

# **Meteo-climatic factors influence upon Cacica salt-mines, Suceava county- natural climatic areal for medical rehabilitation treatment**

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# Research conducted in two projects: ROLINET (National: NASR- National Authority for Scientific Research ) RADO (Norwegian Funding-NILU)

University "Alexandru Ioan Cuza" of Iasi: the partner in the first LIDAR system network in Romania, the only on the North-Eastern region of Romania.

- The installation is completed at the ground level with modern equipment for monitoring environmental pollution. All these devices are called **ATMOSPHERIC OBSERVATORY 3D** (Three Dimensional Atmospheric Research Observatory).

- The current **ATMOSPHERIC OBSERVATORY 3D** Iasi is built on the basis of two projects- one with national funding (ROLINET), the other with international financing (RADO).

- At the national level were created five such observatories.



# INTRODUCTION

Correlating medical scientific research with the challenges of specific scientific and technical developments (genomic medicine, nanotechnologies and bio-nanotechnologies with clinical medical applicability) through the standardization of functional medical recovery protocols from the level of nanostructures to the level of the whole body and the correlations between the climate natural factors with influence of climate changing are one priorities in the field.



# Climatic Factor

Speleotherapy  
and  
Salin  
Hidrotherapy

The Geological and  
Geographical  
Factors upon the  
investigated area

Social economic  
factors

Local authorities

Balneoclimatic  
Area for Therapy

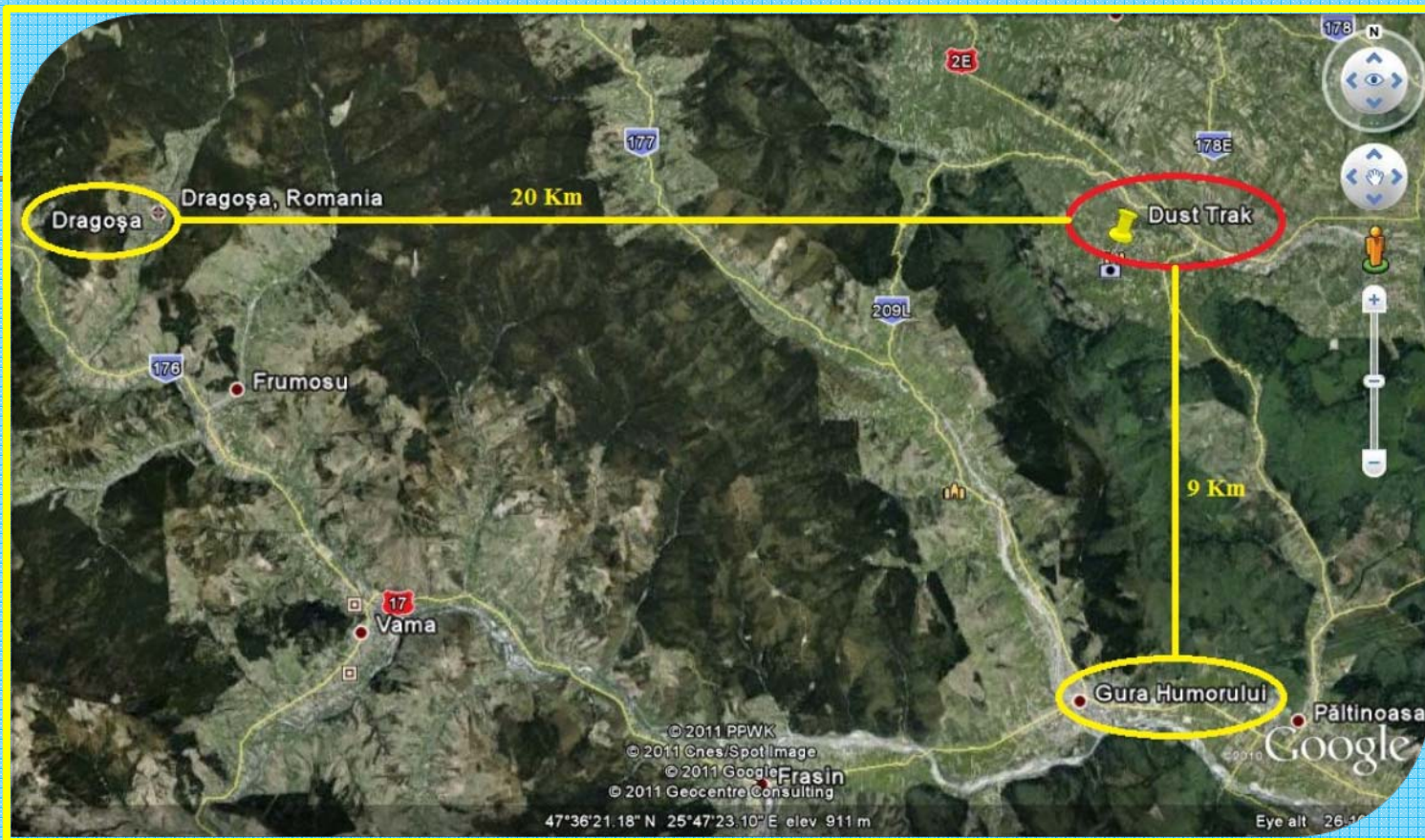


# 1. Climatic Factor



*The investigated area – region Cacica, Suceava County*





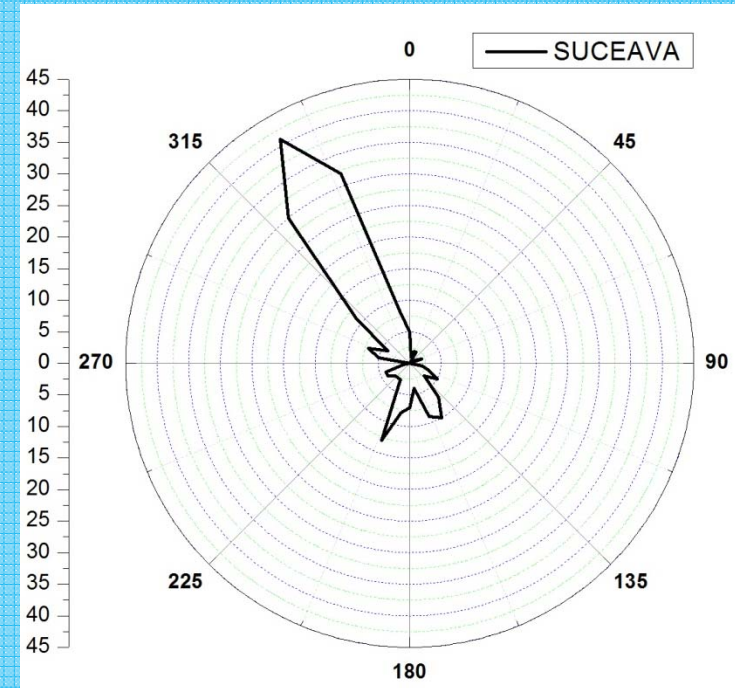
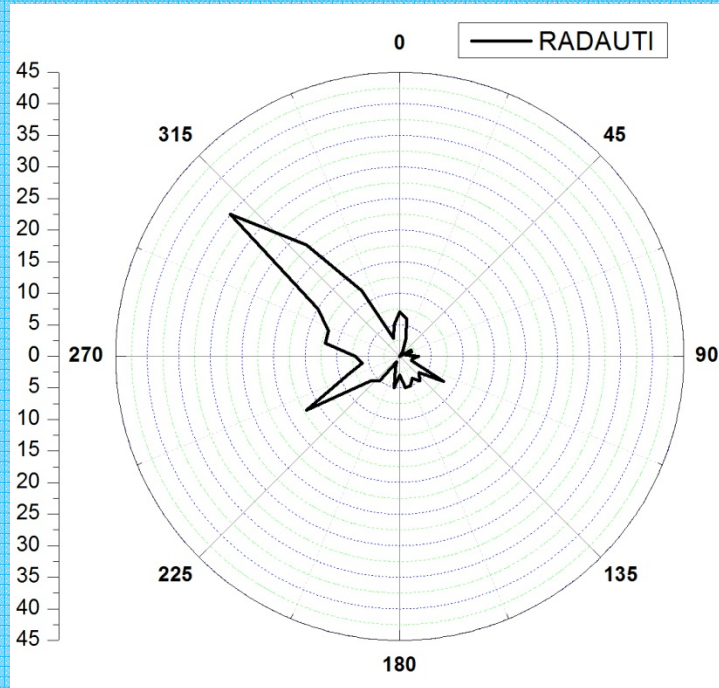
*Hydrometric stations to monitor rainfall  
Gura Humorului and Dragoșă, respectively*

