

Environmental and Social Sustainability of the Belt and Road Projects in East and Central Africa

Abdikani Jama Hassan

Belt and Road School, Beijing Normal University, Zhuhai, China

Email: 3769197274@qq.com, nugaal933@gmail.com

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Abstract

As an important objective of the “Belt and Road” initiative, this paper focuses on countries in Central and East Africa, aligning with a key goal of the “Belt and Road” development. This research analyzes aspects of environmental and social sustainability of the “Belt and Road” initiative as well as development possibility of the project. Questionnaires were sent to the two regions to collect the understanding of the East and Central African respondents on the “Belt and Road” initiative, and data analysis was conducted to summarize the changes it brings to the sustainable development of the environment and society. The results of the survey show that the majority of respondents were young, urban males, with students making up the largest occupational category. While awareness of specific BRI-funded environmental protection measures varied, the project was widely seen as having a positive influence on both environmental sustainability and social development. The findings show a strong link between environmental and social sustainability and economic growth, with social sustainability having a larger impact. However, the study notes obstacles like insufficient cultural preservation and geopolitical issues that might hamper the BRI’s long-term success in the region. Despite these limitations, the BRI has contributed positively to improving local economies and the quality of life.

Keywords

Belt and Road Initiative, Environmental and Social Sustainability, East Africa, Central Africa, Environmental Impact

1. Introduction

The BRI introduced by the Chinese President Xi Jinping is a large and advantageous initiative. Its main objectives include linking Asia, Africa and Europe by sea and by land with a view of increasing trade and commerce, economic development and integration in the regions (Fang et al., 2022). It includes more than 150

countries covering over 50% of the world's Gross Domestic Product and over 75% of the world's population. China aims at maintaining the high rates of economic growth by reorganizing the trade relations through this effort. The BRI has many components, one of which is infrastructure connectivity, but there is also policy cooperation, trade liberalization and facilitation, financing, and people-to-people connectivity. However, the evaluation of the effects of this rather large-scale project is too early at the moment. Moreover, it can turn the less developed regions of the Belt and Road into effective economic zones and can add the experiences of the successful emerging markets to the discussions on economic policies.

When the Belt and Road Initiative was launched, the importance of Central and East Africa had not been well appreciated. The Central Africa region which is an essential part of Africa has five major countries including Burundi, the Central African Republic, Chad, Democratic Republic of the Congo, and Rwanda (see **Figure 1** and **Figure 2**). Most of the African countries have expressed their willingness to participate in the Belt and Road Initiative. These have been facilitated through the opening up of the various sectors for exchange of goods, technology, capital and personnel. It has also promoted the intersectoral coordination of the economy, society, environment and culture in Central Africa, so as to open up more opportunities in infrastructure construction, economic development, trade, exchange and training (Yang & Gao, 2017).



Figure 1. Belt and Road in West-Africa.

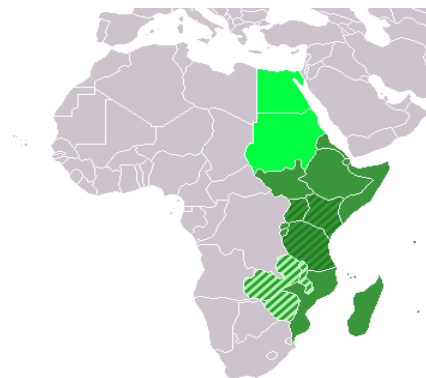


Figure 2. Central and East-Africa.

As an important region of the “Belt and Road”, most East African countries used to be an important part of the Silk Road. Its unique geographical location and good development foundation gives East Africa a significant advantage in in-depth contact with China’s “Belt and Road”. At present, East African countries focus on development, taking modern infrastructure as the starting point. Comprehensively drive national industrialization and modernization, with that in mind prioritizing the “Belt and Road Initiative” and “five links” in logic and practice, providing a solid foundation and broad space for cooperation between East African countries (Fu et al., 2023).

