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MAP Position Paper

LAND USE & CLIMATE CHANGE

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https://rural-interfaces.eu/maps/poland-zachodniopomorskie/

Summary and key messages

Climate change has become a major environmental and socioeconomic challenge facing current and future agriculture and rural areas. This is due to its negative impacts observed at the national and global levels. Climate change is affecting economy, rural livelihoods and land use. The main effects of climate change in rural areas will be felt through impacts on water supply, food security and agricultural income. Changes in agricultural production, food and non-food crops are anticipated in many regions. Hence, measures taken to minimise the negative effects of climate change have become a priority for farmers, planners, policymakers and researchers in various countries. Taking adaptation measures is considered the most effective way to reduce the negative effects of climate change in agriculture (Kandlikar and Risbey, 2000). Adaptation to climate change is an issue that is receiving a lot of attention in the debate about the future of European agriculture. The idea is that adaptation involves adjusting to current or expected (long-term) climate change and its impacts (IPCC, 2014). Adaptation measures can be taken at different levels, with varying degrees of sustainability, intensity, and innovation (Smit et al., 2000). Thoughtful, robustly implemented adaptation measures are effective coping strategies that can increase the resilience of rural society and manage the inevitable impacts. In the face of the uncertain risks of climate change, it is particularly important to accurately assess vulnerability to climate change and to formulate and adopt effective measures for agriculture and rural areas to cope with climate change. The formulation of reasonable and effective measures to cope with climate change requires not only the support of scientific data, but also full consideration of local natural, economic, and social conditions, considering the local rural community's awareness of and attitudes toward climate change and local traditional coping practices

Multi-Actor Platform (MAP) Zachodniopomorskie focused on the topic of vulnerability and perceptions of climate change and adaptation measures. It took full account of the regional economic and social background and local knowledge, with the aim of deepening the understanding of the vulnerability of rural areas and agriculture to climate change and identifying potential solutions to increase their adaptability and transformability, and through this, build and strengthen their resilience in both the short and long-term. The rationale for this work is the need for up-to-date knowledge based on experience from current needs in order to build resilient rural areas and agriculture in the "new reality." In the context of current threats and uncertainties, identification and proper understanding of their sources, impacts, in various dimensions, and how they may affect rural areas, including agriculture, are necessary precursors for considering appropriate tools and instruments, policies and their objectives, and integration in a comprehensive resilience approach. Meetings and interviews conducted with representatives of farmers, governmental and non-governmental organizations, and scientists addressed the following topics: challenges to agriculture in the last 5 years, the degree of exposure to climate risk, what will be the most important strategies for dealing with climate challenges, what changes are needed to adapt rural areas to changing climate conditions, and what are the biggest constraints to climate change adaptation. The results of our research provide a basis for strengthening ongoing development initiatives to reduce the vulnerability of rural areas and agriculture to crises. Building resilience in rural areas, including agriculture, requires improvements that bring existing development policies beyond their current capabilities.

1. Introduction

MAP Zachodniopomorskie operates in a region located in northwestern Poland, by the Baltic Sea. Agriculture in the Zachodniopomorskie region is one of the main branches of the economy and its position is steadily strengthening. In this region, as in other regions in Poland and around the world, climate change is increasingly being felt. These changes, according to climate scenarios until 2050, will result in an increase in the number of heat days and the intensity of heat waves, as well as an increase in the number of days with high precipitation. The effects of climate change are having a serious impact on infrastructure and related critical systems for residents. As global temperatures rise, we will see increasing flood risks on the one hand, and severe droughts leading to declining groundwater levels on the other. These changes will place a heavy burden on agriculture, which may struggle to maintain production at current levels despite extended crop growing seasons. Invasive species will also grow in importance. Thus, changes in agriculture, which take various forms, are proving important (Development Scenarios of Poland in the 2050 Perspective). Inherent in these changes is adaptation to climate change, which is currently taking place.

This report aims to provide an overview of the objectives and sub-themes discussed by the MAP Zachodniopomorskie and to clarify the relevance of the included themes in relation to the area represented by the MAP.

MAP Zachodniopomorskie analysed key scientific evidence on the following dimensions of climate change and land use:

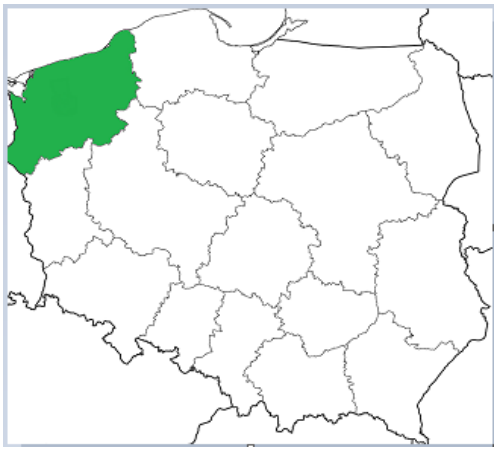
- *Land management practices in the era of climate change.*
- *Needs for adaptation to changing climate conditions.*
- *Constraints to climate change adaptation.*

The key questions raised in the discussions for each dimension were:

1) *What are the key needs and challenges in climate change and land use?*
2) *What are the policy interventions already in place and what are examples of actions taken by local actors to address these needs and challenges?*
3) *What policy interventions (i.e., instruments, measures) are recommended by MAP members for implementation at the local, regional and/or national level? How can the EU support these interventions?*
4) *What are the knowledge gaps and what research projects are needed on climate change and land use?*

The Zachodniopomorskie voivodeship comprises the Territorial Level 2 region (TL2 region), which lies in the northwestern part of Poland along the Baltic Sea coast and borders Germany to the west. It is the fifth-largest region in Poland in terms of size and eleventh in terms of population. Rural areas occupy 94% of the region's area. Clearly lower than in other parts of the country is the share of rural residents in the total population of the region, which is mainly due to the high forest cover and high concentration of rural settlement network.

