN 83-88010-36-0.

Boguta, W.; Siekierski, Cz. (2001). *Grupy producentów rolnych jako czynnik doskonalenia produkcji i obrotu produktami rolnymi*. [w:] Ekonomika i Organizacja Gospodarki Żywnościowej. Zeszyty Naukowe SGGW, nr 43, Warszawa, 53.

Borys, T. (1980). Metody normowania cech w statystycznych badaniach porównawczych. *Przegląd Statystyczny, 2*.

Borys, T. (1982). Przedmiot i podział statystyki i ekonometrii – artykuł dyskusyjny. *Wiadomości statystyczne, 5*.

Bórawski, P.; Pawlewicz, A. (2006). Efektywność ekonomiczna indywidualnych gospodarstw rolnych w aspekcie zrównoważonego rozwoju obszarów wiejskich na przykładzie województwa warmińsko-mazurskiego. *Zeszyty Naukowe Akademii Rolniczej we Wrocławiu NR 540,* 91-97.

Cewra, J. (1994). Badania poziomu życia na wsi. *Socjologia wychowania nr XI*. Wydawnictwo Uniwersytetu M. Kopernika, Toruń.

Chlebicka, A.; Fałkowski, J.; Wołek, T. (2008). *Powstawanie grup producenckich a zmienność cen.* Warszawa, 1-17.

Cupiał, M. (2005). Informacja techniczna w rolnictwie Małopolski. *Inżynieria Rolnicza, 3*(63), 119-124.

Cupiał, M. (2006). System wspomagania decyzji dla gospodarstw rolniczych. *Inżynieria Rolnicza, 9*(84), 8-21.

Czyżewski, A.; Stępień, S. (2010). Reforma wspólnej polityki rolnej a racja stanu Polski. *Wieś Jutra Nr. 10-11-12*, 45-51.

Dąbkowski, J. (1998). Metoda oceny postępu technicznego w rolnictwie z zastosowaniem analizy wielowymiarowej. *Zeszyty Nauk Akademii Rolniczej w Krakowie, rozprawa nr 242.*

Daelemans, J. (1992). *Justified mechanization in forming. CIOSTA-CIGR V Sem*. Proceed. Gyongyos, Hangary, 82-88.

Dick, L. (2003). *Przewodnik po Unii Europejskiej*. Wydawnictwo Studio EMKA, Warszawa.

Duczkowska-Małysz, K. (2003). *Wieś i rolnictwo. Perspektyw rozwoju*. IERiGŻ, Warszawa, ISBN 83-85369-60-0.

Dyka, S. (1991). *Tendencje przemian w obsłudze wsi i rolnictwa.* Materiały z konferencji PAN pt. Dostosowanie się rolnictwa i jego otoczenia do gospodarki rynkowej. Warszawa.

Fereniec, J. (1999). Ekonomika i organizacja rolnictwa. Warszawa. ISBN*:* 83-87251-56-9.

Gaździcki, J. (2002). *Leksykon geomatyczny – Lexicon of Geomatics*. Polskie Towarzystwo Informacji Przestrzennej. Wieś Jutra.

Gołębiewska, B. (2010). Kierunki podejmowanych działań inwestycyjnych w gospodarstwach rolniczych o zróżnicowanych powiązaniach z otoczeniem. *Roczniki Nauk Rolniczych. Seria G, 97, 4*, 60.

Grabiński, T. (1984). Wielowymiarowa analiza porównawcza w badaniach dynamiki zjawisk ekonomicznych. *Zeszyty Naukowe AE w Krakowie*, nr 61, 1-265

Grabiński, T. (1992). *Metody taksonometrii*. Wydawnictwo AE w Krakowie, Kraków. ISBN 8301085967.

