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A Comparative Analysis Of Initiatives And Adaptation Measures To Climate Change Undertaken In Poland And Western Europe

Abstract

Climate change is one of the greatest contemporary threats to our planet's environmental, social and economic well-being, accompanied by major changes in life support systems on Earth, where the far-reaching effects will be felt in the coming decades. The Earth's climate is warming rapidly due to emissions of greenhouse gases caused by human activities such as burning fossil fuels and deforestation.

The Stern Report predicts that in the long term, climate change could cut global gross domestic product (GDP) by 5 to 20% or more each year if it is not brought under control by reducing greenhouse gas emissions.

The purpose of this paper is to compare the degree of influence of climate change on the economies of Western Europe and comparing national strategies for adaptation to climate change in selected countries of Western Europe and Poland.

The analysis of the main initiatives for adaptation to climate change in selected countries of Western Europe and Poland relate to key issues mentioned in the strategic documents of the European Commission. In the United Kingdom the main emphasis is on the reduction of greenhouse gases as a form of preventive action, rather than adaptation to climate change. All strategies recognize the importance of raising public awareness about the negative effects of climate change and the importance of preparing adaptation measures, and stress the need to support the critical and most sensitive sectors of the European economy – forestry, agriculture and fisheries. The Polish strategy of adaptation to climate change does not deviate from the strategy of these countries of

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Western Europe, but it must be emphasized that this is only a document listing recommendations on the scope of operations of adaptation to climate change. Its realization is a separate issue.

Keywords: *climate change, forecasts and costs of climate change, adaptation to climate change*

1. Introduction

The impact of extreme weather and climate on people, property and the environment causes direct harm. Such damage may be related to loss of health and human lives, destruction of the technical infrastructure, the loss of livestock and crops and destruction of ecosystems. Indirect damages are in turn the result of the long-term consequences of extreme weather and climate conditions and cover an area much larger than the directly affected phenomena. This includes, among other things, losses of business profits caused by traffic problems, reduced production entailing loss of competitiveness in selected industries or reduced the demand on the market affected by damage caused (Ministry of the Environment, 2013, p. 13).

Climate change is one of the greatest contemporary threats to our planet's environmental, social and economic well-being, and is accompanied by major changes in life support systems on Earth, with far-reaching effects that will be felt over the coming decades. The Earth's climate is warming rapidly due to emissions of greenhouse gases caused by human activities such as burning fossil fuels and deforestation. Since 1850, the average surface temperature has increased by 0.76 C, with the majority of the increase occurring in the last half century (EC, 2008/2, p. 4).

Across the European continent extreme temperatures have been recorded in recent years. More and more frequent heat waves hit some areas of Europe in the summers of 2003, 2006 and 2007, with record temperatures far exceeding the average. For example, in July and August 2007 parts of south-eastern Europe recorded a temperature of 46° C, which resulted in hundreds of deaths and forest fires and contributed to a decline in agricultural production. Meanwhile, some areas of the UK have been affected by the worst floods in 60 years, which have caused several deaths, losses in the billions of pounds, and the interruption of water supply (EC, 2008/2, p. 11).

The Stern Report predicts that in the long term, climate change could cut global gross domestic product (GDP) by 5 to 20% or more each year if it is not brought under control by reducing greenhouse gas emissions (EC, 2009, p. 7).

The purpose of this paper is to compare the degree of influence of climate change on the economies of Western Europe and compare national strategies for adaptation to climate change in selected countries of Western Europe and Poland (Bogan, English 2010, pp. 13–14).

2. Benchmarking Research

In order to compare the degree of influence of climate change on the economy of individual countries and determine how the countries of Western Europe's strategy for adaptation to climate change compares to Poland, a benchmarking study was carried out.

Benchmarking is a management method that can be defined as a creative comparison with the best practices. This method involves learning from leaders in the field of best practices, not with the aim of copying ready-made solutions, but in order to imitate and improve on ways to handle them. The idea behind benchmarking is the search for ideas outside the main area of business and setting standards for their organizations through creative imitation.