2. Current situation based on background research and evidence



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The area of Zachodniopomorskie, especially in the coastal belt and its immediate vicinity, is characterised by the best wind conditions in Poland. The region is a national leader in green energy production. The province produces about 5,000 gigawatt-hours of electricity using renewable energy sources. The region also has good conditions for obtaining energy from biomass. The agricultural specialisation of the region and the large number of forested areas clearly show the huge potential of the region in the development of this sector[1]. Analyses carried out by the Institute of Soil Science and Plant Cultivation in Puławy (IUNG) show that 6.5% of agricultural land in the region can be used for energy plantations[2] .

The economy of Zachodniopomorskie is spatially and functionally significantly differentiated. The predominant area of the region is occupied by zones: agricultural economy, agro-forestry economy, and intensive agricultural economy. The region's agriculture is characterised by large area farms, the lowest percentage of people working in agriculture in Poland, a high degree of mechanisation and the best conditions for high-commodity production. Constant changes in the structure of farms led to their average size exceed 32 hectares. This is three times higher average size than the corresponding value for the whole Poland, higher even than the EU average. There is a decline in the number of the smallest farms with an area of up to 1 hectare of farmland and a significant increase in the number of farms with the area of above 100 hectares. Their number already exceeds 1,700, and their size, like nowhere else in Poland, creates opportunities for specialisation, concentration of production, as well as use of economies of scale and production of high income and dissemination of best practices for large-scale farms. The region is characterised by the largest in Poland percentage of area with organic production, characterised by high production profitability, but there is still too little investment in processing[3].

Natural hazards and climate change

There is a high risk of natural hazards in the region that directly affect agricultural operations. These risks include, but are not limited to, heavy rainfall/strong storms, strong winds, and epiphytoses (crop pathogens and diseases). Medium risks, on the other hand, include flooding/natural storms, drought, and heavy snowfall (Regional Emergency Management Plan, 2017). The impact of climate on agriculture is undeniable. The number of days with snow cover in the eastern part of Zachodniopomorskie is almost twice as high as in the western part. This is primarily related to the land elevation. Snow conditions of the coastal belt are influenced by the proximity of the Baltic Sea and winds - especially on the section of the lagoon-spit coast, which

[1] http://eregion.wzp.pl/sites/default/files/programochronysrodowiska.pdf
[2] http://rbgp.pl/wp-content/uploads/2019/03/PUB_2018_BEA_APP_Raport_OZE_w-WZP.pdf
[3] https://bip.rbip.wzp.pl/sites/bip.wzp.pl/files/articles/strategiarozwojuwojewodztwazachodniopomorskiegoost_1.pdf

developed within the former Koszalin Bay. The greatest threat of autumn and spring frosts occurs in the Drawsko Lake District and the Bytów Lake District. In terrain depressions and river valleys, temperature drops below 0°C (at the ground surface) and such conditions can occur in all months of the growing season. In spring, plantations are threatened by insufficient soil moisture throughout the province, and in summer and autumn mainly in the southeastern parts of the region (Spatial Management Plan for the Zachodniopomorskie. Volume I. Conditions for shaping the spatial policy of the region, 2020). The projections carried out show that because of increasing temperatures, the growing season will lengthen. In the 1971-2000 multi-year period, the growing season in Poland lasted 214 days (average for the whole country), while in the 2021-2050 multi-year period it is expected to last 230 days. The difference in length between these periods will therefore be 16 days. As a result, there will be a shift in agro-technical treatments and a change in crop productivity. The growing season starting earlier will increase the risk to crops due to the occurrence of late spring frosts. Territorially, the biggest changes in the growing season will take place in the northern and northwestern parts of Poland. At the same time, as temperatures rise, the threat from crop pests will increase, which, like plants, will respond by accelerating their development and pose a greater threat to crops. The predicted climate change and the associated increase in the frequency and intensity of agricultural droughts will increase the demand for irrigation water. Predictive calculations of soil water shortage values for selected crops show that there is a continuous process of soil drying and an increase in the threat of drought. Geographically, this problem is likely to affect Zachodniopomorskie the most. Yield losses are forecast to increase because of the threat of agricultural drought in 2021-2050.

In addition to drought, intense precipitation also poses a threat to crop production. Due to an increase in the frequency of intense precipitation during the summer, an increase in drainage needs can be expected. An increase in the frequency of years with crop losses resulting from adverse weather patterns in the region should be expected. In terms of livestock production, climate change, and thus an increase in the variability of crop and pasture yields, may cause forage shortages on farms and price increases. An increase in the number of very hot days will increase the risk of heat stress in animals, which could reduce herd productivity. Changing thermal conditions in the growing season as well as in winter conditions may lead to an increase in the incidence of previously less significant disease entities affecting livestock health[4].

