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HUMAN SECURITY IN CARBON FOOTPRINT CALCULATOR PROGRAM FOR THE DEVELOPMENT OF SUSTAINABLE TOURISM IN INDONESIA

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HUMAN SECURITY IN CARBON FOOTPRINT CALCULATOR PROGRAM FOR THE DEVELOPMENT OF SUSTAINABLE TOURISM IN INDONESIA

ABSTRACT

This article explores the Carbon Footprint Calculator (CFC) initiative implemented by the Indonesian government as part of its efforts to promote sustainable tourism. The CFC program enables travelers to estimate the carbon emissions generated during their journeys. These emissions are then translated into a monetary value, which travelers are expected to pay as a form of accountability for their environmental impact. The collected funds are used to support environmental restoration projects, such as tree planting and eco-tourism development. To develop this program, the government partnered with Jejak.in, a non-state actor that created the carbon emission calculation technology. This article examines how the CFC program functions in Indonesia and investigates the underlying factors that led to its creation. A qualitative research method is employed, combining interviews with a systematic literature review to analyze the program in depth. Using the human security framework, the article argues that the CFC program was introduced in response to the significant threat that tourism-related carbon emissions pose to environmental, health, and economic security in Indonesia. Through this initiative, the government aims not only to raise travelers' awareness of these threats but also to encourage them to take responsibility for their emissions and actively contribute to the development of low-carbon, sustainable tourism. The program is facilitated through the indonesia.travel website, where travelers can calculate and offset their carbon footprints. This article contributes to enriching literature on sustainable tourism in Indonesia.

KEYWORDS

Carbon Footprint Calculator, Carbon Emission, Human Security, Sustainable Tourism, Indonesia.

INTRODUCTION

Carbon emissions from the tourism industry contribute significantly to climate change, which has become a global concern (Shabirah et al., 2025). According to the Carbon Footprint of Global Tourism study in the journal Nature Climate Change in 2018, carbon emissions produced by tourism activities around the globe have increased from 3.9 GtCO2e to 4.5 GtCO2e from 2009 to 2013. This figure accounts for about eight percent of the total global greenhouse gas emissions, showing the contribution of tourism towards climate change. Carbon footprints left by tourists lead to climate change. In tourism activities, transportation, shopping, and food majorly contribute to global tourism's carbon. Most of the carbon footprint is generated by high-income countries (Mediana, 2022).

The United States is notorious for being one of the biggest carbon culprits in global tourism. As a travel destination and a tourist-sending country, the United States emitted almost twice as much greenhouse gas emissions as China. Traveling across Canada and Mexico's borders into the United States made up 2.7 percent of the global footprint (Lallensack, 2018). Like China and the United States, Indonesia also emits much carbon dioxide. From 1990 to 2015, Indonesia's greenhouse gas emissions have tripled. The increase in Indonesia's greenhouse gas emissions is predicted to continue until 2030 because of the massive use of fossil energy in certain sectors, including transportation. In the tourism industry, transportation majorly contributes to global warming due to fossil fuels used in vehicles for outbound and inbound trips. The carbon footprints left by their domestic and international trips have warmed the archipelagic country. In Indonesia, fossil fuel consumption increased from 68.67 percent in 2015 to 72.25 percent in 2020, resulting in a rise in the production of carbon emissions from 490.84 billion tons in 2015 to 617.97 billion tons in 2019 (Juliani et al., 2021, p. 125).

To address the issue of carbon footprint in the Indonesian tourism industry, the Ministry of Tourism and Creative Economy (Kemenparekraf) unveiled the Carbon Footprint Calculator (CFC) program in January 2022 (Kemenparekraf, 2022). With this CFC program, the government seeks to calculate carbon emissions generated by domestic and foreign travelers in the energy-consuming activities they carry out during their trips. Sandiaga Uno, the Minister of Tourism and Creative Economy, encouraged the public to make their travels more climate-friendly, expecting the move to improve the

Indonesian tourism reputation globally (Hudoyo, 2022). His office teamed up with a non-state actor, Jejak.in to make this program. This startup company created the carbon calculation technology for the CFC program, aiming to address social and environmental problems caused by climate change. The technology allows the program to calculate the carbon footprint left by tourists. The calculated carbon emissions are then converted into money, which travelers have to pay for environment-saving initiatives, such as planting trees and developing ecotourism (Hendriyani, 2023).

This study aims to describe the implementation of CFC and explain Indonesian government's rationale behind the program. This study, therefore, raises these research questions. First, how does CFC work? Second, why does the Ministry of Tourism and Creative Economy launch the program? What is the government's rationale? Using the concept of human security, we argue that the ministry unveiled the carbon calculator tool because of human security issues caused by carbon emissions in Indonesian tourism. These issues influence the Indonesian government to make CFC to save the industry. CFC works in a way that the program seeks to make tourists aware of human security threats and then encourages them to be responsible for the threats. The government considers that the carbon emissions tourists produce threaten three dimensions of human security: health security, environmental security, and economic security. The government uses CFC to make tourists turn their awareness of the three human insecurities into carbon offset initiatives to save tourism: planting trees and developing sustainable tourist destinations across Indonesia.

