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中國私部門的社區貨幣創新與綠色運動——以螞蟻森林為樣本

Ant Forest—A Green Movement Led by Private Sectors and Driven by Community Currency Mechanism

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回顧一〇一年八月來到台灣這片陌生的土地求學，這條路不知不覺已經走了兩千三百多個日與夜，乃至比整個中學生涯還長。在這段時光裡，經歷了很多，磨煉了很多，也開闊了很多……慶幸的是這一路走來，我並不孤單。要感謝父母，當初叛逆的我選擇走這一條“吃螃蟹”的路，你們的擔憂一定不會比我少。感恩我們一家人當初的勇氣，才成就今天完全不一樣的“曾加維”。謝謝你們一直以來的默默支持，無論我做什麼決定，你們都是如此堅定。在這一里程碑上，孩子自覺沒有讓你們失望。還要感謝在台灣的每一段羈絆——在台中匆匆結識的你們；在淡水一起分享喜怒哀樂的你們；碩班兩年一起同甘共苦的你們；還有在廣州乃至世界各地心有靈犀的你們。你們每個人的臉孔，我都如此刻骨銘心。

天下無不散之筵席，在福爾摩沙成長的時光，永遠都是我心中最柔軟的小確幸。有句話我一直斟酌：“所有的漂泊就是為了有一天不再漂泊”，我大概也算是一個“北漂青年”吧。而這一漂，就是六年多。此時此刻，我想念大陸。但台灣，何嘗不是我另一個家？

——畢竟，我的身軀在大陸孕育，我的心靈在台灣洗禮。

願兩岸和平，珍重再見！

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Abstract

Recently, China's green policy has started shifting its emphasis to private capital, and personal carbon trading (PCT) scheme has been introduced in China's environmental governance framework. Ant Forest refers to one of the Chinese practical PCT examples initiated by the private sector. The implication of this case can be associated with the concept of Community Currencies (CCs) according to their internal logic. Accordingly, this study explored the consequences of Ant Forest for Chinese environmental governance mechanism from the CCs view, assuming that Ant Forest is a type of CCs mechanism. In the present study, how Ant Forest participates, integrates and even innovates the mechanism of environmental governance in China was primarily discussed.

From the perspective of 'new economics' on sustainable consumption, a multi-criteria qualitative evaluation tool with five indicators was adapted for the case analysis. Subsequently, a comparison between Ant Forest and the other two similar cases — 'Nu-Spaarpas (NU)' and 'Norfolk Island Carbon and Health Evaluation (NICHE)' is to be drawn. The findings show that the mechanism design of Ant Forest can facilitate local economic cycle, cultivate environmental awareness of citizens, create community interaction and pool social capital. A "bottom-up" structure appeared to be formed in the case of Ant Forest. The study also points to potential concerns and problems of the case.

Keywords: *Community Currency, Complementary Currency, Ant Forest, Personal Carbon Trading, Chinese Environmental Governance, Private Sector, Sustainability, Sustainable Consumption*

社區貨幣、補充性貨幣、螞蟻森林、個人碳交易、中國環境治理、中國私部門、永續消費

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

Table of Contents

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

List of Tables

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

List of Figures

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

1. Introduction

1.1. China's Green Policy Adjustment

In the political sector, with the transformation of China's economic development pattern in recent years, many policies combining economic development with environmental governance have been released. The private sector appears to be inclined to be under China's environmental governance via market mechanisms. The economic restructuring of China is to be specified in section 4.1.5. For policy adjustment, it was in 2016 that developing Green Finance[1] and Financial Inclusion[2] were both written into China's *13th Five-Year Plan* as essential missions. Later in the same year, at the G20 Summit in Hangzhou, both topics above were further promoted by Chinese government as the Summit's primary theme. Conceptually, Green Finance is explored to create a financial mechanism for attracting diverse private investment into the field of environmental governance. In the meantime, the objective of Financial Inclusion is to strengthen financial services for vulnerable groups (e.g. small and micro businesses, rural resident and urban low-income population).

Though Green Finance and Financial Inclusion lay different emphases on development goals and service objects, their development concepts are internally consistent with each other. In other words, both ideas are to expand the scope of financial services. For instance, Green Finance can attract more private capital into environmental governance field by carbon trading, issuing green bonds and adapting the public-private partnership (PPP) model for cooperation, thereby creating a possible and flexible policy implication for China's private sector to get involved into environmental protection industry. Financial Inclusion currently develops 2 branches in China, namely rural finance and micro-credit, which means to guide funds to farmers and consumers. Its specific practice is to cooperate with the national poverty alleviation task related financing projects and products and to adapt to the rapid growth of Peer-to-Peer (P2P) credit business in previous years.

Technically, the environmental businesses were rarely favored by the private sector due to the mismatch between risk and revenue. Under the traditional credit information system, private investors faced difficulties in controlling their risk fully. However, the current leaping of Internet Finance in China is facilitating the situation. China's popularization of mobile payment lays a solid foundation for the subsequent development of Green Finance and Financial Inclusion. That is, the Internet and big data technology can help the financial or private sector obtain more specific personal credit information. Besides, it is also likely for the civil society to be involved deeply in environmental protection. Individuals can start from daily environmental-friendly activities around themselves, and their ecological footprint is also recorded by mobile devices, thereby

1 *Definition of green finance* (Lindenberg, 2014) gives a relatively specific summary and expression for green finance.

2 The World Bank gives an overview that "Financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way." (See https://www.worldbank.org/en/topic/financialinclusion/overview)

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gradually accumulating a large mass base. Large private groups (e.g. Alibaba that develops the Internet and eco-technology) can also be involved by monitoring and recording individual footprints.

Socially, the gradual awakening of civil awareness is another vital factor promoting the adjustment of China's environmental governance mechanism. With the rapid economic growth in the past decades, the income of Chinese citizens has surged. Yin and Wang (2016) suggested that China's Environmental Kuznets Curve (EKC)[3] is getting closer to the turning point as the economy is growing at a higher level where the proportion of service sector keeps improving, and material life is highly demanded by the public. In the *Report of 19th CPC National Congress*, Chinese President Xi stated: "the primary contradiction of Chinese society has shifted to the contradiction between the people's growing demand of well-being and the unbalanced development."[4] The statement of President Xi to some extent reveals the awakening of consciousness. Moreover, under the current pattern of global economic progress, the timetable for China's environmental governance has been remarkably compressed. Thus, it is more necessary to coordinate the economic growth with environmental consciousness mobilization for Chinese society as early as possible. Exploring a bottom-up, reproducible, market-oriented and profitable mechanism will boost this process since the market profit mechanism renders a strong incentive which can stimulate the enthusiasm for citizens to participate in the environmental affairs.

Besides, the continuous development of Internet technology combined with public charity[5] is creating paths for private sector to be involved into environmental protection. With the rapid development of Internet Finance, the communication and fund-raising channels of China's public welfare charities are inclined to be diversified. These days, organizations and enterprises are cooperated to build a platform to lead and drive the public participation to public welfare undertakings. During this cooperation, private enterprises have incentives to improve their corporate image and product attention. Though a few types of literature (Falkner, 2003; Newell, 2001a, 2001b) implicate this type of phenomenon already happened in the developed world, it is only in recent years that the commercial Internet has been used to create a massive public awareness campaign in China. For instance, Chinese Internet companies have added charitable platforms to their social media (e.g. Weibo, WeChat and Alipay), giving users the opportunities to do charity while using their products.

According to the mentioned context, China's private sector participation in environmental governance through the new mechanism has already laid an objective foundation, and the trend towards private sector

3 When a country's economic development level is low, the degree of environmental pollution is relatively light. With the increase of per capita income, environmental pollution increases from low to high, and the degree of environmental deterioration increases with economic growth. However, when economic development reaches a certain level, that is to say, after reaching a certain critical point or an inflection point, with the further increase of per capita income, environmental pollution goes from high to low, the degree of environmental pollution gradually slows down, and the environmental quality gradually improves, finally presenting an inverted u-shaped curve.

4 See http://www.gov.cn/zhuanti/2017-10/27/content_5234876.htm

5 Chinese officials and society refer to this phenomenon as Internet Public Welfare (互联网公益) or Public welfare 3.0 (公益 3.0)

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innovation on Chinese governance causes is being formed. This private sector innovation trend is characterized by the integration of modern Internet technologies and the adjustment of China's green industrial policies. In the meantime, the continuous improvement of civic awareness also acts as an indispensable element of promotion. Some mechanisms (e.g. carbon trading system, Internet public welfare platform and PPP mode) are not initiated in China, yet they to some extent provide a new direction reference for China's environmental governance based on China's national conditions. Thus, they can be considered a type of local innovation. One of them is Ant Forest (蚂蚁森林), namely a tree-planting project launched in Aug 2016 by Ant Financial Services Group, an affiliate of Alibaba Group Holding Ltd, owning 100% Alipay (Fig. 1). This case focused on building a carbon trading platform for individuals to achieve the integration of public welfare and commercial activities around the platform. Since Ant Forests are closely associated with individual carbon trading, the next section is to discuss this specific connection more specifically.

Fig. 1. User Interface of Ant Forest

Sources: (Pandaily, 2018)

Before further discussion, an important premise is whether Alibaba group, which is wholly owned by Ant Financial, is a private sector. Although in mixed-ownership mainland China, private companies are to some extent controlled and implicitly involved by the public sector. However, from the perspective of its company structure (i.e. foreign ownership rather than state capital direct control, and its registration place is not in China) and market-oriented operation style, Alibaba can be regarded as a private enterprise. On the other hand, some public documents, such as FORTUNE Magazine, also distinguish Alibaba from China's state-owned enterprises. Moreover, Ant Financial has also Shared the benefits of the Chinese policy transformation in

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encouraging diversified capital to participate in environmental governance. Although there is still room for discussion on corporate attributes, this study is inclined to classify the Ant Forest case as a green movement led by the private sector.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

1.2. Chinese Personal Carbon Trading and Ant Forest Project

Ant Forest is a tool with close relation to individual carbon reduction. It intersects with the personal carbon trading (PCT) system which is being experimented in China. As another branch of carbon trading, PCT is motivated to build a model or system to encourage individual low-carbon behavior to ultimately reduce greenhouse gas emissions. Despite this generalization, PCT now remains in the development stage, whose practices and cases differ significantly in various regions. The attempt on China's PCT can date back to the pilot establishment of China's carbon market. After the Chinese government set up 7 carbon trading pilots in 2011, a unified national carbon trading market system, considered as one of the vital components of Chinese Green Finance system, was established by the end of 2017. Besides the national carbon market system primarily applied to enterprises, several activities and plans related to PCT were also formulated. The calculation of individual carbon emissions depends on individual daily behavior data, which completely differs from the accounting method applied by enterprises. Since the PCT is specific to individuals, a more accurate measurement methodology is required. Accordingly, most PCT projects remain experimental. By the way, the Norfolk Island Carbon and Health Evaluation (NICHE), was known as the world's first PCT trial example implemented from 2011 to 2013 (Fawcett, 2012).

For the China's development of PCT concept, individuals can register a carbon account on the relevant PCT platform and register their daily payment tools (e.g. mobile phone number, payment account of water and electric, gas card and bus card) on this platform in the beginning. Next, over the next period, the platform will identify and record users' low-carbon behavior and automatically calculate the reduction of emissions. Users can convert their emissions reductions into carbon currency, which can be used to exchange goods or preferences. The above process is illustrated in Fig. 2. According to Carbonstop Co. (2018b), China has conducted many researches and developed trial activities on PCT in recent years, including Guangdong PHCER pilot（广东碳普惠试点), Shenzhen Citizen Carbon Road（深圳全民碳路), Wuhan TANBAOBAO（碳宝包), Beijing One Day Less Driving（北京一天少开车), Fuzhou Low-carbon City（抚州低碳城市), National carbon trading campaign（全民碳交易活动）, etc. The Chinese government even gives these PCT cases a localized term, Tan-Pu-Hui (碳普惠)[6].

Those PCT platforms are to primarily build a positive guidance mechanism combining business incentives, policy incentives and certification of emission reduction transactions. The aim of this mechanism is to popularize Chinese low-carbon knowledge, promote low-carbon life and consumption, and boost the use of

6 Tan-Pu-Hui (碳普惠) is a new term emerging in recent years China, which roughly means that users' low-carbon behaviors in daily work and life are monitored and converted into carbon credits, which can be used to exchange some commodities or discount coupons. Simple understanding is the individual carbon reduction behavior and daily good exchange. (See http://www.carbonstop.net/oridetail15/)

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low-carbon products and technologies. Furthermore, the Chinese PCT style incorporates the orientation of sustainable development policies and the concept of public welfare and promotion using Internet technology. Under the rapid advance in Internet technology, PCT will be a potential mechanism that can be coordinated with sustainable development policies. Besides individuals that can participate in carbon trading, the flexibility of the mechanism creates business opportunities for enterprises.

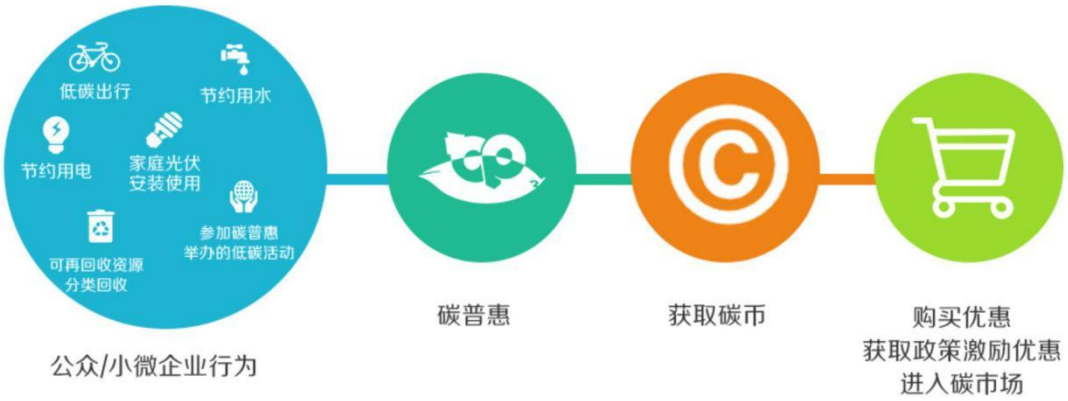

Fig. 2. Chinese Personal Carbon Trading Mechanism
Source: SinoCarbon Innovation & Investment Co., Ltd.
(See https://www.sohu.com/a/153244782_653090)

Based on the concept of PCT, some large Internet organizations have spread carbon accounts to the public. Ant Forest, as one of the most influential products, has established carbon accounts for over 200 million Alipay users by its size advantage. Fig. 3 shows that carbon emissions reduction will be recorded as “green energy” and used to grow a virtual tree in Alipay app if the user performs some low-carbon behaviors that can be verified and quantified by the low-carbon service providers. Here the amount of “green energy” can be considered a type of carbon credits from users’ daily low-carbon lives (Fig. 4). For instance, the low-carbon behaviors include traveling by walking or subways, paying public utility fees online, paying traffic citations online, making an appointment with a doctor online or buying tickets online. Once the virtual tree is matured, Ant Financial will “buy” those virtual trees from users and hand these trees over to relevant non-government organizations (NGOs) or eco-partners to plant real trees in the arid region. For instance, 17.9 kilograms could be used to grow a Saxaul, a data equivalent to the average amount of carbon dioxide it can absorb in a lifetime. There exists other optional tree (e.g. Slix psammophila, Pinus sylvestris, Euphrates poplar, Sea-buckthorn, etc.). Beyond planting trees, the Ant Forest team is also experimenting with new businesses—providing resources to create ecological reserves in certain rural areas to boost the coordinated development of rural economies and ecological benefits. In mid-May 2018, the first ecological reserve was set up in Pingwu county, Sichuan province, focusing on the honey industry.