Land use trends and tendencies

Over the past decade, there has been a trend of decreasing agricultural land in the region. The area of agricultural land in 2020 compared to 2010 decreased by 2.85% (27254 hectares). During the analysed period, an increase in agricultural land in good agricultural condition (by 5.18%) was noted. Arable land (77.58%) and meadows and permanent pastures (19.60%) accounted for the largest share of agricultural land in the West Pomeranian region in 2020. The area of arable land in 2020 compared to 2010 increased from 692131 hectares to 719999 hectares (4.03%). Meadows, which are characterised by higher productivity and alternate use, and permanent pastures, which generally occupy marginal land - difficult to access and low-quality soils increased by 20.88%. The area of green fodder on arable land increased by 39.46%. This is due to the fact that permanent grassland in recent years has not provided a sufficient base of roughage. It therefore became necessary to intensively use arable land for this purpose. The area of fallow land and perennial crops showed the greatest dynamics of change. The area of fallow land decreased by 50.49%. The share of fallow land in the area of arable land decreased from 3.27% to 1.67%. This is mainly due to the restoration of some land to agricultural use. In turn, the share of perennial crops in the area of agricultural land decreased from 2.93% to 1.53%. The area of perennial crops decreased by 49.19%. The forested area also decreased by 3155 hectares (14.99%). During the analysed period, the area of afforested agricultural land unsuitable for agricultural production and not used for agricultural purposes also decreased by more than 65%. In 2010, the area was 340.7 hectares, while in 2020 it was 117.6 hectares.

[4] https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/Strategiczny_plan_adaptacji_2020.pdf

Zachodniopomorskie, compared to other regions in Poland, is characterised by a large number of certified organic farms. The number of these farms in 2020 compared to 2010 increased by 30.11% and the area of agricultural land used by these farms increased from 61491 hectares to 76490 hectares (24.39%).

The area of agricultural land covered by integrated production methods, which take as their basis the application of sustainable technical and biological progress in cultivation, is negligible. In 2020, there were no farms in the West Pomeranian region whose farmland was covered by integrated production methods. In 2010, the area was 55 hectares. In the region, 463 hectares of agricultural land were excluded for non-agricultural purposes in 2020. This was 76.05% more than in 2010. When analysing changes in the agricultural land, of particular importance are the directions of their exclusion, the loss of which is often irreversible, while reclamation is costly. Agricultural land in 2020 was generally allocated for settlement areas (47.30%), industrial areas (20.51%) and other purposes (21.60%). The trend of directions of agricultural land use for non-agricultural purposes shows that in 2020, compared to 2010, the area of agricultural land allocated to industrial areas and estate land increased more than five times. The area allocated for roads and transportation routes more than doubled.

In Zachodniopomorskie, more than 2,800 hectares are devastated and degraded. Devastated land is land that has completely lost its use value. On the other hand, as degraded land is considered land whose use value has decreased because of the deterioration of natural conditions or as a result of environmental changes and industrial activities, as well as faulty agricultural practices (Mickiewicz et al., 2013). In the structure of land in need of rehabilitation, more than 70% was devastated land. In 2020, compared to 2010, their area decreased by 5.88%. In contrast, the area of degraded land increased by 26.15%. Compared to the area of devastated land, the process of reclaiming and restoring it to agricultural use remained slow. The area of reclaimed land in the analysed period decreased by 32.93%. In 2020, a total of 55 hectares were reclaimed, including 29 hectares for agricultural purposes.

Medium-value soils (classes IVa and IVb), which occupy 50.8% of the area of all arable land, prevail in the region. The second largest group consists of weak and very weak soils (classes V and VI). They occupy 25.1% of the arable land area. The lowest share have good soils (classes II, III a and III b), which occupy 24.1% of the arable land area. The use of low-class land for growing energy crops for the needs of local heating plants and the fuel and energy industry has become popular. The region has favourable conditions and climate for growing crops used for energy production. The region has a favourable size structure of farms (32 hectares on average), allowing the concentration of both perennial energy crops and corn crops used in energy production. The area has sufficient raw material potential for the development of biogas investments from both animal and municipal waste. The use of these raw materials is particularly important for environmental protection and reducing CO2 emissions (Jasiulewicz and Janiszewska, 2012).

3. Position of the Multi-Actor Platform

3.1. Identified needs

MAP Zachodniopomorskie divided the topic into 3 areas and discussed these with researchers, representatives of agricultural institutions, and farmers to identify the needs and challenges encountered in the MAP area.

1) Improving the acquisition and use of climate change information

The first of the topics discussed during the MAP Zachodniopomorskie meetings was aimed at finding out the opinions and state of knowledge of MAP members on climate change. The main objective was to obtain information relating to perceptions of climate change, its effects and actions taken in this regard, in particular to identify preferred directions of communication channels and information needs.

Climate information and support services help society cope with climate variability and change through the transformation of climate related data, together with other relevant information, into customised products such as projections, trends, economic analysis and services to user communities in different sectors (European Commission, 2015).

The MAP members indicated that extreme weather events have been a major challenge for rural areas and agriculture over the past 5 years. They highly rated the risk of drought, wildfires, freeze-outs, and excessive precipitation in the region. They believed responding to climate change is necessary and is the most important issue, especially on farms, as climate change significantly affects farm profitability.

As indicated, climate information is a major component of decision-making related to adaptation. Although a lot of climate data exists, there is a gap between the amount of climate data available and its usefulness. Those taking part in the meeting indicated that access to climate change knowledge is not significantly limited, but they are not satisfied with the quality of this information. In their view, the "fit" of climate change information to the local context is insufficient for them to use it in practice. There is a gap between what is currently there and what is needed.