DAY/ LOCATION	11.06	12.06	13.06	14.06	15.06	16.06	17.06	18.06	19.06
Gura Humorului	13.2	0.5	-	2.1	-	-	-	0.6	-
Dragosa	15.2	0.1	0.2	0.8	-	-	-	-	-

*Table 1 - Precipitation recorded at gauging stations Gura Humorului and Dragoșă, Suceava County during 11-19.06.2011 (l/m<sup>2</sup>)*



In the plateau region, the dominant wind direction is NW-SE, with some deviations due to the orientation of the valleys.



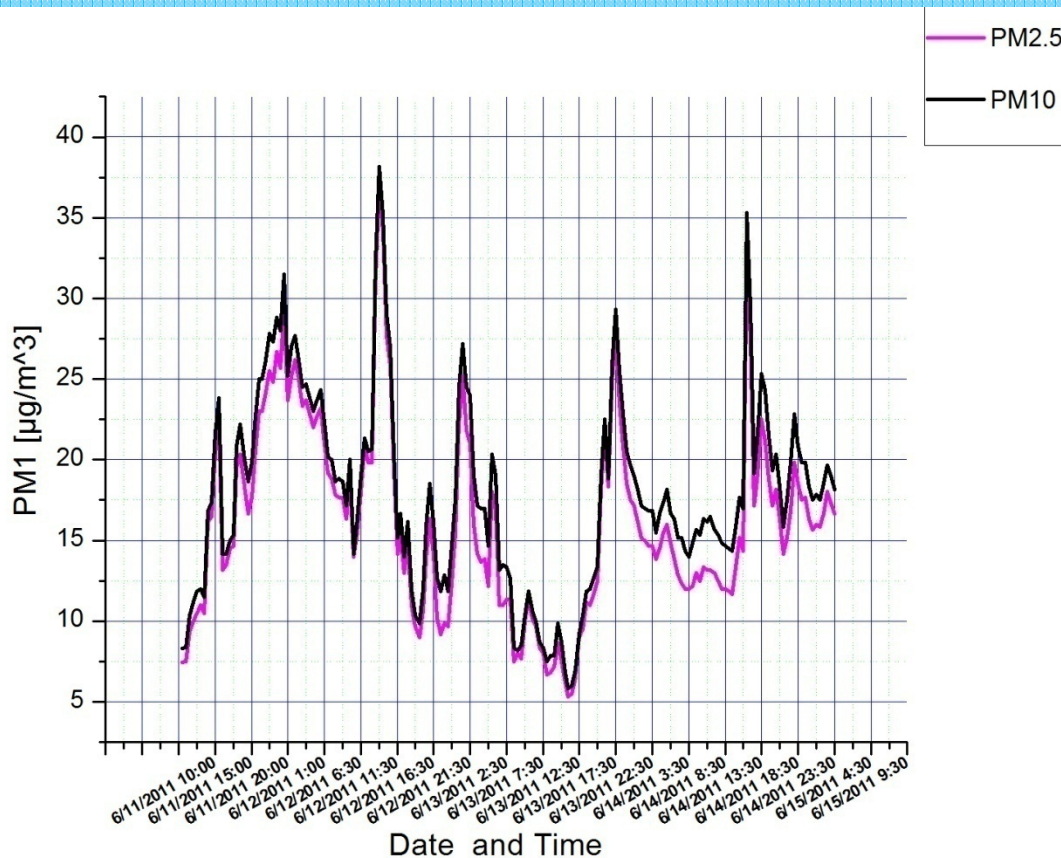
*Compass Rose from the  
Meteorological  
Station Radauti 11-19.06.2011.*