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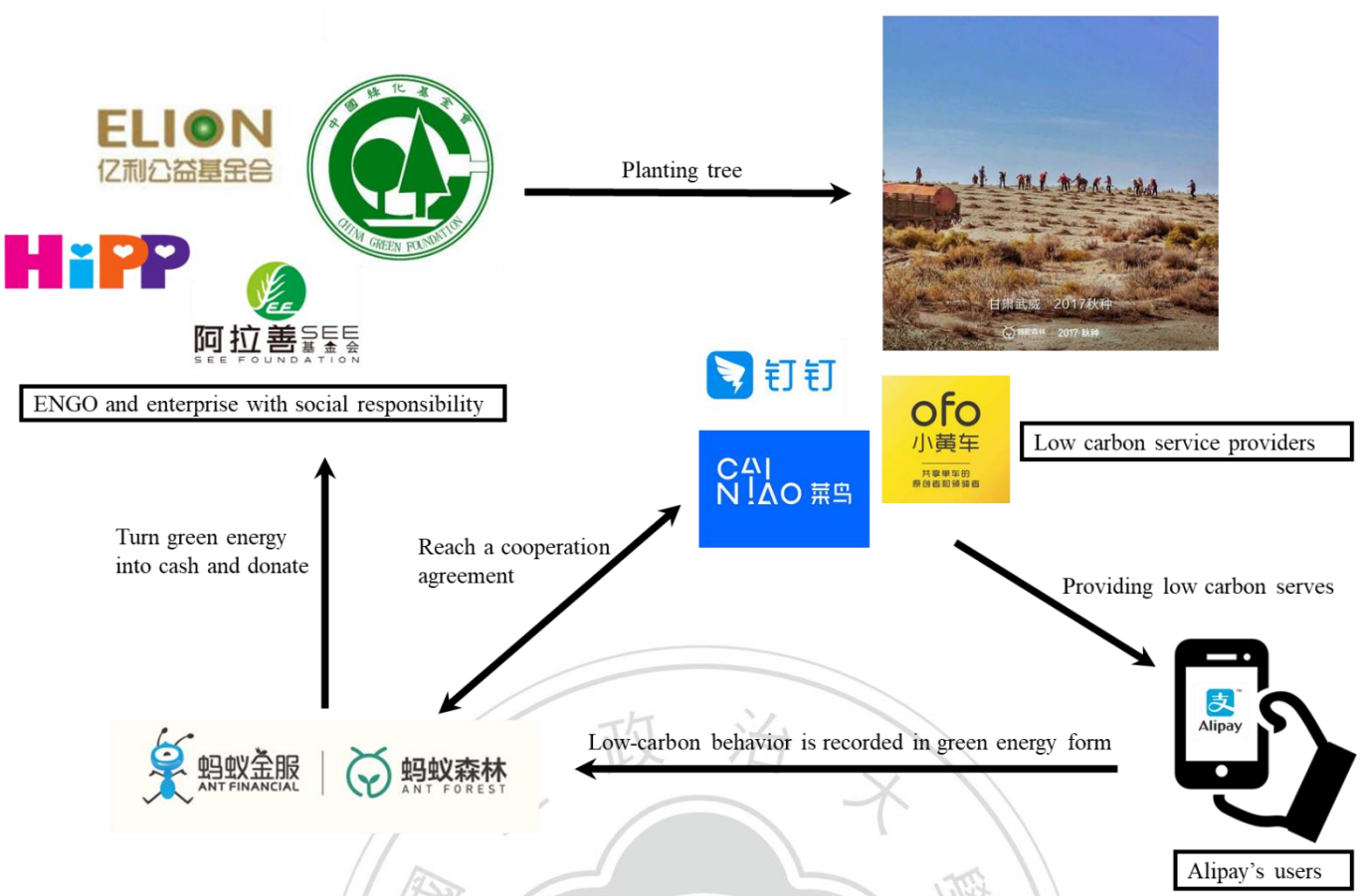

Fig. 3 Operation Pattern of Ant Forest

sources: Collected by Author

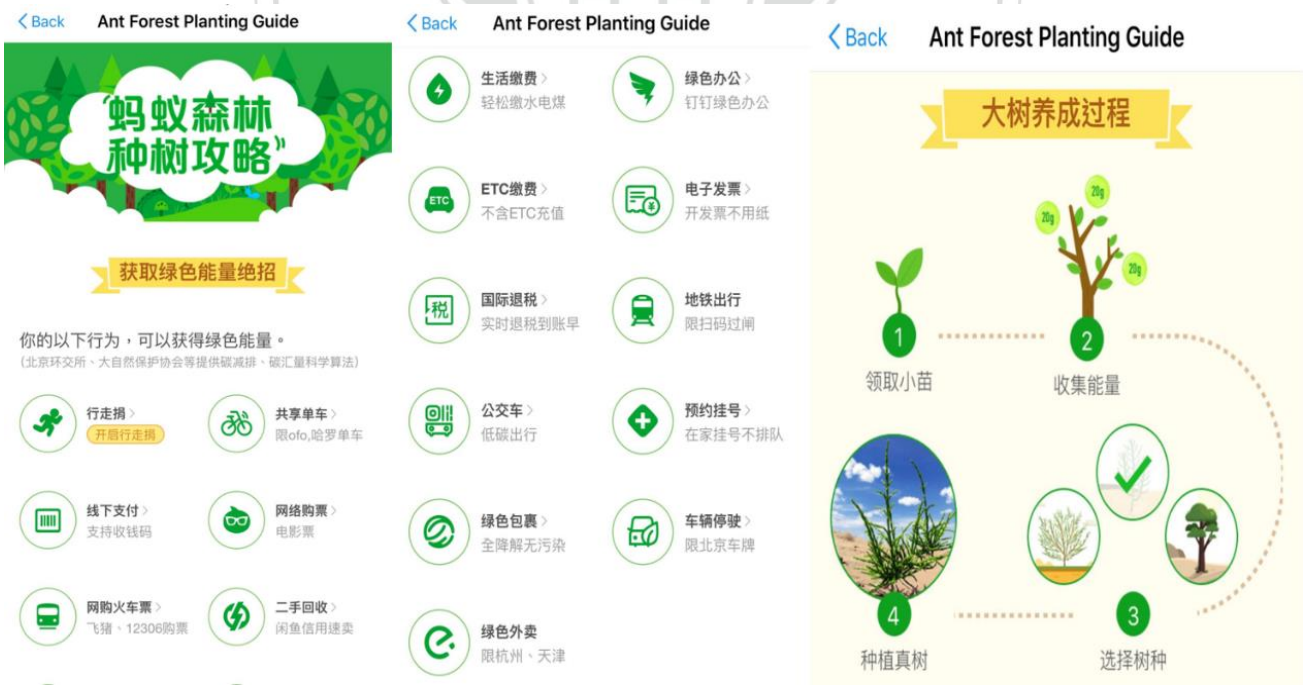

Fig. 4. Ant Forest Planting Guide

Sources: Screenshot from Alipay App.

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1.3. Research Motivation – A Community Currency Perspective

As a Chinese PCT, the term of Tan-Pu-Hui has been rarely mentioned in different reports or literature. However, academic discussion of Community Currencies (CCs, 社区货币) can be made to explain this type of social phenomenon. Some discussion on CCs is to explore the impact of a monetary mechanism confined into the community on the local community. In this regard, relevant international organizations have been developed to explore and study CCs. Based on the improvement of Fare and Ahmed (2017), Colin Williams, Mark Jackson and Gill Seyfang reported the *International Journal of Community Currency Research* (IJCCR) in 1997, thereby providing an essential platform for relevant academic publication of CCs. Subsequently, the Research Association on Monetary Innovation and Community and Complementary Currency Systems (RAMICS), was established in 2016, and regular conferences on CCS were organized in 2011, 2013 and 2015, respectively. The theory of CCs is to be detailed in the literature review.

Back to China, similar ideas of CCs have emerged in recent years, which also aimed to serve specific communities. Moreover, with the rapid development of the Internet Finance, CCs in China is inclined to be transformed from serving the real community to the virtual one, which is exactly similar as Ant Financial develops Ant Forest project based on Alipay. Since the communication channel of the platform was digital, and users also originated from online communities, a Chinese-style CCs movement was being brewed. According to Ant Forest's operation pattern (Fig. 3) described in the above section, users can exchange the green energy they earn from the daily life with Ant Financial or any other cooperative enterprises to gain real trees. The green energy here can be supposed as a type of CCs. With NGOs, these trees are planted in certain desert areas. Thus, the virtual community and the real community are eventually linked.

It is likely that the Internet finance industry, led by Ant Financial and Alibaba Group, is boosting China's environmental governance (Zhang & Zhou, 2017), suggesting the private sectors are gradually involved in China's current environmental governance. Throughout the plan, the private sectors act as a significant facilitator and investor. Thus far, China's CCs movement serves more as a grassroots innovation aiming to raise people's environmental awareness rather than confronting with a government department. In this movement, the private and grassroots sectors (e.g. private enterprise, NGOs and public citizens) have joined China's environmental governance landscape with a new role through the new mechanism.

From the above trend and phenomenon, assuming that the PCT model of Ant Forest is comparable to CCs, this study is interested in the following questions. First, theoretically, how does this virtual CCs combined with online communities arouse public awareness? Further, pragmatically, how does the Chinese private sector participate in the mechanism of Chinese environmental governance through CCs innovations? Has the bottom-up model been built as a part of Chinese characteristics for environmental governance? This study continues

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to adopt Ant Forest as the example to find the way for private enterprises to participate in environmental protection affairs in China and detect its impacts on traditional Chinese environmental governance mechanism. Given that there are now few references to China's CCs cases in international research literature, the article will attempt to supplement the possible practice of CCs mechanism in China by comparing the Ant Forest case with other similar cases in developed countries.

Though Ant Forest combines the issues of environmental sustainability and CCs mechanism, it is not the first case associated with CCs and community sustainability issues. There are also two comparable cases to be introduced here. The first one is Nu-Spaarpas (NU). G. Seyfang, a researcher from the University of East Anglia, suggested in the researches (2006, 2009b) that there was an experimental incentive scheme called Nu-Spaarpas piloted in Rotterdam in 2002. The scheme was formulated by the Rotterdam administration in conjunction with local Banks and the private sector. In Seyfang's paper, the scheme was studied as a type of CCs case. In the NU system, "Green Loyalty Point," considered a type of currencies, is designed to reduce ecological footprints and operates as a reward card, which means it aims to promote green consumption behavior. Moreover, Seyfang also explored and generated the link between PCT and CCs (2007). The other program called Norfolk Island Carbon and Health Evaluation (NICHE). Based on NICHE, from 2011 to 2013, a three-year voluntary PCT scheme was introduced in Norfolk Island, a small Australian island in the Pacific Ocean located between Australia, New Zealand, and New Caledonia. Southern Cross University led the NICHE project and funded by the Australian federal government. The objective of the scheme was to promote carbon emissions reduction and cutting obesity, and the researchers also followed and produced several studies (Fawcett, 2012; Hendry et al., 2015).

If looking at the NU, NICHE and Ant Forest regarding CCs concept, all the cases seem to have some similar characteristics so that Ant Forest could never be the unique case. First of all, NU as an accepted CCs case, was developed with a clear purpose, namely to emphasize on the green consumption of the community and reduce the ecological footprint. Thus, NU has vital reference implication for exploring the potential of CCs in the sustainable direction of the environment. Second, NICHE is considered as the world's first experimental case of PCT, which is of the excellent reference value. Furthermore, the carbon credits created by NICHE only serves the community of Norfolk Island so that it exhibits distinct CCs characteristics. Finally, Ant Forest appears to meet the development conditions of CCs and PCT in the meantime. Accordingly, this study is to compare and analyze the above two cases with Ant Forest to gain further insights into the characteristics and limitations of Ant Forest, as well as answering relevant research questions.

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2. Literature Review

2.1. Introduction of Community Currency

It is noteworthy that the term "Community Currencies" is synonymous with "Complementary Currencies" or "Local Currencies", which could be issued by different non-bank organizations. Due to the rapid social innovation and the blurring of the boundary between different fields, and countries have different names for CCs (Blanc, 2011, p. 4). CCs do not belong to the fiat currency, while it runs parallel to the legal currency and is complementary in a particular community (Lietaer & Hallsmith, 2006). Besides, "They have been developed by groups of individuals, enterprises, local authorities, non-governmental organizations (NGOs), associations, foundations, etc. that have set up trading networks in delimited territories, with a view to account for and regulate the exchange of goods and services." (Fare & Ahmed, 2017, p. 848).

For the purpose and function, CCs was created to not only protect, stimulate or orient the economy, but also to drive specific social, environmental and political goals (e.g. to increase financial stability) (Lietaer, Ulanowicz, & Goerner, 2009). Furthermore, CCs is vital to regulate the consumption behavior of the individual in the community. CCs have a wide range of potential uses, and there are many aspects to discuss. Some literature (C-C.info., 2013a; Fare & Ahmed, 2017, p. 850; Fontinelle, 2011; Seyfang, 1997) also summarized the purpose. In general, CCs may include several functions and objectives as follows:

i. To stimulate the local economy through localized production and consumption
ii. To build active social networks
iii. To encourage sustainable lifestyles
iv. To improve the community environment
v. To involve civil society in economic and monetary decision making.
vi. To provide localized solutions to global problems (i.e., decreasing CO2 emissions)
vii. To facilitate digital transactions
viii. To fill another gap of conventional currency

Preliminary practical application of CCs could date back to the 1980s, mostly in Europe, the Americas, Oceania and Japan (Blanc & Fare, 2013). Ever since then, the theoretical system of CCs and whose practical cases have been gradually built. By 2017, more than 50 countries and regions have established 3,500 to 4,500 CCs systems (Fare & Ahmed, 2017). As the theoretical models presented are inclined to be complex and diverse, the forms and cases of CCs practices are being constantly updated. four generations of models have successively emerged (Fig. 5): local exchange trading systems (known as LETS), time exchange schemes, local currencies system as well as the complex exchange schemes. (Blanc, 2011; Blanc & Fare, 2013; Fare &

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Ahmed, 2017). The case introduction of these generations can also be learned from C-C.info. (2013a, 2013b, 2013c, 2013d, 2014).[7]

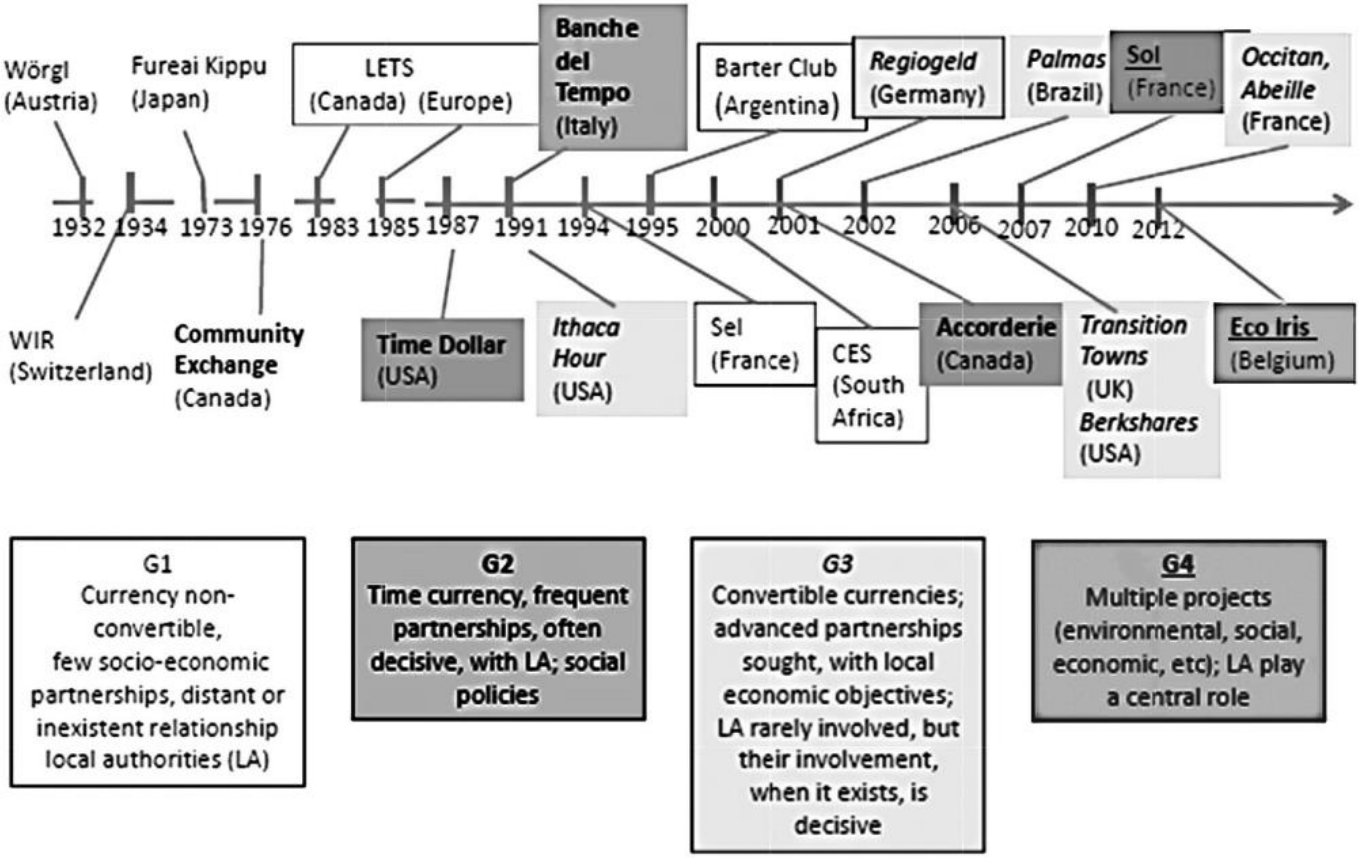

Fig. 5 Simplified Chronology of Main Generations of CCS
Source: (Fare & Ahmed, 2017, p. 852)

- **Local exchange trading systems (G1)**: LETS, as the earliest CCs tool, allows for exchanging skills, services and resources through the credits issued by the local exchange members themselves. The idea was first proposed by Michael Linton and David Weston in 1983. Since this is a mini social-economic partnership of individuals, no other institutions are involved.
- **Time exchange schemes (G2)**: According to Seyfang (2002), the time bank was formed as a community-run organization which can program unpaid time into a commodity and then assign a value to it. Social capital linkages and community self-help will be built through mutual support services between residents (in the form of exchange of points). Thus, the system can proactively build social relations.
- **Local currencies system (G3)**: Local currency systems usually carry some implication and intention of developing the local economy. Unlike LETS, this system operates more broadly and involves more complex partnerships. For instance, Ithaca Hours refers to a type of local currency system that supports community-wide economic, social justice, human vision and ecological development to promote

7 C-C.info. is a gateway developed by the Community Currencies in Action (CCIA) EU Interreg Project in 2014, providing online resources, literature and general knowledge on CCs. (see http://community-currency.info/en/about-us/)

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community self-reliance. The project can not only maintain funding in the local level but also build emotional ties between community citizens.