The following needs in this regard have been identified:

- climate services should focus on **providing information that is relevant to the local context** and offers insights into related management activities, such as relevant tolerance varieties or other inputs for specific climate conditions. In general, this involves climate data that covers the local area at the lowest possible scale, in formats that are easy to understand and incorporate into existing decision-making processes. *"A well-executed climate change forecast for a region is the basis for taking appropriate adaptation measures."*
- **improving the management of climate information distribution**. Climate information is mainly distributed through the public media. Climate information should also be disseminated through awareness-raising programs, such as training courses and community meetings.
- **creation of smart mobile applications** on climate change, designed and dedicated to farmers. Such applications should provide real-time data, but also point to future trends. They can provide farmers with additional information based on which they could make decisions on future adaptation measures.
- **value chain collaboration** involving multiple stakeholders (both public and private, with local and scientific knowledge). This collaboration should be based on fostering linkages and interactions between multiple actors that enable the exchange of acquired knowledge, shared learning and solutions to climate change adaptation and mitigation issues. Sharing information on relevant

regional climate topics can result in the development of solutions that can be applied to specific organisations, structures, and communities.

- **creation of a regional information platform** - an information point where farmers will receive comprehensive environmental and climate information.
- **improving the flow of information through advisory services.**
- **public support in generating and disseminating information**, including creating and improving weather databases and updating agroclimatic risk maps for various crops and regions.
- **greater use of scientific knowledge**, *"scientists are key to providing information, data and knowledge on the challenges and solutions to climate change and land use."*

2) Institutional support for adaptation to a changing climate

The second topic addressed in the meetings of MAP Zachodniopomorskie was aimed at finding out the opinions and state of knowledge of MAP members on climate change adaptation. The main objective was to obtain information relating to identifying effective adaptation measures to adapt to changing climate conditions.

Based on the discussion, it is concluded that changes in land use will be required in rural areas of the region, including adjusting the timing of field operations, proper selection of plants in crop rotation, optimising the use of mineral fertilizers, or replacing crop varieties with more resistant ones. In addition, measures are needed to increase crop irrigation, implement online decision support systems, and increase the scope agricultural advisory services.

Even though the region is a national leader in green energy production, MAP members could not clearly determine whether increasing the acreage of energy crops would be an effective measure to adapt to changing climatic conditions. MAP members pointed out that only a few "gminas" (municipalities) in Zachodniopomorskie are potentially suitable for locating energy crop plantations. Besides, perennial plants with a useful life of 15-20 years are preferred for energy crops, as this reduces the cost of their cultivation. The technical equipment of the farm is also important, as well as the requirements of customers (energy plants) regarding the quality of biomass.

Agricultural advisors play an important role in strengthening adaptation efforts. According to interviewees, *"agricultural advisors are in a prime position to influence farmers. They often interact with farmers and are a trusted source of information," "agricultural advisors are intermediaries of information between science and practice," "the advisor should not only have an educational function, but also and above all an implementation and dissemination function (encouraging the implementation of modern production solutions) and an information function."*

The following needs in this regard have been identified:

- **adaptation of agricultural advisory services on climate change and land use**. In particular, adjusting the offer of advisory services to actual needs and improving the service quality.
- **conducting extensive information and education campaigns and trainings by public institutions** to raise awareness of the validity and necessity of implementing certain adaptation measures in rural areas.
- **increasing environmental education and the use of RES in rural areas**, in particular, conducting trainings, courses and informational meetings for farmers and villagers on the harmonious coexistence with nature, as well as the use of marginal soils (unsuitable for food production) for biomass production, pointing to the improvement of living conditions, including an increase in employment in rural areas, improving labour efficiency in agriculture, or an increase in farmers' income as a result of rising demand and prices for energy.

- **preparation of a guidebook (plan) for adaptation of rural areas and agriculture in Zachodniopomorskie to climate change.**

3) Reducing constraints on the implementation of adaptation measure

The third topic addressed in MAP Zachodniopomorskie meetings was aimed at finding out MAP members' opinions and knowledge of the barriers to implementing adaptation measures in rural areas.

Among the most important barriers limiting adaptation to climate change, MAP members cited:

- limited access to technical and institutional support at the local level,
- uncertainty about risks - there is uncertainty about the scale of climate change, lack of confidence in whether climate change projections are sufficiently reliable,
- lack of sufficient government incentives,
- support from government institutions is inadequate because it does not respond to farmers' needs - much of the financial support offered by governments is considered impractical because the support addresses specific projects rather than overall adaptation goals,
- legislation and policies that do not take climate change into account - the existing legal framework that would support adaptation is not sufficient,
- high transaction costs,
- lack of certainty about the effectiveness of adaptation measures taken - the costs and risks of adaptation may exceed the benefits, uncertainty about success undoubtedly contributes to reluctance to implement innovative solutions,
- limited financial resources.

The following needs in this regard have been identified:

- **developing regional climate change adaptation planning in rural areas.**
- **developing scenarios for climate change and its effects in the region.**
- **creating incentives for farmers to undertaking adaptation measures**- e.g., increasing support for investment in technology and innovation; designing soft loans to facilitate adaptation processes in rural areas (important! the funding provided, however, should be closely managed in conjunction with appropriate adaptation guidelines to avoid inefficiencies resulting from inappropriate use of beneficiaries).
- **increasing the role of the insurance industry in enabling adaptation** - the insurance industry can increase adaptive capacity through the financing it provides after an insured event; appropriately designed insurance products can create incentives to engage in adaptive behaviour.