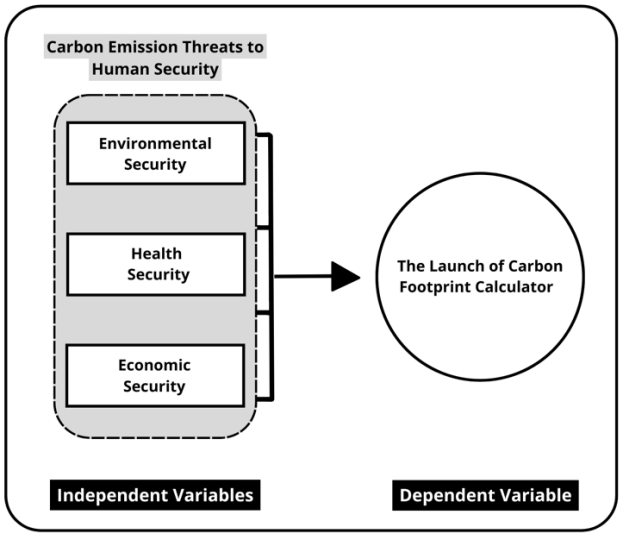
Research on the Carbon Footprint Calculator (CFC) in Indonesia remains limited. The novelty of this research article lies in its focus on examining the implementation and rationale of CFC in the tourism sector in Indonesia. Researchers have yet to explore the use of CFC in Indonesian tourism, making this article the first among few existing literature catalogues on CFC. This explanatory research article, therefore, contributes to enriching the literature. Among the existing works is the research on carbon footprint in the Indonesian plantation sector. Its author, Ernanda et al. (2022), sought to assess the carbon footprint of main commodities, such as sugarcane, by using a carbon calculator. Meanwhile, Hasan et al. (2023) used the calculator to explore the carbon footprint of Pasirkaliki Health Center in Cimahi, West Java, calculating the emissions produced by gas, gasoline, and electricity in the center. Irfany & Klasen (2017) estimated carbon emissions in Indonesian households, using their expenditures from 2005 to 2009 to analyze carbon footprint, from its pattern to its distribution. They sought to highlight the relationship between household affluence and carbon footprints in Indonesian households. Such research articles do not dive into the use of carbon calculators in tourism, a research gap that we would like to fill in this paper. Therefore, in the discussion section, we explain the implementation of CFC in three parts. First, we explain the concept of human security to help readers understand the lens of analysis in this research. Second, we describe how the government implements CFC and carries out carbon offset to realize sustainable tourism in Indonesia. Third, we use human security to explain how human security issues in tourism influence the government to roll out CFC, describing environmental, health, and economic insecurities in the industry.

MATERIALS AND METHODS

This study adopts a qualitative method utilizing an explanatory case study approach. This approach is selected because it allows for an in-depth description and analysis of a system, demonstrating how various components are interconnected and operate in an integrated manner (Meganingratna & Maulana, 2025). With this method, we seek to describe the implementation of the Carbon Footprint Calculator (CFC) and explore the human security issues behind the program. Human security issues are independent variables that motivate the government to make the CFC program. The independent variables comprise the issues of environmental, health, and economic securities. In this qualitative research, we employ interviews and literature reviews to gather primary and secondary data about the CFC program and the issues of the three types of human security. Primary data includes official statements on the government's websites and various official documents, such as reports and press releases. Meanwhile, secondary data sources include journals, books, and news reports in print and electronic media (Babbie, 2007). To collect the data, we also interviewed Ary S. Suhandy, the director and founder of the Indonesian Ecotourism Network (INDECON), vice chair of Asia Ecotourism Network (AEN), and board member of Global Ecotourism Network (GEN), and I Gde Pitana, professor of tourism at Udayana University, on Dec. 14, 2024. The collected data from the interviews and literature

reviews was then analyzed through triangulation technique to comprehensively understand this phenomenon. According to Carter et al. (2014), triangulation serves as a qualitative research strategy to test the validity of the convergence of information from various sources. With a qualitative method in place, this explanatory research aims to explain how those independent variables lead to the launch of the dependent variable: the CFC program (See Picture 1).

Picture 1. Research Model



Source: own design

RESULTS AND DISCUSSION

We argue that the Ministry of Tourism and Creative Economy rolled out the Carbon Footprint Calculator (CFC) program because the Indonesian government intended to spur climate actions and save the tourism industry from human security threats caused by carbon emissions. The government saw that carbon emissions produced by inbound and outbound tourists threatened human security because their carbon footprint caused health insecurity, environmental insecurity, and economic insecurity. The ministry, therefore, urged the tourists to be responsible for their carbon footprint through CFC. This program enables the government to demand tourists to responsibly fund carbon offset projects that reduce emissions, such as planting trees and developing sustainable tourist destinations. The carbon offset aims to compensate for emissions that tourists produce during their travels. The carbon offset seeks to eliminate carbon footprints for human security, helping the Indonesian government realize sustainable tourism.

Human Security in Sustainable Tourism

In International Relations, the concept of human security developed after the Cold War ended. During the Cold War, threats to human security were not deemed urgent. At that time, states considered threats to state security more urgent than threats to human security amid political and military tensions between the Western and Eastern blocs. Human security was overshadowed by state security amid their rivalry. Therefore, human security issues, such as hunger, poverty, and oppression, did not receive the attention they deserved during the Cold War (Hara et al., 2023, p. 4).

The Cold War witnessed the marginalization of human security. Threats to human security were considered less important than threats to state security, such as the Western bloc's military threats to the Eastern bloc. After the end of the Cold War, various human security problems, such as poverty, pollution, and uneven access to education, began to draw attention. According to the concept of human security, a country is considered powerful if it has what it takes not only to secure the country from

threats to territorial sovereignty but also to secure the people from poverty and threats to freedom and health (Hara et al., 2023, p. 6). Poverty not only hinders the fulfillment of basic human needs, but also limits the future opportunities of those affected, especially children and young people (Ariningtyas, 2025, p. 49). Human security protects the most vital things for human beings, ensuring they have freedom and dignity. The vital things, which can be universal or culturally specific, mean what human beings need the most for their interests (Adger et al., 2014, p. 759). As a theory, human security comes from an awareness that individual security is as important as state security. Human security theory emphasizes the importance of protecting human beings and improving their life quality through foreign and domestic policies on security (Setyowati et al., 2024, p. 37).

Table 1. The Differences between State Security and Human Security

	What is the Source of the Security Threat?	
	Military	Military, Non-military, or Both
States **Security for Whom?**	National security (conventional realist approach to security studies)	Redefined security (e.g., environmental and economic [cooperative or comprehensive] security)
Societies, Groups, and Individuals	Intrastate security (e.g., civil war, ethnic conflict, and democide)	Human security (e.g., environmental and economic threats to the survival of societies, groups, and individuals)

Source: Alkire, p. (2003, p. 17)

According to Mahbub ul Haq, human security centers on the security of individuals and people. He said that human security was not about states and nations. Human security stresses the importance of the security of people, not just the security of their countries and nations. Therefore, he added, human security was reflected in people's lives, not in their country's weapons. Human security highlights the safety and well-being of people as a primary value that needs to be protected. Meanwhile, in state security, the primary value is the protection of territorial integrity and national independence. Unlike state security, human security sees poverty, drugs, and diseases as threats. To face the threats and make human security a reality requires development, not arms (Bajpai, 2000, p. 11).