The first of the five major themes of the BRI is green. This process has always followed the concept of green development, which has greatly improved the coordination of countries involved in ecological protection. It is especially important for attaining sustainable development that is harmonized across the economic, social, and natural environments. As the environmental protection issues like climate change and loss of biological diversity new non-financial performances—environmental, social, and governance considerations—are becoming more and more significant factors affecting business, investments in projects, and construction activities. These emerging requirements enhance the significance of the overseas investment partnerships of China and the BRI development strategy. Some of them include the sustainable infrastructure principles, proposed by the United Nations Environment Program as well as the nature-based solutions proposed by the International Union for Conservation of Nature (Wang & Tang, 2024).

This study’s main research topics and objectives are to examine how the Belt and Road Initiative (BRI) has affected social and environmental sustainability in Central and Eastern Africa and to assess the ensuing economic fallout.

Research Hypothesis

- 1) The Belt and Road Initiative (BRI) has made a considerable positive contribution to environmental sustainability.
- 2) The Belt and Road Initiative (BRI) has had a substantial positive impact on social sustainability.
- 3) Social and environmental sustainability have a significant positive impact on economic development.
- 4) Projects under the Belt and Road Initiative (BRI) in East and Central Africa improve social sustainability through community development, job creation, and infrastructural improvements, all of which raise the standard of living for locals.

This paper uses the theory of sustainability to assess the BRI on environmental, social and economic sustainability. However, Africa and especially the Central and Eastern part is getting more and more important within the BRI framework. This paper’s analysis of the implementation of the initiative offers a good starting point for evaluating its impact on sustainable development in different parts of Africa and for developing relevant policies. Studying sustainability in CEA will expand the literature of BRI with reference to sustainability, which is still limited in the existing quantitative studies of sustainable development in Africa, and extend the knowledge on social and environmental sustainability (Yang & Wu, 2023).

2. Sustainable Development Theory

The World Commission on Environment and Development (WCED) first formally proposed the concept of sustainable development in 1987. It stemmed from humanity's reflection on industrial civilization, which holds that development should not only satisfy the needs of the current generation but also provide for those of future generations. At the beginning, the theory of sustainable development aimed at cutting down on the use of energy and improving the state of ecology to support the economy. In 2015, the United Nations came up with seventeen Sustainable Development Goals with topics including hunger, climate, social and economic (Shen, 2023). The theory of sustainable development has since evolved from a focus on environmental and resource sustainability to include economic and social sustainability, encompassing the following aspects (Chen, 2023). The theory of sustainable development has since evolved from a focus on environmental and resource sustainability to include economic and social sustainability, encompassing the following aspects:

1) Ecological environment: as the basis for human survival and economic development, the ecological environment has the characteristics of irreplaceability and scarcity. In the 1970s, many bio-economists included ecological resources and other factors into the consideration criteria of economic development, and internalized external factors to improve the importance of ecological environment (Zhu, 2022). Only on the basis of realizing the balance of ecological environment and good development, can we ensure the sustainable survival and development of human beings (Liu, 2020).

2) Thus, economic development, which is one of the main objectives when it comes to people's existence and enhancement, is an essential aspect of the sustainable development concept. Sustainable economic development seeks to achieve the economic welfare of the current generation and the health of the ecosystems as well as the welfare of the next generations (Chen & Liu, 2021). It is not just about the growth but the change of development paradigm where economic progress is pursued as a sustainable process that does not harm the earth and its ecosystems.

3) Social well-being: The very core of the concept of sustainable development is based on the concept of "person-centered". Taking into consideration the factors that are essential for the sustainable development, it is necessary to mention the economic and ecological aspects as well as such factors as living conditions, social development, population growth, gender and educational equity (Li & Wang 2024). The attainment of social welfare sustainability is therefore crucial in the promotion of a society that transforms in a harmonized and stable manner.

