DOES THE END JUSTIFY THE MEANS? CARBON FOOTPRINT OF VOLUNTEER TOURISM IN AN INDIAN NGO

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ABSTRACT

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Abstract

Tourism is a growing industry and total international tourist arrivals grew by 7% during 2017. Tourism is a major contributor of climate change being globally responsible of about 5% of all CO_2 emissions and could be responsible of even 12.5%, which is why it is important to understand what the main sources of emissions are, for example by investigating the carbon footprint of tourism.

Alongside conventional tourism, a concept of volunteer tourism, so called voluntourism, is emerging. A volunteer tourist is a person who uses "discretionary time and income to travel out of the sphere of regular activity to assist others in need" (McGehee & Santos, 2005, p. 760). Despite research being done in order to understand the carbon footprint of tourism, much less emphasis has been given to the environmental impact of voluntourism, which is usually presented in a positive light, mainstream research highlighting the benefits that volunteers get from their experience.

This thesis discusses the trade-off of voluntourism, especially from the aspect of environmental sustainability, by quantifying a carbon footprint for an Indian NGO that uses international volunteers in its work. The overall carbon footprint of the organization, divided equally between volunteers, interns, staff and family members, in 2018 was **320714 CO_2 eq. kg** and **2182 CO_2 eq. kg** per person. Similar to previous tourism carbon footprint research, aviation was one of the major contributors to the carbon footprint, with a share of 37%. However, more surprisingly, a closer analysis on the transportation of products revealed its importance, as it took a share of 55% of the total carbon footprint. Other contributors were food products (3%), other products (e.g. electronics and tobacco) (2%), use of car (2%) and energy (1%).

The findings of this study suggest the great importance of indirect emissions in calculating a carbon footprint. More research needs to be done to understand the importance of product life cycles to the overall carbon footprint. Furthermore, the carbon footprint of voluntourism can be significant, which is why discussion about the environmental trade-offs of international volunteering should be discussed more closely. While volunteers set on their journey to help those in need and to develop themselves, volunteers should understand that this journey might also contribute to threatening the environment and communities that they set out to help.

Keywords
Carbon footprint, voluntourism, volunteer, tourism, India

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Tiivistelmä Turismi on kasvava ala. Vuonna 2017 kansainvälisesti matkaavien turistien määrä kasvoi 7%:lla. Turismi on myös vastuussa ilmastonmuutoksen kiihtymisestä, sillä se on globaalisti vastuussa noin 5%:sta hiilidioksidipäästöistä, ja saattaa olla vastuussa jopa 12,5%:sta kaikista päästöistä. Siksi onkin tärkeää ymmärtää mistä turismin päästöt syntyvät, esimerkiksi hiilijalanjälkianalyysin avulla. Perinteisen turismin rinnalle on noussut uusi turismin muoto, niin sanottu vapaaehtoisturismi. Vapaaehtoisturisti on henkilö, joka turismin ohella pyrkii auttamaan muita, erilaisten järjestöjen ja projektien kautta, eli tekee vapaaehtoistyötä turismin ohessa. Vaikka perinteisen turismin hiilijalanjälkeä onkin tutkittu, kansainvälisen vapaaehtoisturismin hiilijalanjäljen tutkimus on jäänyt vähälle huomiolle. Vapaaehtoisturismi esitetäänkin usein positiivisessa valossa, ja useissa tutkimuksissa korostetaan vapaaehtoisturismin hyötyjä, joita kertyy erityisesti osallistujille itselleen. Tämä tutkimus analysoi vapaaehtoisturismia ympäristönäkökulmasta arvioimalla erään intialaisen kansalaisjärjestön, joka hyödyntää kansainvälisiä vapaaehtoistyöntekijöitä projekteissaan, hiilijalanjälkeä. Järjestön kokonaishiilijalanjälki, jaettuna tasaisesti koko järjestön henkilöstön, vapaaehtoisten, harjoittelijoiden ja paikallisten perheiden kesken, oli **320714 CO_2 eq. kg** ja **2182 CO_2 eq. kg** per henkilö. Kuten aikaisemmissa tutkimuksissa, lentomatkustus oli yksi suurimmista päästölähteistä 37%:n osuudella hiilijalanjäljestä. Yllättäen tuotteiden kuljetus (tuotannosta myyntiin) oli kuitenkin suurin päästölähde 55%:n osuudella. Muita päästölähteitä olivat ruokatuotteet (3%), muut tuotteet (esim. elektroniikka ja tupakka) (2%), ajoneuvojen käyttö (2%) ja energia (1%). Tutkimuksen tulokset painottavat epäsuorien päästölähteiden tärkeyttä hiilijalanjäljen laskennassa. Tuotteiden elinkaarien vaikutus kokonaishiilijalanjälkeen vaatii lisää tutkimusta. Lisää keskustelua tarvitaan myös kansainvälisen vapaaehtoisturismin ympäristöllisestä kestävyydestä, sillä sen hiilijalanjälki voi olla merkittävä ilmastonmuutoksen kannalta. Aloittaessaan matkansa muiden auttamiseksi ja itsensä kehittämiseksi, vapaaehtoisten olisi hyvä ymmärtää, että heidän matkallaan voi olla haitallisia vaikutuksia niin ympäristön kuin niiden paikallisten yhteisöjenkin kannalta, joita he lähtivät auttamaan.	
Asiasanat Hiilijalanjälki, vapaaehtoisturismi, vapaaehtoistyö, turismi, Intia	
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CONTENTS

1 INTRODUCTION

Climate change, accelerated by anthropogenic greenhouse gas (GHG) emissions, will induce drastic changes in the near future, affecting the environment and consequently the lives of people all around the world (IPCC, 2014). A recent special report by the Intergovernmental Panel on Climate Change (IPCC), estimates that already 1.0°C of global warming after the industrial revolution is caused by human activities, and between 2030 and 2052 the temperature is likely to rise to 1.5°C with the current emission levels (IPCC, 2018). Earlier believed to be a "safe" limit, scientists at IPCC now estimate that having a 1.5°C rise in temperature will pose great risks in terms of health, livelihoods, food security and economic growth among other things (IPCC, 2018). Thus, decreasing the amount of GHG emissions is crucial, in order to limit the harmful effects of climate change in the future.

According to a report by UNEP (United Nations Environment Programme), University of Oxford, UNWTO (World Tourism Organization) and WMO (World Meteorological Organization), tourism is globally responsible of about 5% of all CO_2 emissions, one of the most important GHG contributors of climate change, and could be responsible of even 12.5% of the global emissions (Simpson, M.C., Gössling, S., Scott, D., Hall, C.M., and Gladin, 2008). Furthermore, tourism industry's contribution to emissions is expected to rise, since it is experiencing fast economic growth (Simpson, M.C., Gössling, S., Scott, D., Hall, C.M., and Gladin, 2008; UNWTO, 2018). According to a report by UNWTO (2018), total international tourist arrivals grew by 7% during 2017, which was "highest growth in international tourist arrivals in seven years since 2010" (p. 2). Several studies have highlighted the high emission intensity of tourism (Dwyer, Forsyth, Spurr, & Hoque, 2010; Gössling & Peeters, 2015; Rico et al., 2018; Sharp, Grundius, & Heinonen, 2016; Simpson, M.C., Gössling, S., Scott, D., Hall, C.M., and Gladin, 2008) major impacts including aviation, which is the number one emissions contributor in most of the studies that include aviation in their boundaries, with a share ranging from 50% to 95.6% of the total carbon footprint (Dwyer et al., 2010; Rico et al., 2018; Sharp et al., 2016), other transportation, accommodation, and production and import of goods (Dwyer et al., 2010; Hu, Huang, Chen, Kuo, & Hsu, 2015; Jones & Munday, 2007; Liu et al., 2017; Puig et al., 2017; Rico et al., 2018; Sharp et al., 2016).

Many studies have tried to assess the emissions caused by tourism, which is usually a complicated task because of the complexity of tourism industry that comprises of both products and services, of which indirect impacts have a high importance (De, Peeters, Petti, & Raggi, 2012; Dwyer et al., 2010; Hu et al., 2015; Liu et al., 2017; Munday, Turner, & Jones, 2013; Puig et al., 2017; Rico et al., 2018; Sharp et al., 2016). In quantifying emissions, carbon footprint is one of the widely used tools. Even though there has not been a clear definition for carbon footprint in the scientific literature (Matthews, Hendrickson, & Weber, 2008; Weidmann & Minx, 2008), Weidmann and Minx (2008) suggest that carbon footprint could be defined as "a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product" (p. 4). Although, it has to be noted that this definition does not include other gases than carbon dioxide. One of the keys for the success of carbon footprint as a method for quantifying emissions is its simplicity and straightforwardness, for example, when compared to conventional life cycle assessment (LCA) (Weidema, Thrane, Christensen, Schmidt, & Løkke, 2008). However, Weidema et al. (2008) also point out that because of the simplicity of carbon footprint, it can provide misleading results if it is used to evaluate holistic environmental impacts. Nevertheless, it is a useful tool for companies, organizations, public sector and even individuals for assessing their environmental impact and global impacts in a rather simple manner (Weidema et al., 2008), which is why this study also chose to focus on the carbon footprint approach. Its simplicity and importance in terms of global climate change were some of the factors why carbon footprint was seen as a suitable method for assessing the environmental impact of the studied organization.

An emerging trend alongside conventional tourism is volunteer tourism, so called 'voluntourism' (Wearing & McGehee, 2013). A volunteer tourist is a person who uses "discretionary time and income to travel out of the sphere of regular activity to assist others in need" (McGehee & Santos, 2005, p. 760). It is hard to evaluate whether voluntourism has experienced similar growth than conventional tourism but a report by Tourism Research and Marketing (TRAM, 2008) evaluated that volunteer tourists spend from £83 million to £1.3 billion per year. Despite research being conducted on assessing how international voluntourism impacts the target communities, the volunteers' attitudes and perceptions, and the local environment (Bailey & Fernando, 2011; Brown, 2005; Lough, Sherraden, McBride, & Xiang, 2014; Lupoli, Morse, Bailey, & Schelhas, 2014; McGehee & Santos, 2005; Schneller & Coburn, 2018), little emphasis has been given to the question of how international volunteering affects the global climate and what are the trade-offs of voluntourism in the environmental context (Mustonen, 2007; Rattan, 2015). Similarly, little emphasis has been given to the carbon footprint of voluntourism and its contribution to global climate change. As conventional tourism continues its growth, it is likely that voluntourism will also grow in the future, as more and more young people are interested in making an impact while simultaneously enjoying the cultural experience of tourism (Wearing & McGehee, 2013). Which is why it is important to estimate the climate impact of voluntourism, in order to formulate mitigation policies and inform the voluntourism industry and international volunteers about their environmental impacts. When the quantity of the emissions is known, offsetting, compensation and awareness creation programs can be designed more efficiently and accurately.

A comprehensive carbon footprint analysis was conducted to understand and quantify the extent of emissions of international volunteer tourists working under an Indian non-governmental organization (NGO). Thus, the research question for this study is as follows: what is the carbon footprint of an Indian NGO utilizing international volunteer tourists, and which sectors are the major contributors to the overall carbon footprint? The organization and the author became interested in this question, as it was evident that by hosting international volunteers, the organization had extended its environmental impact from a local, to a global level. Furthermore, it was quite interesting to see how people from the so-called Global North would seemingly not pay so much attention to their consumption of goods and services due to relatively low pricing, as they possibly would in their respective home countries. These thoughts raised further questions: What are the environmental trade-offs of voluntourism? Is international volunteering worthwhile considering the effect it has on the global climate, and consequently on social, economic and environmental issues that it is set to solve in developing countries? Are there trade-offs between social and environmental justice? Even though this research might not be able to answer all these questions completely, it provides some direction and steps to addressing these questions and issues in the future.

The case organization hosts numerous volunteers in collaboration with an international volunteer travel agency. This study focuses on both direct (Scope 1) and indirect (Scopes 2 & 3) emissions, with an emphasis on Scope 3 emissions, them being in many case studies the major contributors of emissions, yet not very widely studied (Larsen, Pettersen, Solli, & Hertwich, 2013; Liu et al., 2017; Matthews et al., 2008; Ozawa-Meida, Brockway, Letten, Davies, & Fleming, 2013; Rico et al., 2018; Sharp et al., 2016). In addition, especially in terms of literature focusing on voluntourism, there is few if any research on the carbon footprint of international volunteering, although its environmental impacts might resemble that of conventional tourism. Discussion should be raised about the environmental trade-offs of voluntourism, as much good as it also does. Furthermore, discussion about the importance of indirect emissions of consumption of goods is raised, since it was one of the major contributors of emissions in this case study, alongside aviation, if transportation of products is included. This was possible because a detailed product analysis was conducted from the waste produced by the volunteers. The study has a rather extensive scope, although many assumptions had to be made due to data limitations. The carbon footprint analysis is based on interviews, observations and waste data collection, and is mainly conducted using openLCA with databases containing information about the emissions of certain activities and processes.

First, a theoretical framework for the study is presented, based mainly on tourism research, with some specific discussion about voluntourism. In addition, definitions and the concept of carbon footprint is discussed. Second, the data and methods are presented, and assumptions that were made. Third, the carbon footprint of the organization is presented. Finally, the results, mitigation options, limitations and further research suggestions are discussed.

2 THEORETICAL FRAMEWORK

2.1 Climate Change and Carbon Footprint

Climate change and global warming are caused by the increase of anthropogenic (originating from human sources) greenhouse gas (GHG) emissions in the atmosphere (IPCC, 2014). The most important GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (IPCC, 2014, see for example pp. 4-5), and their levels have continued increasing throughout the 21st century. According to IPCC (2014), both, human influence on climate change, and the positive relationship between GHGs and climate change, are well-known. "Emissions of CO2 from fossil fuel combustion and industrial processes contributed about 78% of the total GHG emissions increase from 1970 to 2010, with a similar percentage contribution for the increase during the period 2000 to 2010" (IPCC, 2014, p. 5).

The increase of anthropogenic GHG emissions in the atmosphere have caused the rise of average global temperature and sea level (IPCC, 2014). Climate change has been observed to have impacts on physical (e.g. glaciers, rivers, floods and droughts, coastal erosion, sea level), biological (terrestrial and marine ecosystems, wildfires) and human (food production, livelihoods, health and economics) systems, and the adverse effects on these are likely to increase in the near future (IPCC, 2014). Other observed changes in the future include increase of extreme weather events and changes in precipitation. All of these factors pose a great risk to both human and natural systems, if not taken into account. Even if the GHG emissions are stopped, the changes will continue for centuries. However, "The risks of abrupt or irreversible changes increase as the magnitude of the warming increases" (IPCC, 2014, p. 16). Anthropogenic CO_2 and other GHG emissions being the main contributors of climate change, it is of high importance to identify their sources, and consequently mitigate their levels, and perhaps even better, transform the way of production and consumption in industries, households, organizations, nations and individuals.

