



The Motivations of Users to Participate in Sustainable Projects on Mobile Applications

The Case of Antforest

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Abstract

Despite the increasing ecological awareness of contemporary global society, the complexity of motivations and practices for green consumption still poses significant obstacles to the spread of more environmentally conscious consumption patterns. With the current development of technology, digital technology has gradually become an effective way to reduce psychological distance and enhance consumers' participation in sustainable environmental behaviors. Digital technology represented by the Internet is changing the behavioral patterns of individuals participating in environmental protection and may become an effective policy tool. However, due to the scarcity of successful green sustainable software, there are few studies related to its use. This article chooses Ant Forest, a subsidiary of Alibaba Group, as a case study.

This thesis examines the factors that influence user sustainable behavior in mobile applications and the effects of mobile applications on user sustainable behavior, specifically focusing on the case of Ant Forest (AF). This study included semi-structured interviews with seven senior Ant Forest users to document and examine their experiences and ideas. Analysis of the interview data revealed that users are motivated to use Ant Forest by two primary factors: social influences and mobile application features. Furthermore, it was observed that Ant Forest has a beneficial effect on users' adoption of sustainable behaviors. While this instance took place in China, it holds significant relevance for the future advancement of research on users' sustainable behavior in mobile applications in other nations globally.

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1. Introduction

1.1 Background

The economic and social factors are currently posing threats to the protection of natural environment, causing negative impacts such as air pollution, degradation of surface water and toxic waste in groundwater, climate change, and ecological destruction (Brundtland, 1987). To address these challenges, progress must be made in protecting nature while promoting economic development (Brundtland, 1987). Given the heavy dependence of the global economy on natural resources, a failure to adopt appropriate measures could lead to substantial and enduring economic consequences.

In 1987, under the leadership of Gro Harlem Brundtland, WCED published 'Our Common Future', also known as the Brundtland Report, which described sustainable development as "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Since the call for global sustainable development action was issued by WCED, the process of sustainable development has been continuously advancing. In 2015, the United Nations unveiled the 2030 Agenda for Sustainable Development, which includes 17 sustainable development goals and 169 specific targets. This universal agenda demonstrates the scale and ambition of the efforts made worldwide to achieve sustainable development. In recent years, although sustainable development movements have gained widespread attention, the slow progress in the transformation of the entire society due to technological limitations that support our carbon footprint has been noted (Olawumi & Chan, 2018). As sustainable production becomes more advanced, industrial sustainable technology has encountered a limitation. At this point, individuals begin to focus on consumers and eventually recognize that consumers can also play a significant role in promoting sustainability. In recent years, the process of sustainable development has gradually extended from governments and businesses to individual consumers. All sectors of society, including businesses, governments, and organizations, have recognized the increasingly important role of consumers in sustainable development. Therefore, creating sustainable communities for consumers to participate in sustainable development is crucial (Lee et al., 2023).

In terms of businesses, consumer/social reputation may serve as a special business motivator for customer-to-customer (C2C) companies, which is a business model that fosters commerce between private individuals. (Rivera, 2018) C2C companies exhibit significantly higher proactivity in specific environmental measures (climate change and management processes) and are more likely to engage in environmental activities without clear cost-reducing benefits than the other companies. Organizations voluntarily take on corporate social responsibility by using green energy systems and renewable energy, reducing excessive packaging, using recycled and/or recyclable materials, and increasing environmental awareness (The State Council, 2020). With these findings, governments and investors can identify which companies are driving and likely to be leading on specific aspects of the corporate environmental agenda.

On the government front, the UK government has launched various tools and policies to minimize environmental damage, including regulations, information programs, innovation policies, environmental subsidies, and tax credits, in hopes of changing individual consumption patterns (The State Council, 2020).

Furthermore, the global demand for sustainable choices among consumers is continuously increasing, with 66% of consumers (73% of millennials) indicating that they would prefer sustainable offerings (Nielseniq.com, 2015). Therefore, more and more governments, businesses, and organizations are hoping to motivate consumers to engage in sustainable behavior and contribute to the cause of sustainability through various means.

In addition, with the rapid development of technology, there is a technological environment that provides fast and interactive communication access at any time through devices such as smartphones and tablets, which offers new opportunities for software known as mobile applications ("apps").

According to a study by Nielsen, 89% of mobile internet time is spent on consumers using apps, while 11% is spent using traditional browsers (Colwyn, 2014). Therefore, consumers as users of apps are highly likely to be influenced by them.

As a result, there are efforts around the world to combine green features with mobile apps. For example, the Brazilian Banking Federation (FEBRABAN) and the Akatu Institute have stated that consumers are looking for options related to more environmentally friendly choices. The mobile applications developed by FEBRABAN and Akatu encourages green

consumption and the adoption of new habits, with over 44,000 downloads to date (FEBRABAN, 2015). In addition, the U.S. Environmental Protection Agency (EPA) has promoted and provided over 290 green apps to help facilitate green consumption and behavior change. Implanting sustainable concepts into mobile apps by governments, businesses, and organizations provides a promising agenda for engaging consumers in achieving sustainable goals.

1.2 Motivation and choice of study

Despite the growing ecological awareness in contemporary global society, the complexity of the motivations and practices of green consumption still poses significant barriers to the dissemination of more environmentally conscious consumption patterns, as noted in lay discourse and many consumer studies (for commentary, see Moisander, 2000). Different consumers hold different conceptions of ecologically oriented consumer behaviors, and due to the complexity of the concept and morality of ‘ecologically responsible consumer behavior’ and the complexity of ecological information, there may be countless motivations for becoming a green consumer (Henton & Ahtola, 1991; Kempton, 1991; Bell, 1994; Niva & Timonen, 2001; Collins, 2004, as cited in Moisander, 2007).

Moreover, considering environmentally responsible behavior often involves difficult motivational conflicts, which arise from the fundamental incompatibility between collective environmental goals related to environmental protection and self-interested benefits of consumers (Uusi-Talo, 1990; Wiener & Mehrabian, 1991, as cited in Moisander, 2007). With the development of technology, digital technology is gradually becoming an effective way to enhance consumer participation in sustainable environmental behavior by reducing their psychological distance. On the one hand, the behavioral patterns of individual participation in environmental protection are being changed by digital technology, represented by the Internet, and may become an effective policy tool (Mckenna and Bargh, 2000; Engelberg and Sjoberg, 2004; Bierhoff and Vornefeld, 2004). On the other hand, the rapid development of digital technology allows the public to vividly understand environmental changes through convenient tools such as mobile applications, and to participate more easily in global environmental cooperation (Bai et al., 2018; Mentis, 2019, as cited in Moisander, 2007).

Therefore, digital technology has the potential to promote individual online activities on green applications, help individuals participate in sustainable environmental behavior, and increase their willingness to cooperate globally by reducing psychological distance, forming a sustainable community. However, there is relatively little research on the driving factors of applications promoting individual participation in sustainable green activities, and existing research is mostly conducted in experimental environments and there is little analysis of real cases.

1.3 Research question and objectives

Due to the scarcity of successful green sustainable software, this paper selects Ant Forest, a subsidiary of the Alibaba Group, as a case study. Ant Forest is a green project which is based on a professional financial service platform called Alipay that supports low-carbon environmental protection behavior and has achieved success in China. It has even inspired similar sustainable environmental protection apps in the Philippines. However, there is a lack of research and understanding of the driving factors that lead users to use such green software to participate in sustainable activities. Therefore, the main research question of this paper is as follows:

The motivations of users to participate in sustainable projects on mobile applications: A Case Study of Ant Forest

To answer our research question, we examine three dimensions that we have extracted from the analysis of existing literature and the conducted interviews. Consequently, we are prompted to consider the subsequent subquestions:

- **How do social factors drive users' sustainable behavior on Ant Forest?**
- **How do mobile applications factors drive users' sustainable behavior on Ant Forest?**
- **How does Ant Forest impact users' sustainable behavior?**

This study aims to explore the factors that drive consumers to contribute to sustainable projects on mobile applications, using Ant Forest as a case study. Through qualitative research, this study will conduct interviews with Ant Forest users and analyze interview data

to identify the driving factors that lead consumers to engage in sustainable behavior on mobile applications. These factors will be further analyzed in conjunction with user green values and perceptions. This research will provide ideas for future research and the design and development of similar software, as well as empirical support for relevant companies and organizations to formulate sustainable development strategies and offer new theoretical and practical insights into green consumer psychology research.

1.4 Scope

To ensure focus and rigor in our study, we have imposed limitations on its scope. In this study, we solely consider the perspectives of users of the Ant Forest app to explore the factors that drive their engagement in the environmentally-friendly Ant Forest project and their sustained contributions. We aim to provide insights for similar sustainable ventures related to mobile applications in the future. The study does not encompass the viewpoints and opinions of stakeholders from various sectors of society, government entities, or the Ant Forest platform.

Furthermore, we narrowed down the research scope to include only experienced users who have been actively using Ant Forest for at least one year or hold at least one tree-planting certificate. Given the potential variations in usage patterns among Ant Forest users of different experience levels, we believe selecting experienced users who meet specific criteria will yield more reasonable and fact-based data.

Additionally, we limited the geographical focus of the study to China. This restriction is important due to potential geographic, climatic, cultural, and legislative differences across countries.

It is important to clarify that while this research aims to provide relevant insights into the driving factors for users of sustainable mobile applications, it may not be generalizable to sustainable mobile applications in countries/regions other than China. However, it can offer valuable lessons in similar contexts.

2. Literature review

2.1 Sustainable Crowdfunding

Recently, there has been an increasing number of business professionals that have committed to promoting sustainable social change. They want to utilise their creative abilities to discover innovative solutions for societal and environmental issues (Cohen and Winn, 2007). However, sustainable entrepreneurs are required to maintain a balance between economic, social, and environmental objectives, commonly known as the triple bottom line. (Maehle, 2019) This is in contrast to traditional entrepreneurs who primarily focus on commercial aspects (Belz and Binder, 2017). Consequently, these programmes prioritise financial success to a lesser extent, and endeavours that prioritise the production of sustained value often struggle to secure funding from traditional sources. According to Testa et al., (2019) cited by Maehle (2019) Crowdfunding can be a viable solution for addressing the issue of insufficient financial resources, particularly when it comes to supporting sustainable activities.

Crowdfunding platforms have consistently had a dominant position in the crowdfunding market. The phrase "crowdfunding platform" often refers to an online programme that connects project owners with possible backers and enables communication between them, using different economic models (Shneor and Flaten, 2015, p. 188). Internet crowdfunding has experienced a significant surge in popularity in recent years as a novel means of financing businesses and projects.

According to Maehle (2019) cited by Wang et al. (2021), Crowdfunding, in essence, involves the aggregation of relatively small amounts of money from a potentially large number of interested funders, as opposed to large sums of money from a select group of knowledgeable investors and backers, often without the involvement of traditional financial intermediaries. The long-term funding deficit in early-stage entrepreneurship, which has increased in size during the recent financial crisis, is also seen at the market level as a problem that can be addressed by capital markets (Moritz and Block, 2016). Entrepreneurial investment practices during the fundraising stage can provide benefits beyond just raising funds. These benefits include timely feedback on the developing concept,

validation from the market, and opportunities to connect with important stakeholders such as potential investors, business partners, and the media (Mollick and Kuppuswamy, 2014).