Like Haq, the United Nations Development Program (UNDP) also pointed out the security of people in human security (Ulung, 2024). Security here means that people have three fundamental freedoms: freedom from want, freedom from fear, and freedom from indignity. Freedom from indignity allows individuals to make choices and get their basic rights protected. Freedom from fear means that individuals get protection from various forms of direct and indirect violence. Freedom from want enables individuals to get protected access to livelihoods, basic needs, quality of life, and enhanced human welfare (Fuentes-Nieva et al., 2022, p. 35). Human security seeks to protect people from the threats of crime, hunger, disease, unemployment, social conflict, political repression, and environmental hazards. Therefore, human security has seven components: food security, health security, political security, economic security, environmental security, personal security, and community security (Bajpai, 2000, p. 14).

Economic security guarantees individuals to get employment and a social safety net to obtain basic income. Food security provides them with access to food via income or employment. Health security gives individuals freedom from disease and illness and access to health care. Environmental security provides water, land, and air for possible human habitation. Personal security gives individuals protection from crime and violence, particularly women and children. Community security refers to cultural dignity for individuals to live and grow in their community. Political security protects individuals from human rights violations (Bajpai, 2000, p. 15).

The seven components of human security have different threats to deal with. The threats to economic security range from lack of productive employment to the absence of financed safety nets. Lack of food entitlements becomes a threat to food security. Health security faces threats of diseases and the lack of access to healthcare facilities. Pollution, deforestation, natural disasters, declining water availability and arable land threaten environmental security. Threats to personal security include drug trafficking and violent crime. Community security has different threats, ranging from the collapse of traditional languages and ethnic discrimination to genocide and ethnic cleansing. Meanwhile, militarization, human rights violations, and government repressions pose threats to political security (Bajpai, 2000, p. 16). Human security concentrates on individual's rights to basic freedoms, personal safety, and access to sustainable prosperity. Human security promotes the security and stability of individuals in societies, regions, and countries, enabling them to pursue liberty, justice, and happiness in their relationships with others (Liotta & Owen, 2006, p. 40).

Human security has an important position in sustainable tourism. Sustainable tourism aims to establish human security. Sustainable tourism not only seeks to secure the environment but also to preserve the culture, ensure the economic security of the people, and develop the economy of the country. UN World Tourism Organization defines sustainable tourism as tourism that takes full account of its current and future economic, social, and environmental impacts, explaining that sustainable tourism addresses the needs of visitors, the industry, the environment, and the host communities (Kementerian Pariwisata, 2021). Hutapea et al. (2024) also highlight that sustainable tourism maintains the economic, socio-cultural, and environmental dimensions in the aspects of well-being. Sustainable tourism enables the sector to enjoy a balance in social equity, economic growth, and environmental conservation. Sustainable tourism has three key principles: environmental conservation, community engagement, and strategic management. Sustainable tourism conserves the environment because it reduces waste, saves energy and water, and mitigates environmental degradation. Sustainable tourism also engages the communities to ensure local people enjoy its economic benefits and preserve their cultural heritage (Raveendran, 2024). In sustainable tourism, strategic management exists to align tourism practices with sustainability principles (Saragih et al., 2024).

The sustainability principles refer to the four pillars of Sustainable Development Goals (SDGs): social, economic, environmental, and laws and governance. According to Ary S. Suhandy, the director and founder of the Indonesian Ecotourism Network, the pillar of governance is the most important key to realize sustainable tourism. He explained that good governance allowed a country to reap the benefits of tourism while minimizing its adverse impacts on nature. Good governance requires changes in the mindsets and behaviors of human resources. In tourism, the human resources include the people, the government, and the industry players. They need to be aware of the sustainable principles in their mindset and then make a change by adjusting their behaviors to the principles to make sustainable tourism become a reality (Suhandy, interview, Dec. 14, 2024). Such governance can be observed in tourism villages. I Gde Pitana, professor of tourism at Udayana University, shares that tourism villages in Bali reflect sustainable tourism, explaining that the development of the villages shows how tourism can provide economic benefits to local people without damaging nature and ruining culture. He said that the arrival of domestic and international tourists to the tourism villages to enjoy the authenticity and uniqueness of their culture and tradition instead incentivizes the locals to keep nature and protect cultural heritage. Tourism villages illustrate the example of sustainable tourism (Pitana, interview, Dec. 14, 2024).

Sustainable tourism, therefore, contributes to environmental security, community security, and economic security. In Klaten, Central Java, for example, the sustainable development of agrotourism attraction Jlengut Indah provides local communities with new job opportunities, improves their living standard, and leads to better environmental management, stronger societal solidarity, and better traditional culture preservation, according to research by Fahrudin et al. (2023). Fauziah et al. (2024) also found that the sustainable development of Rengganis campsite causes local tourism in Patengan Village in Bandung to grow. The campsite development not only enables local communities to promote local products and increase their income, but also facilitates the protection of the local culture and

environment. The village involves local communities in developing attraction sites and enforcing sustainable principles.

The Implementation of Carbon Footprint Calculator

We argue that the Carbon Footprint Calculator (CFC) program launched by the Ministry of Tourism and Creative Economy shows how the Indonesian government addresses the threats of carbon footprint in the tourism industry to human security, especially health security, environmental security, and economic security. The issues of health safety and environmental security are caused by the high use of fossil fuels in various tourism activities, including using vehicles for transportation. The high use of fossil fuels in tourism contributes to warming the globe. Global warming threatens human security, causing diseases and triggering environmental destruction. By unveiling the CFC program, the Indonesian government encouraged tourists to calculate the carbon emissions they produced and then take responsibility for the calculated carbon footprint they left. The responsibility takes place in a way that they participate in funding carbon offset programs, such as tree planting initiatives and ecotourism development.