Carbon footprint is used as a tool to assess the GHG emissions of a product, service, organization, country or an individual. After knowing the carbon emissions of the target, it is possible to estimate its importance in terms of climate change. Furthermore, it allows researchers, policy-makers and individuals alike to focus on crucial emission points and formulate mitigation strategies for those. In many cases carbon footprint is expressed in terms of CO_2 equivalents (CO_2 eq.) (Weidmann & Minx, 2008). This means that in addition to CO_2, other GHGs such as methane and nitrous oxide, are converted into equivalent amounts of CO_2 based on their radiative properties (IPCC, 2014), also known as the global warming potential (GWP), which is used especially in the context of life cycle assessments.

An important aspect of a carbon footprint is its system boundaries. By defining system boundaries, a person chooses what processes and aspects to include in the scope of the carbon footprint. Carbon footprint commonly uses the concept of life cycle thinking (Weidema et al., 2008), meaning that the emissions are investigated throughout the life cycle of a product, from harvesting of raw materials to the end-use and disposal. Or, in terms of services this could mean the actions that are taken before the service is initiated to the actions that are taken after the service ends. The different boundaries are referred to as "scopes" or "tiers" of the carbon footprint (e.g. Greenhouse Gas Protocol, n.d.; Matthews et al., 2008). **Scope 1** emissions include direct emissions of an organization, e.g. for a manufacturing company, scope 1 emissions would include emissions coming directly from the production of goods in manufacturing sites. **Scope 2** emissions consist of indirect energy emissions, for example, the emissions caused by external energy and electricity providers that a company uses for their processes and offices. **Scope 3** emissions are all other indirect emissions and can be defined in various ways. For the company this could mean the use of different consumables by their employees in their daily work, the production of hardware and tools, the travelling of their employees, the consequential emissions from their waste management and so on. Even though the definition of scope 3 emissions can be a daunting task, these emissions have been the major source of emissions in many studies, implying their importance in carbon footprint analysis (Larsen et al., 2013; Liu et al., 2017; Matthews et al., 2008; Ozawa-Meida et al., 2013; Rico et al., 2018; Sharp et al., 2016). However, sometimes due to data limitations, it is hard to gather all the information required to complete a comprehensive carbon footprint assessment with wide system boundaries.

Matthews et al. (2008) discuss the importance of carbon footprint estimation boundaries in the context of the United States. They estimate that scope 1 emissions only contribute to around 14% of total industry emissions on an average, while scope 1 and 2 combined contribute to around 26%. This would suggest that most of what is left would fall under scope 3 emissions, which raises concern about misleading results if narrow boundaries are followed. Clarke, Heinonen, and Ottelin (2017), raised a similar concern in the case of Iceland, where the national energy supply is almost 100% renewable. However, as they studied the carbon footprint of Icelandic households using a consumption-based method, they found out that transportation, and import of products, were the most important factors in determining high GHG emissions of Iceland. Furthermore, Ivanova et al. (2015) showed, in their study of global household consumption using an environmentally extended input-output (EEIO) database EXIOBASE 2.2, that indirect carbon footprint of household consumption contributes to a major share of the total household carbon footprint in many countries. For example, in India where production is largely domestic, the indirect domestic carbon footprint was relatively large for households. More examples can be found from case studies that studied the carbon footprint of universities. Larsen et al. (2013) and Ozawa-Meida et al. (2013) both found out that scope 3 related emissions formed most of the carbon footprint, for example, transportation, and purchase of consumables and equipment being some of the major contributors of emissions.

Thus, it can be concluded that indirect emissions play a major role in many kinds of cases. Later, it will also be shown that in the case of tourism, definition of system boundaries and taking into account the indirect emissions can be important.

Some scholars have assessed the limitations of carbon footprint. Carbon footprint has been criticised for overly simplifying environmental impacts and consequences (Laurent, Olsen, & Hauschild, 2012; Weidema et al., 2008). Using carbon footprint as the only environmental indicator can lead to misleading results and misguide policy makers (Laurent et al., 2012; Weidema et al., 2008). For example, carbon footprint does not correlate with the possible emissions of toxic substances (Laurent et al., 2012), which is why it could be said that carbon footprint is not always a good representative of holistic environmental sustainability. Weidema et al. (2008) think that the simplicity of carbon footprint as an indicator comes from the fact that its development was not put forward by research, but by companies and NGOs, whereas LCA is seen more as a research tool with a high level of detail. However, they also argue that the simplicity of carbon footprint made it possible for it to become a widely used concept and tool. Whether holistic evaluation of environmental impacts is important or not, carbon footprint can at least provide a direction, which can be enough for decision-making (Weidema et al., 2008).

2.2 Carbon Footprint of Tourism

Tourism is globally responsible of about 5% of all CO_2 emissions and could be responsible of even 12.5% of the global emissions (Simpson, M.C., Gössling, S., Scott, D., Hall, C.M., and Gladin, 2008). The emission intensity of tourism has to be taken into account to tackle climate change effectively. With a growth of 7% in international tourism arrivals in 2017 (UNWTO, 2018) tourism might be an even larger contributor to climate change in the future.

Hu et al. (2015) studied the carbon footprint of accommodation services in an international Taiwanese hotel. They found out that energy consumption was the main source of emissions. However, other activities (such as production and transportation of hotel amenities and other scope 3 emissions) accounted for 15.90% of the total carbon footprint. Another study focusing on accommodation related impacts of tourism also found out that electricity and fuel consumption accounted for more than 75% of the total carbon footprint (Puig et al., 2017). Liu et al. (2017) also studied the carbon footprint of tourist accommodation but considered small service providers in a rural area in China. They found out that 74.99% of the accommodation and service-related carbon emissions were from indirect sources (namely food, construction and production of durable goods) of which food was the most important contributor (43.59% of total indirect emissions). However, these studies did not take into account national and international transportation and the consumption by tourists outside the accommodation but focused on the individual tourist accommodation facilities.

Sharp et al. (2016) studied the carbon footprint of tourism in a larger scale, using a consumption-based LCA methodology to assess the carbon footprint of inbound tourism to Iceland. They found out that 50-82% of the carbon footprint comprises of aviation related impacts, the fluctuation being a result of different flight distances. A case study by Rico et al. (2018) also discussed the importance of indirect transportation related emissions (95.6% of the total emissions), particularly aviation, in the carbon footprint of tourism in Barcelona. They also raised accommodation and leisure activities as important contributors. Overall, scope 3 emissions contributed to 96.3% of the total emissions. However, it is important to notice that this study did not take into account the energy used for production of goods. In the context of Australia, Dwyer et al. (2010) estimated that between 3.9% and 5.3% of the total industry GHG emissions is caused by tourism. They included domestic aviation in the direct emissions, and it contributed to around 56.68% (domestic air transport) of the total direct emissions, followed by accommodation services (9.2%) and shopping (7.1%). The largest contributors in indirect emissions were electricity by coal, which contributed to around 37.44% of the total indirect emissions, followed by agriculture, forestry and fishery (30.64%). These studies suggest the importance of transportation related impacts of international tourism, and that system boundaries should be wide when assessing tourism related carbon footprints.

2.3 Voluntourism

Many researchers have studied voluntourism (volunteer tourism) from a variety of different perspectives ranging from social research investigating the motivations of volunteers (Brown, 2005; Mustonen, 2007) and how volunteering impacts the volunteers and the host communities in a positive way (Bailey & Fernando, 2011; Lough et al., 2014; McGehee & Santos, 2005; Schneller & Coburn, 2018) to research that takes a more critical stance towards voluntourism (Guttentag & Wiley, 2009; Pluim & Jorgenson, 2012). These studies and many others, implicate a strong growth in voluntourism sector, which is further backed up by a review done by Wearing and McGehee (2013).

According to a popular definition volunteer tourists are people "who for various reasons, volunteer in an organized way to undertake holidays that might involve the aiding or alleviating the material poverty of some groups in society, the restoration of certain environments, or research into aspects of society or environment" (Wearing, 2001, p. 1). Another, a bit broader, definition is given by McGehee and Santos (2005) who describe them as people who use "discretionary time and income to travel out of the sphere of regular activity to assist others in need" (p. 760). Popular projects in voluntourism organizations can be for example planting of trees and plants, environmental education, caring and monitoring of wildlife, trail maintenance and organic gardening/agriculture (these would fall under environmental projects), or, education for children and adults, skills training for community members, infrastructure development, promoting income generation activities and empowering women's groups (these would fall under community development or social projects) (Lupoli, Morse, Bailey, & Schelhas, 2014). Similarly, in the target organization of this study, the projects were divided under environmental projects, and community development and education projects, in addition to health-related projects.

Some scholars have attempted to study the motivations of people who embark on a volunteering journey. Brown (2005) lists four main themes as the main motivators for volunteers: cultural immersion, desire to give back, friendship and relationship with other volunteers and family bonding. Her study also identified two different types of volunteers: those who are inclined towards the actual volunteering work (volunteer-minded) and those that have focus on travelling and other tourism related activities (vacation-minded) (Brown, 2005). Mustonen (2007) studied the motivations of volunteers from another perspective, assessing the concept of altruism and egoism and which would be the motivator for a volunteer tourist. He argues that volunteers' motives lie in both altruism and egoism, and that they are interconnected. This mix of motives is formed by a combination of "pursuit of individuality" and sociality (Mustonen, 2007).

Some benefits of voluntourism for its participants and for the society could be enhancement of civic attitudes and activism (Bailey & Fernando, 2011; McGehee & Santos, 2005), growing concern of social and environmental issues among participants (Schneller & Coburn, 2018) and improvement of international concern and intercultural relations (Lough et al., 2014). Furthermore, Schneller and Coburn (2018) reported that host communities (voluntourism target communities) in Costa Rica felt that the implemented projects were meaningful and had visible benefits, and some studies have observed positive cross-cultural exchanges and financial benefits in host community members (Rattan, 2015).

On the other hand, only few researchers have studied the possible negative impacts of voluntourism. Some reported negative impacts include the idea of voluntourism being an alternative form of neo-colonization (Pluim & Jorgenson, 2012). According to this idea, voluntourism promotes dominant values and reinforces superiority-inferiority binary, where host communities see volunteers as something superior. In addition, it is argued that while some volunteering programmes can be quite costly, it mostly allows middle or upper class people to participate, thus reinforcing the value systems that these people have according to their social positioning (Pluim & Jorgenson, 2012). Guttentag (2009) listed "a neglect of locals' desires, a hindering of work progress and completion of unsatisfactory work, a disruption of local economies, a reinforcement of conceptualisations of the 'other' and rationalisations of poverty, and an instigation of cultural changes" (p. 537) as some of the negative impacts of voluntourism. Similarly, Rattan's (2015) review of negative impacts include cultural clashes, effects on local economies (e.g. unemployment) and problem of commodification.

Rattan (2015) suggests that certifications and ecolabels could be the answer to addressing some of the issues caused by voluntourism. However, as he argues, these certifications should be closely followed and including tangible aspects is important. While these certifications could be of help, when the appropriate information about the negative impacts is known, it is evident that there is little if any research focusing on the global environmental impact of voluntourism. Studies on the environmental impacts of conventional tourism are prevalent but to get a comprehensive picture of what is the role of voluntourism in terms of its global impacts, more research needs to be done. This would also assist voluntourism operators in forming suitable certifications and offsetting programmes.

Giving a more comprehensive picture on the environmental impact of voluntourism is one of the main aims of this study, which would hopefully initiate a discussion on not only the psychology and social impact of volunteering but also global environmental impact. Thus, it would be easier for voluntourism researchers, policymakers and practitioners to understand the comprehensive impact of voluntourism from all viewpoints of sustainability.

2.4 The Case Organization

The case organization's name or its partners' names cannot be presented in this thesis. Voluntourism is one of the most important sources of income for the organization and for the involved families. Wherever needed, the case organization is now on referred to as "the NGO" or "the organization".

The NGO operates in the area of Naddi (see Figure 1), Dharamshala, Himachal Pradesh, India. It also operates in other Indian states, such as Punjab and Rajasthan, but volunteers mostly come to Dharamshala area. The NGO operates in close contact with rural communities and its approach to development work is community-based.

Figure 1: A view of the village of Naddi in Dharamshala, one of the operational places of the NGO.

The NGO has a wide repertoire of focus areas, including eco-agriculture, sanitation and health, education, and waste management. When the study was conducted there were around three to five permanent employees (e.g. Programme Director and Assistant Programme Director), in addition to some local personnel (people from the local village). Furthermore, the NGO also has international and Indian interns working for them (unpaid), usually for a time of two to six months, some extending their stay to around 12 months or more. One of the main goals of the NGO, in addition to promoting Sustainable Development Goals (SDGs), is to provide young people with leadership opportunities, in order for them to become responsible world citizens.

The organization collaborates with local families who provide food, accommodation and other services (e.g. laundry). Occasionally, the families provide support for organizational projects. In Dharamshala, the houses of two families contain space for the NGO office, and accommodation for volunteers and Airbnb guests (see Figure 2).

Figure 2: The three houses that host volunteers and Airbnb guests and contains the NGO office as well. On the left you can see the house of family number 1, on the middle the house of family number 2 and on the right house number 3 which is not managed by a family, but by locals who work for the NGO.

A relatively new addition to the organizational operations is the inclusion of short-term international volunteers in their programmes. The volunteers apply through an international volunteer travel agency collaborating with different organizations around the world, who are interested in using volunteers in their work. Around the time of the study, volunteers usually stayed from two to five weeks, some of them staying for two months. The volunteers were assigned to different programmes and projects according to their wishes and the needs of the organization. They were often given a lot of freedom to travel around and explore other places, which is why their working hours were either during the morning or afternoon, or both. The NGO organizes airport pick-ups and drop-offs for the volunteers, and food is provided by the local families three times a day (breakfast, lunch and dinner).

The NGO gains income from voluntourism and Airbnb guests. One of the fundamental ideas of the NGO is that it does not accept any external funding sources (e.g. donations). The Programme Director often referred to the organization as a social enterprise or social business, because they seek opportunities and projects that make a sustainable income for the local communities and the organization. Some of the generated income flows to the families, which makes voluntourism operations an important part of the families' income.

