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### Modern Tools for Sustainable Development of Territories. Special Topic: Project Management in the Regions of Russia

#### WEATHER CONDITIONS AS FACTOR OF SUSTAINABLE DEVELOPMENT OF ST. PETERSBURG

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#### *Abstract*

Weather plays a decisive role in human life, because all people are more or less dependent on weather, not only physically, but also materially. Negative weather conditions influence the human health not in the best way, and result in a decrease in the level of human efficiency. The center of North-West region of Russia is the city of St. Petersburg, recognized as the cultural capital of the country and the center of attraction for tourists from all over the world. However, the residents of the city consider the local climate dreary and gray. Numerous opinions of St. Petersburg residents indicate that the local extremely changeable weather combined with high humidity does not suit everyone. The given research is devoted to studying the impact of the weather of St. Petersburg on health, well-being, mood, and as a result, on the working capacities of city residents. It is necessary to track the effect of weather on personal productivity and performance, to determine the ways of increasing these indicators. The above-mentioned issues have been little studied, both in the scientific and in the public literature, which notable increases the practical significance of the research. It allows identifying the influence of weather in St. Petersburg on the working capacity of city residents, defining the major adverse factors that affect working capacity and developing preventive measures to reduce the negative impact. The measures developed, if successfully applied, could become factors of sustainable development of St. Petersburg in particular and the North-West region as a whole.

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**Keywords:** Factors of improving work efficiency, St. Petersburg, sustainable regional development, weather conditions in the region, working capacity of the population.



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## 1. Introduction

One famous song says that “Nature has no bad weather, all weather is grace”. But in real life it has long been noted that not all weather conditions have a positive effect on health, mood, psycho-emotional state, and, as a result, on a person’s performance. The performance of people, in turn, has a decisive influence on the company’s profit and on the sustainable development of any region (Afanasyeva & Yurina, 2019).

Human being is a part of nature, and the environment has an extremely strong influence on a person’s mental and physical health. The fact that the weather affects a person is an indisputable fact. The number of people feeling weather changes is constantly growing.

This research is relevant due to the fact that residents of St. Petersburg live and work in adverse climatic conditions, for example, the number of sunny days per year is only 62. Weather is of great importance in human life, a person becomes not only physically more sensitive to its changes, but also materially very dependent on it. St. Petersburg is a city with a poor climate on the one hand, and at the same time with fairly low wages and unemployment on the other hand, if these indicators are related. It is necessary to track the effect of weather on personal productivity at work, and determine the ways to increase it.

Researchers note the need to expand the knowledge of residents of St. Petersburg about the key role of climate in their personal and professional life, so that in difficult weather situations citizens can take actions to reduce the negative impact of weather conditions on their health and well-being, to increase their work efficiency.

The research allows us to identify the impact of weather in St. Petersburg on the working capacity of the city residents, to identify the main adverse factors that affect working capacity and to develop preventive measures to reduce their influence.

## 2. Problem Statement

Unfortunately, despite the availability and accessibility of information about weather and climatic conditions (weather forecasts, news reports, and weather data on the Internet), it is often ignored, unprocessed and also insufficiently applied in practice. The influence of health and well-being on people’s performance is a scientific fact, and weather conditions have a direct impact on these criteria (Sharakhina, Azarova, Bykov, & Achkasova, 2018).

Experts note that St. Petersburg has a temperate and humid climate with elements of a transition from continental to marine. For the North-West region, a frequent change in air masses is characteristic, which, to a large extent, is due to cyclonic activity.

Summer in St. Petersburg is rainy and cool. Winter is cloudy and slushy; western and north-western winds prevail. According to St. Petersburg weather stations, which started their observations in 1722, the highest temperature recorded over the entire observation period was + 37.1° C, and the lowest was 35.9° C.

St. Petersburg is a city of high humidity. During a whole year, cloudy and overcast weather with diffuse lighting prevail in St. Petersburg, and on average there are only sixty-two sunny days, due to the insufficient number of sunny days moisture evaporation is slow (Vorobyova, 2015).