In the comparative analysis presented below, benchmarking was conducted using the following steps: determining the purpose of benchmarking, selecting the size of the comparative benchmarking, data collection about the effects of climate change, analysis of data.

The study compared the following data across countries: forecasts of temperature changes during the period from 2071 to 2100; forecasts of changes in rainfall; distribution of loss-producing extreme natural events in Europe during 1980–2010; number of loss events during 1980–2010; overall losses / losses insured, in billion Euro, 1980–2010; the most frequent extreme weather events; the estimated annual impact of climate change on GDP by 208 and the expected annual decline in prosperity by 2080; the estimated changes in agricultural crops caused by climate change by 2080; the climate change vulnerability index; national initiatives for adaptation measures to climate change; and available financial protection.

The data collection process began with a benchmarking analysis of secondary sources, which include, among others, Polish and foreign publications, reports, materials, and websites. The collected data are presented in Table 1.1.

Tab. 1.1. Benchmarking Research bench

Size comparative	Poland	France	Germany	Spain	United Kingdom/ Ireland
Forecast of temperature changes during the period from 2071 to 2100 (PESETA, http://peseta.jrc.es)	Increase of 3.5–4 ° C	Increase of 3–3.5 ° C	Increase of 3–4 ° C	Increase of 4–5.5 ° C	Increase of 2–2.5 ° C
Forecast of changes in rainfall	An increase of 10%	Rainfall will not change in most parts of the country, with the exception of a 15% decrease in the southern part	Increase of 5–10%	Decrease of 20–40%	Rainfall will not change
Distribution of loss-producing natural extreme events in Europe 1980–2010 (Norwegian Meteorological Institute, 2013, p. 80)	Floods from 1997 led to 1956 casualties and material losses estimated at about 12 billion PLN(approx. 4 billion. Dollars.) Flood losses in 2010 exceeded 12 billion PLN (Approx. 4 billion. Dollars.) On relief for the victims handed over more than 850 million PLN. (http://www.imgw.pl)	Winter storm Lothar 1999 – Overall losses 11.5 billion dol. Insured losses: 5.9 billion dol. Winter storm Xynthia, storm surge 2010, Overall losses 6.1 billion dol. Insured losses 3.1 billion dol.	Winter storm Kyrill 2007 – Overall losses 10 billion dol. Insured losses: 5.8 billion dol.	1983 flood produced overall losses of 2 764–8 623 million dol.	1990 winter storm Daria caused overall losses of 6.85 billion dol. Insured losses: 5.1 billion dol. 2007 floods caused overall losses of 8 billion dol. Insured losses: 6 billion dol.
Number of loss events 1980–2010 (Norwegian Meteorological Institute, 2013, p 83)	About 34	410	420	300	400

