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EVALUATION OF CARBON FOOTPRINT FROM TRANSPORTATION IN TURKEY

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ABSTRACT

Today, approximately 95% of the energy consumed for transportation all over the world is met by engines using hydrocarbon fuels. Accordingly, approximately 20% of global greenhouse gases are produced by the combustion of fuels used in transportation. CO₂, CH₄, and N₂O are the most important greenhouse gas emissions from transportation. The identification, monitoring, control, and reduction of greenhouse gases from transportation have a significant impact on global climate change. In this study, the greenhouse gas emissions from transportation in Turkey were evaluated. For this purpose, greenhouse gas emissions measured between 1990-2019 were used. Emission values are taken from the data of the Turkish Statistical Institute (TUIK). CO₂ emissions from transportation in Turkey have increased every year since 1990. CH₄ emissions from transportation have increased since 2000 and have recently reached their highest values. N₂O emissions from transportation showed a small increase and followed a stagnant course for long years.

1. INTRODUCTION

Logistics was first introduced by Colonel Chauncey B. Baker in 1905 to describe military functions such as transporting materials and personnel and supplying them. It came to our country as a sector in the 80s and 90s. All processes in the delivery of raw material or product to the final consumer include logistics. These processes are production, supply, stocking, packaging, data processing, customs clearance, foreign trade, return, insurance and most importantly transportation.

Transportation, which is the important link of logistics, can be defined as the transportation of any product or raw material from one place to another by using certain transportation vehicles, depending on certain conditions. Transportation is divided into airline, seaway, highway, railway and pipeline. The highway is the most preferred mode of transportation because it is the oldest mode of transportation in the world. One of the biggest reasons for this is that there are no airports, railways, and ports everywhere. After the deliveries from a certain place to a certain point by seaway, airline, railway, they reach their final destination by highway. The most reliable transportation is by airline. In the second place is railway transportation. Seaway stands out as the cheapest mode of transportation. The most expensive means of transportation is by airline. Seaway transportation is used mostly in international activities. Today, approximately 95% of the energy consumed for transportation in the world is met by engines using fossil fuels. Approximately 20% of global greenhouse gases are produced by the combustion of fuels used in transportation. The biggest emission source in the transportation sector is highway transportation. The greenhouse gas emissions from transportation are CO₂, CH₄ and N₂O. Monitoring and control of greenhouse gases from transportation has a significant impact on climate change. Almost all countries in the world are working to reduce greenhouse gas emissions from transportation.

Piecyk and McKinnon have estimated the carbon footprint of road freight transport in 2020. In their work, presented the main trends in logistics and supply chain management. Moreover, have reported that different studies applied to determine the environmental effects of CO₂ emissions [1]. Kannan et al. have designed a model for reverse logistics network design aimed at minimizing the CO₂ footprint. The model they designed combines the location/transport decision problem to

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recover used products [2]. Cansız and Ünsalan examined the CO₂ emission in the transportation sector depending on the transportation routes of unimodal transport and multi-modal transport. In the study, the effects of different cargo tonnages on the choice of transportation type were determined for minimum CO₂ emission. They showed that the use of multi-modal transport routes can reduce CO₂ emissions compared to unimodal transport, especially road transport [3]. Bıyık and Civelekoğlu determined the carbon footprint of the road transport sector for Isparta province. In their studies, they focused especially on the calculation of carbon footprint based on CO₂ emissions. Tier 1 and Tier 2 calculation methodologies have used in their emission calculations [4]. Bıyık and Civelekoğlu examined the carbon footprint of Turkey and G20 countries between 1990 and 2016 [5].

2. IPCC METHODOLOGY

Detailed reports on scientific, technical, and socio-economic issues on climate change and its future risks are prepared by countries that are members of the Intergovernmental Panel on Climate Change (IPCC). Energy, industrial processes, use of solvents and other products, agriculture, use of earth's geography and forests, and waste are the main topics in the greenhouse gas inventory calculations of the IPCC [4].

The IPCC uses Tier Approaches when calculating greenhouse gas emissions. In the Tier 1 approach, only fuel consumption is considered. In the Tier 2 approach, fuel consumption groups are separated using emission factors. In the Tier 3 approach, emissions are calculated by taking into account factors such as the length of the vehicles covered or the value of the aged load, unlike the fuel consumption values [5].

3. GREENHOUSE GASES

The rays coming from the sun to our world are reflected after they hit the earth and are kept in the atmosphere, warming the earth. The warming of the Earth by catching the sun's rays by greenhouse gases, which are water vapor, carbon dioxide, methane and nitrous oxide, is known as the greenhouse effect. The greenhouse effect is part of a natural process. However, greenhouse gases are increasing as a result of the necessities of human life and as a result, the problem of global warming arises. The use of fossil energy sources to meet vital needs such as energy, raw materials and products, the change of landforms, the destruction of nature have led to an increase in the amount of greenhouse gases. Carbon dioxide (CO₂), Methane (CH₄) and Nitrous Oxide (N₂O) are among the most well-known greenhouse gases.