The organization recognizes the environmental impact that voluntourism activities have both on the local and global environment. Thus, they are interested in creating environmental policies which would guide the organization itself to pursue environmentally sustainable approaches to voluntourism. This thesis is a part of that effort, because it will attempt to assess the carbon footprint of voluntourism in the organization. The findings make it possible to point out crucial emission sources to evaluate the extent of mitigation and offsetting measures.

3 DATA AND METHODS

The data for the research was collected between June and November in 2018, at the study site in the village of Naddi, Dharamshala, Himachal Pradesh, India. It was collected in order to quantify the GHG emissions caused by voluntourism activities and volunteers in the target organization. Interviews, observations and analysis of consumption from waste package analysis, were used as methods to collect data for the carbon footprint analysis. After the treatment of the raw data (including assumptions made), the carbon footprint was calculated using openLCA software with ecoinvent 4.3 and EXIOBASE 2.2 databases. Some food related carbon footprints were calculated based on Pathak et al. (2010), because the databases did not contain such specific information. A report by UNEP was used to calculate the carbon footprint of liquefied petroleum gas (LPG) as a cooking fuel (Thomas, Tennant, & Rolls, 2000, p.23).

The collected data, methods for the pre-treatment of raw data for the carbon footprint analysis, and the carbon footprint analysis methods are presented in the following sections. In addition, assumptions that were made, in order to calculate a carbon footprint for the whole year (2018), are presented.

3.1 Data

The collected data can be divided into three different sections according to the different scopes of carbon footprint. First, there was data that was collected to answer the components of the scope 1 emissions (flights and transportation by car). This was mostly information from organizational documents and interviews with the Programme Director. In addition, information about the quantity of sanitary waste was collected, in order to find out how much emissions are caused by burning it. However, sanitary waste was excluded from the analysis because a suitable method to calculate emissions was not found. Second, there was data for the scope 2 emissions, namely electricity. The information for scope 2 emissions was collected from electricity bills and interviews. Third, information about the scope 3 emissions (indirect emissions from consumption of food and other products) was collected through intensive waste analysis and interviews with local families. The process of acquiring information will be explained further in the following sections. Table 1 provides a summary of the different data collection methods for different variables.

Table 1: The different sectors and sub-sectors of carbon footprint analysis, and sources of information and methods of calculation for them.

Scope	**Sectors**	**Sub-sectors**	**Sources of information**	**Method of calculation**
Scope 1 - Direct GHG Emissions				
	Transportation	Car transportation (airport pick-up, work transport, local trips)	Google maps, interview with Programme Director, personal observations	openLCA - Ecoinvent 3.4
		Flights	Volunteer Database (Excel)	ICAO Carbon Emissions Calculator
Scope 2 - Indirect Electricity GHG Emissions				
	Energy	Electricity use (hydro)	Electricity Department	openLCA - Ecoinvent 3.4
Scope 3 - Other indirect GHG Emissions				
	Energy			
		Cooking fuel (LPG)	Family interviews	UNEP (Thomas et al., 2000)
	Consumables from family interviews			
		Rice production	Family interviews	openLCA - Ecoinvent 3.4
		Potato production	Family interviews	openLCA - Ecoinvent 3.4
		Tomato production	Family interviews	openLCA - Ecoinvent 3.4
		Pulse (lentils) production	Family interviews	Pathak et al. (2010)

		Poultry meat (chicken) production	Family interviews	Pathak et al. (2010)
		Mutton production	Family interviews	Pathak et al. (2010)
		Egg production	Family interviews	Pathak et al. (2010)
		Milk production	Family interviews	Pathak et al. (2010)
		Onion production	Family interviews	openLCA - Ecoinvent 3.4
		Wheat production	Family interviews	openLCA - Ecoinvent 3.4
		Sugar production	Family interviews	Pathak et al. (2010)
		Cooking oil production	Family interviews	Pathak et al. (2010)
		Salt production	Family interviews	openLCA - Ecoinvent 3.4
		Tissue paper (toilet) production	Family interviews	openLCA - Ecoinvent 3.4
	Consumables from waste analysis			
		Production of food products	Waste Analysis	openLCA - EXIOBASE 2.2
		Production of beverages	Waste Analysis	openLCA - EXIOBASE 2.2
		Production of tobacco products	Waste Analysis	openLCA - EXIOBASE 2.2
		Production of electronics	Waste Analysis	openLCA - EXIOBASE 2.2
	Transportation of products		Waste Analysis	openLCA - Ecoinvent 3.4

Furthermore, Table 2 provides an estimation about the number of different people who are seen as contributors to the carbon footprint of the organization. This information was used to calculate an individual's carbon footprint, if emissions were divided equally between all 147 people of the organization. However, it is important to note that, for example flight emissions were only calculated for volunteers as they were at the focus of the study and they represent a major share of the people in the organization.

Table 2: The estimated number of people involved in the studied operations (aspects of carbon footprint) of the target organization.

Name of group	**Estimated number of people per year**
Volunteers	118
Interns	20
Local family members and NGO staff	9
Total	**147**

3.1.1 Scope 1

Scope 1 data consists of direct GHG emissions produced by the organization and its volunteers. In practice this means emissions from flights and transportations by car. Additionally, incineration of sanitary waste creates direct emissions that could be accounted into scope 1.

The flight data was gathered from a spreadsheet that is kept by the organization to keep account of previous and incoming volunteers. The methods for calculation of emissions and assumptions made are explained further in chapter 3.2.

Transportation with car can be divided into two sections. Work related transportation and leisure transportation. The data for work related transportation data was gathered by interviewing the Programme Director, who estimated the amount of car use per day. There was an attempt to start using a car log, which was initiated but the full implementation would have required some more time, which is why it wasn't used in this study. The leisure related transportation data was acquired by personally estimating the most common destinations by volunteers and how frequently they go there and then estimating the distance by using Google Maps.

3.1.2 Scope 2

The data about the electricity usage comes from two sources. First, there was an interview organized with the local electricity department. However, they couldn't provide specific data about the buildings in question. The important piece of data that they could provide, was information about the price of electricity for private and commercial buildings. The actual electricity usage data was gained from the electricity bills received by the families. Unfortunately, for two buildings this was only for one month. For the third building, data was acquired for several months, because the family requested a more comprehensive list from the electricity department.

Acquiring a comprehensive list of electricity consumption would have probably been possible for the other buildings but was not done due to limitations in communication and lack of time. Having a comprehensive list of electricity consumption for several months would have been important to reliably evaluate the annual consumption of electricity by the two remaining households. However, as shown later, electricity consumption is not a major contributor to the total carbon footprint, largely because electricity is assumed to be produced by hydropower, according to the employees at the local electricity department.

3.1.3 Scope 3

Most of the working time was used for collecting scope 3 data. The data collection can be divided into two sections: Family interviews and waste analysis. The interviews were conducted on 18.7.2018 in an informal manner with the help of a Hindi speaking colleague. The families were asked which kind of food products they use the most and how much they consume in a month for cooking activities. Furthermore, they were asked about how much cooking fuel (LPG), and cleaning and washing chemicals they use per month, even though these were excluded from the carbon footprint analyses. The other family was also asked about how many toilet paper rolls they use per month, because they were supplying toilet paper rolls to volunteers.

The waste analysis took place at the organization's Resource Recovery Stations (RRS) (see Figures Figure 3 and Figure 4). The first RRS was not used as much as station number two. Nevertheless, it was used for data collection. The second RRS was primarily used for data collection and was probably the most used station by volunteers.

Figure 3: The Resource Recovery Station at house number 1.

Figure 4: The second Resource Recovery Station at house number 2.

The data collection phase took place from 18.8.2018 to 10.10.2018. Data was collected by going through the different waste categories and by analysing each waste item to see if it had clear product related information, which meant, most of the times, collecting data from a few specific waste categories. The different variables collected, and their explanations can be found from Table 3. All of these variables were collected from each waste item if possible. Identical products were not registered multiple times, but they were added to the variable "Number of waste items in waste bag". After all the waste items were analysed, they were then stored in storage bags, and the collection bags were ready to be filled again by users (mostly volunteers). Also, before analysing the content of a bag, the weight was measured using an electronic scale. The weight was stored in a different database, which contains all the waste weighting data.

Table 3: Explanations for the different collected variables of the waste analysis data.

Type of Information	**Explanation**
First Identification Date	Date of waste piece identification
Station Name	The name of the Resource Recovery Station
Wastebag Previous Storage Date	When the wastebag was previously weighted and stored (and analysed)
Waste Accumulation Time	The time between Wastebag Previous Storage Date (or date of RRS establishment) and First Identification Date
Product	The specific product group, which characterises the product, e.g. Bottled water or Sweets
Category	·The broader product category, e.g. Beverages or Food
Net Quantity	The quantity of one individual item
Total Quantity	The total quantity of all identified waste items
Unit	The unit of quantity, in grams, liters or pieces.
Ingredients	The ingredients of the product. This applies mostly for food products and beverages.
Code / State	The origin of the product presented with a postal code and state of origin.
Manufacturer / Packager	The manufacturing or packaging company of the product.
Trademark owner / Marketing company / Importer	The owner of the product's trademark. / The product's marketing / importing company.
Brand / Name	The specific brand and name of the product.
Product Price (Indian Rupees)	The price of a single product in Indian rupees
Total Price (Indian Rupees)	The total price of ·all identified waste items.
Waste Item	The waste item used for identification, e.g. a label or a package.
Waste Type	The type of the waste item based on the RRS segregation, e.g. Plastic Aluminium

Number of waste items in waste bag	The total number of waste items in the waste bag during the identification dates of the same bag.
Notes	Additional notes about the product or anything general about the spreadsheet.

Before further analyses it is essential to explain the different Categories that were chosen for this waste analysis, even though not all of them were used in the analyses. The different categories are explained in Table 4. Because of methodological and software limitations, a carbon footprint analysis was only conducted for Food, Beverages, Electronics and Tobacco products. Furthermore, some of the categories (Food (kitchen) and Dairy products) were at a risk of overlapping with the family interview data, thus they were left out from the analyses.

Table 4: Explanations and product examples for the different product categories that were identified during the waste analysis.

Category name	**Explanation of category**	**Product examples**
Food	All kinds of packaged solid food, excluding products in category Food (kitchen).	Bread, potato chips, ice cream, cookies, chewing gum and other snacks.
Beverages	All kinds of beverage products, excluding some products in category Dairy products.	Canned sodas, beer, bottled water and juice.
Soaps	Solid soap products, mainly used for personal hygiene and cosmetic purposes.	-
Chemicals	Chemicals in various forms, used mostly in household activities.	Detergent powder, dishwashing bar, liquid vaporizer, instant adhesive and floor cleaner.
Paper products	All kinds of products made mostly out of paper.	Wet wipes, tobacco rolling paper, tissues and toilet tissues.
Electronics	Electronic products.	Mobile phone, light bulb and USB cable.
Tobacco products	Products that include tobacco as one of their main ingredient.	Tobacco (cigarettes), spit tobacco.
Other consumables	Consumables that are hard to categorize or are small in quantities, thus not needing their own separate category.	Sanitary pads, gel pens, wax crayons, colour pencils, padlock, disposable tableware.

Medical	Products that are likely to be used for medical purposes.	Oral rehydration salts, ointment, antiseptic cream, probiotic capsules, hydrochloride tablets, cough drop.
Chemicals (cosmetics)	Chemicals that are identified as cosmetic products.	Shower gel, face wash, cosmetic oil.
Food (kitchen)	Food products that are most probably used by the family in their everyday cooking activities.	Noodles, rice, spices, tea.
Dairy products	Common dairy products that are also most probably used in the everyday cooking activities in the local families.	Milk, paneer (cheese), dahi (curd)

3.2 Methods

After gathering all the required information and data, either by interviews, observations or waste analysis, the data needed some treatment and assumptions had to be made before a carbon footprint could be calculated. A similar dissemination as in earlier chapters is used, starting from scope 1 data and proceeding to scope 2 and scope 3 data. First, the pre-treatment of the raw data for the calculations is explained further. This includes explanation of assumptions made. Second, the calculation of carbon footprint for the different emission categories is explained.

3.2.1 Scope 1

Transportation related data included airport pick-ups, work-related transportation, some leisure transportation and airport drop-offs. The Programme Director estimated that the NGO car is used on an average 50 kilometres per day, excluding leisure transportation. A yearly average car use was then calculated (50 * 365). In addition, the leisure transportation included two trips per week from the village (Naddi) to a nearby town called McLeod Ganj (based on personal observations). The length of the trip from Naddi to McLeod Ganj and back to Naddi by car is 8 kilometres according to Google Maps. Thus, in a week there would be 16 kilometres of leisure travel in total, and in a year (52 weeks), the total amount of travelling is 52 * 16 kilometres. Then, these two different transportation classes would be combined together to get a yearly total average for car transportation, which was **19082 kilometres** in 2018.

Some assumptions also had to be made about the flight data of the volunteers because there was no accurate information about their departure airports and what kind of flight routes they took. The information that was used was their country of origin. First of all, the flight trip was presumed to be a round trip and that the route in India was through Delhi airport (Indira Gandhi International Airport) to Dharamshala airport (Gaggal airport). For example, a complete trip from London-Heathrow airport would be as follows: London-Heathrow to Delhi airport to Dharamshala airport to Delhi airport to London-Heathrow. This assumption could miss the possibility of connecting flights (e.g. to make a trip cheaper). Furthermore, this method does not take into account people who do additional travelling after their volunteering period.

For most of the countries, the largest airport of the country was chosen as the point of departure. However, some countries have a substantial difference in distance between east and west or south and north, and these countries (namely USA and Canada) needed some sort of compromises. For USA, two airports were chosen: John F. Kennedy International Airport (one of the largest east coast airports) and Los Angeles International Airport (one of the largest west coast airports). The average carbon footprint between these two departure airports was calculated and used. From Canada the average between Toronto Pearson International Airport (one of the largest east coast airports) and Vancouver International Airport (one of the largest west coast airports) was chosen.

In addition, some countries did not have direct flights to Delhi (according to the ICAO emissions calculator and Google Flights search), so more assumptions had to be made for these places. This was solved by using googling the flight from the departure destination to Delhi, and by looking at the most common flight tickets available for purchase, e.g. a flight from Dublin, Ireland would go through London-Heathrow and a flight from Haneda airport (Japan) would go through Shanghai airport based on this quick online examination of available flight tickets. This is probably not an accurate representation of the flight routes that were chosen but it is an assumption and an estimation of what could have been the average case.

