ISSN: 2181-8150 Vol.119, №4 (2026)

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10.63241/AKHVvol119y2026iss4m11

CARBON FOOTPRINT ASSESSMENT AS A FACTOR IN IMPROVING THE ECOLOGICAL CULTURE OF YOUNG PEOPLE: INTERNATIONAL METHODOLOGY AND UZBEKISTAN’S CASE

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Abstract. This article analyzes the importance of raising environmental awareness among young people and assessing their “carbon footprint” in the context of climate change. Drawing on international research experience, it examines how young people’s daily habits affect nature and how they can develop personal responsibility in this regard. This article also serves as a proposal for future actions; its main goal is to summarize existing global knowledge and apply it directly to the national context of Uzbekistan. It argues for the need to apply international experience to the condition of Uzbekistan, conduct systematic research among young people, and increase national environmental literacy.

Keywords: Carbon footprint, young people, climate change, environmental literacy, sustainable development, low-carbon consumption, digital monitoring

Annotatsiya. Ushbu maqola iqlim o‘zgarishi sharoitida yoshlar orasida ekologik xabardorlikni oshirish va ularning “uglerod izi”ni baholashning ahamiyatini tahlil qiladi. Shuningdek, xalqaro tadqiqotlarga tayangan holda yoshlarning kundalik odatlari tabiatga qanday ta’sir qilishi va bu borada ularda shaxsiy mas’uliyatni qanday rivojlantirish mumkinligini o‘rganadi. Ushbu maqola kelajakdagi harakatlar uchun tavsiyalarni ham o‘z ichiga oladi; uning asosiy maqsadi mavjud global bilimlarni umumlashtirish va uni to‘g‘ridan-to‘g‘ri

O‘zbekistonning milliy kontekstiga qo‘llashdir. Maqolada xalqaro tajribalarni O‘zbekistonning o‘ziga xos sharoitlariga moslashtirish, yoshlar o‘rtasida tizimli tadqiqotlar o‘tkazish va milliy ekologik savodxonlikni oshirish zarurligi ta’kidlangan.

Kalit so‘zlar: Uglerod izi, yoshlar, iqlim o‘zgarishi, ekologik savodxonlik, barqaror rivojlanish, kam uglerodli iste’mol, raqamli monitoring

Аннотация. В данной статье анализируется важность повышения экологической осведомленности среди молодежи и оценки их «углеродного следа» в контексте изменения климата. Также, на основе международных исследований, рассматривается, как повседневные привычки молодежи влияют на природу и как они могут развить личную ответственность в этом отношении. Статья также содержит рекомендации для дальнейших действий; ее главная цель – обобщить существующие глобальные знания и применить их непосредственно к национальному контексту Узбекистана. В статье подчеркивается необходимость адаптации международного опыта к специфическим условиям Узбекистана, проведения систематических исследований среди молодежи и повышения национальной экологической грамотности.

Ключевые слова: Углеродный след, молодежь, изменение климата, экологическая грамотность, устойчивое развитие, низкоуглеродное потребление, цифровой мониторинг

INTRODUCTION

Climate change is a pressing issue that is now higher on the global political agenda than ever before. In fact, protecting clean air is not a new issue; it has emerged simultaneously with the development of industrial transport [1]. Various studies are being conducted to adapt to climate change and prevent risks, especially calculating the carbon footprint and identifying its direct and indirect sources, which is important in averting the expected risks.

The carbon footprint is one of the most important factors affecting climate deterioration worldwide [2]. “Carbon footprint” has become a widely used term and concept in public discussions about responsibility and risk reduction in the face of the threat of global climate change [3]. The concept of carbon footprint, based on today’s complex process, is deeply penetrating not only political, but also social life and economy, strengthening its position, in other words, today there is a need to face climate change and take into account the carbon footprint when making any decision.

