Determining the carbon footprint of Russian residents depending on their food and movement patterns

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Abstract. Due to climate change, all the inhabitants of the Earth are increasingly observing various natural anomalies. The consequences of global warming are particularly noticeable for Russia, where it is about 2.5 times faster than in the rest of the world (the Russian Federation almost does not experience the softening influence of the ocean due to geographical features, so the climate is particularly sensitive). In order to successfully forecast climate change and develop an adequate adaptation program, it is necessary to assess the volume of emissions of the main greenhouse gas CO2 in a timely manner. Since the final carbon footprint of the Russian Federation largely depends on the environmental awareness of the young generation and its contribution to the existing climate change problem, the subject of this article was the average carbon footprint of young people (18-25 years old) in the Russian Federation.

1. Introduction
A Special report "Global Warming of 1.5°C" [1] was published by the IPCC in October 2018. The report highlights a number of different climate change impacts that could be avoided by limiting global warming to 1.5 °C or more.

This report implies that limiting global warming to 1.5 °C will require rapid transitions from humanity involving all life-supporting systems: industrial, energy, land, as well as spheres of transport and buildings. Global emissions of carbon dioxide (CO2) caused by human activities will need to be reduced by almost 45% by 2030 compared to 2010 levels, reaching "net zero" by about 2050.

The target global level of emissions which will allow to fight with climate change is 2 tons of CO2-equivalent per person per year [1]. It should be noted that in accordance with [2], as of 2017, the average global carbon footprint per capita is approximately 4.8 tons per person per year, while in Russia this figure is more than twice exceeded and is equal to 11.86 tons [3].
1.1. Methodology of the study
A sample of people aged 18-25 estimated their average spending in rubles per year for each of the 14 different sections of the questionnaire. The sections used for the assessment were selected using "2012 Guidelines to DEFRA / DECC's GHG Conversion Factors for Company Reporting". The source of the data used was the center for sustainable development accounting (CenSA), Leeds, UK. The sections are almost similar to those offered for estimating your secondary carbon footprint using the international carbon Footprint calculator. However, the cost of insurance is excluded from consideration as not significantly affecting the total value of the secondary carbon footprint (less than 0.1% of total emissions). Instead, it includes an estimate of the number of hours that the respondent spends on flights per year, which makes it possible to take into account the carbon footprint, including from air travel.

It is important to note that despite the fact that respondents estimated their expenses for personal transport - cars and motorcycles, only the cost of parts, maintenance and insurance was taken into account, the amount of fuel was not taken into account.

As part of the analysis of the data obtained, outliers were removed from the sample. In this paper, all measured values that deviate from the average by an amount greater than three standard deviations were considered outliers.

1.2. The definitions
It is well known to scholars that the greatest impact on the value of the annual carbon footprint of each person is not only the length in hours of air travel (or the amount of fuel they regularly burn), but also their diet. In order to take this factor into account, in this article the authors took into account the type of nutrition of each respondent.

Emissions calculations take into account the difference between different types of food, such as vegan (vegetarian) or meat-eating. The calculation is made by using special coefficients, that are unique for each type of nutrition. The coefficients are given in the Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK [2], where the following definitions are used:

- **High Meat Eater** > 100 g of meat per day (average)
- **Medium Meat Eater** = 50-100 g of meat per day (average)
- **Low Meat Eater** < 50 g of meat per day (average)

1.3. Calculations and limitations
It should also be noted that since the official currency of the Russian Federation is the ruble, and the currencies accepted for calculations in the Carbon Footprint Calculator are the dollar and the Euro, the study was estimated in euros at the accepted ratio of 1 Euro = 72.4101 rubles (the average annual value for 2019).

Accordingly, the study took into account all areas of life and the main types of expenses, but it is important to note that of the three types of possible transport used: air, land and water, estimates of the carbon footprint were made only for air travel. Accordingly, further research in this area will also need to take into account the release of CO2 from the use of metro, cars, electric trains, trains, ferries, and so on.

2. Main part
To get the overall results shown in figure 1, according to the Hybrid Approach - Hybrid EIO-LCA method, spending on a specific product category was multiplied by the coefficient of the selected industry. There are two main categories that make a global contribution to the carbon footprint of each respondent: food and flights. Let's take a closer look at the statistics below.
Based on the results obtained in the survey, we will build a summary chart and use it to show the trend of changes in human carbon dioxide emissions depending on their preferred lifestyle. Note that the average footprint value for a case involving air travel is slightly higher than the global target, but does not reach the Russian average of 11.86 tons. It indicates that the main categories that affect climate change are not the generation 18-25 years, but other categories, for example, older people, which indicates sufficient environmental awareness of the young generation.

You can follow the trend that the more meat consumption, as well as the number of air travel, the higher the carbon footprint. The best indicators in this study are those of respondents from the first two categories: fish & vegetarian eaters and low meat eater. The highest excess of the global recommended level of emissions was registered in the high meat eater category.

According to the source [6,7], the production of meat and dairy products is in the first place in the world in terms of the degree of influence on climate change. The share of greenhouse gases generated during their production is approximately 25%. This is almost as much as all types of transport in the world produce, including ships and planes.
Figure 2. Respondents carbon footprint as a result of their average annual spending depending on the number of flights and food patterns.

2.1. Nutrition recommendations
According to the statistics obtained, we see that it is not necessary to completely abandon the consumption of meat, you only need to reduce its amount in the daily menu, then even taking into account periodic travel by plane, the target value will not be exceeded.

Therefore, to reduce the climate footprint for the high meat eater, medium meat eater categories, you can act within the framework of conscious consumption: reduce the amount of red meat in the diet, especially beef and lamb, as well as cheese and dairy products. All this should be replaced with vegetable proteins, which will help to avoid a shortage of missing substances without harm to the environment.

Unfortunately, responsible food choices alone will not be enough to significantly reduce the carbon emissions that people are responsible for. This is also affected by lifestyle, such as active use of electricity, the presence of a car, and frequent air travel.

2.2. Recommendations for air travel
It is important to note the significance of reducing the number and range of flights for absolutely all categories of respondents. According to figure 3 you can see that the carbon footprint of each person is higher by 17%-23.5% if the person uses the services of air carriers, and does not prefer, for example, to use the train.

General recommendations for people which will help to reduce the carbon footprint of air travel are:

- fly economy class (instead of business class, it will help to improve efficiency);
- take direct, non-stop flights (it will help to avoid high emissions during takeoff and landing or the plane);
- take daytime flights (due to heat-trapping effect of contrails and cirrus clouds at night, sunlight reflecting during day);
- choose airlines carefully (some airlines do a better job - they have a full passenger loading and use more efficient planes in their aviaparks);
• offset your flights, and avoid flying on either very small or very large planes (very small regional jets or very large aircrafts with four engines are less fuel efficient than typical single aisle or small twin-aisle aircraft).

These tricks generally reduce CO2 emissions from your flights by around 20% to 45%, depending on the route [8].

![Figure 3](image)

**Figure 3.** Percentage of impact of aviation use on the carbon footprint.

3. Conclusion

According to the study, on average, the life activity of representatives of Russians aged 18-25 on average slightly exceeds the established target global level of emissions to combat climate change. But with a small adjustment to the diet and the number of regular flights, in their age category, they can keep global temperatures within acceptable limits. This can also happen due to the formed environmental literacy, shifting the focus from materialism to minimalism, and for many other reasons, for example, economical reasons.

Therefore, it becomes clear that the first step is to study the lifestyle of the older generation and explain to people the consequences of their lifestyle for the planet.

References

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