Evaluation of Sustainable Infrastructure in the Context of the Belt and Road Initiative: A Case Study of Kenya C12 Road Reconstruction Project

Ran Aobo (冉奥博)[1*] and Wang Pusheng (王蒲生)[2]
[1] *Department of Sociology, Tsinghua University, Beijing, China*
[2] *Shenzhen International Graduate School, Tsinghua University, Shenzhen, China*

Abstract: *Sustainable development presents a challenge to most countries involved in the Belt and Road Initiative (BRI). Given the importance of infrastructure as a key aspect of the BRI, it is of great importance to investigate sustainable infrastructure in BRI countries. This paper explores how infrastructure meets the criteria of sustainable development and promotes sustainability. However, existing evaluation frameworks are not target-oriented, systematic, and practical. To fill this gap, we provide the framework based on the United Nations Sustainable Development Goals and apply it to the evaluation of the C12 Road Reconstruction Project. We find that the project promotes local sustainable development as a whole but has negative effects in some respects. In addition to excellent project management, the project still can improve public communication and local integration. In terms of policy implementation, we suggest summarizing the successful business model and promoting top-down and multi-dimensions designs.*

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1. Introduction

The Belt and Road Initiative (BRI) is an international economic initiative put forth by China and an important platform for China's opening up. A priority of the BRI is to create a network of interconnection among BRI countries, and infrastructure is the material foundation of this network. Most BRI countries are developing countries, including some of the least developed countries (LCDs), which have a strong desire for sustainable development. What types of infrastructure should be built is a real question facing the BRI and determines the long-term benefits of sustainable development. The concept of sustainable infrastructure[1] has received great attention from academia and the industry and is recognized as a future direction of infrastructure development; in recent years, it has also been recognized by the international

* CONTACT: Ran Aobo, email: ranaobo@mail.tsinghua.edu.cn.
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[1] Sustainable infrastructure development represents a general trend. In May 2017, the then Ministry of Environmental Protection, the Ministry of Foreign Affairs, the National Development and Reform Commission and the Ministry of Commerce jointly issued the *Guiding Opinions on Promoting the Green BRI*.

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academia as a key challenge to the BRI. This paper offers a response to the heated discussions on this topic.

In the context of the BRI, the development of sustainable infrastructure offers great theoretical and practical benefits. Compared to the green infrastructure theory, sustainable infrastructure extends the original objective of specific ecological engineering to general infrastructure projects and the original ecological dimension to integration of economics, society, and ecology. Given the diverse cultural and natural conditions of BRI countries, case studies on different BRI countries will enrich the conceptions of sustainable infrastructure. As Thomé *et al.* (2016) noted, the future research on infrastructure should incorporate particular economic, social, and other factors. Meanwhile, such research contributes to the sustainable development of the BRI and BRI countries. Traditional infrastructure constructions may intensify income inequality and social injustice in sub-Saharan Africa (Calderón and Servén, 2010), so the relevant research would improve the current situation. This paper uses the framework based on the United Nations Sustainable Development Goals (SDGs) to evaluate a particular case.

Qualitative research is essential to evaluating sustainable infrastructure against the backdrop of the BRI. Despite an abundance of quantitative research on sustainable infrastructure, Conway *et al*. (2019) pointed out that with its people-centered and bottom-up attributes, sociological research remains an important supplement to quantitative research with a particularly important role in investigating economic and social fragility. Given the postcolonial background of many BRI countries, Anderson (2002) and Khandekar *et al.* (2017) both raised doubts over the applicability of the Western-dominated scientific research methods in the post-colonial setting, and scientific innovation requires local knowledge and wisdom. In this sense, qualitative research based on sociological and anthropological methods offers great inspiration, particularly for sustainable infrastructure research under the framework of SDGs. Since qualitative research offers interpretations based on more diverse and person-centered data at the local level, frontier research still requires qualitative analysis (Chester *et al*., 2019; Scott *et al*., 2019). Meanwhile, quantitative research is subject to data collection, which is intractable in many BRI countries, especially African countries, with missing local evaporation and air pollution data, as well as local socio-economic data and other data. Hence, this paper offers a qualitative analysis of the sustainable development effects of Kenya's C12 road reconstruction project based on a field survey.

Kenya is China's comprehensive strategic partner and a fulcrum of the BRI in East Africa and on the west coast of the Indian Ocean. Kenya is faced with many challenges to sustainable development. Kenya's economic and social structures are highly unequal, as manifested in its volatile GDP and nationwide riots triggered by the general elections of 2007 and 2017. Situated at the intersection between the equator and the Great Rift Valley, Kenya is home to numerous nature reserves and national parks under great pressures for environmental and biodiversity protection. Therefore, sustainable development is the only way Kenyan can pick. Unless adequate importance is attached to sustainable development concepts and standards, not only the Kenyan's benefits but also the long-term goals of the BRI will be compromised.

2. Sustainable Infrastructure Concept and Evaluation Framework

2.1 The Current Evaluation Framework

After the United Nations Conference on Environment and Development (UNCED) put forwards the concept of sustainable development, the infrastructure-related academia and industry proposed sustainable infrastructure as a response. From a sociological perspective, Choguill (1996) offered an interpretation of sustainable infrastructure. He identified material infrastructure systems as prerequisites for ensuring the sustainability of human settlements and serving the basic needs of human society. Since traditional infrastructure provided by the public sector could only serve certain groups of people

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rather than the entire people, a new paradigm is thus required to achieve sustainable development for all. Besides, most studies have proceeded from an environmental perspective.[2] Parkin (2000) regarded infrastructure as a boundary between the natural environment and the human society, the stability of which is predicated upon sustainable infrastructure. Martland (2011) and Raworth (2012) believed that infrastructure is subject to environmental sustainability and has to rely on nature to meet the basic needs of human society. In general, sustainable infrastructure refers to the whole process of infrastructure design, construction, and operation in line with the concept of sustainable development and to meet sustainable development goals.[3]

