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WOJCIECH JÓZWIAK
MAREK ZIELIŃSKI
WOJCIECH ZIĘTARA
Institute of Agricultural and Food Economics
– National Research Institute
Warsaw

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DROUGHTS VERSUS THE SITUATION OF THE POLISH FARMS OF NATURAL PERSONS

Abstract

The paper presents the situation of farms located in areas exposed to droughts, emphasising the situation of those having poor quality soils. The research covered 296 farms keeping uninterrupted accounts under the Polish FADN over the period of 2006-2013, in the area of 96 gminas especially affected by droughts, which are situated in the following voivodeships: Wielkopolskie, Lubuskie, Kujawsko-Pomorskie, Łódzkie and Dolnośląskie. As a point of reference the research used 4,294 farms located in the area of other gminas countrywide. The analysis demonstrated that farms situated in the region frequently affected by droughts had worse production and economic results and a factor intensifying the effects of droughts was poor soil quality. Other factors determining the case were only preliminarily indicated, given small number of the analysed sample.

Key words: farms, agricultural drought, climate, soil quality, income, replacement of fixed assets.

Introduction

In the first decade of the current century, Europe noted escalation of extreme weather phenomena: floods, hurricanes and droughts on large areas (Kundzewicz et al., 2006). In Poland, already in the interwar period, naturalists pointed out the phenomenon of "steppe formation" in Wielkopolska and the current literature (Kundzewicz et al., 2006; Górski, 2006) informs on more frequent droughts in plant growing season also in other parts of Poland. Moreover, results of model research, held by climatologists, indicate a possibility of intensifying

winter precipitation and not necessarily of snow, while in summer months precipitation can be even lower than to date. It is also probable that the number of days with the average daily air temperature exceeding 30°C will grow noticeably, which will, in turn, strengthen evaporation (Kundzewicz, 2013).

The winter of 2014/2015, and spring and summer of 2015 can signify the effects of climate change. In the winter there was almost no snow or frost but it was raining, and in the summer – rainfall was only scant and local, and the number of sunny days was higher than in the past, with temperatures exceeding 30°C and more in the hottest time of the day. This caused hydrological droughts manifested by low levels of surface waters and drying out of small water bodies, water courses and part of wells, which was also accompanied by agricultural drought happeningwhen plant roots fail to find water in the soil.

The presented paper attempts at providing an answer to the question on the economic results and types of replacement of fixed assets of farms run in areas often at risk of droughts, and also on the measures taken to mitigate the effects of droughts. Special attention was devoted to the situation of farms with soil quality below the average. Soils formed from sands deposited by winds, and sands and river gravel are characterised by low water capacity. Saturated with moisture they keep sufficient quantity of water for roots of arable crops available for several days, while for good quality soils – hence of high water capacity – water is available for 3-3.5 times longer. A large part of crops in soils of the second type, can thus survive drought during the growing period without high drops in yields, while in poorer quality soils this drop is larger.

Droughts in Poland and their impact on agriculture

Changes to the environment in Poland have varied causes. Some part of them follows from a long-term human activity consisting mostly in felling of trees, mainly to clear land for cultivation. This was the cause of rapid run-off of rain and snow water intensifying water, therevy erosion of soils and increasing evaporation of water triggered by higher temperature of land surface, drop in relative humidity of air and winds. The latter also strengthened wind erosion of soils (Kędziora, 2005). Over time, more and more often deforestation affected forests growing on sandy soils (Degórska et al., 2006), which are more prone to water and wind erosion.

It is estimated, for instance, that in the area of Wielkopolska at the end of the 14th century forests took up over half of the region's total area and in 1928 it was only 21% (Kundzewicz et al., 2006). The decreasing share of forests in the total area is also one of the reasons for lower precipitation (Kędziora, 2005).

Other signs of long-time human activity should also be noted. Rapid run-off of rain and snow water from deforested areas changed meandering rivers into braided ones (Starkel, 2006), thus accelerating the useless run-off of water into the sea.