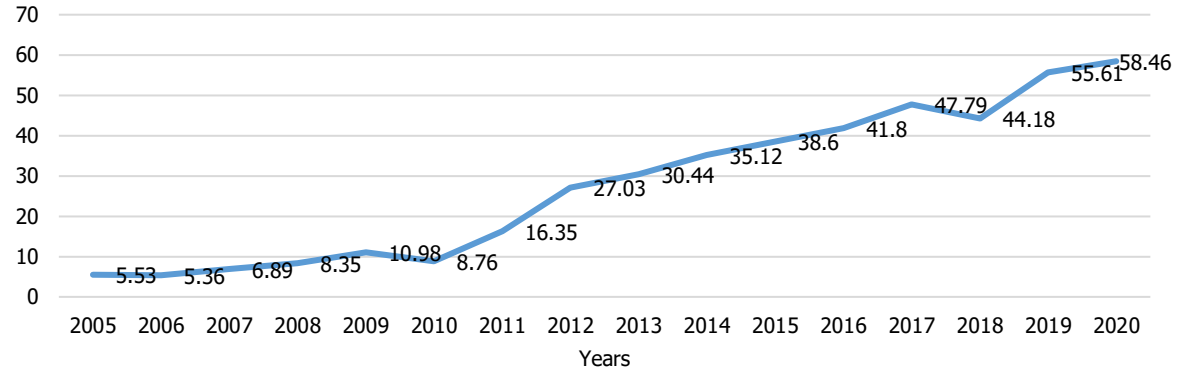
3.2. Existing interventions and actions

In the years 2005-2020 the capacity of wind power in Zachodniopomorskie increased from 56 MW to 1752.68 MW. In this period, the share of energy production from renewable resources increased from 5.5 to 58.5% (Fig. 1). Zachodniopomorskie is a national leader in the development of renewable energy system. In 2020, there were 268 installations producing electricity from renewable energy sources (RES) in the region. Their total installed capacity is 1969 MW, which accounted for 19.8% of RES capacity installed in Poland. Zachodniopomorskie is a national leader in the use of wind energy potential thanks to the fact that its coastal belt and its immediate vicinity have the best wind conditions in Poland. The installed capacity of wind farms

in this region accounts for more than 1/4 of all installed wind power capacity in Poland. In 2020, 5 new wind farms were put into operation with a total capacity of 267.73 MW[5].

In addition, there are 26 biogas facilities in the region, with a total capacity of 19.295 MW producing energy from biogas from wastewater treatment plants, landfill biogas and agricultural biogas. The majority of them - 14 with a total capacity of 13.689 MW - are agricultural biogas plants. Geothermal energy for heat production is used by two plants, and the installed capacity of geothermal exchangers is 13.5 MW. In Zachodniopomorskie region, the installed capacity of small and micro hydroelectric power plants in 2020 was more than 14 MW. In 2020, 31 photovoltaic farms with a total capacity of 27.7 MW were put into operation in the province. The total capacity of photovoltaic installations put into operation in the region in 2020 was 79.4 MW. In 2020, 20 entities applied for the promise of a license or concession for photovoltaic power generation (http://eregion.wzp.pl/obszary/odnawialne-zrodla-energii).

Figure 1. Share of energy production from renewable sources in total energy production in Zachodniopomorskie in the period 2005-2020 in %



Source: Odnawialne źródła energii, Figure 2 retrieved from: http://eregion.wzp.pl/obszary/odnawialne-zrodla-energii

When it comes to energy use, Zachodniopomorskie is also a leader in Poland with 82% of used energy coming from renewable sources. The Polish average is 18.5%[6]. Yet, there is still much potential for growth, especially in using the sun energy. Number of grants awarded in the voivodship under the My Current programme for photovoltaic installation projects per 1,000 inhabitants is, however, the lowest in Poland. The total capacity of these installations per 100 inhabitants is also relatively low (Czerniejewski et al., 2021). In Zachodniopomorskiemust, the development of renewable energy production is to be put in the context of not supportive legal regulations in Poland, especially when it comes to wind installations after 2015, but other regulations also limit the development of renewable energy in Poland (Jastrzębski et al., 2018).

An important part of the Zachodniopomorskie Regional Operational Programme 2014-2020 is low-emissions economy. Yet, within this priority a significant share of support was directed at urban public transport as well as energy efficiency modernisation. However, the highest share of financing for a single measure was planned for the measure 2.10 Increasing the use of renewable energy resources[7].

Among the priorities of the Zachodniopomorskie Regional Operational Programme 2023-2027, there is also the issue of environment and climate changes. The priority 2: Green Zachodniopomorskie includes following specific objectives:

- Specific objective (i) - Supporting energy efficiency and the reduction of greenhouse gas emissions;

[5] http://eregion.wzp.pl/obszary/odnawialne-zrodla-energii
[6] http://eregion.wzp.pl/obszary/odnawialne-zrodla-energii
[7] http://www.rpo.wzp.pl/o-programie/statystyka/osie/dzialania?os_id=359

- Specific objective (ii) - Promoting renewable energy in accordance with Directive (EU) 2018/2001, including the sustainability criteria set out therein;
- Specific objective (iv) - Promoting climate change adaptation and risk prevention to associated with natural disasters and catastrophic events, as well as resilience, taking into account an ecosystem approach;
- Specific objective (v) - Supporting access to water and sustainable water management;
- Specific objective (vi) - Supporting the transformation towards a circular economy and a resource efficient economy;
- Specific objective (vii) –Enhancing the protection and conservation of nature, biodiversity, and green infrastructure, including in urban areas, and to reduce all types of pollution (Pomorze Zachodnie Strategia 2030, 2021).

The Polish CAP Strategic Plan 2023-2027 also envisages measures supporting improvement of land use in relation to the issues of biodiversity and climate changes, including eco-schemes, such as carbon farming or water retention. As the agriculture in Zachodniopomorskie is highly developed, it will surely make use of the support measures offered within the Plan to increase its resilience.

