

THE IMPACT OF THE GLACIER ON THE EVOLUTION OF TERRAIN IN THE POLISH REGION OF WARMIA AND MASURIA

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Abstract: In the article the author described the process of glaciation and its effects, which has an impact on formation of the terrain of Poland and in particular of Warmian-Mazurian region. In the article the author presented the processes of creation and shaping of glaciers, their types and particular features of terrain, which appeared as an effect of the glaciers' activity. The analysis of the Warmian-Masurian region was overtaken from the perspective of the appearance of the effects of glaciers activity in the area, mainly the changes in terrain, climate and vegetation. The author also evaluated the tourist and recreational attractiveness of the area, he presented its great natural richness and assessed its uniqueness in comparison with the rest of Poland and Europe. Also other characteristic of Warmia and Masuria were presented in the article.

Key words: Poland, Warmian-Mazurian region, process of glaciation and its effects

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The process of glaciation and movement of the glacier in Europe and thus in Poland thousands of years ago had a fundamental impact on shaping the surface of the territory where it's wandering took place.

The most interesting shapes of the ground lateral and terminal moraine the glacier left behind in the north-eastern Poland, mainly in the area of today's Warmian-Mazurian Voivodeship. Tourist and environmental values of this area, shaped by the glaciers put it in the place of the most beautiful Polish, European and even World's regions.

In Poland and Europe the region of Warmia and Masuria is seen as an area of great potential for recreational tourism with plenty of lakes, forests and rich historical past. Warmian-Masurian Voivodeship is located in the north-eastern part of Poland and consists of the three largest historical lands, which includes Wamia, Masurian and Powisle.

As it was previously mentioned, the area of Warmian-Masurian Voivodeship is special - it stands out thanks to its unique terrain and its environmental richness, where the foundation is created by remarkable composition of natural forms - which makes the region suitable for resting and recreation.

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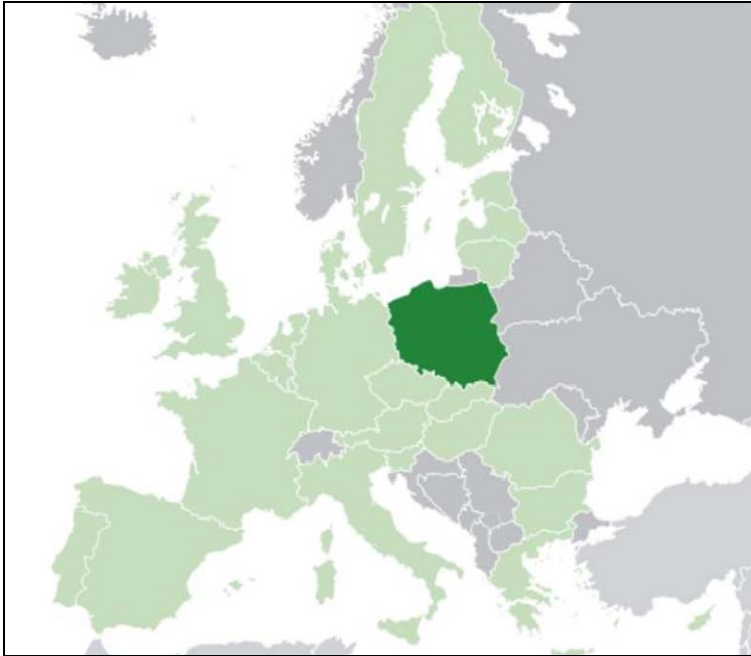


Figure 1. The geographical location of the Polishin Europe.
 (Source: http://watchdog.org.pl/89,narzedzia_polityczne.html)



Figure 2. The place of Warmian-MasurianVoivodeship in the administrative division of Poland.
 (Source: <http://encyklopedia.interia.pl/>)



Figure 3. The administrative division of Warmian-Masurian Voivodeship into Counties
(Source: http://www.bratalbert.org.pl/portal/informator/warmin_m.html)

The uniqueness of the existing terrain and its form is the result of the glacier's action which particularly left its marks on the region of Warmia and Masuria. Studying the changes in lithosphere and in its surface is the task of historical geology. It is assumed that the phenomena and geological processes that took place in the past are mirrored in recently discovered fossils. They allow a very precise estimation of the rocks' age - both absolute and relative dating and hence the time of glaciers movement ¹.

At the turn of tertiary and quaternary - about 1.87 mln years ago - deep and rapid climate changes of global reach took place. Enormous snowfalls and minus temperatures on the remarkable area of the Earth led to the creation of huge glaciers. It was how the era called the pleistocene began ².