Grzelak, A. (2008). *Oddziaływanie agencji rządowych na rozwój rolnictwa w świetle polskich doświadczeń po roku 1990.* Polityka gospodarcza a rozwój kraju, U. Płowiec (red.), Wyd. PTE, Warszawa, 348-365.
Johnson, D.G. (2002). The declining importance of natural resources: lessons from agricultural land. *Resource and Energy Economics, 24*, 157-171.
Józwiak, W. (1998). *Efektywność gospodarowania w rolnictwie*. Encyklopedia agrobiznesu. Fundacja Innowacyjna, Warszawa, 146-149.
Juchniewicz, M. (1999). *Podstawowe kategorie ekonomiczne stosowane w produkcji rolniczej*. Ekonomika i organizacja produkcji rolniczej, pod red. Romana Kisiela, Wydawnictwo ART, Olsztyn, 15-44.
Kania, J. (2008). Znaczenie dopłat bezpośrednich w kształtowaniu sytuacji ekonomicznej gospodarstw rolnych w Unii Europejskiej, *Wieś i Doradztwo, 3-4*, 23-25.
Kierul, Z. (1986). *Ekonomika i organizacja gospodarstw rolniczych*. PWRiL, Warszawa.
Kotler, P. (1999). *Marketing analiza, planowanie, wdrażanie i kontrola*. Felberg SJA Warszawa.
Kowalczyk, Z. (2013). Poziom i formy finansowania inwestycji technicznych w wybranych w gospodarstwach rolniczych. *Inżynieria Rolnicza, 3*(146), 159-167.
Kowalczyk, Z. (2011). Poziom i struktura zużycia technicznych środków trwałych w różnych typach gospodarstw rolniczych. *Rozprawa habilitacyjna*. *Inżynieria Rolnicza, 2*(127), 33-40.
Kowalski, J. i in., (2002). *Postęp naukowo- techniczny, a racjonalna gospodarska energią w produkcji rolniczej*. Kraków PTIR, ISBN 83-905219-9-7.
Szeląg-Sikora, A.; Kowalski, J. (2010). Wyposażenie sadowniczej grupy producenckiej w środki techniczne. *Inżynieria Rolnicza, 4*(122), 205-212.
Kowalski, J.; Tabor, S. (1996). Efektywność postępu naukowo-technicznego w gospodarstwach górskich. *ZPPNR nr 444,* 157-165.
Krzyżanowska, K. (2011). *Stan i perspektywy rozwoju grup producentów rolnych w Polsce*. Szkoła Główna Gospodarstwa Wiejskiego w Warszawie, 85-89.
Kukuła, K. (2000). *Metoda unitaryzacji zerowanej*. Wydawnictwo Naukowe PWN, Warszawa. ISBN 9788901164836.
Kukuła, S.; Krasowicz, St. (2006). *Problemy zrównoważonego rozwoju rolnictwa w Polsce*. IUNG-PIB w Puławy, 3-10.
Kurek, J. (2007). Inwestycje z zakresu wyposażenia gospodarstw rolnych w środki techniczne. *Problemy Inżynierii Rolniczej 2*, 108
Lorencowicz, E. (2004). Zmienny rynek. *Rolniczy Przegląd Techniczny nr 12*.
Lorencowicz, E. (2006). Inwestycje w środki techniczne w gospodarstwach rodzinnych. *Inżynieria Rolnicza, 6*(81), 35-40.
Łukasik, W. (2011). *Potencjalne kierunki rozwoju gospodarstw rodzinnych w aktualnej sytuacji rynkowej*. Agencja Rynku Rolnego, Warszawa, 41-43, 46-47.
Machowski, E. (1998). *Wybrane zagadnienia infrastruktury technicznej w organizacji produkcji rolniczej*. Filia AR w Krakowie, Rzeszów.
Małysz, J. (1996). *Procesy integracyjne w agrobiznesie (ABC integracji).* Wydawnictwo CDiEwR, Poznań, 13-14.
Martynowski, M. (2010). *Organizowanie się gospodarcze polskich rolników po 1990.* Krajowa Rada Spółdzielcza. Warszawa, 5-6.
Michałek, R. i in., (1998). *Uwarunkowania technicznej rekonstrukcji rolnictwa*. PTIR. Kraków, ISBN 83-905219-1-1.
Michałek R. (2002). Wiedza – najefektywniejszą droga restrukturyzacji polskiego rolnictwa. *Problemy inżynierii rolniczej, 4,* Warszawa.
Muzalewski, A. (2000). Aktywność inwestycyjna i wyposażenie gospodarstw w środki mechanizacji. *Problemy Inżynierii Rolniczej, 3,* Warszawa, 95-102.
Muzalewski, A. (2004). Analiza i ocena wyposażenia gospodarstw w ciągniki oraz ich użytkowania. *Inżynieria Rolnicza, 4*(59), 121-129.

Muzalewski, A. (2010). *Ekonomiczno-organizacyjne aspekty zespołowego użytkowania maszyn rolniczych.* IBMER Warszawa, 27.
Niewiadomski, P. (2012) Plany i wyzwania na rynku. *Technika Ogrodnicza Leśna 6*, Poznań.
Nowak, E. (1990). *Metody taksonomiczne w klasyfikacji obiektów społeczno-gospodarczych*. PWN, Warszawa, ISBN: 9788320806892.
Pawlak, J. (1995). *Tendencje i uwarunkowania rozwoju techniki rolniczej*. IBMER, Warszawa.
Pawlak, J. (2012). Rynek ciągników rolniczych w Polsce w latach 2000-2010. *Problemy Inżynierii Rolniczej, 1,* 5-14.
Poczta. W.; Mrówczyńska-Kamińska, A. (2004). *Agrobiznes w Polsce jako subsystem gospodarki narodowej*. Wydawnictwo Akademii Rolniczej, Poznań.
Poczta, W.; Wysocki, F. (2001). Struktura obszarowa rolnictwa polskiego - próba prognozy zmian do 2010 r. *Postępy nauk rolniczych, 1,* Warszawa, 3-16.
Sobczyk, M. (1995). *Statystyka*. PWN Warszawa.
Sosnowska, B. (2000). *Rynek maszyn rolniczych w Polsce*. Wydawnictwo Akademii Ekonomicznej w Poznaniu.
Starzyński, M. (2009). Skala transferów finansowych ARiMR dla rolnictwa. *Wieś Jutra, 10-11-12*, 6-7.
Strahl, D. i in., (1997). Normalizacja zmiennych w skali przedziałowej i ilorazowej w referencyjnym systemie granicznym. *Przegląd Statystyczny, z. 1.* PWN, Warszawa
Sikora, J. (2009a). Analiza zmian potencjału technicznych środków produkcji gospodarstw rolnych w gminach Polski południowej. *Infrastruktura i Ekologia Terenów Wiejskich, 9*, 229-240.
Sikora, J. (2009b). Określenie siły i charakteru autokorelacji przestrzennej na podstawie globalnej statystyki I Morana infrastruktury rolniczej Polski południowej i południowo-wschodniej. *Infrastruktura i Ekologia Terenów Wiejskich, 9*, 217-227.
Sikora, J. (2010). Analiza dokładności pomiarów działek rolniczych w aspekcie dopłat bezpośrednich. *Infrastruktura i Ekologia Terenów Wiejskich, 14*, 87-97.
Sikora J. (2011). Spatial management of agricultural parcels in the context of direct payments. *Infrastruktura i Ekologia Terenów Wiejskich, 12,* 157-168.
Szeląg-Sikora, A. (2010). Efektywność produkcji gospodarstw indywidualnych zrzeszonych w sadowniczej grupie producenckiej. *Inżynieria Rolnicza, 5*(123), 267-268.
Szeląg-Sikora, A. (2011). Analiza wyposażenia gospodarstw w park maszynowy zrzeszonych w grupie producenckiej ukierunkowanej na produkcje mleka. *Inżynieria Rolnicza, 8*(133), 261-267.
Szeląg-Sikora, A. (2013). *Technical modernization of agricultural farms aided with European Union funds as a precondition for development of producer groups*. Rozprawa habilitacyjna PTIR, Kraków, ISBN 978-83-935020-9-7.
Szeląg-Sikora, A.; Oleksy-Gębczyk, A. (2013). Grupy producenckie przykładem przedsiębiorczości zespołowej w rolnictwie. Zarządzanie i Finanse, *Journal of Management and Finance 1 cz. 2,* 341-351.
Szeląg-Sikora, A.; Sikora, J. 2014. Rola grup producenckich w zwiększaniu konkurencyjności gospodarstw indywidualnych. *Roczniki Naukowe, SERIA, t XVI, z. 4*, 288-292.
Szeptycki, A.; Wójcicki, Z. (2003). *Potęp technologiczny i nakłady energetyczne w rolnictwie do 2020 r.* IBMER, Warszawa.
Szumski, S. (2007). *Wspólna polityka rolna Unii Europejskiej 2007*. Wydawnictwa Akademickie i Profesjonalne Sp. z o.o. Warszawa, ISBN 83-60501-21-4.
Wiener, N. (1960). *Cybernetyka i społeczeństwo*. Warszawa.
Wigier, M., i in. (2010). *Kierunki rozwoju polskiego rolnictwa w kontekście realizacji celów określonych w przygotowywanych obecnie dokumentach strategicznych*. Ekspertyza przygotowana na zlecenie Ministerstwa Rozwoju Regionalnego przez zespół ekspertów Instytutu Ekonomiki Rolnictwa i Gospodarki Żywnościowej - Państwowego Instytutu Badawczego, Warszawa, 4-7, 10-11, 16-21, 36-41, 47-54.