With the popularization of the sustainable infrastructure concept, the research on its evaluation models and frameworks is making progress. Focusing on inequality and sustainability in the social dimension and with the town system infrastructure and on-site infrastructure as the two aspects, Choguill (1996) bridged the social rift by integrating the two aspects and developed ten principles for sustainable infrastructure.[4] Ainger and Fenner (2014) identified the following criteria of sustainable infrastructure: Environmental sustainability, including setting goals and making measurements in response to environmental restrictions, and organizing and operating sustainable business modes and projects; socio-economic sustainability, including setting goals and making measurements to achieve socio-economic objectives, and respecting the people and human rights; cross-generational management mode, including long-term planning and full life-cycle considerations; complex systems, including opening problem areas, tackling uncertainties, considering integrated requests, and integrating various objectives and disciplines; learning new skills for sustainable activities, and challenging orthodox and encouraging change. Sarté (2010) provided various sustainable infrastructure models: The pillar model consisting of water, energy, material, ecological and community sustainability, the scale-density model and the cross-section model based on spatial hierarchies; and the built-ecological environment model based on human activity and ecosystem services. The American Institute of Architects and its Committee on the Environment (2015) also identified ten guidelines for promoting sustainable development, including conceptual innovation, regional/community design, land use and site ecology, biological climatology design, lighting and ventilation, water cycle, energy flow and future energies, material and construction, longevity and high-quality development, and collective wisdom and effective feedback. The American Society of Civil Engineers (2018) believed that the principle of sustainable infrastructure is to "do the right projects" and "do projects right," including performing life cycle assessment from planning to reuse, using resources wisely, planning for resiliency, and validating application of principles.

Most existing evaluation frameworks have the following problems. From the perspective of proactive behavior, they clearly regulate and encourage the sustainable behaviors of building and design, but their goal and vision are rather unclear. Therefore, the disconnection between behaviors and goals is unfavorable for evaluation to be carried out effectively. Although Ainger and Fenner (2014), the American Institute of Architects and its Committee on the Environment (2015) and the built-ecological environment model (Sarté, 2010) considered the realization of sustainable goals, their studies are not

[2] This part of research primarily stemmed from research on green infrastructure. Thomé et al. (2016) and other scholars saw green infrastructure as part of sustainable infrastructure, but this view is possibly incomplete. The concept of sustainable infrastructure came into existence in the 1980s when sustainable development was put forth while the research and practice of green infrastructure started as early as the 1960s. So, it is more likely that the environmental aspects of sustainable infrastructure have drawn upon the existing research results of green infrastructure.

[3] Ainger and Fenner (2014) described sustainable infrastructure as "infrastructure for sustainable development."

[4] The ten principles include: The co-existence of formal and informal dwellings in a city; the town system of infrastructure should be operated either by a city authority or a private firm nominated by that city, on a full cost-plus recovery basis; irregular land tenure issues should be resolved within the informal residential sectors of the city; informal infrastructure should be designed and built using external technical assistance as required, to be upgradable from a basic standard to that which can be incorporated, with time, into the town system; informal infrastructure built by the local community should be under its control; the technology adopted for informal-sector infrastructure must be maintainable by the community; the informal structure must be affordable by its low-income users; informal-sector infrastructure must be socially acceptable to the community involved; the government should adopt the role of facilitator and enable rather than merely as provider; non-governmental organizations can play a key role in assisting communities to develop infrastructure systems.

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systematic enough and cannot depict the full picture of sustainability. They are far from the UN's SDGs, which means their frameworks are different to connect with SDGs-related policies, limiting their applicability. Furthermore, the models put forth by Choguill (1996) and the American Society of Civil Engineers (2018) are only guiding principles, which are hard to be applied at the practical level. Due to the problems, we suggest designing the new evaluation framework based on SDGs.

2.2 The Evaluation Framework Based on SDGs

Sustainable infrastructure refers to infrastructure at the service of sustainable development, which points out its goal for service. In establishing a new evaluation framework, therefore, we should reference relevant research on sustainable development. Although scholars (Shepherd, 2015; Chester, 2019) used or called for using the SDGs as the evaluation framework for sustainable infrastructure, in-depth case studies are absent. This paper fills this gap with a detailed case study on Kenya's C12 road renovation project.

In 2015, the United Nations adopted 17 Sustainable Development Goals (as shown in Table 1) to guide and evaluate sustainable development in various countries. This system of indicators is an

Table 1: Sustainable Development Goals (SDGs)

Goals	Descriptions
No poverty	End poverty in all its forms everywhere.
Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
Good health and well-being	Ensure healthy lives and promote well-being for all at all ages
Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Gender equality	Achieve gender equality and empower all women and girls.
Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all.
Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all.
Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
Reduced inequality	Reduce income inequality within and among countries.
Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable.
Responsible consumption and production	Ensure sustainable consumption and production patterns.
Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Partnership for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Source: The United Nations (2015); The General Assembly, the United Nations (2015).

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important supplement of the above-mentioned frameworks for the following reasons. The SDGs comprise a systematic network covering various aspects of sustainable development (Le Blanc, 2015), fully reflecting the economic, social, ecological, and institutional dimensions of sustainable development. The SDGs are goals-oriented, result-oriented, and evaluable, which can be more easily to be applied in specific cases. The SDGs have been agreed upon after long-term and extensive research and discussions among the academia and policymakers and ratified by all UN member states, so they are more acceptable.

