ENVIRONMENTAL AND CLIMATE RISK MANAGEMENT IN AGRICULTURAL HOLDINGS IN BULGARIA

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УПРАВЛЕНИЕ НА ПРИРОДОКЛИМАТИЧНИЯ РИСК В ЗЕМЕДЕЛСКИТЕ СТОПАНСТВА В БЪЛГАРИЯ

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Abstract

The development of agricultural holdings depends on many external and internal factors. The specifics of agricultural production and the high unpredictability of natural phenomena are the reason the factors related to nature and climate to be defined as the risks that have a serious impact on agricultural production. The aim of the paper is to study environmental and climate risks that influence on agricultural holdings in Bulgaria and, on this basis, to propose recommendations for overcoming them. The first part of the paper provides a theoretical overview of the possible climate risks for agricultural holdings. The analytical part of the paper is related to analysis of: 1 climate-related crisis events in Bulgaria for the period 2010 – 2020 and their impact on agricultural production; 2) financial support to compensate damages to agricultural crops caused by the adverse climate events that can be equated to natural disasters for the period 2016 – 2020. Based on the analysis are proposed recommendations for reducing or overcoming the environmental and climate risk.

Key words: climate risk, environment, agricultural holdings, measure

JEL: Q15, Q54

Introduction

The specifics of agricultural production and the high unpredictability of natural phenomena are the reason the factor related to nature and climate to be defined as the risks that have a serious impact on the development of agricultural holdings. Distinguishing the different types of risk enables their effective management (Andreeva, 2022). The classification of the Ministry of agriculture, food and forestry (MAFF, 2016a) classifies risks into external and internal risks, assigning environmental and climate risks to external and linking them to loss or reduction of harvest.

Environmental and climate risks are associated with phenomena such as earthquakes, floods, landslides, storms, hail, large snow accumulations, frosts, droughts, fires. Bielza et al. (2007) add that the main goal of risk management by this type of risk is to protect agricultural production from the harmful effects of natural disasters or catastrophic events. Environmental and climate risks have a direct impact on

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agricultural production, but they also influence on the activity of processors and traders in the sector. Farauta et al. (2011) consider that environmental factors and climate change contribute to the food price crisis and that the impact on agriculture in developing countries is expected to be more serious. Elahi et al. (2019) also share the view that the effects of climate change are more pronounced in resource-poor countries, making them more vulnerable.

Climate risk is one of the risks with serious impact on agriculture and natural ecosystems. Crop yields are affected by many factors related to climate change such as temperature, rainfall and other extreme weather events (Emeka, 2008). In addition, Kanianska (2016) expresses the view that climate change leads to an increase in risk and unpredictability for farmers, increasing the probability of a risk event's occurrence such as drought, changes in rainfall patterns, extreme weather events.

The impact of environmental and climate risks on agriculture at European level is different and depends on the country and region in which they occur. Elahi et al. (2021) consider that the impact of climate change on agricultural holdings and their yields depends on the location and therefore in some latitudes yields will be positively affected while in others negatively. For this reason, knowledge of the local situation has a significant role in the assessment of natural phenomena, the application of appropriate risk management mechanisms (Bielza et al., 2007) and adaptation to the changes that occur. Koleva-Lizama (2017) adds that regardless of the ability of some agricultural holdings to adapt to changing climate conditions, others may not have this ability depending on the specifics of the agricultural activity and the characteristics of the holding.

Methodology

The aim of the paper is to study environmental and climate risks that influence agricultural holdings in Bulgaria and, on this basis, to propose recommendations for overcoming them.

The methodological framework of the paper includes: 1) theoretical overview of the possible environmental and climate risks for agricultural holdings; 2) analysis of climate-related crisis events for the period 2010 – 2020 and their impact on agricultural production; 3) respondents opinion about the environmental and climate risk they met in their farms based on survey[2] (Harizanova – Bartos et al., 2018) ; 4) analysis of financial support to compensate the damages to agricultural production caused by climate events. Based on the analysis are proposed recommendations for mitigating and overcoming the environmental and climate risk.

[2] Some of the conclusions made in the analytical part of the paper are confirmed also by the results based on university project NI 16/2018 Integrated approach to risk management in the agricultural sector

In order to study the impact of occurred environmental and climate risk events on agricultural crop and livestock breeding gross production, a correlation analysis was carried out. Correlation analysis is also done to examine the relationship between the received recovery funds for damages and agricultural crop and livestock breeding gross production. The used probability is 5%, i.e. α-error equal to 0.05.