Witosław, K. (2002). Grupy producentów rolnych szansą na usprawnienie działalności gospodarstw produkcyjnych w Polsce. *Zagadnienia Doradztwa Rolniczego, nr 1*, KCDRRiOW, Poznań, 112.
Woś, A. (2001). *Konkurencyjność wewnętrzna rolnictwa*. IERiGŻ, Warszawa, 14.
Woźniak, A. (2000). Relacje przestrzenne i zróżnicowanie infrastruktury obszarów wiejskich województwa małopolskiego. *Zeszyty naukowe AR w Krakowie nr 365*. *Sesja Naukowa Z. 72,* 87-102.
Woźniak, A. (2001). Relacje przestrzenne w infrastrukturze i technicznym wyposażeniu rolnictwa w województwie małopolskim. *Rozprawa habilitacyjna nr 7.* Polskie Towarzystwo Inżynierii Rolniczej, 9-50.
Woźniak, A.; Sikora, J. (2005). Zróżnicowanie obszarów wiejskich woj. małopolskiego pod względem wyposażenia w środki techniczne gospodarstw rolnych. *Infrastruktura i Ekologia Obszarów Wiejskich nr 3*, Kraków, 135-149.
Woźniak, A.; Sikora. J. (2006). Wykorzystanie skalowania wielowymiarowego w analizie potencjału infrastrukturalnego gospodarstw rolnych w wybranych gminach województwa małopolskiego. *Infrastruktura i Ekologia Obszarów Wiejskich, 3/2,* Kraków, 161-178.
Wójcicki, Z. (2000). Ekonomiczne uwarunkowania modernizacji infrastruktury obszarów wiejskich. *Zeszyty Naukowe AR w Krakowie. Zeszyt 72,* 37-46.
Wójcicki, Z. (2002). Prognozy przemian w rolnictwie i technice rolniczej w kontekście integracji Polski z UE. *Wieś Jutra, 11,* 17-18.
Wójcicki, Z.; Michałek. R. (2002). Uwarunkowanie przemian w rolnictwie polskim do 2020 roku. *Inżynieria Rolnicza, 6*(39), Warszawa, 19-32.
Wójcicki, Z. (2003). Przemiany w rolnictwie i technice rolniczej oraz w zagospodarowaniu obszarów wiejskich. Inżynieria Rolnicza, Kraków, 17-26.

Źródła internetowe:
Powszechny Spis Rolny 2010. Raport z wyników. Pozyskano z: http://stat.gov.pl/ cps/rde/xbcr/ gus/rl_psr_raport_z_wynikow_PSR_2010_260711.pdf
Rynek środków produkcji i usług dla rolnictwa- stan i perspektywy. Analizy rynkowe. Marzec 2005. IERiGŻ, Pozyskano z : https://www.ierigz.waw.pl/.../4063-srodki_ produkcji_39_12_net.pdf
Grupy producenckie. Pozyskano z: http://ksow.pl/grupy-producentow-rolnych/warto-wiedziec.html
Znaczenie rolnictwa w gospodarce Polski. Pozyskano z: https://www.igipz.pan.pl/tl_files/igipz/ ZGWiRL/ARP/01.Znaczenie%20rolnictwa%20w%20gospodarce%20Polski.pdf
Zasady doboru maszyn rolniczych. Pozyskano z: http://www.arimr.gov.pl/fileadmin/pliki/ zdjecia_strony/185/2014_MGR/Aktualizacja_2014_Zasady_doboru_maszyn_rolniczych.pdf
Ustawa z dnia 15 września 2000 r. o grupach producentów rolnych i ich związkach oraz o zmianie innych. Pozyskano z: isip.sejm.gov.pl
Ustawa z dnia 18 czerwca 2004 r. o zmianie ustawy o grupach producentów rolnych iich związkach oraz o zmianie innych ustaw. Pozyskano z: dokumenty.rcl.gov.pl/DU/rok/2004/ wydanie/162/pozycja/1694
Rozporządzenia Rady (WE) Nr 952/97. Pozyskano z: https://www.minrol.gov.pl/pol/content/download /545/.../1257RTF.rtf
Dz. U. Nr 72, poz. 424- zmienione rozporządzeniem Ministra Rolnictwa i Rozwoju Wsi z dnia 10 marca 2011 r. (Dz. U. Nr 62, poz 318). Pozyskano z: http://ksow.pl/grupy-producentow-rolnych/akty-prawne.html