4) Climate action: Climate change is mainly caused by activities that are carried out by human beings. While development of social and economic aspects of human life, the consequences of human activities to climate have been magnified. This is in the form of deforestation, uncontrolled farming, emission of methane, industrial effluence and sea and air pollution which all lead to the unsustainable exploitation of the environment (Wang et al., 2024). Therefore, to promote

sustainable climate development, people's activities must be controlled, and their awareness of the environment and climate effects of these activities improved. Sustainable development theory comprises several systems: the health of the ecosystem, economic activity, social well-being, and the fight against climate change. Sustainability also has to be attained at the level of each system, as well as the interrelated development of these systems to ensure that the external conditions are appropriate for human life. Thus, in the context of the SD theory, this paper is devoted to discussing and analyzing environmental and social sustainability (Robert et al., 2005).

3. Literature Review

(Zhu, 2022) focuses on three agricultural countries in East Africa, which are Kenya, Tanzania, and Zambia; it pointed out that these three countries have similar historical background, national condition, economy, industrialization and education background. These East African nations are major players in the Belt and Road Initiative; therefore, they are important partners for Chinese enterprises in international production capacity cooperation. Chinese firms have been growing their presence and exporting technology and management knowledge. These countries with abundant mineral and human resources have hence used Chinese investment to promote economic growth and development.

(Shen, 2023) selected 77 countries along the Belt and Road Initiative, and the research objects are the agro-ecological environment and agricultural economic resources. Shen came up with an indicator framework that consisted of economic returns, social well-being, ecological surroundings, and climate change interventions to estimate the degree of sustainable agricultural advancement in these countries.

(Yang and Gao, 2017) also discuss history of East Africa as a part of the ancient Silk Road and its present position in the Belt and Road project. They stress on the strategic position of East Africa as a link between the maritime and the overland routes, and propose that, as a continuation of the Silk Road, the region can improve the connection with the continent's interior. In the framework of the Belt and Road Initiative, they suggest creating a security forum to solve security problems, realizing the China-East Africa strategic partnership to the fullest extent, and increasing public diplomacy to expand cooperation and find new avenues for interaction.

According to Fu Bojie and others, the Belt and Road countries' ecological environment governance scientific and technological capability enhancement can promote regional sustainable development.

In this regard, (Chiyemura, Gambino, & Zajontz, 2022) analysed the role of infrastructure development in Africa within the Belt and Road Initiative. They point out that the efficiency and types of national institutions are dependent on institutional, economic, political, and bureaucratic environments of African countries. Their analysis involves the studies of state institutions and the context with more emphasis on the China-Africa relationship.

4. Empirical Analysis

This paper is collected by sending out questionnaires, which are divided into three parts in terms of questionnaire design. The first part is the collection of basic information of the respondents, the second part is the collection of environmental sustainability, and the third part is the collection of social sustainability. A total of 112 questionnaires are collected this time (see **Table 1**), and the data are analyzed by Statistical Package for the Social Sciences (SPSS).

Table 1. Frequency analysis.

		Frequency	Percent
Gender	A Male	71	63.4
	B Female	40	35.7
	C Prefer not to say	1	0.9
age	A 15 - 20 years old	4	3.6
	B 21 - 25 years old	49	43.8
	C 26 - 30 years old	44	39.3
	D 31 - 35 years old	12	10.7
	E Over 35 years old	3	2.7
live in	A City	93	83.0
	B Suburb	14	12.5
	C Rural area	5	4.5
occupation	A Student	69	61.6
	B Teacher/Scholar	8	7.1
	C Engineer	6	5.4
	D Businessperson	9	8.0
	E Government official	5	4.5
	F Freelancer	2	1.8
	G Other	13	11.6

4.1. Frequency Analysis of Respondents

In terms of the gender of the respondents, the proportion of males was 63.4% and that of females was 35.7%, which was much higher than that of females. In terms of the age of the respondents, those aged 21 - 25 accounted for the highest proportion of 43.8%, followed by those aged 26 - 30 accounted for 39.3% and those aged 31 - 35 accounted for 10.7%. In terms of address, 83.0% of respondents lived in urban areas, 12.5% in suburban areas, and 4.5% in rural areas. In terms of occupation, the highest proportion of students was 61.6%, Teacher/Scholar, Engineer, Businessperson, Government official, and Freelancer accounted for 7.1%, 5.4%, 8.0%, 4.5%, and 1.8%, respectively.

