

CLIMATE CHANGE AND ITS IMPORTANCE FOR AGRICULTURAL PRODUCTION

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Summary

Agricultural production, which takes place in rural areas, is the sector of the economy, which is the most dependent on the natural conditions of weather. The climate changes, which are taking place, and the extreme phenomena, which are their consequence, affect precisely these areas the most. The content of the present work is the exploration of the definitions of natural variability, extreme phenomena and disasters, and the analysis of the statistics on natural disasters. In the final part of the paper, we have indicated, which support instruments for farmers are available in such events on the part of the State. Climate change is a fact, and unless we realize that, it will be difficult to take any action allowing us to adapt to the new conditions.

Keywords

natural variability of production • extreme phenomena • natural disasters • rural areas

1. Introduction

Many countries all over the world observe the growing problem of climate change, as well as extreme weather events and conditions resulting from that change. They undertake actions aimed at reducing this impact. In 1988, the United Nations established the Intergovernmental Panel on Climate Change (IPCC), which brings together thousands of scientists from around the world. Their main task is to assess the current state of research, as well as to raise awareness of climate change and its effects. According to the IPCC report, global warming is unequivocal. The atmosphere and the ocean continue to heat, the amount of snow and ice has decreased, while sea level and concentrations of greenhouse gases have increased [IPCC 2013]. According to the Polish Government Centre for Security, Poland is threatened mainly with the following natural events: floods, landslides, storms, hurricanes, tornadoes, severe frosts, droughts, and snow avalanches [RCB 2013]. Some events are more frequent compared to 40–50 years ago. All these result from the noticeable climate change.

The study of the Institute of Meteorology and Water Management shows that when it comes to the environment, the biggest negative impacts of the climate change should be expected in water management (local deficits of water), agriculture (decrease of

stocks of moisture in the soil) and forestry. Major changes are indicated in the chemistry of the atmosphere. An increase in the incidence of phenomena of natural disasters character should also be expected, such as: storms, hurricanes, floods, grads, droughts, and so forth. These, in turn, may cause major breakdowns and technological disasters. We then often face a synergistic effect, in which there is a correlation between the changes in nature, and the reaction of technological systems [IMGW 2012]. In Poland, climate change presents also opportunities: a more friendly, higher water temperature in the Baltic Sea, and in winter, lowered morbidity and mortality as well as savings on heating fuels. At the same time, there are risks: increase in the frequency of heat waves, intense rainfall, floods and landslides, but also drought during the growing season, strong winds and the rise in sea level [Kundzewicz 2013].

In 1997 in Kyoto, governments of many countries have made another step, adopting the Kyoto Protocol. The treaty puts countries under obligation to reduce or limit greenhouse gas emissions. The Kyoto Protocol entered into force in 2005. Until today, it has been formally adopted by 183 countries and the European Union. The Kyoto Protocol sets the levels of greenhouse gas emissions for 37 industrialized countries. Most of these targets assumed the decrease in greenhouse gas emissions by 5–8% compared to the emissions in 1990. Among the most industrialized countries, only the United States refused to accede to the Protocol. The Kyoto Protocol focuses on industrialized countries, which are responsible for a large majority of the past and current emissions of greenhouse gases. It follows that mainly these countries should have the necessary expertise and financial resources needed to reduce greenhouse gas emissions. Greenhouse gas emissions by industrialized countries are ten times higher than in developing countries, which must include Poland [<http://ec.europa.eu/clima>, 12/21/2014].

It should be emphasized that at the forum of the United Nations Framework Convention for Climate Change (UNFCCC), governments of over 190 countries are debating the reduction of greenhouse gas emissions and adaptation to climate change, recognizing that these activities should be carried out in parallel. The need to develop programs of adaptation and tasks of the Parties arise from Article 4 of the aforementioned Convention, and the document adopted therein, titled “The Nairobi Work Programme on impacts, vulnerability and adaptation to climate change” of 2006, which among its other provisions states the need to involve countries in assessing the possible impact of climate change on various areas of life, and to create a strategy for reducing these impacts by adapting to the said changes.