The study conducted by Moritz and Block (2016) identified certain challenges that academic academics should prioritise in the field of early crowdfunding research. The discussed subjects encompass the motivations behind fundraisers opting for crowdfunding, the determinants of successful practices, the legal conformity and challenges associated with different crowdfunding models, the factors influencing backer behaviour, the role of social networks in crowdfunding, the application of signalling theory in crowdfunding, and the categorization of various crowdfunding types and their accompanying strategies. The correlation between these perspectives and the Ant Forest project's successful utilisation of gamification and social involvement to promote public engagement in crowdfunding for sustainable environmental initiatives warrants thorough investigation. (Wang et al., 2021)

2.2 Green psychology

Green psychology, which encompasses factors like green trust, green happiness, and green perceived value, has a significant impact on shaping sustainable consumer behavior in the realm of mobile applications. (Ahmad et al., 2023) Green trust, as conceptualized by Wang et al. (2018), refers to the consumer's confidence in an organization's environmentally friendly characteristics and reputation. Consumers who have confidence in a company's environmental assertions tend to view green products which sustainable products designed to minimize their environmental impacts during their whole life (Das, 2021) in a positive light, leading to the development of favorable attitudes. Insufficient trust, on the other hand, can result in unfavorable perceptions. Green trust improves trust in user-generated content regarding green characteristics, and positively influences Green Purchase Intention (GPI).

According to Chen (2010) cited by Ahmad et al. (2023), Green satisfaction pertains to the gratification obtained from consuming products that fulfill eco-friendly preferences. Studies found that ensuring satisfaction is vital for establishing enduring client relationships and shaping future purchase intentions. It encompasses the satisfaction of consumers, which is determined by their perception of how well a product performs in relation to their

expectations. According to Ahmad et al. research, positive pleasure is experienced when the perceived level of performance surpasses one's expectations. The concept of "green satisfaction" is closely tied to meeting consumers' environmentally friendly preferences and their expectations for sustainable development.

Perceived value (PV) refers to the cognitive evaluations made by purchasers regarding their collaboration with a service provider. (Hutt and Speh, 2007) It encompasses both the advantages and disadvantages associated with the collaboration. Green Perceived Value (GPV) is a comprehensive evaluation of the actual benefit that a client receives from an offering, the entirety of which is provided. (Ahmad et al., 2023) It has an impact on purchase choices by connecting consumers' perceptions of environmentally friendly products to their actual actions. Customers are more inclined to buy green items if they perceive them to have added value. (Confente et al., 2020) GPV is widely recognized as a key determinant in purchase choices among the growing trend of environmentally conscious consumerism. (Ahmad et al., 2023)

The proven association between Corporate Social Responsibility (CSR) and GPI is influenced by green psychological variables, such as green trust, green satisfaction, and green perceived value. CSR acknowledged as an important antecedent to green trust, green satisfaction, and green perceived value. (Gil and Jacob, 2018a) These green psychological variables exert a substantial influence on customers' GPI. Green psychology is closely associated with corporate social responsibility (CSR) and the intention to make environmentally friendly purchases. Green psychology plays a crucial role in motivating sustainable behaviors in mobile applications,

2.3 Green Customer Citizenship Behavior

According to Van Tonder et al. (2023), there is an increasing interest in researching green customer citizenship behaviours that contribute to organisations' environmental efforts. Customer Citizenship Behaviour (CCB) refers to the additional actions that customers voluntarily engage in, without expecting any kind of reward, in order to enhance the quality of goods or services provided by enterprises. (Sarioglu, 2020) Customer Citizenship

Behavior is derived from organizational behavior theory and the relationship marketing paradigm, and it evolves in accordance with the service-dominant logic of marketing. (Mitrega et al., 2022) The study by Mitrega et al. also proposes a definition of CCB as voluntary, extra-role, and non-monetary consumer behaviours that assist a company in value generation.

While there is a widespread agreement on the definition of CCB, discussions continue over the dimensional building blocks of CCB. In 2013, Yi and Gong developed a widely recognized framework for CCB, which consists of four dimensions: feedback, advocacy, assistance, and tolerance. The rise of green consumer citizenship behavior as a subgroup is a reflection of the current focus on environmental actions. Consumers that engage in green citizenship behaviors willingly and discreetly support a company's environmentally friendly efforts, hence contributing to overall environmental sustainability (Mitrega et al., 2022).

The research of Van Tonder et al., (2023) also examines models that incorporate personal and social elements that influence green citizenship practices. It shows that the corporate social responsibility procedures, transparency in green qualities, brand image, trust, and attitudes influence consumers' green citizenship acts. Furthermore, Van Tonder et al.'s study examines the impact of subjective standards and internal values on pro-environmental actions, leading to a comprehensive comprehension of the factors that drive green consumer civic behavior. The Value-Attitude-Behavior Hierarchy (VABH) means the influence should theoretically flow from abstract values to midrange attitudes to specific behaviors within a given situation. (Homer and Kahle, 1988). The focus on the Value-Attitude-Behavior Hierarchy (VABH) is significant in understanding how internal values and attitudes contribute to the promotion of green citizenship practices.

As the literature progresses, there is a demand for research that focuses on these areas of study, which includes the requirement of considering both societal and personal factors. This will help us gain a better knowledge of the intricate nature of green customer citizenship behavior.

2.4 Social engagement

Social involvement means the involvement of people in the activities of a social group is sometimes referred to as social engagement, also known as social involvement. Activity, contact, social exchange, and freedom from coercion are essential components of social engagement. (Prohaska et al., 2012) According to Kate (2001) cited by Wang et al. (2021), social media is the gateway to social relationships as well as the Internet, which implies that social media platforms not only facilitate interpersonal relationships but also act as a portal through which individuals access and engage with the vast array of content and services available on the internet.

According to Liao (2019) cited by Wang et al.(2021), Chinese citizens were previously more acclimated to the "top-down" approach to engaging in environmental behaviours, which focused more on the acts of significant businesses, organizations, or the government. Ordinary folks typically lacked a feeling of purpose and motivation. The public's lack of environmental awareness and motivation has resulted in a relatively low level of social engagement in environmental protection. This, in turn, significantly impedes the establishment of sustainable environmental conservation efforts. But according to Zhang's paper's empirical research, the introduction of Ant Forest significantly increased societal participation in environmental protection actions. (Zhang, 2019)

Along with "Friend PK," "Steal energy," and other co-cultivation themes, Ant Forest has also introduced the planting of family trees, spouse trees, classmate trees, colleague trees, and friend trees. The numerous themes can satisfy the demands of people in diverse identities and social groups to build social engagement with others through co-cultivation by covering users' varied social circles and so accommodating their needs. Specifically, the game satisfies users' demands for social interaction and enjoyment. The user experience and their excitement for participating are therefore considerably improved. (Li et al. 2018)

Since the interactive friends on Ant Forest are imported from the users' address book, a familiar social network of players will develop in the game. Chen also discovered that the engaging game-based form is entirely distinct from direct conversation or image-text communication on any other social media. Instead, it dramatically reduces the space between players in this type of game engagement, significantly raising user stickiness. (Chen, 2019)

Cao et al. (2022) found that both cooperative and competitive interactions can motivate users to participate in low-carbon actions. However, the motivating effect of cooperation in Ant forest was more significant. Moreover, collaborative engagements prompted users' normative, hedonic, and gain incentives to adopt low-carbon behaviours, but competitive engagements only stimulated hedonic and gain goals.

2.5 The interconnectedness of applications and their corresponding functionality

The rapid increase in the number of mobile applications and the constantly changing nature of mobile platforms have brought the concept of mobile ecosystems to the forefront of focus. Basole (2009) defines the mobile ecosystem as an extensive and complex network of companies that engage with one other, both directly and indirectly, to provide a wide range of mobile products and services to end-customers.

According to Gao (2015), the framework for investigating business models of mobile ecosystems in China consists of four dimensions. The first dimension is the value proposition, which focuses on how organisations create value for their customers and all parties involved in service provision. The second dimension is the value architecture, which involves the configuration of an organization's resources and core competencies to create and deliver value to customers. The third dimension is the value network, which encompasses the inter-organizational relationships within a business model. Lastly, the fourth dimension is the value finance, which pertains to the generation of revenue and the structure of costs within the business model.

Within the dimension of value finance, WeChat's transformation from a mere messaging platform to a diverse ecosystem encompassing various features such as gaming, payment services, and online commerce serves as a successful example of the positive association between functions within the mobile ecosystem. The incorporation of casual games in 2012 bolstered user involvement, resulting in heightened monetary transactions for diverse applications. The culmination of this evolutionary process is seen in the introduction of products such as WeChat Wallet and WeChat mobile shopping, which generate revenue

through the collection of commission fees. (Gao, 2015) This example demonstrates that there is a positive association between the functions of a mobile app's ecosystem, which encourages users to utilise other relevant functions within the ecosystem. As a result, this enhances the company's interests.

Facilitating the promotion of events associated with traditional Chinese festivals results in increased user engagement, as demonstrated by WeChat's triumphant Chinese New Year promotion with virtual red envelopes, which corresponds with the traditional practice of gift-giving. Alipay's "Gather Five Fortunes" campaign during the Chinese New Year utilises cultural themes by involving Ant Forest in the interaction process.

In summary, the analysis of the mobile ecosystem highlights the interconnectedness of applications and their corresponding functionality. This emphasises that all participants in the ecosystem can get added value through collaboration, resulting in improved mobile data services for customers. This comprehension is essential for other similar developing organizations striving for success in the ever-changing terrain of the mobile business. The correlation and interdependence between distinct functions within WeChat, as well as Alipay and Ant Forest, demonstrate the complex relationships that influence user behaviours in mobile ecosystems.

2.6 Gamification

Another important component of the study is the implementation of gamification. Currently, the prevailing notion, as forth by Deterding et al. (Deterding et al., 2011), posits that gamification refers to the incorporation of game design features into a setting that is not inherently a game. (Bunchball, 2011) previously defined gamification as the act of incorporating the motivational aspects and mechanics of games into websites, services, content, or activities. Following the publication of Deterding et al.'s theory, they defined gamification as the provision of enhanced interactive services that enhance user motivation and deliver a gaming-like experience, ultimately resulting in value creation for users. According to Ning and Xi (2017) cited by Wang et al. (2021), gamification is a marketing strategy that distinguishes itself from standard points systems in customer loyalty

programmes. It employs game design principles to create extra economic and societal worth by incorporating numerous game aspects and utilising a marketing approach that motivates consumers.