Carbon emissions mean the total amount of carbon or greenhouse gases produced by humans in various activities, from the use of fossil-fuel-based vehicles and the consumption of electricity to the production and consumption of food. These three activities exist in tourism, causing the sector to contribute to releasing carbon emissions. Most vehicles tourists use rely on fossil fuels, such as gas, diesel, and petrol. These fuels pollute the environment and warm the earth for carbon dioxide that they release into the air. The electricity they consume during the trips also speeds up global warming because the electricity is produced by power plants that burn fossil fuels. The livestock and agriculture sectors also significantly produce greenhouse gasses due to pesticide use in food production, the disposal of livestock waste, and the expansion of livestock farming (Jejak.in, n.d.).

The increase in the production of carbon emissions threatens human security because of its negative impacts, ranging from triggering extreme climate change, spreading disease, degrading marine ecosystems, and melting polar ice to polluting clean water. Extreme climate change threatens environmental security and personal security because the extreme increase in global temperatures will trigger natural disasters, such as storms, floods, and droughts. Drought affects health security because the prolonged period of low rainfall leads to a shortage of clean water amid extreme temperature increases. The high increase in temperature also accelerates the melting of polar ice, posing threats not only to health security but also to environmental security for raising sea levels and disrupting ecosystems.

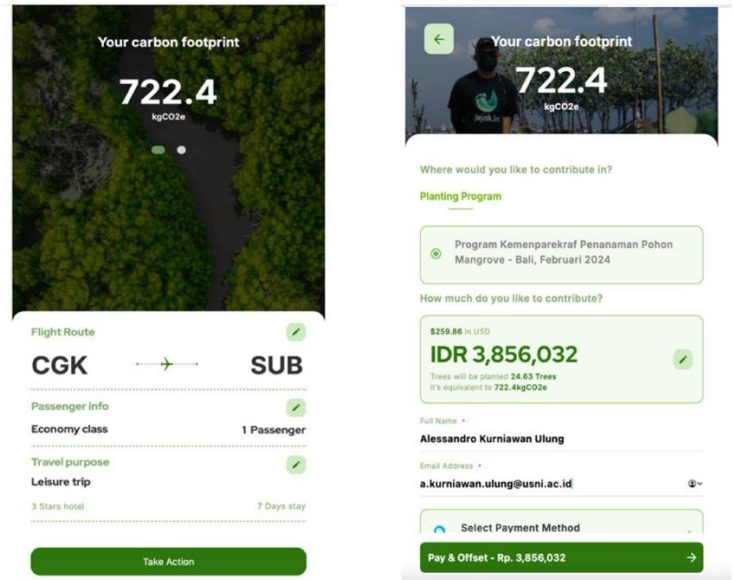
The carbon footprint generated by tourism activities in Indonesia has been studied by several researchers. Salsabilla & Rochman (2024) researched carbon emissions left by tourists in Lembang, West Java, finding that their activities emitted 145,271,586 kgCO2-eq per year, with vehicles contributing the largest carbon emission in the regency. The transportation sector, which accounts for 68 percent of the total carbon emissions in Lembang, is followed by food consumption (15 percent), electricity use (11 percent), and waste disposal (6 percent) (Salsabilla & Rochman, 2024, p. 24).. Rosalina et al. (2023) examined the negative impact of the development of the tourism industry in West Java, finding that carbon emissions produced during the project had polluted the environment and disturbed the activities of local communities despite its contributions in growing local economy and increasing employment rate in the province. Kenedy et al. (2024) examined the carbon footprint generated by villa accommodation services in Badung, Bali, finding the monthly carbon production of 25711.78 g in the regency. He reported 9452.86 g of monthly carbon emissions in South Kuta, making the district the biggest carbon contributor in Badung. Carbon emissions produced by villas in Badung mostly come from the use of liquified petroleum gas (LPG) (Rosalina et al., 2023, p. 44). Satriani (2023) examined the carbon footprint generated by hospitality activities in the Mandalika Special Economic Zone (SEZ) in Lombok, West Nusa Tenggara, reporting 96,051 tons of carbon emissions per year (Satriani, 2023, p. 18). Unlike Satriani and Kenedy, Lenzen et al. (2018) examined the global carbon footprints in tourism, finding that it had increased from 3.9 GtCO2e in 2009 to 4.5 GtCO2e in 2013.

Transportation, shopping, and food sectors in tourism contributed to the hike in global emissions. Such increase in carbon emissions made tourism contribute eight percent of total greenhouse gas emissions worldwide. The majority of carbon emission in tourism is generated by developed countries, such as China, Germany, and the United States (Lenzen et al., 2018).

The carbon footprints left by tourists prompted the Indonesian government to launch CFC. Angela Tanoesoedibjo, Deputy Minister of Tourism and Creative Economy, said that CFC aimed to save the environment from carbon emissions. This move should not be overlooked because environment serves as an important asset in sustainable tourism, according to the deputy minister. She believed that the purpose of preserving the environment in the CFC program would help the ministry realize quality and sustainable tourism in Indonesia. According to Angela, the calculation of carbon emissions represents the concrete action of the Indonesian government in implementing three pillars in the development of Indonesian tourism: people, planet, and prosperity. In developing the tourism sector, the government would not only pay attention to the people, but also ensure the sustainability of the planet in order to give them sustainable prosperity. She believed in the potential of CFC in overcoming global warming and reviving the reputation of Indonesian tourism post-Covid-19 (Kemenparekraf, 2022).

In the making of CFC, the Ministry teamed up with a non-state actor Jejak.in, a start-up company that uses technology and artificial intelligence to solve and mitigate climate change. Their collaboration started in early 2021 (Anditya & Kusumaningrum, 2024, p. 201). This collaboration enabled the state and non-state actors to create a carbon calculator for tourists to calculate their carbon emissions. The government shares the carbon footprint calculator online on the website indonesia.travel. The carbon emission calculation starts with the requirement of informing the departure and destination airports. If the trip departs from Soekarno-Hatta International Airport in Tangerang, Banten to Juanda Airport in Surabaya, East Java, the amount of carbon emissions that will be produced is 722.4 kgCO2e. (See Picture 2). If the trip ends in Lombok Airport in West Nusa Tenggara, it will emit 773.2 kgCO2e of carbon emissions.