10. ANNEX

Table 10.1. Facilities of agricultural producers from the group oriented to milk production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M_1	0.844	0.496	1.000	0.035	1.000	0.000	1.000	0.000	0.479	0.000	0.000	0.345	0.750	0.000	0.405
M_2	0.798	0.515	0.141	0.139	0.307	1.000	1.000	0.000	0.409	1.000	0.000	1.000	0.750	0.394	0.624
M_3	0.237	0.418	0.022	0.041	0.141	0.178	0.000	0.000	0.152	0.000	0.000	0.437	1.000	0.000	0.187
M_4	0.755	0.000	0.022	0.741	0.983	0.444	0.000	0.000	0.978	0.000	0.000	0.437	0.000	1.000	0.411
M_5	0.904	0.446	0.326	1.000	0.983	0.178	0.240	0.000	0.535	0.600	0.000	0.747	0.000	0.000	0.404
M_6	1.000	1.000	0.761	0.759	0.344	0.038	1.000	0.000	1.000	0.000	0.000	0.862	0.000	0.000	0.415

Table 10.2. Facilities of agricultural producers from the group oriented to pig production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T_1	0.089	0.025	0.966	0.323	0.280	0.242	0.500	0.000	0.000	0.600	0.000	0.000	0.000	0.000	0.217
T_2	0.171	0.085	0.966	0.431	0.390	0.242	0.500	0.000	0.745	0.600	0.000	1.000	0.000	0.000	0.335
T_3	0.110	0.050	0.966	0.383	1.000	0.242	1.000	1.000	0.682	0.600	0.873	0.000	0.401	0.000	0.423
T_4	0.479	0.042	0.966	0.379	0.225	0.242	1.000	1.000	0.682	1.000	1.000	0.000	0.719	0.000	0.478
T_5	0.202	0.127	0.000	1.000	0.415	1.000	0.500	0.000	0.591	1.000	0.000	0.000	0.563	0.000	0.466
T_6	0.213	1.000	0.966	0.406	0.800	0.242	0.500	0.000	0.591	1.000	0.000	0.000	0.281	0.000	0.577
T_7	0.054	0.373	0.000	0.867	0.660	0.242	0.500	1.000	0.591	0.600	0.873	0.000	0.281	0.000	0.362
T_8	0.459	0.298	0.966	0.348	0.610	0.242	0.500	1.000	1.000	1.000	1.000	0.000	1.000	0.000	0.587
T_9	0.085	0.085	1.000	0.341	0.610	0.242	0.500	1.000	0.045	1.000	0.873	0.000	1.000	0.000	0.389
T_{10}	1.000	0.231	0.966	0.414	0.470	0.242	0.500	1.000	0.045	1.000	1.000	0.000	1.000	0.000	0.553

Table 10.3. Facilities of agricultural producers from the group oriented to fruit production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
O_1	1.000	1.000	0.000	0.000	0.583	0.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.433	0.408
O_2	0.293	0.073	0.000	0.000	0.583	0.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.433	0.120
O_3	0.547	0.222	0.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.433	0.205
O_4	1.000	0.073	0.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.433	0.209
O_5	0.547	0.222	0.000	1.000	0.583	0.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.433	0.693
O_6	1.000	0.222	0.000	0.000	0.583	0.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	1.000	0.271

Table 10.4. Facilities of agricultural producers from the group oriented to vegetable production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
W_1	1.000	0.976	0.000	0.683	0.400	0.800	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.781	0.449
W_2	0.384	1.000	0.000	1.000	0.400	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.625	0.522
W_3	0.360	0.937	0.000	0.610	1.000	1.000	0.500	0.667	0.000	0.000	1.000	0.000	0.000	1.000	0.711
W_4	0.384	0.000	0.000	0.110	0.000	0.048	0.000	0.333	0.000	0.400	0.000	0.000	0.000	0.000	0.126
W_5	0.033	0.000	0.000	0.402	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.164

Table 10.5. Facilities of agricultural producers from the group of organic farms in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
E_1	0.225	0.029	0.000	0.047	0.000	0.000	0.000	0.000	0.235	0.000	0.534	1.000	0.000	0.000	0.063
E_2	1.000	0.086	0.000	0.276	0.000	0.000	0.000	0.000	0.309	0.000	1.000	1.000	0.000	1.000	0.262
E_3	0.225	0.057	0.000	0.056	0.000	0.000	0.000	0.000	0.235	0.000	0.534	1.000	0.000	1.000	0.164
E_4	0.775	0.057	0.000	0.464	0.000	0.000	0.000	1.000	0.304	0.000	0.534	1.000	0.000	1.000	0.379
E_5	0.225	0.048	0.000	0.248	0.000	0.000	0.000	0.000	0.235	0.000	0.534	1.000	0.000	0.000	0.099
E_6	1.000	1.000	0.000	0.455	1.000	0.000	0.000	0.000	0.286	0.000	0.534	1.000	0.000	1.000	0.729
E_7	1.000	0.048	1.000	0.464	0.000	0.000	0.000	0.000	0.184	0.000	0.534	1.000	0.000	1.000	0.247
E_8	0.195	0.441	0.000	1.000	0.000	0.000	0.000	0.000	0.235	0.000	0.534	1.000	0.000	1.000	0.475
E_9	1.000	0.234	1.000	0.657	0.864	0.000	0.000	0.000	1.000	0.000	0.534	1.000	0.000	0.000	0.352
E_{10}	0.775	0.048	0.000	0.448	0.000	0.000	0.000	0.000	0.194	0.000	0.534	1.000	0.000	0.000	0.149
E_{11}	1.000	0.470	0.000	0.047	0.000	0.000	0.000	0.000	0.260	0.000	0.534	1.000	0.000	1.000	0.410
E_{12}	0.969	0.441	1.000	0.047	1.000	0.000	0.000	0.000	0.244	0.000	0.534	1.000	0.000	0.000	0.307
E_{13}	1.000	0.402	1.000	0.047	0.864	0.000	0.000	0.000	0.104	0.000	0.534	1.000	0.000	0.000	0.277
E_{14}	0.225	0.480	0.000	0.448	1.000	0.000	0.000	0.000	0.240	0.000	0.534	1.000	0.000	0.000	0.340
E_{15}	1.000	0.048	1.000	0.657	1.000	0.000	0.000	0.000	0.765	0.000	0.534	1.000	0.000	0.000	0.239