As can be seen from the below **Table 2**, in terms of understanding the environmental protection facilities financed by the Belt and Road Initiative in Central and East Africa, Afforestation, Ecological restoration, Use of clean energy, Pollution control, Water resource management, I am not aware of any environmental measures accounted for 17.7%, 16.5%, 20.9%, 13.9%, 11.4%, 19.6%, among which

the use of clean energy accounted for the highest proportion, followed by afforestation measures, ecological restoration measures accounted for 16.5%, also 19.6%. A large part of the respondents did not know anything about environmental protection measures.

Table 2. Environmental project frequency.

	N	P	Percentage of cases
Afforestation	28	17.7%	25.0%
Ecological restoration	26	16.5%	23.2%
Use of clean energy	33	20.9%	29.5%
Pollution control	22	13.9%	19.6%
Water resource management	18	11.4%	16.1%
I am not aware of any environmental measures	31	19.6%	27.7%

As can be seen from **Figure 3** below, 57 respondents have a very good understanding of the “Belt and Road” policy, accounting for 50.9%, 24.1% have some understanding, 21.4% have heard of it but do not understand it, and only 3.6% do not understand it at all. Most respondents understand the “Belt and Road” initiative policy. This shows that the “Belt and Road” policy has a far-reaching impact on the local.

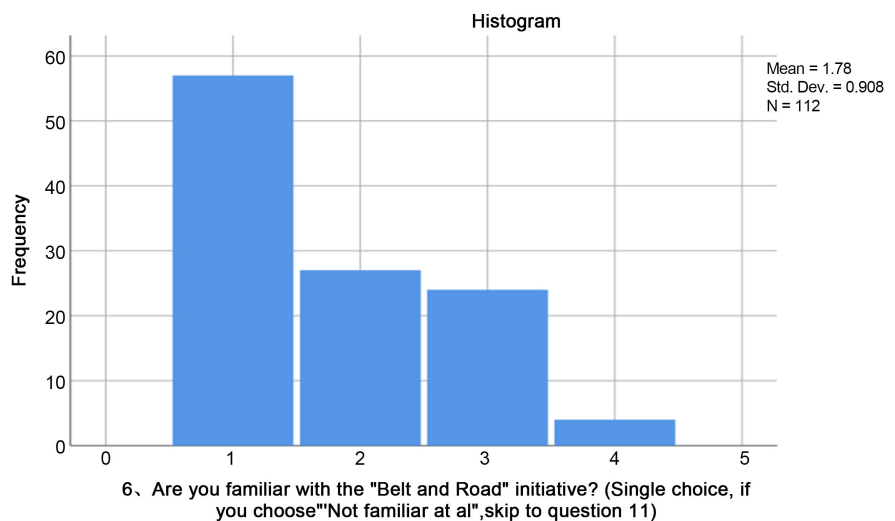


Figure 3. Level of knowledge about BRI.

In the “Belt and Road” to the protection of local traditional culture, can achieve full respect and protection of 0, do most of the time respect and protection accounted for 9.8%, sometimes respect, sometimes ignore 23.2%, often ignore or destroy 30.4%, completely ignore or destroy 36.6% (see **Figure 4**). This shows that the “Belt and Road” policy does not protect and respect traditional culture enough, and further efforts are needed.