Around the middle of the 19th century, industry started to develop in Poland and then, more vividly than before, also agriculture based on the so-called

Norfolk four-course system with plough tillage. Forests were still cleared, as well. Development of the economy accelerated disruption of the balance in natural and partly natural geographical ecosystems leading to intensification of the aforementioned unfavourable phenomena (Starkel, 2006). Nonetheless, for many years, measures to mitigate the negative effects of human activity have been taken, which consisted in afforestation of areas useless for other purposes, construction of water reservoirs restricting the useless water run-off, introduction of forest patches limiting evaporation, use of organic fertilisation that increases the water capacity of soils, etc. Such measures were not taken at a sufficient scale, though.

Environmental changes caused by deforestation started to overlap with climate change, most probably under the influence of the growing greenhouse gas content in the air (Starkel, 2006; Przybylak, 2006).

It is almost certain that in the 20th century the average air temperature in Poland grew by ca. 1°C. No multi-annual trends in the sum of atmospheric precipitation were identified, but the soil water balance points to a negative trend because of evaporation resulting from higher temperatures and sum of insolation (combining the time of sun rays penetration of the earth's surface), which is visible since the 1960s. From that time on, 7 out of 68 lakes disappeared from the Łęczna-Włodawa Lake District (Polish: *Pojezierze Łęczyńsko-Włodawskie*), being one of the most valuable areas as regards natural assets in Europe, several others will disappear shortly and all the remaining ones decreased their surface, etc. (Chmielewski, 2006). Water shortages start to have a parallel negative impact on the economic results of agriculture. These can be felt especially in the spring and summer, during plant vegetation. It was determined that this type of negative trends intensified at the beginning of the current century (Górski, 2006).

Average multi-annual national precipitation amounts to 656 mm (489--764 mm). Lower (by ca. 8%) precipitation is in the area of the Polish Lowland (*Niż Polski*), situated between two borders, norther and southern. The former is marked more or less by the line joining Szczecin, Gdańsk, Lidzbark Warmiński, Ełk and Sejny. The southern border is formed by the line joining Zielona Góra, Opole, northern surroundings of Kielce, estuary of the Czarna River to the Vistula River, estuary of the San River to the Vistula River, southern surroundings of Lublin and further into the east to the border with Ukraine. In the area, it is possible to separate an area with even lower precipitation (by 8-15%). Its borders are designated by the localities: Szczecin – Brodnica – Sierpc – Modlin – Kutno – Konin – Śrem and Poznań (Kędziora, 2005).

The highest evaporation level is observed at places where there are relatively high temperatures and small relative air humidity. This concerns mostly the Polish Lowland, which is characterised by a small share of forests in the total area. It is estimated that in a year over 80% of water from atmospheric precipitation evaporates in the area. In the central-western part of the area and in a small

enclave near the eastern border, the index even exceeds 85%, which is one of the worst indices in Europe. The remaining part of water permeates, run-offs to the Baltic Sea and is used for the living needs of people and for economic purposes (Kędziora, 2005).

In the above light, the thesis on problems caused by water shortages in large areas of Poland (ca. 39%) starts to make sense.

Analysis method

The area of Poland, especially prone to droughts, was delimitated based on the results of the Agricultural Drought Monitoring System in Poland (ADMS), run by the Institute of Soil Science and Plant Cultivation – State Research Institute in Puławy. The System annually provides information on the water balance for all gminas (municipalities) in the country, considering the categories of soil, respective species or groups of cultivated crops and their growing stages. The observations, held in 2006-2013, were used as basis to select gminas which in the eight-year period were affected by droughts for at least 7 years (gminas especially affected by droughts). The phenomenon covered 96 gminas: 30 in Wielkopolskie, 23 in Łódzkie, 21 in Kujawsko-Pomorskie, 14 in Lubuskie and 8 in Dolnośląskie Voivodeships (see Fig. 1).