Table 10.6. Facilities of individual farms oriented to milk production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IM_1	0.093	0.196	0.067	0.583	0.477	0.051	0.240	0.000	0.306	0.000	1.000	0.563	0.000	1.000	0.170
IM_2	0.333	0.878	0.433	0.424	0.477	0.051	1.000	1.000	0.438	0.600	1.000	0.563	0.143	0.000	0.459
IM_3	0.206	0.842	0.067	0.345	0.477	0.051	0.240	1.000	0.327	0.600	1.000	0.563	0.000	0.000	0.268
IM_4	1.000	0.914	0.067	0.375	0.307	1.000	0.240	1.000	0.324	0.000	1.000	0.563	0.000	0.000	0.490
IM_5	0.503	1.000	1.000	1.000	0.284	0.036	0.240	1.000	0.901	0.600	1.000	0.563	1.000	0.000	0.725
IM_6	0.270	0.250	0.067	0.364	0.256	0.051	0.240	1.000	0.476	1.000	1.000	1.000	0.000	0.000	0.248
IM_7	0.220	0.054	0.000	0.345	0.290	0.761	1.000	1.000	0.234	0.600	0.873	0.438	0.143	0.000	0.438
IM_8	0.213	0.302	1.000	0.356	0.250	0.051	0.240	1.000	0.445	0.600	1.000	0.563	0.000	0.000	0.344
IM_9	0.426	0.946	0.433	0.348	1.000	0.015	0.240	0.000	1.000	1.000	1.000	0.688	0.143	0.000	0.488
IM_{10}	0.263	0.233	0.433	0.088	0.256	0.051	0.240	1.000	0.306	0.600	1.000	0.563	1.000	0.000	0.451

Table 10.7. Facilities of individual farms oriented to pigs production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IT_1	1.000	0.824	1.000	1.000	0.729	0.444	1.000	0.000	0.781	0.600	1.000	0.000	1.000	0.000	0.834
IT_2	0.435	0.176	1.000	0.406	0.679	0.444	1.000	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.474
IT_3	0.479	0.870	0.000	0.466	0.214	0.444	1.000	0.000	1.000	0.600	0.000	0.000	1.000	0.000	0.534
IT_4	0.479	0.160	1.000	0.470	0.893	0.444	1.000	1.000	0.242	0.000	1.000	0.000	1.000	0.000	0.539
IT_5	0.516	0.480	1.000	0.760	0.893	0.444	1.000	0.000	0.344	0.000	1.000	0.000	1.000	0.000	0.602
IT_6	0.459	0.840	0.000	0.084	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.310
IT_7	0.142	0.840	0.000	0.090	0.214	0.444	1.000	0.000	0.806	1.000	1.000	1.000	1.000	0.000	0.510
IT_8	0.078	0.896	0.000	0.544	0.000	0.444	1.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.247
IT_9	0.110	1.000	0.000	0.342	0.000	0.444	1.000	0.000	0.204	0.000	1.000	0.000	1.000	0.000	0.262
IT_{10}	0.093	0.944	0.000	0.034	0.000	0.444	0.000	0.000	0.430	0.600	1.000	0.000	0.000	0.000	0.248

Table 10.8. Facilities of individual farms oriented to horticultural production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IO_1	0.577	0.657	0.000	0.043	0.000	0.000	0.323	0.000	0.386	0.000	0.000	0.000	0.000	0.765	0.155
IO_2	0.885	0.657	0.000	1.000	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.179
IO_3	0.577	0.657	0.000	0.043	1.000	0.000	0.260	1.000	1.000	0.000	0.000	0.000	0.000	1.000	0.857
IO_4	0.863	0.657	0.000	0.978	1.000	0.000	0.260	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.382
IO_5	0.718	0.657	0.000	1.000	0.000	0.000	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.941	0.172
IO_6	1.000	0.657	0.000	1.000	0.000	0.000	1.000	0.000	0.386	0.000	0.000	0.000	0.000	0.941	0.295

Table 10.9. Facilities of individual farms oriented to vegetable production in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IW_1	0.035	0.168	0.000	0.793	1.000	0.000	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.121
IW_2	0.252	1.000	0.000	0.814	0.233	0.015	0.067	0.000	1.000	0.000	1.000	0.000	0.000	1.000	0.434
IW_3	0.076	0.092	0.000	0.350	1.000	0.000	0.067	0.000	0.000	0.000	0.466	0.000	1.000	0.000	0.134
IW_4	0.111	0.412	0.000	0.872	1.000	1.000	0.067	0.000	1.000	0.000	0.466	0.000	0.000	1.000	0.629
IW_5	1.000	0.109	1.000	1.000	0.930	0.036	0.278	0.000	0.000	0.000	1.000	0.000	0.000	1.000	0.498
IW_6	0.128	0.109	1.000	0.191	0.971	0.015	0.278	0.000	0.459	0.000	0.466	0.000	0.000	0.000	0.166

Table 10.10. Facilities of individual farms with organic production system in the space of ownership describing potential of the machinery park equipment Φ_1