Picture 2. Conversion of Calculated Carbon Emissions



Source: indonesia.travel

The calculator then converts the amount of calculated emission into money tourists must pay to fund carbon offset initiatives. If the flight trip from Tangerang to Surabaya emits 722.4 kgCO2e of carbon emission, the traveler must pay Rp 3.8 million, equivalent to 24 trees. The traveler can pay the money online to plant the trees in a mangrove forest in Bali (See Picture 2). A sum of money paid by travelers for carbon offset includes the purchase of mangrove tree seeds, the payment of planting permit fees, and the cost of operational and monitoring services. The carbon footprint calculator uses three parameters in calculating emissions: mileage, fuel consumption, and emission factors. In the calculation method, the calculator employs a formula from the Ministry of Environment and Forestry and the Intergovernmental Panel on Climate Change (IPCC). This formula also determines the number of trees that tourists need to plant to absorb the carbon emissions they produce (Kementerian Pariwisata, n.d.).

Mangrove tree planting is carried out in five mangrove forests, namely Plataran Menjangan, West Bali National Park; Tembudan Berseri Mangrove, Berau; Clungup Mangrove Conservation Three Colors Ecotourism Destination, Malang; Klawu Mangrove Tourism Area, Sorong; and Bukit Peramun, Bangka Belitung. The conversion of carbon footprint into mangrove trees is conducted using the assumption of tree growth in a year. Mangrove trees are selected to become a medium for conversion because they can absorb large amounts of carbon, protect coastal areas from erosion, and house terrestrial and marine ecosystems. Therefore, mangrove trees positively impact the environment, including producing clean air. The clean air produced by the mangrove trees is expected to offset the carbon emissions tourists emit (Kementerian Pariwisata, n.d.).

The planting, monitoring, and conservation of the trees are carried out by LindungiHutan, a conservation partner of the Ministry of Tourism and Creative Economy and Jejak.in for carbon offsets in CFC. LindungiHutan provides crowd planting services to invite the public to participate in forest conservation activities (Rianda et al., 2024, p. 1543). LindungiHutan takes care of the mangrove trees and monitors their development three times a year every three and six months. The company observes the trees in June, September, and December, reporting their progress using the Jejak.in system. LindungiHutan will then share the progress of the trees with the public, providing photos of the trees and giving updates about them, from their height and leaf color to branch diameter. LindungiHutan involves local farmers in the observation and monitoring. This startup works with 34 farmer groups, empowering their 746 members to increase their income. LindungiHutan saves the earth and drives the local economy by providing job opportunities and improving the farmers' income through carbon offsets (LindungiHutan, 2023, p. 9).

To promote carbon offsets, Sandiaga Uno, Minister of Tourism and Creative Economy, planted mangrove tree seedlings in several locations, such as Bali, Bangka Belitung, and South Sumatra. In South Sumatra, for example, Sandiaga planted mangrove tree seedlings in Bali Forest Park in July 2022, Sungsang IV tourist village in Banyuasin Regency in May 2023, and Terong village in Belitung Regency on June 2, 2023 (Hendriyani, 2023; Kasmono, 2023; Setiawan, 2022). While in the Bali Forest Park, Sandiaga planted 41,000 mangrove tree seedlings (Setiawan, 2022). During the 2nd UN Tourism Regional Conference on the Empowerment of Women in Tourism in Asia and the Pacific, Sandiaga also invited delegates to plant mangrove seedlings at the Telaga Waja Mangrove, in Benoa, Bali, on May 3, 2024, to invite delegates to pay off the carbon emissions they produce (Wulandari, 2024).

According to a report by LindungiHutan, a partner of the Ministry of Tourism and Creative Economy and Jejak.in for carbon offsets in the CFC program, 912,004 trees in total have been planted for carbon offset. In 2023 alone, 167,725 trees were planted, with 804 tons of CO2eq in carbon emissions absorbed. That year, LindungiHutan received Rp 5.8 billion in donations thanks to 5,347 donors (LindungiHutan, 2023, p. 14). The trees are planted in 50 locations on various islands in Indonesia, ranging from Sumatra (1,222 trees) and Java (152,368 trees) to Sulawesi (1,324 trees) (LindungiHutan, 2023, p. 5).

Table 2. Carbon Offsets 2020-2023

	2019	2020	2021	2022	2023
Donors	2,981 people	9,783 people	11,157 people	No data	5,347 people
Collected donation	Rp. 680,459,295	Rp. 702,048,537	Rp. 3,261,980,057	Rp. 5,553,220,019	Rp. 5,857,014,008
Planted trees	49,005 trees	69,509 trees	199,993 trees	222,388 trees	167,725 trees
Absorbed carbon emissions	No data	No data	99 tons of CO2eq	778 tons of CO2eq	804 tons of CO2eq

Source: LindungiHutan (2019, 2020, 2021, 2022a, 2023)

Despite fluctuations in the number of donors, LindungiHutan saw a sustainable increase in the amount of donation for carbon offsets, which jumped by 88 percent from Rp680 million in 2019 to Rp 5.5 billion in 2022. The increase in donations led to a hike in the number of trees planted and the amount of carbon emissions absorbed. Lindungi Hutan planted 222,388 trees in 2022, contributing to the 87-percent increase in absorbed carbon emission from 99 tons of CO2eq in 2021 to 778 tons of CO2eq in 2022. In 2022, trees were planted in 40 locations in 13 provinces. They comprised 146 trees in Bangka Belitung, 26,7746 in West Kalimantan, 5,188 in Jakarta, 2,956 in Bali, and 4,768 in South Sulawesi. The more mangrove trees planted, the greater the carbon emissions absorbed. In Jakarta, 5,188 mangrove trees absorbed 1,592.70 kg of CO2eq. Meanwhile, 26.7746 mangrove trees in West Kalimantan absorbed 5,071.90 kg of CO2eq (LindungiHutan, 2022, p. 9). The carbon offsets carried out by LindungiHutan lead to economic benefits. The startup, which works with local farmers for carbon offsets, increases their income by 23 per cent and gives 4.6 million people indirect beneficiaries for the economic value of Rp 50 billion it generates annually (LindungiHutan, 2023, p. 18).