The European Commission, with a view to the implementation of the Nairobi Work Programme, published a White Paper on 1 April 2009: “Adapting to climate change: Towards a European framework for action”, COM (2009) 147, which defined the scope of action for the European Community for the years 2009–2012. The White Paper is strategic, and it directs the preparation of an effective response to climate change at the EU and member states. The four pillars of the EU White Paper include: strengthening the evidence base in the field of climate change, introducing the adaptation to key EU policies, financing the adaptation, and strengthening the international efforts of

the EU to adapt. The European Union is a major leader in the global struggle against climate change. Being one of the world's major economic powers, the EU is committed to continuous reduction of greenhouse gas emissions, while being responsible for only 14% of global emissions. The European Union also supports adaptation to climate change through policies in this direction and through financial support, provided in particular to developing countries. The activities are focused on:

- Requirement in relation to the Member States on the assessment of existing flood risk and its management;
- Crop adaptation, in terms of introducing crops that need less water or better tolerate drought;
- Construction of buildings in a way that provides energy saving, as well as protection against storms, floods, heat waves;
- Planning of industrial facilities, while taking into account the adjustment to the new conditions;
- Instructions to main departments and agencies, dealing with health and social issues, which should be prepared for heat waves and other unusual weather conditions;
- Introduction of innovative technologies that reduce waste water, by reducing water use by about 40%;
- Creation of the Nature 2000 network of protected natural areas, designed to help nature adapt to environmental changes.

Polish government adopted a position on the White Paper on 19 March 2010 and decided on the need to develop adaptation strategies for sectors and areas vulnerable to climate change. Therefore a document was created, titled "Strategic Plan for Adaptation of sectors and areas vulnerable to climate change until 2020, with an outlook until 2030", or SPA 2020 for short. The SPA 2020 is one element of a broader research project, called KLIMADA, which covers the period up to the year 2070. According to this document, preparation of a set of directional adaptation measures by 2020 for the sectors and areas sensitive to climate change should take place in relation to the national integrated development strategies in order to improve resilience of the economy and society to climate change and to reduce losses connected thereto. The sectors, on which attention should be focused, because of their sensitivity to climate change, include: water, biodiversity, forestry, energy, transportation, agriculture, land management, housing and health. Among the focus areas, the following were distinguished: coastal zone, mountain areas, urban areas and Nature 2000 areas. For those areas and sectors, actions were listed that must be undertaken in order to combat climate change.

According to the presented document, scenarios of climate change for Poland until 2030 show the greatest threat in terms of extreme weather and climate conditions (torrential rains, floods, landslides, heat waves, droughts, hurricanes, etc.). These phenomena will occur with increasing frequency and intensity, and they will cover more and more areas of the country [Ministerstwo Środowiska 2013].

2. Objectives and methods of the research

The aim of this study is to discuss the definition of normal variability, extreme events and natural disasters, and to indicate the possibility of financial support for agricultural producers who are affected by financial losses because of extreme weather events. The analytical part of the article focuses on demonstrating that the widely discussed issue of climate change is confirmed by the available data on this phenomenon.

The study used the method of literature analysis and quantitative analysis, which enabled the construction of diagrams and charts on the number of natural disasters and their victims, as well as the distribution of phenomena according to the number of victims. Using the data collected in The International Disaster Database (EM-DAT) made it possible to build charts presenting the volume and results of natural disasters occurring in the world since 1900.

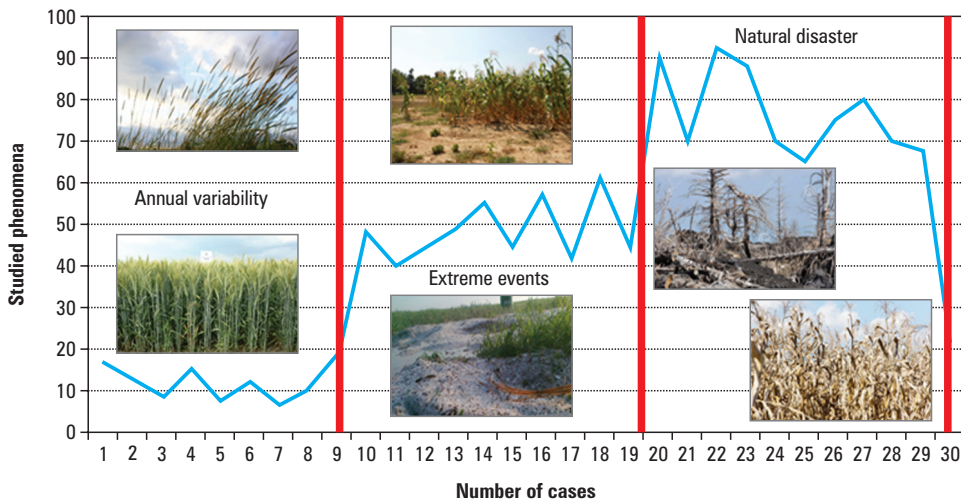
3. Presentation and discussion of results