Table 1 – Examples of actions taken by local actors

Support for energy efficiency in the context of the COVID-19 pandemic (within the Zachodniopomorskie Regional Operational Programme 2014-2020)

The subject of the call was the selection for co-financing of projects that will contribute most to the achievement of the specific objective of the measure: Reduced energy intensity of residential buildings and influences the achievement of indicators:

- Decrease in dust emissions [Mg/year],
- Estimated annual decrease in greenhouse gas emissions [tonnes of CO2 equivalent].

Co-financing will be provided for investment projects in the field of energy modernisation of single-family buildings together with replacement of the heat source with a lower emission one.

Source: http://www.rpo.wzp.pl/skorzystaj/nabory/112-wsparcie-efektywnosci-energetycznej-w-kontekscie-pandemii-covid-19

Local Water Partnerships in poviats

The aim of the Local Water Partnerships (LWPs) is to support cooperation and networking between local society and institutions and authorities in the field of water management in rural areas, with a particular focus on agriculture. The initiative to establish water partnerships in poviats was taken by the agricultural advisory centres, within which local water coordinators were appointed.

A Local Water Partnership can be joined by anyone - an entity/person involved in water management in the area. The partnership should include both those implementing and responsible for water management tasks, as well as individuals/organisations interested in efficient water management. Starting with farmers, water companies and agricultural advisors, through local authorities - commune, district, region, together with the services of the State Water Management Authority (Państwowe Gospodarstwo Wodne Wody Polskie), units responsible for environmental issues and experts operating in the field of hydrology or hydro-technology.

The main objective of the LWP is to improve water management in the district by:

- activating local communities and strengthening cooperation between all actors,

- diagnosing the situation with regard to the management of water resources with regard to the needs of agriculture and the inhabitants of rural areas,
- working out common solutions for improving the broadly understood water management in agriculture and rural areas and co-determining what happens in the area,
- giving opinions and working out investment plans related to water from the point of view of safety and needs of inhabitants as well as securing production purposes and environmental protection,
- promoting and educating residents on rational water management.

Source: https://zodr.pl/lpw2020/lpw2020.html

WATERPROTECT (Innovative Tools Enabling Drinking WATER PROTECTion in Rural and Urban Environments)

The aim of this H2020 project was to develop and demonstrate a new way of managing water resources, based on the principle of cooperation and dialogue between stakeholders. The project involves 28 stakeholders from 7 European Union countries - Denmark, Ireland, Spain, Romania, Italy, Belgium and Poland. The project also involves hydrogeologists from the Polish Geological Institute - National Research Institute.

One pilot catchment was selected in each participating country. In Poland, the Gowienica Miedwiańska catchment, located south of Szczecin, was selected for the study. During the course of the project, a programme of measures was developed that will bring about improvements in water quality in the catchment area. The programme is designed to take into account the needs of all catchment users (farmers, food producers, water and sewage companies) and external stakeholders (environmental inspectorates, water managers, local government administration). A range of information materials have also been developed - the implementers hope that the broad education of catchment users will help to reduce groundwater and surface water pollution by nitrogen and phosphorus compounds and plant protection products.

Source: **https://water-protect.eu/en**

The Scientific and Research Center for Renewable Energy of the Koszalin University of Technology - a spin-off enterprise that has its own energy willow plantation, where research teams of the Koszalin University of Technology conduct experimental research. The plantation was used to grow crops adapted to the agro-climatic conditions of the region for nine varieties of SalixViminalis energy willow. Cultivation started 11 years ago, with harvesting frequency every 3-4 years. It is planned to continue the ongoing research until 2030. The main objective of the research was to develop methods of implementing renewable energy solutions into the energy economy and achieve sustainable regional development. The research allowed the development of solutions for process efficiency and modernisation of the energy economy and improvement of sustainable development parameters. Experimental research was conducted on energy crops and the dissemination of knowledge on their use in the economy. They were the basis for the formulation of many conclusions and solutions for the modernisation of the energy economy and the development of renewable energy. This is especially true of the process of replacing traditional fossil energy sources with new renewable sources, which radically improve the quality of the natural environment and reduce air toxicity and CO2 emissions into the atmosphere. Thanks to the proposed solutions, a number of beneficial effects are obtained for sustainable development, which relate to the functioning of the economy in terms of increased income of the population, diversification of livelihoods, creation of new jobs, as well as an increase in the country's energy security.

The knowledge and experience gained as a result of the research work carried out formed the basis for the development of important strategic documents and the co-creation of the region's sustainable

development policy, including: Rural Strategy of Zachodniopomorskie; Study of Potential and Development of Renewable Energy Sources in Zachodniopomorskie"; Spatial Development Plan of Zachodniopomorskie.

Social effects of the study include: training in renewable energy for individual farmers, local government officials and entrepreneurs, change in behaviour and environmental awareness of the population of the West Pomeranian Province (1,693,219 residents).

Economic effects include: an increase in employment among the rural population, amounting to more than 44,000 by 2020; the creation of new development potentials in rural areas and an increase in the investment attractiveness of rural regions of northern Poland - 42 municipalities with the highest investment attractiveness for renewable energy production; an increase in the installed capacity of biomass equipment by nearly 40%; an increase in energy production in Poland in small biomass RES installations - biogas plants by more than 350%. Environmental effects: reducing air toxicity by reducing the use of traditional energy sources, reducing CO2 emissions by 75.8 million tons for conventional fuels including 12.7 million tons for transportation fuels.