It is feasible and original to introduce this framework for evaluating sustainable infrastructure. In terms of feasibility, the SDGs framework has already some applications at the national level (Bureau of the United Nations and Statistical Commission, 2015) and is also applicable to infrastructure to some extent. Griggs *et al*. (2013) and Shepherd *et al*. (2015) suggested incorporating the SDGs into the decision-making process, and infrastructure contain a series of decision-making about not only engineering but economics, society, and environment as well. In terms of originality, our evaluation under this framework integrates firms and local people into sustainable development, since we interviewed employees and local people about SDGs and the C12 road. The traditional pathway of realizing the SDGs is the top-down approach led by governments and intergovernmental organizations, and that in the future, firms, cities, and the public all need to participate (Hajer *et al*., 2015). Similarly, Stafford-Smith *et al*. (2017) believed that the achievement of the SDGs required the participation of diverse actors including local governments, the government sector, and the private sector in such areas as public finance, financial industry, energy, and transportation under an integrated platform involving high-income, middle-income, and low-income countries. Infrastructure is an integrated platform involving various sectors and actors, and the case study in this paper is also a cross-national one.

The evaluation of sustainable infrastructure also requires overall considerations to add or remove some evaluation criteria due to the complex correlation between various SDGs (Nilsson *et al.*, 2016). Firstly, when various measures can be directly or indirectly linked to poverty eradication, it is hard to evaluate their respective poverty-reducing effects. The General Assembly of the United Nations (2015) identified poverty in all its forms as the biggest challenge to the world. The Open Working Group on Sustainable Development Goals (2014), Pradhan *et al.* (2017) and El-Maghrabi *et al.* (2018) also identified poverty as a manifestation of other sustainable development dilemmas. Secondly, the features of certain programs may also make some SDGs hard to evaluate. For instance, projects located in the hinterland of a continent (such as the case study in this paper) do little to protect life below water, and projects located in uninhabited regions do little to promote sustainable urbanization. Thirdly, infrastructure projects also need to consider the sustainability of the measurements to achieve sustainable development themselves. Projects without sustainable sources of income may promote sustainable development for a certain period but cannot last long. As Ainger and Fenner (2014) emphasized, sustainable business models are indispensable when approaching sustainability. In this case, we adjust the overall evaluation framework by removing the two goals of no poverty and on life below water of the SDGs while adding the goal of sustainable business model for achieving the SDGs.

3. Case Study: Kenya's C12 Road Reconstruction Project

We select Kenya's C12 Road Reconstruction Project as the case considering its importance, complexity, and effective management. Located in Narok County, the C12 Project is 82 kilometers long and serves as a golden channel from Narok County to the Sekenani Gate of Maasai Mara National Reserve. As Kenya's national project, C12 is undertaken by China WuYi (Kenya) Company. The main contents are road surface renovation from 0 to 23rd kilometers, construction of new sub-base, road base, and asphalt road surface from 23rd to 45th kilometers, and construction of road base and asphalt road surface from 45th to 82nd kilometers. The project faces complex social, economic, and ecological

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contradictions. Maasai Mara is the home to multiple ethnic groups with the Maasai being the dominant ethnic group.[5] The region is economically less developed with household income primarily from livestock and tourism industries. This area is located in arid and semiarid regions and adjacent to the Maasai Mara National Reserve, presenting challenges to protecting the fragile ecology. In response, the C12 Project has taken a swathe of mitigation measures to secure sustainable development.

3.1 Clean Water and Sanitation

C12 construction has greatly improved local water conditions and environment and led to progress in environmental sanitation. Although the road construction is normally irrelevant to the water and sanitation, this case is different. The WuYi Company built over 120 ponds for free for local people, each of which is about 8,000 cubic meters and values 1.5 million Kenyan shillings. These ponds store rainwater in rainy seasons preparing for activities during dry seasons. The WuYi Company constructed a small water supply pipeline network for free in the neighborhood near the Sekenani Gate to provide local residents with safe and paid access to drinking water. The Maasai Mara region has distinctive dry and rainy seasons, and water stored in ponds could provide much-needed water in the dry season. In the past, local residents relied on groundwater, sewer water, and crudely filtered domestic wastewater as sources of drinking water. In this region, groundwater has a high saline content and cannot be used as drinking water. Sewer water and domestic wastewater are of poor quality, vulnerable to contamination, unstable across seasons, and susceptible to the transmission of waterborne diseases. Meanwhile, the WuYi Company also planned to provide some households with simple water purification devices made of alums and bamboo charcoal to improve drinking water quality.

The ponds have generated huge social benefits by providing local households with sanitary and stable water sources. During the drought of 2017, in particular, the ponds served as a valuable water source for local households and livestock. In March 2020, the ponds storing unusually a mass of rainwater decreased the losses caused by continuous floods. During C12 construction, some ponds were under the joint management of the project headquarters and local communities and were transferred to local communities after project completion with a safety warning signboard. Most ponds are already under the management of local communities and have enhanced the management of water environment in local communities. Additionally, the WuYi Company made some wasted asphalt barrels into makeshift toilets to prevent open defecation.

3.2 Decent Work and Economic Growth

The WuYi Company offered a large number of jobs of all types, contributing to local economic growth and C12 will make such contribution as well. Without experiences of non-farm occupation, most Maasai people performed poorly in terms of punctuality, arithmetics and working efficiency in this case. The WuYi Company cultivated the culture of modern and industrial occupation, since it is the largest infrastructure project in Maasai Mara. The company directly employed 283 local workers and local subcontractors employed about 80 workers, offering local people decent jobs ranging from unskilled workers, mechanical drivers, gaugers, foremen, domestic helpers, gardeners, and cooks. The company also provided local employees with accommodations and non-local workers with job security[6] and basic vocational training to reduce the proportion of untrained youngsters. The company has also

[5] The Maasai is the most famous (semi)nomadic tribe in East Africa who was the biggest tribe in this area before colonization. Even now, the Maasai tribe still mainly keep the original and distinctive lifestyles, folk customs and social structure. The details can be referred to Homewood *et al*.(2009) for the Maasai ethnic group's history and evolution in modern society.

[6] Under Kenya's local parliament institution, local protectionism is prevalent among various counties. Members of local assemblies and executive officers would create barriers for residents from other countries to seek jobs in local jurisdictions to protect local employment. To some extent, legal aid may help nonlocal employees overcome those barriers.