In the analysed period, 296 farms in these gminas conducted uninterrupted accounting for the Polish FADN, in the other gminas countrywide (other gminas) such accounting continually covered 4,294 farms. The results of this monitoring were the source of data enabling to perform relevant analyses.

Among the analysed 296 farms functioning in gminas especially affected by droughts, there are 3 with production value amounting to at least PLN 1 million per 1 ha of utilised agricultural area (UAA). One of them, having 0.6 ha of UAA, specialised in horticultural crops, two others – in poultry production. A farm with 2.2 ha of UAA had livestock population at ca. 156 LU (livestock unit), while for farms with less than 0.1 ha the livestock population was at ca. 55 LU. This corresponded to, respectively, ca. 11 thousand and 4 thousand laying hens and 2 times more broilers. Such production organisation strongly limited the impact of drought on the obtained results. Horticultural production was conducted under covers and probably with the use of sprinkling, while poultry production was based on purchased feeds.

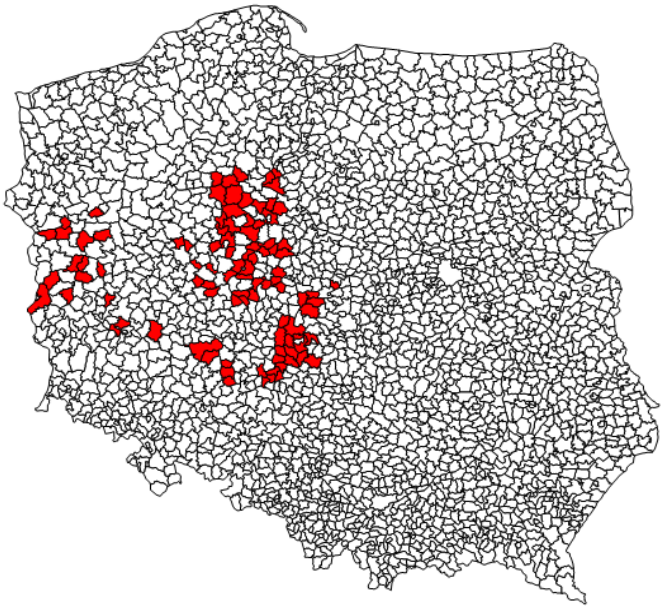

Fig. 1. Gminas especially affected by agricultural droughts in Poland in 2006-2013.
Source: own study based on the ADMS data for 2006-2013.

The above-remarks were used in the account of effects of frequent droughts for farms with soils below the average quality. From the group of farms situated in the area of gminas especially affected by droughts, 3 farms were selected (ca. 1% of the total) with production value of at least PLN 1 million per 1 ha of UAA. Out of 4,294 farms from other gminas, 8 (0.2% of the total) such farms were selected. From the two groups thus determined, farms with soils below the average quality were selected (soil valuation index (*wskaźnik bonitacji gleb*, *WBG*) set for own land at WBG ≤ 0.7) and they were also analysed.

Moreover, differentiation of characteristics of 108 farms was checked against farms with poorer quality soils that conducted agricultural production in gminas especially at risk of agricultural droughts. To this end, the group was divided into quartiles, taking as their basis the production value per one area unit of UAA.

Situation of farms of natural persons functioning in gminas especially affected by droughts

The characteristic of farms functioning in gminas especially affected by droughts was presented against farms from other gminas (Tables 1-3).

Table 1

Production potential of farms from the analysed groups and use of foreign factors of production (annual averages for 2006-2013)

Measures, indices and names	Farms in gminas: especially affected by droughts	Farms in gminas: other	Difference in percentages (2-3)/3 · 100
1	2	3	4
Number of farms in a group	296	4,294	X
Average UAA (ha)	34.4	36.5	-5.8
including rented land (%)	20.6	22.1	-1.5[a]
Share of farms situated in LFA[b] (%)	65.5	56.3	9.2[a]
Average age of a farm manager (years)	48.0	45.2	6.2
Total labour inputs per 1 ha of UAA (hours)	122	121	0.8
including hired employment (%)	7.5	8.8	-1.3[a]
Average value of assets per 1 AWU[c] (PLN thousand)	313.1	317.0	-1.2
Debt rate (%)	10.8	11.7	-0.9[a]

[a] Difference in percentage points (2-3).