Overall losses, / losses insured, in billion Euro 1980–2010 (Norwegian Meteorological Institute, 2013, p 83)	Total losses caused by adverse weather events in Poland in 2001–2011 Amounted to about 90 billion PLN(about 30 million dollars.)	55/25	68/29	34/4	55/34
The most frequent extreme weather events	Drought, flood, high winds	Southern France-drought. Northern France-flood	Drought, hail	Drought	Flood
The estimated annual impact of climate change on GDP by 2080 (Ciscarand others, 2011, p. 2681)	Loss of approx. EUR 12 million (the maximum estimated value of EUR 25 million)	Loss of approx. EUR 4 million (the maximum estimated value of EUR 9 million)	Loss of approx. EUR 12 million (the maximum estimated value of EUR 25 million)	Loss of approx. EUR 9 million (the maximum estimated value of EUR 42 million)	Loss of approx. EUR 4 million (the maximum estimated value of EUR 8 million)
The expected annual decline in prosperity by 2080 (Ciscarand others, 2011, p. 2682)	A decrease of approx. 0.45% (maximum estimated value: a decrease of 0.7%)	A decrease of approx. 0.4% (maximum estimated value: a decrease of 0.6%)	A decrease of approx. 0.45% (maximum estimated value: a decrease of 0.7%)	A decrease of approx. 0.35% (maximum estimated value: a decrease of 1.7%)	A decrease ofapprox.0.25% (maximum estimated value: a decrease of 1.3%)
The estimated changes in agricultural crop output caused by climate change by 2080[29] (EC, 2009, p.18)	Northern region: drop of 5%. Polish central region: drop of 5–10%. South-western Region: a drop of 10–15% South-West growth of 10–15%.	Western part of the country: a drop of 15–30%. Northeastern Region: a drop of 5–10% Southeastern region: at growth of5-30%.	Northern region: an increase of 10% Central Region: a drop of 5–10% Southern Region: a drop of 10-30%.	Except for the extreme south-west region across the country a drop of 15–30% An extreme south-western region of growth of 5-30%.	Northern region: an increase of 15–30% Central Region: an increase of 5–10% Extreme southern region: a drop of 5–15%.
Climate change vulnerability index (EC, 2009, p. 24)	0.21–0.37	0.21–0.37	0.19–0.3	above 0.52	0.21–0.37

[29] Data using from ECHAM4/RCA3 climate mode.

National initiatives for adaptation measures to climate change	Strategic Plan for Adaptation of sectors and areas vulnerable to climate change by 2020 looping forward to 2030 (Strategiczny Plan Adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020-SPA2020, Ministry of Environment)	-National Adaptation Strategy (NAS 2006), – Action Plans (NAP2011).	The German Strategy for Adaptation to Climate Change (Deutsche Anpassungs Strategie DAS)	Plan Nacional de Adaptaciónal Cambio Climático, PNACC (National Plan for Adaptation to Climate Change)	The United Kingdom's Climate Change Programme
Available financial protection (Łozowski, Obstawski, 2009, pp. 192–193)	Compulsory insurance in agriculture. Government finances 50% of the purchase of crop insurance.	French insurers insure crops only against hail (corn and sunflower also against hurricane). In case of a natural disaster in order to receive assistance it is necessary to have comprehensive property and crop insurance and the minimum loss of a particular crop must be 27%, and 14% for the whole farm. Government finances 50% of the purchase of crop insurance.	Hail insurance or single-products insurance. There is no public support for insurance.	Under the system, farmers can insure approx. 30 different crops from the risk of hurricane, hail, frost, torrential rain, drought, fire, disease and pests. The state budget provides subsidies depending on the insured crop, region and scope of risks, ranging from 20 to 55% of the insurance premium	Hail insurance or single-products insurance. There is no public support for insurance.

Source: Author’s own compilation based on the source given in each particular column.

3. Conclusions from the benchmarking study

In the last century the average air temperature at the earth's surface has risen by 0.74 C, and continues to increase. In the years 2071 until 2100 a further increase in temperatures in the analyzed countries is expected, with the smallest increase recorded in the UK, where there is a stable situation in terms of rain. Spain most felt the change of weather – with a temperature rise of 5.5° C, and it is the only country among the analyzed which recorded a drop in rainfall of up to 40%.The European economies have been confronted with a natural total economic catastrophe loss burden of € 415 billion (in 2010 values). The most costly perils have been storms and floods. Storms and floods each accounted for 35% of all direct economic losses, the equivalent of € 145 billion each. The insured losses for all types of hazards amounted € 130 billion, mainly consisting of insurance coverage for storms, which accounted for roughly two-thirds of this total, i.e. € 82 billion.