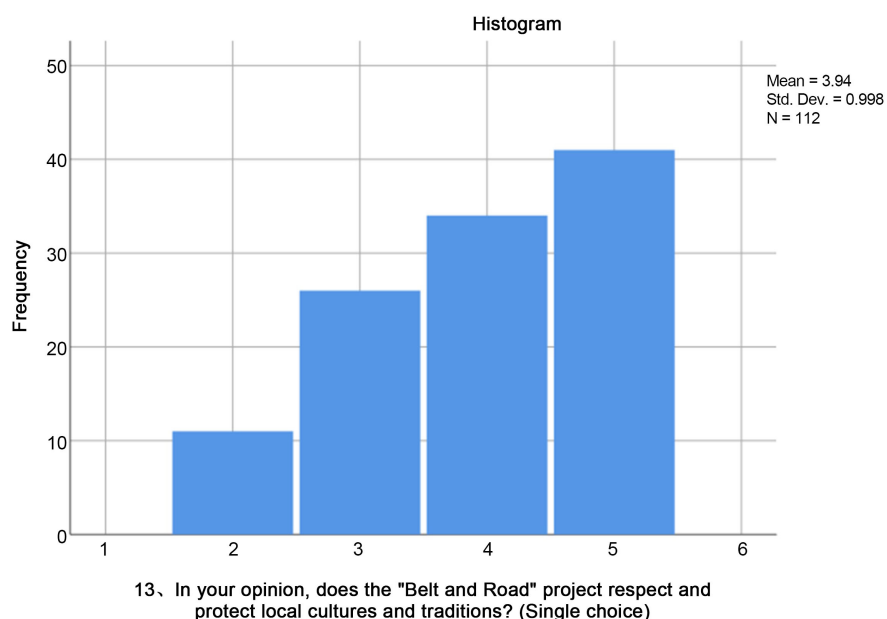


Figure 4. BRI Protection level of traditional culture.

4.2. Descriptive Analysis

Environmental sustainability is supported by the “8. How would you rate the efforts of the “Belt and Road” project in environmental protection? In your opinion, has the implementation of the “Belt and Road” project fully considered the protection of biodiversity? 15. Do you believe the “Belt and Road” project contributes to mitigating climate change? The average value of the eighth question “One Belt and One Road” in terms of environmental protection is 3.97, the ninth question is 4.07, the fifteenth question is 4.03, and the overall average value is 4.02, indicating that the surveyed people believe that the “One Belt and one Road” policy has brought a good effect on environmental sustainable development (**Table 3**).

Table 3. Environmental sustainability descriptive statistics.

	N	Min	max	M ± SD
8. How would you rate the efforts of the “Belt and Road” project in environmental protection?	1121		5	3.97 ± 1.044
9. In your opinion, has the implementation of the “Belt and Road” project fully considered the protection of biodiversity?	1121		5	4.07 ± 0.824
15. Do you believe the “Belt and Road” project contributes to mitigating climate change?	1121		5	4.03 ± 1.009
Environmental sustainability	1121		5	4.02 ± 0.789

As can be seen from below **Table 4**, social sustainability is supported by the “11. How do you think the “Belt and Road” project has impacted the development and quality of life in local communities? 12. Has the “Belt and Road” project promoted local employment and social welfare? 13. In your opinion, does the “Belt and Road” project respect and protect local cultures and traditions? 16. Do you think the “Belt and Road” project’s investment in education and skills training is

sufficient? The mean value of the four questions is 4.03, 4.01, 3.94 and 4.00 respectively, and the mean value of the overall social sustainability is 4.03, indicating that the “Belt and Road” has also played a good role in social sustainability.

Table 4. Environmental sustainability descriptive statistics.