- **Complex exchange schemes (G4)**: Fare and Ahmed (2017) showed that the model emerged after 2000 in many cases incorporating electronic money and smart cards. Compared with previous systems, it integrates separate objectives and environmental issues more aggressively. These complex systems often have large social networks, covering partnerships with local government agencies. One of the typical cases was NU-Spaarpas experiment in Rotterdam from 2002 to 2003. This is also the case for the comparison in the following sections.

The above classification gives CCs relevant case a more precise outline, and it is more conducive to extending subsequent studies. However, there are no Chinese cases in the specific list. Thus, it is unclear what form will be taken by China's CCs. Since CCs' impact is usually dependent on the size of the community and the base of the residents. If CCs exists in China, it will have profound impact. While talking about the development of China's CCs, Xiong (2009, p. 43) proposed four primary potential paths for the trial operation of community currency in China:

i. The community currency with public welfare as the central theme is examined in urban communities.
ii. Rural communities try out credit certificates aiming at poverty alleviation;
iii. Implement social dividends under the leadership of the government;
iv. The private sector and the government share the power of legal tender issuance.

From the above, vital clues for the following Ant Forest case analysis can be provided by the first, second and fourth paths of mutual aid in urban areas, poverty alleviation in rural areas and the sharing of currency distribution rights by the private sector. Also, it is a viable way for the private sector to break through the government's monopoly on currency issuance, which echoes the pattern of Ant Forest development. Also, Xiong (2009) supported that the virtual currency created from online community has more and more influence on real society. It gradually forms a function similar to traditional currency, and the boundary with real money gradually overlaps.

The virtual currency here can be considered as one of the concrete manifestations of CCs in the Internet era. Bei and Luo (2013) revealed that besides CCs, there are other concepts (e.g. electronic money and virtual currency) which are prone to confusion, and they advocated there should be a distinction in the definition of electronic money and virtual currency. European Central Bank (Bank, 2012, p. 5) defined virtual currency as: "A virtual currency can be defined as a type of unregulated and digital money, which is issued and usually controlled by its developers and then used and accepted by the members of a specific virtual community." Bank (2012, p. 16) also listed various differences between electronic money and virtual currency (**Table 1**),

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and the essential difference is: "… the link between the electronic money and the traditional money format is preserved in electronic money schemes, thereby laying a legal foundation, as the stored funds are expressed in the same unit of account." Referring to the explanation of European Central Bank, Bei and Luo (2013, p. 7) generalizes the interactive relationship of various currency concepts from the perspective of administrative management, legality and monetary form (**Table 2**), and continued to list four clarifications as below:

i. The network is the carrier of electronic money.

ii. Electronic money contains both non-bank related virtual currency and digital legal tender.

iii. There are various forms of complementary currency (community currency), and virtual currency is only one of them.

iv. Supplementary money (community money) and electronic money have overlapping parts, whereas they are different dimensional concepts.

Table 1. Differences Between Electronic Money Schemes and Virtual Currency Schemes

	Electronic money schemes	Virtual currency schemes
Money format	Digital	Digital
Unit of account	Traditional currency (euro, US dollars, pounds, etc.) with legal tender status	Invented currency (Linden Dollars, Bitcoins, etc.) without legal tender status
Acceptance	By undertakings other than the issuer	Usually within a specific virtual community
Legal status	Regulated	Unregulated
Issuer	Legally established electronic money institution	Non-financial private company
Supply of money	Fixed	Not fixed (depends on issuer's decisions)
Possibility of redeeming funds	Guaranteed (and at par value)	Not guaranteed
Supervision	Yes	No
Type(s) of risk	Mainly operational	Legal, credit, liquidity and operational

Source: (Bank, 2012, p. 16)

Table 2. Interaction Between Different Currency Concepts

		Administrative Supervision	
		Unregulated	Regulated
Currency Format	Physical	Part of the community currency	Paper currency, Banknote, Coins
	Electronic	Virtual Currency	Electronic money (including electronic cheque)
		CCs	Legal tender
		Legal Status	

Source: Adapted from Bank (2012, p. 2), and Bei and Luo (2013, p. 7)

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Michel and Hudon (2015, pp. 161-168) quantitatively investigated the contribution of CCs to three sustainable development directions, namely economic, social and environmental sustainability. According to the results, CCs significantly impact social sustainability while its impact on the local economy is also relatively limited since the results of CCs are relatively small in scale. Also, the research on the environmental impact assessment of CCs remains insufficient so that there has been no conclusion on the environmental impact of CCs in their finding. They also encourage more standardized measures for CCs and strengthen its legitimacy to remain its continued development. According to **Table 1**, if CCs takes the form of virtual currency, there could be risks (e.g. legality, credibility and liquidity). Those risks should be considered in discussing the CCs. When considering the growth and expansion of CCs, studies above have discussed the legality and policy support of CCs. The following case studies will also cover the transformation of government policy support and environmental mechanisms.

For the relationship between CCs and administrative management, Helleiner (2000, pp. 37-49) emphasized that CCs, inspired by green theory, has three characteristics that deviate from neoliberalism. First, CCs brings a more local view of economic development than an emphasis on scale. Second, CCs encourages the community to retain some political capacity to seek the interests of the collective compared with the de-politicization advocated by neoliberalism. Finally, CCs upholds some communitarian elements rather than radical individualism. The argument was a shock to the neo-liberal western society at the time, and that led to thinking of CCs' introduction of sustainable development into the neo-liberal economic system.

The above review suggests that CCs remains in a continuous development stage, with various forms and great flexibility in different regions. The literature also suggests that CCs is inclined to take an increasingly diverse form because of the innovations that have resulted from interdisciplinary and regional integration. Thus, assuming that the CCs phenomenon exists in China, we can expect that the form of CCs in China could enjoy its characteristics under China's unique social development background. The literature suggests that China's CCs features could be disseminated as a virtual currency.

Given the generation evolution of CCs model, the target positioning of CCs, the potential for China CCs and the intervention of external technologies, Ant Forest in China should be positioned as a fourth-generation CCs complex model incorporating online communities and virtual currencies, taking the improvement of the environment as the leading factor and integrating such elements as citizen education, economic cycle, poverty alleviation campaign and network construction. The case study section will refine this definition more specifically. Therefore, this study will use the same fourth-generation NU as the comparison case. Furthermore, NICHE case also shows characteristics similar to the fourth-generation CCs in terms of target, operation and technical means, so it is also included as a reference.

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2.2. Community Currency on Environmental Governance

When discussing the associations between CCs and sustainable development, Seyfang made extensive studies and numerous publications[8]. Seyfang and Haxeltine (2012) showed that CCs could be recognized as the derivative of grassroots innovation for boosting sustainable development in 3 aspects, namely economic sustainability, environmental sustainability and social sustainability. For environmental sustainability, Seyfang extended the discussion of the potential link between CCs and a range of environmental issues (e.g. personal carbon credits). Seyfang (2009a) took the UK's Time Banking as an example of a potential connection between CCs and low-carbon tools. She revealed that the Time Banking's case formed a supportive social network via the community exchange system. The network would help to meet the residents' spiritual and psychological demands (e.g. self-esteem, empathy, identity and belongingness), thereby reducing the intake of material consumption for the community residents, suggesting the possible achievement of reduction and low-carbon communities. Thus, Seyfang proposed that the concept of CCs can be used to generate a trading system in line with sustainable development goals. Also, she suggested that CCs should be given a wider value than as a currency, and policy support is also vital for developing CCs system. It is likely that CCs become a carbon reduction tool guiding the low-carbon behavior in the community. The above review appears to correspond precisely to the objective of Chinese PCT policy, namely to guide citizens' low-carbon consumption by the monetization of personal carbon reduction.

According to Seyfang and Longhurst (2013), there exists several tendencies and interpretations for CCs. First, economic and social development is the most crucial driver of the sustainable development issues supported by CCs, and considerable amount of CCs projects have clearly stated to support the environment as the primary objective. This suggests that CCs is inclined to focus on community's practical needs instead of ideological expression. Second, the decline of older CCs suggests that new forms of CCs will emerge and replace existing ones. Third, the spread of CCs around the world is highly geographical, spreading primarily along countries that shared a common language. Also, the form of CCs will be adjusted and adapted in the specific context and background of different countries, which can be recognized as a process of innovation. Finally, Since CCs are a voluntary, activist-led, unofficial movement, resources and support are vital for CCs innovation and stable development. These implications and explanations help to study the potential development of CCs in China.

8 Gill Seyfang is a senior lecturer in sustainable consumption as well as an interdisciplinary environmental social scientist who linking sustainability policy agendas with 'new economics' theories and cutting-edge community-based practice. She is the author of 'The New Economics of Sustainable Consumption: Seeds of Change', the co-editor of the International Journal of Community Currency Research (IJCCR), an observer of the Community Currencies in Action Project (CCIA). Dr. Seyfang currently leads two research projects, on complementary currencies and community energy.
(See http://community-currency.info/en/glossary/gill-seyfang/)

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According to Seyfang (2006), in the process of exploring environmental governance in the past decades, sustainable consumption has gradually become one of the popular topics in the international community. However, in the traditional structure of supply and demand in society, it is difficult for individual consumption behavior to achieve obvious adjustment. Consequently, the idea of creating an alternative supply system with social ties, economic institutions and infrastructure has been advanced. This alternative system requires specific functions, development goals, and a redefinition of wealth. Furthermore, this alternative supply model is endowed with richer political economic and sociological implications. For this, the design of the collective system is also considered to be a key factor contributing to the realization of sustainable consumption. The above ideas and propositions are mainly put forward from a school of thought that can be summarized as 'new economics' on sustainable consumption. Her research (2009, p. 21) also lists similarities and differences between the new economic view and the mainstream view of sustainable consumption (**Table 3**).

Table 3 Comparing Mainsteam and New Economics Models of sustainable Consumption

	Mainstream Sustainable Consumption	New Economics Sustainable Consumption
Objective	Incremental improvements in resource efficiency; continual economic growth through 'consuming differently'	System-wide changes in infrastructures of provision to reduce absolute consumption levels by 'consuming less'
Mechanism	Sustainable consumers send market signals for sustainably-produced goods and services, which drives innovation and improvement	Collective action reshapes socio-technical infrastructures of provision, creating new systems and non-market alternatives where necessary
Consumers	Individual green consumers	Ecological citizens within communities of place, practice and interest
Progress measured by	Traditional measures of economic growth; consumption as a proxy for utility (happiness)	New measures of sustainable wellbeing; consumption not necessarily related to wellbeing
Theories of consumption	Utilitarian Social/psychological	Utilitarian Social/psychological Infrastructures of Provision
Examples	Green and ethical consumerism; corporate greening of global capitalism; social marketing	Local provisioning e.g. farmers' markets; mutual aid e.g. LETS; self-reliance e.g. low-impact development

Source: Seyfang (2009, p. 21)

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

As for the meaning of 'new economics', Seyfang (2006, p. 784) referred to the view of Jackson (2004)[9] and indicated: "The new economics is an environmental philosophical and political movement founded on a belief that economics cannot be divorced from its foundations in environmental and social contexts, and that sustainability requires a realigning of development priorities away from the primary goal of economic growth". To achieve the goal of sustainable consumption, 'new economics' advocates the development of new tools, and CCs become one of its practical tools. Synthesizing some of the literature on "new economics" perspective, Seyfang (2006, p. 784; 2009a, p. 5; 2009b, p. 62) indicated that sustainable consumption has five characteristics as follow:

i. Enhancing localization
ii. Reducing ecological footprints
iii. Building community
iv. Developing collective action
v. Constructing new social institutions

These characteristics constitute a set of indicators for evaluating political actions. Therefore, the contribution of CCs to community development could be assessed from the features of sustainable consumption. By this qualitative evaluation tool, Seyfang compared different CCs model oriented by economic development, social relations construction and environmental improvement, respectively. Through analyzing the adaptability of different CCs to these indicators, the effectiveness and contribution of CCs can be qualitatively judged. In her studies (2006, pp. 785-788; 2009b, pp. 145-159), three different generations of CCs, namely LETS (G1), Time Banks (G2) and Nu Spaarpas (G4), were tested. (**Table 4**) Rather than adopting a particular case, she adopted a category (generation) to represent a range of similar CCs cases and then compared the differences among categories. LETS aims to rebuild local economies and encourages residents to use local credit other than traditional currencies for transactions that are voluntary and do not require interest payments. Using time credit as a tool, Time Banks seeks to strengthen community networks based on voluntary interaction between community residents. Green consumption in the community will be rewarded with green credit and recorded in a specific account. In NU case, green consumption within the community will be rewarded with green credit and recorded in a specific account. These green credits can be exchanged for goods in the subsequent consumption. NU adopts such a model to boost the sustainable consumption of the community.

In general, the three lay different emphases. LETS focuses on the economic cycle of the local community and makes the economic multiplier decisive in the community. Time Banks is committed to building a closer

9 Jackson, Tim. (2004). *Chasing Progress: Beyond MeasuringEeconomic Growth: New Economics Foundation.*

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and harmonious community network, while NU is inclined to achieve the sustainable consumption goal of the community and promote the improvement of the community environment. Depending on different designed purposes of CCs, these three generations of CCs can be complementary to each other and cover all aspects of sustainable consumption together. Accordingly, she believes that the establishment of a diversified CCs trading mechanism is a way to achieve sustainable development of the community. Seyfang's research methods give the author of this study profound inspirations. Using this set of qualitative tools to explore the sustainable development of Ant Forests in communities and even the change of environmental governance mechanism in China appears to be feasible. Thus, the next section will expand on this 'new economics' approach.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

Table 4. Evaluating Community Currencies as A Tool for Sustainable Consumption: Key Findings

Sustainable Consumption Indicator	LETS	Time Banks	NU
Localisation	Economic tool, locally-bounded money to boost local multiplier, employment and self-reliance.	Community self-help is primarily locally-based anyway, so no net localisation.	Rewards buying from local businesses.
Reducing Ecological Footprint	Some evidence of reducing resource use: sharing facilities, recycling, localisation cuts transport costs (eg food miles).	Time banking concentrates on services, not material consumption. Some developments in rewarding recycling etc.	Incentivises recycling, public transport, local, organic and fair trade products and energy efficiency.
Community-building	Large social and community benefits, boosting social cohesion and inclusion.	Very large social and community benefits: boosting social inclusion and social capital.	Individualistic tool. But inclusive (not dependent upon spending money).
Collective Action	Individualistic rather than collective action tool. Promoted by local government to mitigate poverty and unemployment.	Promoted by central government to build capacity in voluntary sector and deliver public services. Could be basis for 'co-production' model of public service provision, and reward active citizenship.	Individualistic tool, but promoted by local government. Influences public sector action in transport and waste.
New Social Institutions	Some egalitarian measures eg minimising wage disparities. Capacity to value non-marketed work. Abundant medium of exchange. Localised monetary design.	Central principle of valuing all types of work equally, rewarding unpaid community efforts. Reciprocity and mutuality.	Points system adjusts relative prices to incentivise sustainable consumption. Anticipates internalisation of social and environmental costs and benefits.

Source: (Seyfang, 2006, p. 785; 2009b, pp. 157-158)

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3. Research Methodology – A Multi-Criteria Qualitative Evaluation Tool

According to the literature review (**Table 4**), a multi-criteria qualitative evaluation tool based on 'new economics' view was introduced to analyze the contribution of CCs to the sustainable development of the community. This tool was developed by Seyfang from the perspective of sustainable consumption by referencing 'new economics'. 'New economics' is a set of theories regarding environmental governance and sustainable consumption. Thus far. 'new economics' has developed its own theoretical system, aiming to deconstruct and readjust the supply and demand structure in the economic system to achieve the sustainable consumption goal. Accordingly, the critical point of 'new economics' is to achieve sustainable consumption.