While the available reports indicate that Poland was the region with the smallest number of extreme weather events, it should be taken into account that in Poland reporting systems began to develop much later than in Western European countries, and these systems are still vague and inconsistent. In the period 1980–2010, Germany was the country with the highest number of weather anomalies (455 events), and the biggest losses caused by weather events (68 trillion dollars). France and the United Kingdom recorded the same level of losses (about 55 trillion dollars), followed by Spain (33 trillion dollars) and finally Poland. The 30 million dollar amount in the case of Poland may be underestimated, since it concerns a shorter period. In Poland there is no reliable data on the amount of paid insurance following a disaster. In the case of the other Member the highest percentage of insurance paid in relation to the losses occurred was in the UK (61.8% of incurred losses were offset by insurance), then sequentially France (45.5%), Germany (42.6%) and Spain (12%). France recorded the largest losses caused by a single extreme weather phenomenon, which amounted to 11.5 trillion dollars, of which more than half was compensated by insurance. The lowest losses were recorded in Poland and Spain.

The largest increase in the frequency of weather-related loss events since 1980 occurred in Germany, with a 200% increase in the number of such events. The second largest increase was in Spain, 120%, while the increased occurrences in France and the United Kingdom (both 30%) were comparatively low (Norwegian Meteorological Institute, 2013, p. 84.).

The most frequent extreme weather phenomenon in the analyzed countries was drought. Only the UK was the not exposed; however the UK is exposed to occurrences of flooding.

In Poland, the problem of flooding affects all sectors of the economy, and especially the existing infrastructure in areas at risk of flooding. Floods occur each year and cause losses at an average level of 0.08–0.1% of GDP. Once every dozen or so years, however, there are major flood disasters causing above-average losses. Within the analyzed period these were the floods of 2001 and 2010, resulting in destruction valued respectively at 0.5 and 0.9% of GDP. Next to flooding, significant damage to the economy was also caused by drought and strong winds and hurricanes. In 2006 there was a significant loss of yield because of a severe frost and a subsequent drought (including hydrological), followed by heavy rains. During this time the estimated agricultural losses were several times higher than the losses in the sector caused by flood in 2010. In 2001, the flooding which took place on Polish territory caused about 3.6 billion PLN in losses (in 2010 prices).

Depending on the severity of climate change, the greatest losses caused by extreme weather events are likely to be recorded in Poland and Germany (from 12 to 25 million per year by 2080), although Spain can lose the most (up to 42 million per year) if carbon dioxide emissions remain unchanged and if the darkest scenarios for the rise in temperatures take place. The smallest losses should occur in France and the UK. For the whole of the European Union losses are estimated at 22 million euros a year based on a moderate climate change scenario, but if adaptation measures are not taken, this loss could be as high as 68–70 million per year (Ciscar J and others 2011, p. 2683). Differences in the declines in GDP and overall prosperity depend on the extent of the impact of climate change on the agricultural sector. In analyzing Europe as a whole, overall agricultural productivity is expected to decline in the new climate realities. In the analysis of individual regions one can note some projected positive effects of climate change on agricultural production in some regions due to, *inter alia*, the possibility of planting crops that were not possible in the earlier weather conditions (such a situation will take place mainly in Northern Europe). This is confirmed by data on the estimated return on crops caused by climate change by 2080. In all the countries analyzed in the southern parts of Europe less efficient agriculture is expected, with the largest declines occurring in Spain. Climate change will affect agriculture positively only in the northern and central parts of the UK.

The impact of climate change on European regions is presented in the form of a synthetic index. The climate change index combines information on vulnerability to drought, populations affected by river flooding and exposed to coastal erosion, and the exposure to climate change of the agriculture, fisheries and tourism sectors. The index shows an asymmetric core/periphery pattern for the EU More than one third of the EU population lives in those regions most affected by climate change, i.e. a total population of about 170 million. The regions under the highest pressure are generally located in the south and east of Europe,

including the whole of Spain, Italy, Greece, Bulgaria, Cyprus, Malta and Hungary, as well as most of Romania and the southern parts of France. This is due mostly to changes in precipitation and an increase in temperature, which will have an impact on vulnerable economic sectors, with river flooding also contributing to the overall effect in Hungary and Romania. Limited impacts will be recorded for Northern and Western Europe, apart from the lowland coastal regions around the North and Baltic Seas, which have a high exposure to coastal erosion resulting from extreme weather events. In some cases severe impacts will be felt in regions with a low GDP per capita and therefore a lower capacity for adaptation to climate change (EC, 2009, p. 24).

