

BRI International Green Development
Coalition

The Belt and Road Initiative Green Development Case Studies Report 2020



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The BRI International Green Development Coalition (BRIGC) was officially launched by the Ministry of Ecology and Environment of China (MEE) and international partners in April 2019. BRIGC secretariat has been working on promoting policy dialogue, joint research, knowledge sharing, capacity building and technology transfer among the partners. A series of report concerned with climate change, biodiversity, energy, green supply chain, etc. had been released. Please refer to the website of BRIGC for detail information. (<http://en.brigc.net>)



Preface

Practicing green development is a profound change in the development concept and promoting green development has become a common goal pursued by the world. The Belt and Road Initiative (BRI), aimed at building a community of shared future for mankind, will contribute Chinese solutions to global governance reform and high-quality development.

Green is the underlying color of BRI development. Peace and development remain the themes of our time. Due to different national conditions and capabilities, all countries are seeking a development path compatible with their own situations. The development path they have chosen may differ, but the pursuit of high quality development is the common consensus. Development cannot be achieved at the price of resource exhaustion, nor via a path featured by pollution first and treatment afterward. Green should be the underlying color for development. A harmonious development between the economy, society and the environment is the key to increasing the sense of attainment and happiness for people around the world. The BRI provides a platform and opportunities for BRI participating countries to achieve the 2030 Agenda for Sustainable Development by integrating sustainability into project selection, operation and management.

The energy that win-win cooperation brings about from green development practice can always be felt when we are compiling this report. If green development is the golden key to solving major problems of the globe, the practical cooperation of all parties is the hand on this key. The BRI, together with other development cooperation initiatives, offers a good platform where countries can coordinate and cooperate with each other.

In this special moment of fighting against the COVID-19, the concerted efforts made by the international community further highlight the significance and necessity of BRI international cooperation. The space for jointly building BRI is further expanded. The pandemic triggered an in-depth reflection on the harmonious coexistence between man and nature. Against the backdrop of sluggish economic growth, green recovery will be an important driving force for the post-pandemic high quality development. The international community highly expects that BRI can play a leading role in the global green recovery.

In 2019, the BRI International Green Development Coalition (BRIGC) is jointly initiated by the Ministry of Ecology and Environment of China and international partners. It aims to develop an open, inclusive and voluntary international network which facilitates policy dialogue, information sharing, technology transfer and pilot projects on green development, in an effort to fully integrate green development into BRI development and help BRI participating countries achieve 2030 Agenda for Sustainable Development.

The purpose of this report is to share good practices in environmental and ecological protection with cases and to boost protection efforts. The report has been officially publicized during the BRIGC 2020 Policy Studies Release. The BRIGC remains ready to mobilize resources and pool strength from its partners in an open and inclusive manner, so as to produce concrete outcomes and actively contribute to the green development in BRI participating countries.

The report is prepared by the BRIGC Secretariat. Chapters 1 and 2 are written by Tian Fang, Chap. 3 by Peng Ning, Chap. 4 by Lan Yan, Chap. 5 by Zhao Wenkai, Chap. 6 by Li Panwen, Chap. 7 by Li Gongtao, and Chap. 8 by Zhao Haishan.

The information and data of this report is mainly provided by relevant enterprises, including China Railway Construction Corporation Limited (CRCC), China Communications Construction Company Limited (CCCC), China Petro chemical Corporation (Sinopec Group), the China Three Gorges Corporation (CTG), the China Everbright Environment Group Limited, the China CAMC Engineering Co., Ltd, the Shanghai Electric Power Co., Ltd (SEP), Esquel Group and the Royal Golden Eagle's Group of Companies.

April 2021

Editorial Committee

Congratulatory Message

The United Nations Office for South-South Cooperation would like to congratulate the Belt and Road Initiative International Green Development Coalition (BRIGC) on its recent report entitled, “The Belt and Road Initiative (BRI) Green Development Case Studies Report 2020”.

The good environmental and climate solutions documented in this report have shed light on how development can be achieved through supporting all the three pillars (economic, social and environmental) of sustainability at the same time. The report also showcases what can be achieved through South-South Cooperation, with solidarity, mutual trust and people-to-people connection, developing countries are capable of helping each other solving similar problems that are met along their development paths.

The Belt and Road Initiative, initiated by the Government of China not only provides a good platform for countries to share experience and development outcomes, it is also an important space where green growth principles can be put into practice. The case studies introduced in this report demonstrate this opportunity to BRI partners and offer new perspectives on how developing countries can collaborate towards achieving the 2030 Agenda for Sustainable Development, through South-South and Triangular Cooperation.

The United Nations Office for South-South Cooperation stands ready to support its Global South partners in achieving inclusive, sustainable and durable development gains. That includes sharing knowledge and experiences that can help countries leapfrog to more sustainable development. I hope that more knowledge products like this will be produced and led by Global South institutions to share their unique and valuable experience on South-South and Triangular Cooperation.

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Executive Summary

The Belt and Road Initiative (BRI) focuses on both economic prosperity and green development. In building BRI, China has always adhered to the green development concepts, promoted the green and low-carbon infrastructure building and management, highlighted the ideas of ecological civilization in investment and trade, and strengthened the cooperation in domains such as ecological environment governance, biodiversity conservation, and the fight against climate change.

Since 2013, the Chinese government has successively issued a series of policies, including the *Guidelines on Environment Protection in Foreign Investment and Cooperation*, *Guidance on Promoting Green Belt and Road*, and the *Belt and Road Ecological and Environmental Cooperation Plan*, which provided guidance for businesses to actively fulfill their social responsibilities in protecting biodiversity and ecological environment.

At the first Belt and Road Forum for International Cooperation in 2017, Chinese President Xi Jinping stated, “We should pursue the new vision of green development and a way of life and work that is green, low-carbon, circular and sustainable. Efforts should be made to strengthen cooperation in ecological and environmental protection and build ecological civilization to realize the SDGs at the heart of the 2030 Agenda.”

At the second Belt and Road Forum for International Cooperation in April 2019, Chinese President Xi Jinping said, “We need to pursue open, green, and clean cooperation. The Belt and Road aims to promote green development. We may launch green infrastructure projects, make green investment, and provide green financing to protect the Earth which we all call home.”

BRI and the 2030 Agenda for Sustainable Development are highly compatible, complementary, and synergistic in their concepts, principles, and goals. The “Policy Coordination, Facilities Connectivity, Unimpeded Trade, Financial Integration, and People-to-people Bond” proposed by BRI highly corresponds with the 17 goals of the 2030 Agenda for Sustainable Development.

This report, in accordance with the 2030 Agenda for Sustainable Development, showcases 17 projects covering eight fields, namely, biodiversity and ecosystem, clean energy, clean water, sustainable transportation, solid waste treatment, sustainable consumption and production, green buildings, sustainable food production and

corporate social responsibility. These projects were initiated by different parties, some were invested and constructed by Chinese businesses, some by host countries and contracted to Chinese businesses, and also the third-party markets project jointly developed by Chinese businesses and businesses from other countries. More importantly, the successful implementation of these projects has made great contributions to the socio-economic development in the countries where the projects are launched.

The *Biodiversity Management Plan* was formulated prior to the construction of the Karot Hydropower Station in Pakistan, and the project asked fish and fishery experts to conduct research on the fish species in the channel segments of concerned areas, so as to map out strict measures for fish protection based on the results. Moreover, the New Container Terminal Project of Tema in Ghana has built a sea turtle hatchery. Through cooperation with the Ghana Wildlife Society, the hatchery hires experts specialized in sea turtle hatching to provide guidance and establish professional sea turtle conservation patrols. By 2019, a total of 11,114 baby sea turtles had been hatched and released into the ocean.

The Cabinda water supply project in Angola will provide access to water for 95% of the residential areas in Cabinda, directly benefiting more than 600,000 people. In some villages in Cabinda, it is the first time that the villagers could ever use the water supply. It was BRI that realized what they had dreamed of for years. The Peljesac Cross-sea Bridge of Croatia, a project that Croatian people have been looking forward to for many years, will connect the southernmost region with the north of Croatia upon completion and allow the residents to drive from south through north within a few minutes, cutting a two- to three-hour driving journey to a few minutes. The Can Tho Waste-to-Energy Plant in Vietnam not only solves the problems resulting from domestic waste stacking in the open air, but also brings China's most advanced technology of electricity generation from waste incineration, facilitating the exchanges and transfer of environmental technologies.

Aiming at achieving green development, these projects, in their implementation, adhere to the concept of ecological civilization, combine China's strict environmental protection systems and international standards, and take various measures of environmental protection based on the conditions of the local environment. These measures include joint efforts with local governments, businesses and communities, optimization of design and construction plans, strict control over different types of pollutants, and in situ conservation of species and ecosystems.

The Chinese business translated the concepts of ecological civilization and green development into concrete actions in BRI cooperation. China will continuously advance the high-quality development of BRI, proactively build a "Green Belt & Road" with participating countries, achieve the 2030 Sustainable Development Goals (SDGs) in joint efforts, and thus contribute to the building of a community with a shared future for mankind.

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About the Author

BRI International Green Development Coalition In May 2017, Chinese President Xi Jinping first proposed to establish a BRI International Green Development Coalition (BRIGC) at the Opening Ceremony of the First Belt and Road Forum for International Cooperation (BRF). The BRIGC was officially launched by Chinese and international partners in April 2019 at the Second BRF.