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Analysis of environmental and climate risk management in agricultural holdings in Bulgaria

Analysis of climate-related crisis events for the period 2010 – 2020 and their impact on agricultural production

Figure 1 presents the total number of climate related crisis events in Bulgaria. For the period 2010 – 2020, their decrease is observed, and the variation in the number is most strongly affected by the fires and floods that have occurred.

The highest number of crisis events was observed in 2015, and the lowest in 2018, with a difference of more than 4.5 times. In 2020, there were 907 crisis events related to climate phenomena. Most of them – 83% are fires.

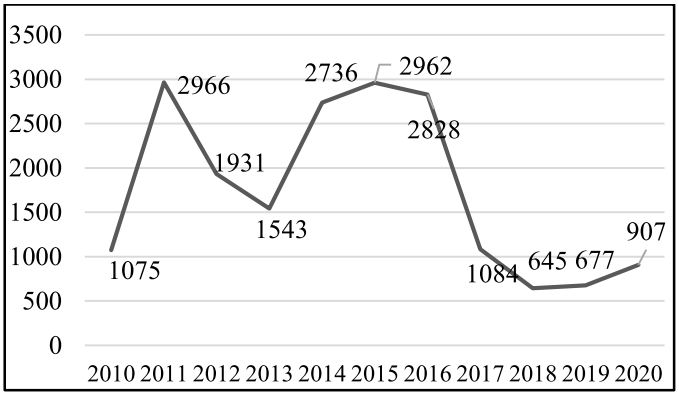

Figure 1. Total number of climate-related crisis events in Bulgaria for the period 2010 – 2020

Source: NSI, 2021, Crisis events for the period 2010 – 2020.

The data of the type of crisis events related to climate phenomena, which also have an impact on agricultural production, shows that for the period 2010 – 2020, the number of fires are the most in 2014, 2015, 2016 (Table 1). The number of landslides in 2020 was at least – 24, floods also decrease from 651 in 2010 to 100

in 2020. The number of hail followed a decreasing trend and during the period they decreased more than 5 times. Snowstorms, icing and frost also a decreasing trend and the reduce around 9 times.

Table 1. Number of crisis events related to climate phenomena by type for the period 2010 – 2020

Crisis event	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fires	163	2185	301	764	2245	2474	2448	741	480	521	754
Landslides	59	76	72	51	75	125	71	32	27	31	24
Earthquakes	12	4	22	6	4	1	2	.	.	.	.
Droughts	6	30	23	3	1	.	.	28	.	4	1
Floods	651	382	692	547	360	266	184	159	84	108	100
Storms, tornadoes, whirlwinds	47	48	528	89	14	12	29	6	13	5	15
Hails	16	13	14	13	8	21	5	14	8	3	.
Snowstorms	103	94	93	50	26	56	87	52	13	4	11
Icing, frost	18	134	186	20	3	7	2	52	20	1	2

Source: NSI, 2021, Crisis events for the period 2010 – 2020

Data on damages determined due to crisis events related to climate phenomena (Figure 2) show that the financial value of damages was the highest in 2011 and 2013 due to floods and landslides (Table 2). In 2012 are determined the lowest damages – 10 616 thousand BGN.

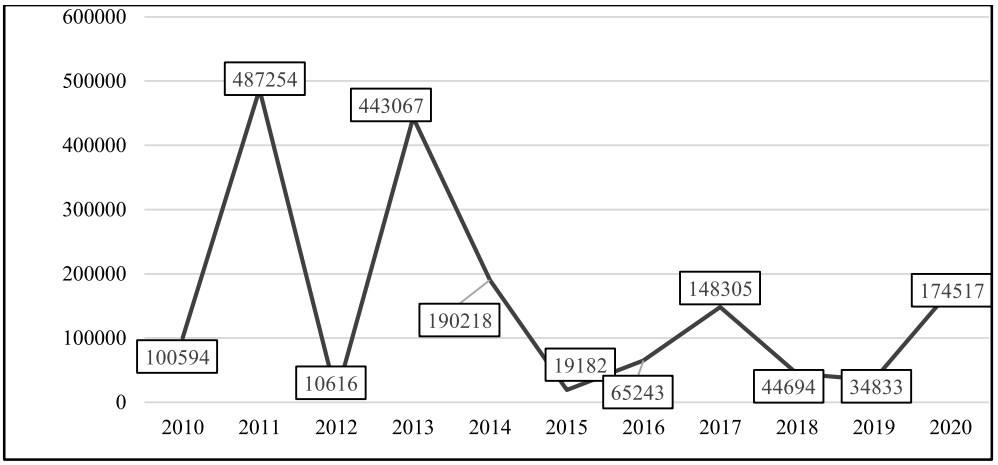

Figure 2. Damages determined as a result of crisis events related to climatic phenomena, thousand BGN