[b] Less-favoured areas.

[c] Number of full-time employees.

Source: calculations by M. Zieliński drawn up on the basis of the results of the Polish FADN monitoring.

Table 2

Structure (%) of basic types of farming (TF8) in the analysed farms (averages for 2006-2013)

Type of farming	Farms in gminas: especially affected by droughts	Farms in gminas: other	Difference in percentage points (2-3)
1	2	3	4
Total	100.0	100.0	X
Specialisation in:			
– field crops	25.7	22.7	3.0
– horticulture	0.3	2.9	-2.6
– permanent crops	1.0	3.7	- 2.7
– dairy cows rearing	14.5	23.1	-8.6
– rearing of other livestock fed mostly with roughages (grazing livestock)	3.4	2.1	1.3
– rearing of livestock fed mostly with concentrates (granivores)	7.8	7.5	0.3
Unspecialised production (mixed)	47.3	38.0	9.3

Source: as in Table 1.

Table 3

Value of production, income, labour efficiency and fixed assets replacement rate in farms from the analysed groups (annual averages for 2006-2013)

Measures, indices and names	Farms in gminas: especially affected by droughts	Farms in gminas: other	Difference in percentages (2-3)/3·100
1	2	3	4
Average production value from a farm (PLN thousand)	333.9	448.9	-25.6
Average income per farm (PLN thousand)	73.2	83.2	-12.0
Income as above per one unit of own labour input (PLN thousand per 1 FWU[a])	39.6	43.3	-8.5
Fixed assets replacement rate (%)	0.2	0.7	-0.5[b]

[a] Own labour input at a farm per one full-time employee.

[b] Difference in percentage points (2-3).

Source: as in Table 1.

From the Tables above it follows that farms in gminas especially affected by droughts against other gminas, have the following characteristics:

- they are slightly smaller in terms of area and more often situated in less--favoured areas (LFA), thus, they have poorer soil and demographic conditions, while the effects of unfavourable soil conditions deepen the effects of droughts;
- they specialise in milk production clearly less frequently (scarcity of roughages caused by drought requires reduction of cow herd and its reconstruction takes years); besides, the share of farms specialising in intensive crops (vegetable and fruit) is lower, because their water demand per area unit is larger than for less intensive crops;
- they have much lower production scale, significantly lower income and slightly lower profitability of own labour;
- lower income of farms and lower profitability of own labour are probably caused by lower extended replacement rate of fixed assets, which limits the adaptation possibilities of farms and decides on lower UAA.

Table 4 presents a short numerical characteristic of farms of the two groups, but with soil quality below the average.

Table 4

Utilised agricultural area, income, labour efficiency and fixed assets replacement rate in farms from the analysed groups with poorer quality soils – WBG < 0.7 (annual averages for 2006-2013)

Measures, indices and names	Farms with poor soils (WBG < 0.7) in gminas:		Difference in percentages (2-3)/3·100
	especially affected by droughts	other	
1	2	3	4
Number of farms in a group[a]	108	1,608	X
Average UAA (ha)	30.2	35.8	-15.9
Average production value (PLN thousand)	169.1	218.4	-22.6
Average income per farm (PLN thousand)	54.6	73.1	-25.3
Income as above per one own labour unit (PLN thousand per 1 FWU[b])	30.0	37.1	-19.1
Fixed assets replacement rate (%)	-0.7	1.0	-1.7[c]

[a] This number does not cover farms with production value above PLN 1 million per ha (poultry farms and farms with production under covers).

[b] Established based on employment estimates.

[c] Difference in percentage points (2-3).

Source: as in Table 1.