BRIGC is an open, inclusive and voluntary international network which will bring together partners' environmental expertise to ensure that the Belt and Road brings long-term, planet-friendly growth in support of the 2030 Agenda for Sustainable Development.

BRIGC's mission is to integrate sustainable development, in particular environmental sustainability, across the five priorities of the Belt and Road Initiative: policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds.

It aims to promote global consensus, understanding, cooperation and concerted actions to achieve green development of the Belt and Road Initiative (BRI) and the Sustainable Development Goals. BRIGC partners include representatives from the government, private sector, academia, civil society and other stakeholder groups.

The BRIGC Secretariat is hosted by the Foreign Environmental Cooperation Center of the Ministry of Ecology and Environment.

Chapter 1

Biodiversity and Ecological System



1.1 Nairobi–Malaba Standard Gauge Railway (Phase I)

With the rapid development of economic globalization and informatization, transport has become increasingly important. Apart from offering people convenience, it also speeds up logistics, and information and cultural exchanges between regions, thus mutually tackling the weak links in development. The underdeveloped transport in Africa has seriously constrained regional economic development and hampered the improvement of people's livelihood. Meanwhile, the unique natural geographic environment and high levels of biodiversity in Africa pose a huge challenge to long-distance and large-scale projects like railways. The Nairobi–Malaba Standard Gauge Railway (SGR) (Phase I), built by China Communications Construction Company (CCCC), tried to minimize the environmental impact in project design. Therefore, while pressing ahead with infrastructure construction, it realized ecological protection and offered support and guarantee for the implementation of Goal 15 of SDGs: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.

1.1.1 Background

The Nairobi–Malaba SGR, a flagship project in Kenya Vision 2030,¹ starts from Nairobi and terminates in Malaba, a city bordering Uganda, with a total length of

¹ Kenya Vision 2030 was put forward by the Kenya government in 2008. Focusing on three key areas, namely, politics, economy, and society, Kenya Vision 2030 aims to transform Kenya into a newly industrializing, middle-income country. It is the blueprint for the long-term development for Kenya.

489.57 km. Following its completion, the railway will connect to the Mombasa–Nairobi SGR and domestic railways in Uganda, and gradually connect to railways in Tanzania, Rwanda, Burundi and South Sudan, thus forming the “main artery” of public transport in Eastern Africa, and further advancing sub-regional interconnectivity and integration across Eastern Africa.

1.1.2 Project Overview

As the extension of the Mombasa–Nairobi SGR, the Nairobi–Malaba SGR adopted the technical standards, and construction and management model of the former. It was designed according to China’s national class I railway standards, with the CCCC undertaking design, construction and procurement as the EPC² contractor. The SGR will be constructed in three phases. Phase I runs 120.4 km from Nairobi to Naivasha and will be used to carry both passengers and goods. The designed speed is 120 km/h for passenger trains, and 80 km/h for freight trains. The construction of Phase I formally started in January 2018 and was put into operation in October 2019.

On the morning of October 16, 2019, at the inauguration ceremony, Kenyan President Uhuru Kenyatta remarked that Phase I of the Nairobi–Malaba SGR will bring about more development opportunities for inland Kenya and other neighboring inland countries including Uganda, South Sudan and Burundi, and also consolidate Kenya’s position as the regional transportation and logistics hub (Fig. 1.1).³

1.1.3 Boosting Local Employment and Technological Development

During its construction, the Nairobi–Malaba SGR (Phase I) employed over 26,000 local workers, accounting for about 90% of the total employees, among which 45% were technical and managerial staff. In addition, the constructor also cooperated with over 400 local material suppliers and over 100 sub-contractors, creating more than 20,000 job positions in an indirect manner. The project has promoted the development of Kenya’s cement, steel and transportation industries. Chinese enterprises assisted suppliers with funding, technology and management, thus contributing to local industrial upgrading. Meanwhile, the project has also cultivated many local

² Engineering Procurement Construction means a company (the contractor) is commissioned by the owner to undertake the whole or part of the construction work including design, procurement, construction, and trial operation of engineering construction projects in accordance with the contract. The contractor is responsible for the quality, safety, expenses, and progress of the project as per the contract.

³ http://www.xinhuanet.com/world/2019-10/17/c_1125113863.htm.



Fig. 1.1 Kenyan president Uhuru Kenyatta attended the inauguration ceremony

technical staff who help the country gradually realize independent operation of the railway.

Railway construction requires large quantities of reinforcing bars (rebars). The Nairobi–Malaba SGR (Phase I) winds its way through the fault zone of the Great Rift Valley, and the complicated geological conditions means that the railway should be able to withstand earthquakes. However, the local industry was incapable of producing such rebars, and imported earthquake-resistant rebars were costly and time-consuming with high carbon footprint. This added difficulties to project construction. Facing this dilemma, the CCCC entered into cooperation with Prime Steel Mills Co., Ltd. in Kenya. The CCCC invited Chinese experts and sent technical staff from its laboratory to conduct joint research and development (R&D) with the technical team of Prime Steel Mills, so that the latter could reliably produce standard earthquake-resistant rebars. The project settled the issue of urgent supply and purchase of earthquake-resistant rebars, reduced procurement cost and carbon footprint, and ensured that construction was advanced as scheduled. During the process, Prime Steel Mills improved its production techniques, which brings the company more local orders.

1.1.4 Protecting the Migration Corridors of Wildlife

To protect vegetation in the park, the construction work was divided into several stages with land reclamation along the way, so as to keep the original land and plants intact. To minimize the impact of construction, the working plane of the project was only 40 m wide compared with the nearly 120 km² park.



Fig. 1.2 Nairobi national park bridge

To ensure free passage of wildlife, especially giraffes and other large animals, the Nairobi–Malaba SGR (Phase I) adopted the blueprint that proposes to build a 6.5 km-long bridge traversing the park, with the shortest pier being 7.5 m and the tallest 41.5 m, making it the longest single-track railway bridge in Eastern Africa. In addition, the bridge is also equipped with noise barriers to reduce noise when trains pass, so as to minimize the impact on wildlife (Fig. 1.2).

1.1.5 Collecting Materials According to Local Conditions to Protect the Rivers

Sand is an important material of concrete making. Most areas in Kenya lack water and river sand all year round. Also, due to its focus on environmental protection, river sand mining is restricted. To protect the ecological environment, the project only used machine-made sand, which brought about another challenge. Most machine-made sand is made of limestone in China, which cannot be found along the Nairobi–Malaba SGR. Instead, there is igneous rock.⁴ Facing this, the CCCC brought domestic experts together to conduct technical research and eventually applied machine-made sand made of igneous rock to the construction of railway concrete. The successful application of such sand in the Nairobi–Malaba SGR remarkably reduced transportation cost and energy consumption, shortened the construction period, and reduced carbon emissions, thus producing significant economic, environmental and social benefits.

⁴ Igneous rocks are also known as volcanic rocks, which crystallize when lava comes into and then out of the earth's surface and solidifies.

The Standard, one of the most influential media in Kenya, wrote that construction of the Nairobi–Malaba SGR (Phase I) utilized machine-made sand made of local igneous rock to replace traditional “river sand,” which should be widely used in infrastructure projects in Kenya as it catered to local conditions, saved energy and protected the environment. The report pointed out that igneous rock is abundant in the fault zone of Kenya, but it is not effectively exploited yet. The technique developed as part of the Nairobi–Malaba SGR offered an approach to developing idle igneous rock resources in the local area. In the meantime, collecting igneous rock locally also provides an environmentally friendly, efficient and energy-efficient solution to the construction of railways, roads and buildings in fault zones, and helps reduce the cost and improve the efficiency of a large number of projects.

1.2 New Container Terminal Project of Tema, Ghana

The construction area of the New Container Terminal Project in Tema, Ghana is one of the main spawning grounds of sea turtles in Western Africa. During the construction process, special attention was paid to monitoring their living environment and keeping away from their breeding grounds. Meanwhile, a “sea turtle breeding center” was put together within the red line to strengthen the in-situ conservation of sea turtles. The center cooperated with the Ghana Wildlife Society (GWS), invited professionals to guide their incubation, and formed a special patrol for sea turtle protection. By 2019, a total of 11,114 baby sea turtles had been incubated and set free, which significantly contributed to their conservation and ecological balance, improved local awareness of environmental and wildlife protection, and set an example for implementing SDG15 in infrastructure construction.

1.2.1 Background

The New Container Terminal Project of Tema, Ghana, situated in the Gulf of Guinea in Western Africa, is Ghana’s largest waterborne construction project so far. Following its expansion, the Tema Port will become an important freight hub of Western Africa, which is not only capable of loading and unloading the largest container ships in the world, but also providing high-quality and user-friendly port infrastructure and service for the whole world.



Fig. 1.3 Aerial view of the port

1.2.2 Project Overview

Undertaken by China Harbour Engineering Company (CHEC), a subsidiary of China Communications Construction Company Ltd. (CCCC), the construction of the project was commenced in July 2016 and finished in June 2020. The CHEC built a 3,558-m breakwater, four deep-water container berths with a total length of 1,400 m, 121-hectare land reclamation with dredged sediment and foundation treatment, harbor basins and foundation trench dredging, revetment construction and ancillary facilities, so as to accommodate advanced handling facilities and large vessels (Fig. 1.3).