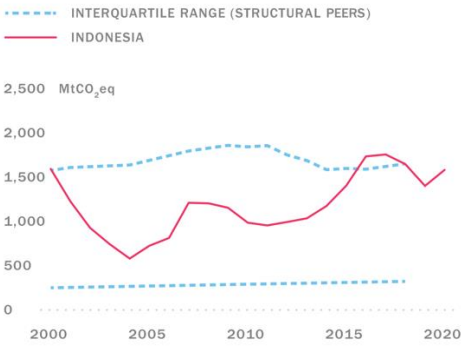
Ary Suhandy of INDECON praises CFC, believing that the carbon calculator can make travelers more aware of the carbon they produce and urge them to be more responsible for the pollution they create during their trips. However, for Ary, the awareness of and responsibility for offsetting carbon are insufficient. He expects travelers to do other eco-friendly, climate-positive practices to reduce emissions and realize sustainable tourism, such as booking sustainable properties and choosing green tours. He worries that such sustainable travel actions are overlooked because travelers assume that carbon offset suffices. Ary opined that reducing emissions was not travelers' responsibility alone, urging hotels, tour operators, and other tourism players to be pushed to adopt more sustainable measures. More tour operators, for example, are expected to roll out ethical, eco-friendly tour packages, provide green accommodation, and offer souvenirs that preserve local culture and support local communities (Suhandy, interview, December 14, 2024). Airlines, among other travel and trade players, draw the attention of Professor I Gde Pitana of Udayana University the most. He demands that airlines and other transportation providers shoulder an enormous responsibility to offset the emission for the development of sustainable tourism (Pitana, interview, December 14, 2024).

Threats of Carbon Emissions to Human Security in Tourism

The Carbon Footprint Calculator (CFC) program created by the Ministry of Tourism and Creative Economy shows that the government perceives that carbon emissions in the tourism industry increasingly threaten human security, including health security, environmental security, and economic security. These three types of human security are affected by carbon emissions produced by tourists. The fact that a large number of people in Indonesia fall ill and die from diseases caused by carbon emissions polluting the air shows that health security is under threat. In 2019, for example, more than 168,300 people died in Indonesia from stroke, heart disease, lung cancer, and other chronic respiratory diseases due to outdoor air pollution. With that number in place, Indonesia has one of the highest death

rates among G20 member countries (Climate Transparency, 2022, p. 2). The tourism industry also contributes to accelerating global warming due to carbon emissions from using energy in various services, especially transportation services. Energy consumption from the transportation sector comprised 33 percent of total energy consumption in Indonesia. Oil meets as much as 95 percent of energy needs in the transportation sector. Therefore, Indonesia urgently needs a strong policy for decarbonization in its transportation sector (Climate Transparency, 2022, p. 1). In 2018-2020 alone, Indonesia's average annual carbon emissions reached 1,495 MtCO2eq. With this figure, Indonesia contributes around 3.5 percent of the world's total greenhouse gas emissions. Carbon emissions produced by Indonesia tend to fluctuate but show an increasing trend from 2005 to 2020 (World Bank, 2023, p. 4) .

Graphic 1. Greenhouse Emission in Indonesia, 2000-2020



Source: World Bank, p. (2023, p. 4)

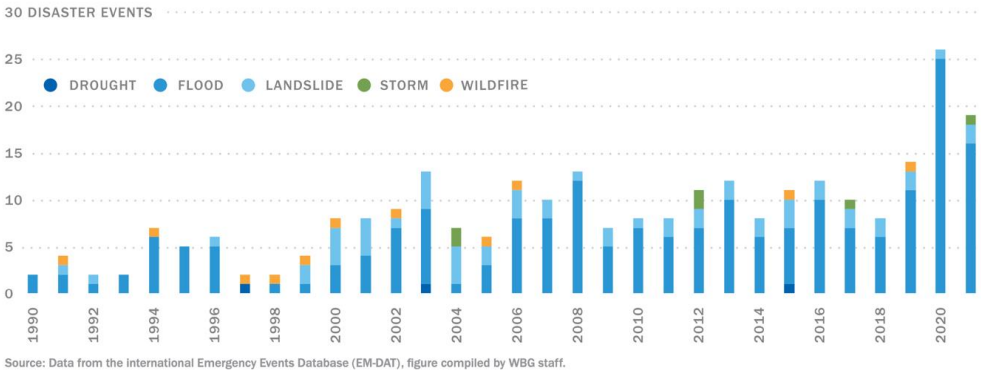
In the concept of human security, health security has an important position because health is related to the protection of vital things in human life, both in exercising their freedom and meeting their daily needs. A person's ability to exercise his or her freedom and meet his or her needs depends on his or her health, meaning that health directly affects the welfare of human life because health helps humans to pursue what they want. On the contrary, poor health will hinder human welfare. Health threats will challenge human security (Fuentes-Nieva et al., 2022, p. 119). Heat waves, extreme weather, floods, and droughts triggered by climate change cause various diseases, such as malnutrition, malaria, and dengue fever. Various diseases caused by climate change threaten the health of workers in various sectors, including the tourism sector. In 2021, for example, high heat exposure in Indonesia led to the loss of 5.1 billion potential working hours, a 25% increase from 1990–1999, according to Climate Transparency (2022). Meanwhile, according to International Labor Organization (ILO), Indonesia will lose 2.97 percent of total working hours in 2030 due to diseases caused by high-temperature rises (World Bank, 2023, p. 11). ILO states that rising temperatures will affect labor productivity. Extreme heat also economically threatens jobs in various important sectors. In 2021, the potential loss of revenue due to reduced labor capacity caused by extreme heat weather reached USD 18.3 billion, or 1.59% of GDP (Climate Transparency, 2022, p. 3).