The glacier's ice is created above the area of snow line. On this level snow practically never melts - so the consequence of further downfall is its piling. Because of the weight of the upper layers, the lower layers take the form of ice grains, called firn therefore these areas are called firn fields. Observed from the distance - firn is white which is caused by air bubbles inside it. Lower parts of the glacier are darker - there are less bubbles inside and even frozen water can be found there.

As a consequence of the changes, firn turns into firn ice (intermediate stadium between firn and glacier's ice) which consists of ice crystals joined by fine-crystalline ice mass created as a result of melting of the surface snow. At a time when the thickness of the ice layer reaches 50 metres the glacier starts to spread sideways - „*advance*”.

Thanks to the permanent cold climate the thickness of the layer of pressed ice grows and the glacier spreads sideways or it radiates outside the point of the highest pressure. The weight of accumulated masses of snow can cause itself the sliding of the glacier on the surface and in consequence - movement. Glaciers are divided into ice sheets and mountain glaciers, as well as some sort of an intermediate version - glaciers of Norway.

¹ <http://www.wiking.edu.pl/article.php?id=17> of 02.02.2012

² http://www.wiking.edu.pl/article.php?id=285#zasiegi_zlodowacen_w_polsce of 02.02.2012



Figure 4. Iceland glacier
(Source: <http://pl.wikipedia.org/wiki/Lodowiec>)



Figure 5. The example of contemporary glacier in Argentina
(Source: <http://www.hondavaradero.pl/Ameryka/cel.html>)



Figure 6. The Aletsch glacier in the Bernese Alps.
(Source: <http://pl.wikipedia.org/wiki/Lodowiec>)

Ice sheet takes a lot of space including mountains as well as lowlands. Existing ice sheets of Greenland and also those of Antarctic are the remnants of the last ice age which took place in Pleistocene. During its lasting a huge areas of Europe, Asia and North America were covered in ice sheet. After its presence vast areas appeared which are recognized today by their postglacial terrain. Currently ice sheets cover the area of 14 mln sqkm, accumulating about 24 mln km³ of sweet water - it is about 1,1% of hydrosphere and about 96% of land surface water, while ice sheet can achieve the thickness of about 4,78 km.

Norway glaciers build vast ice cups which cover top parts of mountain ranges and they go down the valleys with their numerous tongues. They can be observed in Norway, Island, Novaya Zemlya and Patagonia.

Mountain glaciers are the smaller form which lies in the deep basins situated above the snow line, called glacier cirque or corrie. Here, as a result of snowfall accumulation fluent transformation into firn and glaciers ice happened. As a result of the abundance of produced ice the glacier is moved from firn field and directed below the snow line and take form of glacial lake, which further flows to the place, where the temperature enables to set the stability between the content of flowing and the melting of the ice.

The appearance of the glaciers is not an archaic phenomenon as even nowadays we can find mountain glaciers for example those in the Himalayas, the Karakoram, the Hindu Kush, the Tian Shan, the American Cordillera, the Andes, Kilimanjaro the Alps or in the Scandinavian Mountains. In case of the ice sheet (continental glacier) it appears in the Antarctic, Greenland and Island. The examples of existing glaciers on different continents are presented below in the pictures 1, 2, 3.

The erosive-accumulative activity of glaciers manifests in glacial terrain which contains a lot of terrain forms. Remarkable areas of the Earth are influenced by glacial morphogenesis.

In the landscape formed by the ice sheet, we find such forms as:

1) Moraines are the forms created by drift clay carried and settled directly by the glacier. They accumulate rocky material, which had their beginnings in exaration of the rock surface on the area of Scandinavia. In case of moraines which were created depending on the way of sediments accumulation we enumerate the following forms:

a) terminal moraine - parallel to the ice sheet forefront the rows of embankment, as well as hillock appeared as an effect of its prolonged stop. While the rock material was accumulated as a result of intense melting the ground moraines were formed from ice.

b) ground moraine - these are the vast flattened or wavy areas differentiated by contained cuppings (the lakes of ground moraine). They were formed on the back of ground moraines as a result of drift clay accumulation under the ice sheet.

2) moraine lake - „released” elongated zones which were accumulated in time of the movement of the melting ice sheet forefront.

3) Sandar are vast areas made of gravel and sand settled as a result of waters of glacier's origin, while the stop or recession of melting glacier, formed on the outskirts of ground moraines. As a result of joining of fans they created vast sandurplains, surfaces appearing on the area of Polish low.

4) Urstromtals are the broad valleys of flat bottom created in the period of the longer stop of the ice sheet. Later water from the melting glacier flowed this way.