1.2.3 Strict Environmental Protection Measures

The project actively fulfilled its social responsibilities. An environmental baseline study and EIA were carried out before construction, with corresponding environmental certificates secured. Meanwhile, an environmental management plan for the construction period was formulated to handle environmental issues and their impacts during the construction period in a detailed and comprehensive manner. This included the impact of dredging and land reclamation activities on the receptor environment, the impact of discharge into the atmosphere and dust, the impact of noise and vibration, the impact of traffic, the potential impact of dredging on surface water and turbid plume, the impact on marine ecology and biodiversity, the impact on soil and groundwater, the production and management of waste during construction, the impact on terrestrial ecology and biodiversity, as well as the impact on coastlines. The project went all out to avoid pollution and destruction, in order to satisfy

the requirements of the IFC (World Bank), Ghana Environment Protection Agency (GWS), other licensing conditions and general environmental requirements in terms of health, safety, public order, environment and social responsibility.

The project spent much in developing the capability of environmental monitoring, including RMB 307,600 invested in two Honeywell MultiRAE Lite gas detectors, two EPAM-5000 dust and particle detectors, and two CASELLA CEL-246 noise meters/noise detectors, a special environmental monitoring team that continuously conducted monitoring every week, and special vehicles that monitor the ecological environment at the construction site in the Tema Port and self-run quarry 60 km away. There were also vehicles spraying water in designated areas, so as to effectively reduce the total suspended particles. Temporary waste storage points and oil stacking points were also set up at the construction site, enabling daily monitoring of waste oil and residues.

1.2.4 Sea Turtle Breeding Center

The spawning period for sea turtles lasts from October to April in the following year, and the beach at the construction site is one of their main spawning grounds in Western Africa. Also, sea turtles are one of the animals protected by local laws. Considering the impact of construction progress on the original beach where sea turtles were incubated, the project team decided to carry out in-situ conservation, so as to ensure that their breeding is not disturbed and that ecological balance within the construction area is maintained.

For the personnel of the project, the protection of sea turtles is a brand-new challenge. Through communication with the Ghana Environment Protection Agency, Forestry Commission, Wildlife Division and Fisheries Commission, the project team came into contact with the GWS, signed the monitoring agreement of marine mammals-sea turtles, and invited professionals from the GWS for on-site guidance on sea turtle conservation.

Following on-site inspection and communication with multiple parties, the team decided to open up a special area west to the east revetment of Phase I and in front of the camp to build a “sea turtle breeding center” similar to their incubation environment in line with the guidance of technical experts. Having received training by technical experts, a group of people took charge of the protection and monitoring of sea turtles. Specifically, they collected sea turtles’ eggs within the red line and on nearby beaches, and put them into the spawning pool, so that the eggs could be looked after and hatched together. Another piece of local beach named Sakumono was chosen to set these baby sea turtles free following assessment by local experts (Fig. 1.4).

The “sea turtle breeding center” should be built in a relatively quiet place which is not affected by night lighting, and the foundation should be made relatively higher than the surroundings with dry, fine sand. Since metal structures will affect the inherent navigation abilities of baby sea turtles, metal cannot be used to build the



Fig. 1.4 Exteriors the “Sea Turtle Breeding Center”

spawning pool. For this reason, the project team used some PVC tubes from construction materials to build the main structure of the spawning area which spans for nearly 50m² and could accommodate more than 40 nests of sea turtle eggs.

Sea turtles mainly lay eggs at night, and their spawning grounds can generally be found through their flipper prints on the sand. However, as they are relatively alert to white light, once discovered, they should be tracked with soft red light. When moving sea turtle eggs, a thin layer of fine sand should be put at the bottom of the container, and the eggs should be handled gently. After returning to the breeding base, a 20 cm wide and 50 cm deep hole similar to their nest used for spawning in nature should be dug, and sea turtles should be placed in the hole with the sand put back. Outside the spawning area is the fence and resting facilities, where the monitoring staff took shifts day and night, and filled in the patrol and observation record. The incubation period of sea turtle eggs is roughly 45 to 60 days. After discovering signs of incubation, the monitoring staff would inform technical experts and project managers immediately, and the managerial personnel would coordinate in the work to set baby sea turtles free (Fig. 1.5).

With regard to finding sea turtles, moving turtle eggs, digging incubation nests, detailed conditions for sea turtles’ incubation, as well as site selection and technical requirements for building the “breeding center”, professionals from the GWS organized special training sessions for the project team. All the staff responsible for protecting and patrolling sea turtles, observing their incubation and setting baby sea turtles free can only take their job after training.

Following professional suggestions, the project dispatched six people for 24-h patrolling of the beach in turn, with special staff keeping a record, and a specialist responsible for sea turtles’ breeding. Meanwhile, the project also employed six local



Fig. 1.5 Sea turtle caring professionals sending baby sea turtles home

villagers to help with sea turtle protection at the beach close to the construction site by patrolling the beach every night.

By June 1, 2019, a total of 15,255 sea turtle eggs were collected by the project team of the Tema Port, and 11,114 hatched, representing 86.8% of the total (under natural conditions, the hatching rate is normally between 10 and 20%).

In addition, the project team also promoted the knowledge of sea turtle protection in nearby schools, boosting the awareness of environmental protection (Fig. 1.6).



Fig. 1.6 Publicity activities on environmental protection on campus

1.2.5 Main Experience of the Project

The New Container Terminal Project of Tema has made remarkable achievements in protecting local ecology and is widely appreciated for the endeavor. Four pieces of experience are summarized as follows:

1. When selecting the site for the project, it is necessary to investigate the environment thoroughly beforehand, and visit local fishery committees, municipal councils, environmental protection bureaus, fire departments, marine bureaus, mining bureaus, as well as organizations such as local communities, schools and churches, in order to collect their suggestions and advice on the environmental protection work of the project, and coordinate relationships between these stakeholders in advance.
2. In the course of construction, staff should be arranged to continuously monitor the environment, including but not limited to the monitoring of surface water quality and air quality (including the monitoring of the working environment at quarries, environmental monitoring of traffic lines). Wastes should go through regular classified treatment, and repositories for chemicals and signboards should be set up. Trainings in environmental protection, such as emergency exercises for marine oil spills, field training in the prevention of oil spills, and clearance of oil spills on the spot, should be carried out periodically.
3. If the project will inevitably have an effect on local wildlife, the project team should actively communicate and cooperate with local governmental institutions, put forward corresponding protection plans as soon as possible, and keep track of any change in the ecological environment nearby. The monitoring results should be recorded continuously.
4. With regard to project impact, both the construction sites and neighboring areas should be taken into account. And construction plans should be developed accordingly, and construction techniques improved. The location of spoil grounds and waste treatment sites should be properly selected, so as not to cause surface runoff and rainfall erosion, or other ecological damage in the construction area.

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Chapter 2

Clean Energy



2.1 Karot Hydropower Station in Pakistan

Pakistan boasts abundant clean energy and promises huge development potential, but the exploitation rate is low and the conflicts between power supply and demand are prominent. The Karot Hydropower Station invested and built by China will be able to ease the conflicts between power supply and demand in Pakistan, contribute to its sustainable economic and social development and push it to meet SDG7: Ensure access to affordable, reliable, sustainable and modern energy. With the advancement of the China-Pakistan Economic Corridor (CPEC), clean energy is expected to become the highlight in the country's energy structure by empowering its endeavor to realize industrialization and generating enormous social and environmental benefits.

2.1.1 Background

Punjab in East Pakistan is the country's second largest province and the most populous province with a total population of 110 million. Meanwhile, it houses Pakistan's most sophisticated industrial and agricultural sectors and leads the rest of the three provinces in view of economic strength.¹

Severe power shortage has a profound impact on the economic hub's production and life. For local residents, it is nothing out of the ordinary to experience a one-hour power failure every one or two hours on a daily basis, which means that they could face at least eight hours of blackout every day, or even as long as 16 h under the worse scenario. Unstable voltage often damages electrical appliances. Worse still, during the long, scorching summer, Punjab has to endure high temperatures—over

¹ <https://go.huanqiu.com/article/9CaKrnJUimr>.

40°C—every year, during which heatstroke-related deaths due to the lack of power are frequently reported.²

Statistics show that the total power installed across the country in 2016 merely reached 25,000 MW and the actual power transmission capacity was only 17,000 MW or so, indicating a low utilization rate of the installed capacity. The short supply of power means that Pakistan suffers long-term power shortage. During the past few years, the government of Pakistan rolled out restrictive measures for power consumption on a large scale, including requesting factories in different provinces to suspend production in turn, suspending the use of outdoor advertising boards and neon lights, and using some natural gas intended to power transportation and chemical fertilizer production for power generation. By the end of 2016, there were still approximately 51 million people living without access to electricity in the country.³

All the five tributaries of the Indus River run through Punjab, so it is called “the land of the five rivers” in history. In fact, the name “Punjab” is a compound of two Persian words—five and river. The Jhelum River, one of the five tributaries, is also one of the largest rivers of the Indus system, and its mainstream is located in the province, extending for a total length of 725 km and covering a drainage area of 63,500m². The natural fall of its upstream is estimated to be 700 m, promising huge potential for the development of hydropower. The rich hydro energy of the province makes it possible to secure the stable supply of clean electricity.

2.1.2 Project Overview

In April 2015, driven by the BRI, the Silk Road Fund, China Three Gorges Corporation (CTG) and the Private Power and Infrastructure Board (PPIB) of Pakistan signed the *Memorandum of Understanding on the Joint Development of the Hydropower Project in Pakistan* (Fig. 2.1).