Seyfang further applied this set of tools to the case evaluation of CCs. She effectively founded the link between 'new economics' theories and CCs. In accordance with the New Economic theory, she employed the multi-criteria qualitative evaluation tool to assess the effectiveness of various types of CCs cases in achieving sustainable consumption. She transformed the views and strategies on sustainable consumption in 'new economics' into five qualitative indicators, and those indicators are listed in **Table 5** below.

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Table 5. Five 'New Economics' Sustainable Consumption Indicators Used to Evaluate CCs Cases

Indicator	Description	Example
Localisation	Making progress towards more self-reliant local economies; import-substitution; increasing the local economic multiplier; reducing the length of supply chains.	Supporting local businesses; eating more local, seasonal food to cut food miles; encouraging money to circulate locally; 'buy-local' campaigns; DIY, growing food on allotments.
Reducing ecological footprints	Shifting consumption to cut its social and environmental impact on others, to reduce the inequity of current consumption patterns; cutting resource use; demand-reduction; carbon-reduction and low-carbon lifestyles.	Downshifting; voluntary simplicity (accepting cuts in income in return for higher quality of life and lower consumption); energy and other resource conservation e.g. water-saving devices, energy efficiency and insulation, buying local to reduce transport costs; choosing ethical and fair trade where possible; sharing goods instead of owning them; cutting consumption; choosing less carbon-intensive goods and services; avoiding flying.
Community-building	Nurturing inclusive, cohesive communities where everyone's skills and work are valued; growing networks of support and social capital; encouraging participation to share experience and ideas.	Developing social networks around green building, local food, community volunteering; overcoming social exclusion barriers to participation; fostering shared experiences through group activities; growing friendships.
Collective action	Enabling people to collaborate and make effective decisions about things which affect their lives; changing wider social contexts by institutionalisation of new norms; active citizenship.	Boosting self-efficacy and empowerment; encouraging participation in local organisations; engaging with local government and public policy; generating critical mass so that new sustainable behaviours become the norm.
Building new infrastructures of provision	Establishing new institutions and socio-technical infrastructure on the basis of New Economics values of wealth, work, progress and ecological citizenship.	Alternative food systems which avoid supermarkets; autonomous housing which doesn't rely on mains services; new systems of exchange which value abundance and reward sustainable consumption.

Source:(Seyfang, 2009b, p. 62)

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The various environmental governance scaling is deeply connected with this set of assessment tools that involve environmentally-oriented CCs. First and foremost, Bai made a discussion about the barriers between global environmental issues and local management. On the one hand, Bai (2007) indicated environmental problems conflict with urban managers on the three dimensions, namely space, time and regime. On the other hand, Bai argued that developing cities cannot be wholly detached from global environmental protection issues. Thus, how local governments address environmental issues that go beyond the scope of administration is a of huge significance. This scaling can be well geared into the localization goals CCs is pursuing, and it smoothly form a conversation with the localization metrics in the tool. Moreover, Harriet (2005) supported that networks of different groups (e.g. the elite, the public and NGOs) can be integrated. In this regard, the initiative of different groups on policy can serve as a clue for further analysis. Also, Reed and Bruyneel (2010) revealed that when a role of a country in environmental governance is weakened, its functions can be redistributed to international organizations, local governments and NGOs. In the middle and late 1980s, the discussion of localization of environmental governance emerged, there developing the concept of multi-center governance which included cross-geographical space and cross-level organizations. Accordingly, the effective integration of social resources is a vital indicator of CCs as well. Reed and Bruyneel also mentioned that more intensive work involving social and historical concepts contribute to the exploration of problems and the production of theories, which can correspond to CCs on community building and institutional innovation.

To sum up, this type of multi-criteria qualitative evaluation tool from the perspectives of New Economics can fully reflect multi-scale analytical thinking of environmental governance, and this study will draw on the tool for research. In the next chapter, the mentioned five indicators are to be incorporated into the analysis of Ant Forest. Also, some of the views on the development of CCs mentioned in the literature review will be echoed in the analysis. Subsequently, similar CCs types will be introduced for comparison to yield some valuable clues. According to the literature review, the fourth-generation CCs case, which is environment-oriented with complex mechanisms, is more suitable for comparison with the Ant Forest case. Besides, this explains why NU case and NICHE case are referenced for the research motivation here other than introducing the practical cases of CCs in China. The contribution of Ant Forest to the sustainable development of the community can be assessed from a qualitative perspective by giving the references. Also, this can further qualitatively explain the consequence of private sector participation in environmental governance.

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4. Findings

4.1. Case Analysis for Ant Forest

4.1.1. Localization—Establishment of Local Circular Economy

One of the essential functions of CCs is to be able to incorporate issues involving a wide range, large and global scale into a localized solution. In the case of Ant Forest, there are big topics (e.g. desertification control, reduction of greenhouse gas emissions, green construction, as well as poverty alleviation campaign). Through the mechanism of Ant Forest, these essential issues are integrated, and CCs plays a fundamental lubricating role. A vital background is that CCs can form a closed system that operates independently. Accordingly, the impact of external forces is small, which contributes to achieve specific policy objectives. In other words, CCs can break down broad and abstract global governance issues into regional governance objectives. This closed system can positively influence the local economy, which can fall into two aspects. One is the CCs mechanism itself, which can stimulate the positive behavior of residents and effectively establish a cycle to expand the impact. The other is to see whether CC itself can have a substitution effect or multiplier effect to supplement the shortage of legal currency.

For the mechanism, CCs enables residents to participate in the governance of their communities virtually from day to day, as is evident in Ant Forests, where the cost of collecting and spending green energy is meager. In other words, individuals are already contributing to a wide range of issues without realizing it. In particular for China, a country with a large population, the potential energy accumulated by these individuals is huge. According to *Ant Financial 2016 Sustainability Report*, by the end of April 2017, the population of Ant Forest users exceeded 220 million, with an average daily emission reduction of 5,000 tons, a total emission reduction of 670,000 tons and a total planting of 8.45 million saxauls. However, the business data may not be entirely accurate or objective, and it partly reflects the rapid expansion of Ant Forest in China through Alipay's user base.

Helleiner (2000) suggested that the neoliberal school argues for increased competition through economic globalization to boost industrial division and efficiency, whereas the small-scale community economy triggered by CCs contradicts this logic. The key is that CCs can effectively reduce transaction costs because in closed systems CCs does not consider traditional currency exchange. This encourages local consumption and, naturally, the economic cycle of the community. In this case, the "green energy" in Ant Forests as a form of CCs flows independently. From the time the energy is collected by the user to the time it is converted into plants or other environmental-friendly products in a specific environmental control area, the flow process is done in a closed loop. First, Ant Forest encourages users to collect green energy through their daily low-carbon activities, which puts greenhouse gas reduction into practice for individuals. Second, by transforming green

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energy into environmental protection investment in ecologically fragile areas, the goal of environmental protection has been achieved. Third, the ecological protection area can export agricultural products and sell back to users through the market operation of Ant Forest, and eventually form economic recycling. Though the recycling of agricultural products still relies on cash transactions rather than green energy conversion, a closed and circular community economic system has been formed. The local product cycle will be discussed further while talking about the Guanba nature reserve that set up by Ant Forest in the section 4.1.3.

However, Ant Forest still faces a liquidity problem for the carbon credit in terms of monetary properties. As mentioned in the earlier section about general information, those green energies will be represented on the platform as virtual trees or a piece of virtual nature reserve, and Ant Financial will subscribe them from users and seek collaborating environmental NGOs (ENGOs) to plant real trees or to generate ecological zone. Thus far, this has been the only viable way to trade collected carbon credits in the account of Ant Forest, which is a single and crude form of trade. This is because personal carbon trading system is different from the carbon trading system among companies that have developed a rigorous methodology, and it is supported by regulations. Current methods of calculating and recording individual carbon footprints are far from accurate and perfect. Accordingly, this limits the circulation of carbon currency.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

4.1.2. Reducing Ecological Footprints – Motivation of Sponsors and Participants

For business incentives, Chen (2017) showed the commercial motives behind Ant Forest. First, since the Ants Forest is reflected in the Alipay, which makes the Alipay can easily access different aspects of the user's data and through big data analysis to help conduct targeted business activities. Second, users will use Alipay in more situations as driven by a sense of responsibility and achievement, which will help to improve user activity. Finally, investing in environmental protection will significantly contribute to the construction of a corporate image. According to the planning of Ant Forest, in the early stage, Ant Forest purchased the "green energy" accumulated by individual carbon account through public welfare foundation and transformed it into tree-planting behavior. In the next stage, the project is expected to link to the carbon trading market, so that individuals can be involved in the trading and investment of the carbon market. Also, the forest can be recognized as a type of carbon sink[10] resources (Baccini et al., 2017). Ant Forest's trees accumulated in desert areas are also potential carbon assets worth exploiting. Accordingly, Ant Financial Co. as a private sector, has reasonable commercial incentives to develop Ant Forest projects. This statement can link to a phase of CCs expansion. As noted in the literature review, the continued growth of CCs depends heavily on the resources and support of developers.

To achieve the goal of low-carbonization of individual behavior, there are three steps generated by the operator. The first step is to calculate emissions reductions for individuals that can be monitored electronically, which can be achieved today using the relatively developed Internet communication technology. Since Ant Financial itself is the leading Internet finance company in China, the technical support for Ant Forest program is relatively mature. For instance, since accurate calculations are needed to support an individual's carbon footprint, the carbon emission reduction algorithm of Ant Forest was jointly developed by Ant Financial and China Beijing Environmental Exchange (CBEEX, 北京环境交易所). At present, there are more than ten low-carbon behaviors that users can collect energy in Ant Forest, and the emergence of each method reveals that the algorithm is updated. Numerous types of low-carbon behaviors in future life can be calculated into emission reduction behaviors and get accurate results, which requires constant upgrading of the algorithm. Thus, In June 2017, Ant Financial announced the establishment of an expert committee on personal carbon emission reduction to promote large-scale algorithm standards of personal carbon emission reduction. However, there may be privacy disputes over documenting a wide range of low-carbon practices, advances in technology are also rising the impact and the reach of CCs.

The second step is to create a carbon account capable of linking personal consumption. In these respects,

[10] The United Nations Framework Convention on Climate Change (UNFCCC) defines a carbon sink as a process or mechanism for removing greenhouse gases such as carbon dioxide from the atmosphere

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Ant Forest exhibits a comparative advantage. On the one hand, Ant Financial operates Ant Forest by, and its parent company is Alibaba Group with abundant source of funds and social resources. Those resources refer to the funds, users and partners of Alibaba Group. Also, government provides policy incentives on green, and Ant financial serves as a promoter and stakeholder of China's Green Finance. Its Ant Forest project involves environmental governance innovation and will be supported by government policies (Chen, 2017). Thus, the private sector's CCs movement in China may also comply with government policy. On the other hand, since Ant Forest is a program of the Alipay app, its users are highly overlapped with Alipay users, and even each Alipay user has a carbon account. Alipay is one of the largest third-party payment companies with more than 800 million users along with its strategic partners as of the first quarter of 2018 (Retail Banker International, 2018), so it has enormous usage flow.

The third step is to design the trading and circulation mechanism of carbon credit and further guide the human consumption behavior smoothly towards low carbon. For the working principle, Ant Forest makes a significant contribution in reducing ecological footprint. On the one hand, it inspires daily low-carbon behavior using an experimental personal carbon trading model. Moreover, more low-carbon scenarios that can be calculated are being developed. On the other hand, it converts these virtual carbon footprints into forest carbon sinks for carbon neutralization. Accordingly, it has double positive effects on reducing greenhouse gas emissions. Moreover, the trading and circulation mechanism of carbon credit is realized through gamification in Ant Forest case. From the perspective of gamification strategy, Hu and Zhang (2018) pointed out that, on the one hand, based on the social connection between friends, Ant Forest brings the fun of social interaction to users and makes low-carbon emission reduction a daily topic and activity. On the other hand, the comparison between friends also gives more impetus to the implementation of users' low-carbon behaviors. Community interactions are explained further in the next section.

Such a gamified and interactive PCT mechanism has certain positive effects on improving public interest and action. Ant Forest project has played a certain role in cultivating the public's environmental awareness. However, actions based on the game mentality may not necessarily represent the improvement of the environmental awareness of the public. At this point, more quantitative or qualitative analysis involving the psychological level of users, including questionnaires and interviews, is needed. It is also necessary to understand the motivations of individuals in the public to participate in the program.

As for the user's motivation, there are some preliminary questionnaires at present about the willingness to use Ant Forest. A research (Yin, Yuan & Liu, 2017) shows that the users of Ant Forest are mainly students and young business staff, and the top three factors influencing users' participation in Ant Forest are "feeling useful", "feeling easy to use" and "product innovation" in order. Hu (2018) made a questionnaire about the influence of Ant Forest on the behavior and values of young people. The results show that the online public welfare

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represented by Ant Forest is subtly changing the living habits of young people and trying to guide their living habits to a healthier and environmentally friendly way. Specifically, more than 50 percent of the respondents are willing to participate in carbon emission reduction activities in order to accumulate green energy. About 90 percent of the respondents believe that online public welfare activities like Ant Forest will have a positive impact on their living habits and consumption concepts. In addition, another study (Hu, Hou & Li, 2018) found a significant correlation between the purpose and frequency of Ant Forest use, and the purpose of "contribute to environmental protection" is the largest number. Meanwhile, up to 70 percent of users who do not use Ant Forest believe there may be a personal information leakage problem.

According to the above survey results, it is not excluded that some people participate in the emission reduction activities of Ant Forest because of the game mentality, but a considerable degree of respondents have the subjective willingness to participate in environmental protection public welfare activities. The Ant Forest project gives the latter a convenient and feasible path. Therefore, it cannot be denied that Ant Forest has stimulated the environmental awareness of some people

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4.1.3. Community Building—Construction of Online and Offline Community

The communities served by Ant Forest are no longer limited to specific rural areas, towns or cities, whereas the form of online social media combined with offline governance areas. Thus, when the concept and boundaries of communities become complex and abstract, the circulation or transaction mode of community currency needs a new interpretation.

The community construction can be discussed in two parts, namely an online community and offline community. Ant Forest not only improves the environment in the desert area but also improves the user's environmental awareness (Wang, 2017). An article of Carbonstop Co. (2018a) argues that low-carbon communities should not only have facilities that satisfy the requirements of environmental protection, complete environmental management system and residents' participation mechanism, but also propose innovative mechanisms that can stimulate low-carbon behavior. It is also required to further arouse the residents' sense of community, including the sense of identity, belonging and participation in the community. Accordingly, the community residents form the emotional connection. Carbonstop Co. (2018a) also upholds that this goal can be achieved through the combination of the Internet community service and the PCT mechanism, and practically to start with small urban communities and create online and offline interaction. This appears to fit the understanding of Ant Forest.

The online community is connected to a considerable number of Alipay users, as Ant Forest and Alipay is a joint account. Those users are residents from all over China who accumulate green energy (carbon credits) from their daily low-carbon lives. Besides creating and exchanging green energy, online communities also exhibit social functions. Since Ant Forest is embedded in the Alipay's app, the user's Alipay contact is also his or her Ant Forest partner, and the mechanism itself is designed to encourage interaction among friends. For instance, after doing green consumption, the generation of green energy is not instantaneous but should wait for a period. If somebody forgets to collect energy, his or her energy can be "stolen" by friends, and vice versa. Besides allowing competition to collect other people's green energy, users can also "water" their friends' virtual plants occasionally, namely to give a small part of their green energy to each other. Furthermore, friends can work together to plant trees in the online community. Like Hu poplar, costs more than 200kg of a person's emissions-reduction equivalent and can be shared by several friends. These social features add interest to the platform and inspire more Alipay users to join Ant Forest's plan, which contributes to the community building.

Areas where Ant Forest operating environmental protection are offline communities. In this offline community, Ant Forest connects traditional ecological governance with the national goal of poverty alleviation through commercial innovation. To meet the goal of eradicating poverty by 2020 and achieving the goal of *Building a Moderately Prosperous Society in All Respects* (全面建成小康社会), the Chinese government is

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working to alleviate poverty in remote areas. Thus, besides planting trees in arid areas, Ant Forest is also intended to promote local poverty alleviation campaigns. According to Zhang & Zhou (2017), Ant Financial team conducted field visits as well as several project presentations and training for the herdsmen who participated in the planting of trees. It can be observed that residents also enter the project structure of Ant Forest as participants. In this case, the company subsidizes the herdsmen, and the NGOs help them grow trees, which has quietly changed the local way of production. In the meantime, it also a way can help to reduce overgrazing and protect the fragile local ecological environment. For Ant Forest's performance in community construction, the development form of CCs in China could be a link between online and offline communities. In Chinese CCs can not only activate the initiative of individuals to participate in environmental governance through social media but also extend sustainable development projects according to the developing situation in different regions. In this case, the private sector in local environmental governance is permitted and supported by the local government. There is the following evidence match CCs' argument for stressing sustainable development at domestic level and empowering communities to manage (Helleiner, 2000). Though it remains to be seen whether changes in the local economy will ultimately benefit residents, it is an initiative by companies to cooperate with national policies.