*Compass Rose from the  
Meteorological Station Suceava  
11-19.06.2011.*



DATA	MAX ( $\mu\text{g}/\text{m}^3$ )	MIN ( $\mu\text{g}/\text{m}^3$ )	AVERAGE ( $\mu\text{g}/\text{m}^3$ )
11.06.2011	37	8	20
12.06.2011	67	7	18
13.06.2011	30	5	15
14.06.2011	69	13	20
15.06.2011	48	22	33
16.06.2011	68	19	33
17.06.2011	80	32	42

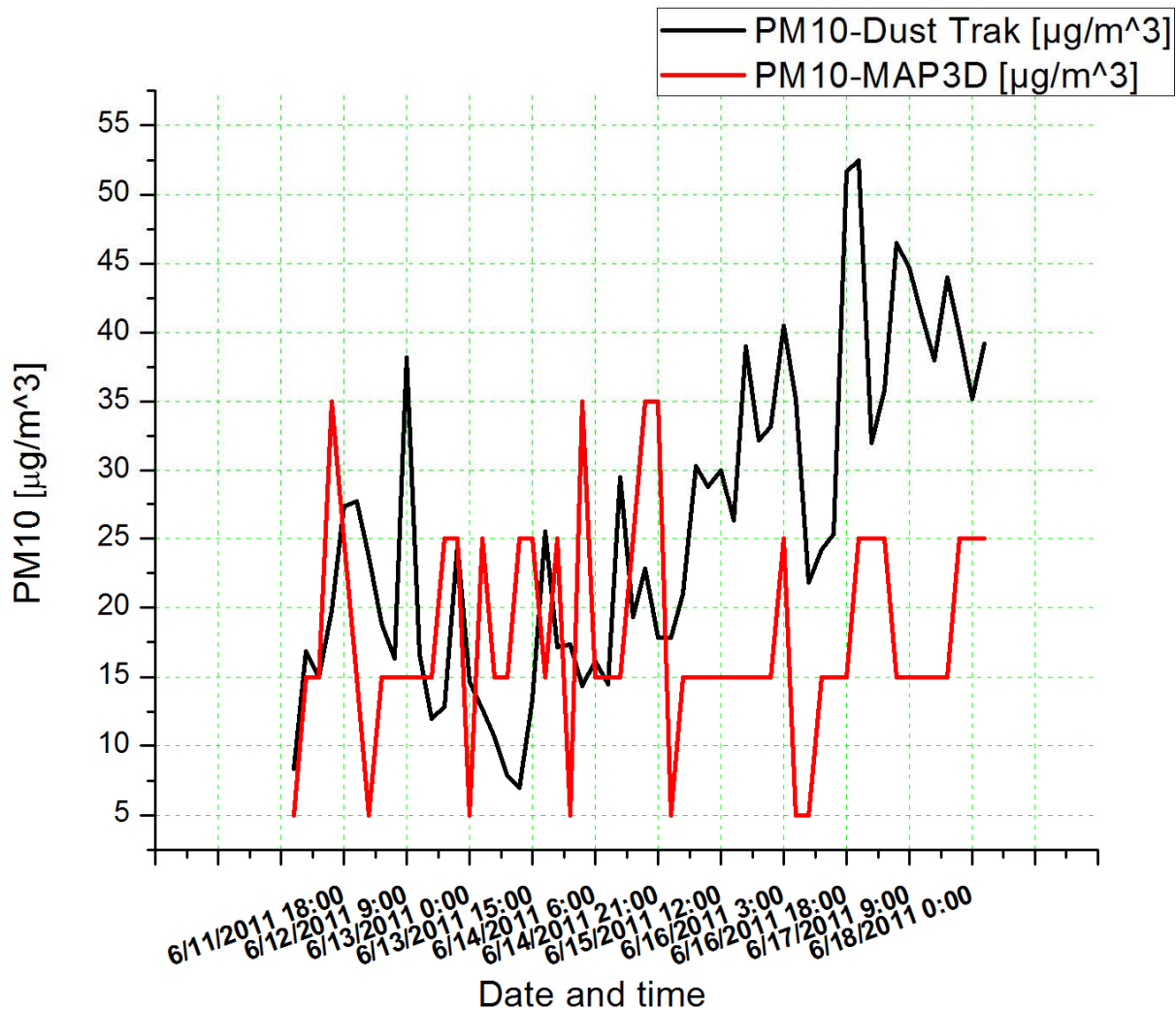
*Extreme and average values for PM10 as measured by DUST-TRAK in Cacica region.*