The Karot Hydropower Station is the first hydropower project funded by the CPEC as well as the first investment made by the Silk Road Fund after its inauguration. Developed on a Build-Own-Operate-Transfer (BOOT) basis, the project was started in December 2016 and slated to go into operation in 2021 with an operation period of 30 years, after which the ownership will be transferred to the government of Pakistan free of charge. The planned installed capacity of the power station is 720 MW. When the power station is put in place, it could provide approximately 3.2TWh of clean electricity every year, which is equivalent to 10% of the country’s total hydropower generation in 2017 and could satisfy the power demand of more than two million Pakistani households for a year.⁴ The Karot Hydropower Station could curtail at least 2.7 million tons of CO₂ emissions every year, if calculated according to the

² <http://news.haiwainet.cn/n/2019/0321/c3543228-31520988.html>.

³ https://www.sohu.com/a/197007510_444154.

⁴ <http://news.sina.com.cn/o/2018-09-24/doc-ihkmwytn9014395.shtml>.



Fig. 2.1 The Karot hydropower station

CO₂ emissions of 844 g/kWh⁵ which was issued by the statistics of China Electricity Council (CEC).

2.1.3 Sustainability of Project Financing

A total of USD 1.74 billion will go into this project. The CGT only contributes 20% of funds as a major shareholder, and the rest of the 80% of funds are from international syndicated loans issued by the Export–Import Bank of China, China Development Bank (CDB), the Silk Road Fund and the IFC (a global financial firm under the World Bank). This financing mode is called “limited recourse financing.” As a prevailing financing mode in the international community, its basic principle is to make repayment and reap return on investment (ROI) with the revenue generated by the project. More risks are shared by those financial institutions in the loan syndicate, which ensures the sustainability of financing.

2.1.4 Strict Administrative Measures for the Environment and Biodiversity

The EIA of the Karot Hydropower Station Project had to comply with the requirements of Pakistan’s laws and regulations on environmental management as well as consider the environmental and social responsibility framework of the IFC. The EIA report needed to be approved by the government of Pakistan and the IFC as well, after

⁵ <https://www.cec.org.cn/detail/index.html?3-282208>.

which the local department of environmental protection granted an environmental permit to the project.

During the project construction, as requested by the EIA report, the CTG has set up a social and environmental management system and prepared detailed social and environmental management plans. Among them, eight are relevant to the environment and biodiversity, namely the *Biodiversity Management Plan*, the *Water Quality Management Plan*, the *Air Quality Management Plan*, the *Control Plan for Surface Runoff and Rainfall Erosion and Rain-wash*, the *Noise and Vibration Management Plan*, the *Waste Management Plan*, the *Waste Materials and Side Slope Stability Management Plan*, and the *Leakage Prevention and Response Management Plan*. The company has employed professional environmental engineers to guide and manage the execution of these plans, and train workers, relevant operating staff and management staff of the project with regard to environmental protection, and soil and water conservation.

In 2015, during the EIA of the project, the CTG organized experts to perform a critical habitat assessment of the area where the project was carried out. According to the assessment results, the area is not a critical habitat, but it is the natural habitat of several fish species, which are on the IUCN Red List of Threatened Species. On that account, it was concluded that the CTG needs to develop a separate *Biodiversity Management Plan*. In 2015 and 2016, the company engaged with fish experts to carry out an investigation into the fish in the relevant reach to determine the protection baseline. As the investigation reveals, these endangered fish species are breeding in nearby open channels, which deserve careful protection. The *Biodiversity Management Plan* has listed all data on these fish species and come up with protective measures. Some of the measures are as follows. Firstly, the speed of the downstream base flow of the dam should not be slower than 5m³/s during the initial filling and operation period to strictly maintain the downstream aquatic environment of the dam. Furthermore, in the course of construction, the “No Fishing” signs have been set up in the construction site, and ecological flow release holes and gates on the spillway have been installed to release ecological flows during the shut-down period (Fig. 2.2).

2.1.5 Green Construction Measures

While implementing the project, local-produced construction materials are used whenever possible to facilitate the effective utilization of resources. For example, natural sand and gravel from nearby rivers are used for dam filling after examining and comparing different technologies. The exploitation of these resources strictly meets the requirements of environmental protection and biodiversity protection.



Fig. 2.2 Construction of the spillway

The project has adopted $15\text{m}^3/\text{h}$ buried sewage treatment equipment with an Anaerobic/Anoxic/Oxic (A2O) process and the nitration, denitrification and dephosphorization of backflows. Bio-contact oxidation is at the core of the project's wastewater treatment. The wastewater of the sand and gravel system is treated via pre-treatment of silt sand recycling plus sedimentation of radial-flow sedimentation tanks plus mechanical dewatering through a filter press, enabling a recycling rate of 90%.

Oil storage zones and usage zones have been equipped with specialized oil stain treatment toolkits, and the operating staff would receive pre-job training in professional oil stain treatment. The company has secured licenses for heavy fuel oil (HFO) fired power plants, asphalt mixing plants and the storage of hazardous substances from the local bureau of environmental protection beforehand and developed special environmental management rules for their implementation, operation, emergency response and process control.

In respect of waste management, trash cans and trash recycling stations have been set up in the living areas, and a company specializing in waste recycling has also been employed to dispose of domestic waste.

In view of the conservation of water and soil, all exposed ground has been covered with plants to contain surface runoff and rainfall erosion, and dust.

Furthermore, with a view to meeting various restrictive and controlling indicators of environmental protection, the CTG has employed a third-party environmental monitoring firm to perform environmental monitoring every quarter, so that all parties involved could fully commit themselves to their duties.



Fig. 2.3 Construction site of the dam zone

2.1.6 Building of Supporting Infrastructure

The CTG has renovated the old Karot Bridge and relevant roads in the dam zone. In the reservoir zone, it has built a 200 m-long reinforced concrete highway bridge, a 277 m-long suspension footbridge over the Jhelum River and a 7.1 km-long highway (Fig. 2.3).

During the construction of the Karot Hydropower Station, the CTG also invested more than USD 6.4 million in social responsibility projects in areas affected by the project, including local education and medical care facilities, public water supply systems and roads, and public libraries and lounges, in a bid to greatly improve infrastructure and the living standards of local residents. By September 2020, it has transferred the ownership of two hospitals, four schools and one lounge to the local government. Currently, the planning of one highway, one school and one hospital is still under way. The company is performing an upfront survey of the roads, healthcare conditions and water supply conditions of neighboring villages, and will kick off the construction of these facilities, once all the resources are available (Fig. 2.4).

2.1.7 Establishment of Permanent Exchange Mechanisms with Local Governments and Communities

The CTG has developed the *Stakeholder Management Plan* and the *Community Complaint Mechanism* according to IFC's performance standards and Pakistan's



Fig. 2.4 New building of the Kannada Primary School

laws and regulations, and international good practices. Then, it moves on to establishing permanent communication and exchange mechanisms with local governments, communities, social organizations and residents under the framework of these guidelines.

1. **Complaint Committee Put Together with Meetings Held Regularly**
 Members of the complaint committee include representatives of the company undertaking the project, the EPC contractor, the governments in charge of the regions affected, immigrants and communities affected. Pursuant to the *Community Complaint Mechanism*, the complaint committee convenes a meeting every quarter to discuss community issues related to the project and identify solutions through friendly negotiation with these stakeholders.
2. **Community Liaison Persons Appointed To Visit Communities, Local Governments and Other Stakeholders on a Regular Basis**
 The company undertaking the project has assigned staff to serve as community liaison persons to promote the procedures of the complaint mechanism, regularly collect complaints from local residents, organize irregular meetings to communicate with local residents, and handle community complaints promptly.
3. **Complaint Boxes Set Up**
 In order to open up channels for stakeholders of the project to lodge complaints and propose suggestions, the company has set up complaint boxes in nearby communities heavily influenced by the project to collect and document written complaints from local residents on a regular basis and assign community liaison



Fig. 2.5 Community liaison persons are holding a meeting with local residents

persons to respond to these matters in a timely manner and give feedback on how they are handled (Fig. 2.5).

2.1.8 Boosting Local Employment and Skills Training

As of September 2020, the project has employed 1,253 Chinese workers and 3,374 Pakistani workers with the ratio of Chinese workers to Pakistani workers reaching 1:2.7, creating numerous job opportunities for local residents.

Apart from providing compensations for local immigrants whose livelihood is affected, the CTG has also implemented the “Livelihood Improvement Plan,” through which it provides training in wealth management and skills for immigrants aged over 16 to cultivate electricians, plumbers and car drivers, so that they could be empowered to better use the compensations to improve their life and make a living with other skills.

In addition, in order to empower local communities and enormous immigrants to seek ongoing development in the future, the CTG together with the University of the Punjab, the Confucius Institute, and Jiangxi University of Science and Technology has launched the “Pakistan Immigrant Scholarship Program” to select students from eligible immigrant families to participate in the “Joint Training of “2 + 2” Bachelor’s Degrees of Chinese and Pakistani Universities.” These students will receive a full-ride scholarship for four-year undergraduate education of electrical engineering and find stable jobs at the hydropower station in the future. Currently, a total of 33 Pakistani students are studying in China (Fig. 2.6).



Fig. 2.6 Some employees of the Karot hydropower station project

2.2 Mozura Wind Park in Montenegro

Mozura Wind Park, jointly built by Shanghai Electric Power Co., Ltd. of State Power Investment Corporation (SPIC) and the Maltese government, has made it possible for Montenegro to transmit power to the European Continent and to realize the vision of becoming the hub of Southern European power grids. The project will effectively push forward its energy development strategy, accelerate the implementation of SDG7, and play an important role in fulfilling the commitments it made when it applied to join the European Union (EU).