Upon reviewing several literature sources on the gamification of Ant Forest, we have identified three key results that are representative from several perspectives. According to Zhang (2021) cited by Wang et al. (2021), Ant Forest's incorporation of gamification into public welfare can effectively engage users and encourage their active participation. The game's design, which involves users exchanging green energy with or stealing it from their friends, adds an element of interest and enhances interaction among users. Furthermore, the system's daily presentation of "green energy" values, the progression of "virtual trees," and the bestowal of "tree planting certificates" to users are genuine manifestations of users' accomplishments, enhancing their feeling of achievements. According to Jia (2020) cited by Wang et al. (2021), Ant Forest adopts gamification techniques and incentive structures to enhance users' motivation to engage in eco-friendly mobile software activities which offers a fresh answer to the existing challenge of environmental communication, including both environmental concerns and economic development. As the green economy continues to advance and the carbon trading market improves, environmental concerns and economic progress are no longer at odds. Instead, there is potential for mutual gain. Zhang (2020) contends that customers have developed a strong emotional connection with Alipay's Ant Forest, leading to increased user loyalty and engagement. The company not only fulfils customers' need for payment software, but also accomplishes the objective of promoting the common good. The integration of value co-creation and low-carbon environmental preservation greatly promotes the sustainable development of the social economy.

While there are numerous favourable remarks on the gamification of Ant Forest, certain scholars have highlighted the drawbacks of this trend. One such drawback is the intricate and costly design process associated with gamification. Companies may have the problem of incurring substantial development expenditures when implementing gamification strategies. Furthermore, the expenses associated with upkeep are significant, given that games depreciate in value as time passes. This places a financial burden, especially for smaller companies. (Gupta, 2022)

2.7 Summary of research questions and literature review

This literature review delves into the realm of sustainable consumption, specifically examining green psychology and green customer citizen behavior. Sustainable user behavior on the internet is identified as a crucial component of sustainable consumption, closely linked with user behavior in the online environment. This literature review also found that current research on internet user behavior encompasses various aspects, including social factors such as social engagement, and software-related factors such as gamification and software ecosystems. Notably, extensive research exists on sustainable consumption and mobile application mechanisms; however, there is a noticeable gap in studies focusing on the motivation behind online user sustainable behavior. Understanding user motivation is paramount, as it lays the foundation for fostering sustainable behavior within mobile applications.

In order to contribute to the research gap, we will use Ant Forest as an example to study the behavioral motivations of Ant Forest users. Specifically, we will address the following research questions:

- 1. How do social factors drive users' sustainable behavior on Ant Forest?**
- 2. How do mobile applications factors drive users' sustainable behavior on Ant Forest?**
- 3. How does Ant Forest impact users' sustainable behavior?**

3. Research Methodology

In this chapter, we have outlined the methodology chosen for this research paper. Careful and rational selection has been made to ensure an appropriate relationship between the methodology and the research questions. We have described the research design and strategy chosen, as well as the methods for data collection and analysis. Additionally, I have addressed potential ethical issues, as well as the limitations.

3.1 Research design

The general plan for how to answer the research question is the definition of research design (Saunders, Lewis, & Thornhill, 2016, p.163). It is a framework that includes methods for collecting and analysing data from the research question. Research design can be exploratory, descriptive, explanatory, evaluative, or a combination of these.

In this study, we have chosen an exploratory research design from various research methods to answer our research question. This is because the phenomenon we are studying is relatively new, and existing research is limited. Our goal is to gain a deeper understanding and improve our knowledge of the driving factors behind consumers' green behavior on green applications. Consumers' green behavior is a complex and dynamic phenomenon, especially when considering the factors involved in application carriers. The flexibility of exploratory research design is its advantage, which allows us to make timely changes when new data emerges. (Saunders et al., 2016, p.174) We aim to explore the driving factors of users' sustainable development application software usage and lay the foundation for future research. Therefore, we are trying to use induction to construct theory through data collection and analysis (Saunders et al., 2016, p.51)."

3.2 Case study

To ensure methodological coherence throughout our research design, it is crucial to select an appropriate strategy. This paper employs a case study strategy, selecting Ant Forest as a case to gain in-depth understanding of the factors driving users' engagement with sustainable mobile applications.

Case study is an approach to investigating empirical subjects by following a set of predefined procedures. As a research method, case studies have been employed in various instances to help us understand individuals, groups, organizations, societies, politics, and related phenomena. The unique demand for case studies stems from the desire to comprehend complex social phenomena. Case study helps to develop extensive and "in-depth" descriptions of certain social phenomena, such as "how" or "why" certain social phenomena operate (Yin, 2014, p.4). Given these characteristics of the case study method, it is highly suitable for our exploratory research questions regarding the phenomenon of Ant Forest software.

3.2.1 Selecting informants

According to Saunders et al. (2016), researchers often have to select a sample of the population as it is practically impossible to collect or analyze all available data due to constraints such as money, time, and access. Additionally, in-depth interviews require at least one hour per interviewee to gain deep insights. Considering these factors, it is not feasible for us to interview all users of Ant Forest.

Therefore, we selected some experienced users of Ant Forest, referred to as informants, as our sample based on specific criteria. The first criterion was that informants have been using Ant Forest for over a year. Another criterion was that informants have received at least one tree-planting certificate in Ant Forest. This ensures that informants have a significant and in-depth usage experience with the Ant Forest software, which is essential for our study.

3.2.2 Informants

To ensure that our data does not contain any information that can identify the identity of the respondents, all respondents were kept anonymous, and we assigned them codes as A1, A2, A3, A4, A5, A6, and A7. This approach protects the identity information and personal privacy of the respondents to some extent.

In the following paragraphs, we will provide a brief introduction to Ant Forest and the selected respondents. Ant Forest is a public welfare project operating in China aimed at promoting low-carbon emissions among the public. In Ant Forest, individuals' low-carbon

behaviors are counted as "green energy" within the app. For example, buying electronic movie tickets (paperless), paying for public transportation, etc. can be converted into green energy. In addition, Alipay is also associated with the health information of the mobile phone. Therefore, with the user's authorization, Alipay can understand the user's daily walking data. When walking to a certain amount, it will also obtain green energy. When a certain amount of "green energy" is accumulated, individuals can use their mobile phones to apply for planting a real tree in ecologically vulnerable areas or "claim" protection rights in areas requiring biodiversity conservation. The ecological restoration projects in different regions are funded by the Ant Group, and specific tasks such as planting and conservation are organized by charitable organizations under the supervision of local forestry departments. Each project has corresponding donation agreements and acceptance reports. On September 19, 2019, the "Ant Forest" project in China received the United Nations "Earth Champion Award."

3.3 Data collection

When researchers attempt to explore and gain a deeper understanding of a phenomenon, qualitative methods are often preferred (Saunders et al., 2016, p. 168). Given that our study is exploratory in nature, we chose to employ qualitative methods in our research. We conducted interviews with knowledgeable and relevant informants to collect the primary data for this qualitative study.

3.3.1 Semi-structured interviews

Semi-structured interviews are characterized by their non-standardized nature and are commonly employed in qualitative analysis research (Saunders et al., 2016, p. 391). The choice of using semi-structured interviews stems from their flexibility, allowing us to comprehend the "what," "how," and "why" aspects of the research questions. Additionally, we were able to employ a range of prepared themes and questions, thus maintaining some control over the interviews. To achieve this, we prepared an interview guide with pre-

defined questions prior to the interviews (see Appendix A). However, we also ensured the flexibility of the interviews, allowing for adjustments in the line of questioning based on the respondent's performance and the situational context during the interview. Adjustments in semi-structured interviews may involve changing the sequence of questions to ensure smooth conversation. Moreover, it enabled us to request elaboration from the informants when necessary to gain deeper insights into the issues and obtain more comprehensive answers.

We contacted all the respondents via email and instant messaging participants to inquire whether they were willing to participate in our interviews. The respondents were given the option to choose between online or offline interview formats. Three interviews were conducted offline, with two taking place at coffee shops and one at a library. The remaining four interviews were conducted over the phone. Each interview lasted approximately forty-five minutes to one hour. After the interviews, we continued to engage with several respondents through email and instant messaging, posing additional questions that proved valuable to our research. These follow-up inquiries helped clarify certain statements and allowed us to obtain more comprehensive responses from the respondents, contributing to the overall refinement of our study.

3.3.2 Preparation

Thorough preparation in advance is crucial for the success of interviews. This primarily involves acquiring a rich understanding of the research topic (Saunders et al., 2016, p. 401).

To ensure a detailed understanding of the research topic, we made the following efforts:

Firstly, prior to the interviews, we conducted an extensive literature review, encompassing not only relevant academic knowledge but also examining relevant information on Ant Forest case studies.

Secondly, we developed an interview guide that included appropriate questions and topics for exploration, enabling us to obtain comprehensive and in-depth responses to our research questions. To allow respondents sufficient time for reflection and preparation, we sent them

the interview guide one week before the interviews, allowing them to prepare for the interview-related information in advance (see Appendix A). By receiving the relevant information beforehand, respondents could gather supporting documents from other sources if necessary, which might have some influence on the reliability and effectiveness of the research and could potentially impact the dynamics and naturalness of the interviews.

Additionally, we researched available information about the individuals we were going to interview. Interviewing is both a research methodology and a social relationship. (Seidman et al., , p.81) As interviews involve a relationship, being familiar with the informants and establishing a good rapport with them can increase their willingness to share information that may not be accessible through other means.

Lastly, we engaged in several insightful and productive discussions regarding the research topic and the information providers, which prepared us for potential challenges that might arise during the interview process.

3.4 Analysis of data

In order to ensure that all the information from the interview conversations was captured, with due consideration for the privacy of the respondents, all interviews were recorded with the informed consent of the participants. Subsequently, to "avoid the accumulation of recordings and associated transcription work," each interview was transcribed shortly after its completion (Saunders et al., 2016, p. 572). Following the transcription, we carefully reviewed each interview, allowing us to identify key themes within our data for further research and exploration. We decided to employ thematic analysis, a commonly used method in qualitative analysis. It includes six steps: Familiarization of data, Generation of codes, Combining codes into themes, Reviewing themes, Determine significance of themes, Reporting of findings. (Saunders et al., 2016, p. 579).

Our approach involved deriving thematic categories from the collected data. Firstly, to ensure logical and systematic analysis, we needed to establish a framework for analysis. This analytical framework was based on thematic categories derived from the collected interview data, with different relevant thematic categories listed in an analysis matrix, which was

crucial for our subsequent analysis. The thematic categories included in this matrix were initially derived from the literature review, and further refined and expanded with the analysis and synthesis of the transcribed interview texts after conducting the interviews.

The next step in our analysis process is to categorize data units into one or more relevant thematic categories. Data units were selected excerpts from the collected interview data that pertained to specific thematic categories, typically comprising individual words, sentences, dialogues, or complete paragraphs.

It is important to note that during the analysis process, certain categories may be merged due to their close relationship, aiming to enhance the focus of our analysis. Furthermore, as some data may involve multiple categories, certain data units may be assigned to multiple categories.

Subsequently, through the process, we incorporated the data units into their respective thematic categories, resulting in an organized and arranged list. This process enabled us to explore and discover different categories within the collected data, organizing and synthesizing the gathered information according to these categories, thus laying the groundwork for a structured analysis.