5) Subicevalley was a result of eroding activity of subsurface waters flowing in the cracks in ice. They're ususally long, relatively narrow, mostly deep with an uneven bottom and steep sides. Sometimes they're filled with water (tunel-valley lake)

6) Tunel-valley lake-these are the lakes which appeared in the valleys after the melting of the ice sheet.

7) Loess is a yellow sedimentary rock which causes the fertile soil (chernozem) to appear. A lot of dissertations express no doubt that the decisive event which has a significant impact on the terrain in Warmia and Masuria was the last glaciation which covered the whole Northern Europe including current Polish territory (Achremczyk, 2000).

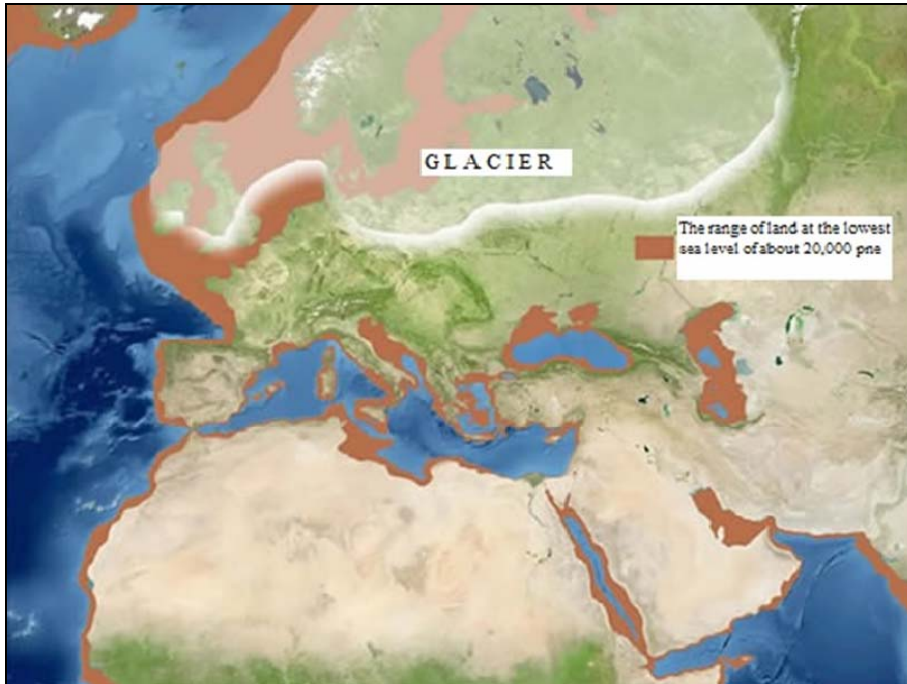


Figure 7. The range of glaciation in Europe from the so called Vistula period
(Source: http://www.historiasztuki.com.pl/10_PRE_01.html)

Picture 4 illustrates the area of glaciation in Europe including the current Polish territory. The most important centre of glaciation on the continent was Scandinavia. As a result of even climate changes after the cold wave the warming began, which led to spreading of the ice sheet on the vast areas of European continent covering 5 mln sqkm where in the consequence of warmer periods it withdrew (melt). Intervening (transgression) of the ice sheet on the particular ground in chilly periods is defined as glacial (glacial period). In contrast, withdrawing or recession of ice cup from the area is called interglacial. During glacials smaller oscillatory movements happened but they didn't lead to the full withdrawal of the glacier.

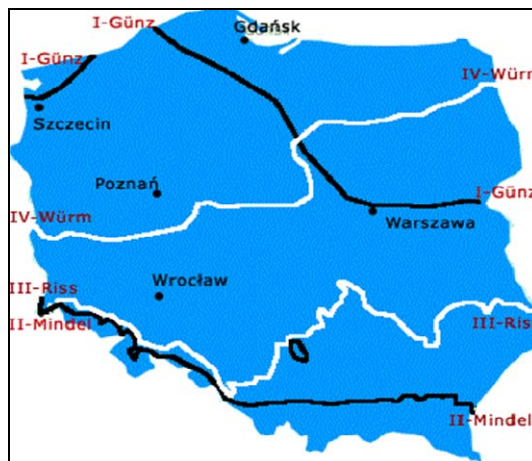


Figure 8. The reach of the fourth glaciation in Poland
(Source: <http://www.mount.cad.pl/g/historia/prawa/plejstocen/plejstocen.html>)

There were stadials or phases (the cycles of ice sheet accretion) as well as interstadials (the cycles of withdrawing of the ice sheet). According to scientists ice sheet reached Poland 4 times so we had four glacials. Assuming that the period in which we live. Holocene-is an interglacial another glaciation is supposed to come. While the territory of Poland was covered to a bigger or lesser degree by the Scandinavian glacier, in the high mountains (Tatras and Krknose) local mountain glaciers were formed. In the period of glaciations the precinct of ice sheet changed for a few times. This is possible to establish which grounds were in the reach of each glacial basing on the analyses of sediments or glaciers' forms characteristic for the development of the glaciers.