2.2.1 Background

Suffering from domestic power shortage for a long time, Montenegro often has to import electricity from countries such as Serbia, Macedonia, and Albania. In 2017, roughly 32% of its total power consumption relied on import.⁶ As a candidate country for EU membership, Montenegro also has to fulfill its commitments to the EU as requested and develop clean resources. In accordance with its energy development strategy, “by 2020, 33% of power should be generated from renewable energy.

⁶ http://www.xinhuanet.com/2019-04/11/c_1124355731.html.

2.2.2 Project Overview

The project is situated in the mountain area in the southern Montenegro. The project built 23 China-made 2 MW low-speed intelligent wind turbine generators, with a total installed capacity of 46,000 kW. Construction formally began on November 7, 2017. On December 22, 2018, the first wind turbine generators was connected to the grid. On February 8, 2019, all the wind turbine generators were connected to the grid and the project went into trial operation legally stipulated by the Montenegrin government. Following technical acceptance on November 15, 2019, the project secured a usage license from the Montenegrin government and was concluded. On December 26, 2019, the project received the usage license and priority generators' qualifications issued by the Energy and Water Regulatory Agency of Montenegro. On April 25, 2020, the project was put into trial operation.

After it went into operation, the project will help Montenegro realize its goal of “doubling installed new energy capacity,” and supply 110 million kilowatt hours of clean power per year, roughly accounting for 5% of its total power generation. It will mainly satisfy the power demand of 100,000 residents in Bar and Ulcinj, and reduce roughly 3,000 tons of greenhouse gas emissions per year.⁷

2.2.3 China’s “Smart Wind Power” Technology

To ensure power generation capacity, the Mozura Wind Park adopted China’s advanced “smart wind power” technology, which constructs energy networks through smart control technology and advanced communication and information technology. At its core is the smart control technology, which uses artificial intelligence (AI) algorithms to push the technical limits of traditional wind turbine generators and accordingly improve the efficiency of such generators by 15% to 20%. In addition, the smart wind park software developed by China is able to convert traditional wind parks into smart ones, featuring centralized monitoring, mobile maintenance and unattended operation. Besides, it realizes information transparency and closed-loop management based on power losses, power grid friendliness based on wind flow models, as well as maintenance based on health degree management. Compared with traditional wind farms, its electricity generation grows by 10%, whereas its operation cost drops by more than 20% (Fig. 2.7).

2.2.4 Contribution to Energy Technology Transfer

Mozura Wind Park is a successful case of China-Malta cooperation in the field of energy. Prior to this, the two countries had been working together for many years.

⁷ <http://www.sasac.gov.cn/n2588025/n2588139/c11632202/content.html>.



Fig. 2.7 Mozura wind park

For quite some time, Malta had been relying on cross-border power transmission through submarine cables that are connected with Sicily, Italy. However, due to frequent technical failures of submarine cables, power outage occurred frequently. In 2014, the power outage suffered by Maltese users averaged 9.69 h.⁸ Due to the lack of natural resources, Malta has long depended on power import, in which over 63% is used for power generation. When the D3 power plant, the largest one in the country, was built, it only had eight HFO generator sets, with annual output of only 136,800kWh, and the black smoke from its power generation led to serious air pollution. With a view to improving its energy structure, reducing power cost and ensuring the safety and stability of power supply, Malta has been actively looking for capable partners.

In December 2014, Shanghai Electric Power signed an agreement on packaged cooperation with Enemalta for in-depth cooperation. The former invested EUR 100 million for a minority stake in Enemalta, and EUR 150 million to buy D3 Power Generation Ltd. (150 MW). In addition, the two sides jointly invested in an international renewable energy development company and an international energy service center, so as to promote the development of clean energy in the Mediterranean region. With the strong support of Shanghai Electric Power, Malta has made significant progress in the field of energy (Fig. 2.8).

1. Malta has seen improvements in its overall investment environment and higher sovereign rating. With a series of technical and managerial improvements,

⁸ http://www.spic.com.cn/ztjj/zlld/lxsd/201812/t20181213_296188.html.



Fig. 2.8 D3 power plant in Malta

Shanghai Electric Power has helped the Maltese government fulfill its commitment of “reducing electricity price for residents and commercial users by 25%”. Electricity price has fallen from the top three to one of the lowest in the EU, thus substantively improving the business environment of the country and contributing to its continuous rating upgrades to “A+”.

2. The energy structure has improved and stabilized. Following its involvement in the operation and development of Enemalta, it only took Shanghai Electric Power three years to save Enemalta from the brink of bankruptcy and generate stable profits for it. The safety, stability and reliability of the Maltese power grid were significantly boosted, with the average hours of power outage reduced by 90% to 0.44, non-technical line losses dropping from 14% to 4.7%, and grid reliability reaching 99.99%.
3. With the support of Shanghai Electric Power, Malta is able to meet EU standards on environmental protection, energy conservation and emission reduction. Having owned a controlling stake in D3 Power Generation Ltd., the largest power plant in Malta, Shanghai Electric Power led the oil-to-gas conversion of the eight generator sets by providing natural gas units, transforming internal combustion engines and upgrading the flue gas system. Following the transformation, Malta has fully abandoned HFO power generation, with the overall efficiency rising from 46.7% to 50%, and the emission levels of Nitrogen Oxides and CO significantly lower than the local government limit. As a result, the country has managed to meet the EU emission standard and recorder one of the highest overall operational indicators.

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Chapter 3

Clean Water



3.1 Cabinda Water Supply Project in Angola

Thanks to the sound, and high-quality water supply system, the Cabinda Water Supply Project in Angola has not only provided local residents with safe and clean drinking water for effectively improving people's livelihood, but also improved local environment and delivered more benefits to communities, by means of construction and operation of sustainable infrastructure and social services as well, resulting in the accelerated progress of realizing the SDG6: Ensure access to water and sanitation for all. After the project is completed, the water supply system will be able to cover 95% of the populated areas of Cabinda. In addition, the project will deliver water to seven water plants in Cabinda City and neighboring cities (regions) to tame the challenge of insufficient water supply. At the same time, it will provide clean and safe drinking water to nearly 110,000 households (over 600,000 people in total) in the city through nine looped water supply networks, secondary pipeline networks, household pipeline networks and public water supply facilities. According to the *Sustainable Development Goals Report 2020*, Angola is securing increasingly positive progress on the way to meeting SDG6, which is largely attributed to this water supply project.

3.1.1 Background

Cabinda Province is an enclave in northernmost Angola, covering an area of 7,270 km², with the Republic of the Congo to the north, the Democratic Republic of the Congo to the east, and the Atlantic Ocean to the west.¹ As of mid-2019, the province was home to approximately 820,000 residents with around 790,000 living in the urban

¹ Agencia Angola Press.

area,² most of whom reside in Cabinda City, capital city of the province. Cabinda Province is also the second largest city following Luanda, capital city of Angola and one of the political and economic hubs of the country.

The Chiloango River and other two main rivers running through the Cabinda Province are the major water sources of agricultural and industrial production and domestic use. As the industrialization has gathered speed in recent years, environmental pollution has been getting worse and the water quality of rivers and streams which play a significant role in water supply for urban residents is suffering ongoing degradation, severely undermining the safety of domestic water use. Besides, the municipal infrastructure in the urban area of Cabinda including water supply facilities and urban roads is in poor condition. The low coverage rate and penetration rate of the water supply system, and the uneven distribution of water supply has led to unstable quality and availability of domestic water use for most residents. Prior to the launch of the project, about 40 to 50% of the population in the city had no access to clean water for domestic use.³ Poor hygiene conditions combined with the shortage of water resources as well have pushed up the morbidity of malaria, diarrhea and cholera in the region.⁴ Thus, it has become imperative to improve the safety, reliability, cleanness and relevant hygiene conditions of water supply, given the increasing demands for clean water resulting from an expanding urban population. Hence, the government of Angola decided to launch the Cabinda Water Supply Project to improve local people's livelihood.

3.1.2 Project Overview

The Cabinda Water Supply Project, the most important livelihood project in Cabinda Province, is initiated and funded by the Ministry of Energy and Water of Angola and supervised by PROFIS, an engineering consulting firm. China Railway Construction Corporation Limited (CRCC) is responsible for the design, construction, and pre-stage operation and maintenance of the project, which consists of a whole set of water supply facilities including pumping stations, water purification plants, high-level reservoirs and water filtration pipelines.⁵ The project was kicked off in October 2016. Section I of the project is primarily responsible for the restoration of ETA2-THIZO, a water supply system and the construction of 7,000 m³ high-level reservoirs, 48.6 km main water supply pipelines and 18 km water distribution networks. Section

http://www.angop.ao/angola/en_us/portal/provincias/cabinda/conteudo/2013/7/34/The-Province,e089aa92-16e4-4216-aec0-bbb16bd18dfb.html?context=04239561-2759-4ebd-86c6-326b0000054a

² <https://populationstat.com/angola/cabinda>

³ <https://www.idrc.ca/en/research-in-action/improving-water-security-and-reducing-climate-risk-angolas-coastal-cities>

⁴ <https://www.idrc.ca/en/research-in-action/improving-water-security-and-reducing-climate-risk-angolas-coastal-cities>

⁵ http://www.cr20gf.com/art/2018/12/16/art_19322_2802472.html

II sets out to build five 5,550 m³ large concrete reservoirs, three 50 m³-370 m³ water towers, one office building, 24 km main water distribution pipelines, nine looped networks across the province with a total length of 64 km, 1,100 km supporting secondary pipeline networks and household pipeline networks, and 219 public water supply facilities.