In terms of mitigating climate change and preventing its tragic consequences, different approaches are being taken to the issue, depending on the situation in regions and countries. In particular, active efforts are being made in climate policy in Uzbekistan. For example, the declaration of 2025 as the “Year of Environmental Protection and Green Economy” in Uzbekistan [4] is significant at a time when the

consumption habits of the population, especially millennials, are significantly affecting the country's carbon emissions. Although young people have environmental knowledge, the problem of their inability to accurately visualize their personal carbon footprint creates the need for the widespread introduction of digital tools such as carbon calculators [5] among young people.

In recent years, human factors have been directly influencing climate change. People use more of their daily needs, while waste is returned to nature, which leads to air pollution and soil degradation. This unsustainable pattern of consumption and disposal significantly contributes to greenhouse gas emissions, which are the main factors of global warming, and to the associated environmental, social and economic problems. Understanding and quantifying these virtual emissions, often referred to as an individual's or legal entity's carbon footprint, is an important step towards effective mitigation strategies [5].

Experts say that in recent decades, the climate system has undergone unprecedented changes and a significant increase in external temperatures. For many years, human activities have flooded the environment with greenhouse gases such as methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O). They are now recognized as the main contributors to climate change [6]. Given the urgency of addressing climate change, it is crucial that we understand the perspectives and attitudes of young people, who are active participants in social life, towards climate change [7].

A personal carbon footprint is determined by calculating the amount of carbon dioxide (CO_2) an individual emits into the atmosphere, directly or indirectly. Calculating and reporting a carbon footprint allows us to manage the risks of greenhouse gases and identify opportunities to reduce them [8]. On the other hand, reducing our carbon footprint is also important in mitigating climate change and reducing the risks associated with global warming. The carbon footprint defines the direct emissions of carbon dioxide from the burning of fossil fuels, which are reflected in our electricity consumption and the use of various means of transport (cars, planes and trains). Through this footprint, we can directly control the amount of our emissions [9]. Footprint assessment increases the level of environmental awareness of the population and provides a basis for measuring the impact of future policy and technical measures to reduce consumption and related greenhouse gas emissions [10].

Environmental literacy plays an important role in helping individuals understand the consequences of climate change [7]. Reis and Ballinger concluded that information from climate change organisations (such as the Intergovernmental Panel on Climate Change, or IPCC) was not being communicated satisfactorily at the local level [11].

METHODOLOGY

The sources of carbon footprint are not limited to companies or organisations; there are many sources of its generation. For example: carbon footprint of

individuals, carbon footprint of products, services and events, etc. Each carbon footprint category has different methods of determination and thresholds. The values of individual carbon footprints are related to people's lifestyles and the impact of their activities on the environment [6].

Within the framework of this study, three main scientific criteria were identified and applied in practice for the systematic selection of comparative and analytical materials. First, it was checked that the selected literature focused on models for measuring carbon footprints at the personal or household level, rather than macro-industry indicators. Second, the sources were selected for works that empirically studied the impact of digital monitoring tools on the consumer culture of young people. Third, the priority criterion was whether the analyzed documents reflected mechanisms for integrating digital tools into the education system or specific results that could be measured in practice.

The database was based on international scientific sources, the National Committee of the Republic of Uzbekistan for Ecology and Climate Change, the International Foundation "Zamin", as well as UNDP reports and official reports of the "Gazeta.uz" publication. As part of the study, digital experiences abroad were compared with cases of a newly emerging ecological culture and sense of belonging, as well as carbon literacy, in Uzbekistan.

RESULT AND DISCUSSIONS

A study conducted among students at North Carolina State University (NCSU) found that activities that focused on carbon footprint, ecological footprint, and lifestyle change not only provided project participants with new knowledge, but also encouraged them to think critically about their own ecological footprint. Students analyzed the effectiveness of their personal actions by implementing daily changes into their routines. The impact of these activities extended beyond the classroom to the campus community and increased a sense of collective responsibility for sustainability issues. Although there were factors beyond the students' control, such as financial constraints, rental housing, dietary restrictions, and health concerns, through EF activities, students reflected deeply on their outcomes. They made conscious changes to their lifestyles, which had a significant impact on their environmental choices, regardless of the chosen path. When analyzing student performance, approximately 24 percent of participants acknowledged that even small individual actions can have a significant impact on society as a whole [12].