Source: NSI, 2021, Crisis events for the period 2010 – 2020

For the period 2010 – 2020, the highest amount for damages as a result of floods were determined, with the amounts varying from 15 285 thousand BGN to 206 659 thousand BGN. In 2011 and 2013, damages due to landslides were respectively

224790 thousand BGN and 294 459 thousand BGN. During the analyzed period, the determined damages from fire decreased significantly (about 8 times) from 2239 thousand BGN to 281 thousand BGN. In 2020, the highest amount for damages is for landslides – 154996 thousand BGN, and the least for icing and frost – 20 thousand BGN.

Table 2. Damages determined because of the crisis events related to climate phenomena by type for the period 2010 – 2020, thousand BGN

Crisis event	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fires	2 239	2 186	1 437	2 013	729	1 795	1 061	1 250	1 703	194	281
Landslides	21 82	224 79	17 384	294 459	9 291	10 011	9 632	7 720	6 248	8 101	154 996
Earthquakes	224	.	59 037	915	62	.	.	.	.	.	.
Droughts	1	117	149	.	1	.	.	.	.	.	.
Floods	38 882	206 659	20 898	15 285	177 604	171 032	30 617	135 530	28 384	21 173	16 664
Storms, tornadoes, whirlwinds	54 722	1 614	3 488	99 387	746	1,64	3 267	45	3 266	451	561
Hails	505	50 150	187	.	853	583	10	1 978	89	935	.
Snowstorms	441	1 205	945	200	410	5 436	351	757	79	600	794
Icing, frost	.	128	135	.	.	200	2	20	25	.	20

Source: NSI, 2021, Crisis events for the period 2010 – 2020.

In order to study the impact of occurred environmental and climate risk events and also the influence of recovery funds for damages to agricultural crop and livestock breeding gross production, a correlation analysis was carried out. Table 3 presents the correlation coefficient between the number of environmental and climate risk events and gross production in agriculture for the period 2010 – 2020. The coefficient of correlation between the number of environmental and climate risk events and the total gross production in agriculture for the period 2010 – 2020 according to the Pearson scale is negative "- 0.18", and this negative correlation is weak. The degree of significance is 0. The coefficient of determination is 0.33, which means that a 33% increase in the occurrence of environmental risks is associated with a decrease in gross production in agriculture. The coefficients of statistical significance of the relationships between the number of climate risks and gross production from livestock breeding and crop production are higher than the acceptable error, and therefore these results have to be approached with caution due to the fact that one of the conditions of the correlation analysis is not met.

Table 3. Correlation coefficients and significance between the number of environmental and climate risk events and gross production in agriculture, 2010 – 2020

	Number of environmental and climate risk events	Number of environmental and climate risk events	Number of environmental and climate risk events
Gross production – total	-0,18 0		
Gross production – crop production		0,58 0,16	
Gross production – livestock breeding			-0,74 0,14

Source: own calculation.

The correlations between the funds for recovery as a result of environmental and climate risk events and the total gross production in agriculture for the period 2010 – 2020 and the gross production from crop and livestock breeding are positive. The coefficient of correlation dependence between the recovery funds and the total gross production in agriculture for the period 2010 – 2020 is low on the Pearson scale – 0.2, with a significance level of 0.03. This means that the total gross production in agriculture is slightly influenced by the recovery funds. The relationship between recovery funds and gross production from livestock breeding is also weak, the correlation coefficient is 0.3 with a statistical significance coefficient of 0.03. Above average correlation dependence is the connection between recovery funds and gross crop production. The correlation coefficient is 0.57 with a statistical significance coefficient of 0.03. It can be concluded that recovery funds affect the gross crop production. According to the coefficient of determination, a 37% increase in the recovery funds for damages from environmental and climate risk is associated with an increase in the gross crop production. A 9% increase in recovery funds is associated with an increase in gross production from livestock breeding.

Table 4. Correlation coefficients and significance of recovery funds as a result of environmental and climate risk events and gross production in agriculture, 2010 – 2020

	Recovery funds	Recovery funds	Recovery funds
Gross production – total	0,2 0,03		
Gross production – crop production		0,57 0,03	
Gross production – livestock breeding			0,3 0,03

Source: own calculation.