*Profiles of the PM10 (black) and PM2.5 (magenta) concentrations, experimentally measured by DUST TRAK*







*Profiles representing the comparison of PM10 concentrations measured by DUST TRAK (black) and predicted by MAP3D model (red), respectively*



## 2. The Geological and Geographical Factors upon the investigated area

### Location

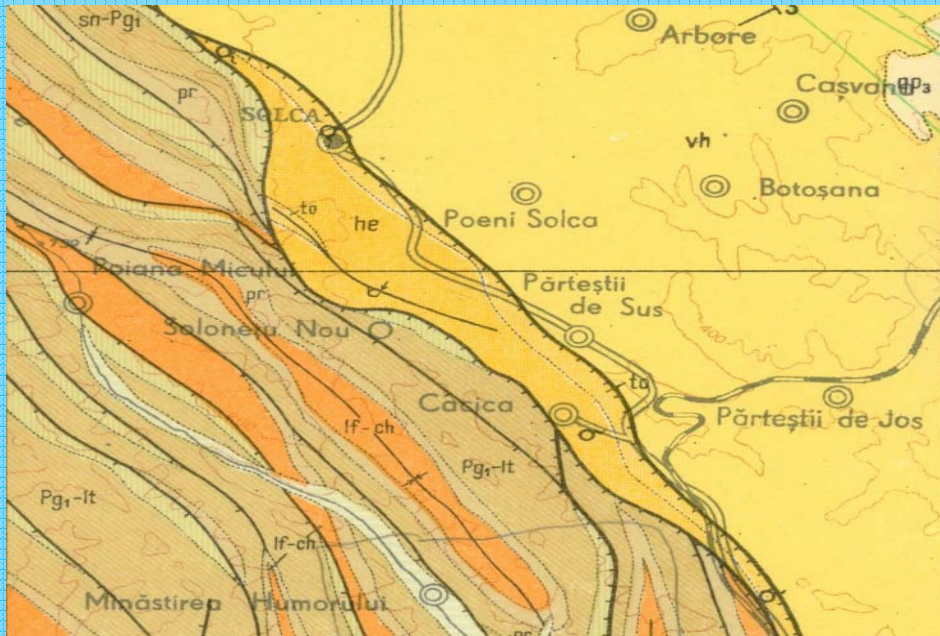
*Romania – Cacica, Suceava county.*

The village, only 40 km from the city of Suceava, was founded in 1791 with the putting in operation of the salt mine by the Habsburg Empire.

**Speleotherapy** is done in spaces left open by the salt mine – Horizon I (40m) and Horizon II (61m), pathologies treated being those of the respiratory tract (allergic and chronic diseases).