First Podlaskie's glaciation (Gunz) involved only the area of North-Eastern Poland and the part of the Litoral Szczecin. In the Western part of the country no signs of the oldest glaciation can be observed.

The second Southern-polish glaciation (Mindel) with its maximum reach (San's glaciation II) is the biggest spreading of the ice sheet in our country, reaching as far as the northern declivities of the Karpathians and the Sudetes (400 m. above the sea level). Then the Glacier pushed deep into the area of middle-mountainous dells and valleys, Mount Slezka, as well as the highest tops of Swietokrzyskie Mountains, which appeared from the ice as nunataks - rocky hummock surrounded by the ice cover.

During the next middle Polish glaciation (riss) of the maximus stadial the glacier reached the Sudetes and the northern line of Lesser Polish Upland and Lublin Upland. Using the terrain's orography the ice sheet wedged into the gap from Vistula, Raciborska Dell, and it also covered the most of Silesian Highland and Nidzińska Basin.

In the case of northern Polish glaciation (wurm) the borderline for the biggest spreading of the ice sheet is a line, which goes from Gubin, Zielona Góra, Leszczno the north of Konic in the direction of Płock, further east from Vistula through Nidzica, SzczytnoGrajewo and Augustów up to Grodno. Mountain glaciers as well as the ice sheet had a gigantic impact on the Polish terrain. As the result of their movement the bedrock was destroyed, which is called egzaratation process, where they accumulate and spread the rock material previously located in the ice.

This is how the glacial (postglacial) terrain was formed and we can divide this into:

- lowlands, for example lake landscape (Warmian-Masurian);
- mountainous, for instance Alpine landscape.

The glacier caused climate changes as well, which manifest in the difference of forestation, hegemony of one type of plants or the appearance of a new species of trees or domestic plants.

The changes were dictated by the ice age, counted in hundred thousands years, and its last appearance took place 70 thousands years ago and finished only just in 12 300 BC. It was when the landscape of Baltic littoral and lakes were formed. During the warmer periods of the ice age the ice sheet withdrew, stopped or came back, which was the possible cause of cooling.

Finally, the glacier's withdrawal formed the zones of ground moraines, lakes of Wamia and Masuria and vast sandurs, which are called piskie, kurpiowskie, suwalskie or augustowskie. In the final phase of the ice age the melting waters from the glaciers formed vast lakes in the valleys and cavity of the ground. Also the Prussian plane was shaped which was divided by the hummocks ground moraines of Elbląska Upland, Górowskie Mountains as well as Sambijska moraine. Withdrawing ice sheet left behind the piles of sand, gravel, stones, clay, or the blocks of ice buried deep inside, which, as a result of climate warming started to melt and erode river valleys. This is how the terrain of Warmia and Masuria started to create. Thanks to the climate warming the vegetation started to grow. In the beginning it was limited and not entirely rooted in the sand, later with the flow of time and closer to our epoch forests appeared, which started to cover the majority of the studied area.

Before the ground was covered in forests, there was a period of treeless tundra. In the fresh postglacial landscape of Warmia and Masuria the fens were formed, which were soon covered in grass, bottlebrush, moss or dwarfish birch-wood. In the thriving landscape occasional groups of trees appeared which signalized the oncoming appearance of tundra. The evidence is given by the sediments which can be found in the Mikołajski and Kruklin lakes. The method of counting the

content of radioactive carbon isotope showed that about 9500 or 9080 years BC in the Masuria there was a pine wood and birch-wood forest and the average temperature could even reach about 12 degrees Celsius. Climate conditions controlled the development of the forest, constantly spreading its reach³. Just when the ice sheet moved to the northern Europe accompanied by the climate warming, tundra became covered by forest and animals appeared. Between 8300 - 4500 BC another climate warming took place, characterized by warmer winters and higher humidity which enabled thermophilic trees to grow. On the sandy areas pine wood primeval forests dominated whereas on the fertile grounds leafy forests dominated - with the predominance of oak, ash wood and elm tree. Harry Lauder's walking stick also became visible.

In the neolithic (younger stone age), which took place in 4 - 1,5 thousands years BC climate changes appeared which gave ground to the appearance of civilization.