Another such study was conducted in Italy to assess the impact of digital tools on young people's minds in the context of climate change adaptation, as well as to increase their awareness of environmental responsibility and carbon footprint. The researchers say that simply providing theoretical knowledge is not enough. Increasing young people's awareness of their personal carbon footprint helps them

answer the question "What does my action give?" and feel personal responsibility [13].

In general, calculating ecological footprints alone is not enough to create an environmentally literate population, but hands-on experiences that connect students personally have been shown to be highly effective in developing personal responsibility. The North Carolina State University researchers say their approach can play a role in communicating the importance of behavioral change, increasing campus sustainability, and guiding university policies toward sustainable resource use [12].

Edstrand, another expert who conducted a survey among students, notes that the main purpose of the carbon footprint tools they created is to give people, especially students, more information about the greenhouse gases they emit, so the main focus in the design of these tools is on educational purposes, rather than prioritizing the achievement of an accurate carbon footprint estimate. This deliberate emphasis is crucial to raising awareness among individuals, especially students, about their environmental impact, rather than striving for flawlessly accurate calculations. As a result, while the tools provide an estimate of carbon footprints, particularly in terms of CO_2 equivalent emissions for various sectors, their main goal is to develop a deeper understanding and awareness of the environmental consequences of human actions [14].

Although research methods in higher education institutions vary, they all share a common goal of ensuring the active participation of stakeholders in reducing the risks of climate change. The researchers emphasize that the intended purpose of the research is not one-sided, and that digital tools aimed at calculating carbon footprints and student surveys are intended to provide theoretical knowledge, raise awareness, as well as encourage practical action, thereby building environmental responsibility.

Youth participation in climate risk management: The case of Uzbekistan

The scope of environmental reforms in Uzbekistan is expanding. By government decree, the Green Initiatives Support Fund was established under the Youth Affairs Agency, which provides for financing youth projects related to ecology, green energy, and nature protection with up to 10 billion soums annually [15]. By December 2024, 112 eco-volunteer clubs were registered (3 times more than in 2020) and more than 65,000 members were mobilized. More than 600 volunteers were involved in the "Train to the Aral Sea" campaign in May 2025 [16].

An innovative initiative to provide climate education to 1.3 million young people in 2025, in partnership with UNDP, EAA, Zamin Foundation and MMTV, has been launched. This three-year project, with a total budget of 7.5 million USD, is an important step in introducing environmental governance principles into the education system of Uzbekistan [17]. Additionally, today 258 schools are participating in the Eco-Schools Uzbekistan project, which brings together more than 94 thousand students, 3 thousand eco-activists and 1 thousand teachers. More

than 30 online trainings, more than 15 hashar events and international camps have been organized within the framework of the project [18], which also indicate that the number of green and sustainable future initiators in the country is increasing. At the same time, it would be appropriate to use digital tools to further complement such initiatives, conduct deeper analyses of the environment, air pollution, emission sources and the impact of anthropogenic factors on it.

The comparison shows that while individual digital monitoring tools (calculators) are developing in Western countries, in our country it turned out that youth activism is taking place more in the form of mass actions. There are a number of national and structural specifics in adapting Western models of personal carbon monitoring to the lives of urban youth in Uzbekistan. For example, international calculators often offer the user to switch to an alternative green energy provider, but since the energy system in Uzbekistan is centrally managed by the state, it was found that local calculators need to direct young people to energy-saving technologies at home. Besides that, due to the high price sensitivity among local youth, calculators can help young people not only reduce environmental damage, but also achieve economic incentives by saving resources.