**Hydrotherapy** is performed with saline water..





From geological point of view, as shown in the attached map, in the Cacica area predominate deposits belonging to that age of the upper Miocene, respectively Helvetian (he) and Badenian (to).

The geological evolution of these deposits were born within the Area of Molasa, Carpathian structural component, defined as the most external unit for alpine crumpling from Oriental Carpathians, between the external limit of flysch and pericarpethian line identified from the country's northern border, up to the Dimbovita valley



### 3. Balneoclimatic Area for Therapy

**Speleotherapy** is done in spaces left open by the salt mine – Horizon I (40m) and Horizon II (61m), pathologies treated being those of the respiratory tract (allergic and chronic diseases).

**Hydrotherapy** is performed with saline water..



# Speleotherapy and Salin Hidrotherapy

## information

Cacica saline, with the two locations: the church hall and the sport hall, was studied beginning with 19.05.2004 and the following parameters were noted:

- air temperature: 11.0 – 12.0 °C;
- atmospheric pressure: 100925 Pa (757 mmHg);
- surface altitude: 447 m;
- altitude in the saline: 416 m;
- level difference: 31 m.

The aerosol concentration was estimated based on the data obtained by means of the particle counter (Table 3) and of the conductometric method (Table 4) for the two chambers of the saline, by applying the methodology described above with the Slanic – Prahova saline.



## Determination of concentration, based on the data on the distribution of particle

number according to size and of their total volume in Cacica saline

\*) Estimated by calculation based on the total particle volume, and the density of  $\rho_{\text{NaCl}} = 2.3 \times 10^6 \text{ g / m}^3$

Particle diameter, $d_i$ ( $\mu\text{m}$ )	Church hall		Sport hall	
	Number of particles of diameter $d_i$ , $\Delta n_i$ ( $10^6 \times \text{m}^{-3}$ )	Total volume of particles of diameter $d_i$ ( $10^{-14} \times \text{m}^3$ )	Number of particles of diameter $d_i$ , $\Delta n_i$ ( $10^6 \times \text{m}^{-3}$ )	Total volume of particles of diameter $d_i$ ( $10^{-14} \times \text{m}^3$ )
0.3	2461.4	3475.74	3677.6	5193.14
0.5	151.4	989.76	232.8	1521.92
1.0	5.2	271.96	15.9	831.58
2.0	3.8	1589.92	0.34	142.26
5.0	1.4	9152.50	0.38	2484.26
<b>TOTAL</b>	<b>2623.2</b>	<b>15479.88</b>	<b>3927.02</b>	<b>10173.16</b>
<b>Concentration* of NaCl aerosol (<math>\text{mg}/\text{m}^3</math>)</b>		<b>0.356</b>		<b>0.234</b>



## Experimental data on the conductometric measurements in Cacica saline

Device	4a		4b		4c		Solution temperature (°C)	
Bubbling time (min)	$\chi$ ( $\mu\text{S/cm}$ )		$\chi$ ( $\mu\text{S/cm}$ )		$\chi$ ( $\mu\text{S/cm}$ )		Church hall	Sport hall
	Church hall	Sport hall	Church hall	Sport hall	Church hall	Sport hall		
0	4.6	2.1	4.0	1.7	2.0	1.9	10.4	12.3
15	5.3	2.6	4.7	2.2	2.1	2.0	10.1	11.5
15	6.0	3.1	5.3	2.7	2.2	2.1	9.9	11.0
15	6.7	3.6	6.0	3.2	2.3	2.2	9.6	10.4
15	7.4	4.1	6.7	3.7	2.4	2.3	9.3	10.1
$\Delta\chi / 15 \text{ min}$	0.7	0.5	0.7	0.5	0.1	0.1	$\Delta\chi_{\text{medium}} = 0.6$	$\Delta\chi_{\text{medium}} = 0.4$
Solution concentration (mg NaCl/L)	<b>Church hall: 0.2857</b>				<b>Sport hall: 0.1904</b>			
Aerosol concentration (mg NaCl/m <sup>3</sup> )	<b>Church hall: 0.317</b>				<b>Sport hall: 0.211</b>			