3.5 Evaluation of our research method

3.5.1 Validity

Effectiveness refers to the extent to which the collected data is relevant and appropriate in addressing the research questions, the accuracy of data analysis, and the generalizability of research findings. Effectiveness can be divided into internal validity and external validity, with distinctions between the two (Saunders et al., 2016, p. 181). To ensure rigor and comprehensiveness in our study, we will analyze internal and external validity separately.

Internal Validity

In qualitative research, internal validity pertains to the credibility of the findings. It signifies the extent to which our findings align with reality, i.e., whether our study effectively measures what we intended to measure. To enhance internal validity, we formulated exploratory questions that urged informants to elaborate on their viewpoints, aiming to increase the credibility of the results and align our findings with reality (Saunders et al., 2016, p. 400).

On one hand, due to the choice of Ant Forest case as our focus, interviews were conducted in China, raising concerns about potential misunderstandings stemming from language and cultural differences. To ensure the fidelity of the data, it was crucial for us to clarify any ambiguities. Because both the interviewer and the interviewee were native speakers of Chinese, and the interview was about the interviewee's experience in China, the interview was conducted in Chinese to avoid ambiguity and misunderstanding. Subsequently, a Chinese-speaking doctoral candidate in Norway transcribed the conversations to eliminate any ambiguity that may arise during the translation from Chinese to English. These measures were taken to guarantee that the data were not misunderstood or subject to misinterpretation due to linguistic disparities.

On the other hand, throughout the entire interview process, necessary measures were taken to ensure internal validity. Prior to the interviews, the interview questions were thoroughly reviewed and discussed with the supervisor to ensure their clarity. Before the interviews, both Chinese and English versions of the relevant interview questions were provided to the participants for review, with additional clarifications offered if any questions were unclear. Thus, we aimed to minimize the potential for misunderstandings and ensure that the respondents' answers genuinely addressed our questions. During the interview, a similar interview question outline was used for all participants to enhance internal validity. We also made efforts to avoid leading questions, ensuring that the respondents were not influenced by any potential biases we may hold, and focused on actively listening to their responses. Additionally, as we interviewed Ant Forest users with more than one year of experience or individuals who had obtained a tree-planting certificate, we could ascertain that they possessed relevant experience and knowledge of the Ant Forest project, thereby contributing to the effectiveness of our study.

After the interviews concluded, we sent follow-up emails, instant messages, or conducted brief interviews to further clarify and validate the themes expressed by the participants. This was done to ensure that our interpretations aligned with the actual intentions of each informant. In qualitative research, another consideration is how participants perceive the interview questions (Saunders et al., 2016, p. 402).

External Validity

External validity refers to the extent to which research findings can be generalized or transferred to other contexts or populations. Given that we are conducting a case study, generalizability of the results is a concern (Saunders et al., 2016, p. 398). Our study aims to explore and explain complex phenomena within a specific context, and as a case study, the results may not be readily applicable to all populations. As our research is conducted in China, there may be limitations in generalizing the findings to other countries. However, we believe that these findings can be transferred to similar environments, and the lessons learned and conclusions drawn from our study can be applied in other contexts.

3.5.2 Reliability

Reliability pertains to the degree of consistency and reproducibility of our findings. (Saunders et al., 2016, page 202). High reliability refers to the degree to which a system or process consistently performs its intended function without failure or error. It is always preferable because it signifies the reliability of the outcomes. However, data obtained from non-standardized research methodologies may not be suitable for conducting reproducible investigations due to the dynamic and complex nature of events, which can alter over time (Saunders et al., 2016, p. 398).

A concern about the reliability of this study is the semi-structured interviews are characterized by a lack of standardization. These types of interviews can be prone to bias. An example of bias pertains to the influence of the interviewer on the interviewee's response through factors such as tone of voice, body language, and other forms of nonverbal communication (Saunders et al., 2016, p. 397). This bias can arise when the interviewer

possesses personal thoughts and beliefs, which subsequently influence the direction of the interview. Data interpretation can potentially result in bias (Saunders et al., 2016, p. 397). To mitigate the impact of interviewer bias, we employed open-ended questions to avoid any potential influence on informant responses due to our subjective beliefs. (Saunders et al., 2016, p. 397). To mitigate issues related to response bias, we make an effort to project competence and reliability in order to establish confidence. Prior to conducting interviews, all participants were provided with information regarding the objective of our study. In addition, we provided a concise overview of our backgrounds and research throughout each interview to ensure that the interviewees were adequately informed. Respondents selected the interview location and time according to their preferences (Saunders et al., 2016, p 397).

To summarize, qualitative research can encounter issues that diminish the study's dependability.

3.5.3 Ethical considerations

Throughout the different stages of the research process, several ethical issues may arise.

Firstly, ethical concerns can arise from the interaction between researchers and participants. In this case, it is crucial that participants engage in the interviews voluntarily and do not feel coerced to participate (Saunders et al., 2016, p. 249). When making initial contact with all informants via email and sending interview requests, we explained the purpose of our study and their potential role in our research, proceeding with the interview process only if their willingness was ensured. This ensures that no undue pressure is placed on individuals to participate and informs them of their right to withdraw from the study at any time. Additionally, participants are informed about their role and contribution in the research, ensuring sufficient information is provided regarding the purpose of our study (Saunders et al., 2016, p. 252). Detailed explanations are provided not only during the initial contact but also before the formal interview process begins, emphasizing the specific information about our research and the importance of their involvement throughout the research process.

Secondly, we assure all participants of confidentiality and anonymity. All participants involved in the interviews are kept anonymous in the research paper. In all interviews, written information about the purpose of our study and how we believe they can assist us, including a consent form outlining that the interviews will be recorded, is provided to all participants. This further informs participants that the data will be analyzed and used in our master's thesis and that their quotations may be utilized. Written consent forms are signed by both parties to ensure participants' informed consent.

4. Findings and Discussion

In this chapter, we have analyzed our findings based on the theoretical framework presented in Chapter 2. We have categorized our findings and discussions into three main sections: the social factors that influence users' behaviour of using Ant Forest, including green customer citizenship behavior and social engagement; mobile application factors that influence users' behaviours, including interconnectedness with other apps, gamification, and incentives; and the impacts of Ant Forest on users' sustainable behavior. For each section we selected specific sentences or dialogues from the collected interview transcripts and combined them with existing literature analysis to strengthen our points. Specifically, our initial focus was on evaluating user interview data and summarizing different types of drivers or impacts. We will then look for relevant literature to explain these links and subsequently explore how these drivers influence user behavior.

4.1 Introduction of the case and participants

4.1.1 Introduction of the case

Alipay is a professional financial service platform developed by Alibaba Group, it was first born as a supplementary financial function of Taobao, the dominated e-commerce platform in China, in order to solve the trust issue between internet buyers and sellers. With more than 1 billion users across the world and 320 million daily active users, Alipay owns 54% of China mobile payment market. (globepay, 2020)

Ant Forest creates a mobile platform that everyone may use by utilizing a cutting-edge "Game + public welfare" paradigm. (Wang et al., 2021) Launched by Ant Financial Services Group, an Alibaba affiliate, Ant Forest promotes greener lifestyles by inspiring users to reduce carbon emissions in their daily lives. Users may earn the necessary "green energy" through low-carbon activities like online ticket purchases and shared bicycle transportation, among others, by creating personal low-carbon accounts with Ant Forest. When they accumulate a certain number of points, an actual tree is planted. Users can view images of their trees in real-time via satellite. The system will then provide users a certificate for tree planting. The public enjoys this intriguing, game-based type of engagement, and it does draw a sizable number of individuals to join voluntarily. (Environment, 2019)

Figure 1 shows the process of "Ant Forest" can be summarized as follows: planting users' electronic tree - selection of tree species online - offline planting of real trees. (Li and Peng, 2019)



Figure 1: Flow chart of Ant Forest operation



Figure 2: My page of Ant Forest

Figure 2 illustrates how walking, making in-store payments, and using Alipay to pay utility bills may all earn users points on their own website.

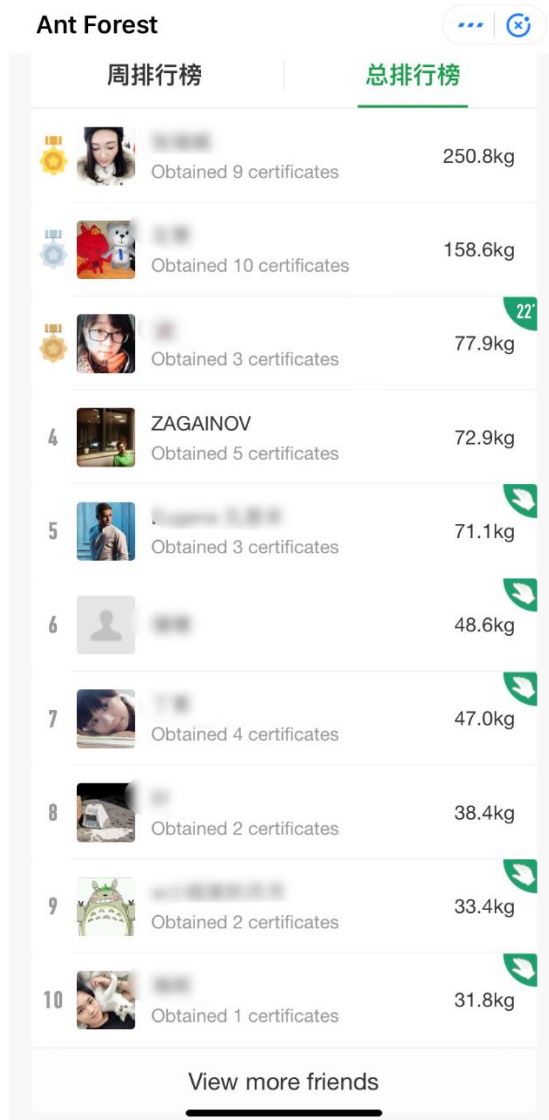


Figure 3: The ranking of Ant Forest



Figure 4: The other's page of Ant Forest

The program also has a competitive aspect, which is a friend ranking where users can check their friends' energy collected, number of trees planted, and other information, as illustrated in Figure 3.

It's another person's page in Figure 4. There are two options for us, if a friend is unable to gather energy on time: we can either help them cultivate and gather energy, or we can choose to steal energy from them. (Zagainov, 2020)

In addition to Alibaba, there is another major Internet company in China called Tencent. QQ, or Tencent QQ, is a Chinese instant messaging and social networking service owned by Tencent. Launched on Feb. 4, 1999, it is one of the most popular messaging and social media apps in the world. QQzone was established by Tencent in April 2005 and it was planned as an addition to the many social offers that Tencent provided its customers with. QQFarm is one of the game functions in QQzone. (businessideaslab, 2012)

4.1.2 Introduction of the participants

Informants	Type of interview	Interview length	Total Energy amount	Number of certificates obtained	Years of using Ant Forest
A1	Face-to-face	1:06:26	594.2kg	87	5
A2	Face-to-face	1:05:35	23.8kg	27	4
A3	Online	47:26	30.3kg	28	4
A4	Online	47:55	96kg	37	6
A5	Online	48:56	210kg	29	3
A6	Online	48:38	1.2t	49	5
A7	Face-to-face	57:23	40.6kg	29	3

Table 1: Overview of informants

The table provided presents our interviews. We conducted interviews with a total of 7 individuals, with 3 of them being conducted in person and 4 being conducted online. I will provide details of the individuals who were interviewed as follows.