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brought banking and insurance services to local employees. In the past, most Maasai employees had no social insurance, medical insurance, and bank accounts. The WuYi Company purchased social insurance and medical insurance for all its employees and invited the Equity Bank to assist employees in applying for bank accounts. After its completion, C12 will facilitate transportation to the Maasai Mara National Reserve and promote tourism and Maasai folk culture such as folk art and handicrafts.[7] Many interviewed local women aim to sell Maasai souvenirs as self-employment.

3.3 Industry, Innovation and Infrastructure

C12 has greatly improved local infrastructure and expedited industrial development and innovation. C12 is intended to provide an affordable and high-quality road in Maasai Mara, designed to withstand rainstorms and other natural disasters, to shorten the journey from the original 2-2.5 hours to one hour. However, given the sporadic settlements of local residents, they were difficult to access the main road, which means the transportation in the area alongside C12 cannot be greatly improved. Therefore, the WuYi Company also constructed village roads when building stockyards and reservoirs in the local villages for local residents to access the main road with more convenience. The construction is conducive to logistical transportation and the development of industrial enterprises. Along the road, some private investors have established clothes factories and slaughterhouses. Improving access to transportation, as a whole, is conducive to an open socio-economic environment and helps promote small businesses in catering, hospitality, and manufacturing businesses. The WuYi Company also spent 1.5 million Kenyan shillings on the construction of base stations to eliminate mobile signal blindspots and deliver full signal coverage from Narok to Sekenani Gate.

3.4 Reducing Inequality

C12 will generally reduce national-wide regional and tribes' inequalities in Kenya and inequalities in local communities. The Narok County is a less developed region in Kenya with GDP per capita ranking the 33rd out of 47 Kenyan counties (Bundervoet *et al.*, 2015) primarily due to its failure to make effective use of local tourism, farming, and livestock resources. C12 road accelerates external flows of people, materials, capital, and information to Narok County and facilitates tourism development based on the Maasai Mara National Reserve, as well as agriculture and livestock. With Narok County as one of its primary settlements, the Maasai ethnic group has been at the fringe of Kenya's economy. By promoting local development, C12 helps balance the economic status of ethnic groups. The problem of wealth gaps also exists within the Maasai ethnic group, sharpened by drought in the dry season. While prosperous residents paid for the construction of ponds, the poor became worse off in drought. By constructing ponds free of charge for the poor, the WuYi Company helped to improve the abilities of local communities to cope with drought and water shortages, and thus narrowing wealth gaps within the Maasai tribe.

3.5 Sustainable Cities and Communities

C12 has facilitated the development of towns along the route, especially Narok. C12 passes through Narok, Ewaso Ng'iro, Nkoilale, Ngoswani, and Sekenani, bringing a greater flow of tourists to those villages and towns and prospering new settlements along the road. Narok is a vital city connecting Nairobi with the Maasai Mara National Reserve. In the past, Narok's development has been hindered by more than 2.5 hours' travel time to the Maasai Mara National Reserve. With improving the road condition and halving the amount of time, Narok has the promise to become an important distribution

[7] In our interview with Prof. Moses Muraya, dean of the Tourism and Hotel Department of the Maasai Mara University, he believed that road construction and the external shocks would change the Maasai people's ways of life but would not fundamentally weaken the Maasai culture. On the contrary, it would promote Maasai culture through tourism development and make it better known to outsiders.

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hub of tourism and logistics[8] and develop a thriving serving industry, including hotels, restaurants, and retail business. By linking urban areas with suburban areas and the nature reserve, C12 helps forge economic, social, and environmental linkages in the locality. C12 used to be a rural dirt road rife with floating dust polluting local communities alongside the road caused by motor vehicle travel. After its completion, the new asphalt road is expected to sharply reduce floating dust.

3.6 Responsible Consumption and Production

This project contributes to local sustainable production and consumption, also in terms of C12 and the WuYi Company. Improving road conditions will facilitate transporting livestocks to other regions with fewer losses during the transportation. Increasing visitors and the local population will increase the consumption of milk, which often became wasted due to the lack of preservation techniques. The WuYi Company procured materials locally, such as stones, earth, and other industrial materials, and recycled surplus building materials and lubricants in an eco-friendly manner. It regularly drafted environmental performance reports, HIV/AIDS reports and incorporated relevant sustainability information into those reports. Its effective initiatives of sustainable development have been summarized and communicated to the headquarters for broader implementation.

3.7 Climate Actions

The WuYi Company has built large and medium-sized ponds to cope with regional climate change and extreme weather. The seasonal distribution of precipitation is extremely uneven in the Maasai Mara, which has been intensified in recent years amid climate change. Increasing volatility in precipitation - as reflected in the drought in 2017 followed by excessive rainfall in 2018 (Kahongeh *et al*., 2018), has posed severe challenges to local residents. Ponds constructed by the WuYi Company can store the excess rainwater and alleviate water shortage in the dry season. Instead of searching for water in the daily grazing during the dry season as they did in the past, the Maasai people now have convenient access to drinking water from ponds at or near their homes. In addition, the regional microclimate can also be improved by using ponds at scale. The WuYi Company is expected to reach the density of one pond every 500 meters, which will increase the humidity of the area by expanding the evaporation area, thereby improving the extremely arid climate and biodiversity.

3.8 Life on Land

By building ponds and green channels, the WuYi Company promotes sustainable ecosystems on land. Increasing water areas and improving grassland ecosystems and biodiversity will prevent desertification. Ecological improvement, in turn, broadens the space of survival for wildlife. The ponds have attracted wildebeests, zebras, kangaroos, and occasionally even elephants, as their drinking water resources. On both sides of the road, “no poaching” and “no wildlife trading” signboards have been put up at short intervals. C12 has also erected speed humps in the road sections frequented by wildlife to slow traffic and avoid road accidents that may kill wild animals or built culverts allowing wild animals to pass through. Wild animals unexpectedly killed in car crashes are required to be buried.