In general, measures and studies related to reducing the carbon footprint are being implemented in stages. Similarly, the calculation of Uzbekistan's domestic carbon footprint is also being carried out on the basis of a specific strategy. The importance of carbon footprint issues in Uzbekistan Uzbekistan's greenhouse gas emissions profile is a serious challenge for its climate goals. The country emitted 132.4 million tons of CO_2 in 2022, which is 3.7% more than the previous year. This per capita figure is 3.79 tons of CO_2 per person. When all greenhouse gases are taken into account, the figures are even higher, with total emissions in 2021 amounting to 192 million metric tons of carbon dioxide equivalent, making Uzbekistan the 37th largest emitter in the world. This shows a worrying upward trend in the country's emissions. The macro-level problems in the country are rooted in energy sources. However, this macro trend makes the proposed project even more important. While the calculator cannot directly change the national energy grid, it does address the demand side of the energy equation. By raising personal awareness of the carbon impact of everyday electricity use, it can drive demand for energy efficiency and sustainable practices [5,19]. In addition to methods that allow companies, organisations, cities, products, and services to assess their carbon footprint, it is also important to develop methods that allow individuals to assess their own individual carbon footprint. Knowing their carbon footprint can help raise awareness of the problem for each individual. However, the approach here should be quite different from that used for companies, as the focus should be on user-friendly questionnaires that can be completed in a short time. Moreover, the questions should be easy to answer without asking for information that most people would not be able to provide [13].

International research and analysis of current environmental initiatives in Uzbekistan show that the role of young people in the fight against climate change is invaluable, but much remains to be done in this regard. Studies conducted abroad have shown high efficiency in analyzing student behavior and carbon footprints [12]. In the conditions of Uzbekistan, it is necessary to increase scientific research that studies the consumption habits of local students and young people, their impact on climate change. This will provide a basis for understanding the exact scale of the problem and developing national strategies. In Uzbekistan, digital tools should be popularized so that young people can see in concrete numbers how their daily lives (energy, transport, waste) affect nature. Also, the "Green Initiatives" and climate education projects implemented in Uzbekistan [15,17] are in line with the internationally recognized principle of "change through education". Through eco-volunteering and practical projects, young people not only gain knowledge, but also become the main force promoting a sustainable lifestyle in society. Ultimately, adapting foreign experience to the national context, forming a culture of carbon footprint calculation among young people, and supporting these processes with systematic research are the most appropriate ways for Uzbekistan to ensure climate sustainability.

CONCLUSION

In summary, given that carbon emissions, air pollution, and ultimately, climate change are the main causes of anthropogenic factors, it is necessary to raise the awareness of the population, especially the growing younger generation, to improve their sense of environmental responsibility, thereby facilitating the transition of society to a sustainable and green lifestyle. Since climate change poses a serious threat to the stability of communities, as well as to the health of individuals [20], solving these problems and preventing future losses is almost impossible without the participation of the general public. Similarly, combating the climate crisis requires action from all of us. In addition to government and corporate actions, the widespread implementation of individual actions (for example, choosing energy-efficient vehicles, consuming plant-based alternatives to meat products, abandoning unnecessary needs, thereby forming a culture of sustainable consumption, as well as energy saving measures) will help reduce greenhouse gases [21]. None of the environmental reforms will give as effective results as raising awareness of the population and ensuring their participation in the process of finding solutions [7].

Based on the results of the analysis, some practical measures are proposed to systematically form a low-carbon consumption culture among young people. First, based on the specific characteristics of the Uzbek consumer market, it is necessary to create and implement a simplified national digital carbon calculator mobile application. Also, the gradual integration of interactive modules on practical calculation of personal carbon footprint into the curricula of universities and secondary schools can be an important step in forming environmental awareness and a sense of responsibility among young people.

American climate scientist Louis J. Bitgan said: “One of two things: people will clean the air – the smoke in the air will decrease, or the smoke will make it so that it will clean people from the ground – it will kill them” [1]. Therefore, it is necessary to ensure the active participation of industry experts, political circles and representatives of the general public in studying any positive and negative changes related to climate change, their causes and eliminating their consequences.

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