By October 2020, Section I had been completed successfully. As to Section II, reservoirs, water towers, the office building, main water distribution pipelines, nine looped networks and 200 km supporting secondary pipeline networks and household pipeline networks have been put in place. The construction of remaining supporting secondary pipeline networks and household pipeline networks, and household connection work are under way.

After the project is completed, the water supply system will be able to cover 95% of the populated areas of Cabinda Province. While delivering water to seven water plants in the urban area, it also provides clean and safe water for over 600,000 residents through nine looped pipeline networks, secondary pipeline networks, household pipeline networks and public water supply facilities.

The Cabinda Water Supply Project could solve its problems troubling the production, storage and distribution of drinking water and provide user-friendly and efficient processing and supply system of drinking water that can be easily and rapidly operated and maintained at a low cost. As the project gives priority to public health, it has eliminated and reduced secondary pollution in the water supply project, improved the quality of drinking water, realized safer and cleaner drinking water supply, improved the health of local people, facilitated water fetching, and improved the living standards of local residents. It has also laid a solid foundation for the province to carry out the reform of water conservancy, planning of drinking water and urban planning, and pursue economic growth (Fig. 3.1).

3.1.3 Strict Measures for Environmental Protection

At the beginning of the project, the CRCC commissioned a local environmental assessment firm to conduct an all-round investigation into the overall environmental impact of the project and protective measures needed. Then, it prepared the “*Plan for Engineering Environment and Social Management*” (hereinafter referred to as the *Management Plan*) in accordance with the standards and requirements laid down in the *Basic Environmental Law (No. 5/98)*, Decree No. 51/04 on Environmental Impact Assessment (EIA) promulgated on July 23, 2004 and the *National Environmental Management Plan (PN GA)*, and filed with the employer and department of environmental protection for approval and record. Afterwards, the CRCC has strictly implemented the *Management Plan* throughout the process under the supervision of the employer, the supervisor and the local department of environmental protection (Fig. 3.2).

Since the implementation of the project, the CRCC has followed relevant requirements set forth in GB/T 24,001:2016 and ISO 14,001: 2015 for environmental

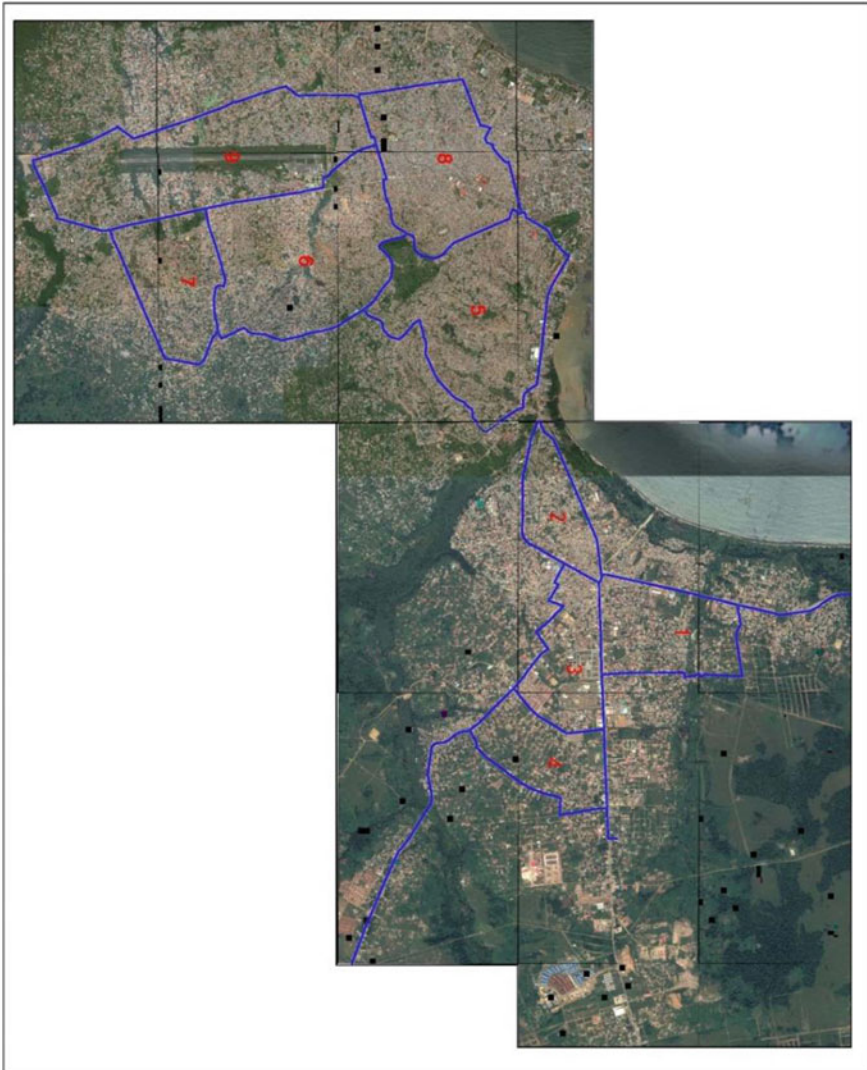


Fig. 3.1 Construction of the cabinda water supply project

management systems to push forward the project by establishing a system featuring the sharing of design, construction and utilization between facilities for the management of energy conservation and environmental protection and the project construction. In so doing, the CRCC has fully disclosed its technology beforehand, exercised stringent supervision and control during the process and performed scientific assessment afterwards. The CRCC has also met the “six 100% construction site standards” used in China, namely ensuring 100% enclosure of the construction site,


 <p>MINISTÉRIO DA ENERGIA E ÁGUAS DIRECÇÃO NACIONAL DE ÁGUA</p> <p>PLANO DE GESTÃO AMBIENTAL E SOCIAL DE OBRA</p> <p>工程环境与社会管理计划</p> <p>Obras de reforço do sistema de abastecimento de água à cidade de Cabinda, Lote 2</p> <p>安哥拉卡宾达供水二标段工程</p> <p>Setembro de 2017</p>	<table border="0"> <tr><td>1. INTRODUÇÃO</td><td style="text-align: right;">8</td></tr> <tr><td>1.1. PRINCÍPIOS E POLÍTICAS AMBIENTAIS</td><td style="text-align: right;">7</td></tr> <tr><td>1.2. ORGANIZAÇÃO DO PISA (PLANO DE GESTÃO AMBIENTAL)</td><td style="text-align: right;">8</td></tr> <tr><td>2. IDENTIFICAÇÃO, LOCALIZAÇÃO E CARACTERIZAÇÃO DA EMPREITADA</td><td style="text-align: right;">10</td></tr> <tr><td>3. ORGANIZAÇÃO E ESTRUTURA DE GESTÃO AMBIENTAL</td><td style="text-align: right;">10</td></tr> <tr><td>4. DESCRIÇÃO DE RESPONSABILIDADES</td><td style="text-align: right;">12</td></tr> <tr><td>4.1. ENGENHEIRO RESIDENTE (ER)</td><td style="text-align: right;">13</td></tr> <tr><td>4.2. RESPONSÁVEL AMBIENTAL ADJUDICATÁRIO (RAA)</td><td style="text-align: right;">15</td></tr> <tr><td>4.3. AUDITOR AMBIENTAL ADJUDICATÁRIO (AA)</td><td style="text-align: right;">17</td></tr> <tr><td>4.4. ADJUDICATÁRIO</td><td style="text-align: right;">17</td></tr> <tr><td>5. LEGISLAÇÃO AMBIENTAL - LEGISLAÇÃO APLICADA</td><td style="text-align: right;">24</td></tr> <tr><td>6. PROCEDIMENTOS OPERACIONAIS</td><td style="text-align: right;">25</td></tr> <tr><td>6.1. LOCAL DE CONSTRUÇÃO</td><td style="text-align: right;">25</td></tr> <tr><td>6.2. ESCVAÇÃO E MOVIMENTAÇÃO DE TERRAS</td><td style="text-align: right;">30</td></tr> <tr><td>6.3. SAÚDE E SEGURANÇA</td><td style="text-align: right;">31</td></tr> <tr><td>6.4. TRANSPORTE E ARMAZENAMENTO DE MATERIAS E EQUIPAMENTOS</td><td style="text-align: right;">33</td></tr> <tr><td>6.5. ARMAZENAMENTO E MANUSEAMENTO DE PRODUTOS QUÍMICOS</td><td style="text-align: right;">35</td></tr> <tr><td>6.6. SUBSTÂNCIAS PERIGOSAS</td><td style="text-align: right;">38</td></tr> <tr><td>6.7. RESÍDUOS SÓLIDOS QUOTIDIANOS</td><td style="text-align: right;">38</td></tr> <tr><td>6.8. CONTROLO DE RUÍDOS</td><td style="text-align: right;">38</td></tr> <tr><td>6.9. CONTROLO DE TRÁFICO RODOVIÁRIO</td><td style="text-align: right;">39</td></tr> <tr><td>6.10. CONTROLO DE ÁGUAS PLUVIAS E RESÍDUOS</td><td style="text-align: right;">40</td></tr> <tr><td>6.11. GESTÃO DE PRAGAS</td><td style="text-align: right;">41</td></tr> <tr><td>6.12. CONDIÇÕES SANITÁRIAS E DE SALUBRIDADE</td><td style="text-align: right;">41</td></tr> <tr><td>6.13. CONTROLO DE PATRIMÓNIO HISTÓRICO, CULTURAL E ÉTNICO</td><td style="text-align: right;">42</td></tr> <tr><td>6.14. INTERRUÇÃO TEMPORÁRIA DE OUTRAS ESTRUTURAS E SERVIÇOS</td><td style="text-align: right;">42</td></tr> <tr><td>6.15. CONCLUSÃO DA OBRA</td><td style="text-align: right;">43</td></tr> <tr><td>6.16. PREVENÇÃO E CONTROLO DE INCÊNDIOS</td><td style="text-align: right;">44</td></tr> </table>	1. INTRODUÇÃO	8	1.1. PRINCÍPIOS E POLÍTICAS AMBIENTAIS	7	1.2. ORGANIZAÇÃO DO PISA (PLANO DE GESTÃO AMBIENTAL)	8	2. IDENTIFICAÇÃO, LOCALIZAÇÃO E CARACTERIZAÇÃO DA EMPREITADA	10	3. ORGANIZAÇÃO E ESTRUTURA DE GESTÃO AMBIENTAL	10	4. DESCRIÇÃO DE RESPONSABILIDADES	12	4.1. ENGENHEIRO RESIDENTE (ER)	13	4.2. RESPONSÁVEL AMBIENTAL ADJUDICATÁRIO (RAA)	15	4.3. AUDITOR AMBIENTAL ADJUDICATÁRIO (AA)	17	4.4. ADJUDICATÁRIO	17	5. LEGISLAÇÃO AMBIENTAL - LEGISLAÇÃO APLICADA	24	6. PROCEDIMENTOS OPERACIONAIS	25	6.1. LOCAL DE CONSTRUÇÃO	25	6.2. ESCVAÇÃO E MOVIMENTAÇÃO DE TERRAS	30	6.3. SAÚDE E SEGURANÇA	31	6.4. TRANSPORTE E ARMAZENAMENTO DE MATERIAS E EQUIPAMENTOS	33	6.5. ARMAZENAMENTO E MANUSEAMENTO DE PRODUTOS QUÍMICOS	35	6.6. SUBSTÂNCIAS PERIGOSAS	38	6.7. RESÍDUOS SÓLIDOS QUOTIDIANOS	38	6.8. CONTROLO DE RUÍDOS	38	6.9. CONTROLO DE TRÁFICO RODOVIÁRIO	39	6.10. CONTROLO DE ÁGUAS PLUVIAS E RESÍDUOS	40	6.11. GESTÃO DE PRAGAS	41	6.12. CONDIÇÕES SANITÁRIAS E DE SALUBRIDADE	41	6.13. CONTROLO DE PATRIMÓNIO HISTÓRICO, CULTURAL E ÉTNICO	42	6.14. INTERRUÇÃO TEMPORÁRIA DE OUTRAS ESTRUTURAS E SERVIÇOS	42	6.15. CONCLUSÃO DA OBRA	43	6.16. PREVENÇÃO E CONTROLO DE INCÊNDIOS	44
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Fig. 3.2 Plan for engineering environment and social management