From Table 4 it follows that farms with soil quality below the average and from gminas especially affected by droughts against similarly selected farms from other gminas were characterised by:

– clearly smaller UAA and much lower production value;
– much lower income and own labour profitability;
– negative replacement of fixed assets, while in other gminas this index was positive.

A question appears: whether in the group of 108 farms with poorer soils, situated in gminas especially at risk of agricultural droughts, productivity and profitability of land and other features is varied. To this end, as already mentioned, the group was divided into quartiles, taking as their basis the production value from area units of UAA. Tables 5-7 include respective numbers.

Table 5

Production potential of analysed farms with poorer soils – WBG < 0.7 (averages for 2006-2013)

Specification	Farms with poorer soils (WBG < 0.7):				
	in gminas especially at risk of drought				in other gminas
	total	including those within quartile			
		I < 25%	II and III 25-75%	IV ≥75%	
Number of farms	108	27	54	27	1,608
Share of farms in LFA[a] (%)	95.4	100.0	94.4	96.3	89.8
Own soil valuation index	0.5	0.4	0.5	0.5	0.5
Share of farms managed by people with agricultural education (%)	56.5	55.5	59.2	51.8	61.1
UAA (ha)	30.2	22.6	36.6	25.5	35.8
– including rented land (%)	12.3	9.2	12.9	18.8	21.8
Total labour inputs per 1 ha of UAA (hours)	133.4	150.1	107.2	182.3	124.4
– including hired employment (%)	4.2	3.1	4.5	7.2	6.0
Value of assets per 1 AWU[b] (PLN thousand)	256.9	201.0	270.8	252.1	280.4

[a] Less-favoured areas.

[b] Total labour input at a farm per one full-time employee.

Source: as in Table 1.

Table 6

Structure (%) of basic types of farming (TF8) in the analysed farms with poorer quality soils – WBG < 0.7 (averages for 2006-2013)

Specification	Farms with poorer soils (WBG < 0.7):				
	in gminas especially at risk of drought				in other gminas
	total	including those within quartile:			
		I < 25%	II and III 25-75%	IV ≥ 75%	
Total	100.0	100.0	100.0	100.0	100.0
Specialisation in:					
– field crops	22.2	37.0	9.3	11.1	9.4
– horticulture	0.9	-	-	3.7	3.0
– permanent crops	-	-	-	-	1.8
– dairy cows rearing	22.5	14.8	27.8	22.2	36.9
– rearing of other livestock fed mostly with roughages (grazing livestock)	2.6	11.1	7.4	3.7	3.7
– rearing of livestock fed mostly with concentrates (granivores)	6.3	-	1.8	14.8	7.9
Unspecialised production (mixed)	45.5	37.0	53.7	44.5	37.3

Source: as in Table 1.

Table 7

Labour productivity, income and fixed assets replacement rate in the analysed farm groups with poorer soils – WBG < 0.7 (annual averages for 2006-2013)

Specification	Farms with poorer soils (WBG < 0.7):				
	in gminas especially at risk of drought				in other gminas
	total	including those within quartile			
		I < 25%	II and III 25-75%	IV ≥ 75%	
Number of farms	108	27	54	27	1,308
Labour efficiency (PLN thousand per AWU[a])	86.4	46.6	95.0	100.8	104.0
Farm income (PLN thousand)	54.6	18.1	58.6	79.0	73.1
Farm income (PLN thousand)					
– per 1 ha of UAA	1.8	0.8	1.6	3.1	2.0
– per 1 FWU[b]	30.0	11.7	33.1	38.9	37.1
Income from a farm without subsidies for LFA per 1 ha of UAA (PLN thousand)	1.6	0.6	1.4	2.9	1.8
Fixed assets replacement rate (%)	-0.7	-1.8	-0.4	0.6	1.0

[a] Total labour input at a farm per one full-time employee.

[b] Own labour input at a farm per one full-time employee.

Source: as in Table 1.