The results from the correlation analysis show, that crop production is strongly influenced by the natural and climate risks occurred and the impact is more significant for crop production than for the production from livestock breeding. This and other conclusions made in the analytical part of the paper could be confirmed also by the results from the university project NI 16/2018 Integrated approach to risk

management in the agricultural sector (Harizanova – Bartos et al., 2018). On the question of self-assessment of how risk-oriented are crop and livestock farms, the results show that livestock farms are defined as more risk-oriented – score 8.43 (the scale is from 1 – low to 10 – high), and the score for crop farms is 6.72. Owners of crop farms take risks relatively less often, which is mainly due to the probability of occurred environmental and climate risk event, on which crop production activities depend strongly. The results of a survey conducted under the project show that agricultural producers consider that the most important factors that limit the economic development of their holdings are environmental and climate factors (Table 5).

Table 5. Distribution of farms depending on the occurrence of climate risk, its effect and frequency of occurrence, %

Climate risk	Value
Agricultural holdings, that meet climate risk, %	42
Effect of climate risk on agricultural holding (from 1 – low to 5 – high)	3.4
Frequency of occurrence of this risk for the holding (from 1 – low to 5 – high)	3.6

Source: Harizanova – Bartos et al. (2018).

They receive the score of 4.6 according to 5-point scale where 5 is the highest score and 1 the lowest. Farmers are of the opinion that natural disasters such as floods, droughts, hailstorms are relatively less predictable and may affect the development of their farms, causing losses or reduced harvest.

The frequency that farms are affected by environmental and climate risks is 42%, and the effect of this risk was above average – 3.4 out of 5 maxima, and the frequency of occurrence of climate risk was estimated at 3.6.

In relation to climate risk, 29% of farmers undertake compensation with other production or take a loan, 21% undertake nothing, 14% rely on state financing, and only 7% use insurance as a strategy, regardless, many authors (Andreeva, 2021) share a view that have to undertake activities to achieve e financial results and to reduce the risk.

Analysis of financial support to compensate the damages to agricultural production caused by climate events

To deal with environmental and climate risks, farmers could use state financial support. According to the Agricultural report (MAFF, 2021), the funds spent on prevention of the harmful effects of natural and climatic factors in 2020 are over 45.9 million BGN. The report states that this is the highest amount for the last three years, as in 2018 it was 27.08 million BGN, an increase of 41%.

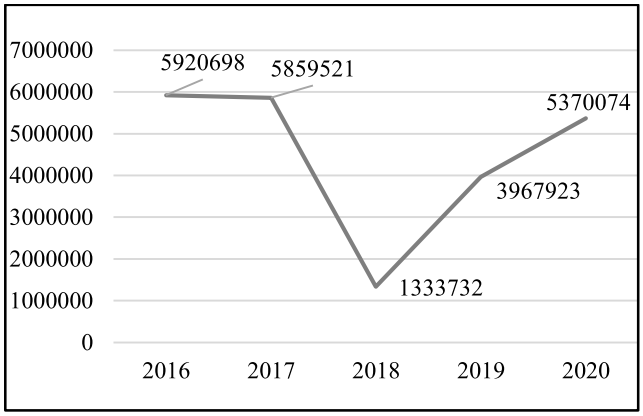

Figure 3. Disbursed financial resource to compensate for damages to crops caused by adverse climate events that can be equated to natural disasters for the period 2016 – 2020, mln. BGN

Source: MAFF, Agricultural report 2017, 2018, 2019, 2020, 2021.

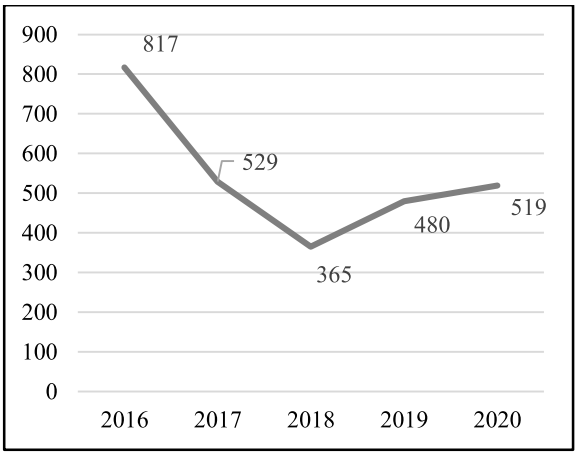

Figure 4. Number of beneficiaries financed to compensate for damages to crops caused by adverse climate events that can be equated to natural disasters for the period 2016 – 2020

Source: MAFF, Agricultural report 2017, 2018, 2019, 2020, 2021.