Farm name	Normalized variables describing the level of the machinery park equipment														q_i
	$1Z_1$	$1Z_2$	$1Z_3$	$1Z_4$	$1Z_5$	$1Z_6$	$1Z_7$	$1Z_8$	$1Z_9$	$1Z_{10}$	$1Z_{11}$	$1Z_{12}$	$1Z_{13}$	$1Z_{14}$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IE_1	0.165	0.337	0.469	0.202	0.083	0.000	0.278	1.000	0.037	0.000	0.000	0.603	0.000	0.433	0.362
IE_2	0.169	0.411	0.000	0.226	0.083	0.329	0.278	0.000	0.000	0.000	0.534	0.603	1.000	0.433	0.259
IE_3	0.273	0.443	0.063	0.917	1.000	0.000	0.067	0.000	0.121	0.600	0.534	0.603	0.000	0.433	0.359
IE_4	0.169	0.411	0.000	0.231	0.083	0.329	0.278	0.000	0.000	0.000	0.534	0.000	1.000	0.433	0.215
IE_5	0.119	0.065	0.000	0.726	0.000	0.732	0.278	1.000	1.000	0.000	0.534	0.000	1.000	0.000	0.501
IE_6	0.073	0.024	0.406	0.981	1.000	0.018	0.000	1.000	0.261	1.000	0.000	0.603	0.125	0.000	0.372
IE_7	1.000	0.894	0.000	0.544	0.929	1.000	0.278	1.000	0.877	1.000	1.000	0.603	0.125	1.000	0.900
IE_8	0.786	0.443	0.000	0.539	0.117	0.000	1.000	0.000	0.261	0.000	0.534	0.603	0.000	0.433	0.414
IE_9	0.128	0.385	0.406	1.000	0.486	0.000	0.000	0.000	0.159	1.000	0.000	0.603	0.000	0.000	0.213
IE_{10}	0.308	0.385	1.000	0.163	0.083	0.000	0.278	1.000	0.037	0.000	0.000	0.444	0.000	0.567	0.388
IE_{11}	0.813	0.655	0.406	0.051	0.595	0.286	0.000	0.000	0.625	0.000	0.000	1.000	0.167	0.000	0.337
IE_{12}	0.241	1.000	0.406	0.246	0.607	0.286	0.067	0.000	0.364	1.000	0.534	0.444	0.000	0.433	0.363
IE_{13}	0.039	0.395	0.000	0.887	0.452	0.286	0.000	0.000	0.289	0.000	0.000	0.444	0.167	0.000	0.199

Table 10.11. Facilities of agricultural producers from the group oriented to milk production in the space of ownership describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
M_1	0.867	0.822	0.326	1.000	0.748	0.208	0.573
M_2	0.966	0.768	0.752	0.673	0.711	0.363	0.631
M_3	0.742	0.754	0.533	0.806	0.165	1.000	0.691
M_4	0.768	0.525	0.698	0.502	1.000	0.275	0.578
M_5	0.695	0.438	0.731	0.490	0.786	0.325	0.540
M_6	1.000	1.000	1.000	0.480	0.805	0.465	0.723

Table 10.12. Facilities of agricultural producers from the group oriented to pigs production in the space describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
T_1	0.508	0.849	0.378	0.122	0.206	1.000	0.395
T_2	0.510	0.631	0.445	0.129	0.471	0.419	0.368
T_3	0.874	0.974	0.574	0.367	0.256	0.463	0.463
T_4	0.544	0.737	0.264	0.143	1.000	0.189	0.440
T_5	0.615	0.729	0.923	0.236	0.182	0.714	0.470
T_6	0.751	0.964	0.975	0.280	0.195	0.684	0.513
T_7	0.487	0.849	0.408	0.133	0.359	0.509	0.358
T_8	0.563	0.743	0.311	0.180	0.844	0.184	0.422
T_9	0.748	0.812	0.380	0.277	0.345	0.389	0.395
T_{10}	1.000	1.000	1.000	1.000	0.122	0.407	0.692

Table 10.13. Facilities of agricultural producers from the group oriented to fruit production in the space describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
O_1	0.877	0.641	0.641	0.826	0.823	0.406	0.766
O_2	0.915	0.418	1.000	0.760	0.378	1.000	0.496
O_3	1.000	0.568	0.982	0.990	0.374	0.848	0.591
O_4	0.877	0.558	0.813	0.694	0.607	0.655	0.624
O_5	0.955	0.641	0.969	0.703	0.695	0.615	0.695
O_6	1.000	1.000	0.614	1.000	1.000	0.314	1.000

Table 10.14. Facilities of agricultural producers from the group oriented to vegetable production in the space describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
W_1	0.984	1.000	1.000	1.000	0.234	0.060	0.331
W_2	0.620	0.628	0.489	0.436	0.324	0.063	0.255
W_3	1.000	0.929	0.083	0.580	1.000	0.025	0.511
W_4	0.561	0.671	0.192	0.481	0.121	0.139	0.228
W_5	0.786	0.825	0.225	0.552	0.020	1.000	0.618

Table 10.15. Facilities of agricultural producers with organic production system in the space describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
E_1	0.666	0.473	0.119	0.796	0.567	0.230	0.630
E_2	0.628	0.679	0.287	0.695	0.551	0.256	0.668
E_3	0.725	0.625	0.334	0.597	0.452	0.420	0.647
E_4	0.766	0.674	0.395	0.663	0.460	0.393	0.699
E_5	0.923	0.880	0.280	0.864	0.338	0.493	0.888
E_6	0.411	0.411	0.742	0.455	0.264	0.535	0.424
E_7	1.000	0.686	0.527	0.567	0.525	0.525	0.746
E_8	0.799	0.987	0.272	0.463	1.000	0.269	0.770
E_9	0.228	0.025	1.000	0.182	0.332	0.589	0.135
E_{10}	0.885	1.000	0.515	0.417	0.406	0.817	0.788
E_{11}	0.527	0.482	0.765	0.584	0.196	0.719	0.527
E_{12}	0.879	0.687	0.827	0.681	0.217	0.927	0.744
E_{13}	0.824	0.689	0.765	1.000	0.129	1.000	0.825
E_{14}	0.451	0.237	0.451	0.215	0.667	0.492	0.296
E_{15}	0.636	0.530	0.855	0.520	0.273	0.701	0.559

Table 10.16. Facilities of individual farms oriented to milk production in the space of ownership describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IM_1	1.000	0.806	0.546	0.901	0.220	0.527	0.399
IM_2	0.905	1.000	0.526	1.000	0.182	0.519	0.408
IM_3	0.825	0.573	0.675	0.935	0.149	0.620	0.372
IM_4	0.720	0.499	0.610	0.883	0.215	0.396	0.339
IM_5	0.631	0.654	0.458	0.230	1.000	0.287	0.423
IM_6	0.590	0.425	0.551	0.648	0.214	0.445	0.295
IM_7	0.744	0.430	0.770	0.638	0.148	0.823	0.347
IM_8	0.527	0.597	0.411	0.766	0.146	0.493	0.297
IM_9	0.658	0.525	0.743	0.341	0.519	0.389	0.350
IM_{10}	0.759	0.450	1.000	0.235	0.337	1.000	0.380