Rising temperatures and humidity also affect foreigners' visits to Indonesia. According to Susanto et al., p. (2020, p. 6), an increase in temperature of one percent led to a decrease in foreign tourist visits by 1.37 percent. Meanwhile, an increase in humidity of one percent caused a decrease in tourist arrivals by 0.59 percent. Susanto revealed that the increase in temperature and humidity caused by climate change in Indonesia has led to a decrease in foreign tourist arrivals from Europe, Australia, and America. The decrease in the number of foreign tourists visiting Indonesia disrupts the country's economy and the income of tourism players. It shows that carbon emissions that cause climate change disrupt health security and environmental security and threaten economic security.

Disasters caused by climate change issues also threaten the economic security of the people and the country. From 1990 to 2021, more than 300 natural disasters occurred in Indonesia, including 200 floods that impacted more than 11 million people (Measey, 2010). Disasters caused by climate change also affect foreign tourists' visits to Indonesia. According to Susanto et al. (2020), whirlwinds, earthquakes, and tsunamis significantly influence foreign tourist visits to Indonesia. Whirlwinds significantly influence the interest of tourists from Europe, Australia, and the United States to visit Indonesia (Susanto et al., 2020, p. 7). The threat of floods, storms, and sea level rise is strongly felt by tourists, especially tourists who stay on the coast and coastal areas (Wijaya & Furqan, 2018, p. 541). For example, safety reasons on the Kuta, Bali coast encourage tourists to be more aware of the threat of extreme weather changes, erosion, and storms (Furqan & Winandi, 2018, p. 96)..

Of the total natural disasters in Indonesia from 1990 to 2021, the frequency of floods reached 70 percent. The frequency of floods tends to increase. This trend is forecasted to continue due to climate change. Increasingly high rainfall plays a role in increasing the intensity of floods and landslides. Rising sea levels, changes in rainfall, and flooding lead to a decline in freshwater quality. Poor freshwater quality will ensure that drinking water quality is not maintained. Polluted drinking water will cause malaria, hepatitis, and cholera (Measey, 2010). It is estimated that the total losses from climate change impacts will increase to 1.24 percent of GDP in 2027 and 2.59 percent in 2037 (Kompas et al., 2018, p. 1161). Various diseases caused by rising emissions and climate change threaten health security, food security, and economic security.

Graphic 2. Rising Incidence of Climate-Related Disasters in Indonesia



Source: World Bank, p. (2023, p. 11)

At least 37,010 people were affected by natural disasters caused by climate change in Indonesia from 2000 to 2019. Total financial losses in the period amounted to $44 million. If the impact caused by natural disasters is calculated from 1993, the number of casualties reached 5,960 people, and the total losses reached 15 billion dollars (Beirne et al., 2021). The number of casualties and financial losses shows the magnitude of the threat of climate change to various aspects of human security, including economic security.

Table 3. Impacts of Climate-Related Natural Disasters in ASEAN Countries, 2000-2019

Country	Total Deaths (Average 2000–2019)	Total People Affected (Average 2000–2019)	Total Losses in Million US$ (Average 2000–2019)	Total Losses as Share of GDP in % (Average 2000–2019)*	Number of Events (Total 2000–2019)
Cambodia	42	646,601	54.46	0.44	24
Indonesia	30	37,010	44.78	0.01	189
Lao PDR	14	177,989	22.85	0.27	20
Malaysia	4	65,377	30.19	0.01	47
Myanmar	3,489	158,644	104.62	0.27	40
Philippines	83	522,994	76.23	0.04	273
Thailand	31	941,647	574.33	0.19	82
Viet Nam	34	268,182	135.4	0.11	142

Source: Beirne et al., p. (2021, p. 5)

Climate change caused by increased carbon emissions also threatens the lives of marine biota, including turtles and coral reefs. Rising sea surface temperatures cause damage to coral reefs and lead to biodiversity loss. Indonesia's sea turtle population is also threatened by rising sea levels, increasing extreme weather conditions, and warming temperatures (Measey, 2010). The threats to marine life due to climate change are found in tourist destinations in Indonesia, including Gili Trawangan in West Nusa Tenggara. According to Kusmawan (2013), climate change has damaged the beauty of coral reefs and decreased the number of marine species on Gili Trawangan, such as green turtles, spotted sharks, and Napoleonic fish. The deterioration of the quality of coral reefs and the reduction of marine life have caused a shift in the peak of tourist visits and a decrease in tourist vacation time. This reduction in vacation period has caused a drop in the business income of local people in Gili Trawangan.

In addition to marine life, the orangutan population is also threatened by climate change. To survive, orangutans rely heavily on forests because the trees and vines that roam the forest produce their main food source. Orangutans need a habitat with trees that can produce nutrient-rich fruits. However, they face challenges in getting such fruits because of the global warming. Warming temperatures and changes in rainfall affect the phenology of trees and fruits and thus negatively impact the life of orangutans. A longer dry season will reduce the production of fruits. The reduced number of fruits will limit the reproduction of female orangutans because they cannot conceive baby orangutans when their food sources are limited (Measey, 2010). Indonesia's orangutan population is threatened by the deteriorating quality of the fruit and the increasingly intense forest fires due to climate change. In 2015, for example, more than 2.6 million hectares of forests, peatlands, and other land were burned. In addition to the destruction of thousands of hectares of forest and the death of orangutans and other endangered species, forest fires in Indonesia threaten human health security due to the production of carbon emissions. In October 2015, daily emissions from forest fires in Indonesia reached more than 15.95 million tons of CO2 emissions per day. This figure is greater than the total carbon emissions in the United States (Sitabuana et al., 2017, p. 190). The carbon emissions produced by forest fires in Indonesia has caused not only economic security problems in the form of financial losses worth more than 16 billion dollars in 2015 but also environmental security problems in the form of the destruction of orangutan habitats and health security problems in the form of various respiratory diseases. Human security issues caused by forest fires affect Indonesia's attractiveness as a tourist destination country, including its sustainable tourist destinations.