If we consider the total length of the day, it ranges from 5.51 hours in winter up to 18.50 hours during the summer solstice; when the period of “white nights” sets in, the sun goes down over the horizon by no more than 9 degrees and evening twilight merge with the morning.

It follows that negative weather factors prevail in St. Petersburg, therefore, it is necessary to analyze their impact on the working capacity of city residents, as well as develop recommendations to reduce their negative impact, which can result in:

- the increase of the economic well-being of St. Petersburg residents (scientists note that an increase in human performance leads to an increase in labor productivity by an average of 3-20%);
- the increase of economic welfare level of St. Petersburg;
- reducing the psychological burden during periods of unfavorable weather conditions;
- the increase of reserve psychophysical capabilities of St. Petersburg residents;
- enhancement of the health and creative longevity of residents of St. Petersburg;

further sustainable development of the North-West region (Akhmetshin, Ilyina, Kulibanova, & Teor, 2019).

### **3. Research Questions**

- 3.1. What are major features of weather and climatic conditions in St. Petersburg?
- 3.2. How do weather conditions affect the psycho-emotional state and health of residents of St. Petersburg?
- 3.3. What is the correlation between weather conditions and the health of residents of St. Petersburg?
- 3.4. What measures will reduce the negative impact of weather on the working capacity of the region’s residents, thereby contributing to economic growth and sustainable development of the center of the North-West region?

### **4. Purpose of the Study**

The purpose of this study is to find out if the weather conditions in St. Petersburg affect the working capacity of city residents, to determine the degree of this effect, to develop recommendations on reducing the negative factors of the weather impact on the work efficiency of residents of the North-West region of Russia, taking into account the further sustainable development of this region. The intended use of the results: the results of the questionnaire, focus groups and the developed recommendations on how to improve the working capacity of the residents of St. Petersburg can be successfully applied by the

residents of St. Petersburg and the heads of companies, businesses and organizations; it will successfully affect both the psychological and economic constituents of each individual and the economic component of the city as a whole and will contribute to the sustainable development of the North-West region of Russia.

## 5. Research Methods

Economic, mathematical, structural and logical research methods were used; analysis of various documents, regulations, decrees and laws was carried out; a study and analysis of literature was conducted; observation, group interviews, a focus group, a survey, photographing, and a diagnostic experiment were organized.

## 6. Findings

According to the acute coronary syndrome research laboratory of FSBI “National Medical Research Center named after V. A. Almazov”, meteorological dependence, i.e. the connection between weather and people’s well-being, is not a completely proven fact, although there is still some correlation (Pokrovskaya, 2015).

It is proved that in a cold and wet weather – from December to March – in St. Petersburg the number of heart attacks and strokes increases several times. Those who feel unwell on such days begin to associate their health deterioration either with the weather or poor nutrition.

The first stage of the study was organized from 11/01/2018 to 01/05/2018; the main goal was to conduct a sociological survey and to question 1034 residents of St. Petersburg with the aim of studying the influence of weather conditions in St. Petersburg during the winter-spring period on such indirect performance factors as mood, health, and well-being.

The second stage of the study took place from 01/06/2018 – 20/09/2018 in order to study the influence of weather conditions in St. Petersburg (summer-autumn period) on indirect factors of performance.

Since people are born and live in the cities at very different heights, it is impossible to say that there is an ideal atmospheric pressure for a person. The results of a survey of respondents on the issue of weather dependence in St. Petersburg and the data are presented in (Table 01).

**Table 01.** Results of a survey of respondents on the issue of weather dependence in St. Petersburg

Weather dependence	Indicator, percent
Do not consider themselves weather dependent	45.5
Consider themselves weather dependent	54.5

According to the results of the survey, 45.5% of respondents do not react to weather changes, the remaining 54.5% are weather-dependent to one degree or another, of which:

- the weather greatly affects my health – 19.2%;
- the weather, one way or another, affects health – 35.3%.

According to the results of the study, the most optimal humidity for a person of is 50%, the highest humidity is the most difficult to tolerate; 76% of participants experience a health deterioration in high humidity.