100% coverage of construction materials, 100% coverage of water-based operation procedures in earth excavation, 100% coverage of tarmac and cement roads, 100% coverage of vehicle washing services and 100% coverage of airtight transportation by trucks carrying construction waste.

In order to ensure the waterproofing materials on the inner walls of the eight concrete reservoirs are harmless to the human body and meet the requirements of ecological and environmental protection, the CRCC took the initiative to communicate with the employer and supervisor and adopted Sika, a new environmentally-friendly waterproofing coating solution that can come in contact with drinking water as ratified by the French High Council for Public Health. This decision has not only ensured the quality of the construction work and realized the waterproofing requirement, but also prevented environmental pollution (Fig. 3.3).

3.1.4 Solution to Surface Runoff and Rainfall Erosion

Cabinda Province, with an equatorial rainforest climate, is mainly a hilly area with a vulnerable ecological system. The rainy season begins in October and ends in next May with frequent and heavy rainfall. Hence, the province frequently struggles against surface runoff and rainfall erosion, gully erosion and other natural disasters, which have become a stubborn challenge for the local government and residents as well as an acute problem in the project construction.

Fig. 3.3 Application of sika, waterproofing coating



All things considered, the CRCC has taken a mix of measures to effectively solve the problem. To begin with, it has prepared a general plan according to the climate and geological characteristics of the province, so that the construction work on steep road segments with deep foundation trenches can be carried out during the dry season. Furthermore, it has employed green technology and approaches to reinforce the project. To be more specific, it makes the best of waste bituminous concrete removed from paved road segments to pave those severely affected by rainfall. Next, rollers are used to compact the road, so as to protect backfilled grooves against rain-wash. In addition, the CRCC has strengthened the control of surrounding slopes. For slopes which are not part of the road, it has used ecological technology to protect these slopes after laying pipeline through boosting the vegetation coverage in a timely manner, so as to reinforce slopes and prevent runoff-induced landslides (Figs. 3.4 and 3.5).

3.1.5 Sound Environmental and Social Benefits

In the course of carrying out the Cabinda Water Supply Project, the project management staff of the CRCC has strictly abided by local laws and regulations, respected local customs, helped the local government with economic growth and worked hard on employment and people's well-being. While ensuring the water supply project delivers its intrinsic environmental and social benefits, it has substantially improved the environment and boosted community well-being.



Fig. 3.4 Use of waste bituminous concrete to protect steep road segments from runoff

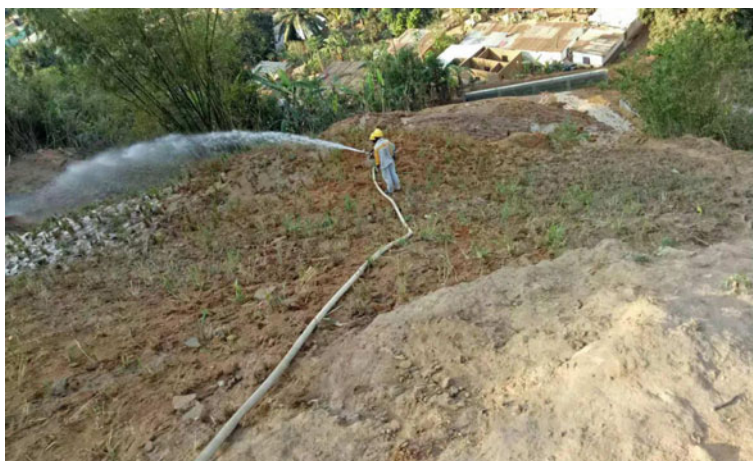


Fig. 3.5 Growing plants on slopes to prevent runoff

(1) **Environment-friendly measures**

In the course of construction, the CRCC has regulated the use of machinery, strictly avoided local residents' rest time, imposed speed limits, prohibited honking without good cause, ensured that trucks are sufficiently covered and took measures like water-spraying to reduce dust concentration. With these measures in place, the CRCC has ensured that local residents are not

disturbed by the noise of machinery and equipment and that there is no environmental pollution resulting from engineering operations. It is not only well-received among the public, but also repeatedly interviewed and promoted by the national media of Angola. High-ranking government officials like the President of Angola, the Minister of Energy and Water and the Governor of Cabinda Province paid several visits to the construction site, during which they expressed appreciation for and spoke highly of the Chinese enterprise for its attempt to protect the environment and fulfil social responsibility in the implementation of the project (Figs. 3.6 and 3.7).

(2) **Creation of Jobs and Enhancement of Workers’ Vocational Skills**

While carrying out the project, the CRCC has recruited many local workers and continuously created job opportunities. The ratio of Chinese workers to Angolan workers of the project has witnessed a growth from 3:7 at the very beginning to 1:17. Since the project was kicked off, it has provided approximately 400 jobs for local residents on average every day, helping the local department of labor to create jobs for about 6,000 people. As an employer, the



Fig. 3.6 OPAIS news, Angola’s state newspaper actively reported the cabinda water supply project



Fig. 3.7 The president of Angola investigated the construction site

CRCC has fully respected all kinds of rights of its workers, created a positive working environment, paid workers generously and supported them to settle disputes with the help of the local department of labor. Thanks to well-regulated employment practices, the project has never met with any labor dispute since the launch.

The CRCC has also worked hard to improve the skills and abilities of local workers. At present, the skills of Angolan team leaders, safety officers, mechanical operators and measurement teams are as good as Chinese employees. In order to realize the sustainable operation and management of the project, the CRCC has also concluded a deal with the water company of Cabinda to train 20 technicians for the latter, who will take charge of the routine operation of the project after it is handed over to the latter.

(3) **Establishment of Communication Channels to Serve the Local Community**

Since the pre-stage of the project, the CRCC has established ties with the local government and water firm to grasp information of local demands and provided services as best as it can, so as to enhance community well-being. During the implementation of the project, it often helps the local water firm to repair damaged water pipelines, cooperates with government departments on the removal of urban garbage, delivers water to residents living nearby free of charge and provides local employees with regular and irregular physical examination. After COVID-19 broke out, in response to the request of the Ministry of Energy and Water of Angola, the CRCC has borrowed a water tanker to the local water firm free of charge to satisfy local people's basic needs (Figs. 3.8, 3.9 and 3.10).