Spain began developing a National Plan for Adaptation to Climate Change (Plan Nacional de adaptación al Cambio Climático, PNACC) in February 2006. This plan aims to support the coordination of governmental bodies in the assessment of environmental impacts, vulnerability and adaptation to climate change in Spain. In order to submit a plan for approval by the relevant authorities, this Plan underwent a process of public consultation, during which both government organizations, NGOs, and representatives of social movements could provide their comments and suggestions as to its content. These comments resulted in the introduction of more than 50 changes in the content of the final PNACC.

The entire plan is presented clearly and legibly in a brochure, available in Spanish and English on the website of the Ministry of Environment and Rural and Marine Areas (Ministerio de Medio Ambiente y Medio Rural y Marino). It explains what adaptation to climate change is and how climate change may affect 15 sectors/systems and the accompanying ecological, economic and social changes in Spain (biodiversity, water resources, forests, agriculture, coastal, hunting and inland fishing, mountain areas, soil, fisheries and marine ecosystems, transportation, human health, industry and energy, tourism, finance-insurance, urban planning and construction).

On its website the Ministry of Spain proposes six different educational programs, including green house holding for families who want to lead more environmentally friendly lifestyles, or Kyoto teaching, aimed at students and teachers.

The aims of the United Kingdom's 2000 Climate Change Programme are not only to cut all greenhouse gas emissions by the agreed-upon 12.5% (from 1990 levels) in the period 2008 to 2012 (the international Kyoto commitment), but to go beyond this by cutting carbon dioxide emissions by 20% from 1990 levels by 2010. The stated strategies of the 2000 programme were to improve business's use of energy, stimulate investment and cut costs, stimulate new, more efficient sources of power generation, cut emissions in the transport sector, promote better energy efficiency in the domestic sector (saving households money), improve the energy efficiency requirements of building regulations, continue cutting emissions

from agriculture, and ensure that the public sector took a leading role (http:// chronmyklimat.pl/wiadomosci/jak_hiszpanie _adaptuja_sie_do_zmian_ klimatu_).

The United Kingdom also has the following programmes (https://www. gov.uk/government/policies/climate-change-adaptation): climate Change Act 2008, renewables Obligation, housing and community grants, CRC Energy Efficiency Scheme, the Green Deal, and Electricity Market Reform

The objectives of the German Adaptation Action Plan (DAS) are to promote the concrete application of the DAS, specify priority activities for the Federal Government in the field of adaptation to the impacts of climate change – including activities undertaken in cooperation with other actors – and lay down future steps for the further development and implementation of the DAS. The Action Plan therefore also takes into account the fact that the current and potential impacts on the individual fields of action and sectors are depicted in different forms and the fact that there are disparities between the growing amount of knowledge available and the subjective perception of the significance of 'adaptation', which are advancing at different speeds. The conception for the Action Plan is oriented towards the objectives specified in the DAS: mitigating the vulnerability of natural, social and economic systems to the impacts of climate change, while at the same time increasing the adaptability of these systems and enhancing the exploitation of possible opportunities. In this regard, one essential objective of the Action Plan is to reinforce the actors' capacity for action at all relevant levels and their ability to provide for themselves – often designated as 'adaptive capacity' (http://climate-adapt.eea.europa.eu/countries/ germany).

In France, a national adaptation strategy (NAS) was adopted in 2006. Regional impacts, vulnerability, and adaptation studies were carried out to implement sub-national adaptation planning policies (The Regional Climate, Air and Energy Schemes process). The French Environment and Energy Management Agency (ADEME) supports local initiatives through training and on-line tools, in particular at the regional level. A wiki-based local adaptation initiative provides mapping, albeit not extensive, and collects some experiences.