As follows from the Tables, farms from the IV quartile – hence with the highest production value per area unit of UAA – which conducted production in gminas especially affected by droughts, failed to differ significantly in terms of economic results from farms functioning in the other gminas. The former even had higher income per farm and this income as per area unit of UAA and per unit of own labour inputs. The fixed assets replacement rate was lower, but this was extended replacement. The lower replacement rate decided on a much lower UAA and lower value of assets per unit of total labour inputs.

It is difficult to clearly indicate the reasons for a rather beneficial situation of farms from the **IV quartile**. This could be the selection of production structure (type of farming) limiting the risk of farming. Among farms especially affected by droughts as compared to farms from other gminas, the share of farms specialising in rearing of livestock fed mostly with concentrates (with the use of purchased feeds), and farms with mixed production was clearly higher, while it was clearly lower for farms specialising in rearing dairy cows or other livestock fed mostly with roughages. It is surprising that the share of farms specialising in horticulture, which requires significant water inputs (water-intensive), is relatively high and this suggests irrigation of crops. Hence, it cannot be excluded that some part of farms from gminas especially affected by droughts had access to large water resources (underground, lake, river water) enabling irrigation of crops.

It draws attention that the share of farms managed by people with agricultural education was in the IV quartile much lower than for farms from other gminas. It was also lower than in three other quartiles of farms from gminas especially affected by droughts. It is commonly known though, that there is a positive correlation between the level of formal professional preparation of agricultural producers and results of farms they manage. Thus, it can be concluded that given the small number of farms in the described quartile some interdependencies are random. Consequently, the observations formulated hereunder should be approach with caution.

The data characterising the joint comparison of the **II and III quartiles** deserve a slightly greater trust, since the number of analysed farms is twice as high. At the background of farms used for comparisons, they had at their disposal a slightly higher UAA with the same quality soils and only a tad lower share of people with formal professional preparation managing them. They also had a little lower value of assets per unit of total labour inputs. Despite that, they had much worse economic results which is evidenced by lower income per farm and income per area unit of UAA and per unit of own labour inputs. Farms from the II and III quartiles were, moreover, characterised by negative replacement of fixed assets.

Nearly 54% of the characterised entities run mixed farms (unspecialised), combining different types of crop production with rearing various species of animals and various utility groups of animals, which probably limited the risk of farming. However, it draws attention that over $^1/_3$ of farms specialised in rearing animals fed mostly with roughages, above all, dairy cattle. Given, as it was noted before, that milk production in drought conditions is a risky venture.

The **I quartile** covered the same number of farms as the IV quartile; hence there can be doubts regarding observations concerning it, as well. All farms from the I quartile were run on less-favoured areas (LFA). From the other farms they were differentiated by: the worst soil quality measured by the soil valuation index, the smallest UAA, the lowest share of rented land and hired employment and also lower value of assets per unit of total labour inputs.

Other observations are rather hard to understand. What draws attention is the share of farms – the highest against farms from other analysed groups – specialising in field crops, which could result in limited organic fertilisation and, consequently, deepen the negative effects of droughts. Probably a large part of owners of such farms had to seek other sources of income, mainly from gainful employment, and this excluded livestock production, which requires constant supervision. Thus, farms from the I quartile differed from the others with the highest share of farms specialising in field crops. This deepened the economic risk, but the effects of the phenomenon were mitigated by funds obtained from outside of the conducted type of farming. Despite a relatively high share of farms managed by people with agricultural education,

the obtained income was very low. As per unit of own labour inputs they were by nearly 70% lower than the average in farms from other gminas. This was most probably caused by a negative replacement of fixed assets and lower value of assets per unit of total labour input.

Conclusions

In Poland the issue of droughts and their effects in the Wielkopolskie agriculture were mentioned several dozen years ago. The research by climatologists shows that the phenomenon strengthened and currently covers a much larger area. Specifically, escalation of agricultural droughts was observed in the central--western part of the Polish Lowland. The opinion was confirmed in the following paper. It was established, namely that in the eight-year period of 2006-2013 as much as 96 gminas, in the: Wielkopolskie, Łódzkie, Kujawsko-Pomorskie, Lubuskie and Dolnośląskie Voivodeships, were affected by droughts for at least 7 years. Over the same eight-year period 296 farms in the gminas conduced continuous accounting for the Polish FADN. They provided information enabling to draw up an analysis of their income, type of replacement of fixed assets and methods to prevent the effects of droughts. As a point of reference, the research used 4,294 farms located in the area of other gminas.