	N	min	max	M ± SD
11. How do you think the “Belt and Road” project has impacted the development and quality of life in local communities?	112	1	5	4.03 ± 1.078
12. Has the “Belt and Road” project promoted local employment and social welfare?	112	1	5	4.01 ± 1.095
13. In your opinion, does the “Belt and Road” project respect and protect local cultures and traditions?	112	1	4	3.94 ± 0.998
16. Do you think the “Belt and Road” project’s investment in education and skills training is sufficient?	112	1	5	4.00 ± 0.822
Social Sustainability	112	1	4.75	4.03 ± 1.078

4.3. Correlation Analysis

As can be seen from below **Table 5**, the correlation coefficient between the impact of economic development and environmental sustainability is 0.492, which is a positive correlation. The higher the environmental sustainability, the higher the impact of economic development. The correlation coefficient between economic development and social sustainability is 0.546, the higher the social sustainability, the higher the impact of economic development; The correlation coefficient between environmental sustainability and social sustainability is 0.666, and the higher the environmental sustainability, the higher the social sustainability.

Table 5. Correlation analysis.

		Economic development impact	Environmental sustainability	Social sustainability
Economic development impact	P	1	0.492**	0.546**
	Sig.		0.000	0.000
	N	112	112	112
Environmental sustainability	P	0.492**	1	0.666**
	Sig.	0.000		0.000
	N	112	112	112
Social sustainability	P	0.546**	0.666**	1
	Sig.	0.000	0.000	
	N	112	112	112

** . At level 0.01 (two-tailed), the correlation was significant.

4.4. Regression Analysis

It can be seen from the model summary **Table 6** that the adjusted R of the model is 0.316, indicating that the independent variables social sustainability and

environmental sustainability can explain 31.6% of the changes in economic development, and the model has good explanatory ability.

Table 6. Model summary.

Model	R	R square	Adjusted R square	Errors in standard estimates
1	0.573 ^a	0.328	0.316	0.821

a. Predictors: (Constant), Social sustainability, Environmental sustainability.

As can be seen from below **Table 7**, $F = 26.594$, $P = 0.000$, and the significance P value is less than 0.05, indicating that the model is significant and the independent variable has a significant impact on the dependent variable.

Table 7. ANOVA^a.

	Model	Sum of Squares	Df	Mean Square	F	Sig.
	Regression	35.883	2	17.942	26.594	0.000 ^b
1	Residual	73.536	109	0.675		
	Total	109.420	111			

a. Dependent Variable: Economic development impact; b. Predictors: (Constant), Social sustainability, Environmental sustainability.

As can be seen from the coefficient **Table 8**, the regression coefficient of social environmental sustainability is 0.289, $t = 2.182$, $P = 0.031 < 0.05$, indicating that environmental sustainability has a significant positive impact on the dependent variable. When environmental sustainability increases by 1, the impact of the dependent variable on social development increases by 0.289. The regression coefficient of social sustainability is 0.475, $t = 3.739$, $P = 0.000 < 0.05$, indicating that social sustainability has a significant positive impact on the dependent variable, and the impact is greater than that of environmental sustainability. When social sustainability increases by 1, the dependent variable socio-economic development increases by 0.475. In the process of participating in the construction of the “Belt and Road”, East and Central Africa have also encountered a lot of challenges, including the political transformation challenges faced by African countries, security issues, and the game competition among great power strategies. On the whole, it has a good impact on environmental sustainability and social sustainability, further promotes local economic development, and people’s lives are improved because of the “Belt and Road” policy.

Table 8. Coefficients^a.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.159	0.433		2.674	0.009
1 Environmental sustainability	0.289	0.132	0.230	2.182	0.031
Social sustainability	0.475	0.127	0.393	3.739	0.000

a. Dependent Variable: Economic development impact.