The humidity got higher, the time of plant vegetation lengthened, fens were formed, the area of oak forest widened, spruce forests appeared and fertile brown soils were formed, which was dictated by the development of leafy wildwoods.

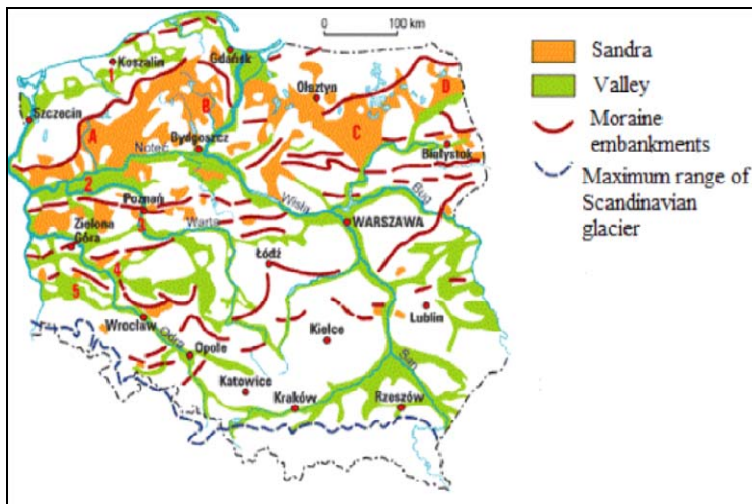


Figure 9. The typical elements of postglacial terrain
(Source: <http://wiking.edu.pl/article.php?id=285>)

Picture 6 shows the formed terrain after the withdrawal of the glacier. The area of Warmia and Masuria which is of our interest is characterized by a differentiation of terrain as well as by the appearance of such elements as: sandurs, Urstromtals, ground moraines, lakes, rivers and hilly terrain. Summing up the period of research on the history of Warmia and Masuria and the formation of their terrain, climate and vegetation after the ice age, it should be highlighted that the land in the north-eastern part of Poland is very characteristic and rich in nature's variety. This is what marks it out from other regions of Poland. As a result of the activity of continental glacier the terrain of today's Warmia and Masuria was formed in a very interesting way. The chain of moraine hills appeared, the biggest of which are Mount Dylewskain the West (312 metres) and Szeskie Hill in the East (309 metres), numerous hummocks of eskers and silicons, vast sandur plains fans, or endoheric cavities. By the indundation as well as along the northern boarder terrain was remarkably erected. The range of hills which were formed here consist of the Kamieńska Upland in the east with its highest point at 216 metres above the sea level) and the Elblaska Upland in the west.

One of the most characteristic areas for Warmian-Masurian Voivodeship is the region of the Masurian Lake district which is situated between Valley Vistula and Polish border in the north

³ Ibidem, p. 11

-south, without clear boundaries it turns into the vast Masovian Plane. The terrain of this part of the country, which is named the Masurian Lake district is extremely varied as a consequence of an ice sheet activity and fluvo-glacial waters. You can observe here numerous hummocks, plains, valleys cut by rivers, streams, and creeks of different width but a remarkably big slope. Despite all this, the lakes dominate the area and that is why this region is called "*The land of the thousands lakes*". The group of lakes of glaciers origin on the Masurian Lake district consists of over 2700 natural water tanks of the Iha - surface.

On the the Masurianlake district we can find two types of lakes:

- ribbon lakes formed as a result of glazier's erosion. It went through complicated development and is now characterized by huge extension, steep banks and also quite impressive depth;
- Moraines' lakes were formed as a result of glacier's withdrawal. They are characterized byacorrie shape with interesting coastal line.

The other division of lakes can be based on the biological features- starting from young oligotrophic forms, (rare plant species can be found)

- indigent in nutrient elements and up to the lakes rich in plant and animal life;
- eutrophic or the lakes which are prone to peat.

The biggest cluster of the lakes, the so called Masurian Lakes, is located in the area of Wegorzewo, Gizycko, Orzysz, Mikolajek and Rucian. The other smaller group is located near Iława, Stary Dzierzgon and Ostroda. Besides, the Masurian lake district is full of lakes of different sizes (Panfil, 1968). The biggest lakes of Warmia and Masuria, as well as in Poland, are Sniardwy (113,8 sqkm) and Mamry (104,9 sqm).