3.2.2 Scope 2

The scope 2 related data also needed some treatment and assumptions because of limited data availability. The electricity usage for buildings one and three was only known for one month (date of electricity bill issue 19.7.2018), and for building two it was known from January 2018 to August 2018. Buildings one and three were assumed to be residential units (electricity price 4 rupees per kWh) and building two was assumed to be a commercial unit (electricity price 5.5 rupees per kWh) (based on the words of the Programme Director on 4th of October, 2018; electricity pricing from the local electricity department interview on 26th of July, 2018). Monthly and annual averages for each building were calculated, for example for buildings one and three this meant using the given value for one month, assuming it would represent the whole year. Then the annual total electricity use was calculated by summing up each of the different buildings' electricity usage during a year. The value is **492300.75 kWh** in 2018**.**

3.2.3 Scope 3

Scope 3 data required some more work before the actual calculations could be done. First, the interview data gathered from the two families had to be summed up together and then the annual average amount of each product could be calculated. Some product groups overcame changes during the process. For example, the families estimated the amount of meat products, but in the carbon footprint databases these had to be segregated into different groups. So, in the case of meat products, it was assumed that the proportion of chicken and mutton (the most commonly used meat products around the area) are equal, in other words 50% of the meat products is chicken and 50% is mutton. Furthermore, the families gave the amount of eggs used, but for the calculations, it was necessary to know the weight of the eggs. It was found out that one egg weighs approximately 0.055 kilograms (IndiaAgroNet, n.d.). Similarly, a conversion had to be made for toilet paper rolls. One roll weighs approximately 0.227 kilograms (Massachusetts Institute of Technology, n.d.).

A report by UNEP revealed that LPG emits 2.95 tonnes of CO_2 per tonne of LPG (Thomas et al., 2000, p. 23). The annual estimation of LPG consumption amount was first converted into tonnes and then multiplied by the emission intensity value (2.95) to derive the carbon emissions induced in LPG consumption.

The waste analysis data was aggregated into larger product groups, which were Food, Beverages, Soaps, Chemicals, Paper products, Electronics, Tobacco products, Other consumables, Medical, Chemicals (cosmetics), Food (kitchen), Dairy products. This was necessary because the carbon footprint databases (EXIOBASE and ecoinvent) mostly use aggregated product groups. To estimate the annual amount of product consumption (in other words, waste product accumulation) the waste accumulation time was examined more closely. The maximum waste accumulation time for the examined waste items were 127 days, because the first Resource Recovery Station (RRS) was established approximately on 1st of June 2018 and the final date of waste analysis was on 8th of October 2018. Even though the analysis of the waste was started much later (18th of August, 2018), it included the examination of the storage bags, including the waste that was accumulated from the beginning of the RRS establishment. Next, the proportion of 365 days (1 year) from 127 days (maximum waste accumulation time) was calculated in order to find out the value, which could be used to multiply the waste data, in order to estimate the annual amount of product consumption. The assumption was that this waste analysis sample of 127 days can be expanded to represent the results of an analysis of one year. So, after multiplying the results with 365/127 (equals approximately 2.87) an annual estimation was done. Which is how the annual Total Quantity, Total Price and Total Number of Items for the different product groups were found out. This information was then used to calculate a carbon footprint for the different product groups. When using EXIOBASE 2.2 database, the consumption metric for the products had to be given as a price in euros. The product price was known in Indian rupees, so it had to be converted to euros using an online currency converter (XE, 2019).

Furthermore, the transportation of products was later taken into account because of the extensive amount of information about the manufacturing locations of different products. There were multiple steps in finding out the transportation value for the carbon footprint calculations.

Nearly all examined products had a postal code in their package implicating their manufacturing or production site. Most of the products came from India and some from abroad, however foreign products were not taken into account due to lack of information. Different postal codes and the number of their appearances were registered, and they were put into different groups according to which Indian state the postal code was from. Then it was found out how many different postal codes there were inside a specific state and how many occurrences there were in total (e.g. if postal code 1 appeared two times and postal code 2 eight times inside a specific state, then the total occurrences would be ten).

Using the help of Google Maps, the distance from each postal code to the village of Naddi was found out and an average distance from a state calculated (these findings are presented in chapter 4.2). To estimate the average distance covered per state to reach Naddi, an assumption had to be made. It was assumed that products from the same location might be included in the same transportation vehicle for logistics purposes. Which is why it was decided that to estimate the total distance from a state to Naddi, the average distance to Naddi had to be multiplied with the quantity of different locations. This would at least mitigate, although not remove completely, the risk of double counting. An annual estimation of different locations was not made, since it was assumed that the quantity of locations during the study period would probably be representative for a year (most of the products would assumedly be coming from these same locations, thus making the extrapolation of data unnecessary), and it would not be accurate to assume that the quantity of locations would grow much even if the study period would be longer. Even so, this piece of data is probably not representative for a whole year, because products are probably not transported only once from these different locations but represents emissions during the study period and gives some hint of the quantity of annual emissions of product transportation. Multiplying the quantity of different locations with the average distance to Naddi resulted in approximately **248042 driven kilometres**. This estimation is very coarse and is probably one of the biggest error factors in the calculation because there was limited amount of information which resulted in several assumptions made. Nevertheless, it does not seem likely that this assumption would at least largely overestimate the distance driven by the vehicles.

After the distance driven was known, other factors had to be investigated, such as the capacity of an average vehicle to transport goods and what was the proportion of goods consumed by the volunteers from the total goods delivered. The capacity of an average vehicle was found out from a report by an Indian transportation company, Premier Road Carriers (n.d.). The report specifies different types of commercial vehicles and their capacity in tonnes. Using this information, it was possible to calculate an average capacity of a commercial vehicle, which is 15.6 tonnes. Thus, the total quantity delivered (approximately 3104 tonnes) can be found out by multiplying the quantity of different locations per year (199) with the average capacity of an Indian commercial vehicle (15.6 tonnes). Furthermore, by estimating the total amount of goods consumed by the volunteers per year based on the waste analysis data (approximately 2345 kg, which is 2.345 tonnes) it was found out that the proportion of these goods from the total quantity of goods delivered by all the commercial vehicles, would be around 0.000755, or 0.0755% from the total quantity. After multiplying the total quantity with the total distance driven (t*km), the data was ready for a carbon footprint analysis.

3.3 Carbon Footprint Analysis

After the pre-treatment of the data, it was possible to initiate the carbon footprint analysis. Four main methods were used to calculate the carbon footprint: ICAO Carbon Emissions Calculator, openLCA with EXIOBASE 2.2 database, openLCA with ecoinvent 3.4 and a research by Pathak et al. (2010). The steps for the analysis and the inputs used are explained in the following sections, divided by the different analysis methods. Short introductions to the different databases are also given. In addition, a UNEP report by Thomas et al. (2000) was used to calculate the emissions from liquefied petroleum gas (LPG) use as a cooking fuel, this calculation was briefly explained in chapter 3.2.3.

openLCA is an open source life cycle assessment software, developed by GreenDelta in 2007 (GreenDelta, 2018a). In addition to being used by several institutes, organizations and researchers, openLCA matches with 28 search results in the International Journal of Life Cycle Assessment (GreenDelta, 2018b). The version used in this study was openLCA 1.7.

3.3.1 ICAO Carbon Emissions Calculator

ICAO (The International Civil Aviation Organization) is a special agency operating under the United Nations, founded in 1944. ICAO works broadly in the sector of civil aviation, for example, by ensuring "safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector" (ICAO, 2019a).

The ICAO Carbon Emissions Calculator is a tool used to calculate the carbon dioxide emissions from air travel. It utilizes publicly available industry data, such as, aircraft types, route specific data, passenger load factors and cargo carried to calculate a comprehensive carbon footprint for air travel. However, it can already be noted that this calculator does not take into account the whole life cycle of emissions, e.g. materials used for aircraft and life cycle of fuels used. Furthermore, significant differences have been found between the results that different existing flight emissions calculators give (Baumeister, 2017). Nevertheless, ICAO Carbon Emissions Calculator is recognized as a widely used calculator in the aviation industry (Baumeister, 2017). Next, the steps to calculate the flight emissions relevant for this study are explained, with information about the inputs given to the calculator.

First, a round-trip for a trip from Delhi to Dharamshala was calculated using inputs visible in Figure 5. The value under "Total passengers' CO2/journey (KG)" was the desired final result. Then the flight emissions for different volunteers were calculated according to their nationality, which was assumed as their country of departure. The assumptions made for different departure airports and travel routes were explained in section 3.2.1. The emissions caused by a volunteer's round-trip to Delhi from their country of origin were added up to the emissions caused by a Delhi-Dharamshala round-trip. When each volunteer had their own flight carbon footprint, they were all summed to derive a total flight emissions value for 2018.

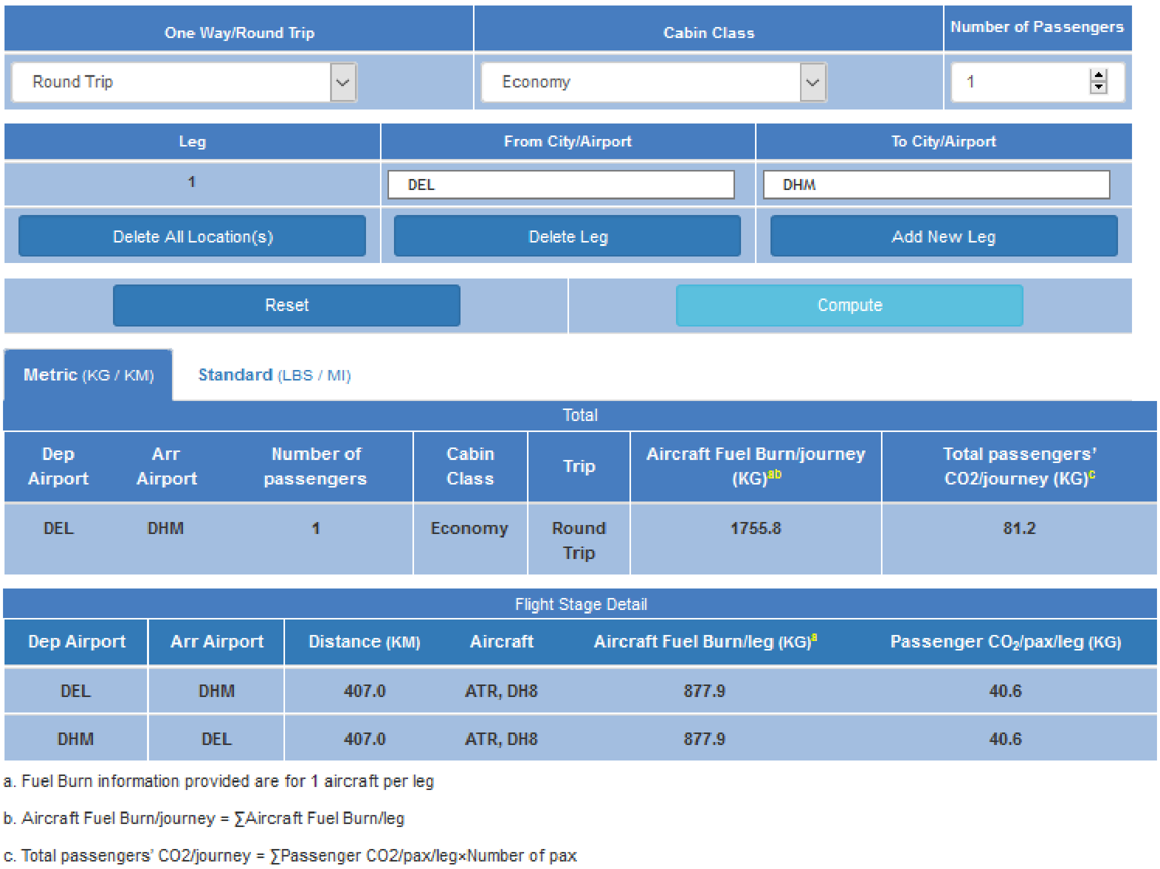

Figure 5: Inputs and results for a round-trip from Delhi to Dharamshala using the ICAO Carbon Emissions Calculator (ICAO, 2019b)

3.3.2 openLCA with EXIOBASE 2.2

EXIOBASE 2.2 is a multi-regional environmentally extended input-output (EEIO) database (Tukker et al., 2013; Wood et al., 2015). EEIO analysis links trade with associated environmental impacts and provides global and regional insights into the impacts of economic activities (Kitzes, 2013). Kitzes (2013) provides a comprehensive introduction to EEIO analysis and found two common goals for an EEIO analysis: calculating, (1) indirect, hidden impacts embedded in consumption activities, and, (2) impact embedded in goods that are internationally traded (p. 490).

In this study the focus was not on these two goals, even though analysing the global impact more closely could be interesting, but EXIOBASE was useful because of the level of aggregation it has, even though there are even 200 different products and 163 industries (Wood et al., 2015). Nevertheless, as it can be seen from Table 1, EXIOBASE was used to calculate the impacts of products identified in the waste analysis, because these products had to be aggregated into larger product groups, thus making it possible to use EXIOBASE, which does not go too deep into different product categories. Furthermore, having data from 48 different regions (Wood et al., 2015), including India, EXIOBASE was considered to be accurate enough for the carbon footprint analysis. In addition, it is possible to download EXIOBASE 2.2 (at the moment of writing, also version 3 is available) to use in openLCA, which made it slightly more dynamic and faster to use, especially if knowledge about input-output analyses and related mathematics is limited. Also, some of the product categories were not found from other databases or research papers. The inputs used in openLCA are explained next.

For each of the calculations, a product system was created, which included the relevant process as a reference process (e.g. a product system called FoodProducts, would have 'Food products nec' (India) as its reference process) and a cut-off of 1.0E-5 was used because of the large size of the database (Ciroth, 2017). Then the reference amount was defined, and while EXIOBASE 2.2 requires the use of monetary units in euros, the amount was derived from the currency converter operation, which was explained in section 3.2.3. Next, the Quick Results option was used, and CML, 2001 – baseline defined as the impact method, because it includes the Global Warming Potential (GWP) for 100 years. GWP was earlier decided to be used as the carbon footprint indicator and CML, 2001 – baseline was used because EXIOBASE 2.2 did not contain an impact assessment method that would only consider GWP (such as IPCC 2013 GWP for 100 years which can be found from the impact assessment methods of ecoinvent 3.4), nevertheless, CML, 2001 – baseline also reveals the GWP value, which is why it was suitable for the analysis. The setup and inputs for each of the EXIOBASE openLCA calculations are provided in Table 5.

Table 5: The setup and inputs used to calculate carbon footprints using EXIOBASE 2.2 in openLCA.