3.1. Definition of terms

In a study of natural phenomena occurring in rural areas, we should distinguish between natural variability, extreme events and natural disasters. In every agricultural production carried out within rural areas there is a degree of natural variability. It depends on natural variability of precipitation, air temperature and winds, the variability in the occurrence of plant diseases and pests in a given year, the quantity and quality of the work in the field, the quality and quantity of fertilizers and plant protection products used on the farm, and so forth. All these elements influence the fact that agricultural production runs a variable course; it varies from one year to the next.

Extreme phenomena, events and processes were defined by Zwoliński [2008], among other authors. An extreme event is an extraordinary empirical fact of reality, subject to observations using available methods and means. According to Niedźwiedź et al. [2004], the uniqueness of an extreme phenomenon refers to such concepts as the absolute extremes (the highest or the lowest value, which had been noted to date in relation to the characteristics of the phenomenon); extreme events (phenomena or values close to absolute extremes of the given characteristics, for instance climatic, hydrological, or geomorphological, where the probability of exceeding these values is less than 10%, which means the chance of their occurrence is once every 10 years); unique extreme events (phenomena or values close to absolute extremes of the given characteristics, where the probability of exceeding that value is less than 1%, which means that the chance of their occurrence is once every 100 years); and natural disasters (natural or man-made disasters, due to human interference, which occur randomly and cause a major destruction, including sometimes numerous deaths). An extreme event is such that can be placed in space, by quoting four dimensions: three dimensions defining location and time; while the extreme process is a directed chain of specific changes, consecutive in space and causally related, processing the input state into the output state through the developmental stages of extreme events.

According to Anderson [1990] a natural disaster is a temporary event caused by natural hazards that overwhelm local response capabilities and seriously affect the social and economic development of the region. On the other hand, Susman et al. [1983] describe disasters as phenomena linked with extreme environmental conditions and their impact on the human population, while Burton et al. [1993] assume that disasters result from the interaction of the physical effects on the space, the human impact on the environment, and the vulnerability of space and the environment in a variety of events. In turn, the International Disaster Database (EM-DAT) defines extreme events as such that overwhelm local capacity, forcing assistance at national or international level, are unpredictable, and generate destruction and injure people [Kocur-Bera 2015]. The International Disaster Database qualifies extreme events according to the following criteria (1) 10 or more people killed; (2) 100 or more people affected; (3) causing the intervention of the state; (4) causing the affected country to ask for international aid. Figure 1 positions extreme events between natural variability in manufacturing and natural disasters.

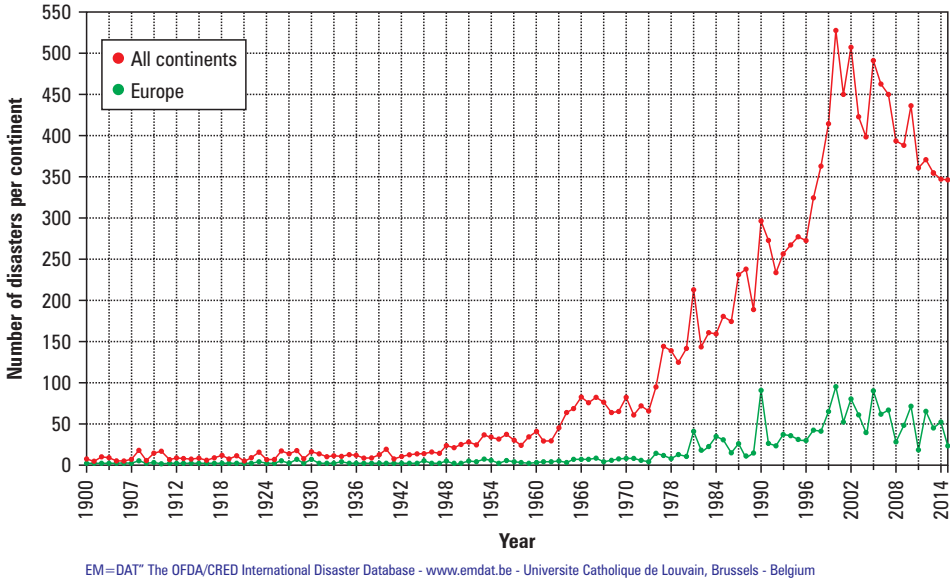


Source: author's study

Fig. 1. Positioning of extreme events and natural disasters in the production variability