To overcome the damages due to climate risk, farmers have been benefited from government aid to compensate for crop damages caused by adverse weather events that can be equated to natural disasters. Figure 3 and Figure 4 present state support and the number of beneficiaries to compensate for damages to agricultural crops caused by adverse climatic events that can be equated to natural disasters for the

period 2017 – 2020. It is observed that in 2018 the utilized financial resource and the number of beneficiaries was the lowest.

In 2020, under the planned in RDP 2014 – 2020 measure 5 Restoration of agricultural production potential damaged by natural disasters and introduction of appropriate preventive measures, two sub-measures were opened – Sub-measure 5.1 Support for investments in preventive measures aimed at mitigating the consequences of probable natural disasters, adverse climatic events and catastrophic events 5.2 Investments for restoration of agricultural land potential and agricultural production potential disturbed by natural disasters, adverse climatic events and catastrophic events. They can also be used by farmers to reduce damages caused by climate risk events. According to sub-measure 5.1, 46 project proposals were received, and the value of the requested subsidy is 25 256 217.05 BGN. According to sub-measure 5.2, there were 3 received project proposals with requested subsidy of 1 903 599.96 BGN.

Conclusion

The frequency of occurrence of many environmental and climate risks is low, but their impacts on agricultural production are significant. Due to the fact that these types of risks are difficult to predict, preventive actions could be taken. For this reason, an appropriate measure to reduce the risk due to fires, landslides, earthquakes, storms are insurance and the diversification of agricultural activity. The reduction of the risks of drought and floods can be realized by fulfilling the goals set in the Strategy for the management and development of hydromelioration and protection from the harmful effects of water. This will provide opportunities for: 1) building institutional capacity for the management of sustainable hydromelioration systems; 2) irrigation and drainage of agricultural holdings; 3) access to the hydromelioration infrastructure of agricultural lands; 4) sustainable functioning of the infrastructure for protection against the harmful effects of water. (MAFF, 2016 b). The actualization of the Flood risk management plans for the period 2022 – 2027 initiated by the MEW would also reduce the risk of floods and landslides and take measures to prevent them. In conclusion Figure 5 presents some of the measures to prevent or reduce environmental and climate risk and some of the institutions related to climate risk management in agriculture.

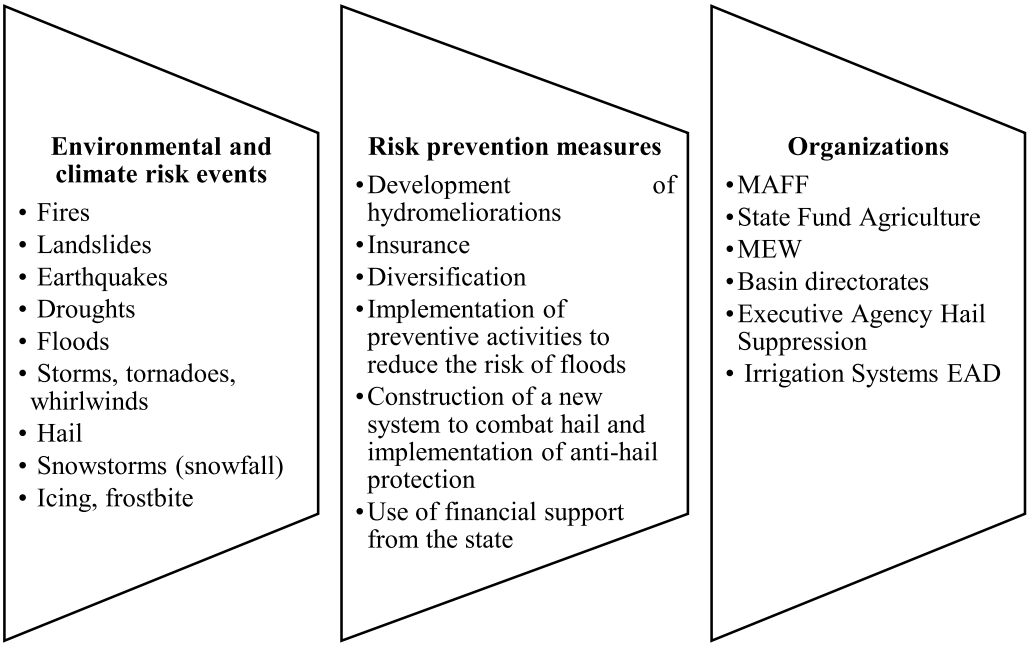

Figure 5. Measures to prevent or reduce environmental and climate risk and some of the institutions related to climate risk management in agriculture

Source: own survey.

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