From the above-deliberations it follows that escalation of droughts was an important reason for worse economic results of farms and their limited adaptation capabilities (which is communicated by lower fixed assets replacement rates) than in the panel of farms with the same soil quality but situated in other parts of the country. This phenomenon was especially acute for farms having UAA with soil quality below the average. Incomes calculated per farm were lower there by ca. 1/4 than in other farms with the same soil quality situated in other parts of the country, and apart from that such farms witnessed depreciation of fixed assets, contrary to farms being the point of reference. This happened despite subsidies to farms functioning in less-favoured areas (LFA).

In-depth analysis showed, however, that 25% of farms situated in soils of less than average quality, managed to limit the effects of droughts, and even made themselves independent from them, by production organisation and change in technology, developing, for instance, crop production under covers combined with sprinkling, crops or livestock production using purchased feeds. These farms achieved higher income even by ca. 8% than farms used for comparisons, but they were characterised by slightly lower, but still positive, fixed assets replacement rate.

As much as 50% of the analysed farms reached lower, by ca. 20%, income per farm than those used for comparisons. From the latter they are differentiated by a negative fixed assets replacement rate.

The remaining of the analysed farms were characterised by poorer soil quality as compared to those used for comparisons. They also had lower, by ca. 75%,

income and depreciation of assets was clear in their case. There are reasons to believe that a major part of the farms (37%) reorganised production in such a manner (specialisation in field crops) so as to enable the owners and possibly their family members to undertake permanent gainful employment off-farm.

Around 48% of farms with soils of lower than average quality and carrying out production in gminas with escalation of droughts sought possibilities of limiting the effects of unfavourable natural conditions of farming in running unspecialised production (mixed, multisided). This was ca. 10 percentage points more than in farms used for comparisons. Although it is known that mixed (multisided) production fails to improve farm income, it limits the fluctuations of income from year to year.

Conclusions included in the paper should be treated as initial. Hence, they were drawn based on information taken from the results of the Polish FADN monitoring, which does not cover all farms. Apart from that, the conclusions referring to varied farms with UAA having lower than average soil quality, were based on the analysis of information taken from a group amounting to only 108 farms.

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WOJCIECH JÓZWIAK
MAREK ZIELIŃSKI
WOJCIECH ZIĘTARA
Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej
– Państwowy Instytut Badawczy
Warszawa

SUSZE A SYTUACJA POLSKICH GOSPODARSTW ROLNYCH OSÓB FIZYCZNYCH

Abstrakt

W opracowaniu przedstawiono sytuację gospodarstw rolnych funkcjonujących na obszarach narażonych na susze, z podkreśleniem sytuacji tych z glebami gorszej jakości. Badaniami objęto 296 gospodarstw prowadzących w sposób ciągły rachunkowość rolną w ramach Polskiego FADN w latach 2006-2013 na terenie 96 gmin dotkniętych szczególnie suszami z województw: wielkopolskiego, lubuskiego, kujawsko-pomorskiego, łódzkiego i dolnośląskiego. Podstawą odniesienia były 4294 gospodarstwa położone na terenie pozostałych gmin kraju. Analiza wykazała, że gospodarstwa z rejonów częstego występowania susz uzyskiwały gorsze wyniki produkcyjne i ekonomiczne, a czynnikiem pogłębiającym skutki suszy była zła jakość gleb. Inne czynniki, które o tym przesądzały, wskazano tylko wstępnie z uwagi na małą liczebność analizowanej próby.

Słowa kluczowe: gospodarstwa rolne, susza rolnicza, klimat, jakość gleb, dochody, reprodukcja majątku trwałego.

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