3.9 Partnerships for the Goals

C12 project has strengthened partnerships between China and the local community in Maasai Mara, as well as cooperation among industry, universities and research institutions. In particular, the WuYi Company has maintained good relationships with the chief of Maasai tribe Sayialel and local

[8] The best visiting time for the Maasai Mara National Reserve is dawn and dusk. Without C12, travel time is too long and forces many tourists to either stay at the reserve overnight or miss the best visiting time. Therefore, it makes no difference whether tourists stay in Nairobi or Narok since they will miss the best visiting time anyway. As soon as C12 road is put into operation, tourists will be able to stay in Narok and still reach the reserve in the best visiting time.

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sheriffs,County Assembly members and executive officers. In the project design stage, the Chinese contractor worked closely with and offered numerous suggestions to the Kenyan designer, which represents a kind of technology transfer. Since 2017, C12 started to develop a doctoral internship program with Tsinghua University, China, which accepted postgraduate students from various disciplines such as water conservancy, environmental engineering, social sciences and business management.

3.10 Sustainability Measures

Instead of traditional one-way spending, the WuYi Company's sustainability measures are mutually beneficial in the long run. The company reduced material costs for road construction by making use of standard stone and earth materials left over from pond excavation or materials mined from the area belonging to the household whose pond is constructed by the company. While each pond with ancillary facilities costs 1-2 million Kenyan shillings to build, a borrow pit for stone and earth costs 1-1.5 million Kenyan shillings. Therefore, the pond construction is partly reciprocal. In addition, C12 supplies water stored in some of the ponds to the construction site, thus conserving water costs. These measures have reduced financial pressures for sustainable infrastructure and are easier to implement sustainably.

3.11 Other SDGs

Regarding zero hunger, the ponds would facilitate irrigated agriculture and create conditions for the development of privately invested farms alongside the road. At vegetable farms built in the WuYi Company's main camp, local residents are trained to use goat manure as organic fertilizer, build wind sheds and apply regular irrigation and other farming techniques. Regarding good health and well-being, the WuYi Company proactively carried out public communication on HIV/AIDS and distributes free condoms, and attaches great importance to their psychological health. Kenyan employees are free to go to church on Sunday, and the company allows religious practice in their living area provided by the company. Regarding quality education, C12 and village roads provide local children, especially Maasai children, with convenient transportation to schools, thus increasing local gross enrolment rates. The WuYi Company also provide unskilled local workers with vocational education. Regarding gender equality, the WuYi Company has implemented the policy of prioritizing female workers and paying female workers equally with their male counterparts. In addition, the project construction teams have also hired local women as cooks, providing them with job opportunities. Regarding cost-effective clean energy, the WuYi Company's camps use solar energy to heat water.

In a nutshell, the project has significantly positive effects on the achievement of ten SDGs, including clean water and sanitation, decent work and economic growth, industry, innovation and infrastructure, inequality reduction, sustainable cities and communities, responsible consumption and production, climate actions, life on land, and partnerships for the goals. It has relatively small or indirect effects on five SDGs, including no hunger, good health and well-being, quality education, gender equality and affordable and clean energy.

4. Policy Implications

This case demonstrates how the SDGs framework can be applied into a specific case and how a infrastructure project promotes sustainable development. Based on the previous analysis, we put forth the following policy implications:

4.1 Focus on the Key Goals and Key Initiatives

Sustainable infrastructure should find the main conflicts and key goals of the sustainable development which should be resolved and achieved respectively by the key initiatives, thus contributing to local sustainable levels increasing. In our case study, opening up and water resources are the key goals to infrastructure projects in the Maasai Mara. The construction of C12 increases the openness of

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this region, allowing it to be integrated into a broader and nationally unified market and even the global value chain. The ponds will improve local water environment and the capacity of climate response. Ecological environment is a fundamental factor of Maasai Mara's local economy dominated by tourism and livestock industries.

4.2 Sustainable Business Model for Win-Win

Sustainable infrastructure projects should match local conditions and adopt long-lasting business modes. In our case study, unlike the traditional model of one-way aid, the WuYi Company has designed a sustainable business model for the construction of ponds at scale. The company considers what the local community desires and what it can provide, and also what the local community can provide and what it wants. Based on both sides, the company launched the initiative of local ponds. Only when the business model considers what the local community really needs are the initiatives put into practice.

4.3 Attaching Importance to Localization and Cultural Exchanges

Sustainable infrastructure should participate in local governance and conduct cultural exchanges with local communities. In our case study, the WuYi Company has demonstration programs for modern agriculture, sanitation, and solar heaters, but their influences are limited due to the insufficiency of public communication with local communities, not to mention contributing to the SDGs. Although the company established friendly relationships with some local leaders, the company has little cooperation with diverse local institutions, especially universities and other institutions without direct business ties. We suggest infrastructure projects should cooperate with universities, cultural institutions, and restaurants for cultural activities such as the Chinese culture festival and the Chinese food party. Through cooperation with local communities, tribes, and churches, we can create a governance platform of cross-border consultation, joint contribution, and shared benefits and deepen local public awareness of the BRI and sustainable infrastructure.

4.4 Top-Level Policy Design for Global Governance

Through high-level dialogues and top-level policy framework, we should create a global governance system encompassing business environment, risk management, and green finance. The BRI is faced with great challenges of business climate and risk mitigation. Without a conducive business climate, it would be difficult to form sustainable business interactions. Without appropriate risk management, it would be challenging for the BRI to yield fruitful results in the long run. Negative effects of the infrastructure project as in this case study on local peace, justice and corruption are also common challenges for other infrastructure projects alongside the Belt and the Road. Transparency, supervision, and the rule of law are essential but beyond the remit of companies and require top-level policy design. The green finance system should be integrated into the BRI initiative to offer preferential loans and subsidies based on the evaluation criteria for sustainable infrastructure. Successful models of sustainable infrastructure operation should be identified and promoted according to local conditions.