Type of result	Quick result	Quick result	Quick result	Quick result
Reference process	Food products nec	Beverages	TobaccoProducts	Electrical machinery and apparatus n.e.c.
Reference process location	India	India	India	India
Product	Food products nec	Beverages	TobaccoProducts	Electrical machinery and apparatus n.e.c.
Amount (EUR)	898.9068113	757.8683798	75678.58268	79512.51969
Impact method	CML, 2001 - baseline	CML, 2001 - baseline	CML, 2001 - baseline	CML, 2001 - baseline
Normalisation & weighting set	none	none	none	none
Allocation method	none	none	none	none
Cutoff	1.0E-5	1.0E-5	1.0E-5	1.0E-5
Date	27.10.2018 16:34:08	27.10.2018 16:47:37	2.11.2018 15:46:10	2.11.2018 15:51:04

3.3.3 openLCA with ecoinvent 3.4

ecoinvent is a life cycle inventory (LCI) database, used to assess life cycle impacts in different companies, organizations and research studies to aid decision-making and identification of environmental impacts throughout a life cycle of a product or service. The ecoinvent Association is a not-for-profit association and it was founded by institutes of the ETH Domain and the Swiss Federal Offices (ecoinvent, 2019). Nevertheless, one needs to pay in order to use the database, unless one is an educational user in a non-OECD country. The revenues are reinvested to develop ecoinvent further (ecoinvent, 2019).

ecoinvent version 3.4 was used because it contains international information on several different products and product sectors, which made it possible to calculate a fairly representative life cycle carbon footprint for some of the products included in this study. Like EXIOBASE 2.2, it was also possible to use ecoinvent 3.4 with openLCA. The major difference to EXIOBASE (besides the database using different methodology) was the ability to use physical units instead of having to rely on monetary conversions. Similarly, a product system was created with a reference process and its location being in India wherever possible (otherwise Rest-of-World was used). IPCC 2013 GWP for 100 years was used as the impact method, which directly gave the desired GWP value. Cut-offs were unnecessary with the ecoinvent database. Table 6 provides the setup and inputs used in openLCA.

Regarding the calculations done for transportation of products, three different setups were used. Since the capacity of Indian commercial vehicles varied from 3 to 27 tonnes (Premier Road Carriers Ltd., n.d.), it was decided that the carbon footprint can be calculated by using ecoinvent Processes which represent lorry capacities between 16 to 32 tonnes, 7.5 to 16 tonnes and 3.5 to 7.5 tonnes, and the average result from these was calculated. Furthermore, the emission standard of EURO4 was used because India has officially shifted to using EURO4 emissions standard (also known as Bharat Stage IV in India) nationwide in 2017 (DieselNet, 2019). The setup is presented in an aggregated way in Table 6 to make the table functional and easy to read.

Table 6: Setup and inputs used to calculate the carbon footprint of case products using openLCA with ecoinvent 3.4 database.

Type of result	Quick result	Quick result	Quick result	Quick result	Quick result	Quick result	Quick result	Quick results	Quick results	Quick results
Reference process	rice production |rice|APOS, U	potato production | potato | APOS, U	tomato production, fresh grade, open field | tomato, fresh grade | APOS, U	onion production | onion | APOS, U	wheat production | wheat grain | APOS, U	tissue paper production | tissue paper | APOS, U	sodium chloride production, powder | sodium chloride, powder | APOS, U	transport, freight, lorry 3.5-7.5 / 7.5-16 / 16-32 metric ton, EURO4 | transport, freight, lorry 3.5-7.5 metric ton, EURO4 | APOS, U	transport, passenger car | transport, passenger car | APOS, U	electricity production, hydro, run-of-river | electricity, high voltage | APOS, U
Reference process location	India	India	India	India	Rest-of-World	Rest-of-World	Rest-of-World	Rest-of-World	Rest-of-World	India, Himachal Pradesh
Product	rice	potato	tomato, fresh grade	onion	wheat grain	tissue paper	sodium chloride, powder	transport, freight, lorry 3.5-7.5 / 7.5-16 / 16-32	transport, passenger car	electricity, high voltage

								metric ton, EURO4		
Amount	1140.0 kg	300.0 kg	210.0 kg	540.0 kg	900.0 kg	272.4 kg	72.0 kg	7.7E8 t*km	19082.0 km	492300.75 kWh
Impact method	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a	IPCC 2013 GWP 100a
Normali-sation & weighting set	none	none	none	none	none	none	none	none	none	none
Allocation method	none	none	none	none	none	none	none	none	none	none
Cutoff	none	none	none	none	none	none	none	none	none	none
Date	23.10.2018 11:56:13	25.10.2018 15:29:35	25.10.2018 15:36:35	26.10.2018 13:31:06	26.10.2018 14:29:05	26.10.2018 16:08:07	26.10.2018 16:27:55	04.02.2019	25.10.2018 15:13:58	23.10.2018 11:37:17

3.3.4 Carbon footprint of food items

Pathak et al. (2010) gathered information about the carbon footprints of Indian food items to investigate the carbon footprint of an average Indian meal (vegetarian and non-vegetarian). Two tables from their study were utilized to calculate the carbon footprint values in this study (Tables 3 (p. 69) and 5 (p. 71) in Pathak et al. (2010)). Their study was used because it contained information about Indian food items that were not available in such accuracy in other databases. Although, it is necessary to point out that some of the sources used in their research are rather old and could be outdated in certain areas.

Table 7 presents the information that was obtained from the paper by Pathak et al. (2010). Some products' GWP was calculated according to the values given for dry weight and some according to values given for fresh weight, because it was assumed that families gave their interview estimations of food quantities according to how they buy these products. For example, pulses are generally bought as a dry product and chicken (poultry meat) is bought as a fresh product. The GWP values were then multiplied with the interview results to calculate the GWP for each product of this case study.

Table 7: Global warming potentials (GWP) of different Indian food items, according to their dry or wet weight and where to find the information from the research of Pathak et al. (2010).

Food Item	**GWP (g CO2 eq. kg-1)**	**Dry / Fresh weight**	**Source (in Pathak et al. 2010)**
Pulses	790.9	Dry weight	Table 3 (p. 69)
Poultry meat	801.1	Fresh weight	Table 3 (p. 69)
Mutton	9149.3	Fresh weight	Table 3 (p. 69)
Eggs	668.0	Fresh weight	Table 3 (p. 69)
Milk	766.8	Fresh weight	Table 3 (p. 69)
Sugar	845.0	Unknown (presumable dry weight)	Table 5 (p. 71)
Oil	422.5	Unknown (presumably fresh weight)	Table 5 (p. 71)

4 RESEARCH FINDINGS

Before the findings of the carbon footprint analysis are presented, an overview of the results gained through interviews and waste analysis are presented. This will help in understanding the numbers behind the calculations and give interesting information about the physical quantities of different product categories.

Proceeding to the carbon footprint analysis, the general findings are first presented for each category. Then the results will be displayed in different charts and in different forms of comparison in order to illustrate the relationships between the different emission categories. The results are presented in an illustrative way because it is of great importance that the readers can quickly understand the major contributors of the overall carbon footprint. Furthermore, some of the findings are presented without the analysis of transportation of products to compare the possible results without this specific viewpoint because it takes a lot of space (the highest contributor of the carbon footprint) from the presentation of other results.

4.1 Family Interviews and Waste Analysis

There were two families who prepared food and other services for the volunteers. The mothers of these families were interviewed since they are mostly responsible of doing the purchases and cooking, alongside children/young adults (mostly girls and women). The interviews were conducted with the help of a translator. The results of the interview can be found from Table 8. The amounts presented are for a period of one month, since this seemed to be a unit that the families could easily estimate. Furthermore, as mentioned earlier, a waste analysis was conducted to see what kind of products are consumed and how much (especially by the volunteers). These findings can be found from Table 9.

Table 8: Family interview findings, which were collected on 18.7.2018.

Name of product	Amount (per month)	Unit	Household number	Total amount for households (per month)
Liquefied Petroleum Gas (LPG)	16	kilograms	1	
Liquefied Petroleum Gas (LPG)	16	kilograms	2	32
Cleaning chemical (Phenile)	5	liters	1	
Cleaning chemical (Phenile)	5	liters	2	

Cleaning chemical	2	liters	3	12
Dishwash bar	15-20	pieces	1	
Dishwash bar	10	pieces	2	25-30
Washing powder (laundry)	15	kilograms	1	
Washing powder (laundry)	15	kilograms	2	30
Toilet paper	100	rolls	All houses	
Rice	50	kilograms	1	
Rice	40-50	kilograms	2	90-100
Pulses (lentils)	15	kilograms	1	
Pulses (lentils)	10	kilograms	2	25
Meat products (chicken, mutton)	15	kilograms	1	
Meat products (chicken, mutton)	5-10	kilograms	2	20-25
Eggs	240-300	eggs	1	
	200-300	eggs	2	440-600
Noodles	80-100	packets	1	
	40-50	packets	2	120-150
Wheat flour	50	kilograms	1	
	25	kilograms	2	75
Potatoes	10-15	kilograms	1	
	10-15	kilograms	2	20-30
Milk	35	liters	1	
	60	liters	2	95
Onion	30	kilograms	1	
	15	kilograms	2	45
Sugar	15	kilograms	1	
	10	kilograms	2	25
Salt	3-5	kilograms	1	
	2	kilograms	2	5-7
Oil	12-15	liters	1	
	6-7	liters	2	18-22
Tomatoes	15-20	kilograms	1	
	-	kilograms	2	15-20

Table 9: The aggregated dataset derived from the waste analysis. Some product categories do not have a Total Quantity and Unit because individual products

had different units, or they did not have a reasonable unit. Also, please note that this dataset represents an annual estimation of product consumption.

Category	**Total Quantity**	**Unit**	**Total Price (Indian Rupees)**	**Total number of items**
Food	218559	Grams	75038	2549
Beverages	1572	Liters	63251	1946
Soaps	3498	Grams	448	29
Chemicals	17450	Grams	5216	75
Paper products	0	-	2647	75
Electronics	0	-	79513	69
Tobacco products	5731	-	75679	333
Other consumables	-	-	8611	181
Medical	-	-	1668	57
Chemicals (cosmetics)	-	-	2914	95
Food (kitchen)	71770	Grams	12897	250
Dairy products	23686	-	9369	250

4.2 Location Analysis for Transportation of Products

In addition, to providing information about the type and quantity of different products consumed, the waste analysis also provided answers about the manufacturing and production locations. The results for the location analysis can be found from Table 10. The data presented is an estimation for one year. The most common product origins (total quantity of occurrences) are from the states of Uttar Pradesh & Uttarakhand (503), Punjab (371) and Maharashtra & Goa (371), the average distance from these manufacturing states is 637, 371 and 1929 kilometers, respectively. Figure 6 shows the location of the village of Naddi (NGO location), where different products come from and the annual estimation for the quantity of products derived from Table 10.

Table 10: The findings of the location analysis and the calculated average distance to the village of Naddi. The findings represent an estimation for one year.

Name of state/s	**Quantity of different postal codes (inside the state/s)**	**Total quantity of occurrences**	**Average Distance to Naddi (km)**
Assam	6	9	2765
Gujarat	52	83	1529
Haryana	46	121	460
Himachal Pradesh	57	227	181
Jammu & Kashmir	3	3	180
Karnataka	52	95	2709
Kerala	3	3	3207
Madhya Pradesh	17	80	1135
Maharashtra & Goa	83	253	1929
New Delhi	17	40	487
Punjab	63	371	250
Rajasthan	11	60	646
Tamil Nadu	20	37	2863
Andhra Pradesh & Telangana	37	55	2179
Uttar Pradesh & Uttarakhand	89	503	637
West Bengal	14	78	2002

Figure 6: A thematic map of India (Rajeshodayanchal, 2011, modified) showing the location of Naddi and number of products per state of origin.

There were also some imported products from foreign countries, including Austria, China, Colombia, Iran, Ireland, Malaysia, Nepal, Netherlands, Scotland, Singapore, Spain, Sri Lanka, Thailand, Turkey and USA. However, these products were excluded from the analysis, because their overall quantity was small (during the study period, a total of 26 imported products) and it would have been very difficult to estimate the distance and mode of transportation

4.3 Carbon Footprint

Next, the results of the carbon footprint analysis are presented. Table 11 provides an overview of the carbon footprint of each category, divided by the different scopes of carbon footprint. Figure 7 aims to illustrate the results to get a better picture of what is the proportion of each category in relation to the others. However, Figure 7 does not contain the transportation of products since it was seen as a special case because of its high contribution to the overall carbon footprint.

Table 11: Annual CO_2 eq. emissions (kg) per different product sectors divided to the different scopes of carbon footprint. Categories identified as "waste" are products that were identified in the waste analysis.