Table 10.17. Facilities of individual farms oriented to pig production in the space of ownership describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IT_1	0.184	0.234	0.513	0.055	0.822	0.360	0.373
IT_2	0.386	0.533	0.313	0.215	0.332	0.476	0.346
IT_3	0.806	0.818	1.000	0.790	0.090	1.000	0.720
IT_4	0.601	0.580	0.270	0.526	0.405	0.249	0.434
IT_5	1.000	1.000	0.933	1.000	0.097	0.905	0.793
IT_6	0.320	0.263	0.317	0.094	1.000	0.302	0.395
IT_7	0.459	0.643	0.449	0.311	0.207	0.629	0.410
IT_8	0.390	0.640	0.165	0.202	0.290	0.587	0.329
IT_9	0.346	0.599	0.140	0.183	0.314	0.532	0.308
IT_{10}	0.305	0.541	0.123	0.164	0.339	0.484	0.288

Table 10.18. Facilities of individual farms oriented to fruit production in the space of ownership describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IO_1	0.922	1.000	0.139	0.741	0.835	0.163	0.845
IO_2	0.874	0.950	0.171	0.721	1.000	0.133	0.928
IO_3	0.922	0.910	0.218	0.575	0.965	0.182	0.882
IO_4	0.838	0.964	0.190	0.707	0.922	0.141	0.877
IO_5	0.884	0.939	0.267	1.000	0.436	0.222	0.647
IO_6	0.981	0.905	0.317	0.659	0.756	0.216	0.780
IO_7	0.701	0.796	0.245	0.875	0.453	0.194	0.597
IO_8	1.000	0.993	0.497	0.721	0.353	0.430	0.565
IO_9	0.793	0.740	0.429	0.799	0.300	0.362	0.497
IO_{10}	0.911	0.937	1.000	0.685	0.146	1.000	0.420

Table 10.19. Facilities of individual farms oriented to vegetable production in the space of ownership describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IW_1	0.329	0.201	0.422	1.000	0.042	0.863	0.412
IW_2	0.923	1.000	0.854	0.452	0.268	0.833	0.664
IW_3	0.567	0.199	0.574	0.910	0.074	0.925	0.444
IW_4	0.529	0.204	0.724	0.580	0.167	0.598	0.361
IW_5	0.089	0.126	0.113	0.117	1.000	0.083	0.350
IW_6	0.412	0.184	0.607	0.190	0.237	1.000	0.328
IW_7	0.597	0.198	0.499	0.211	0.526	0.588	0.392
IW_8	0.566	0.245	0.719	0.372	0.294	0.565	0.367
IW_9	0.683	0.241	0.452	0.543	0.181	0.760	0.409
IW_{10}	1.000	0.276	1.000	0.287	0.395	0.965	0.495

Table 10.20. Facilities of individual farms with organic production system in the space describing efficiency of agricultural production Φ_2

Farm name	Normalized variables describing agricultural production efficiency						q_i
	$2Z_1$	$2Z_2$	$2Z_3$	$2Z_4$	$2Z_5$	$2Z_6$	
1	2	3	4	5	6	7	8
IE_1	1.000	0.136	1.000	0.336	0.433	1.000	0.496
IE_2	0.227	0.363	0.151	0.445	0.401	0.185	0.339
IE_3	0.255	0.155	0.302	0.374	0.513	0.193	0.253
IE_4	0.339	0.188	0.283	0.180	1.000	0.274	0.239
IE_5	0.374	0.234	0.417	0.143	0.818	0.467	0.257
IE_6	0.275	0.528	0.237	0.443	0.214	0.422	0.415
IE_7	0.251	0.298	0.280	0.631	0.538	0.107	0.378
IE_8	0.367	0.194	0.426	0.390	0.600	0.228	0.311
IE_9	0.306	0.464	0.345	0.886	0.111	0.454	0.530
IE_{10}	0.122	0.144	0.175	0.342	0.269	0.193	0.194
IE_{11}	0.352	1.000	0.157	1.000	0.191	0.268	0.773
IE_{12}	0.220	0.445	0.275	0.409	0.290	0.270	0.356
IE_{13}	0.166	0.353	0.281	0.341	0.106	0.665	0.284

Table 10.21. Facilities of agricultural producers from the group oriented to milk production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
M_1	0.984	0.524	0.817	0.165	0.147	0.276
M_2	0.974	0.555	0.665	0.623	0.616	0.614
M_3	0.990	0.575	1.000	0.115	0.107	0.266
M_4	0.995	0.830	0.806	1.000	1.000	0.955
M_5	1.000	1.000	0.871	0.287	0.426	0.511
M_6	0.969	0.424	0.718	0.697	0.685	0.648

Table 10.22. Facilities of agricultural producers from the group oriented to pig production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
T_1	0.996	0.742	0.920	0.792	0.854	0.841
T_2	0.998	1.000	0.670	0.812	0.830	0.800
T_3	0.964	0.626	0.351	0.273	0.325	0.358
T_4	0.977	0.839	0.665	0.338	0.483	0.534
T_5	1.000	0.868	0.540	1.000	1.000	0.854
T_6	0.996	0.653	0.468	0.753	0.743	0.661
T_7	0.975	0.726	1.000	0.727	0.718	0.805
T_8	0.980	0.834	0.629	0.299	0.396	0.488
T_9	0.954	0.743	0.400	0.292	0.407	0.413
T_{10}	0.959	0.606	0.287	0.890	0.873	0.683

Table 10.23. Facilities of agricultural producers from the group oriented to fruit production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
O_1	1.000	0.651	1.000	1.000	1.000	0.938
O_2	1.000	1.000	0.922	0.615	0.622	0.687
O_3	1.000	0.736	0.857	0.615	0.622	0.640
O_4	1.000	0.749	0.986	0.369	0.356	0.432
O_5	1.000	0.652	0.910	0.000	0.000	0.117
O_6	1.000	0.418	0.914	0.846	0.778	0.741