Weather dependence is a concept that is very closely connected with atmospheric pressure. Many people report health deterioration due to changing weather conditions. This phenomenon is called weather dependence and manifests itself as the effect of atmospheric pressure on human blood pressure. Due to the fact that St. Petersburg is lower in regards to sea level than Moscow, the higher pressure is the norm. On average, normal atmospheric pressure for St. Petersburg is 753-755 mm Hg. However, in some sources you can see another figure – 760 mm Hg. But this figure is valid only for lowlands of St. Petersburg (Parshutina, Plakhova, Zakharkina, Sokolova, & Isakova, 2019).

Changes in the body occur with any deviation of atmospheric pressure, but the weather-dependent person is especially hard-pressed to suffer a decrease in atmospheric pressure, 79% of respondents noted deterioration in their condition with lowered atmospheric pressure. During this period, a person's breathing quickens, as one experiences oxygen starvation, and one's heart rate increases. The strength of the heartbeats becomes weaker. With increased atmospheric pressure, changes in the state of the body were noted by 73% of respondents, other changes also occur during this period, but they are less significant for a person's health: pulse rate and blood pressure decrease.

Table 02 shows the impact of bad weather on the “loss of strength and drowsiness” of the respondents.

**Table 02.** Results of survey on the sensitivity of respondents to weather changes

<b>Respondents feel</b>	<b>Indicator, percent</b>
Feel a breakdown and drowsiness in cloudy weather	33
No correlation between weather and activity	67

According to the survey, 67% of respondents do not feel “loss of strength” in cloudy weather, perhaps this is due to the fact that residents of St. Petersburg have adapted to cloudy weather and feel quite comfortable. The remaining 33% said they felt a breakdown during cloudy weather. There are several reasons for this. The first is a lack of oxygen in the blood. With a drop in atmospheric pressure, our body lowers blood pressure and reduces the heart rate. The oxygen concentration in the blood drops, it affects the activity of the nervous tissue of the brain, and it also decreases. As a result, the drowsiness occurs.

It is believed that good weather accompanies an upsurge and rain plunges us into depression, the question arises if such a pattern really exists.

Respondents were asked to answer various questions by analyzing their emotional state for several months; the data obtained were processed according to the existing methodology (Grishakina, Manova, & Manova, 2009). The following results were obtained: more than 52% of the respondents in St. Petersburg believe that there is a direct correlation between weather and human mood.

An important criterion for assessing the impact of weather on residents of St. Petersburg is the number of colds per year (Table 03).

**Table 03.** The frequency of colds in St. Petersburg

The frequency of colds in St. Petersburg	Indicator, percent
1-2 times a year	22
3-4 times a year	35
5-6 times a year	32
6-8 times a year	8
More than 10 times a year	3

On average, the interviewed residents of St. Petersburg suffer from colds 3-4 times a year, which is the norm regardless of the territory of residence. According to immunologists, it's "allowed" to get sick quite a lot, up to 5-6 times a year, if a person is a "couch potato", and up to 10 times a year, if a person leads an active social life. We would like to note that not every disease is the same. If a slight health discomfort passes quickly enough and does not bring complications, it is considered normal, but if it ends with pneumonia or bronchitis, then it is serious. So, if 10 easy colds in a year fit perfectly into the norm, two or more cases of pneumonia is already the evidence of a breakdown in the immune system. For healthy people, the climate of St. Petersburg is not dangerous, but those who suffer from chronic respiratory diseases must be very careful about their health (Troshin, 2004).

The average weather score in St. Petersburg, according to the respondents, was 6 points (out of 10 possible); the main reasons why the respondents lowered the points were the following: a small number of sunny days, high humidity and rain, frequent winds, gray sky. According to most respondents, frequent rains, little sun and wind are the main causes of poor climate.

According to the majority of respondents, the main characteristic of the weather in St. Petersburg is its changeability and cloudiness. 67% of respondents in focus groups believe that the climatic conditions of St. Petersburg have a significant impact on human health, and as a result on personal performance. During the process, an interesting fact was found out, namely: the majority of respondents residing in St. Petersburg do not consider light rain to be bad weather; they consider this weather to be normal and even pleasant. To bad weather the respondents attributed a strong wind combined with heavy rain.