Fig. 6 shows the linkage mechanism between online and offline communities. In May 2018, Jing, the chairman, and CEO of Ant Financial Services announced a new initiative to alleviate poverty: to upgrade the Ant Forest from an environment governance platform involving individuals to an ecological poverty alleviation platform[11]. Subsequently, Ant Forest signed a contract with Pingwu county of Sichuan province, marking Pingwu the first piloted county for ecological poverty alleviation in Ant Forest. To be specific, Ant Financial will cooperate with top scientific research institutions, e.g. the Chinese Academy of Sciences (中科院), to assess the ecological value service of Pingwu county and help Pingwu find a green industry suitable for local development. Ant Financial will also support public welfare partners, e.g. The Paradise Foundation (桃花源生态保护基金会), to exploit and operate some public welfare and natural protection zone in Pingwu to improve effectiveness of protection and create employment opportunities for the rural resident in forest protection and management.

Moreover, Ant Financial plans to initiate a local pilot green product marketing through the electric business platform to promote environmental-friendly high value-added products (e.g. honey). In the case of Guanba ecological reserve in Pingwu county, users can spend green energy in claiming the protected land in the Ant Forest. Then, Ant Financial and the Paradise Foundation jointly input resources for green construction. Agricultural products from the reserve will be added to Taobao's sale chain, and the Central Academy of Fine

[11] See http://hzdaily.hangzhou.com.cn/mrsb/2018/05/17/article_detail_3_20180517A247.html

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Arts (中央美术学院) will be commissioned to design products. In the meantime, Ant Forests are working with the NGOs to develop conservation standards and operational strategies for harvesting replicable sample. Finally, the sample can be spread nationwide through more participation of NGOs. The relevant departments of the Chinese Academy of Sciences make a case study of Guanba ecological reserve in Pingwu county to investigate the virtuous cycle of economy and ecology and provide a theoretical reference for more practices of ecological poverty alleviation. In August 2018, a total of 10,000 bottles of honey from the Guanba ecological reserve, managed by Ant Forest team in Pingwu county, were put on sale on Taobao the online shopping platform of Alibaba Group. Ant financial claims the profits from selling honey were all returned to the local beekeeping demonstration base[12].

Though the transaction model still uses cash payments, it exhibits the positive effect of business innovation on domestic environmental governance and poverty alleviation. An ecological industrial chain that balances environmental and economic benefits is being developed. In this case, the products sold out in one day, reflecting the confidence and enthusiasm of consumers in the market. Under the Ant Forest's PCT structure, it narrows the gaps between the online community and the local community and lays a foundation for the possible monetization of carbon credit to participate in commodity trading. In brief, besides connecting the effective access between online and physical communities, Ant Forest is also gradually building a large and complex social network. That is, the Pingwu's example significantly proves that Ant Forest promotes economic localization as a CCs tool, as well as building a model of community interaction.

[12] See http://wemedia.ifeng.com/87000782/wemedia.shtml

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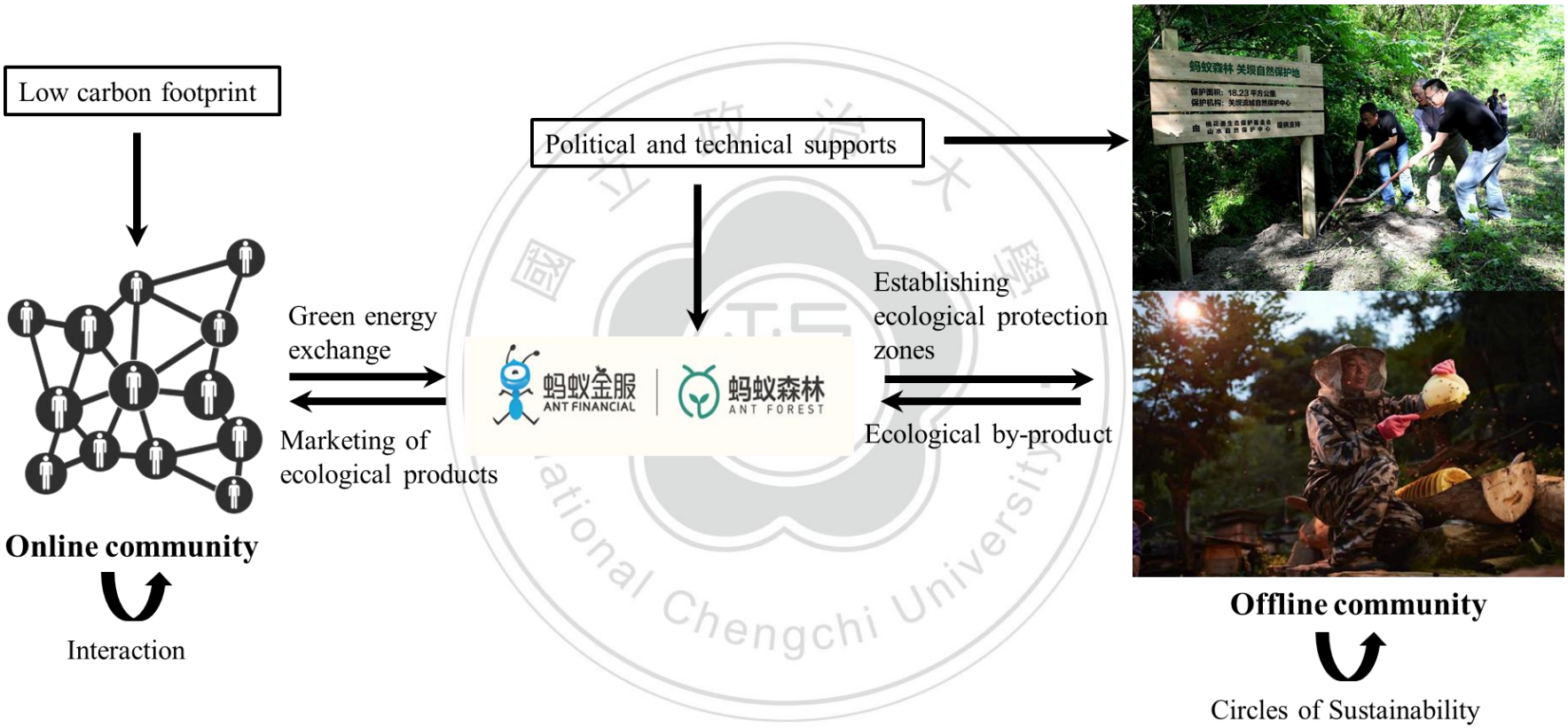

Fig. 6. Linkage Between Online and Offline (Local) Communities

Source: Collected by Author

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4.1.4. Collective Action—Social Network Integration and International Community

There are various types of actors in the environmental governance mechanism created by Ant Forest. Wang (2017) suggested that enterprises, media and public citizens are communicators, while NGOs serve as intermediary coordination during the communication of the Internet public welfare projects. Through the coordination and integration by NGOs, the communicators are expected to maximize the public interest of the society, which is reflected in the case of Ant Forest. Besides, the communication results suggest that actors in Ant Forest project have achieved a win-win situation. For the enterprise, the design of the product enhances the user's stickiness. For individuals, fun and low cost significantly promotes user engagement. For NGOs, the efficiency of their operations is further enhanced by the power of the enterprise. However, there exist other possible participants (e.g. the government, the international community and diversified capital).

Obviously, the project covers some actors (**Table 6**). The interaction among these participants constitutes an environmental governance profile, and the originator or leader of this framework is a Chinese private enterprise. Though Ant Forest is a leading green movement initiated by private enterprises, other sectors are still included in the social network in the actual activities. Given this, Ant Financial serves as the platform provider, yet it relies on NGOs to help with environmental governance. NGOs in China must register with the government. For both public foundations and private foundations, there are some foundation like China Green Foundation（中国绿化基金会）and ELION Foundation（亿利公益基金会）. They were founded by government departments, which can be considered as an extension of government management. For other NGOs or scientific research institution, they are formed by the entrepreneurs, experts and scholars who are closely related to policymakers. This suggests that the effects of the government will permeate in different types of NGOs. Thus, the traditional top-down model still maintains its running track in the case of Ant Forest.

There is also evidence that the government is working directly with Ant Forest. In October 2018, Chinese state forestry department officially incorporated Ant Forest into the national compulsory tree planting duty system. The cooperation makes the connection between Ant Forest Tree Planting Certificate (蚂蚁森林植树证书) and National Obligation Tree Planting Certificate (全民义务植树尽责证书)[13], suggesting that Ant Forest users planting trees online are officially recognized as one of the forms of citizens' legal obligation to plant trees. Moreover, in August 2018, CBEEX initiated the share expansion plan to increase its registered capital from 300 million to 500 million RMB. Ant Forest then became one of the two investors in the project. According to the stock expansion cooperation agreement, CBEEX and Ant Forest, based on their respective expertise, will jointly develop Chinese PCT market, expand the carbon reduction scenarios and develop carbon neutralization services for individuals and small and micro businesses. It is observed that, at least in this case,

[13] See http://www.xinhuanet.com//fortune/2018-10/24/c_1123606969.htm

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

the public sector is no longer an absolute investor and leader. Instead, there is the emergence of various capital.

Moreover, besides Ant Financial Services and Alibaba themselves are both the leading builders and investors of Ant Forest, some foreign or private companies join in the project, e.g. AEGON-INDUSTRIAL Fund (兴全基金), Saic general motors co. LTD（上汽通用汽车有限公司） and HiPP (喜宝). Their participation can take the form of fund donation or hands-on participation in planting trees. No matter how they participate, their motivation is to improve their corporate social image.

The historical review shows that in the past, international organizations have faced obstacles when rolling out environmental projects in China. Some of these obstacles come from the government's control of foreign organizations, while others originate from the low involvement of the public in environmental affairs. Morton (2006) suggested that the United Nations Development Program (UNDP) and the World Bank (WB) faced a low level of civic engagement when promoting environmental governance projects in China. In other words, Chinese citizens had a relatively weak awareness of environmental governance around the early twentieth century when the elite in China pushed environmental governance. The top-down mechanisms were common in China to the environmental protection field. Though there have been examples of private companies working on environmental projects in China in the past, e.g. the business model of the photovoltaic industry is similar to that of state-owned enterprises. Given this, internationally, it is often the Chinese government that initiative endorses these industries to enhance the popularity of its products and the reputation of its companies. This phenomenon cannot reflect that the private sector has any innovation and vacillation on China's environmental protection mechanism.

However, in the past two years, with the promotion of Ant Forest, this situation could be reversed. The international community was shifting its focus to this community environmental protection product in China. Over the past year, Ant Forest has been invited by relevant UN departments to participate in some environmental conferences. For instance (**Table 7**), in January 2017, Ant Financial and the United Nations Environment Program (UNEP) jointly launched the Green Digital Finance Alliance (GDFA, 绿色数字金融联盟）during the World Economic Forum in Davos, which is the first time that UNEP has launched an international alliance with a Chinese private company since its establishment (Pandaily, 2018). Afterwards, in February 2017, the United Nations Development Program (UNDP) released the *Environomist China Carbon Market Report 2017*（中国碳市场研究报告 2017）in Beijing, which introduced a special section on Ant Forest. In September 2017, during the United Nations Convention to Combat Desertification (UNCCD) 13th conference of the parties (COP13), the operating model of Ant Forest was shared as a case study. Besides, the Ant Forest team also announced continued investment in funding, technology and resources, including at least 200 million RMB to support the efforts of the Chinese government to combat desertification in areas along the One Belt & One Road line. Also, in September 2017, Ant Financial ranked the third in the Fortune

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Magazine's Change the World List of top 50 companies as the result of the innovation of the Ant Forest business design. At the end of 2017, Ant Forest attended in the 3rd UN Environment Assembly to introduce its model of Internet technology combined with sustainable development. The above events reveal the international community's concern and recognition of Ant Forest.

Through such integration of the green movement, these forces can gradually develop a new trend of bottom-up environmental governance in China in the future, which is also consistent with the concept that CCs itself is initiated from grassroots innovation. Also, communitarianism supported by CCs (Helleiner, 2000) can be compatible with China's social system and governance concepts. Thus, though the government has partially intervened in the Ant Forest case from top to down, the current operation shows that the convergence between the two models rather than the conflict. The evidence also reveals that trends of Chinese environmental governance may transfer to be actively promoted by international organizations. This transformation not only creates potential international space for China's development of CCs but also improves its legal status. It has also made it necessary for the Chinese government to adjust relevant policies following its development trend. Driven by this positive demonstration effect, there may be more CCs innovation cases in China. Under demonstration effect and actual legality, more potential CCs innovations may be uncovered.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

Table 6. Social Network in Ant Forest

Actors	Type	Executive	Function
China Green Foundation (中国绿化基金会)	Public foundation	National Forestry Administration	Promote greening of the land
SEE Foundation (阿拉善 SEE 基金会)		Entrepreneurs unite to lead	Protection of natural ecological environment
ELION Foundation (亿利公益基金会)	Private foundation	United Front Work Department of CPC Central Committee	Prevention and control of desertification
The Paradise International Foundation (桃花源生态保护基金会)		Jack Ma (马云) & Pony Ma (马化腾)	Biodiversity conservation and sustainable development promotion
Alibaba Foundation(阿里巴巴公益基金会)		Alibaba Group Holding Ltd	Alibaba Group announced that it would allocate 0.3% of its annual revenue to a public welfare fund from 2010, primarily for environmental protection
SHANSHUI Conservation Center (山水自然保护中心)	ENGOs	Professor Lu	Biodiversity conservation
Green Anhui（安徽绿满江淮环境发展中心）		A council of 10 people from different fields of work	Primarily engaged in Anhui local environmental protection business
AEGON-INDUSTRIAL Fund (兴全基金) Saic general motors co. LTD（上汽通用汽车有限公司）	Sino-foreign joint venture enterprise	INDUSTRIAL SECURITIES CO., LTD	The company will take 5% of the management fee income from the Xingquan Social Responsibility Fund as the special fund to invest in social welfare undertakings
		Saic general motors co. LTD	Organize planting activities
HiPP(喜宝)	Foreign-funded enterprise	HiPP	Sustainable development investment and management
Chinese Academy of Sciences (中科院) Central Academy of Fine Arts (中央美术学院)	Academic institution	Government sector	Provide methods and technical support
Beijing Environmental Exchange (CBEEX, 北京环境交易所)	Franchising organizations	Local government	Research and development of emission reduction models

Source: Collected by Author

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Table 7. Ant Forest Milestones

Date	Event
◆ August 2016	Ant Forest was founded.
◆ September 2016	Ant Financial signed a strategic cooperation agreement with UNEP. Erik Solheim, UN Deputy Secretary-General and Executive Director of UNDP, used the Ant Forest feature to experience it.
◆ January 2017	Ant Forest users exceeded 200 million.
◆ January 2017	Ant Financial and UNEP jointly launched the Green Digital Finance Alliance (GDFA) on the 2017 World Economic Forum in Davos, exploring ways to promote Ant Forest globally.
◆ March 2017	Ant Forest users first visited the forestation site.
◆ September 2017	Ant Forest launched the land protection project, enabling the public to adopt existing unmanaged forests to help restore forest ecology besides planting trees.
◆ September 2017	Ant Financial ranked third in the Fortune Magazine's Change the World List of top 50 companies. It is primarily due to Ant Forest that Ant Financial made a list.
◆ November 2017	Ant Forest worked with GaGo Group and XAIRCRAFT to launch tree monitoring features via satellites and drones.
◆ December 2017	Ant Forest attended in the 3rd UN Environment Assembly
◆ By the end of 2017	13.14 million real trees had been planted, and 12111 mu (8 k ㎡) of land were adopted. Ant Forest had planted nearly 12.14 million Saxauls, 1 million willows, and 3000 scots pine trees, covering an area of more than 190,000 mu (126.67 k ㎡).
◆ March 2018	Ant Forest users exceeded 300 million.
◆ March 12, 2018	Ant Forest announced its plans to increase investments in ecological protection, and the total investment in environmental protection is expected to exceed 500 million RMB ($79M) by the end of 2018.
◆ April 2018	Ant Forest users visited the site for the second time.

Source: Collected from Pandaily.com (2018)

(see See https://pandaily.com/ant-forest-allowed-more-than-a-quarter-of-chinese-netizens-to-participate-in-charity-programs-through-the-mobile-Internet/)

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

4.1.5. New Social Institutions—Changes for Chinese Environmental Governance

Since Ant Forest is a private sector-led environmental movement, it is necessary to review the formation and transformation of the Chinese government's attitude towards environmental governance in the form of historical development since the communist party seized power. During the Mao's revolution, the Chinese government implemented the planned economy, and some socialist reconstruction experiments have been performed in mainland, China. At that time, China's human social activities blindly intervened and reformed the natural environment under the absolute dominance of the state apparatus, thereby leading to serious environmental consequences (Shapiro, 2001).