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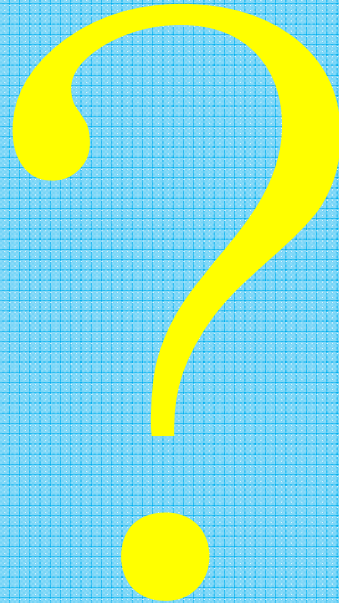
The Cacica saline situated at a depth of 31 m shows quite different concentrations for the two locations (0.356 mg/m<sup>3</sup> in the church hall and 0.234 mg/m<sup>3</sup> in the sport hall) but the values determined by the two methods are very close. The impurification degree of the aerosol is lower (~ 10 %) and it shows a very good stability of the submicronic particles (< 0.5 μm);





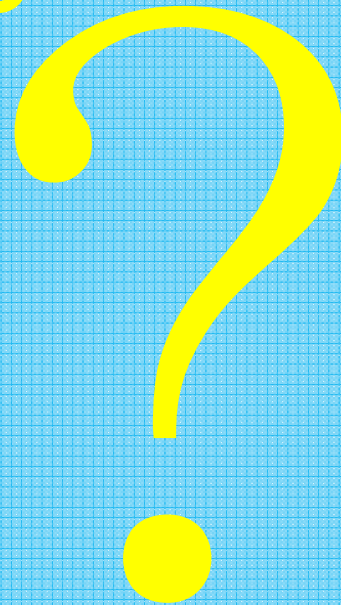
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## 4. Social economic factors



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## 5. Local authorities



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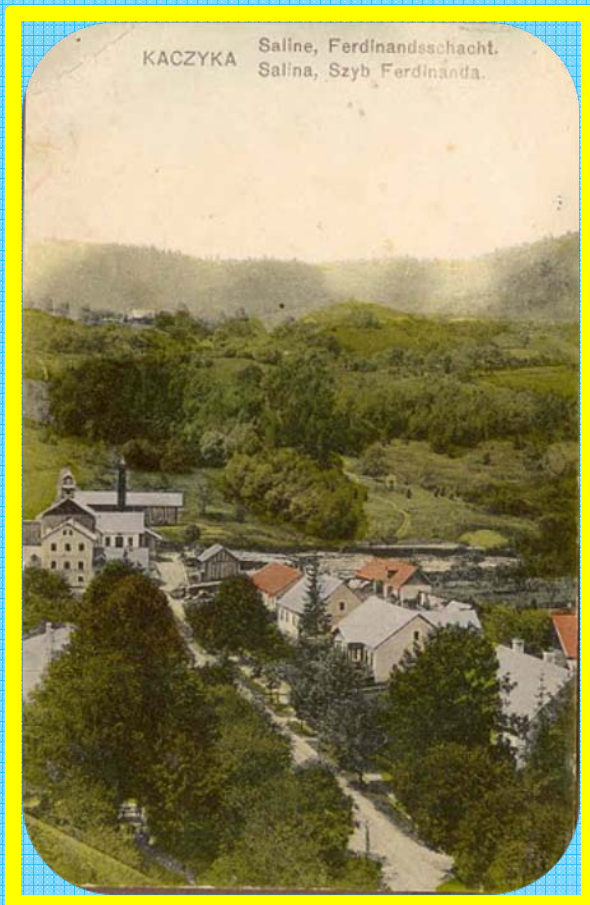
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# 4.























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Thanks very much for  
listening!  
Any Questions?