National Network of Demonstration Farms - based on the initiative of the Agricultural Advisory Center, in cooperation with the Regional Agricultural Advisory Centers, the National Network of Demonstration Farms was established. The network was created due to the need to implement innovations and disseminate good agricultural and production practices on farms. The network consists of farms from each Polish region, whose achievements and experience are to serve as a model for other farms. Farms run by both natural persons, legal persons or organisational units without legal personality are invited to join the National Network of Demonstration Farms. Farms belonging to agricultural schools, universities or institutes can also be included in the Network. Demonstration farms are a place for farmers to gain knowledge and experience, particularly valuable for demonstrating current and viable solutions. On a demonstration farm, farmers can make observations, compare with their own ways of farming, as well as exchange experiences and gain confidence in the applicability of new, better-than-usual solutions. Demonstration farms welcome groups of farmers selected according to their interests. The demonstration activities carried out at them concern the specifics of various types of crop and livestock production, non-agricultural activities in the countryside, the use of modern machinery and equipment, the use of various cultivation procedures, adaptation to farming under changing climate conditions, and compliance with regulations arising from national and European Union agricultural policy. (https://gospodarstwademonstracyjne.cdr.gov.pl/)

BOX 1. Demonstration farm in the gmina Kamień Pomorski (Zachodniopomorskie) - the farm grows reeds for roofing. The farm is located among forests and marshes in the Natura 2000 area Rozwarowski Bagna, in the western part of the mesoregion called Gryfice Plain. This area includes the wetland valley of the estuary of the Grzybnica and Wolczenica rivers. The farm has about 620 hectares of UR owned and leased from the Wolin National Park. This area consists of 85 hectares of arable land and about 535 hectares of TUZ. The specificity of the farm is the cultivation of reeds and grass. The arable land is entirely sown with grass. Livestock production is carried out on the farm. At the moment, the cattle are not for sale but used for grazing on the islands. The growth cycle of the reeds lasts about 4 months. At the end of August, it is already uprooting. The cane harvest begins in early December and sometimes lasts until March. After the first frosts, when the leaves fall and the reeds turn straw-colored, and the moisture level reaches 16-18%, then specialised machinery is driven into the perches. The farm has benefited from RDP measures: Farm Modernisation and Natura 2000. The machinery park has been retrofitted with machines, tractors, mowers, rakes, balers and other equipment. With a view to an environmentally friendly economy and placing great emphasis on the welfare of the surrounding nature on the farm, agro-environmental-climate measures, packages 4.6, 4.8 and 4.9 are being implemented. Nature conservation and biodiversity on the farm is a priority. There is an area considered a bird

sanctuary of European rank. 23 species of birds from Annex I of the Birds Directive and 8 species from the Polish Red Book of Animals have been recorded here. More than 400 hectares of the farm are in a Natura 2000 area. Within the framework of the EU LIFE-Nature project, the aquatic warbler, a small migratory bird of the reed family has found its enclave there.

Sellected presentation topics:	• environmentally friendly and climate change preventing technologies • emission reduction • precision agriculture • rational management of permanent grasslands

3.3. Recommendations from the MAP

3.3.1. Recommendations for future rural policies

Climate change is already having impact on environmental, social, economic and natural resource. While all communities are affected by climate change, it may disproportionately affect rural communities in both scale and intensity. Rural communities need technical, institutional and financial support to overcome climate challenges and to maximise the available opportunities to adapt to climate change. The responsibility to respond and adapt lies with public institutions (national and regional) as well as rural communities.

Key recommendations include:

- developing scenarios representing possible directions for place-based land use change,
- increasing the integration of agriculture (at regional level) with climate change policies at national level,
- improving funding (appropriate targeting of funding adapted to the characteristics of different areas and economic activities),
- increasing the use of scientific data and local community knowledge in the development of climate change adaptation programmes (plans),
- creating regional platforms based on the exchange of knowledge between science and society, platforms where information can be exchanged, experiences can be shared and new effective solutions for climate change and land use can be created. The aim of the platform should be to create more space for dialogue, to promote joint ventures, to support climate change adaptation,
- a land use policy that promotes transformative land use and rewards landowners for adopting climate change mitigation and adaptation practices,
- providing support to land managers in transition to alternative land uses. Assistance is needed in the form of gaining new skills, training and information to implement new land uses, better apply new technologies and practices, as well as support to deal with the high upfront costs of this adaptation and transformation,
- improving access to information on the impacts of a changing climate. Adaptation actions must be based on robust data and risk assessment tools that should be accessible to all,
- public education - conducting information and education campaigns to accelerate adaptation and improve decision-making on climate change adaptation strategies and good land use practices,

- increase the role of agricultural advisory services - advisors should act as initiators of land use change and climate change adaptation,
- establishing a research agenda for relevant climate change adaptation in rural areas, focusing on the use of current capacities and methods to analyse real-world problems, as well as more innovative research (in which new methodologies are tested) relevant to rural areas and agriculture at national and regional level. The programme should have a clear imperative for integration, which calls for teams of researchers from different disciplines and institutions to focus on tangible problems facing stakeholders.

3.3.2. Recommendations for future research agendas

Based on our findings, it emerged that there are knowledge gaps on adaptation processes in rural areas. As a result, research to bridge these gaps were identified.

Research is needed to better understand the geographical contexts shaping economic situation of different agricultural regions. Research is also needed on a diverse group of rural communities and farmers, heterogeneous in terms of socio-economic resources, which together constitute the potential for rural and agricultural development, while influencing decisions that reduce vulnerability and increase adaptive capacity to a changing climate. Firstly, research projects should investigate on: determining the costs and benefits of implementing changes in farm management; changing systems in agricultural production; changing the use of agricultural land to non-agricultural use; the use of water for irrigation; the role of biotechnology in climate change adaptation; identifying techniques for optimising specific adaptation actions to maximise the likelihood of successful adaptation; the role of education in implementing adaptation actions. Research should include rural communities, farmers and agricultural professionals. This will allow for a better understanding of the context of adaptation to climate change and land use change at national and regional levels. The project will enable the accumulation of up-to-date knowledge to ensure that decision-makers are fully aware of current and emerging climate change adaptation.