3.1. Carbon dioxide (CO₂)

About 75% of greenhouse gas emissions caused by humans are carbon dioxide. The biggest factor in the formation of CO₂ is the use of fossil energy sources such as coal, oil and natural gas. The change in landforms and the destruction of nature have also helped increase CO₂ emissions. CO₂ is the gas that retains the most heat among the greenhouse gases.

3.2. Methane (CH₄)

Although the ratio of methane gas among greenhouse gas emissions is 16%, it is 25 times more effective in global warming than CO₂ due to its very high capacity to absorb infrared radiation. Methane gas arises as a result of the breakdown of organic wastes, incomplete combustion in combustion processes, energy production and use and livestock activities.

3.3. Nitrous oxide (N₂O)

N₂O is naturally present in the atmosphere due to the nitrogen cycle. The lifespan in the atmosphere can be more than 100 years. About 40% of N₂O in the atmosphere originates from humans. Its ratio among all greenhouse gases is 6%. Processes such as the use of fertilizers in agricultural activities, combustion in internal combustion engines, the use of fossil fuels and the cleaning of domestic wastewater cause the formation of N₂O. N₂O has about 300 times more impact than CO₂ on global warming.

4. RESULTS

Data from the Turkish Statistical Institute (TUIK) were used to evaluate the carbon footprint of transportation in Turkey. The data used are the emission values measured for the years 1990 to 2019. Figure 1 shows the CO₂ emissions from transportation and the amount of these emissions in Turkey's total CO₂ emissions. CO₂ emissions from transportation have increased continuously since 1990 and it is seen that this increase reached its highest values after 2016. The highest CO₂ emission value among the analyzed years reached its highest value of 82953 thousand tons in 2017. In the following years, it has continued at close values. It is seen that total CO₂ emissions in Turkey have the highest value in 2017.

Figure 2 shows CH₄ emissions from transportation and the amount of these emissions in Turkey's total CH₄ emissions. CH₄ emissions from transportation have increased especially since 2000 and this increase reached its highest values after 2018. In Figure 2, it is seen that the highest CH₄ emission value is 16 thousand tons. And this value was first measured in 2018 and then in 2019. It is seen that total CH₄ emissions in Turkey have the highest value in 2019.