Emission Category	**CO_2 eq. kg / year**	**Share from the total carbon footprint (%), without transportation of products**	**Share from the total carbon footprint (%), with transportation of products**
Scope 1			
Flights	119036	82.44	37.12
Use of car / Transportation	6476	4.48	2.02
Scope 2			
Electricity (hydro)	2188	1.52	0.68
Scope 3			
Cooking fuel (LPG)	1133	0.78	0.35
Rice production	2129	1.47	0.66
Potato production	109	0.08	0.03
Tomato production	57	0.04	0.02
Pulses (lentils)	237	0.16	0.07
Poultry meat (chicken)	108	0.07	0.03
Mutton	2745	1.90	0.86
Eggs	229	0.16	0.07
Milk	874	0.61	0.27
Onion	303	0.21	0.09
Wheat	707	0.49	0.22
Sugar	254	0.18	0.08
Oil	101	0.07	0.03
Salt	19	0.01	0.01

Tissue paper (toilet)	227	0.16	0.07
Food products (waste)	257	0.18	0.08
Beverages (waste)	46	0.03	0.01
Tobacco products (waste)	1441	1.00	0.45
Electronics (waste)	5717	3.96	1.78
Transportation of products	176322		54.98
Total (without transportation of products)	**144393**	**100**	
Total (with transportation of products)	**320714**		**100**

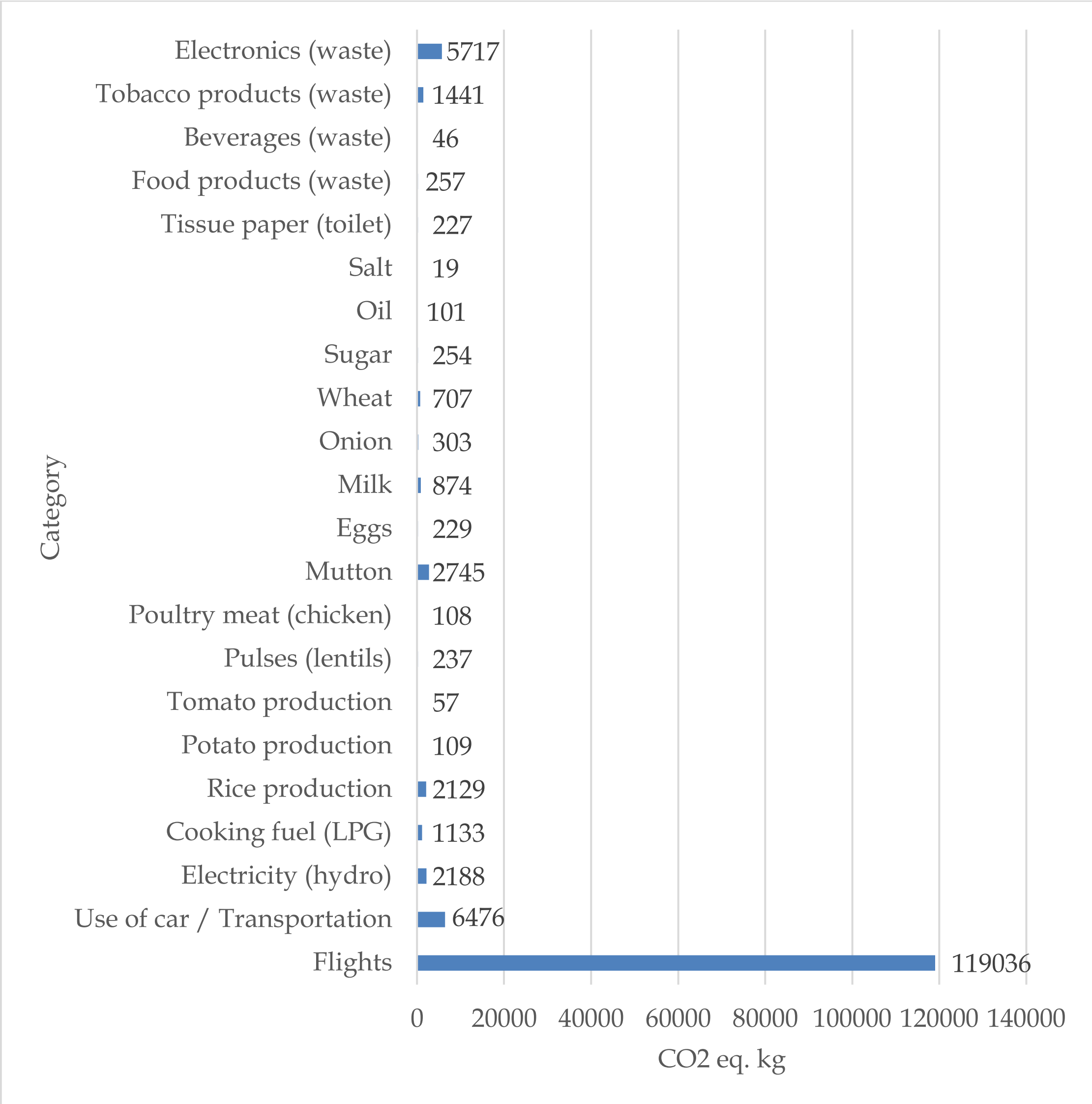

Figure 7: The overall annual carbon footprint results (CO_2 eq. kg) for all categories and emission scopes (except transportation of products).

The major contributors to the total carbon footprint in this case are 'Flights' (119036 CO_2 eq. kg/year), 'Use of car / Transportation' (6476 CO_2 eq. kg/year) and 'Electronics (waste)' (5717 CO_2 eq. kg/year). Least amount of emissions came from 'Salt' (19 CO_2 eq. kg/year), 'Beverages (waste)' (46 CO_2 eq. kg/year) and 'Tomato production' (57 CO_2 eq. kg/year). 'Transportation of products' contributed to around 176322 CO_2 eq. kg/year. The total annual carbon footprint without the 'Transportation of products' is approximately **144393 CO_2 eq. kg**, while including it raises the total annual carbon footprint to approximately **320714 CO_2 eq. kg.**

The overall emissions per person in 2018 (total emissions divided equally among 147 people) are approximately **982 CO_2 eq. kg**, without 'Transportation of products. Adding 'Transportation of products' into the calculations increases per capita emissions to approximately **2182 CO_2 eq. kg.**

When looking at the different emission scopes, Figure 8 reveals that Scope 1 emissions contributed to 87% of the total emissions, whereas Scope 2 and Scope 3 emissions contributed to around 1% and 12%, respectively, when 'Transportation of products' is not taken into account. Later, the same results are presented including 'Transportation of products', to see how it will affect the division of emissions between different categories and scopes.

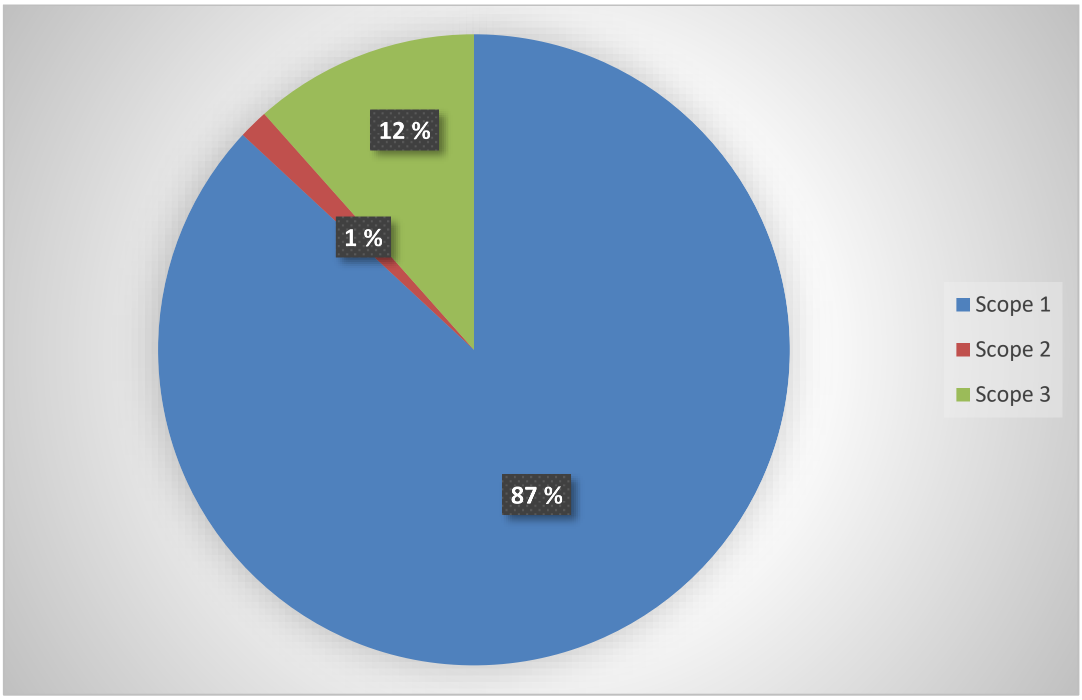

Figure 8: The share of each scope's carbon footprint in relation to the total carbon footprint, excluding transportation of products.

Different categories in Table 11 can also be aggregated into different emission sectors. Figure 9 shows the proportion of emissions for each category, which are 'Flights' (82%), 'Use of car / Transportation' (5%), 'Energy' (2%), 'Food products' (6%) and 'Other products' (5%). Energy includes both 'Cooking fuel LPG' and 'Electricity (hydro)'. 'Other products' includes the following categories: 'Tissue paper (toilet)', 'Tobacco products (waste)' and 'Electronics (waste)'.

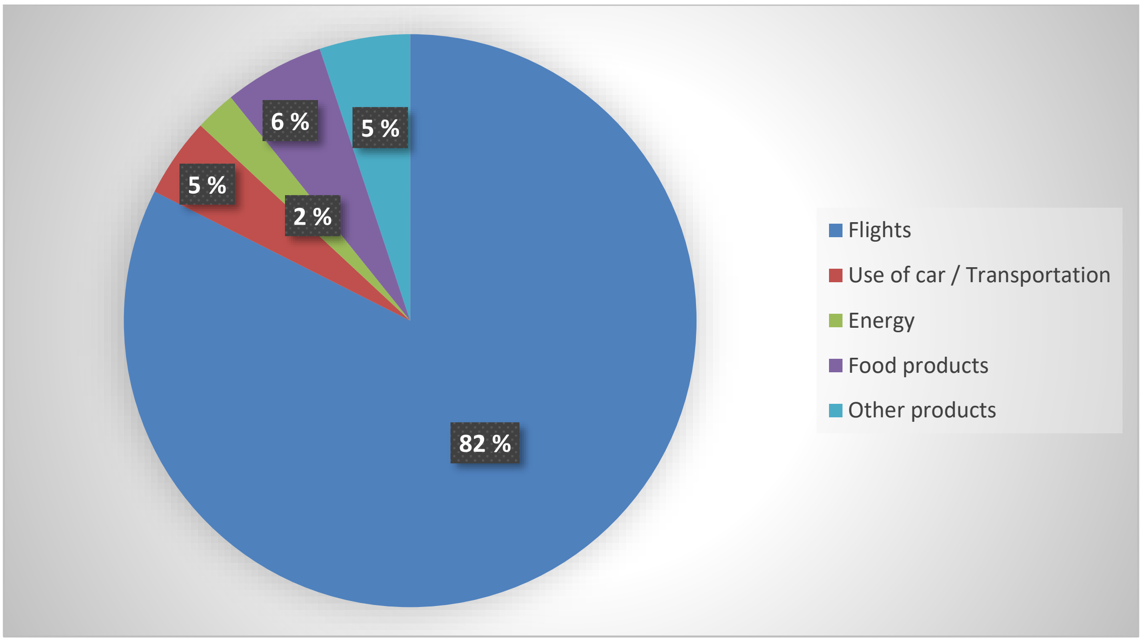

Figure 9: The share of emissions between different sectors, excluding transportation of products.

4.3.1 Detailed scope 3 carbon footprint

As there are several different emission categories in scope 3, it is meaningful to have a separate comparison for them and see what the major carbon footprint contributors are inside scope 3. From Figure 10 it can be seen that major contributors to the total carbon footprint of scope 3 are 'Electronics (waste)' (5717 CO_2 eq. kg/year), 'Mutton' (2745 CO_2 eq. kg/year) and 'Rice production' (2129 CO_2 eq. kg/year).

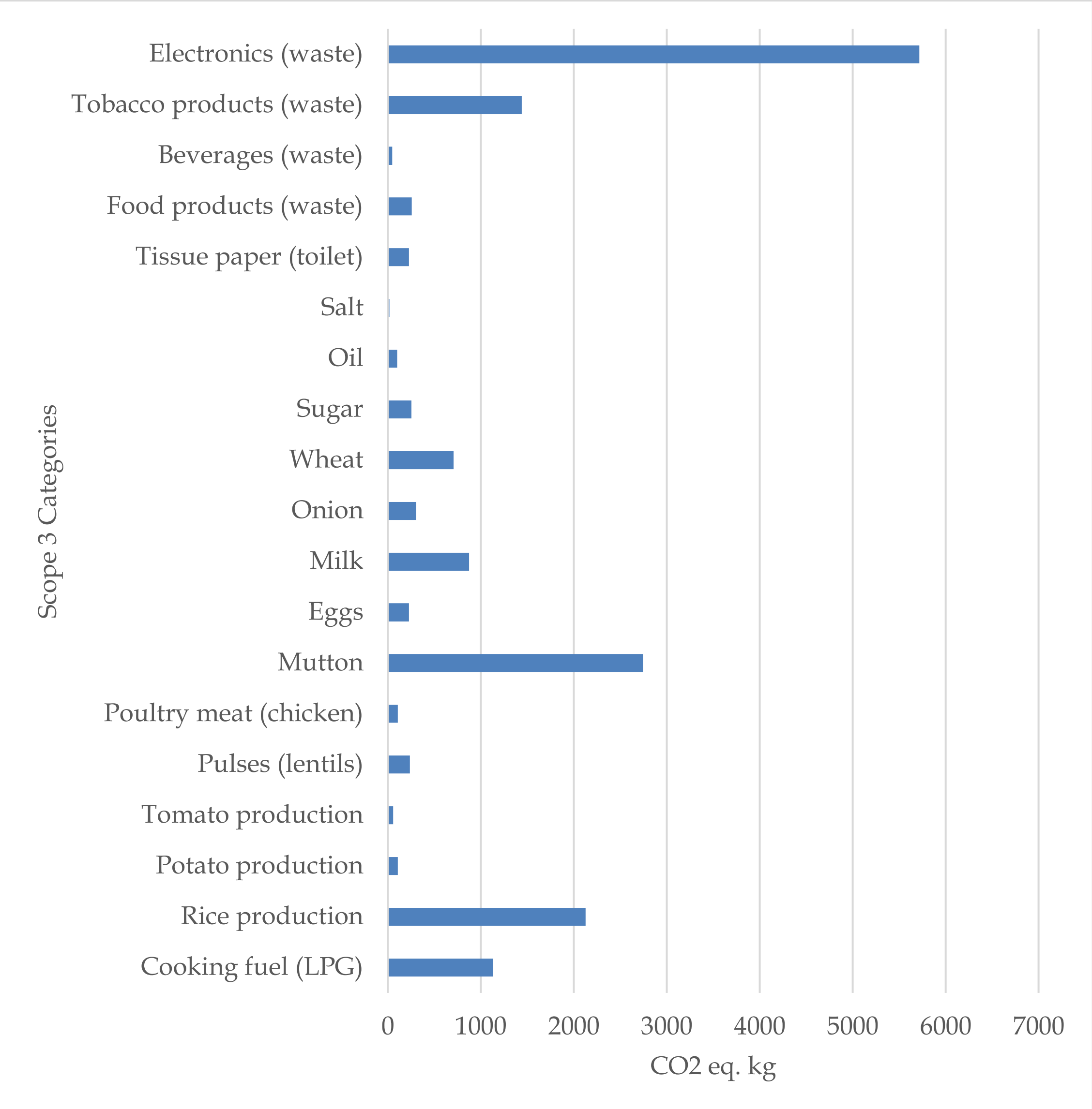

Figure 10: Annual carbon footprint (CO_2 eq. kg) for scope 3 product categories.