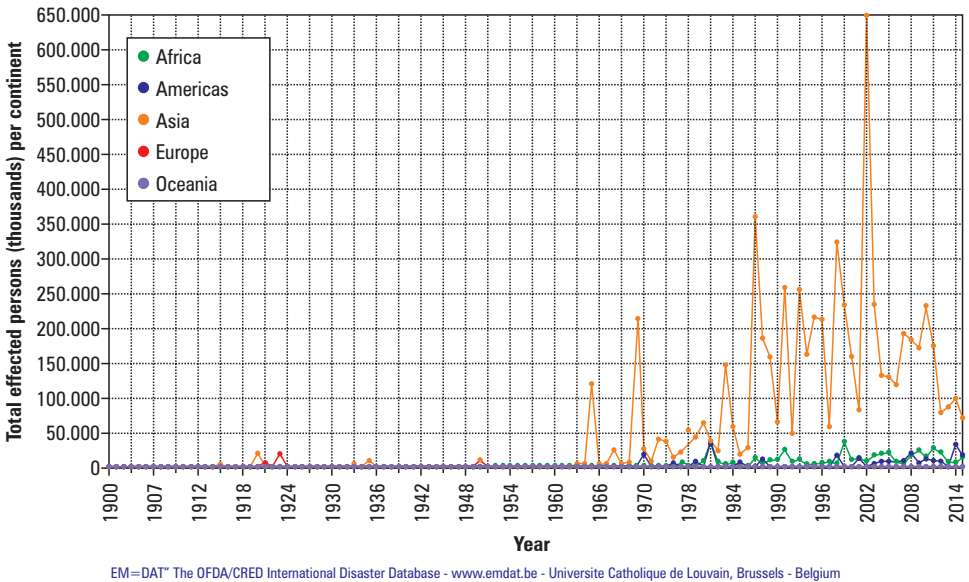
3.2. Statistics confirming the changes taking place

The literature deals extensively with reports about the changes. A database of information was built regarding the number of natural disasters, which occurred in the years 1900–2015. The International Disaster Database collects the data on persons injured and killed, on the number of events, and the size of the losses resulting from natural disasters around the world. Figure 2 shows the number of natural disasters in the world in relation to those in Europe. We note a substantial increase in natural disasters, particularly in relation to the last two decades. This increase is associated with climate change, but it also depends on the development of infrastructure.



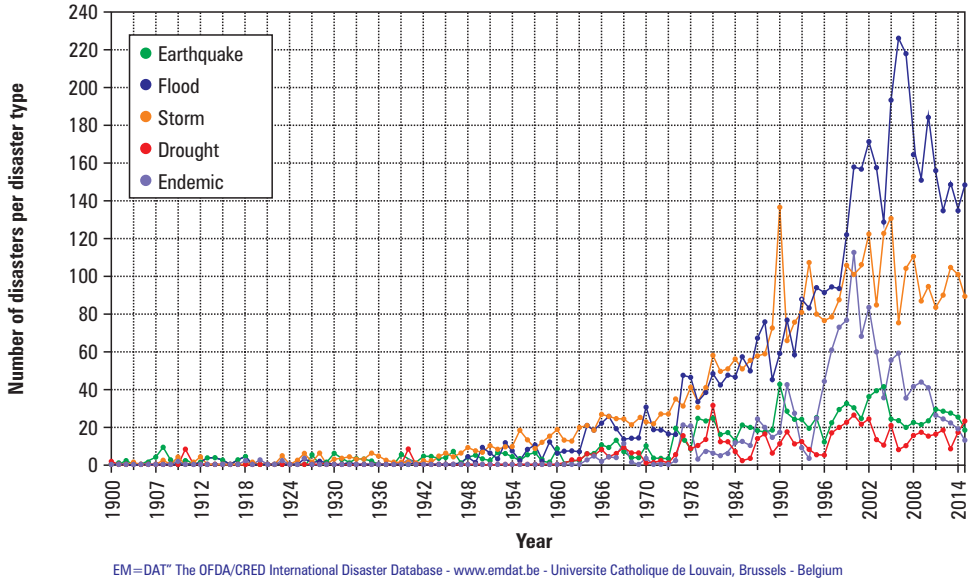
Source: author's study based on EM-DAT

Fig. 2. Number of natural disasters between 1900–2014, in the world and in Europe