4.5 Materializing the Concept of Community with Shared Future for Humankind

Sustainable infrastructure development under the BRI is not only an improvement of material conditions but represents the concept of community with a shared future for humankind by applying Chinese experience and wisdom in light of local conditions. A community with a shared future for mankind is a concept that goes beyond the concept of a country and a nation and is based on the unity of mankind. It is a value-guide for the development of diversification, civilization, and modernization. In promoting sustainable infrastructure, China can bring its experience and lessons of modernization and ecological civilization to BRI countries, expand the achievements of the BRI, and develop an awareness of the concept of community with shared future for humankind.

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Annual Data

		1952	1960	1970	1978	1980	1990	2000	2010	2015	2016	2017	2018	2019	2020
GDP (RMB billion)		68	146	226	368	459	1,887	10,028	41,303	68,905	74,359	82,712	90,031	99,087	101,599
China's GDP share in the world (%)		5.20	4.37	3.13	1.74	1.70	1.60	3.61	9.22	14.69	14.64	15.01	15.86	16.33	17.38
GDP growth rate (%)			0.0	19.3	11.7	7.8	3.9	8.5	10.6	6.9	6.7	6.8	6.6	6.1	2.3
GDP index (1978=100)		21	43	63	100	116	282	760	2,073	3,027	3,231	3,452	3,677	3,902	3,992
GDP per capita (RMB)		119	220	279	385	468	1,663	7,942	30,808	50,028	53,680	59,201	64,644	70,774	72,447
GDP composition (%)	Compensation of employees							53.9	45.0	47.9	47.5	47.5			
	Capital income							34.5	39.7	37.2	38.3	38.3			
	Net production taxes							14.2	15.2	14.9	14.2	14.2			
	Primary industry	50.5	23.4	35.2	27.7	29.6	26.6	14.7	9.5	8.8	8.6	7.9	7.2	7.1	7.7
	Secondary industry	20.9	44.5	40.5	47.7	48.1	41.0	45.5	46.4	40.9	39.9	40.5	40.7	39.0	37.8
	The tertiary industry	28.6	32.1	24.3	24.6	22.3	32.4	39.8	44.1	50.2	51.6	51.6	52.2	53.9	54.5
	Final consumption expenditure	78.9	61.8	66.1	61.4	64.9	62.9	63.3	48.5	51.8	53.6	53.6	54.3	55.4	
	Gross capital formation	22.2	38.1	33.8	38.9	35.5	34.4	34.3	47.9	44.7	44.1	44.4	44.9	43.1	
	Net export	-1.1	0.0	0.1	-0.3	-0.3	2.7	2.4	3.7	3.4	2.2	2.0	0.8	1.5	
Industrial production index (1978=100)		6	31	50	100	122	304	1,109	3,267	4,792	5,080	5,406	5,735	6,062	6,232
Gross fixed asset formation (RMB billion)		8	47	55	111	135	464	3,353	18,583	30,150	31,808	34,937	38,077	42,202	
State finance (RMB billion)	Income	17	57	66	113	116	294	1,340	8,310	15,227	15,960	17,259	18,335	19,038	18,290
	Expenditure	17	64	65	112	123	308	1,589	8,987	17,588	18,776	20,309	22,091	23,887	24,559
Money supply (RMB billion)	M0	3	10	12	21	35	264	1,465	4,463	6,322	6,830	7,065	7,200	7,549	8,286
	M1						695	5,315	26,662	40,095	48,656	54,379	53,569	55,305	58,975
	M2						1,529	13,461	72,585	139,228	155,007	169,024	177,022	191,839	211,653
Foreign reserves (USD billion)		0	0	0	0	-1	11	166	2,847	3,330	3,011	3,140	3,073	3,108	3,217
Import & export (USD billion)	Export	1	2	2	10	18	62	249	1,578	2,273	2,098	2,263	2,487	2,498	2,591
	Import	1	2	2	11	20	53	225	1,396	1,680	1,588	1,844	2,136	2,077	2,056
	Net export	0	0	0	-1	-2	9	24	182	594	510	420	352	422	535
China's export share in the world (%)			1.44	0.72	0.75	0.92	1.80	3.90	10.30	13.80	13.10	12.68	12.69	13.23	14.74
FDI (USD billion)							3.49	40.72	105.74	126.27	126.00	131.04	135.00	156.70	163.00
External debt (USD billion)						4.5	52.6	145.7	548.9	759.5	933.0	1141.4	1325.8	1329.4	1399.8
Exchange rate (USD)		2.227	2.617	2.462	1.720	1.490	4.783	8.278	6.770	6.228	6.642	6.752	6.617	6.976	6.897
Residence (RMB)	Urban per capita disposable income				343	478	1,510	6,256	18,779	31,195	33,616	36,396	39,251	42,359	43,834
	Rural per capita net income	57			134	191	686	2,282	6,272	11,422	12,363	13,432	14,617	16,021	17,131
Population	Population (billion)	0.57	0.66	0.83	0.96	0.99	1.14	1.27	1.34	1.37	1.38	1.39	1.40	1.40	1.41
	Fertility rate (‰)	37.00	20.86	33.43	18.25	18.21	21.06	14.03	11.90	11.99	13.57	12.64	10.86	10.41	8.52
	Mortality (‰)	17.00	25.49	7.60	6.25	6.34	6.67	6.45	7.11	7.07	7.04	7.06	7.08	7.09	7.07
	Natural population growth rate (‰)	20.00	-4.57	25.83	12.00	11.87	14.39	7.58	4.79	4.93	6.53	6.53	3.78	3.32	1.45
	Children's dependency ratio (%)						41.5	32.6	22.3	22.6	22.9	23.4	23.7	23.8	26.2
	The aged dependency ratio (%)						8.3	9.9	11.9	14.3	15.0	15.9	16.8	17.8	19.7
	China's population to the world (%)	21.87	22.00	22.21	22.33	22.13	21.49	20.65	19.32	18.68	18.57	18.46	18.34	18.24	18.11
	On-campus student number (million)	0.19	0.96	0.05	0.86	1.14	2.06	5.56	22.32	26.25	26.96	27.54	28.31	30.32	32.85
Share of state financial educational funds expenditure in GDP (%)		1.62	3.18	1.22	2.04	2.49	2.45	2.56	3.56	4.24	4.21	4.11	4.02	4.04	4.22
Registered urban unemployment rate (%)		13.20			5.30	4.90	2.50	3.10	4.10	4.05	4.02	3.90	3.80	3.62	4.24
Urbanization rate (%)		12.46	19.75	17.38	17.92	19.39	26.41	36.22	49.95	56.10	57.35	58.52	59.58	60.60	63.89