It requires changes in the mindset and behavior of human resources in Indonesian tourism to save the industry from human security issues and realize sustainable tourism, according to Ary Suhandy. For the chairman of INDECON, to make the changes is a challenge. He calls it the challenge because tourism players in Indonesia still overlook the importance of implementing sustainable principles and have yet to be aware of the importance of enhancing sustainable business. Their behaviors describe this challenge. Tourists, for example, still litter and overuse electricity. Meanwhile, the government does not enforce the regulation that it has rolled out. Big hotel chains already apply sustainable measures, but many small and medium-sized hotels still ignore sustainability. The lack of

awareness in sustainability worries Ary because budget hotels outnumber chain hotels. Ary found the need for more awareness of sustainable principles not only in trade players but also in travelers and local governments. The lack of such awareness leads to the lack of sustainable actions, such as cutting carbon emissions. Therefore, Indonesian tourism players, from tourists, hoteliers, travel operators, to the government, need to change their mindset, paying more attention to sustainability for the development of sustainable tourism in the country (Suhandy, interview, Dec. 14, 2024).

Ary appreciates the Ministry of Tourism and Creative Economy for involving local communities in building sustainable tourism in Indonesia. The participation of local communities can help the government enhance environmental sustainability, drive local economic growth, and empower local people. Their collaboration took place in the development of green tourism and community-based tourism, among other things. For example, in Tihingan village in Klunkung, Bali, ecotourism is growing thanks to the collaboration between the government and local communities. The government supports the communities' endeavors of developing ecotourism by improving tourism accessibility and developing a more friendly environment in the village. The government improves the infrastructure, enhancing the connectivity of the village to stimulate tourism activities and ease travel to tourist destinations across the village. In his research, Nugraha et al. (2024) show that the government's involvement contributes 52.5 percent of sustainable tourism development variance in Tihingan. The government also involves academics in the project, inviting them to provide training to increase the skills of human resources in the village. These trainings help locals preserve culture and tradition and protect nature and the ecosystem, ensuring they get sustainable financial benefits in Tihingan ecotourism (Nugraha et al., 2024, p. 12). People need to actively participate in implementing the principles of sustainable tourism. Locals' active participation in sustainable tourism development will increase their awareness, improve their knowledge, and enhance their independence as part of the tourism industry. Their welfare will sustain, thanks to better awareness, knowledge, and independence (Fauziah et al., 2024, p. 131).

Sustainable tourism initiatives benefit local communities by developing local economies, promoting cultural preservation, and triggering environmental sustainability. These initiatives empower locals to engage in tourism, maintain their cultural identity, and keep their natural resources. Sustainable tourism leads to economic benefits, cultural preservation, and environmental sustainability. Sustainable tourism gives locals economic advantages by opening employment opportunities and growing local businesses. In the Tangkahan Buffer Zone of Leuser National Park, local communities received revenue 87.7 times larger than the park authorities, according to Wiratno et al. (2022). His research shows that sustainable tourism in the park triggers alternative local economic activities and increases people's income. In West Papua, the Indigenous people from the Kamoro tribe also receive economic benefits from tourists enjoying the ecotourism they provide, according to Anindhita et al. (2024). Her research shows that ecotourism not only gives them economic benefits but also allows them to promote their culture, tradition, and lifestyle. Ecotourism development in West Papua enables Kamoro Indigenous people to engage culturally. Cultural engagement means they get the opportunity to showcase their culture, tradition, and customs, giving tourists the experience of enjoying cultural exchange and education.

Like West Papua, Gresik in East Java also enjoys economic and social benefits from sustainable community-based tourism that the regency has developed, thanks to the involvement of local communities. In Sekapuk tourism village, for example, local communities actively strengthen community roles, leverage local resources, and foster sustainable practices. In Sekapuk, locals stand on the front line of developing tourist attractions, such as Setigi, which gives them economic benefits and fosters a sense of ownership. Sekapuk people not only obtain economic profits from revenue sharing from Setigi attraction but also get the opportunity to strengthen their social ties with tourists through the local culture and traditions they introduced and promoted (Isa et al., 2024). The experience of locals managing the ecotourism above sites also shows how local knowledge in managing resources helps protect ecosystems and ensure the tourism sector does not harm the environment. In the Tangkahan Buffer Zone of Leuser National Park, the park authorities involve local communities to reduce illegal activities

and enhance ecological values and human well-being. The collaborative management strategies between the authorities and communities play an important role in protecting the park from encroachment, poaching, and illegal logging (Wiratno et al., 2022, p. 14). Their collaboration also shows that sustainable tourism makes people have environmental awareness, motivating them to participate in conservation practices.

The development of sustainable tourism involves public participation in the practices of conservation. In the CFC program, they play essential roles in carbon offsets. In 2023, 2,873 people took part in planting 167,725 trees in 47 locations to offset carbon emissions (LindungiHutan, 2023, p. 14). The planted trees included 17,562 mangrove trees planted on Pari Island, Jakarta. On the island, 45 farmers enjoy a 25 per cent increase in their income for taking care of the mangrove trees, showing that sustainable tourism benefits locals and leads to a sustainable local economy. LindungiHutan has a total of 34 farmer groups supporting its sustainable initiatives, with the group members totaling 746 people (LindungiHutan, 2023, p. 9). In 2022, the number of people joining the carbon offset reached 9,340, up 63 per cent from 3,392 in 2019 (LindungiHutan, 2022, p. 3). The hike in public participation in carbon offset shows their considerable awareness of saving the environment from carbon emissions. They understand that carbon emission threatens human security, particularly health, environmental, and economic security. Therefore, they stand on the front line of offsetting carbon emissions to make sustainable tourism a reality.

CONCLUSIONS AND SUGGESTION

This explanatory study found that the Ministry of Tourism and Creative Economy launched the Carbon Footprint Calculator (CFC) initiative as a response to human security challenges in Indonesia's tourism sector, aiming to reduce carbon emissions that threaten environmental, health, and economic stability. The study identifies environmental, health, and economic security concerns as key independent variables that motivated the government to collaborate with Jejak.in in developing the program. This finding contributes to the existing literature on carbon footprint calculators and underscores the significance of human security alongside state security. The study affirms the urgency of addressing human security issues. However, it also highlights a research gap, as areas such as food security, political security, community security, and personal security were not explored. Future research could address these areas, assess the effectiveness of the CFC program in tourism, or explore the decision-making processes that led to its creation. Given that the CFC initiative is still relatively new in Indonesia, there remains broad potential for further investigation into its implementation, impact, and broader implications within and beyond the tourism sector.

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