The total annual scope 3 carbon footprint (in other words, production of goods) without transportation of products, is **16692 CO_2 eq. kg.** If food products are combined together to represent a larger category, 'Food products', they comprise of 49% of the total scope 3 carbon footprint, followed by 'Electronics (waste)' with a share of 34% (see Figure 11).

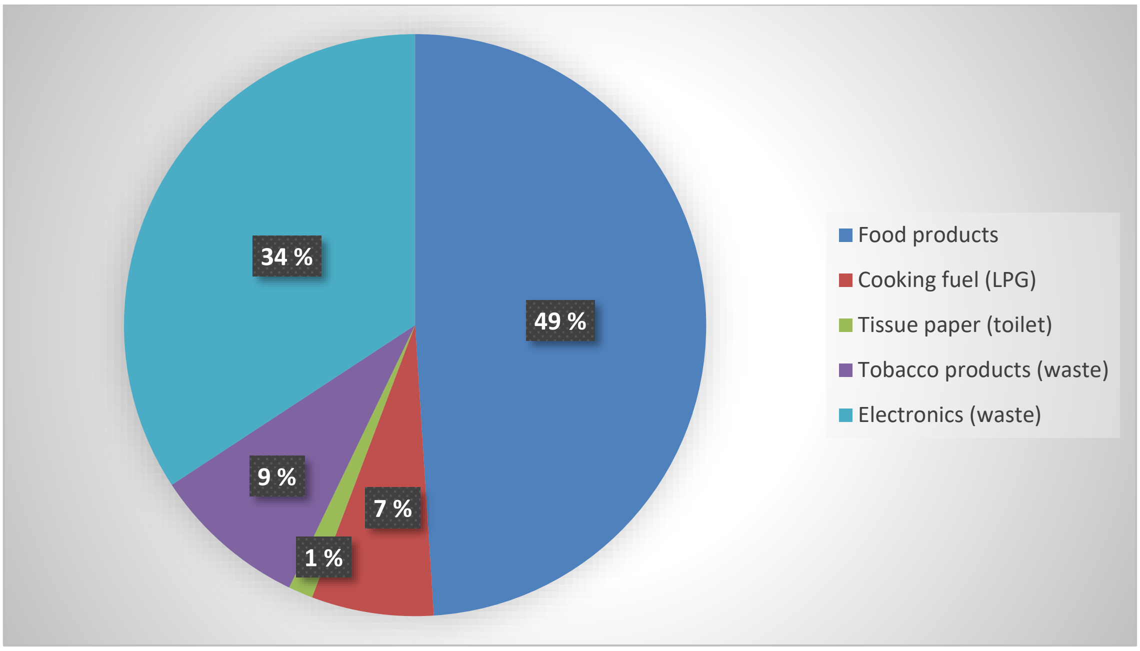

Figure 11: The share of categories inside scope 3 if food related products are combined and transportation of products excluded.

Figures Figure 12 and Figure 13 show the impact of adding 'Transportation of products' into the overall carbon footprint. Now the proportions have changed quite significantly. Scope 1 emissions would now account for 39%, while scope 2 emissions would account for only 1% and scope 3 emissions for 60% of the total emissions (see Figure 12).

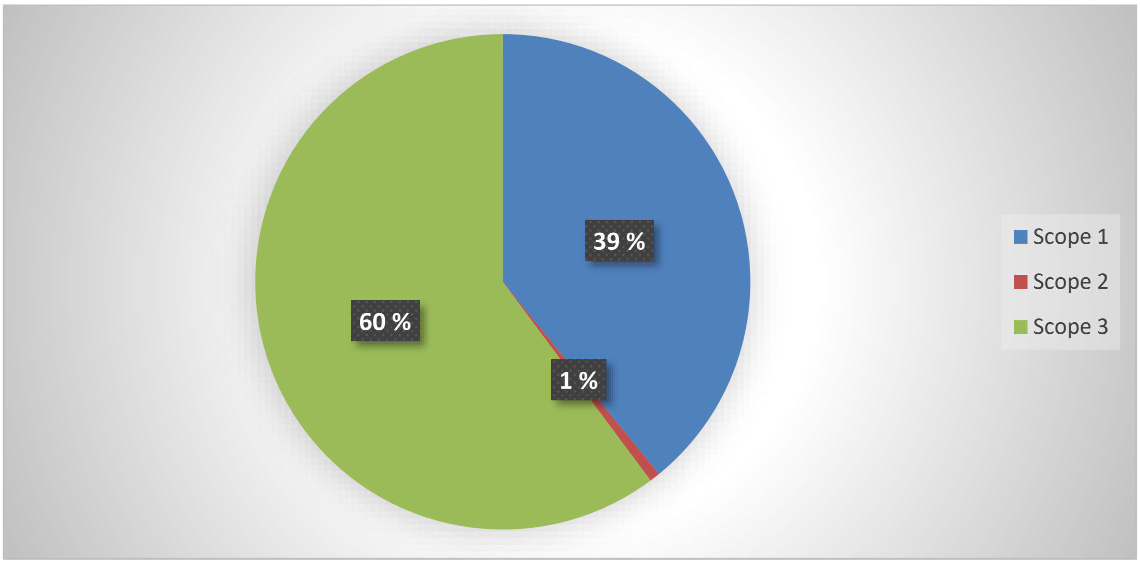

Figure 12: The share of each scope's carbon footprint in relation to the total carbon footprint, with transportation of products.

Disseminating these results into different sectors, reveals that 'Transportation of products' (55%) and 'Flights' (37%) comprise of majority of the emissions, with a total share of 92% (see Figure 13). The rest eight percent is divided between 'Food products' (3%), 'Other products' (2%), 'Use of car / transportation' (2%) and 'Energy' (1%).

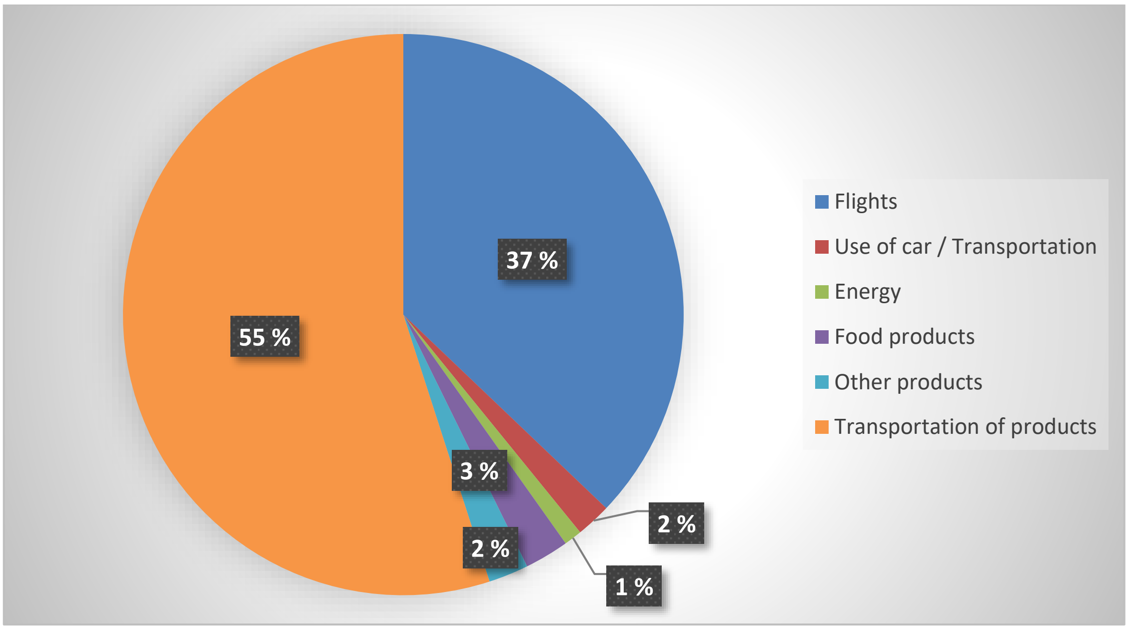

Figure 13: The share of emissions between different sectors, with transportation of products.

5 DISCUSSION

The findings revealed that depending on what is included in the calculation of the carbon footprint and what is not, the results can vary quite significantly. On the other hand, scope 1 emissions, comprising mostly of flight emissions, are the most important contributors to the overall carbon footprint, while adding transportation of products to the scope 3 emissions, lifts scope 3 emissions to the first place. This would highlight the importance of indirect emissions in carbon footprint analysis. However, it is important to note that what falls under direct and what falls under indirect emissions, is a matter of classification, which varies from study to study. Most importantly, overall carbon footprint of the organization being 320714 CO_2 eq. kg per year and 2182 CO_2 eq. kg per person (with transportation of products), the contribution of voluntourism to climate change is evident, although these results should only be used directionally. Nevertheless, the global environmental impacts of voluntourism are not discussed widely, which is why the contribution of this study is important to understand the extent of voluntourism induced GHG emissions.

Next, the implications of this study are discussed in more depth to highlight the importance of this study to researchers, policy-makers and practitioners working in the field of voluntourism and environmental management, and to position it in the existing scientific literature on tourism and voluntourism. Furthermore, possible solutions and mitigation potential are discussed, followed by limitations of this research. Finally, some ideas about future research on voluntourism and its environmental impacts is given with some thoughts on carbon footprint research in general as well.

5.1 Implications to Voluntourism and Carbon Footprint Research

The important role of aviation related emissions in tourism is highlighted by several studies (Dwyer et al., 2010; Rico et al., 2018; Sharp et al., 2016). Similarly, in this study aviation comprised of approximately 37% to 82% (depending on the inclusion of transportation of products), which highlights the contribution of aviation to tourism carbon footprint, and more specifically, to voluntourism carbon footprint. Sharp et al. (2016) reported a contribution of 50-82% for aviation from the total carbon footprint of inbound tourism to Iceland, while Rico et al. (2018) and Dwyer et al. (2010) reported 95.6% and 56.68% contributions, respectively. However, there are several ways to calculate aviation related impacts, e.g. whether the whole life cycle of aircrafts and fuel is included or not and what kind of calculators are being used (Baumeister, 2017).

While this study has similar results to other studies when transportation of products is excluded, the results change significantly with the inclusion of transportation of products, aviation related emissions "only" comprising of 37% of the total carbon footprint. Even though this is merely a directional result, it raises an important question about the boundaries of carbon footprint analysis. Dwyer et al. (2010) included emissions from transport of imports (expenditure-based approach), they only accounted for 2.6% of the total direct and indirect GHG emissions in the Australian context. Similarly Jones and Munday (2007) found out that in the context of tourism consumption in Wales distribution and retail contributed to 4% of total emissions. However, as we can see, in this study the transportation of products accounted for 54.98% of the total carbon footprint. These numbers are probably not comparable because of the different methods used and the aforementioned studies being more extensive in both scale and scope and focusing on regional and national consumption. Nevertheless, the difference in numbers proves that more research to account for the total life cycle emissions of tourism and tourism related consumption needs to be done. It seems that carbon footprint boundaries play an important role while accounting for tourism related carbon footprint, and excluding life cycle of product consumption might highlight the role of aviation, even though the role of transportation and production of goods might be one of the major contributors to carbon footprint as well. De Camillis et al. (2012) discussed the use of life cycle assessment (LCA) methodology in the context of tourism in order to account for tourism related impacts comprehensively. However, as they said, setting a goal and scope for tourism related LCA studies can be a hard task.

The role of electricity production remained small in this study, accounting for 0.68%-1.52% of the total carbon footprint. Some accommodation related studies highlighted the importance of electricity consumption, Puig et al. (2017) reporting electricity and fuel consumption taking a share of 75% of total emissions in coastal Spanish resorts, and Hu et al. (2015) similarly reporting electricity taking a share of 83.79% of total carbon footprint of a Taiwanese hotel. It is important to note that the facilities provided for volunteers in this study were mostly supplied by hydroelectricity, which would explain its small contribution to the overall carbon footprint. In addition, the facilities were rather small and there were no luxurious facilities, the rooms also being quite modest in most cases (e.g. no TV, no additional electrical appliances, few lights etc.). The highest electricity bills were for house number two, which is probably explained by the frequent use of washing machine to wash both volunteers' and nearby hotels' laundry. It would also be interesting to know if volunteer tourists are somehow different in their consumption of electricity than "normal" tourists. Furthermore, other environmental impacts related to hydroelectricity production are not accounted for here.

Even though production of electronics was the top emitter in the indirect emissions category (after transportation of products), food production also has an important role in the indirect emissions, comprising of 3%-6% of the total carbon footprint (with or without transportation of products), exceeding the emissions created by car use. Furthermore, food products also contributed to around 49% of the total scope 3 carbon footprint. In addition, Liu et al. (2017) also reported that food production was the most important contributor of indirect emissions, with a share of 43.59%. Looking closer at food production induced emissions in this study, one can see that mutton and rice production are the major contributors, followed by milk and wheat. Even though emissions created by mutton consumption are considerable and should be taken into account, for example, by replacing mutton with poultry meat, a bigger concern comes from rice consumption. Rice is one of the most prominent food items in the studied region (and India in general), still it seems to be a major source of GHG emissions in the context of food consumption. Thus, it could be important to find alternative options for rice to mitigate the adverse impacts it has on the organizational and volunteer carbon footprint. Furthermore, as majority of the indirect product consumption comprises of food products, at least in terms of mass (Table 8 and Table 9), they might also take a major share from the emissions originating from transportation of products. Thus, giving attention to indirect emissions arising from product consumption and use, especially food products that are imported from other areas and states in India, is important. It would be interesting to know if the low price levels in India (and in Himachal Pradesh) for volunteer tourists affect the way how they consume products. It might be that the lower prices drive tourists and volunteer tourists to consume more products, especially in terms of food. In terms of carbon footprint research, these findings support the thoughts of Matthews et al. (2008) about the importance of carbon footprint estimation boundaries.

Looking at the overall carbon footprint of the organization and its volunteers (with transportation of products), the number 2182 CO_2 eq. kg per person does not necessarily say much, which is why it could be meaningful to compare it to other relevant carbon footprint numbers. The average carbon footprint of a tourist visiting Iceland in 2013 was 1350 CO_2 eq. kg, being significantly lower as in this study, although in the Icelandic case it ranged from 1090 to 3250 CO_2 eq. kg depending on the length of the flight route, which might explain some of the differences between their study and this thesis (Sharp et al., 2016). Still, this would suggest that a volunteer tourist's carbon footprint might be similar to that of a "conventional" tourist. According to Hertwich and Peters (2009), the per capita GHG emissions of India in 2001 were 1800 CO_2 eq. kg, in comparison to the 2182 CO_2 eq. kg emissions per capita in this Indian voluntourism organization. Thus, the organizational per capita emissions would represent a share of 121% from the Indian per capita carbon footprint. From the other end, Hertwich and Peters (2009) found that the per capita GHG emissions of the United States were 28600 CO_2 eq. kg, of which the organizational per capita emissions of this study would represent approximately 7.6%. The German Advisory Council on Global Change (WBGU, 2008) suggested a global per capita climate budget to reach the target of halting global warming to 2 °C. The extent of this annual climate budget would be 2700 kilograms of CO_2 per capita, and what's worrying is that the studied carbon footprint is already approximately 81% from the budget, so it doesn't leave much room for additional emissions.