The NAP has prioritized 240 concrete measures covering the twenty thematic areas of the plan: Cross-cutting actions, Health, including "Plan Canicule", Water, Biodiversity, Natural hazards, Agriculture, Forests, Fisheries and aquaculture, Energy and industry, Transport infrastructures, Urban planning and the building environment, Tourism, Information, Education and training, Research, Funding and insurance, Coastlines, Mountains, European and international actions, and Governance. At the regional level, all the 26 (One per Region) SRCAEs, (Regional Scheme(s) on Climate, Air and Energy) have been approved. They include mitigation, air and adaptation actions, and other measures. The type of adaptation

measures depend on the region. At a more local level, the SRCAE are translated into local (Cities or Inter-municipality associations) plans (PCET: Climate Plan on Energy and Territory) or Urban plans (PLU Local Urbanization Plans). The number of envisioned plans numbers over 400. These plans should have coherency with SRCAEs and the national plans and strategies on mitigation and adaptation.

4. The programs of adaptation to climate change in Poland

The basics for creating a strategy for adaptation in Poland result from the position of the Government adopted on 19 March 2010 by the European Committee of Ministers of the Council, as the fulfillment of the provisions of the strategic document of the European Commission [COM (2009) 147] White Book on Adaptation to climate change. The Government created the basis to launch, in 2011–2013, the project "Development and implementation of a strategic plan to adapt sectors and areas vulnerable to climate change" with the acronym KLIMADA. The results of this project were the basis for the preparation of the Strategic Plan for Adaptation 2020 (with the prospect of 2030) (SPA 2020). The main objective of SPA 2020 is to ensure sustainable development and the efficient functioning of the economy and society in terms of climate change. This objective also consists of sub-goals, such as (Ministry of the Environment, 2013, pp. 36–48):

Objective 1. Ensuring energy security and good environmental status. (Including: adjusting the water sector to climate change; coastal zone adaptation to climate change; to adapt the energy sector to climate change; protecting biodiversity and forest management in the context of climate change; adaptation to climate change in land management and construction; and to ensure an effective health care system in terms of climate change).

Objective 2. Effective adaptation to climate change in rural areas (including the creation of local monitoring and warning systems against threats, creation of organizations, and technical adjustment of agricultural and fisheries to climate change).

Target 3. Development of transport in terms of climate change (including development of design standards which take into account climate change and management of transport routes in terms of climate change).

Objective 4. Ensuring sustainable regional and local development during climate change (including monitoring for environmental and early warning systems and responses in the context of climate change, and urban spatial policy taking into account climate change).

Objective 5. To stimulate innovation and promote adaptation to climate change (including the promotion of innovation at the organizational level and management actions to adapt to climate change, and building a system of support for Polish innovative technologies on adaptation to climate change).

Target 6. Shaping social attitudes conducive to adaptation to climate change (including: increased awareness of the risks associated with extreme events and methods to reduce their impact; and the protection of vulnerable groups from the effects of adverse weather conditions).

Other research projects implemented in Poland in Framework Programmes or EU Operational Programmes include (http://klimada.mos.gov.pl/zmiany-klimatu-w-polsce/projekty-badawcze):

- Developing Policies & Adaptation Strategies to Climate Change in the Baltic Sea Region (ASTRA), Gdynia Polish Geological Institute (2006–2007);
- Global Climate Change's Impact on Building Heritage and Cultural Landscapes (NOAH ARK), Institute of Catalysis and Surface Chemistry PAS (2004–2006);
- Central And Eastern Europe Climate Change Impact and Vulnerability Assessment (CECILIA), Warsaw University of Technology (2006–2009),
- Adaptation Of Agriculture in European Regions at Environmental Risk under Climate Change (ADAGIO), Poznan University of Life Sciences (2007–2009);
- Projection Of cconomic impacts of climate change in sectors of the European Union based on a bottom-up Analysis (PESETA II) (http://peseta.jrc.ec.europa.eu/),
- Innovative Technologies for safer European coasts in a changing climate (THESEUS), IMGW-PIB, IBW PAN (2009–2013),
- Hydrological Cycle in the CADSES area (HYDROCARE), IMGW-PIB (2006–2007),
- The influence of climate change on society, the environment and economy (CLIMATE), IMGW-PIB (2009–2012),
- Adaptive Management of climate-induced changes of habitat diversity in protected areas (HABIT-CHANGE), IEP-NRI, Warsaw Agricultural University, Biebrza National Park (2010–2013);