A1 has accumulated 594.2 kg of energy in Ant Forest. He is a senior user of Ant Forest and has been using it since his sophomore year in college, consistently using Ant Forest every morning. He is an environmentalist and strongly supports the public welfare initiatives of Ant Forest.

A2 has accumulated 23.8 kg of energy in Ant Forest. She was attracted to Ant Forest through its marketing campaigns during the Spring Festival. She finds the game interesting and uses Ant Forest, but she prefers tangible rewards over sustainable incentives.

A3 has accumulated 30.3 kg of energy in Ant Forest. She also started using Ant Forest due to Alipay's promotion and recommendations from friends. She finds the collaborative planting feature of Ant Forest intriguing and enjoys interacting with friends. She feels that Ant Forest provides a platform for her to do meaningful things for society, which attracts her.

A4 has accumulated 96 kg of energy in Ant Forest. She was introduced to Ant Forest by her family, and she finds it meaningful to plant trees together with them. The commemorative aspect of tree planting motivates her to use Ant Forest consistently.

A5 has accumulated 210 kg of energy in Ant Forest. He was introduced to Ant Forest by his girlfriend. Although he personally is not very enthusiastic about Ant Forest, he waters the couple tree they planted together every day to make his girlfriend happy, symbolizing their love.

A6 has accumulated 1.2 tons of energy in Ant Forest. He discovered Ant Forest through Alipay's recommendation. With ample free time, he enjoys using Ant Forest in his spare moments. He appreciates the opportunity to contribute to the collective well-being and feels a sense of social value.

A7 has accumulated 40.6 kg of energy in Ant Forest. She clicked on a related link in Alipay out of curiosity. She enjoys games with a sense of freshness and likes using the decorative features within the app, which uplifts her mood. Additionally, the public welfare aspect of Ant Forest strongly appeals to her.

4.2 Social Driving factors of users' sustainable behaviour on Ant Forest

4.2.1 AF's competitive rankings increase urgency, driving maintenance for psychological satisfaction amid competition.

A1: Because I noticed that my friends ranked higher than me, which I can hardly accept.

Q: Is there a ranking? Did you rank the first before?

A1: Yes. I was far ahead of my friends. When I realized that my friends are catching up and may even surpass me, I started to "steal" the energy again

Q: Why you want to maintain your previous ranking and not willing to let others surpass you?

A1: Previously, the difference between my friends and me are huge. A massive gap. Suddenly others are catching up. I felt a sense of urgency. Suddenly, inexplicable sense of urgency. Then I decided to restart using it and "steal" others' energy.

Q: Sense of urgency? (Is that due to your) ambition? Or something else?

A1: Possibly. When you get used to occupying a leading position, you will subconsciously create the gap to enhance the leading position.

Q: What will happen if you maintain the position? How does that influence your feeling?

A1: Nothing changed. It's just a kind of psychological satisfaction, maybe.

The ranking of ant forests encourages a sense of competitiveness, which serves as an attractive incentive for users to use the ant forests more frequently. In the context of competing with friends, achieving a higher ranking creates psychological satisfaction, and if ranked well, individuals work hard to maintain their position.

A1 expressed difficulty in accepting that their friend was ranked higher than them, especially since they had previously held the top ranking position. When he realized that his friends were catching up and might surpass his ranking, it would promote him to "steal" energy more actively to improve his ranking.

When asked about their motivation for wanting to maintain their previous rank rather than letting others pass them, A1 mentioned a sense of urgency when they see others close the gap. This sudden, inexplicable sense of urgency drives them back into using the Ant Forest more actively to accumulate energy and even "steal" energy from others. Asked if this sense of urgency was driven by ambition or other factors, A1 responded that when one person is used to taking the lead, there is a subconscious drive to create gaps in order to cement the lead. Regarding the consequences of maintaining the position and how it affected their feelings, A1 mentioned that there were no substantial changes. Their status is maintained primarily as a source of psychological satisfaction.

Overall, these interviews suggest that, in the context of ranking competition, individuals develop a sense of urgency and strive to maintain their high position, deriving psychological satisfaction from ranking. This will drive continued user engagement with AF.

4.2.2 AF friends are mainly acquaintances can reduce the psychological distance between participants

A2: My friends in AF are basically friends in Alipay. I normally add friends when I transfer money or receive money from others. I consciously add friends to my Alipay. Also, the more friends I got, the more places I can "steal" energy from.

A2: I don't think AF will affect my social relationship. But sometimes, when I post pictures (of AF) on WeChat, some people may add me as friends in AF since they want to participate in activities (in AF). In general, AF has little impact on my social life. Because we rarely use AF to communicate. In addition, most of my friends rarely use it, not like everyday users. Maybe just appear randomly and collect some energy. In my opinion, AF and social life are not so relevant.

Q: So it is feasible if based on existing social networks.

A2: Yes, it is not an icebreaker. Not for breaking the ice. It is more like a catalyst; you got a something new to talk with your friends.

Q: You just said that you can infer your friend's activities based on the energy generated. Can you explain it?

A2: Different activities generate different amount of energy. For instance, if you watch a movie, you can get 180g energy. Offline payment will generate 5g energy. If you buy air ticket or train ticket, it seems to be 240g. You may generate a certain amount of energy according do activities. Therefore, you can make a guess about your friend's activities according to energy generated per day. If the energy is about less than one or two hundreds, most likely it is generated by walking. Different activities will generate different amount of energy.

Q: So for the social perspective, would you continue using it because your friends are also using AF?

A2: I think the trend has gone. The trend of stealing from your friends' farms has gone. People are less aggressive now. I feel now more people are anti-social, and do not want to meet new people. I think it is suitable for those who don't like social life.

Friendships with AF are primarily acquaintances, which might lessen the psychological distance between participants and encourage the use of AF. Based on the payment software's social network, it largely comprises of connections and individuals with economic transactions, resulting in the construction of a familiar social network among game participants. Participation in this game type considerably lowers the gap between

participants. (2019, Chen Hong) Therefore, most friends are familiar acquaintances from real-life rather strangers. It acts as a catalyst for interacting with existing friends rather than expanding social connections. However, as A2 said, there is a privacy issue since people can infer other people's activities by observing their different energy amounts, which may reveal personal information.

A2 mentioned that their friends on the Ant Forest (AF) platform are primarily friends from Alipay. They add friends when conducting remittances or receiving funds. Adding friends on Alipay is a conscious decision as it may lead to more financial transaction in the future. Moreover, having more friends provides more opportunities to "steal" energy from others. However, A2 believes that AF has minimal influence on their social life. Although some individuals may add A2 as an AF friend after seeing AF-related posts on WeChat, it does not significantly impact their social interactions. AF is rarely used for communication, and most of their friends on the platform are non-frequent users, randomly appearing to collect energy. A2 perceives a weak connection between AF and their social life.

When asked about the feasibility of using AF to broaden the social network, A2 states that it is not an icebreaker for strangers but rather a catalyst for new topics among friends. Regarding the social perspective, A2 believes that the trend of adding new friends in order to collect energy from them has decreased. People are less aggressive in this aspect and increasingly averse to social interactions, reluctant to meet new people. A2 considers AF more suitable for individuals who are not fond of an active social life.

Because people can infer the personal activity of others based on observing the amount of energy in the Ant Forest, people prefer to use AF with acquaintances rather than strangers for privacy reasons. Different activities generate varying amounts of energy, such as watching a movie (180g), making offline payments (5g), or purchasing flight or train tickets (240g). Thus, one can speculate about their friends' activities based on their daily energy generation, which clearly may not be appropriate for strangers on the internet. It is worth mentioning that in order to solve this problem, Ant Forest has provided an optional energy value hiding function. Regular interactions among acquaintances in AF can reduce the psychological distance between participants and increase intimacy, hence encouraging users to engage in AF.

4.2.3 AF integrates family, friends, and lovers trees, fostering unique shared goals and enhancing user engagement.

A1: Another point, I may call it a social extension. AF introduced like Family Tree, Friends Tree, and Lovers Tree. For couples, you may plant a tree together. Both of you are working for the same goal, which I think could be a unique experience. Friends Tree is like several friends working for the same goal. Although I knew some people are using this (function), but not many. Still relatively niche. I rarely see the Friends Tree or Lover Tree among my friends. Another possible reason is that getting up early is quite challenging for many Chinese. For many people. You have to get up early every single day.

Q: Why his girlfriend...Their original intention... Why this girl forces him to plant the tree. And why was he willing to change his habit and get up early to plant the tree?

A1: Probably they want something special to celebrate their love. They plant a Huyang (Populus euphratica tree). Huyang can live for a thousand years and can still stand for another thousand years after death. I guess they want this to celebrate their love, I think.

Q Why is that? A1: Romance is the reason, I believe.

Q: Is it because a girlfriend is more intimate compared to friends?

A1: I think so. I believe this is one reason. Romance is such a strong motivation.

Q: Do you also want to plant trees with others? A1: No, I don't think so. I prefer to do it alone. I feel others might slow down the speed.

A7: The ant forest is mainly for watering trees, and you can also plant a tree together with your own family members, which further promotes the relationship between family members. Sometimes you don't know what to chat with your family members, and then mentioning that the ant forest can sometimes become a topic for everyone to talk about, and everyone cooperates to plant trees, which can further promote the relationship between family members. This is also the reason inside.

A7: Among friends, it is also fun for everyone to steal energy from each other. How many grams of energy you stole from me today, and how many grams of energy I stole from you, is a kind of interaction, and you can pour as many grams of water as there are friends you have a good relationship with, and it also increases the emotional aspect between you and him increase their friendliness to others.

The concept of intimacy is closely intertwined with the idea that individuals in close relationships often share similar goals and work together to achieve them. In the context of AF, this concept is exemplified through features like the Family Tree, Friends Tree, and Lovers Tree. As stated in the literature study by Li et al. (2018), Ant Forest also incorporates the cultivation of family tree, spouse tree, classmate tree, colleague tree, and friend tree. The many themes encompass various social spheres of users, catering to the requirements of individuals with distinct identities and groups to foster social relationships through collective nurturing, thereby significantly enhancing users' engagement and involvement. Our interview data has also corroborated this issue. For couples, planting a tree together can be seen as a commemoration of their love and a shared goal they strive for. It becomes a unique experience that strengthens their bond. Similarly, the Family Tree and Friends Tree represent a group of friends or family members working towards a common objective. However, it appears that these features are not widely adopted among individuals, indicating their relatively niche nature. The limited adoption could be attributed to the difficulty of organizing groups to wake up early. Because the energy of AF is generated early every day and the quantity is limited. It is first come, first served. If people wake up late, they will not be able to “steal” the energy.