After the introduction of reform and opening up, the Chinese government changed to take economic construction as the central task. As a result, China's economy has undergone rapid growth for more than 30 years. In the meantime, environmental problems have become increasingly dangerous. Environmental and sustainable problems have significantly deepened the difficulty of China's environmental governance, which include pollution and depletion of water resources, air pollution, soil erosion, energy, transportation and food shortages (Cann, Cann, & Gao, 2005) The Chinese government had been aware of the seriousness of the environmental problems and had started to clean up the administrative and judicial aspects. Besides, the government requires other external forces to facilitate environmental governance (Economy, 2005).

Since the 2008 financial tsunami, the state-own capital intervention in the market has once again become a hot topic. Lin (2017) showed the significance of the state-own capital to intervene in the environment-related pillar industry in China (e.g. food market). On the other side, there might be risks and adverse effects of the state-own capital in environmental governance (e.g. lacking responsibility and the awareness of an unexpected development). Compared with state-own capitalism, varieties of capitalism, as another notion to combining with emerging capitalist models, are worth exploring. Accordingly, for a long time, the Chinese public sector has taken the absolute leading power in the field of environmental governance, and top-down was the main pattern.

However, the Chinese government's overwhelming dominance of environmental affairs is inclined to exhaust public financial resources, which is largely attributed to the economic situation and the government's fiscal situation. In the past few years, China faced enormous challenges of economic restructuring due to the bottleneck for economic growth. Fig. 7 shows that GDP growth rate of China experienced a constant declination from 2012 to 2016. China's industrial manufacture continuously suffers from problems like excess production capacity, environmental degradation, resource exhaustion, etc. Under the context of the downward trend of economic growth, the national revenue growth also showed a slowdown. Furthermore, the Chinese government at different levels keep expanding fiscal expenditures to maintain stable economic growth, and

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spending appears to grow faster than income. As a result, the gap between fiscal revenue and expenditure is growing.

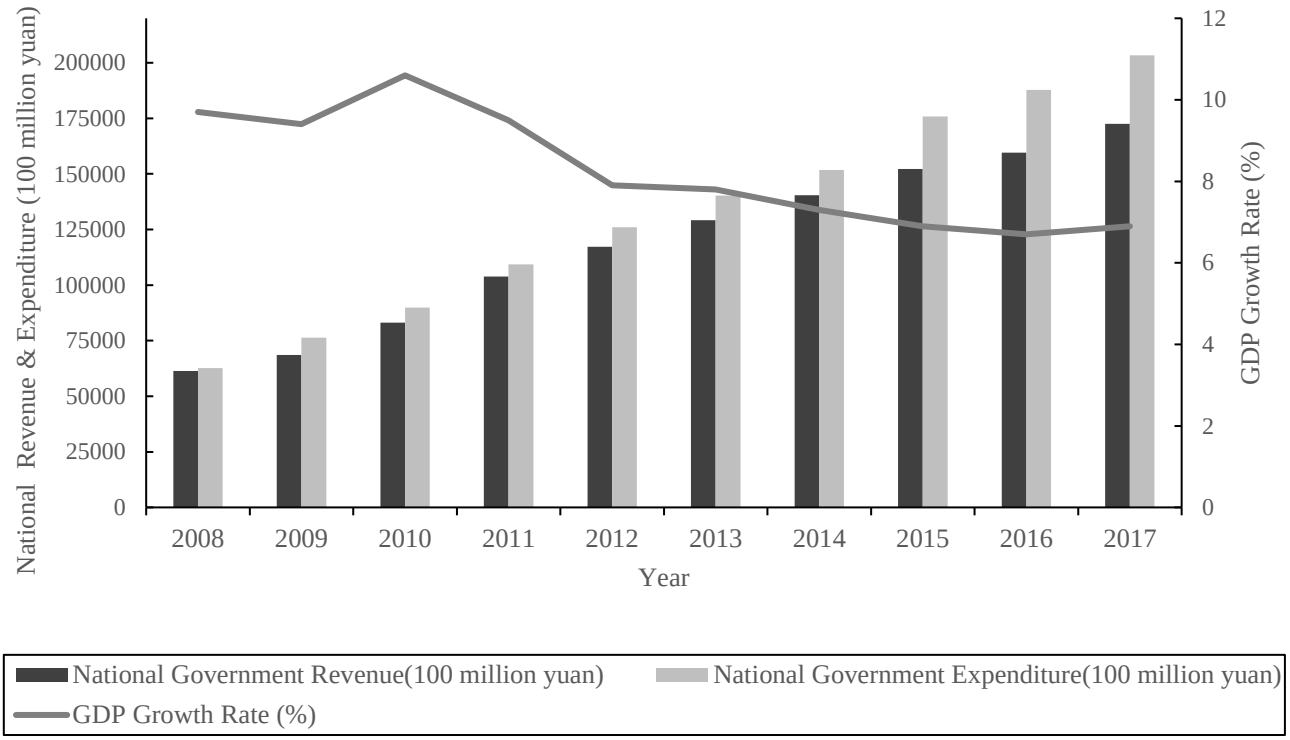

Fig. 7. China's national revenue, expenditure and GDP growth (2008-2017)
Source: Collected from National Bureau of Statistics of China

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It is also obvious that Chinese fiscal stress is on the rise, and the size of the government's deficit (Fig. 8) and debt (Fig. 9) is more consistent with this view. For the deficit, the chart suggests that China's budget deficit size has been expanding since 2012 and up to a record low of -3.80 percent of GDP in 2016. The deficit size remained at -3.5% in 2017, reflecting the severe fiscal situation of Chinese governments at all levels. For debt, the Chinese government debt has been growing since 2012. China recorded a government debt equivalent to 47.60 percent of the country's Gross Domestic Product in 2017, the highest level of all time. The massive debt burden did not help the government plan its future budget. For instance, there is a widespread shortage of funds in the local environment bureaus, and the salaries of relevant employees are low (Chen, 2009).

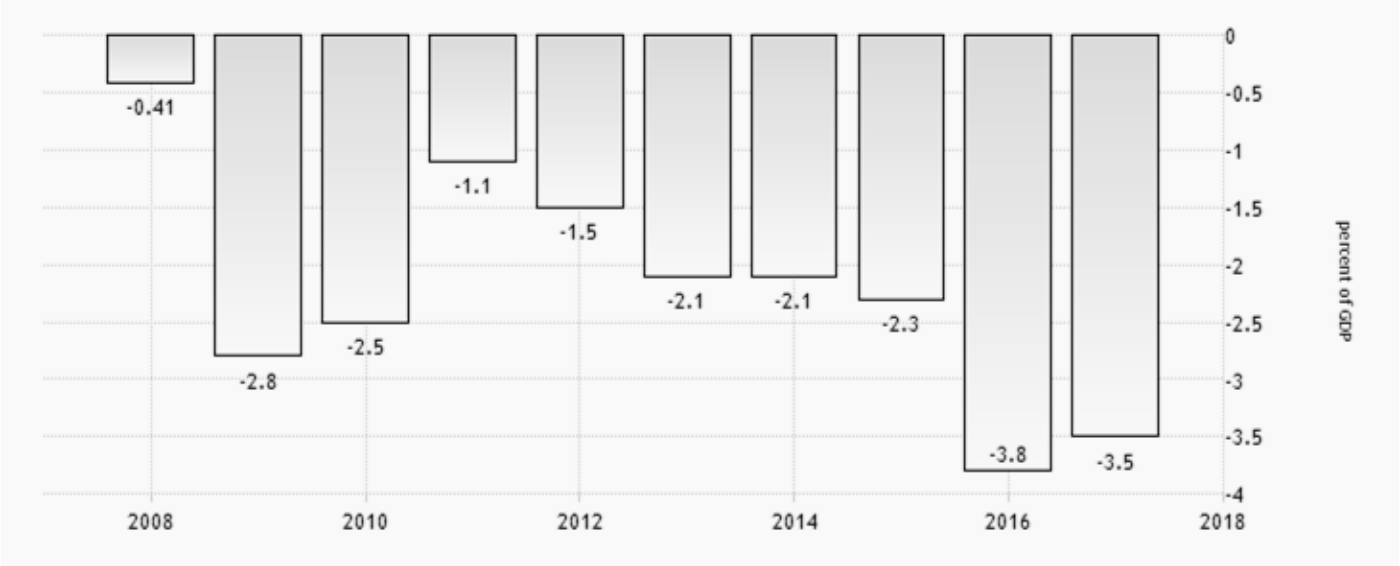

Fig. 8. China Government Budget, 2008-2017 (% of GDP)
Source: TRADINGECONOMICS.COM

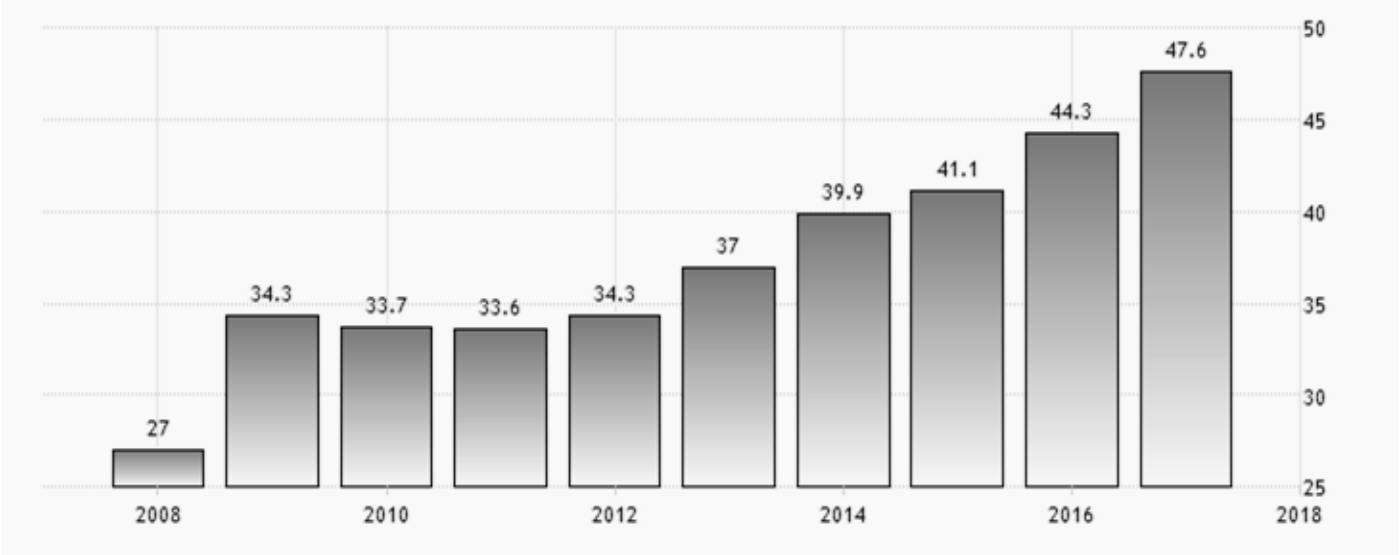

Fig. 9. China Government Debt to GDP, 2008-2017 (%)
Source: TRADINGECONOMICS.COM

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Besides, the growth rate of national expenditure on environmental protection, agriculture, forestry, and water affairs has been gradually slowing down over the past decade except for 2015, though government spending on these things is still rising (Fig. 10). In general, this is the financial motivation of the Chinese government to introduce private capital in environmental governance affairs. This can be one of the reasons why China's PPP has boomed in the past few years, though some argue that it has yet to curb the growth of local debt. Bringing CCs to the world of environmental governance may be another way forward. Through its own attributes and functions (e.g. promoting increased mobility and sustainable consumption, building a harmonious social network, and balancing economic and environmental benefits), CCs can cover the lacked functions caused by government financial constraints at the present stage.

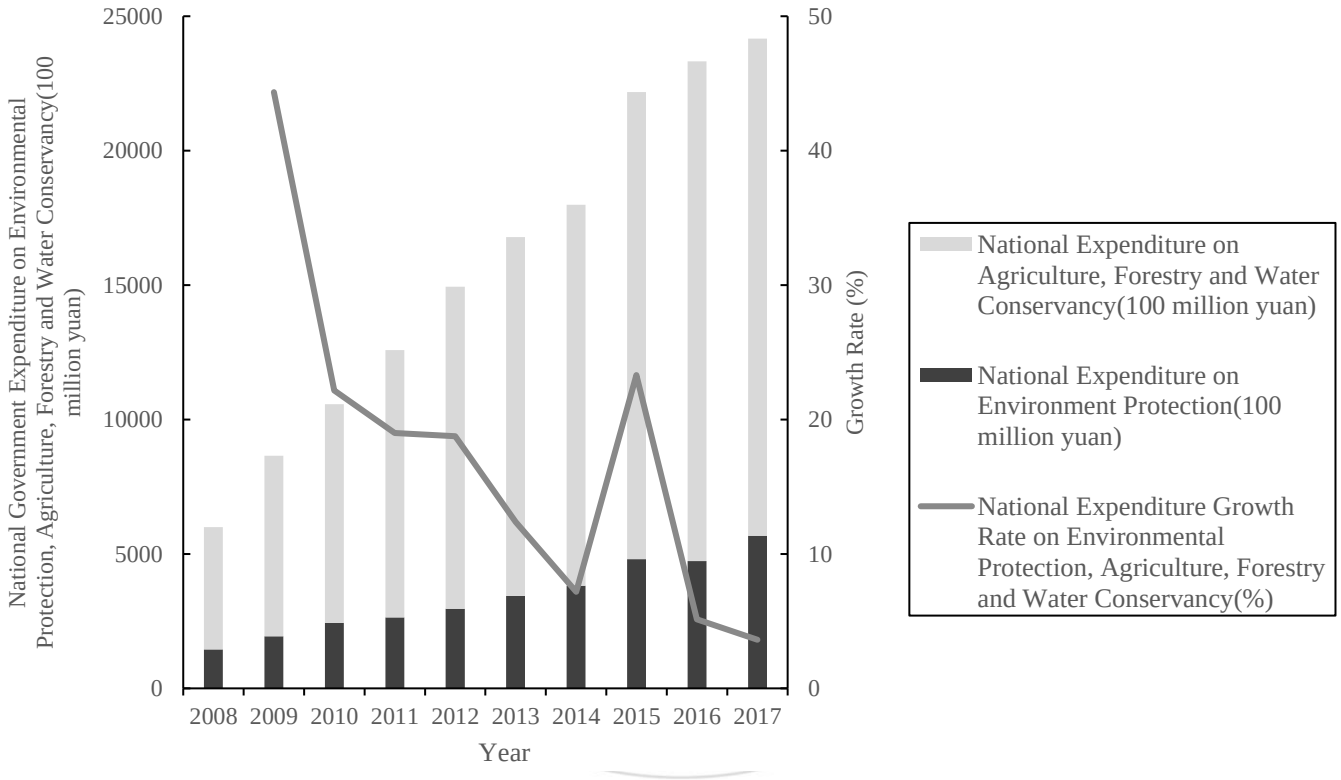

Fig. 10. National Government Expenditure on Environmental Protection, Agriculture, Forestry and Water Conservancy[14] (2008-2017)

Source: Adapted from National Bureau of Statistics of China

[14] Specific items of this subject include: environmental protection, agricultural expenditure, forestry expenditure, water conservancy expenditure, south-to-north water diversion expenditure, poverty alleviation expenditure, general agricultural development expenditure, and other expenditure on agriculture, forestry and water affairs.
(See http://yss.mof.gov.cn/zhuantilanmu/ggwd/200902/t20090223_115892.html)

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While developing the economy, it is not advisable to neglect environmental benefits. Though the Chinese government has started to adjust its environmental governance mechanism of the administrative and judicial system, the government is at the initial stage of introducing a market mechanism to environmental governance from the political perspective Signs are showing that Chinese private sector is joining the cause of environmental governance through such mechanisms and Ant Forest is one of the typical examples that refer to community environmental governance, and the concept of CCs can explain such mechanism.

The traditional Chinese concept of community has been updated. Because of Financial Internet and Internet of Things technology booming in China, which makes the Chinese society to form a substantial mobile payment user. Around the Alipay and other third-party payment application, online community gradually formed, and CCs is developed in such online communities through the Ant Forest project. In the meantime, it has also promoted user's offline green activities and improved the ecology of vulnerable areas. This improvement can be considered as the readjustment and innovation of CCs in China, which also demonstrates the evolving trend of CCs around the world. Through cross-sectoral cooperation, Ant Forest could access to more emission reduction scenarios, which will bring more "green income" to users. Furthermore, Ant Forest is trying to combine different environmental governance areas except planting trees. For instance, green energy will be allowed to be exchanged for green products in ecologically protected areas to support local sustainable development, which will increase the number of ways users can consume by using their carbon asset.