Note: Absolute value in the table is the current prices; relative value is calculated at constant prices. Export share of China to the world in 1978 was substituted by the data of 1980.

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Monthly Data

			2020				2021								
			Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
GDP	Absolute amount (RMB billion)		26,617	29,630			24,931			28,286			29,096		
	Cumulative growth rate since the beginning of the year (%)		0.7	2.3			18.3			12.7			9.8		
Growth rate of industrial added value (%)			6.9	6.9	7.0	7.3		0.0	14.1	9.8	8.8	8.3	6.4	5.3	3.1
Money supply	Absolute amount (RMB billion)	M0	8,240	8,100	8,160	8,430	8,960	9,190	8,650	8,580	8,420	8,430	8,470	8,510	8,690
		M1	60,230	60,920	61,860	62,560	62,560	59,350	61,610	60,540	61,680	63,750	62,040	62,670	62,460
		M2	216,410	214,970	217,200	218,680	221,300	223,600	227,650	226,210	227,550	231,780	230,220	231,230	234,280
	Month-on-month growth (%)	M0	3.0	-1.7	0.7	3.3	6.3	2.6	-5.9	-0.8	-1.9	0.1	0.5	0.5	2.1
		M1	0.2	1.2	1.5	1.1	0.0	-5.1	3.8	-1.7	1.9	3.4	-2.7	1.0	-0.3
		M2	1.3	-0.7	1.0	0.7	1.2	1.0	1.8	8.1	8.3	1.9	-0.7	0.4	1.3
Foreign reserves	Absolute amount (USD billion)		3,143	3,128	3,179	3,217	3,211	3,205	3,170	3,198	3,222	3,214	3,236	3,232	3,201
	Month-on-month growth (%)		1.6	0.7	2.7	3.5	3.1	3.2	3.6	3.5	3.9	3.3	2.6	2.1	1.9
	Year-on-year growth (%)		-0.7	-0.5	1.6	1.2	-0.2	-0.2	-1.1	0.9	0.7	-0.2	0.7	-0.1	-1.0
New credit	Absolute amount (RMB billion)		1,919	666	1,530	1,146	3,820	1,341	2,751	1,284	1,430	2,316	839	1,271	1,777
	Month-on-month growth (%)		9.0	21.8	12.2	6.4	9.4	86.2	-9.5	-20.9	-7.8	21.7	-17.9	-10.5	-7.3
	Year-on-year growth (%)		35.1	-65.2	129.6	-25.2	233.4	-64.9	105.1	-53.3	11.4	62.0	-63.8	51.5	39.8
Urban fixed-asset investment	Absolute amount (RMB billion)		5,770	4,676	1,627	1,935		4,524	5,076	4,781	5,011	6,198	4,663	4,438	5,091
	Month-on-month growth (%)		-4.8	-5.9	-28.8	8.9		35.8	-0.1	-9.2	-19.7	-24.8	-2.1	-10.6	-11.8
State revenue	Current amount (RMB billion)		1,423	1,753	1,096	1,341		4,181	1,531	2,089	1,845	2,066	2,060	1,237	1,393
	Month-on-month growth (%)		4.5	3.0	-2.7	17.4		18.7	42.4	29.4	18.7	11.7	11.1	2.7	-2.1
Price index	CPI Month-on-month growth (%)		1.7	0.5	-0.5	0.2	-0.3	-0.2	0.4	0.9	1.3	1.1	1.0	0.8	0.7
	PPI Month-on-month growth (%)		-2.1	-2.1	-1.5	-0.4	0.3	1.7	4.4	6.8	9.0	8.8	9.0	9.5	10.7
PMI	Manufacturing (%)		3.4	4.3	3.8	3.4	2.6	41.7	-0.2	0.6	0.8	0.0	-1.4	-1.8	-3.7
	Non-manufacturing (%)		4.1	6.4	3.7	4.1	-3.1	73.7	7.7	3.2	3.0	-1.7	-1.7	-14.0	-4.8
Import & export	Absolute amount of export (USD billion)		239.8	237.2	268.1	281.9		468.9	241.1	263.9	263.9	281.4	282.7	294.3	305.7
	Month-on-month growth (%)		9.9	11.4	21.1	18.1		60.6	30.6	32.3	27.9	32.2	19.3	25.6	28.1
	Year-on-year growth (%)		1.9	-1.1	13.0	5.2				9.5	0.0	6.6	0.4	4.1	3.9
	Absolute amount of import (USD billion)		202.8	178.7	192.6	203.8		365.6	227.3	221.1	218.4	229.9	226.1	236.0	239.0
	Month-on-month growth (%)		13.2	4.7	4.5	6.5		22.2	38.1	43.1	51.1	36.7	28.1	33.1	17.6
	Year-on-year growth (%)		15.0	-11.9	7.8	5.8				-2.8	-1.2	5.3	-1.7	4.4	1.3
FDI	Absolute amount (USD billion)		14.25	11.83	14.38	12.68	13.47	12.60	18.79	14.18	13.05	16.17	9.78	13.04	15.48
	Month-on-month growth (%)		23.70	18.40	5.60	2.20	6.20	87.56	59.21	39.84	32.22	-0.03	0.08	0.08	0.09
	Year-on-year growth (%)		0.18	-0.17	0.22	-0.12	6.23	-6.46	49.13	-24.53	-7.97	0.24	-0.40	0.33	0.19
Weighted average interbank loan rates (%)			1.80	2.13	1.98	1.30	1.78	2.06	2.01	2.01	2.09	2.13	2.08	2.08	2.16
Local and foreign currency deposit	Current month absolute amount (RMB billion)		1,739.9	-276.3	2,061.3	-267.5	3,850.0	1,297.3	3,693.8	-515.9	2,523.0	3,982.6	-1,280.7	1,400.6	2,298.5
	Month-on-month growth (%)		142.4	-179.8	59.7	-143.6	31.0	12.7	-9.2	-144.0	9.0	29.1	-1,230.0	-30.5	32.1
	Year-on-year growth (%)		-13.7	-115.9	845.9	-113.0	1,539.4	-99.4	184.7	-114.0	589.1	57.9	-132.2	209.4	64.1
Reserve requirement ratio	Large financial institutions (%)		12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.0	12.0	12.0
	Small and medium sized financial institutions (%)		10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.0	10.0	10.0
China Economist survey	Economic climate index		68	80			139			102			98		
	Trade indicators		59	92			128			141			127		
	Price index		158	127			143			144			136		
	Employment index		39	41			114			112			98		