- Environmental Management Optimization of irrigation with the Combined Use and Integration of High Precision Satellite Data, Advanced Modeling Process Control and Business Innovation (ENORASIS), IUNG-PIB (2012–2014)[1];
- Integrated Water resources and coastal zone management in European lagoons in the context of climate change (Lagoons), IBW PAN (2011–2013) (http:// lagoons.web.ua.pt/);
- Development and application of mitigation and adaptation strategies and Measures for counteracting the global phenomenon of Urban Heat Islands (UHI), IGiPZ Academy of Sciences (2011–2014)[2];
- Assessing the sensitivity of water resources to global change at the regional, national and global Scale – Flood risk on the northern foothills of the Tatra Mountains (FLORIST), (http://www.isrl.poznan.pl/florist);
- The Report: Climate change impacts and adaptation for international transport networks, B. Rymsza IBDiM 2012 UNECE (Economic commission for Europe),
- Project Operational decision supporting platform-dependent state of the atmosphere (PROSE) ICM, Forest Research Institute, the Institute of Horticulture, Institute of Oceanography (2008–2013);
- Towards An Integrated Framework for Climate Impact Assessments for International Market Systems with Long-Term Investments;
- CLIMARK US-European project, the NSF Award CNH 0909378 (http://cherry. cse. msu.edu/index.html);
- Climate Change impact on Hydrological Extremes (China), Institute of Geophysics, (2013–2015).

Adaptive national initiatives include:

- The Program IUNG-PIB, for many years, the task 1.1. Information on the impact of climate change on agriculture and adaptation methods.
- Agricultural Drought Monitoring-System in Poland (SMSR), carried out for the Ministry of Agriculture and Rural Development since 2007, IUNG-PIB.

[1] This project is funded by the EU 7th Framework Programme under the theme Eco-Innovation. The project aims to implement tools based on modern information and communication technologies (ICT) and a decision support system (DSS) for sustainable irrigation of crops. The created system is aimed at determining the need for irrigation of crops based on mathematical models using: assessment of current weather conditions, forecasts on consecutive days, and measurements of soil moisture under cultivation.

[2] The main objective of the project is to develop structure and strategy decision support systems for the integrated management of lagoons on the basis of broad recognition processes occurring on the land-sea boundary, using a common platform of communication science-policy-user.

- Impact of climate change on the quality of public health in different Polish regions and forecast to 2100, OPUS project NCN K Błażejczyk IGiPZ Academy of Sciences (2011–2014).

5. Conclusions

The regions most vulnerable to climate change include Southeastern Europe, the Mediterranean basin, and Central Europe, where both natural systems and economies are influenced by climate change and changes in the use of the earth's surface. In contrast, Northern Europe and some regions of Western Europe can deal with climate change, especially in the area of agriculture.

In Central and Eastern Europe the growth of average annual temperatures is predicted to reach 3 to 4°C above today's level, with increasing amounts of rainfall in the winter, and droughts in the summer. It is expected that agriculture will suffer losses associated with soil erosion, loss of soil organic matter, migration of pests and diseases, and summer droughts and high temperatures. However, it may benefit from an extended growing period. There may be a decrease in the number of deaths from the cold in Poland and Romania, but also an increase the number of deaths caused by heat (EC, 2008/1, p. 13).