In the process of conducting focus groups, the following interesting fact appeared that a person performs work tasks more successfully not in a sunny weather, but in a cloudy weather. 22% of respondents said that they noted a decrease in their working capacity at a time when the sun was shining brightly on the window, however, when the weather worsened, the working capacity, according to respondents, increased. The respondents attribute the results to the fact that under bad weather conditions they don't have thoughts about walking or resting, at this moment they are not distracted from their current work and their productivity is increasing. When the weather is good outside, respondents begin to think about a walk or a trip out of town, and their productivity begins to decline. It turned out that 62% participants in the focus groups noted a change in physical condition during a change in weather conditions. Most often a young age respondents (up to 35 years old) experience headaches, fatigue, and a sharp change in mood. The older age respondents reported joint pain, changes in blood pressure, migraines.

According to the research results, almost every employee is seriously affected by the environment, weather and climatic conditions (Gasarov, Boiko, & Frolova, 2019).

## 7. Conclusion

According to the results of the study, the following conclusions were made:

1. In St. Petersburg the number of weather-dependent people is, on average, 54.5%.
2. Changes in the weather do not equally affect the health and well-being of people. For example, a healthy person's body adapts to weather changes in a timely manner, the physiological processes in the body also adapt to changing weather and climate conditions.
3. Worst of all, according to respondents, they tolerate both very hot weather from + 30°C and above and negative temperatures starting from -10°C.
4. 79% of respondents noted health deterioration in conditions of low atmospheric pressure. During this period, a person's breathing quickens, as a person experiences oxygen starvation, and the heart rate increases.
5. 76% of participants experience health deterioration in high humidity period.
6. On average, the surveyed residents of St. Petersburg suffer from colds 3-4 times a year, which is the norm, regardless of the territory of residence.
7. 67% of respondents do not feel a breakdown in cloudy weather, perhaps due to the fact that residents of St. Petersburg have adapted to cloudy weather and feel quite comfortable.
8. The average score given to the weather in St. Petersburg was 6.7 out of 10 possible.
9. According to respondents, the main characteristic of the weather in St. Petersburg is its changeability and cloudiness.
10. Residents of St. Petersburg, do not consider light rain as bad weather, they consider this weather normal, and even pleasant. To bad weather, the respondents attributed a strong wind in conjunction with heavy rain.
11. Despite the negative factors that white nights have on the human body, about 82% of respondents said they do not feel discomfort during this period. It could be due to the fact that people often simply do not associate the negative phenomena that occur in their bodies with the season of white nights or have adapted to it.
12. According to the results of the experiment, the following data were obtained: 57% of respondents noted a decrease in working capacity during the experiment, 36% of them had increased blood pressure, 27% had a low blood pressure. The results of the experiment show that there is a direct correlation between working capacity and blood pressure; thus, arterial changes in blood pressure lead to a decrease in work capacities.
13. After analyzing the data on work efficiency, the results of the study showed that in bad weather people make fewer mistakes and also manage to do much more work. However, when it is warm and sunny on the street the work efficiency decreases.
14. According to 40% of respondents, the working mood does not depend on weather conditions, 38% said that they have more strength and energy in cloudy weather, 22% said that they work better in sunny weather.

According to the results of the study, weather conditions in St. Petersburg affect the performance of city residents. Thus, the hypothesis of the study was confirmed.

Preventive measures (to reduce the possible environmental risk) include body hardening, rational healthy nutrition, taking vitamin and mineral supplements, active lifestyle, sound sleep, refusing bad habits (Press Service of the National Medical Research Center named after A. A. Almazov, 2016).

The practical significance of the work lies in the possibility of its use by residents of St. Petersburg and the North-West region in order to increase the level of health and performance. Conclusions and recommendations presented as a result of the research can be useful to all people who care about their health, performance and financial well-being.

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