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Call for Papers for the Summit of Economists from Developing Countries

For the purpose of promoting Sino-foreign frontier exchanges and dialogue on economics and advancing the development of economics as a discipline in China, *China Economist* intends to co-organize "the Summit of Economists from Developing Countries" in partnership with well-known international research institutions to provide academics from various countries a platform of communication and academic discussions on issues related to developing countries.

The first forum is scheduled take place in May 2022 on the theme of "Global Cooperation and Economic Development in the Era of Digital Economy" in Beijing. The event will take an online and offline hybrid mode featuring keynote speeches and academic parallel forums, Chinese and international academics will be invited to participate. We hereby call for Chinese and English-language papers from Chinese and international academics in the field of economics. With the tenet to promote global cooperation between development economist and economic development in developing countries, the forum encourages academics to investigate issues related to international cooperation and development in the era of digital economy from diverse perspectives and engage in discussions on a global scale. We welcome contributions from interested academics.

The Summit is planned to be held once a year alternatively in China and other developing countries. The first forum will feature the selection of excellent papers. Authors of excellent papers wishing to have their papers first published in *China Economist* will be invited to take part in the Second Summit (temporarily decided to be held overseas), and the international travel expenses will be covered by the forum's organizers (financial support is planned to be granted to three to five excellent authors at the first forum).

1. Topics of papers for submission may include (without limitation):

Global cooperation and economic development in the era of digital economy
Digital economy and technology innovation
Sustainable development in the era of digital economy
Trade and regulation of digital products
Digital economy and common prosperity
China-Africa cooperation for industrial and supply chain stability and upgrade

2. Requirements on submissions

Papers for submission should be unpublished original academic papers in Chinese or English language. Please refer to papers already published in *China Economist* as a style guide. Each Chinese paper should be no shorter than 15,000 Chinese characters, and each English paper should be no shorter than 10,000 English words.

3. Deadline of submission

Please submit your paper in electronic format to **editor@ChinaEconomist.com** before February 28, 2022. The subject line of email should indicate "Summit of Economists from Developing Countries", and the name of attached document should be in the format of "name of first author + title of submission"; author information (name, affiliation, address of correspondence, telephone, email, etc.) should be separately indicated in the first page of submitted paper.

4. Review

The Forum's review committee consists of senior Chinese and international academics active in the frontier research of economics. Conference papers will be selected from all submissions. Notification of acceptance and a formal invitation will be sent to the author of the selected paper before March 31, 2022.

On the day of the event, invited Chinese and international well-known academics in the field of development economics will deliver keynote speeches; participating authors will deliver presentations and communicate with their peers in relevant fields of research. The review committee will select a certain number of excellent papers from all submissions. Excellent papers will be given priority in entering *China Economist*'s review procedure, and the *China Economist*'s editorial division will have selected Chinese papers translated into English for publication.

5. Other related matters

No conference fee will be charged for this forum. Participants should cover their own transportation and accommodation costs. Meals during the forum will be provided by the organizer free of charge.

Contact:
Dr. Qin Yu
Editorial Division of *China Economist*
Telephone: +86 010-68025916
Email: qinyu@cass.org.cn
WeChat: qinyu969311896

Editorial Division of *China Economist*

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Awards received: "the Best Works Award", "The Chinese Government Award for Publishing", "the Sun Yefang Prize in Economic Sciences". Some books have been listed as key projects supported by the State, like the support by the National Press Fund and the Publishing Planning Project of National Key Publications.

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The Chinese economy has been growing rapidly for more than two decades and is forcefully changing the global economic pattern.

It seems that the world was ill-prepared for such dramatic changes in China. This has made it even more necessary for China to understand itself and to deepen its knowledge of the rest of the world. In turn, the world also needs to better comprehend China's background and current situation. Thus, it has become an international trend to study China and to explore the global meaning of the China phenomenon. However, despite the fact that learning Chinese as a foreign language is in vogue throughout the world, few foreigners can read Chinese articles without difficulty. *China Economist*, therefore, comes in handy for our foreign readers as an English periodical that focuses on economics and business management as well as on other fields of social sciences in China.

Specifically, *China Economist*'s role is to inform the world of the latest academic progress in Chinese economics and business management, to publish original academic papers and research reports on the Chinese economy, and to disseminate China's experience in economic development and corporate governance as well as the results of empirical studies in these fields.

Prof. Li Yang Academy Member of Chinese Academy of Social Sciences (CASS)

Prof. Jin Bei Academy Member of Chinese Academy of Social Sciences (CASS)

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