The analysis of the main programs of adaptation to climate change in selected countries of Western Europe and Poland shows that they relate to key issues mentioned in the strategic documents of the European Commission, except that in the United Kingdom the main emphasis is on the reduction of greenhouse gases, hence it is conducting preventive action rather than adaptation to climate change. All strategies recognize the importance of raising public awareness about the negative effects of climate change and the importance of creating adaptation measures, and stress the need to support the critical and most sensitive sectors of the European economy – forestry, agriculture and fisheries. The Polish strategy of adaptation to climate change does not deviate from the strategies of these countries of Western Europe, but it must be emphasized that this is evidenced only in documentation listing recommendations on the scope of operations for adaptation to climate change. Their realization is a separate issue.

The significance of the conduct of adaptation actions is reflected in the data. In the case of the Polish Ministry of Environment, it is estimated that the likely consequence of not taking adaptation actions will be a loss of approximately 86 billion PLN per year in 2020, and in the years 2021–2030 may reach up to 120 billion PLN. The costs of inaction are based on an estimate of potential losses associated with climatic events, assuming that no additional prevention and

adaptation measures are taken. Loss as a percentage of GDP generated during the period is expected to also grow slightly as compared to the loss in absolute terms. This is due to the fact that a large part of the increase is due to the losses suffered by richer society, the accumulation of wealth and capital, and the creation of new infrastructure (Ministry of the Environment, 2013, p. 52).

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Streszczenie

ANALIZA PORÓWNAWCZA INICJATYW DZIAŁAŃ ADAPTACYJNYCH DO ZMIAN KLIMATU PODEJMOWANYCH W POLSCE I W PAŃSTWACH EUROPY ZACHODNIEJ

Zmiany klimatu to jedno z największych współczesnych zagrożeń dla naszej planety w wymiarze środowiskowym, społecznym i gospodarczym. Następują wielkie zmiany w systemach podtrzymujących życie na Ziemi, których dalekosiężne skutki odczuwalne będą w nadchodzących dziesięcioleciach. Klimat Ziemi gwałtownie się ociepla w wyniku emisji gazów cieplarnianych spowodowanej działalnością człowieka, taką jak spalanie paliw kopalnych oraz wylesianie.

Raport Sterna przewiduje, że w dłuższej perspektywie zmiany klimatu mogą zmniejszyć globalny produkt krajowy brutto (PKB) o 5 do 20% lub więcej każdego roku, jeśli nie zostaną one poddane kontroli poprzez redukcję emisji gazów cieplarnianych.

Celem niniejszego artykułu jest porównanie stopnia wpływu zmian klimatu na gospodarkę krajów Europy Zachodniej i porównanie krajowych strategii adaptacji do zmian klimatu w wybranych państwach Europy Zachodniej i w Polsce.

Z przeprowadzonej analizy głównych programów adaptacyjnych do zmian klimatu w wybranych Państwach Europy Zachodniej i Polsce wynika, że dotyczą one kwestii kluczowych wymienianych w dokumentach strategicznych Komisji Europejskiej. Jedynie Wielka Brytania główny nacisk kładzie na obniżenie gazów cieplarnianych, czyli prowadzenie działań zapobiegawczych a nie przystosowawczych do zmian klimatu. We wszystkich strategiach podkreśla się istotność podnoszenia świadomości społeczeństwa na temat negatywnych skutków zmian klimatu i istotności prowadzenia działań adaptacyjnych oraz podkreśla się konieczność wsparcia kluczowych i najbardziej wrażliwych sektorów gospodarki europejskiej – leśnictwa, rolnictwa i rybołówstwa. Polska strategia działań adaptacyjnych do zmian klimatu swym poziomem nie odbiega od strategii wymienionych państw Europy Zachodniej, jednak należy podkreślić, że jest to tylko i wyłącznie dokument wymieniający zalecenia co do zakresu prowadzonych działań adaptacyjnych do zmian klimatu, jego realizacja to już odrębna kwestia.

***Słowa kluczowe**: zmiany klimatu, prognozy i koszty zmian klimatu, działania adaptacyjne do zmian klimatu*