Secondly, we believe that there is an opportunity to better understand the complex interactions between climate variability and its impacts on land use change. The rationale for such a project is to capture this opportunity by developing analyses that can correctly analyse the impacts of climate change on land use change. Such a project should include objectives i.e.: to develop methodologies to analyse the occurrence of regionally most important climate change (e.g. drought, freeze-thaw, excessive precipitation); to develop climate model scenarios; to develop methodologies for agricultural production: to determine how to produce updated and improved information on the likely impacts of climate change on agricultural production at national and regional levels. The benefits of this project are to provide a compressed and well-established source of information on past and future climate risks, thereby significantly improving risk awareness.

Thirdly, we propose research areas that will deepen the understanding of rural vulnerability to crises and identify potential solutions to enhance the adaptive capacity and transformability of rural communities, and through this build and strengthen their resilience in both the short and long-term. In the context of current risks and uncertainties, identifying and properly understanding their sources and impacts, across different dimensions, and the ways in which they may affect rural areas, is an essential precursor to considering appropriate tools and instruments, policies and their objectives, and integrating them into a comprehensive approach to resilience. The benefits of such a project are the identification of effective ways to build rural resilience and the identification of concrete actions to strengthen rural resilience before, during and after a crisis.

Conclusions

The effects of climate change are already transforming land use. More knowledge and technical, institutional and financial support is needed to effectively implement and use already available adaptation measures in rural areas. Climate change adaptation and related land use modifications are also needed. Citizens requires different types of support to effectively implement adaptation measures. Support is needed both in terms of access to up-to-date and reliable data on future climate change and its potential impacts, financial support to offset the transaction costs of implemented adaptation actions and educational support, in the form of training and courses. Support is also needed for the establishment of focus groups (platforms) through which knowledge and experiences can be shared and new and better solutions tailored to a changing climate can be sought. Importantly, this support should take into account the context of the place and be tailored to the environmental and socio-economic conditions of the region. Insufficient knowledge of climate change, lack of awareness of the risks, or insufficient funding to implement adaptation measures is a major obstacle to building resilient and climate-resilient rural areas. Therefore, more use should be made of scientific knowledge to build scenarios of future climate change and its impacts and to understand the factors that determine the implementation of adaptation actions. The use of scientific knowledge together with the rural community's experience in perceiving and mitigating the impacts of climate change will enable the development of region-specific adaptation plans (programmes). Involving the rural community (as experts) will result in building mutual trust between different stakeholder groups. Governmental and agricultural NGOs should be more active in promoting land use change so that rural communities better adapt to a changing climate. This should primarily include awareness-raising activities on the benefits (environmental, social, economic) of implementing adaptation measures.

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Annex 1 Methodology used by the MAP

MAP Zachodniopomorskie consists of 20 members: farmers (5), representatives of agricultural organisations (2), local government officials (1), representatives of NGOs (2), members of NGOs/CEEs (2), local entrepreneurs (1) and scientists (7).

The survey was conducted in the period May-September 2022. The survey used methods such as:

- desk research (including literature review, analysis of statistics, industry reports, provincial office websites, provincial status reports, provincial strategic documents),
- workshops - provided access to empirical and contextual knowledge and provided more detailed insights. They provided added value in the area of formulating opinions and recommendations. They enabled the exchange of experiences between representatives of different groups,
- direct survey using a survey questionnaire. The purpose of the survey research was to find out opinions on the state of knowledge regarding climate change and adaptation measures taken in the region. The survey questionnaire was used during an organised workshop with MAP members,
- field research - conducted to seek a detailed assessment of human behaviours related to climate changes. 40 face-to-face interviews were conducted using a survey questionnaire (the same one used during the workshop). The questionnaire was built on existing knowledge. It included not only quantitative but also qualitative data, the combination of both types of data gave us a synergic effect. The survey questionnaire was aimed at farmers. We assumed that farmers (agricultural producers) are the most vulnerable group to the risk of climate change. This social group should be the most aware of the climate change taking place and the need to take adaptation measures. The selection of respondents for the study was random and based on a snowball technique. This gave us the opportunity to obtain information from a diverse (in terms of UR area, type of production, economic size) group of farmers. An in-depth interview was also used here - the respondent was able to explain their unique perception of the problems of climate change, land use and climate change adaptation. In the case of this survey, we learned not only what actions the farmer is or is not taking, but more importantly the rationale for these actions or lack thereof. The respondent during the survey was also able to raise important issues not included in the questionnaire - this gave us the opportunity to learn about issues that we did not include in the questionnaire, but from the respondent's point of view were important and further deepened our knowledge.

The results have enriched our existing knowledge and brought us closer to a better knowledge and understanding of the rural community's perception of climate change and the actions taken to strengthen their adaptive capacity. It has also allowed us to identify needs, challenges and knowledge gaps in this area.

Experiences following meetings with MAP members indicate that studies are needed to robustly capture the impact and outcomes of rural community involvement in studies such as ours. Research to develop approaches and conduct a full cost-benefit analysis of community involvement in research would be beneficial. There would need to be a particular focus on qualitative research to capture the experiences and perspectives of research partners (particularly rural communities) who have had positive and/or negative experiences of participating in research such as ours. It would be helpful to further explore the value that research partners and researchers place on payments and their effectiveness in increasing research engagement and impact.

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