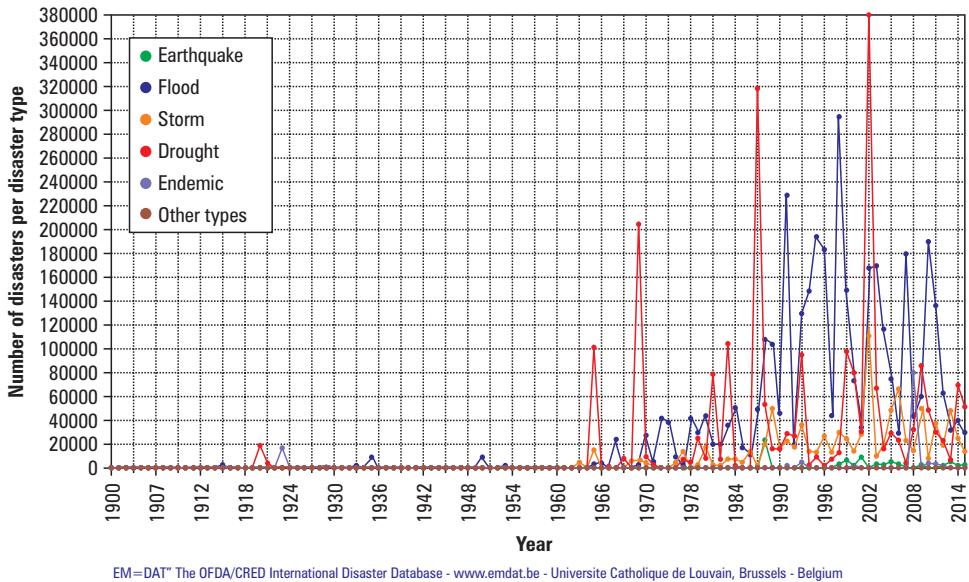
Source: author's study based on EM-DAT

Fig. 3. Number of persons injured as a result of natural disasters between 1900–2014 according to continent



Source: author’s study based on EM-DAT

Fig. 4. Number of natural disasters in the world between 1900–2014 according to type of event



Source: author’s study based on EM-DAT

Fig. 5. Number of persons injured as a result of natural disasters between 1900–2014 according to type of event

Figure 3 shows the number of victims of natural disasters on various continents. Asia is in the lead: in the last four decades, the Asian continent has seen a significant increase in the number of victims as a result of natural disasters.

Figure 4 contains the number of events divided by type. Over the last century, floods and storms (hurricanes) were the events that occurred the most often. Also, a significant increase was noted in the number of epidemic outbreaks, while droughts and earthquakes were noted in the lowest number, according to the present analysis. The number of events is not the only guideline; in fact, the scale of the phenomenon that occurs, and the number of people affected by the occurrence of such an event, are of a greater importance.

Figure 5 demonstrates the number of persons affected, depending on the type of event. Droughts and floods generate the greatest number of victims. Drought is a phenomenon that has the greatest devastation impact in the poorest countries. The population in these countries live mainly on the products they grow themselves; therefore in the absence of rainfall, the whole societies are deprived of their basic sustenance.

The phenomenon of flooding tends to generate the highest number of victims. Processes of urbanization and changes in the structure of the agricultural landscape and forestry are responsible for this, as they result in the reduction of natural water retention and contribute to increasing the likelihood of floods. The phenomenon of urban flooding and local flooding is also caused by increased levels of sealed land, while maintaining the traditional collective systems for rainwater discharge [Romanowicz et al. 2014]. In Poland, the reasons for this, according to Kindler and others [2014], include shortcomings in the exercise of the authority by the Water Management Organisational Units, anachronistic treatment of tasks and objectives of water management, faulty legal provisions related to water management, and poor organization of water management system.