It seems that voluntourism plays an important role as one of the drivers of global climate change. The environmental impact of tourism has already been studied, but what's missing is discussion on the role of voluntourism and its contribution to global environmental impact, especially in terms of carbon emissions. The discussion about the environmental trade-offs of voluntourism is important because voluntourism is often seen as a way to have a positive impact, which surely is the case from certain aspects, but in order to achieve a sustainable voluntourism industry it is important to account for the environmental impacts and take actions accordingly. Voluntourism might be playing an important part in growing responsible global citizens, nevertheless global environmental justice, which often seems forgotten in voluntourism discussion, should also be an integral part of global citizenship.

5.2 Mitigation and Possible Solutions

The mitigation and prevention of carbon emissions is crucial to halt drastic changes in the global climate system (IPCC, 2014, 2018). Changes should take place in many levels: individual, community, organizational, national and international levels, for example. In this study example, a lot of the responsibility falls for the individual volunteer tourists who themselves decide to embark on this journey and who make conscious decisions on their own consumption. However, some responsibility would also fall on the local community and organization who provide the arrangements on spot, in addition to airline companies, producers of goods and different governmental levels (e.g. local, state and national). The responsibility network can be a complex web comprising of small (individuals, small communities) and large pieces (governments, large companies).

An emerging concept alongside the concept of carbon footprints and such, is the concept of handprints. An environmental handprint "refers to the good we do for the environment" (Biemer & Dixon, 2013, p. 146). Instead of focusing on the harmful impact our actions can cause, the focus could also be on the positive impact our action could have (Biemer & Dixon, 2013). This could enable a change in thinking from only trying to mitigate the carbon footprint to reach a net zero impact, to completely transforming the system to reach a net positive impact.

Another important concept that supports this way of thinking is regenerative design or regenerative development, especially applied in the building industry. Regenerative design builds upon a co-evolutionary approach, where human and natural environments are integrated, thus making the human environment part of the natural cycle and creating possibilities for a "positive" impact (Cole, 2012). Some scholars have already studied the concept of regenerative design in the building industry (Craft, Ding, Prasad, Partridge, & Else, 2017; Gou & Xie, 2017; Svec, Berkebile, & Todd, 2012), in addition to a few practical applications of regenerative design being studied (Busby, Richter, & Driedger, 2011; Oliver et al., 2016). The idea of regenerative design could be used in the organization to enhance the connectivity of the buildings with the surrounding environment. Good examples are already emerging, such as vertical gardening (see Figure 14), kitchen garden (see Figure 15) and forestry projects. However, the scale of vertical and other gardening would probably have to be much larger in order to achieve a meaningful level of regenerative development. A clear goal and design for the desired level of regenerative development would also be beneficial. Furthermore, some more research would need to be conducted in order to assess the potential for a regenerative approach in this area, and to which extend could it offset the carbon footprint.

Figure 14: Example of vertical gardening at one of the houses.

Figure 15: The kitchen garden of the organization. Another example of how carbon footprint could be mitigated at the local level.

As aviation is one of the major contributors of the carbon footprint, perhaps some solutions should be found in that sector. Voluntary carbon offsetting is one of the possibilities raised in that sector for individuals to mitigate their carbon footprint. According to a report by The International Air Transport Association (IATA, 2018) carbon offsetting refers to "an action by a company or individual to compensate for their emissions by financing a reduction in emissions elsewhere" (p. 2). Airline companies provide opportunities for individuals to compensate their carbon footprint, by collaborating with different offsetting providers. Some voluntourism organizations also provide carbon offsetting schemes, for example, International Volunteer HQ. Their offsetting programs include tree planting and environmental education (International Volunteer HQ, 2019). However, a study by Eijgelaar (2011) assessed the mitigation potential of voluntary carbon offsetting regarding tourism and aviation emissions. It was found out that "current sales of flight offsets compensate less than 1% of tourism aviation respectively all aviation emissions" (p. 291), which suggests that the current mitigation potential could be low (Eijgelaar, 2011). Perhaps more emphasis should be given to what could be the offsetting potential of volunteers who participate in forestry and agricultural projects.

Some more specific solutions to mitigating the carbon footprint at the community and individual level relate to the consumption of food and other products. Emphasizing the already existing culture of vegetarian diet, is an important way to reduce meat consumption (excluding possible health-related aspects), as mutton consumption was one of the major contributors of indirect GHG emissions. Furthermore, some alternatives to rice consumption could also help in mitigating the overall carbon footprint. For example, the GHG emissions created in the production of rice are much more extensive than in the production of potatoes (Green et al., 2018; Vetter et al., 2017), their global warming potential values reaching from 1221 grams CO_2 eq. per one kilogram for ordinary rice to 25 grams CO_2 eq. per one kilogram of potatoes (Pathak et al., 2010). Another alternative to rice, at least nutritionally could be millet (Bergamini, Padulosi, Ravi, & Yenagi, 2013).

Regarding transportation of products, an effective way on the individual level would be to consume less products and try to favor products that are manufactured closer, since transportation of products was the highest contributor to the overall carbon footprint. As most studied products included a postal code of the manufacturing site, a labelling system (or awareness creation within the community and volunteers) could be created to emphasize the lower impact of products coming from "nearby" states. Table 12 shows how the first two digits of postal codes could be used to help volunteers (and other customers) in assessing the sustainability of a product, based on the average distance driven from a state to the village of Naddi in Dharamshala, Himachal Pradesh. However, this method does not necessarily include any other aspects of sustainability, for example what ingredients does the product comprise of and what would be the manufacturing method etc. Thus, a more comprehensive sustainability indicator system for products would be beneficial, and transportation of products could be one component of it.

Table 12: An example of how average transportation distance could be used to indicate the extent of the carbon footprint of a product. From least distance driven (green) to most distance driven (red). Mid-range distances are in the middle (yellow and orange).

First two numbers of the postal code	Name of the state	Average distance to Naddi (km)
11	New Delhi	487
12-13	Haryana	460
14-16	Punjab	250
17	Himachal Pradesh	181
20-28	Uttar Pradesh & Uttarakhand	637
30-34	Rajasthan	646
36-39	Gujarat	1529
40-44	Maharashtra & Goa	1929
45-49	Madhya Pradesh	1135
50-53	Andhra Pradesh & Telangana	2179
56-59	Karnataka	2709
60-64	Tamil Nadu	2863
70-74	West Bengal	2002
78	Assam	2765

Education and awareness creation should also be done among volunteers to help them understand the impact of their consumption choices, even though prices might be low to their standards and products largely of domestic origin. This kind of educational session could easily be integrated into the integration day, which is organized on their first working day. Furthermore, volunteers could be approached by the international volunteering agency before their departure, to help them in providing effective mitigation solutions, for example in terms of carbon offsetting.

On the national and state level an effective solution in helping consumers choose products with smaller carbon footprint, could be the use of carbon labels revealing the amount of carbon emissions induced in the production and transportation of the product. This could already be piloted on the local level by the organization if it were to do a comprehensive product analysis and then provide information about the product carbon footprint to the local community and volunteers. In addition, local production of goods should be emphasized.

Nevertheless, the concept of international volunteering should be viewed critically, and more emphasis could be put on local volunteering. In addition to mitigating environmental problems (e.g. international aviation), the use of local volunteers could address some of the observed social and economic issues prominent in international volunteering (Guttentag & Wiley, 2009; Pluim & Jorgenson, 2012).

5.3 Limitations

Despite the effort in making this study as reliable as possible, research had to be done within certain limits, thus this study also has limitations that should be addressed and analyzed accordingly. The main limitations of this study relate to the collection and use of data, assumptions made in the progress of calculating the carbon footprint, and exclusion of certain aspects and data from the overall carbon footprint. The limitations are addressed by the different scopes of the carbon footprint, as each aspect had different kind of data collection methods and limitations. Lastly, the limitations of the overall carbon footprint are discussed.

5.3.1 Scope 1

There was only data about the country of origin of each volunteer in 2018. This meant assuming the country of origin as the departure point of flight as well, which might be different to the country of origin as many volunteers seemed to travel around different places before and after the volunteering period. Furthermore, it was impossible to gain accurate data about the flight routes, which might have caused some error into the carbon footprint calculations of flights. In addition, trips in their originating destination to and from the airport could not be accounted for.

The car use data was based solely on the informal interviews with the programme director, who made estimations about the car use. This could have been done more accurately, for example by keeping a car log within the cars. Other car use related data, such as the trips to nearby towns was also based on personal observations and estimations, and could have been more accurately estimated by making scientific notes and observations about the use of taxis for a certain period of time, or by formally interviewing volunteers about leisure travelling. For example, it is known that a trip by taxi that was often (perhaps once every two or three weeks) made by volunteers to a city called Amritsar was excluded from these analyses.

Another aspect that is missing from the direct emissions is the incineration of sanitary waste. Sanitary waste mainly consisted of toilet tissues, which were mostly used by volunteers because locals used water. Sanitary waste also included other paper products and sanitary pads. It was usually burned on the rooftop in an open metal barrel, since other options were not available. It might be that this would have had a major impact on the total carbon footprint, however reliable information about the emissions of burning sanitary waste was hard to find, thus it was excluded from the analysis. In addition to GHG emissions, this kind of open burning most probably affects the local air quality and health of local people and volunteers.

5.3.2 Scope 2

The largest uncertainty in scope 2 related data is because of the limited amount of data. Only one of the households had comprehensive data about the electricity usage during 2018, the other two houses had information for only one month. It would have probably been possible to gather more information about the two houses, but due to lack of time and local cooperation, this was not possible.

Another issue is the assumption related to the use of hydroelectricity. The local electricity department claimed that the electricity supply is completely provided by hydropower. However, there is a possibility that there might a mix of other power sources as well.

5.3.3 Scope 3

There were several data collection methods to find out scope 3 related consumption activities, varying from interviews, personal observations, assumptions and waste analysis. The interviews conducted relied on the knowledge of a few family members and the programme director. Relying solely on people's estimations can cause errors in the data, because of errors made in estimations by individual people. For example, it is hard to say how accurately the family members could estimate the consumption of certain food products for a month's time. This data coming from two families, and the interviews done separately without the other one hearing the other one's answers, at least slightly mitigates the risk for error. Furthermore, only consumption of certain food items was asked from the families. This could exclude the use of certain important food items that did not come into the minds of the interviewers in the interviewing situation. These food items were also not the only ones the volunteers were consuming, as they quite often visited local restaurants and cafeterias. In addition, used chemicals (for cleaning and laundry) were not included in the analyses, even though they might have an important effect on the environment, due to lack of grey water treatment.

An important limitation regarding the waste dataset, is that only products that were identifiable (e.g. product name, quantity, price, location visible) were analyzed. For food products this seemed to work well, because they would usually have easily identifiable packaging. However, this sort of analysis could have excluded many other kinds of products. Also, this was probably not the only place where volunteers would bring their waste, although it has to be said, that this was one of the few places to throw waste into, at least in the nearby area. In other words, the waste analysis did not cover the full scale of the volunteer consumption. Sometimes families could also be seen throwing waste to the local dumpsite (see Figure 16), which of course limits the accuracy of the collected waste data. The dumpsite was used for disposing of all kinds of waste. Usually the site was unmanaged, but from time to time some incineration of waste took place. Afterwards, some thought was also given to the data collection method, and a good alternative could have been to also interview the volunteers about their consumption, or to closely follow some individuals (with consent) for a few weeks and make notes about their daily purchases, or to ask some volunteers to do these notes by themselves. However, the strength of analyzing waste data is that the data that was collected is accurate in the sense that the consumption of identified products actually happened, so this collection method does not rely on subjective assumptions and estimations.

Possible spots for error could also include the conversions that were made. For example, when Indian rupees had to be converted into euros to use EXIOBASE 2.2 or when the information for the weight of eggs and toilet paper rolls was collected from somewhere else. However, even though it is hard to give any specific numbers, it could be estimated that these conversion errors are probably rather small and would not dramatically affect the direction of the results.

Figure 16: The local dumpsite in the village.

5.3.4 Overall carbon footprint

As said before, carbon footprint does not necessarily represent holistic environmental sustainability (Laurent et al., 2012; Weidema et al., 2008), which is why the results of this thesis should also be considered carefully. The carbon footprint represented in this study may not be an accurate representation of all the aspects of environmental sustainability (e.g. ecotoxicity and water footprint), but it provides direction for further research and improvement.

The emissions were divided equally between all relevant stakeholders (e.g. families, organizational employees, volunteers, interns), which does not probably represent the whole truth. For example, flight emissions are only known for volunteers so in theory these emissions should only fall on the shoulders of volunteers (perhaps on the organization as well). Furthermore, not all products are shared equally between people, and for example using a taxi was not common for the families. Nevertheless, it was decided that sharing emissions equally between all relevant stakeholders can be meaningful as everyone is in one way or another involved in the activities creating emissions. And from an organizational perspective, it is interesting to know what the extent of the emissions is per capita to inform and advice future volunteers about their impact and mitigation methods, and to create effective environmental policy and strategies, both on the individual and organizational level.

5.4 Ideas for Further Research

More research on the environmental impact of voluntourism should be done. Its environmental impacts might resemble that of conventional tourism, however, it seems that voluntourism often dodges these issues by focusing on the good that is being done by the volunteer work and by the positive impacts it has on the participants. Furthermore, more research should be done to understand the contribution of complex product life cycles to the overall carbon footprint of consumption. As this study shows, the contribution of consumption of goods can be significant to the overall carbon footprint.

In the local context, it would be interesting to know what the local organization and its volunteers would have to do in order to compensate for the carbon footprint. For example, what should be the extent of forestry projects to reach a carbon neutral or carbon positive organization. As volunteers embark on a journey of self-development and helping those in need, it would also be beneficial both for the global community and the local communities being helped, that international volunteers understand the extent of their environmental impact, which possibly contributes to climate change, and the adverse effect it will have on those same people they set out to help.

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