A1 mentioned the social aspect of AF, such as the Family Tree, Friends Tree, and Lovers Tree. For couples, planting a tree together can be a unique and special experience as both individuals are working towards a common goal. When asked about why A1's friend's girlfriend forced him to plant a tree and why he was willing to change his habit of waking up early, A1 suggests that they may want something unique to celebrate their love. Planting a *Populus euphratica* tree, known for its longevity, symbolizes their love and commitment. A1 believes that romance is a driving force behind this decision, as the intimacy between couples is often stronger compared to friendships.

When asked if A1 would also like to plant trees with others, they express a preference for doing it alone, as they believe involving others may slow down the process. This sentiment indicates A1's value for personal efficiency and the perception that others might hinder the desired pace. For people who value personal effectiveness, the drive to increase intimacy may not be as strong as the drive for personal effectiveness.

Additionally, A7 mentions that discussing the Ant Forest can foster connections among family members. Sometimes, individuals struggle to find topics to discuss with their family,

but mentioning the Ant Forest can serve as a shared interest, encouraging cooperation and enhancing familial relationships. Similarly, among friends, the act of stealing and gifting energy can be seen as an enjoyable interactive experience. It becomes a form of interactive competition and displays friendliness, fostering closeness and amiability among the participants. According to Cao et al. (2022), the motivating effect of cooperation in Ant forest was more significant. The interactive function of AF strengthens the bond between family, friends, and romantic partners, hence motivating users to utilise AF regularly.

4.3 Mobile applications factors of users 'sustainable behaviour on Ant Forest

4.3.1 The relevance of AF to other software promotes interactions and adds value to users.

A1: I started using AF in 2016, about my second year in university. At that time, I noticed that there is a new mini-program popped up in Alipay. The new mini-program is about (recording your) Carbon-free activities, like your daily walk (instead of using transportations) and online payment. Such activities could accumulate green energy in that program and eventually promote environmental protection. When your green energy reaches a certain level, it will help you plant a real tree in northwestern China. I think it is such a meaningful activity. Besides, I have to get up very early every day (to collect the energy in the program), because the green energy is usually generated between 7:15 AM - 7:20 AM. I usually collect my energy at 7:16 AM because my energy is generated at that time. Since then, I started to "steal" the green energy from all of my friends, similar to a game called QQ Farm (in another app called QQZone) that you can steal other's vegetables in their farms.

A1: Previously, I was a QQZone - QQ farm user. And I saw that now it is possible to plant a real tree, better than QQ farm. I feel this is more advanced, so I want to give it a try. Also, I get up very early every day, and there is nothing else to do.

A1: For instance, I use mobile payment. The interaction is that I use less cash or other unnecessary things. Less paper consumption. The process can help me generating more green energy, also help me to plant a tree. It is like a chain effect. Such interaction made me feel that Alipay is not just a wallet; it can do much more than a wallet.

A1: I think we need more exposure to make more people aware of it. We can make it more attractive; for instance, AF is closely related to Alipay campaigns. I think it is a good combination but needs more exposure.

The connection between Ant Forest and other applications, such as the similarity to the early QQ Farm concept, as well as the range of extra services offered by Alipay for Ant Forest, improve the entire user experience for Ant Forest consumers and strengthen the motivation for users to utilise Ant Forest. Ant Forest shares a similar user engagement pattern with QQ Farm in terms of cultivating user habits. QQFarm is a business simulation game that allows players to experience the fun of farming and harvesting virtual crops, and they can steal vegetables and other crops from other friends based on their QQ friend lists. A1 mentioned the act of "stealing" green energy from friends in Ant Forest, which resembles the gameplay of "stealing" vegetables from others' farms in the QQ Farm game within QQ Zone. A1 further explained their motivation for using Ant Forest, referring to their previous experience with the QQ Farm game in QQ Zone. They perceive planting real trees in Ant Forest as an improvement over QQ Farm, considering it more advanced and expressing a desire to give it a try. This indicates that imitating game models that have previously gained a large user base can facilitate the acceptance of new software by users.

In addition, Alipay can improve the situation of user participation in Ant Forest by providing various supplementary services. A1 emphasizes the interaction with mobile payment as another aspect of their involvement in Ant Forest. They mentioned starting to use Ant Forest in their second year of university in 2016 and noticing a new mini-program within Alipay that focused on recording carbon-free activities, including exercise and mobile payments. By using mobile payment and reducing the use of cash and unnecessary items, A1 generates more green energy, contributing to tree planting. A1 sees this process as a chain reaction, illustrating how Alipay goes beyond being a mere wallet and can achieve more. According to Gao (2015), Alipay's ecosystem revolves around mobile payments and integrates gamification elements to enhance user involvement and subsequently offer social services. Ant Forest, as a participant in the Alipay ecosystem, receives a range of additional services from Alipay. These offerings are designed to enhance the overall user experience for Ant Forest customers and incentivize consumers to engage with Ant Forest and.

The other motivation of using Ant Forest, A1 believes it more appealing, particularly by closely linking Ant Forest with Alipay campaigns. As an illustration, Alipay's "Gather Five

Fortunes" promotion during the Chinese New Year incorporates cultural elements by using Ant Forest in the engagement procedure. (Gao, 2015) In conclusion, the correlation between AF and other applications can enhance the utility for users and foster their adaptability and motivation to utilize AF.

4.3.2 The various gaming mechanics of AF enhance user engagement.

A1: Also, the methods for accumulating energy are more diversified. For example, it is not just for your daily consumption and exercise. Other activities, such as purchasing movie tickets, train tickets, and air tickets online, can also generate energy. So it covers more aspects of daily life in AF. In my opinion, it is a suitable marketing medium for Alipay. People will tend to use Alipay instead of WeChat for accumulating energy.

A1: In my opinion, two reasons. One reason is that AF provides more ways of generating energy; the other reason is enhanced awareness. People tend to choose paperless services, like online payment, reduce unnecessary use of papers, and avoid pollution. For example, when ordering a food delivery service, you can choose not to have disposable chopsticks and generate green energy. Small behaviors like this together may have huge impacts. Quantitative change eventually produces qualitative change. It is really not a big thing. But if many people are doing the same, it can create massive power. I think this is something that AF is trying to do.

A1: Yes, "steal" from others. You can use "Yijianshou," that you click on only one button to collect energy (from all your friends). It a button to enter a group of people that you can "steal" energy from. I usually use the button. Before, it was very inconvenient. You need to check each individual to see whether they have the available energy for you to collect. It was so tiring.

A1: Some small tools have been introduced. For instance, to facilitate the generation of energy. There is also a tool card to double the energy, which should appear in the second half of 2020. I feel AF changed a lot during the second half of 2020. For example, previously, you can only collect your friend's energy once. When you use the double energy tool card, you could collect twice. You got one more chance. This largely increases the efficiency of collecting other's energy. I remember it so clearly since I once use this tool card and got almost 2000g of energy that day.

That's around the National day, yep. Around that time, the tool card for double energy was introduced. During that holiday(about seven days), the energy I collected is much more than what I previously can get in half month.

A1: There is one you can raise chicks. For me, raising chicks is just watching the chicks eating fodder. And the fodder was obtained through various methods similar to (generating energy in) AF. I used it for a short period previously, but I think it was a bit inefficient. You can only donate when you collected five eggs. Then I give up. I just randomly have a look. But most of the time, I use AF.

The Ant Forest application offers a multitude of methods for obtaining energy in real-life scenarios. This increase in diversity of inputs leads to increased user participation, which, in turn, encourages individuals to engage in various low-carbon behaviors to acquire energy, thus forming a cycle. Furthermore, AF incorporates a variety of energy collection projects aimed at improving efficiency.

Bunchall (2011) has described gamification as the integration of the motivational elements and mechanics of games into a website, service, content, or activity. A1 mentioned that AF use extral accumulated energy as rewards for users' daily low-carbon activities, not only daily consumption and exercise, but also includes activities such as online purchase of movie tickets, train tickets, and air tickets, which enhances users' motivation for low-carbon behavior. This broader scope encompasses multiple aspects of daily life within the Alipay ecosystem. AF's initiative to transform Alipay-related low-carbon activities into energy offers customers a broader array of energy generation approaches, consequently strengthening users' motivation.

As to Zhang Meng's research (Zhang Meng, 2021), the game's design of AF has a mechanism where users can exchange or pilfer green energy from their pals, so introducing an intriguing element and fostering greater user involvement. A1 also mentioned the ability within AF to "steal" energy from others using the "One-Click Collection" button, which allows users to collect energy from their friends. Previously, it was inconvenient to check each individual's available energy, but with the introduction of this button, the process has been streamlined, thereby increasing efficiency. To further facilitate energy generation, AF has introduced small tools like the tool card, which doubles the collected energy. A1 vividly recalled an instance when they used this tool card and collected nearly 2000g of energy in a day, representing a significant increase compared to previous energy collection rates. These enjoyable or efficient game mechanisms are also motivators for people to join in Ant Forest.

In summary, AF's diverse ways of collecting energy and interesting game props contribute to increased user engagement and the overall success of the application.

4.3.3 The visualisation of AF's Reward Tree improves users' perceptions of green value, thereby promoting the use of AF.

A6: Later, AF kept improving its services. First of all, the type of trees you can choose from was increased, such as Huashan pine, Populus euphratica tree, and many other trees. I can't remember (all the names). Many Nature reserves were introduced (in the program). (Your green energy can be used for activities) such as protect golden monkeys, clouded leopards, and animals in Laojun Mountain Reserve. (You can also help with) wetland constructions in reserves. Things like this (was added to AF).

A6: There is another improvement. As far as I can remember, AF can provide (users) a precise location or a specific area to let you see your trees. For instance, you will receive information such as we (AF) have planted this Haloxylon ammodendron tree or Populus euphratica tree in this location. And we welcome you to have a look. Consequently, users can see from their eyes that trees have been planted. I think it is a way to let users feel a sense of accomplishment. At the same time, it can trigger people's interest in environmental governance in Northwestern China and the frontiers area. Because (AF) said the trees were planted where it is most needed.

A6: I think it allows the public to see the development of China's greening project construction in the past decades. I remember one old news about a forest in Dunhuang that has been cut down. It triggered a lot of discussion and concern. Before, people are less sensitive about issues concerning the environment. It was more like empty slogans and lacked intuitive meanings. AF made it possible to visualize it. AF made it possible to see how efforts were made to change a desert into a forest.

A6: You have to tell him/her (the person who donated) that money he/she donated can plant a certain type of tree in a certain area. So that people can have a very clear idea concerning what they have done. Like "I contribute to plant this tree, and I contribute to this forest". I think it is easier for people to accept it, and easier to promote.

The Ant Forest application offers a wide range of tree species, providing a high level of selectivity. The implementation of visualization allows users to see real-life images of the trees they plant on AF, giving them a stronger sense of their contributions and making it easier for them to observe their efforts. These measures can motivate users to engage with the Ant Forest application.