For the operational logic, community concept and social resource integration mentioned above, a relatively different environmental governance mechanism has emerged (Fig. 11). China's private sector launched the CCs movement rather than the public sector or state-owned capital through the private sector is still not out of government in social networks. However, there is clear evidence that the private sector's green movement has generated a widespread response.

First, the environmental awareness of the masses has been aroused significantly, and individuals have an effective way to substantially participate in China's environmental governance with relative high enthusiasm. The improvement of awareness is completely different from the previous phenomenon that citizens participate in environmental issues through passive behaviors (e.g. protests and lawsuits).

Second, through private sector environmental platforms like Ant Forest, international environmental organizations have new options and mechanisms to enter China's environmental agenda. The private sector is expected to work with the international community to help the Chinese government adjust its environmental policies. Thus, it is forming a new bottom-up mechanism and combining external forces, which adds a new element to the long-standing top-down environmental governance mechanism.

Third, under such a movement, the social network will revolve around Ant Forest as well as Ant Financial. In the case of Ant Forest, local NGOs, public institutions, local government departments and foreign

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enterprises are observed to play different functional roles in the movement. Cross-sectoral cooperation will become more frequent and involve diversified actors. It is noteworthy that foreign companies have also been engaged in the movement, and which is indeed creating new possibilities and inspiration to China's environmental governance mechanism.

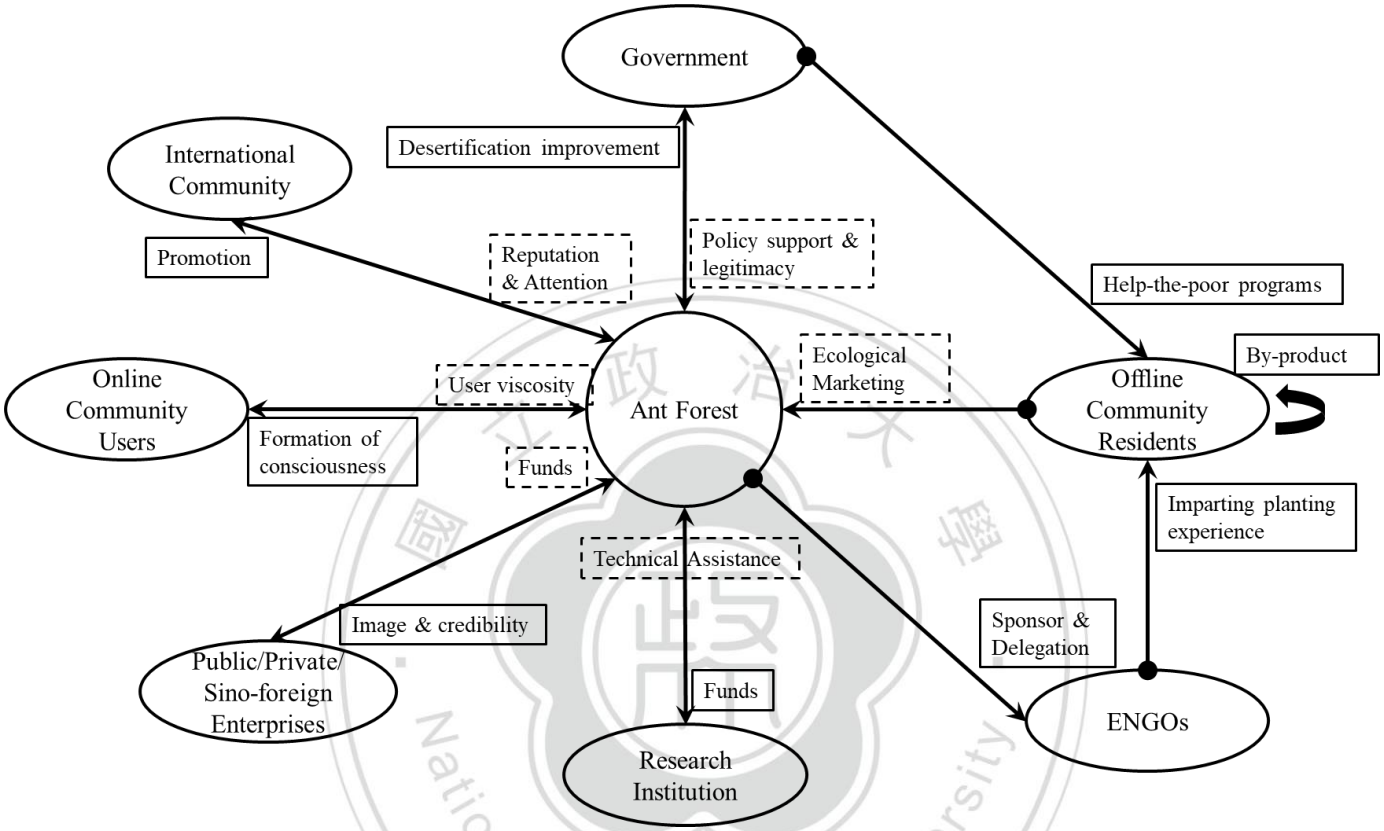

Fig. 11. Association Diagram of Ant Forest Project Participants

Source: Collected by Author

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4.2. Case Comparison

First and foremost, in this section, each case has a qualitative comparison of some basic features to observe the structural similarities and differences among CCs mechanisms, and they are listed in **Table 8**. The items will involve the implementation background, organizer, purpose, principle, object and limitation of the case. After comparing the essential condition among cases, this study continues to assess the qualitative contribution of the three mechanisms to environmental governance. It is based on the qualitative indicators designed by Seyfang (2006), which is mentioned in the previous research methods. (**Table 9**). It should be explained in advance that the discussion of the NU project is based on reports by Van Sambeek and Kampers (2004); the discussion of NICHE refers to Fawcett (2012) and Hendry et al. (2015). When discussing Ant Forest, it will be summarized from the previous study for Ant Forest.

Green Consumption Oriented Case—Nu Spaarpas (NU)

As Seyfang G. highlighted in her article (2006, pp. 787-788) NU is a community currency system designed to promote sustainable consumption for specific purposes. In NU system, "Green Loyalty Point," considered as a community currency, is designed to reduce ecological footprints and operates like a reward card. The "Green Loyalty Points" could be earned from some environmental-friendly consumer behaviors (e.g. separating the waste for recycling, using public transport, or shopping locally). "Green Points" are circulated in a closed system within a certain range of the city, and cooperative merchants transfer data to a central account when they are doing a card scan.

From the background of mechanism formation, in the 1990s before NU was created, people in Netherland had already gained an insight into sustainable development. The incentive mechanism of sustainable consumption has to a certain extent been studied and practiced, which was orientated by consciousness and theory. The initiators of the NU scheme are Rotterdam's municipal departments, the local bank like Roteb Sanitation Department, and another private business sector (Sambeek & Kampers, 2004). Namely, NU is a cooperative scheme among local governments, local businesses, and NGOs. While focusing on sustainable development of the community, the core topic of NU is to guide the low-carbon behavior of the residents. The scheme implemented incentive points as the "Green Loyalty Points" in green consumption. At the point of exchange or transaction, NU utilizes the more traditional method of exchanging points for specific goods or services, which not only facilitates the transformation of sustainable consumption but also activates the local market through regional circulation of community currency. NU was primarily intended for consumers, especially those who usually lack a sense of sustainable consumption.

In the course of implementation, NU had a problem with front-end consumption. According to Sambeek & Kampers' report (2004), NU's incentive structure encountered some subjective and objective obstacles on

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the consumption. First and foremost, consumers very concerned about the functionality of the goods. At this point, various environment-friendly products sometimes only emphasized environmental protection instead of practicality. Second, the price competitiveness of sustainable goods was not so good as that of ordinary goods of the same type. Third, the lack of sales channels for sustainable products was another vital issue. Sometimes, it was difficult for customers to find a specific environmental protection product in the market. Fourth, it was a challenge to change consumption habits in a short time owing to the negative psychological impression of sustainable products or services or the influence of traditional cultural concepts. Finally, lacking information about sustainability, or unreliable information, which affected consumer confidence.

According to a case study of Seyfang (2006, pp. 787-788) First, NU's community currency can flow smoothly in local circulation. Individuals within the community can obtain community currency from commodities and then put community currency into the consumption of community goods or services again. Since money circulates within a closed system, this significantly strengthens the economic multiplier of money and thus promoting local economic development. Second, NU's role in reducing the ecological footprint is significant. In particular, NU encourages mass transit, recycling, energy efficiency and more. Third, regarding collective action, NU does not perform well here. The main reason is that it is just a tool around individual consumption, with no additional social functions attached. Fourth, Since NU was set up by the municipal department, it facilitated the local government's specific environmental goals. Among the directly related items are public transport and waste disposal. Thus, sustainable consumption behavior of the individual in the NU case has promoted the improvement of some areas related to public environmental governance to some extent. Finally, NU's institutional innovation around the fundamental goal of sustainable consumption is to create a points system to stimulate individual green consumption. The NU mechanism internalizes environmental costs and translates them into commodity prices, lowering the threshold for people to participate in environmental protection. Thus, NU itself can be considered a reliable provider of environmental information.

The Earliest PCT Program—Norfolk Island Carbon and Health Evaluation (NICHE)

The NICHE project originated from the academic research on the relationship between obesity and personal carbon footprint. Previous research on NICHE had rarely performed practical testing. The combination of the PCT system and policy maturity made NICHE the first relevant experimental project. As mentioned in the research motivation section, NICHE was funded by the Australian federal government and planned by Southern Cross University. The plan was designed to study whether the PCT system can encourage more low-carbon lifestyles and therefore contribute to improving the health of residents, especially reducing obesity. It can be observed that, unlike some other cases that focus on community development, the starting

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point of NICHE is more on individuals, which is to discuss the relationship between low-carbon life and individual health. Later the research team chose to perform experiments on Norfolk Island. Similar to the allocation of carbon quotas in the corporate carbon trading system, at the start of the experiment, the islanders were given a carbon credit card that contained a certain number of carbon units. People can use the card to pay for gas or electricity while the project is being implemented. Moreover, residents who are more likely to adopt a low-carbon lifestyle (e.g. walking or cycling) and use less electricity at home will save more carbon credits in exchange for more cash at the end of the year. As the experiment continues, the number of carbon credits that are reissued each time will decrease, forcing individuals to work harder to maintain their low-carbon lives. With a population of just over a thousand and a relatively simple economic structure, the research team can easily calculate a person's carbon footprint.

Unlike some other cases that focus on community development, the starting point of NICHE is to focus more on individuals and explore the relationship between low-carbon life and human health. As far as the results were concerned, quantitative studies revealed that the experimental population's cognition of reducing obesity and reducing carbon emissions was correlated. However, the results are limited to some extent, for example, the geographical and demographic characteristics of the island may differ from other regions. In addition, the attitude of the experimental population will be adjusted with the change of annual carbon credit allocation. Thus, the setting of individual quota is also a challenge for the promotion of this case (Webb, g. et al. 2014). At present, PCT is still in its infancy, and there is still a lack of sufficient research to confirm its effectiveness and balance the equity and efficiency and the impact of carbon currency circulation in PCT on the community economy is not yet clear (Yael Parag & Tina Fawcett, 2014). In the NICHE case, though the correlation between people's health awareness and environmental awareness can be verified, it is not excluded that people will stop consumption to alleviate carbon emissions.

Chinese CCs Example—Ant Forest

The emergence of Ant Forest is driven by Internet Technology and national policy, which belongs to the technology and policy orientated type. As far as the current situation is concerned, CCs theory can be summarized from NU and used to explain and study the case of Ant Forest. However, in the process of applying CCs theory, it should be fitted for the change of some qualitative elements. First and foremost, Ant Forest project is organized by the private sector, thereby creating a network that includes NGOs, multi-capital, government agencies, and research institutions. For purpose, Ant Forest takes individual low-carbon behavior as the primary reference to taking incentives. Besides guiding the low-carbon behavior of the public, Ant Forest also uses actual tree planting to improve local ecology. Ant Forest introduces the innovation mechanism of planting, which improves desertification to a certain extent. The target group of Ant Forest is particular, and

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its product design is separated into an online community and offline community. The online community is doing the same as NU, motivating user's low-carbon behavior. For the offline community, the Ant Forest project team cooperate with NGOs or government departments to carry out environmental governance. In the meantime, they target poverty alleviation under the support of national poverty alleviation policies, which is also named as "Ecological Poverty Alleviation" by Alibaba group.

However, since the points cannot circulate among users or between users and merchants, the community currency loses its economic function, what new economics calls the economic multiplier. Besides, other problems of Ant Forest primarily lay in the middle and backstage, which is the data processing related to carbon footprint and the cost of planting trees. The obstacles to Ant Forest are primarily from data and funding. As for the data problem, the accuracy of carbon footprint estimation needs to be improved. The carbon footprint data recorded by individual mobile devices are only a rough number, and the problem of data cheating should be avoided. The data issue could explain why carbon credits in Ant Forest accounts cannot be traded and circulated. Also, collecting carbon footprint also reveals that users are required to provide information about their daily positioning, consumption and activities, which can result in privacy issues.

For funding, it costs a lot to grow tens of millions of plants in the desert, and the cost of follow-up maintenance is huge with the increase in the scale of cultivation. Also, system development and management costs may be overlooked. At present, and financial service is based on improving social enterprise image, improving the user viscosity and taking the initiative of individual carbon trading. These incentives all depend on the subjective commercial judgment of the private enterprise itself, which is not indispensable. Accordingly, there is uncertainty. Once the capital chain of the enterprise is problematic, the project may be interrupted. There are other unstable factors or limitations in Ant Forest.

According to the previous description of Ant Forest. First, Community currency in Ant Forest is not mobile. At present, the only way for community money to flow is for enterprises to purchase the carbon credit in the hands of individuals by planting trees. In this case, Carbon credit itself cannot be freely circulated. As a result, the community currency loses its economic multiplier effect and cannot boost local economic vitality. Second, Ant Forest combines the latest mobile payment and big data technology so that it can be recorded in more diverse ways to reduce the ecological footprint (e.g. reducing paper vouchers through online payments, sharing vehicles, using biodegradable packaging, etc.). Third, Ant Forest shows a prominent performance in this aspect.

On the one hand, for the online community, an important reason is the interactivity of the tools. On the other hand, for the offline community, the process of planting trees or alleviating ecological poverty requires coordination and communication between organizations. Volunteers and staffs also work with local farmers, which is the other an example of Ant Forest promoting community building. Fourth, In the case of Ant Forest,

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the individual green behavior is linked to collective action and can be thought from several aspects. First of all, the desertification problem in northwest China is relatively severe. The government environment and forestry authorities have actively coordinated Ant Forest's tree-planting campaign. Besides government departments, ENGO, some public institutions with official backgrounds, are actively involved in the scheme. Second, Ant Forest is cooperating with national poverty alleviation, establishing environmental protection pilot projects in remote areas and letting users spend green energy subscription to assist local farmers to develop green agricultural products, yet the follow-up results need to be continuously observed. Finally, the project has attracted private capital and international attention. In general, this case has mobilized various social capital to participate in offline activities, which reflects an essential collective nature. Finally, Ant Forest breaks through the traditional “top-down” environmental governance mechanism in China. Relying on market size and commercial innovation, it is building a “bottom-up” environmental governance system. Moreover, compared with most of the previous times when the elite was the main force involved in environmental protection, Ant Forest could help increase the enthusiasm of citizens to participate.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

Table 8. Qualitative Comparison of Conditions for NU, NICHE and Ant Forest

Items	NU	NICHE	Ant Forest
Background	The idea of a sustainable incentive system began to grow in the Netherlands in the 1990s.	NICHE is originated from academic research on the relationship between obesity and personal carbon emissions.	Based on the integration of Internet finance, Internet public welfare, and PCT
Executive	A public-private collaboration of government and the business sector	Collaboration between government and academic institutions	Multi-social organization network with the private sector as the core.
Purpose	To guide the transformation of people's sustainable consumption behavior	To prove the positive relationship between low-carbon lifestyle and individual health	Guide users to sustainable consumption while considering the improvement of community ecology.
Operating principle	Each time the owner of the NU card consumes an environmental-friendly product in the community store, some points are awarded, which are automatically retained in the NU card for a specific product or service.	Issuers use a carbon credit card to allocate carbon quotas to residents. Users who hold carbon credit cards could use the amount in their cards for purchases of non-renewable energy sources, whereas they can also reduce spending the amount through more frequent low-carbon behavior. These carbon credits can be exchanged for cash in an annual settlement.	Online users collect low carbon footprints, or green energy (carbon credit), through their daily low-carbon activities. If a certain amount of green energy is achieved, a virtual tree can be formed. Operators will buy the virtual tree (i.e., carbon credit) from users and plant the real tree offline to achieve carbon neutralization.
Target groups	It aims primarily at consumers who are relatively passive regarding sustainability.	Voluntary participants in the community and visitors	Online part for frequent users of Alipay. Offline part is for residents of ecologically fragile areas, which are often also areas in need of poverty relief assistance.
Problems	The market share of sustainable products is limited. Negative issues associated with the function, quality and price of sustainable products will reduce consumers' purchasing enthusiasm. Cultural and psychological aspects also make it harder to change spending habits.	It is difficult to generalize, and the residents' attitude to emission reduction to some extent depends on the allocation of annual carbon quotas.	There exist problems like inaccurate carbon footprint data, personal privacy leakage and the high cost of planting and maintenance.