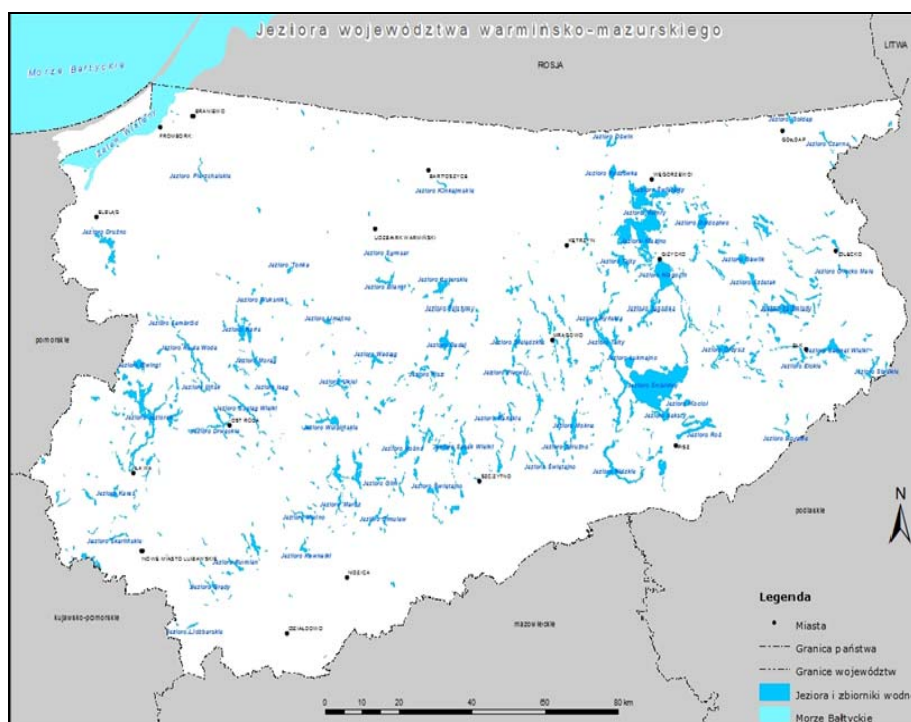


Figure 10. The lakes of Warmian-MasurianVoivodeship
(Source: My own work)

If we take into consideration the hydrography of the Masurian Lake district this is the most interesting area for tourist and recreational purposes. Numerous natural water trails, the richness of lakes and their location close to each other, primeval areas of swamps and fens give this area a

very specific look, different from other Polish areas. Special attention should be paid to three water sections: the Wisla basin with its right-banks Vistula drainage basin Pregola dehydrated by Lyna and Węgorza and the rivers by the sea with Bauda and Pasleka.



Figure 11. Main rivers of Warmian-Masurian Voivodeship
(Source: My own work)

The uniqueness of this area, its tourist and recreational values make it irresistible not to spend a weekend with your family there. Definitely the most prestigious, as well as distinguishing feature of this area is the possibility to use water tourism, all thanks to the existence in the area of Warmia and Masuria, the remarkable number of water channels, lakes and rivers, which won't disappoint even the biggest connoisseur of this type of sport. This harmonious part of Poland is a safe heaven and the place to rest for those who has to struggle with city life, far away from natural beauty, fresh air and peace.

The beauty of the Warmian-Masurian landscape initiated the creation of many brilliant tourist routes - perfect for canoeing or sailing, which are settled and marked by different organizations and institutions, including PTTK. Because of the creation of tourist trails the tourism and recreation from inside and outside the country started to develop.

The uniqueness of Warmia and Masuria landscapes, their diversity, its terrain and historical past caused that this region took part in the competition called "7 World's Wonders" organized by prof. Federico Mayora, former head of UNESCO. This is the proof of the "craftiness" of glacier's work, which without human interference, created such beautiful places as Warmia and Masuria, characterized by picturesque nature and breathtaking landscapes. To present the complete data of Warmia and Masuria the detailed characteristic of this region is presented below (data was collected in 2011). It concerns the population of the region, its ethnic groups, production, company's structure and the strategy for tourism and recreational development. Warmian-Mazurian Voivodeship is inhabited by 1,4 million people. The majority lives in Olsztyński (112.440 people), Ostrodzki (105.604) and Iławski (89.908) County. The smaller number of

people inhabit the Węgorzewski (23.738 people), Gołdapski (27.062) and Indzicki (33.971) County. The density of the population is the lowest here- 59 people per sqkm (whereas in Poland 122). This is the most differentiated region in Poland, there are numerous ethnic minorities: Ukrainians (about 80000 people), Germans (20000), the Romani, Belarusians. The society is relatively young: 23.2% is in pre-productive age, 63,5% in productive age and 13,3% in post-productive age. This Voivodeship is characterized by the highest birth rate: 1,6 (Poland - 0,2). In this Voivodeship 108910 economic subjects are registered in REGON system. The private sector is dominant -94%. The sold production of the industry in the region amounts to 15,8 billion zlotys- it gives the 11th place of the 16th. Private sector takes 86% of the sold production of industry. In the general number of economic subjects 76,3% is run by human legal person, 0,7% by cooperative, 10,9% economic law co-partnership. Only 0,056% of the overall number of enterprises are owned by the state.