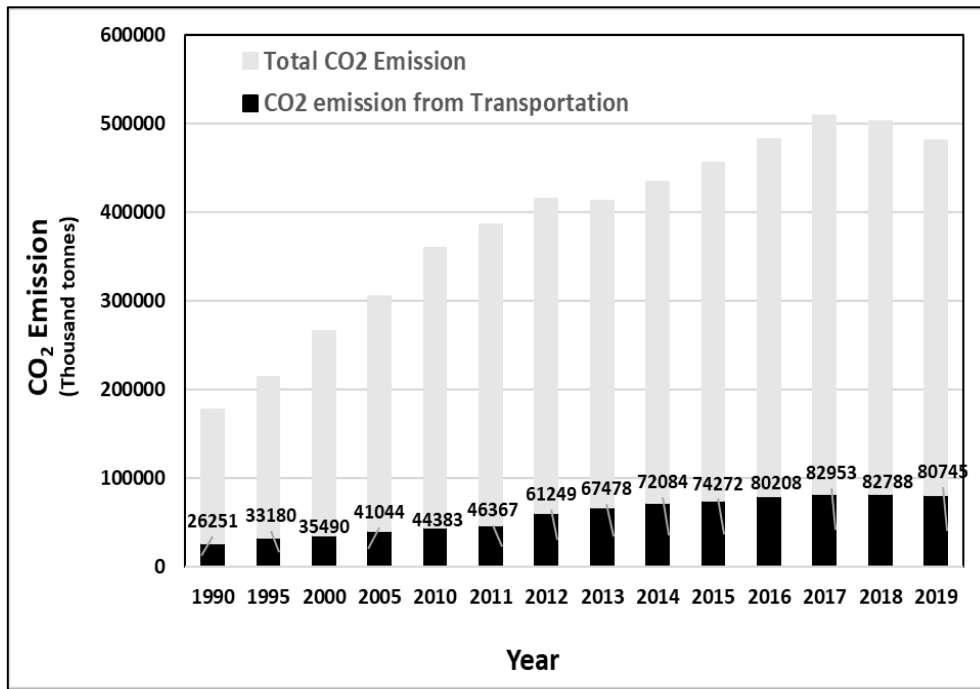


Fig 1. CO₂ Emissions from Transportation

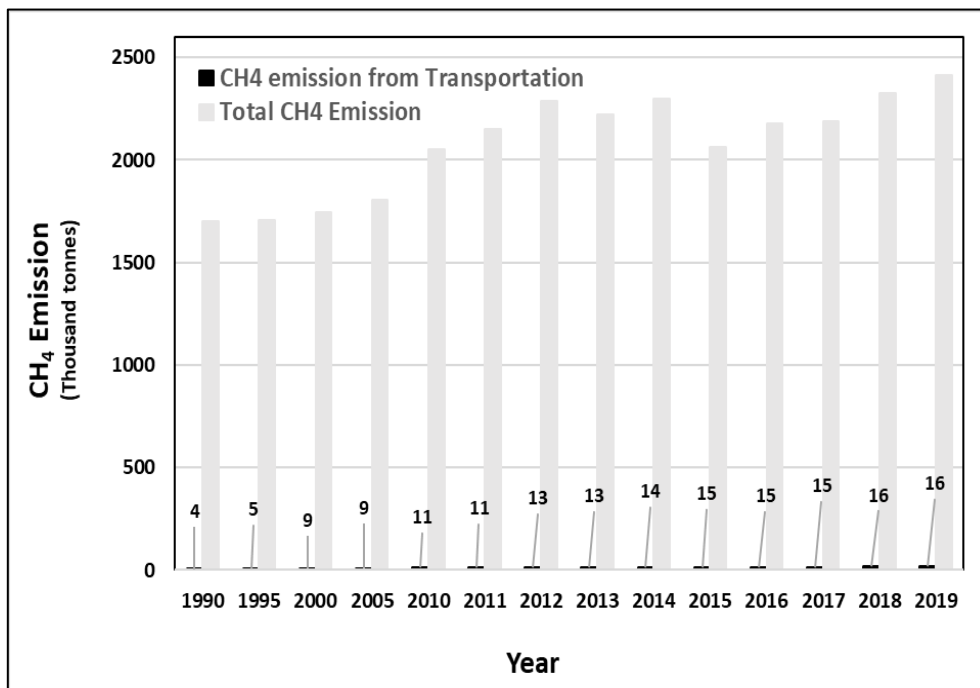


Fig 2. CH₄ Emissions from Transportation

N₂O emissions from transportation and the amount of these emissions in Turkey's total N₂O emissions are given in Figure 3. Figure 3 shows that N₂O emissions from transportation have remained the same at 4 thousand tons since 2013. It is seen that total N₂O emissions in Turkey have the highest value in 2019. And this value is approximately 135 thousand tons.

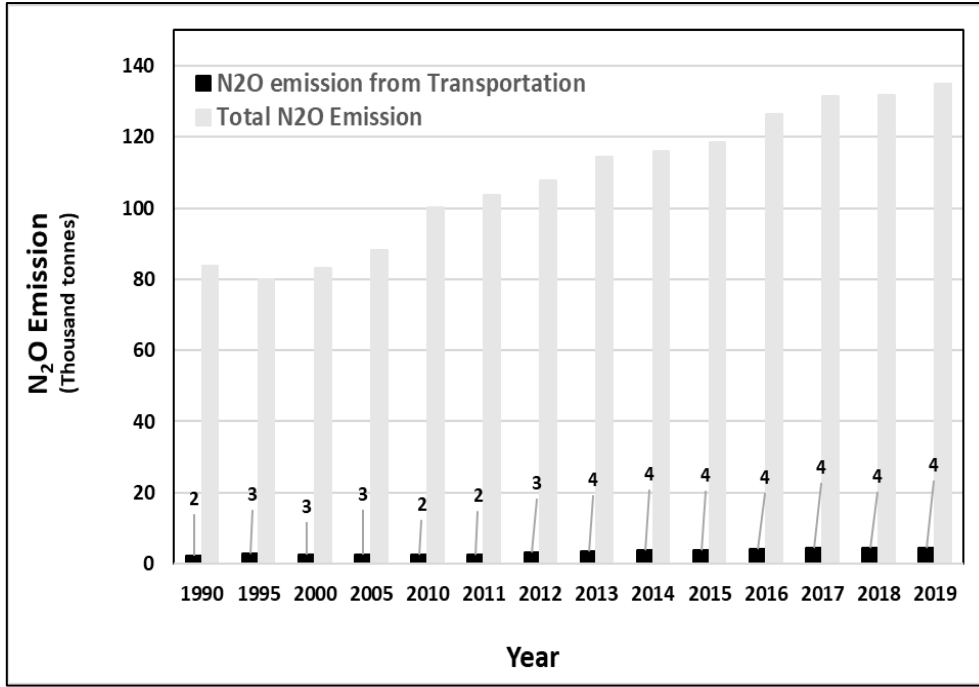


Fig 3. N₂O Emissions from Transportation

5. CONCLUSIONS

20% of greenhouse gases that cause climate change are emissions from transportation. And it is formed as a result of the combustion of fossil fuels. In this study, an evaluation of carbon emissions from transportation in Turkey has been made. It has been observed that carbon emissions from transportation in Turkey are increasing year by year. Some suggestions can be made to reduce emissions from the transport sector, especially road transport;

- Fuel consumption of vehicles used in transportation should be reduced.
- Alternative fuels such as liquefied petroleum gas (LPG), compressed natural gas (CNG) and liquefied natural gas (LNG) should be used in vehicles,
- The use of hybrid and electric vehicles should be increased,
- The use of electric vehicles in logistics should be increased,
- Transport policies should be revised,
- Public transportation should be encouraged,
- Rail and sea transportation should be preferred,
- Legal arrangements should be made to reduce emission values.

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