Table 10.24. Facilities of agricultural producers oriented to vegetable production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
W_1	0.924	0.580	0.539	0.556	0.591	0.580
W_2	1.000	1.000	0.925	1.000	1.000	1.000
W_3	0.973	0.657	0.551	0.000	0.000	0.095
W_4	0.953	0.891	1.000	0.361	0.429	0.463
W_5	0.949	0.722	0.697	0.328	0.324	0.383

Table 10.25. Facilities of agricultural producers with organic production system in the space describing financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
E_1	0.995	0.055	0.401	0.163	0.363	0.094
E_2	0.986	0.038	0.462	0.217	0.535	0.103
E_3	0.980	0.041	0.376	0.005	0.013	0.029
E_4	0.982	0.038	0.358	0.049	0.090	0.043
E_5	0.974	0.029	0.301	0.057	0.120	0.040
E_6	1.000	0.063	0.701	0.559	0.560	0.241
E_7	0.974	0.037	0.260	0.305	0.374	0.133
E_8	0.988	0.026	0.380	0.228	0.451	0.099
E_9	0.974	1.000	1.000	0.006	0.015	0.646
E_{10}	0.983	0.026	0.331	0.711	0.725	0.271
E_{11}	0.974	0.052	0.521	0.900	0.900	0.355
E_{12}	0.974	0.037	0.302	1.000	1.000	0.381
E_{13}	0.974	0.037	0.327	0.117	0.288	0.066
E_{14}	0.981	0.107	0.559	0.012	0.030	0.074
E_{15}	0.974	0.048	0.423	0.055	0.135	0.051

Table 10.26. Facilities of individual farms oriented to milk production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IM_1	1.000	0.534	0.429	0.923	1.000	0.716
IM_2	0.967	0.416	0.559	0.000	0.000	0.110
IM_3	0.994	0.747	0.489	0.762	0.832	0.639
IM_4	0.983	0.847	0.553	1.000	0.839	0.740
IM_5	0.981	0.646	0.774	0.346	0.581	0.446
IM_6	0.988	1.000	0.689	0.000	0.000	0.183
IM_7	0.961	0.964	0.493	0.346	0.581	0.445
IM_8	0.985	0.710	1.000	0.769	0.645	0.641
IM_9	0.992	0.815	0.648	0.385	0.645	0.480
IM_{10}	0.969	0.928	0.490	0.000	0.000	0.153

Table 10.27. Facilities of individual farms oriented to pigs production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IT_1	1.000	1.000	0.972	0.450	0.650	0.753
IT_2	0.977	0.429	0.498	0.581	0.850	0.604
IT_3	0.977	0.280	0.179	0.152	0.150	0.194
IT_4	0.976	0.394	0.232	0.104	0.075	0.198
IT_5	0.977	0.229	0.143	0.425	0.580	0.362
IT_6	0.956	0.853	0.388	0.256	0.300	0.435
IT_7	0.910	0.331	0.396	0.133	0.080	0.232
IT_8	0.977	0.357	0.646	0.693	1.000	0.695
IT_9	0.967	0.378	0.809	1.000	0.695	0.739
IT_{10}	0.989	0.428	1.000	0.420	0.483	0.584

Table 10.28. Facilities of individual farms oriented to fruit production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IO_1	1.000	0.740	0.751	0.829	0.850	0.833
IO_2	1.000	0.779	0.793	0.786	0.813	0.798
IO_3	1.000	0.813	0.734	1.000	1.000	0.988
IO_4	1.000	0.767	0.839	1.000	1.000	0.984
IO_5	1.000	0.788	0.778	0.000	0.000	0.052
IO_6	1.000	0.817	0.679	0.714	0.625	0.679
IO_7	1.000	0.930	1.000	0.000	0.000	0.062
IO_8	1.000	0.745	0.677	0.000	0.000	0.050
IO_9	1.000	1.000	0.842	0.714	0.625	0.691
IO_{10}	1.000	0.790	0.750	0.929	0.813	0.865

Table 10.29. Facilities of individual farms oriented to vegetable production in the space of ownership, which describes financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IW_1	0.820	0.513	0.167	0.390	0.284	0.375
IW_2	0.820	0.103	0.070	0.537	0.570	0.489
IW_3	0.820	0.518	0.090	0.000	0.000	0.102
IW_4	0.839	0.516	0.100	0.098	0.071	0.170
IW_5	1.000	1.000	1.000	0.859	1.000	0.945
IW_6	0.927	0.633	0.144	0.000	0.000	0.123
IW_7	0.876	0.557	0.091	0.171	0.199	0.261
IW_8	0.889	0.456	0.100	0.146	0.106	0.196
IW_9	0.877	0.458	0.080	0.171	0.124	0.213
IW_{10}	0.899	0.410	0.055	1.000	0.993	0.901

Table 10.30. Facilities of individual farms with organic production system in the space describing financial external support for agricultural farms Φ_3

Farm name	Normalized variables describing the level of external support for agricultural production					q_i
	$3Z_1$	$3Z_2$	$3Z_3$	$3Z_4$	$3Z_5$	
1	2	3	4	5	6	8
IE_1	0.876	1.000	0.081	1.000	0.900	0.995
IE_2	0.944	0.402	0.615	0.000	0.000	0.193
IE_3	1.000	0.996	0.413	0.767	0.690	0.864
IE_4	0.993	0.819	0.304	0.000	0.000	0.355
IE_5	0.990	0.654	0.280	0.500	0.900	0.579
IE_6	0.934	0.274	0.579	0.022	0.030	0.157
IE_7	0.873	0.454	0.441	0.000	0.000	0.210
IE_8	0.972	0.776	0.273	0.556	1.000	0.657
IE_9	0.936	0.313	0.436	0.556	1.000	0.479
IE_{10}	0.851	0.913	0.884	0.333	0.600	0.576
IE_{11}	0.867	0.134	0.733	0.500	0.900	0.376
IE_{12}	0.897	0.312	0.726	0.889	0.623	0.669
IE_{13}	0.879	0.385	1.000	0.556	0.940	0.504