Source: Collected by Author

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Table 9. Evaluating NU, NICHE and Ant Forest as CCs Tools for Sustainable Consumption

Indicators	NU	NICHE	Ant Forest
Localization	☺ Earn green credit from community consumption, which can only reward for local commodity consumption	😐 The impact of the carbon quota introduced in the NICHE on the community economy was uncertain, and it cannot be ruled out if it had an inhibiting effect on consumption.	😐Though the economic cycle is beginning to take shape locally, the green energy is available only in personal accounts and cannot be directly circulated or used for local consumption.
Reducing Ecological Footprints	☺ A series of green consumption behavioral incentives have been enhanced	☺ The project aimed at the control of non-renewable energy consumption, and carbon quota plays a useful role in guiding people to save energy and reduce emissions in their lives.	☺ The mechanism lays out a series of low-carbon consumption behaviors that can earn carbon credit, thereby boosting the motivation of sustainable consumption.
Community Building	☹ As a tool to guide individual behavior, it has no noticeable effect of building a community network	☹ Also, as the individual consumption behavior improvement project, lacks the interactivity between the individual.	☺ Online community users can help each other collect energy and cooperate to plant virtual trees. Agencies combines poverty alleviation policies to reach cooperation with residents in the rural area (offline community)
Collective Action	😐 They are promoted by local governments and involve the public sector in improvements within a range	😐 It is a cooperative project between the government and research institutions, reflecting certain policy support and openness.	☺ Different levels of government agencies, NGOs, public and private sectors, research institutions are involved in the campaign.
New Social Institutions	☺ Green credit has guided the society and environment to be sustainable.	☺ As the first pilot project of PCT, it tests the correlation between people's health awareness and environmental awareness from a quantitative perspective, providing an essential reference for follow-up research or practice.	☺ China's “bottom-up” environmental governance mechanism is being shaped by the private sector-led green movement under business innovation. Civic engagement has also been widely inspired.

Source: Referred to Seyfang (2006, p. 785) and summarized from the case analysis section of this study

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

The comparison suggests that Ant Forest has stronger ability of community construction and social capital integration. On the one hand, it added the concept of online community and virtual currency and extended the concept of local community to the Internet. As a result, the scale of community systems become large and complex. However, the Internet technology to some extent guarantees the effective operation of the whole system, which makes it possible to integrate many resources that were difficult to achieve in the past. On the other hand, the Chinese government's attitude is positive, at least it does not exclude the model innovation brought by private capital. It is analyzed that this phenomenon is partly associated with the government's financial situation.

Though the combination of PCT and Internet finance gives Ant Forest its unique appeal, the drawback of this product is that the collection and storage of personal carbon footprint data largely relies on mobile devices. The question of accuracy and stability needs further improvement. Moreover, carbon credit is also related to virtual currency to a large extent, so Ant Forest will face various uncertain risks in its development. NU and NICHE, however, are comparatively better at circulating and handling currency data. Since both cases use credit card - like methods to record and exchange ecological footprints, the process is relatively simple.

For mechanism innovation, the three cases have made innovations in their own time and space background. NU, as the fourth generation CCs case in the early 2000, began to use a more complex mechanism to affect the behavior of community citizens to achieve the goal of sustainable development. In the early 2010, NICHE pioneered PCT concept to create a low-carbon and healthy community. The recent Ant Forest shows more complex operational logic than its predecessor. First, it breaks new ground in governance by linking issues such as ecological protection, reducing greenhouse gas emissions and helping the poor. Second, it blurs the boundaries of the community and connects the virtual community with the real community to increase the visibility of environmental governance. Third, it should integrate as many social organizations as possible so that diverse social capital can be introduced to the green movement for peace.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

4.3. Promotion of Ant Forest Model

From a promotional point of view, Ant Forest appears to have more feasibility of promotion. The leaders of Ant Forest are private enterprises. As result, the project was endowed with more commercial implications by managers. For instance, first, by setting up PCT platform, enterprises can cultivate the market in advance and occupy the market share of PCT in the future. Second, the mode of Internet public welfare is helpful to improve user stickiness to increase the probability and frequency of users using enterprise related products. Third, planting trees also has economic benefits, including the harvest of ancillary products and the accumulation of forest carbon sink resources. Thus, a brand-new industrial chain of ecological agriculture can be constructed. Finally, the project helps to enhance the corporate image to obtain additional support from the government and the international community. This is different from NU, which serves local government policy objectives, and NICHE, which serves academic research in research organizations.

As mentioned in section 1.2 of this study, there are many different forms of PCT, and Ant Forest is just one of the innovative mechanisms. Most of Chinese PCT platforms initiated by private sector have one similar characteristic, that is, they try to build an internal carbon trading mechanism. They formulate a set of rules to circulate carbon currency in this closed loop, and finally cultivate a whole low-carbon economic chain. This type of business logic is not only applicable to Ant Financial, many large enterprises or institutions with a user base can also develop relevant businesses.

There is a couple of examples. Industrial Bank Co., Ltd (CIB) of China, launched a tree planting program that similar to Ant Forest in the first half of 2018. The program encourages customers to donate their VIP points to plant trees, and every 100 points can donate a tree seedling. CIB will convert the donation points into corresponding donations and give them to the China Green Foundation to organize needy family in Guyuan, Yuanzhou district, Ningxia province to plant Chinese wolfberry trees[15]. (Fig. 12). In November 2017, Sina Weibo organized an activity aims at scientific restoration of bamboo forest ecology of giant panda habitat through social welfare activities of netizens to alleviate the problem of wild giant panda habitat fragmentation[16]. The project combines virtual and real public interest participation and exchanges virtual bamboo for real bamboo through online cultivation, like Ant Forest. Users can plant virtual bamboo in the virtual space for feeding and raise their own “panda babies”, such as collecting energy on Weibo, watering the virtual bamboo, and finally forming a “bamboo” when the energy value reaches a certain level. (Fig. 13) Subsequently, the China Green Foundation and the Shaanxi provincial forestry bureau will plant a real bamboo plant for Weibo users in the Qinling Mountains of Shaanxi province. Also, the project team will hire local workers to plant and

[15] See https://www.cib.com.cn/cn/aboutCIB/about/news/2018/20180327.html
[16] See https://www.weibo.com/u/6378485548

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care for them to achieve the dual public welfare behaviors of poverty alleviation and environmental protection.

The evidence suggest that Ant Forest patterns are replicable. Though these two promotion cases refer to the planting model of Ant Forest, they jump out of the carbon footprint monetization logic of individual carbon trading and replace it with other virtual points with features. Such virtual CCs cases are shown with the potential of extension, and PCT is just one of the development directions.

Fig. 12 Tree Planting Plan of CIB

Source: See https://jingyan.baidu.com/article/84b4f565b503a860f6da322b.html

Fig. 13 Bamboo Planting Plan of CIB

source: See https://jingyan.baidu.com/article/37bce2be42b49c1002f3a2de.html

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

5. Conclusions, Suggestions and Limitations

Based on the above case study of Ant Forest, this study attempts to provide a Chinese example in the field of CCs. As a CCs case, Ant Forest combines the ideas of PCT to try to monetize individual carbon footprints and establish a sustainable consumption system that operates independently. Moreover, the case also integrates some large-scale issues in China (i.e. ecological protection, energy conservation and emission reduction, and poverty alleviation). The Ant Forest project can be a private sector-led green movement with reference value in China's environmental governance. Even without PCT, the mechanism of Ant Forest still has promotion value. It shows that the development trend of CCs in China can be diversified. Similar to other environmental oriented CCs examples, Ant Forest also emphasizes on the sustainable development goals of the community environment. An important feature of Ant Forest is the extension of community from physical community to the cyberspace, which complicates the mechanics and social networks involved in the case. However, all the clues center on the Ant Forest.

From the above, the environmental governance features of Ant Forest case are different from those of China's traditional environmental governance mechanism. Ant Financial has gradually developed an environmental governance mechanism with the private enterprise as the core and connected social networks of different levels of government departments, the international community, NGOs and other public or private enterprises. Also, the environmental movements that have taken place in China are often violent, passive, confrontational and top-down. Unlike the past, Ant Forest has achieved a considerable scale in inspiring individual environmental action and enabled users to participate in low-carbon life spontaneously, proactively and unconsciously. This achievement partly complements the shortcomings of the previous top-down governance model. Furthermore, **Table 10** lists some of the potential qualitative results from the case study and maps them to the CCs literature' viewpoint presented above for reference as they are largely conducive, which can serve as qualitative indicators.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

Table 10. Findings Respond to The CCs Literature

CCs Related Literature	Viewpoints	Outcomes from Case Analysis
Blanc (2011)	Standard classification for different types of CCs is carried out here and described in the order of four generations	Ant Forest belongs to a multiplex (G4) CCs schemes aiming for the sustainable development of community environment
Seyfang (2006)	The solution to the sustainable consumption goal is to develop a diversified CCs trading scheme	Besides Ant Forest itself to strengthen the circulation of its community currency, China should have more other types of CCs samples added.
Seyfang (2009)	CCs can also build social networks in communities to satisfy people's spiritual and psychological needs, thereby promoting the transformation of community residents' consumption behavior.	Ant Forest encourages individual community interaction via online social media
Helleiner (2000)	The CCs mechanism challenges the globalization, depoliticization and radical individualism that neoliberalism claims.	Given that China is not a neo-liberal system, Ant Forest has made a significant contribution to the implementation of national policies and the cohesion of social capital.
Michel, A. and Hudon, M. (2015)	◆ According to the results, CCs significantly impacts social sustainability. Its impact on the local economy is also relatively limited, and a lack of research on the environmental impact assessment of CCs remains. ◆ CCs needs more legitimacy	◆ The case study of Ant Forest also shows such a trend. ◆ Ant Forest has considerable policy support and relatively high legitimacy in China
Seyfang G. and Longhurst, N. (2013)	◆ New forms of CCs will emerge and replace existing ones, and the form of CCs will be adjusted in different countries and in specific contexts, which is an innovative process. ◆ Resources and support are critical to the innovation and steady development of CCs.	◆ Ant Forest incorporates Internet technology, the concept of individual carbon trading and Chinese desertification control, which can reflect the innovation of CCs. ◆ The project is integrating the social network, and the current resource situation is relatively stable.
Xiong (2009)	Four potential paths for China to develop CCs are proposed	The Ant Forest guides the low-carbon behavior of urban residents to establish agricultural and ecological poverty alleviation system and strives for the right of individual carbon trading. However, the results need to be verified.
European Central Bank (2012)	"Virtual currencies are not only affected by credit, liquidity and operational risk without any underlying legal framework, these schemes are also subject to legal uncertainty and fraud risk, because of their lack of regulation and public oversight."	All these risks are precisely the weakness of virtual CCs, which are being eliminated by Ant Forests.

source: Collected from Author

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At the same time, there are a few anxieties and suggestions of the case:

- **Financial Constraint:** In the existing Ant Forest system, the green energy pipeline is single. If the virtual CCs of online communities is supposed to affect offline communities, it is required to rely on enterprises (e.g. Ant Financial) to subscribe and then exchange the virtual currency into real currency. The lack of financial way will consume much corporate capital, and doubts about the sustainability of the movement are raised. As a matter of fact, success in business innovation means the harvest of the new market for the enterprise, yet it may be abandoned when it, in turn, drags down the current profits of the enterprise.
- **Maintenance Problem:** Though Ant Forest so far has grown many drought-resistant plants in arid areas, the ecological environment in these regions is relatively fragile. Questions are raised, e.g. whether the maintenance work after planting trees can be implemented appropriately. The proposal is that economic cycles should be established so that the plants should not only perform their ecological functions but also discover their economic value. Only in this way can the planters be more motivated to maintain the plants. Several perspective have been developed about the possible economic value of Ant Forest plans in the future. As mentioned earlier, potential forest carbon sink resources can be further verified and then added to the carbon trading scheme. Besides, the development of ancillary products and tourism resources in the ecological zone can be considered.
- **Technology:** The current calculation method of the carbon footprint remains not accurate and rigorous enough, which will lead to significant cheating and inequity. Such crude carbon credits cannot be widely available for circulation. Accordingly, equity should be dealt with during its development, which also suggests that there is much room for the growth of individual carbon market and carbon benefit mechanism. CCs around the carbon footprint and the Internet requires more technical support than previous CCs cases. Moreover, this technical support is not limited to a single subject area but cross-disciplinary. Higher levels of integration across sectors are required, whether private, public, non-governmental, international or research.
- **Privacy Issues:** Privacy protections in China are often weak. Collecting users' carbon footprint is equivalent to knowing their daily behaviors, and the data may be at risk of leakage and abuse. For example, if a user forgets to block his or her green energy number, a friend can determine the user's whereabouts by the number and amount of green energy he or she produces each day. This is tantamount to revealing the user's personal privacy. This also is the reason that many Alipay users choose not to open Ant Forest. Therefore, operators should pay more attention to the privacy of users, and improve user confidence
- **Legitimacy:** Though Ant Forests are backed by governments from the international community to local governance, the implicit legitimacy CCs is increased, and which is a benefit for the expansion of CCs. Lacking complete high-level laws and regulations, on the one hand, means that enterprises and the CCs.

DOI:10.6814/THE.NCCU.IMES.001.2019.F06

They can have a lot of development space. On the other hand, it will also cause high uncertainty and risk of CCs development in the absence of legal supervision. For instance, when the virtual community currency gradually circulates in the real economy of China in the future, it could significantly influence the economy. The policy maker should carefully assess the status and make regulations to avoid the substantial impact on the original legal tender operation system caused by the influx of virtual community currency into the economic society.

- **Double Counting:** Since the PCT project is primarily dependent on the firm's capital strength and its user base, it is conceivable that the high market share of Ant Forest in related governance field is apparent. However, if there are similar products in the market that also collect user's low carbon footprint, the problem of repeatedly calculating the impact of emission reduction may occur, and the real effect of environmental governance cannot be achieved. Thus, though the individual carbon market remains in its early stages of development, an all-social personal carbon asset voucher and its registration system should be planned and designed early.

The last but not the least, this study may have some limitations. In the case comparison, this study adopts five indicators to assess the sustainable contribution of the case using the qualitative model designed by Seyfang (2006). The model is used to compare specific CCs types for the first time, which are academically classified. However, the three cases selected here all tend to be similar environmentally oriented projects, and Ant Forest and NICHE are not very typical CCs definitions. Also, Ant Forest combines Internet finance so that it has elements that cannot be assessed using existing indicators. For instance, the introduction of the concept of virtual community and virtual currency makes its service scope beyond the traditional sense of community. Moreover, Ant Forest exhibits the characteristics of PCT but does not allocate carbon quota to users as NICHE does. Instead, Internet technology is employed to collect users' low-carbon data in this case, which creates uncertainty, thereby affecting the performance of liquidity. However, this is just a methodological limitation and does not necessarily suggest that Ant Forest rarely contributes to community economic development.

Since Ant Forest have only been operating for less than two years, available quantitative observation and statistics are lacked, so it is difficult to assess its environmental impact from a quantitative perspective. In this study, the mechanism for China's private sector to be involved in environmental governance is analyzed qualitatively from the CCs perspective and using the case, whereas the specific impact of the mechanism on the environment needs to be further quantified. Current statistics on Ant Forest are messy and inaccurate. In fact, new things are growing so fast, and the numbers are going to be different in the short term. This reflects that the information disclosure of the private sector to participate into the environmental governance process through commercial operations is not in place. Besides the periodic and systematic disclosure of relevant

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information by the enterprise itself, the management department should also formulate relevant laws and regulations to standardize the disclosure of environmental governance information of the enterprise. In the future, more opening and long-term quantitative observations are required.

Helleiner (2000) believes that the advent of CCs challenged three neoliberal claims in the early 21st century, which were globalization, depoliticizing and radical individualism. However, this is for countries with a generally neoliberal economy. In contrast, CCs may fit into China's national policies and institutions instead of challenging these directions since China has a vague mixed economy. In the case of Ant Forest, the CCs movement in China often appears to comply with the government's economic policies and governance institutions. However, this argument needs a more in-depth discussion on China's economic system. Ant Forest appears to have considerable policy support and relatively high legitimacy in China, which will be a benefit for its development in the future.

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