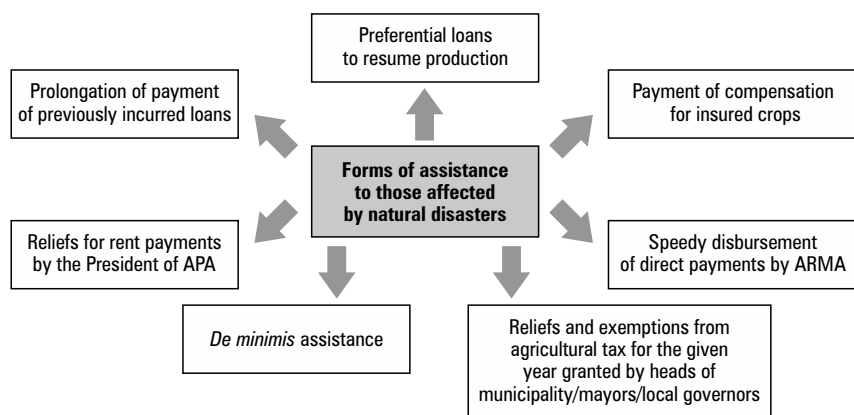
3.3. Options for the support of agricultural producers following the occurrence of extreme events

The most affected sectors of the economy are those whose income level is determined by the natural weather conditions. These include agricultural production, in particular plant-based. Within the current legal framework, the following forms of assistance are distinguished, and may be available to persons who suffered in connection with natural disasters:

- Granting preferential loans to resume production on farms and special sectors of agricultural production that have experienced damage caused by drought, hail, torrential rain, the negative effects of winter, spring frosts, flood, hurricane, lightning, landslide or an avalanche – on the basis of the ruling by the Polish Council of Ministers of 22 January 2009 on the implementation of certain tasks ARIMR [Rozporządzenie... 2009].
- Extension of the repayment period of loans contracted earlier, in order to resume production on farms and special sectors of agricultural production affected by natu-

ral disasters, and prolongation of the repayments of loans and preferential interest disaster and investment loans within the credit period set for a given line of credit.

- Payment of the part of compensation to agricultural producers under the Law of 7 July 2005 on the insurance of agricultural crops and livestock [Ustawa z dnia 7 lipca 2005 roku o ubezpieczeniach upraw rolnych i zwierząt gospodarskich, Dz. U. Nr 150, poz. 1249 z późn. zm.].
- Assistance by the President of the Agricultural Social Insurance Fund, at the request of the individual injured farmer, in the payment of current contributions for social insurance and regulation of arrears on this account in the form of a deferment period for payment of contributions and subdividing them into convenient instalments. Injured farmers can also apply for modification to the existing terms for the repayment of debt. It is possible to offer redemption in whole or in part of current contributions.



Source: author's study

Fig. 6. Forms of assistance to persons injured as a result of natural disasters

- Application by the President of the Agricultural Property Agency (APA) of the reductions of rent charges brought by farmers whose crops were affected by drought, pursuant to article 700 of the Civil Code.
- Facilitating a speedy disbursement of direct payments by the Agency for Restructuring and Modernisation of Agriculture (ARMA).
- Application by the heads of municipalities, mayors, and/or local governors of reliefs and exemptions from agricultural tax charges for the year, based on the Law of August 29, 1997 on Tax Ordinance [Ustawa z dnia 29 sierpnia 1997 r. ordynacja podatkowa, Dz.U. z 2005 r. Nr 8, poz. 60 z póź. zm.].
- Helping farming families in the form of a lump sum paid to farming household under the Law of 12 March 2004 on social assistance [Ustawa z dnia 12 marca 2004 r.

o pomocy społecznej, Dz.U. z 2008 r. Nr 115, poz. 728 i Nr 171, poz. 1056], upon the estimation of the losses in farms as a result of natural disasters by the committees appointed by provincial governors, depending on the level of these losses and possible budget resources, within the limits permissible by the European Commission Regulation (EC) No 1857/2006 on the amount of State aid to small and medium-sized enterprises active in the production of agricultural products. On this basis, in order to mitigate the effects of natural disasters, the Council of Ministers defines the criteria for social assistance to farms – victims of natural disasters by resolution, creating specific conditions for implementing the aid program for farming families.

4. Conclusions

Climate change, as seen from the statistics included herein, is a fact. Poland joined the program to address climate change. However, we need to take into account that the existence and the effects of all natural events stem not only from the forces of nature. They are also heavily influenced by man – both in terms of human activities, which are secondary causes of climate change, but also in terms of defective functioning of the bodies and agencies responsible for spatial management. Measures introduced to support agricultural producers are necessary, however it is also advisable to increase the knowledge about the climate change and its effects, and to educate towards possible ways of preventing them. Mitigation and adaptation actions constitute one of the ways in which we can strive to limit the effects of climate change.

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