5. Conclusion

In the central and eastern African region of the Belt and Road Initiative, the use of clean energy accounts for the highest proportion of environmental protection measures, but 19.6% of the respondents have no understanding of environmental protection measures, and the majority of the respondents understand the “Belt and Road” policy, and the degree of protection of local traditional culture is insufficient. From the descriptive statistics of environmental sustainability and social sustainability, the mean values are all above 3.9, indicating that the implementation of the Belt and Road Initiative has played a good role in local sustainable development. It can be seen from the regression analysis that the sustainable development of environment and society also has a positive impact on the economy.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix

East and Central Africa “Belt and Road” Project Environmental and Social Sustainability Survey Questionnaire

Dear Participant,

Greetings! This questionnaire aims to collect information on the impact of the “Belt and Road” initiative projects in East and Central Africa in terms of environmental and social sustainability. Your opinions will provide valuable data support for our research work. Please complete this questionnaire seriously and objectively based on your actual situation and views. All data will be used solely for academic research purposes, and we commit to protecting your personal privacy. Thank you for your participation and support!

[Personal Information]

1. What is your age? (Single choice)

- A. 15 - 20 years old
- B. 21 - 25 years old
- C. 26 - 30 years old
- D. 31 - 35 years old
- E. Over 35 years old

2. What is your gender? (Single choice)

- A. Male
- B. Female
- C. Prefer not to say

3. Which country/region are you in? _____ (Fill in the blank)

4. What type of city/village do you live in? (Single choice)

- A. City
- B. Suburb
- C. Rural area

5. What is your occupation? (Single choice)

- A. Student
- B. Teacher/Scholar
- C. Engineer
- D. Businessperson
- E. Government official
- F. Freelancer
- G. Other

[Perceptions of the “Belt and Road” Initiative]

6. Are you familiar with the “Belt and Road” initiative? (Single choice, if you choose “Not familiar at all”, skip to question 11)

- A. Very familiar
- B. Somewhat familiar
- C. Heard of it but not familiar
- D. Not familiar at all

7. How do you think the “Belt and Road” project impacts the economic

development of East and Central Africa? (Single choice)

- A. Very positive impact
- B. Some positive impact
- C. Minimal impact
- D. Negative impact
- E. Unable to evaluate

[Environmental Sustainability]

8. How would you rate the efforts of the “Belt and Road” project in environmental protection? (Single choice)

- A. Very sufficient
- B. Some effort made
- C. Average
- D. Insufficient
- E. Did not focus on this issue

9. In your opinion, has the implementation of the “Belt and Road” project fully considered the protection of biodiversity? (Single choice)

- A. Yes, very thoroughly
- B. It has been considered, but there is room for improvement
- C. Not sure
- D. Not considered or insufficiently addressed
- E. Not considered at all

10. Are you aware of any environmental measures taken by the “Belt and Road” project in East and Central Africa? (Multiple choices)

- A. Afforestation
- B. Ecological restoration
- C. Use of clean energy
- D. Pollution control
- E. Water resource management
- F. I am not aware of any environmental measures

[Social Sustainability]

11. How do you think the “Belt and Road” project has impacted the development and quality of life in local communities? (Single choice)

- A. Significantly improved
- B. Somewhat improved
- C. No noticeable impact
- D. Reduced quality of life
- E. Uncertain/unable to evaluate

12. Has the “Belt and Road” project promoted local employment and social welfare? (Single choice)

- A. Significantly promoted
- B. Somewhat promoted
- C. No significant change
- D. Somewhat inhibited

E. Completely inhibited

13. In your opinion, does the “Belt and Road” project respect and protect local cultures and traditions? (Single choice)

A. Fully respects and protects

B. Mostly respects and protects

C. Sometimes respects, sometimes neglects

D. Often neglects or undermines

E. Completely neglects or undermines

14. What are your suggestions or comments on how the “Belt and Road” project can achieve environmental and social sustainability in East and Central Africa? Please feel free to express your views. (Open-ended question)

(Environmental Sustainability)

15. Do you believe the “Belt and Road” project contributes to mitigating climate change? (Single choice)

A. Yes, significantly

B. To some extent

C. Minimal impact

D. No contribution

E. Uncertain

(Social Sustainability)

16. Do you think the “Belt and Road” project’s investment in education and skills training is sufficient? (Single choice)

A. Very sufficient

B. Relatively sufficient

C. Average

D. Insufficient

E. Completely insufficient