AF continuously improves its services by expanding the options for tree selection. As mentioned by A6, AF has introduced tree species such as Huashan pine, Populus euphratica tree, and various others, while incorporating many nature reserves into the program. Users'

green energy can be utilized to support activities in the Laojun Mountain Reserve, such as the conservation of golden monkeys, clouded leopards, and other animals, as well as contribute to wetland constructions within the reserves. These additions broaden the rewards offered by AF, and the availability of a diverse range of tree species may appeal to users with different preferences for tree types.

Furthermore, AF provides users with a valuable enhancement in the form of precise location and real-life images of the trees they planted. The project measures and updates the "green energy" value and the growing status of users' "virtual tree" every day. User's "trees" may be watched and seen in real time. Users receive notifications from AF indicating the planting of a particular tree species, such as *Haloxylon ammodendron* tree or *Populus euphratica* tree, in a specific location. This feature enables users to visually perceive the presence of the planted trees, fostering a sense of accomplishment. According to Chen (2019), the visual representation of data in Ant Forest serves three purposes: to provide users a feeling of accomplishment and contentment, to highlight the platform's reliability and enhance user loyalty, and to entice future users.

Green Perceived Value (GPV), as stated by Hutt and Speh (2007), is a crucial factor influencing customers' purchasing decisions. It links consumers' views of environmentally friendly items to their actual buying behaviour. Customers are more likely to purchase environmentally friendly products if they believe that these products offer additional benefits. AF suggests that informing donors about the specific tree species and designated planting areas resulting from their donations would enhance feasibility. This approach allows individuals to have a clear understanding of their contributions. By providing this level of clarity, it becomes easier for people to accept and support the initiative, thus encouraging user engagement in AF.

4.3.4 The commemorative value of AF's reward tree boosts users' green satisfaction and increases users' enthusiasm for AF.

A7: Sometimes, I use it to make a resolution or set a small goal. For example, I went abroad on July 26, 2019. At that time, I discovered that the tree that needs the highest energy in the entire AF is Huyang (Populus euphratica tree)? Huyang. It can live for a thousand years and will not fall after dying and stay still for another thousand years. It is a living fossil. Then I wanted to plant a Huyang. I plan to study abroad for one and a half years. Well, I will use the one and half years to plant a Huyang.

Since then, I started to increase my daily walk steps to generate a lot more energy. Besides, I "steal" (others') energy more frequently, like twice or three times per day. For instance, I check both in the morning and at night, almost every day. Around October last year, I have got sufficient energy for Huyang. Later, I discovered that maybe much more people paid attention to AF. Before, no one paid attention to it, and now you need to raffle to get a Huyang. (The raffle was) on the 20th of every month, at 10:00 AM, you can register/apply to get the Huyang. Just like buying limited-edition sneakers. And I waited for three months; on February 20, I finally got my Huyang.

A7: To give me a bit more sense of ritual and accomplishment. I did not think much about it. During a certain period... Later, I have the idea to plant a tree for myself on every birthday. Last year was an exception since I saved the energy for Huyang. For the rest years, I have planted a tree on my birthday.

From an individual perspective, tree planting within the context of Ant Forest may possess a distinctive commemorative value, serving as a form of motivation. As described by A7, tree planting can be associated with personal determination or small-scale objectives. For instance, A7 shared their experience of setting a goal to plant a *Populus euphratica* tree during their study abroad period. They increased their daily step count to generate more energy and actively collected energy from others. Through these endeavors, they accumulated sufficient energy to obtain the desired tree. This demonstrates that people's commitment and determination in achieving their goals motivate them to continue actively using AF.

Furthermore, the significance of acquiring a *Populus euphratica* tree on a specific date adds to the sense of ceremony and accomplishment associated with personal tree planting. A7 expressed the idea of planting a tree on each birthday, considering it as a meaningful tradition. Although A7 deviated from this practice in the preceding year to conserve energy for the *Populus euphratica* tree, they have continued the tradition of planting a tree on all

other birthdays. This further emphasizes the personal significance and sense of achievement of this behaviour, thus increasing the green satisfaction of users. Green satisfaction refers to the contentment derived from consuming items that meet eco-friendly preferences, as measured by individuals' judgement of how well a product performs in respect to their expectations. This definition is provided by Ahmed and Zhang (2020) and Chen (2010). Positive pleasure arises when the perceived level of performance exceeds one's expectations. It is a crucial element in building long-lasting client connections and influencing future purchase intentions.

In Ant Forest's reward system, planting a tree carries a distinctive commemorative significance for the user. This not only significantly enhances the user's green satisfaction but also caters to the consumer's preference for eco-friendly practices. Moreover, it serves as a crucial motivation for users to continue using the app in the long run.

4.4 The impacts of Ant Forest on users' sustainable behavior

4.4.1 The accessibility and usability of Ant Forest (AF) enhances Green Customer Citizenship Behavior

Q: What drives you to use Ant Forest?

A3: It can let me engage in real activities for environmental protection. Because I like to participate in (charitable) activities such as donation in Ant Donation (another mini program in Alipay), (one can) donate money for orphans or the disabled. I personally enjoy devoting myself to public welfare. AF provides a possible way for me to get involved. And it makes more people aware of environmental protection. AF engages people in such activities and lets them witness the gradual improvements of environmental protection in China, especially in the northwestern and southwestern areas. From this perspective, AF undertakes more social obligations and social responsibility. AF involves many people in similar activities. I think they have done a great job in this regard. Due to AF, the idea of environmental protection has been planted in many people's minds and influences their behaviors.

A3: I think it is hard. Because fruit trees are cash crops, and many people are planting them. But in AF, those trees are not cash crops. They are for preventing soil erosion. It (AF) shows more social responsibility, but fruit trees are about a sense of satisfaction. In AF, your satisfaction comes from social responsibility. But in the Baba Farm, the satisfaction is connected to a physical reward for what you have done. You can see your efforts when getting the fruits, but not relevant to social responsibility.

Q: Did you mean that you enjoy the feeling of contributing to society, but not necessarily the feeling of harvest?

A3: It is about what I considered valuable. I have read a sentence: unwilling to give up even a hair. In my opinion, if I can make the world better at a very small cost, it is definitely worth doing. I really hope more people are willing to contribute or sacrifice a little for society or the collective.

A3: I have donated to several charities. I am also considering donating blood. I even signed the agreement to donate my remains.

Q: Why you decided to do that?

A3: Life is only about seventy, eighty, or ninety years. I feel my life is more meaningful or more valuable if I can help more people. It may sound "fancy," but sometimes, these thoughts just popped up in my mind. You won't lose anything to do this. You don't have to do anything specific. You can just have the attitude in daily life.

The analysis of the interview data shows that the accessibility and usability of Ant Forest offer users the chance to assume social responsibility and recognise their ability to contribute to society. As a result, this promotes the development of consumer citizenship behaviour (CCB). Users choose to utilise Ant Forest since it provides them with a sense of satisfaction, pride, and other similar emotions as a result of their contributions.

Participant A3 expressed that Ant Forest provided them with the opportunity to actively participate in genuine environmental initiatives, facilitating their motivations to engage in environmental activities. Ant Forest offers individuals an opportunity to actively participate in promoting public welfare and safeguarding the environment. A3 acknowledges the social duties and obligations that Ant Forest assumes and emphasizes its impact in fostering ecological consciousness and shaping individuals' conduct. According to Van Tonder et al. (2023), Customer Citizenship Behaviour (CCB) emphasizes its dependence on external influences, which can facilitate or hinder its occurrence. The availability of software, as a positive external factor relative to the users themselves, can promote users to cultivate CCB. This literature explains the phenomena we observed from the interview data.

Participant A3 contrasted the involvement in Ant Forest with other fruit tree-related activities (such as Baba's Farm), highlighting the significance of their societal impact and the positive transformation they bring to the world. Baba Farm is a game owned by Alibaba. Users can get real free fruits as long as they perform "watering and fertilizing" online regularly. (Zhu, 2020) In Ant Forest, satisfaction stems from fulfilling one's social responsibility, while in other activities involving fruit trees such as Baba Farm, satisfaction is linked to material rewards. A3 also expressed the belief that even a minor contribution to society holds substantial worth. A3 advocated for increased participation and selflessness in order to enhance societal well-being, highlighting the significance of individual efforts and sacrifices for the collective's welfare. A3 is driven by the conviction that life gains greater significance and gratification through acts of altruism, viewing these contributions to create a beneficial influence.

In conclusion, it is established that the user-friendliness of Ant Forest enhances users' motivation and retention to utilise the platform through facilitating the adoption of green customer citizenship behaviours and the assumption of social responsibilities..

The Value-Attitude-Behavior Hierarchy (VABH) proposed by Homer and Kahle (1988) explains how personal values and attitudes play a role in encouraging the adoption of green citizenship practices. Once consumers have established their values and attitudes, they actively participate in green customer citizenship behaviors and willingly engage in environmental actions. This study portrays the underlying drives and viewpoints of individuals who highly appreciate the chance to actively participate in society and actively strive to create a beneficial influence. Analysis of the interview data shows that the accessibility and usability of Ant Forest combined with personal values enable users to exhibit green customer citizenship behaviors and therefore continue to use Ant Forest.

4.4.2 The interrelationship between AF and green lifestyle habits.

A1: Recently, people may start their jobs, there are more physical activities. On average, I can get more than 700g per day. When (we were) in school, we were not very active. The amount of green energy (I can get from my friends) was only about 600g, more than 500g, almost 600g.

A1: I think it motivates us to move. For example, if you calculate the calories, you are more motivated to go jogging a bit (instead of doing nothing). Or you calculate how much you have exercised and generate more green energy. I think it is advantageous. The intention is to encourage us not to stay still and do some exercise.

A5: From my own point of view, for example, I walked a lot of steps on a certain day, and I walked 30,000 steps. I think that before I go to bed, I will definitely open Alipay to collect my energy, so as not to waste it.

A5: It is not so much linked to sports as it is built on top of sports. I don't think I will walk more roads because I want to get higher energy, maybe first Walk more, and you can get more energy by the way the next day.

There is a mutually reinforcing and positive motivating effect between the use of Ant Forest and the adoption of green lifestyle habits. The energy collection and generation methods of Ant Forest implicitly promote the cultivation of healthy lifestyle habits such as early rising, regular physical exercise, and the use of public transportation. Simultaneously, individuals who already have green living habits are more likely to utilize Ant Forest.

A1 suggests that Ant Forest acts as a catalyst for physical activity and green habits. By calculating calories or measuring exercise levels, Ant Forest generates more green energy, this gamified reward model of Ant Forest motivates people to participate in activities like jogging instead of remaining sedentary. This method motivates individuals to abandon sedentary lifestyles and engage in physical activity.