The Warmian-Masurian Voivodeship is one of the cleanest areas of Poland and is under the protection of "Green Lungs of Poland" programme. The main sectors of the economy are here: production of healthy food, wood industry, eco-friendly forest economy, ecotourism, the productions of tyres, machines and equipment with the usage of clear industrial technologies and where only reusable sources of energy are used.

The most dominant is the production of animal products and beverages (about 32,2% of the sold production in industry), then the production of clothes and furs (about 1,6%).

42,5% of the state production of hollow rubber goods comes from Olsztyn, where the tyre factory is located. Gross Domestic Product for one person which is 16,504 zlotys is lower than average Polish Gross Domestic Product. (21 366) and in 2002 it reached 77% of the average Polish outcome.

Building minerals - natural break-stone, quartz sands necessary to the production of a sand lime brick and cells concrete, clayish material to produce ceramics building and light break-stone. Minerals used in farming - lake chalk and peat. Minerals useful in medicine - peloid (the areas of Gorowo Iławieckie, Barcian and Goldapia). Arable land forms 46,3% of the area of this voivodeship (including 33,4% of arable grounds, 7,5% for rough grazing, 7,5% for grazing land, 0,1% for orchards). Forests take the space of 29,9% of the whole area of this region.

Natural conditions such as short period of vegetation, the type of terrain and differentiation of soil, raise a demand for high level of technical equipment and it make the costs of unit production more expensive and the average income lower than in other regions of our country. Nearly all of the agricultural holdings are private properties. The surface of the average agricultural holding is quite big and it is usually up to 14 ha. The proportion of the agricultural holding of a surface up to 20 ha (14,5%) is definitely higher than the country's average.

Waters in the voivodeship takes 6,0% of the general area, which is 18,2% of the overall surface of waters in the country. Fishing industry plays an important role and it develops in three directions: lake, pond and river economy. Sea fishing is performed on the waters of Vistula Lagoon.

On the market scale agriculture in the region produces and converts mainly crops (79,4% are under crop) and potatoes (3,8%). Poultry, pig farming, livestock, horses and to the lesser degree also sheep are bred here.

The strategy of the socio-economical development passed by Office of the Seymik of Warmian-Mazurian voivodeship says that the wealth of the region will strongly depend on the progress in three basic economical branches: agriculture, tourism economy and industry of eco-friendly technology. The development of these areas is financed by numerous founds from European Union. 182 million euros is only the amount of money from structural founds.

Warmia and Masuria is the area of a high tourist and recreational value. It is called "the land of the thousand lakes" although there is twice as much of them. The biggest lake are Śniardwy (113,8 sqkm) and Mamry (104,4 sqkm). The deepest are Wuksniki (68 m), Babieta Wielkie (65 m), Piłakno (56,6 m) and Elckie (55,8 m). Some part of these lakes, joined by canals and rivers, form long water trails. The most famous is Elblaski Chanel with the system of ramps allowing travelling by boat on the land. The real treasures of the

area are forests and primeval forests which take place of 30% of its area with numerous scenic parks and nature reserve. The beauty of the natural landscape is completed by the works of human beings: well-maintained Gothic castles, churches and palaces. From the list of 100 remarkable Polish landmarks, prepared by "*Rzeczpospolita*" 16 of them is located in Warmia and Masuria. Tourist attractions are the reason why the region is annually visited by 5 millions of tourists. (every fifth of them is a foreign visitor). There are 34 thousands of dosshouses available for them.

The number of tourists is attracted by Grunwald fields where in 1410 the Polish-Lithuanian army defeated the Teutonic Order's force. For its anniversary festivals are organized in order to commemorate this historical event and teach people something interesting about the knights culture. The place which is of an interest of tourist are the ruins of Hitler's quarter in Gierłoża near Kętrzyn, as well as the Demotic Building Museum in Olsztynek. The network of roads allows successful communication between the areas. The most important are state roads nr 7- Gdansk-Olsztynek-Nidzica-Warszawa, nr 16 - Iława-Olsztyn-Augustow as well as nr 51 Olsztynek-Olsztryn-Bezledy. The rate of public roads with hard pavement is 53,5/ 100 sqkm (Poland 80). Also train system is well developed allowing people to commute between the most important cities and giving access to Kalinigrad Oblast. The density rate of rail lines is 5,5/ 100 sqkm (Poland 6,7). In Szymany near Szczytno there is an international airport "*Mazury*" – serving usually only small air traffic plus air charter. The only harbor in the area is located in Elbląg next to Vistula Lagoon. In 1997 about 641,000 t of goods were loaded here and about 16,000 passengers were welcomed.

Elblak's harbour has 2,5 km of a coastal line. On its property the granaries, sidings, maintenance dockyard, numerous nautical luggage are located. Warmian-Masurian voivodeship boarders with the Kalinigrad Oblast of Russian Federation. This over 200 - km fragment of Polish-Russian border is an outside boarder of the European Union. There are 6 boarder rails and road check points and there are plans to build another three. Telecommunication infrastructure allows the region to have a constant and easy access to the rest of the world. Per 1000 inhabitants there are 301,2 phone lines (Poland - 321), there are over 50000 of digital connection ISDN, and there are 389 postal establishments. In the spring and in autumn there are numerous fairs organized. The biggest and most popular takes place in the city centre in the building called "*Urania*". The organizers of these fairs offer the participants the places for indoor and outdoor display as well as in display pavilions. Patricipants are usually producers or distributors of technology and building material, house, offices, sanitary, heating and farming equipment.

Foreign fund in the voivodeship consists of only about 0,8% of the overall foreign fund in Poland. About 43% of this is located in co-partnership. There exist about 4,525 trade copartnership, in which there are 779 that use foreign fund. According to PAIZ in the middle of 2002 52 investors from the overall 920 registered in PAIZ (investors which invest about 1 mln USD in Poland) is connected with Warmia and Masuria. So this region is in the 14 place on the list of voivodeships having big investing projects. From the biggest foreign investors in Warmia and Masuria we can mention: Michelin (France, tyre production in Olsztyn), Safilin (France, flax processing in Miłakowo and Szczytno), Philips Lighting (Holland, electromechanical industry in Kętrzyn), Heineken (Holland, brewery in Elbląg), Schieder (Germany, furniture), Ikea, (Sweden, furniture in Lubawa), Alstom Power (turbine producer in Elbląg), Smithfield Food (USA, copartner in meat works in Elk, Morliny and Ekodrob in Iława). In the Warmian-Masurianvoivodeship there are about 435 000 people employers. The structure of employers in this voivodeship and in Poland does not differ essentially. The number of people working in agriculture or in industry is comparable to that in Poland. There are however more people working in Service. For a few years Warmian-Masurian voivodeship has the highest level of unemployment. The unemployment rate, measured by the proportion of the number of the unemployed to the employed at the end of 2006 reached 24,4%.

Olsztyn, the capital of the area is an important centre of the development of diary products industry in Europe. The dairying development Institute, the Institute of animals reproduction and food study PAN, The head office of Polish Committee of the International dairying Federation are

all situated here. The University department of the environment protection and fishing, testing station PAN and fish reproduction farms are also important potential of studies on inland fishing.

There are 9 functioning schools in the region, where in the academic year 2004/2005 61353 students (including foreigners) studied. The biggest university of the area is Warmian-Masurian University in Olsztyn, which educates over 30 000 students. About 1720 academic teachers work here, 213 out of which are professors and 215 completed their PhD. Out of 1 departments of the university, 7 of them have full academic rights, so the rights which enable them to grant PhD degrees - in 16 scientific fields. UWM is just behind Warsaw University if it comes to realization of new inventions and achievements in science. Over 8% of people from the voivodeship finished upper level education. There are different annual cultural events taking place in the region. Worth mentioning are: International 'country Fair in Mrągowo, International Traditional Jazz Festival 'Golden Grater' In Iława, International singing contest "*Shanties in Giżycko*", international Meetings of Musical Families in Dobrze Miasto and International Castle Meetings "*Let's sing poetry*". The other event of international importance are "*Sunday organ concerts*" which take place in the most beautiful cathedrals and churches of the region (in Frombork, Giżycko, Morąg, Olsztyn, Saint Lipka). Every year in Wegorzewo Polish youth take part in the Rock Music Festival and on "*Przystanek Olecko*", which consists of plays, happenings and poetic song concerts. Recently Kresy culture Festival in Mrągowo has gained popularity. There are two theatres in the voivodeship: im. Stefana Jaracza in Olsztyn and Teatr Dramatyczny in Elbląg. Philharmony in Olsztyn is named after the composer Feliks Nowowiejski, who was born in Warmia⁴.

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⁴ <http://wrota.warmia.mazury.pl/Informacje-o-regionie.html> info. z dn. 31.01.2012