In addition, A5 highlights the connection between Ant Forest and green behaviors and emphasizes that individuals with green habits such as walking, taking public transportation, making online payments, and avoiding disposable tableware when ordering takeaway are more likely to use Ant Forest. A5 indicates that after accumulating a significant number of steps, they feel compelled to open Alipay before bedtime to collect energy and avoid wasting their daily physical activity. This suggests that individuals with healthy lifestyle habits may be more motivated to utilize Ant Forest, as they would otherwise perceive it as wasting their daily exercise efforts.

Based on these interview data, it can be inferred that there is a bidirectional relationship between Ant Forest and the cultivation of healthy lifestyle habits. The mechanism of Ant Forest increases the likelihood that individuals with healthy living habits would exhibit green citizenship behaviours and remain committed to Ant Forest. Conversely, users who engage in Ant Forest primarily to accumulate more energy are more likely to adopt green lifestyle habits.

4.5 Summary of our findings

Using Ant Forest (AF) as an example, this thesis explores the factors that determine users' sustainable behaviour in mobile applications and the impact of mobile applications on users' sustainable behaviour. Various significant findings have been drawn from different aspects of the study. We explored the drivers that increase users' use of AF in terms of both social and mobile application factors and found the impact of AF on users' sustainable behaviour.

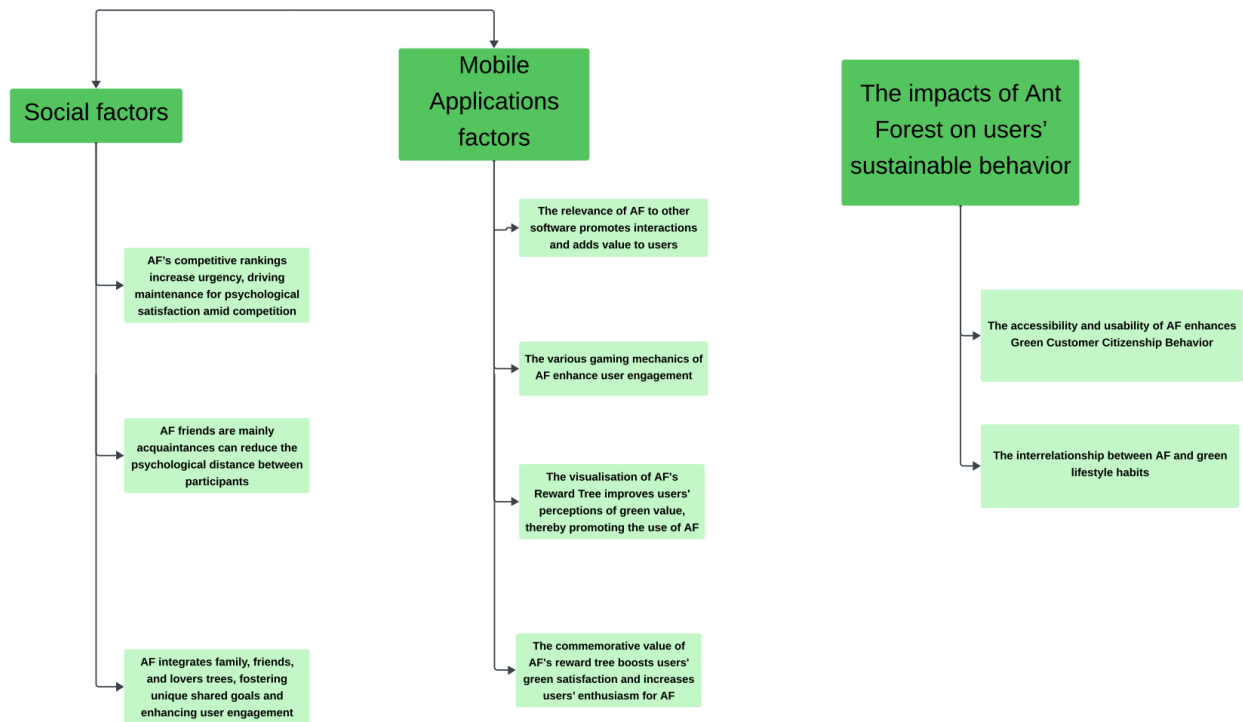


Table 2: Overview of Findings

- ***How do social factors drive users' sustainable behavior on Ant Forest?***

The competitive rankings on AF create a sense of urgency and psychological fulfilment, motivating users to strive for and preserve their top places. The social network mostly consists of individuals that are personally known to one other through Alipay, making it easier to reduce the psychological distance. The incorporation of family, friends, and romantic partners' genealogical records promotes common objectives, augmenting user involvement through distinctive and personal relationships.

- ***How do mobile applications factors drive users' sustainable behavior on Ant Forest?***

AF's association with other programs such as Alipay enhances user engagement. The integration of AF with Alipay for various supplementary services highlights the interconnectivity within the value network.

AF incorporates a range of game techniques, such as diverse means of generating energy and tools like the tool card, to enhance user involvement. AF's success in incorporating sustainability into daily life is demonstrated by the enhanced user engagement resulting from the mix of real-world events and gamification aspects.

The inclusion of AF's Reward Tree, which showcases a diverse array of tree species and provides detailed location information, heightens users' appreciation for the environmental benefits of greenery. Planting trees in AF has a huge commemorative value, as it provides a personal touch and serves as a strong motivator for users.

- ***How does Ant Forest impact users' sustainable behavior?***

AF's accessibility and usability are crucial in promoting Green Customer Citizenship Behaviour. Users enthusiastically participate in environmental activities, in accordance with their tendency towards altruism. The users of AF can gain the distinct pleasure obtained from social accountability. In terms of the interconnectedness with Healthy Lifestyle behaviours, AF's design not only encourages the adoption of environmentally friendly behaviours but also leverages the existing habits of its customers. The reciprocal correlation between AF and healthy lifestyle choices underscores the app's function as a stimulant for physical activity and environmentally friendly practices, establishing a constructive feedback loop.

In summary, this thesis explores the dynamics of AntForest (AF) sustainable behaviour, focusing on social and mobile application factors and the overall impact on users' sustainable behaviour. In terms of social factors, AF's competitive ranking within friends creates a sense of urgency. AF's social network of acquaintances minimises psychological distance. Shared tree-planting goals resulting from close relationships with family, friends, and romantic partners can enhance user engagement. In terms of mobile application factors, AF's integration with Alipay and diverse gaming techniques enhance user engagement. In addition, the reward tree featuring a variety of tree species and visual information deepened users' understanding of the environmental benefits. Planting a tree in AF becomes a significant and inspiring personal achievement. AF actively promotes green customer citizenship behaviour through its availability. AF creates a constructive positive feedback

loop with users' healthy lifestyles. This study provides a deeper understanding of what drives users to use Ant Forest and the impact of Ant Forest on users.

5. Summary

5.1 Conclusion

To explore the research questions in this paper, we used Ant Forest, a subsidiary of Alibaba, as a selected case study. The study used qualitative research methods including interviews with Ant Forest users. This study identified motivational factors that drive users to engage in sustainable activities on mobile apps can be categorised into social and software factors. Social factors include the tension generated by competition between friends and the co-operation between acquaintances and close relationships can be a driver for users. Software factors, on the other hand, include the correlation between software to provide better services to customers, gamification to increase user interest, and incentives to increase user stickiness will be the driving force for users. In addition, the impact of mobile apps on users' ability to engage in sustainable activities was also found, with influences including the availability of mobile apps that can motivate green citizenship behaviours as well as the mutual positive feedback between having healthy low-carbon lifestyle habits and using Ant Forest. A foundation is laid for understanding the drivers that influence users to engage in sustainable activities on mobile applications. It provides valuable ideas for future research, software design, and empirical support for companies to develop sustainability strategies.

5.2 Theoretical implications

Sustainable user behaviour on mobile applications is relatively new as a phenomenon and needs to be explored further. Currently, globally, an increasing number of mobile applications are guiding their users towards sustainable behaviour. However, research related to this area is limited, with a large number of existing studies currently focusing on directions such as sustainable consumption or software mechanisms. We explored the drivers of sustainable activity with software and the impact of mobile applications on users from a user perspective. Few studies have investigated users' sustainable behaviours on mobile apps, so our study enriches the literature in this area and is expected to increase the understanding of the drivers and impacts of users' sustainable activities on mobile apps.

5.3 Limitations

This study endeavoured to address potential issues related to reliability and validity. However, there are limitations to our study. By conducting a case study it is easy to allow ambiguous evidence or biased views to influence the direction of the findings and conclusions. (2014, Yin, p. 14) These biases have been discussed in the methodology chapter, along with actions to avoid or limit them. Whilst this study aimed to achieve a high level of reliability and validity, we were unable to ensure that it was free from bias. Our study included seven interviewees, and the responses of the interviewees involved personal opinions, making it difficult to ensure whether they represented the truth. In addition, since the target is Ant Forest in China, it is difficult to determine whether the results of the study can be generalised to other countries. Another point is that our research subjects are senior Ant Forest users, and other new users may contribute to more diverse findings.

5.4 Future Research

To enhance future research, it is feasible to expand the user profile of the study and incorporate quantitative research to get more universally applicable conclusions. For instance, this study revealed that the factors influencing sustainable behaviors can differ based on geographical region, age, degree of education, or income. Further exploration of this type of research on diverse population profiles is warranted.

Furthermore, researchers have the opportunity to broaden the study's scope by including additional geographic locations, such as the Nordic countries, in order to gain a more comprehensive understanding within a distinctly diverse cultural context.

Ultimately, this study aims to establish a foundation for future theoretical advancement and research. I anticipate that the findings of this study will make a valuable contribution to the advancement of sustainable behavior in mobile applications within the Norwegian environment.

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Gamification -The elements involved in creating a successful experience Section IV:

Summary and Next Steps -Where to go from here? Section V: About Bunchball and

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APPENDICES

Interview guide

- Present yourself
- Very short about the project – and why it is important to you to talk with consumers such as your informants.
- Sign letter of consent

Q: First I would like to hear about your personal story (as much as possible about the details of your) and experience at using Ant Forest app?

When was the last time you visited the Ant Forest app? – talk as much as possible

What did you do on the app during your last visit? – explain details

Is this how you normally engage with the app? – make the informant reflect on how they use and have used, and possibly changed their use over time.

Then you can probe the below question if they do not come up in the natural conversation of the first three questions.

Following questions may be covered:

How long have you been a registered user of Ant Forest?

How did you learn about Ant Forest?

What was your motivation to start using Ant Forest?

How often do you use Ant Forest?

Why do you keep using Ant Forest?

Which features of Ant Forest do you use most?

Which kind of new features do you think would make you use Ant Forest more often?

Q: Could you please tell me as much as possible about how do you think Ant Forest has affected your

- Daily life (how is different from social life?)
- Social life
- Society?

Following questions may be covered:

How do you know your friends in Ant Forest?

How do you think your social relationships will be affected by Ant Forest and why?

Would you recommend Ant Forest to others and why?

How does Ant forest effect your behavior in your daily life?

How do you think Chinese society has been affected by ant forest and why?

Test the revised on one informant to see how it works. – Good luck I think that 1 hour is a minimum time if you want to achieve some in-depth information/consumer stories.

Appendix A: interview guide