Fig. 3.8 The CRCC is helping local government organs repair damaged water supply pipelines



Fig. 3.9 The CRCC delivers free water to local residents



Fig. 3.10 The CRCC provides regular physical examination for local workers

3.2 Padma (Jashaldia) Water Treatment Plant Project in Bangladesh

The Padma (Jashaldia) Water Treatment Plant Project in Bangladesh is a vital livelihood project jointly promoted by the Chinese government and the Bangladeshi government under the framework of the BRI. The project could improve the water quality of Dhaka, capital of Bangladesh, step up environmental protection, improve people’s living quality, help Bangladesh realize SDG6, and contribute to its sustainable economic and social growth.

3.2.1 Background

With a large river network, Bangladesh is known as the “land of rivers.” However, the country faces the severe shortage of water treatment facilities. Its capital city Dhaka primarily relies on groundwater for the supply of drinking water. With the depletion of groundwater and worsening pollution of water sources (arsenic levels are dangerously high) in Dhaka, it has become imperative for the Bangladeshi government to provide citizens with safe and clean drinking water, which is vital to its economy and people’s livelihood.

The Bangladesh-China-India-Myanmar (BCIM) Economic Corridor is one of the six economic corridors envisioned in the BRI planning. Bangladesh, an important party in the BCIM Economic Corridor actively participates in the cooperation under the framework of the BRI. The Padma (Jashaldia) Water Treatment Plant in Bangladesh undertaken by China CAMC Engineering Co., Ltd. (hereinafter referred to as the CAMCE) is a vital livelihood project jointly promoted by the Chinese government and the Bangladeshi government.

3.2.2 Project Overview

Initiated by the Dhaka Water Supply and Sewerage Authority (DWASA), the Padma (Jashaldia) Water Treatment Plant Project is located in the suburb of Dhaka. With a total investment of USD 290.8 million supported by the preferential loans for foreign aid issued by the Chinese government, the project built a pumping station, a water purification plant with a daily capacity of 450,000 tons, a booster pumping station, double-circuit overhead high-voltage cables and 33 km-long large-caliber raw water and purified water distribution pipelines. The CAMCE was responsible for design, materials supply, construction, installation, debugging and training (Fig. 3.11).

The CAMCE signed a contract with the DWASA in September 2012 and launched the project on October 1, 2014, which passed the completion acceptance in January 2019, as all indicators met the requirements set forth in the contract. The project went into service and began to provide water to the urban area of Dhaka after it was connected with the water distribution networks in October 2019.



Fig. 3.11 Aerial view of the water purification plant



Fig. 3.12 Sheikh Hasina, prime minister of Bangladesh, attended the completion ceremony of the project on October 11, 2019

The project provides local residents with clean drinking water from surface water sources, and effectively boosts the capacity of surface water supply system of Dhaka, thus benefiting approximately three million local residents. At the same time, it has effectively controlled the geologic hazards resulting from the overexploitation of groundwater, and employed engineering approaches to realize water security and improve sanitation. In so doing, the project has made great contribution to bolstering local economic growth and protecting the ecological environment (Fig. 3.12).

3.2.3 Measures for Pollution Control

While implementing the Padma (Jashaldia) Water Treatment Plant Project, the CAMCE faced a series of acute problems including water pollution, solid waste pollution and noise pollution, so it took a range of effective measures to tackle these challenges for green sustainable development.

(1) Measures for Water Pollution

In order to alleviate the pollution to the groundwater environment generated by construction-related wastewater and domestic sewage, the CAMCE carried out classified collection and composition-based treatment of construction-related waste water, before discharging it to the nearby receiving waters. Domestic sewage was released to the nearby receiving waters after it was collected by a grease trap and septic tank and subject to ecological treatment. The waste mud

generated in the course of construction was discharged to a mud pit and then subject to precipitation, and be discharged after meeting the standards.

(2) **Measures for Solid Waste Pollution**

The solid waste generated in the course of construction primarily comprised construction waste and household waste, which were cleaned and transported to designated dumping ground according to the rules for the disposal and management of construction waste and waste materials. The following measures were taken by the CAMCE to dispose of solid waste during the construction of the project. (1) Solid waste was stored by type at fenced and covered dumping ground and facilities with sufficient capacity, and subject to reinforced management. (2) Waste materials were recycled whenever possible to facilitate afforestation, road paving and the construction of other ecological landscapes. A landfill was set up on the construction site for construction waste and back-filled in a timely manner. Random dumping was banned. Domestic waste was subject to prompt and unified clearance. (3) When the project was completed, temporary construction facilities were dismantled and the remaining construction garbage and waste materials were cleaned, so as to ensure “all waste materials are removed from the construction site upon completion.”

(3) **Measures for Noise Pollution**

The CAMCE adopted strict measures to reduce and control noise to keep noise pollution under control and reduce the impact of noise on residents living nearby. As the construction was brought to an end, the impact of the noise was eliminated. It took the following measures to achieve that goal. (1) It employed high-quality soundproofing components to insulate the noise source of construction equipment from the environment to keep the construction noise enclosed in these components and narrow the scope and intensity of noise pollution. (2) It installed sound absorption panels made of fiber materials, granular materials and foam materials around noisy construction equipment like pile drivers and sawing machines. (3) Spring shock absorbers, rubber dampers, pipeline shock absorbers and damping technology were applied to the areas between construction equipment and the basic parts or connection points to cut momentum and reduce noise. (4) The CAMCE appropriately designed the layout of the construction site and set up fences for operation zones at all stages. (5) It employed professionals to operate low-frequency and low-noise vibrators for concrete pouring. Meanwhile, it made sure that vibrators were not submerged into steel or templates during the operation, so as to avoid strong noise-induced environmental pollution and prevent it from disturbing residents. (6) It reduced the noise of the steel templates during the vibration by replacing small steel templates with bamboo plywood.

The local department of environmental protection and a third-party environmental assessment agency performed two EIAs respectively in the early stage of the project and after the completion of the project, in line with relevant provisions of Bangladesh. Main conclusions of the EIAs are as follows:

- i. Assessment of environmental pollution: the pH scale of precipitated sludge discharged by the water plant is 7, so it can be used as backfill materials for the restoration of farmland and roads and poses no risk to the surroundings and people living nearby.
- ii. Assessment of the ecological environment: The water source of the Padma (Jashaldia) Water Treatment Plant Project in Bangladesh is the Padma River and the ecological environment along the river remains intact.
- iii. Assessment of status quo: The vegetation and grassland along the pipelines have been restored before and after the construction of the project. At the same time, the vegetation and grassland in the construction site of the water plant and those nearby were protected, according to the special environmental protection plan prepared before the commencement of the construction work. They were transplanted before excavation and maintained by designated personnel. After the completion of the project, they have been restored promptly.

3.2.4 Application of Green Technology

(1) Frequency Conversion Technology for Water Pumps

The Padma (Jashaldia) Water Treatment Plant Project has a daily water supply capacity of 450,000 tons. The clean water that meets relevant standards will be delivered to the water distribution network in the urban area of Dhaka through the 30 km-long transmission pipelines. Given that the temporal distribution of urban water consumption is uneven, the CAMCE considered frequency conversion technology regarding the design of intake pumps, delivery pumps and booster pumps. The frequency conversion technology for water pumps is an automated control technology that changes water flows by regulating the frequency of input power. Compared with previous valve regulation, it features less noise pollution, higher energy efficiency and higher operating efficiency, making great contribution to the utilization rate of water resources (Fig. 3.13).

(2) Recycling of Water for Production

In order to increase the utilization rate of water resources and minimize the discharge of industrial wastewater to nearby natural water bodies, the project took the recycling of industrial wastewater into account by reusing the drainage of water for the backflushing of the filter after it met relevant standards through treatment. In so doing, it curtails the discharge of wastewater. At the same time, it also cuts the amount of water from the water source and keeps the water utilization rate of the plant under three%, thus laying a foundation for the water plant to seek environmentally friendly operation in the long run.

(3) Design Philosophy of Sponge Cities

In Bangladesh, there is intense rainfall in the wet season with frequent heavy rain and rainstorms. For this reason, external drainage has to draw on the concept of sponge cities. Therefore, “green” measures like sunken green-belt and vegetation-covered shallow gullies for drainage were taken by the



Fig. 3.13 Aerial view of intake facilities

CAMCE. The idea is to drain water away slowly and disperse the source of drainage, so as to release the massive rainfall from the plant progressively through different channels during rainstorms. In this way, on the one hand, it reduces the use of mud dredging in the early stage of plant building; on the other hand, it reduces the massive use of pipelines, which is typical of traditional drainage networks. While curtailing investment in the project, this solution has also properly handled the challenge of drainage during the wet season.

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Chapter 4

Sustainable Traffic



4.1 South-North Expressway of Montenegro

To realize the design objective of pursuing green development and environmental protection, the South-North Expressway of Montenegro Project adopted the green design strategy and technical solutions of closed drainage systems, reduced the content of water pollutants on the road surface, and reached the EU standard for wastewater discharge (EN858). The closed drainage system, featuring high technical integration and process innovation, can be effectively harmonized with expressway construction. The “green and environmentally-friendly” design concept can fully filter out water pollutants on the road surface, reduce the damage caused by surface water to water resources and the environment along the road, and produce favorable environmental and social benefits.

4.1.1 Background

The South-North Expressway is the largest infrastructure project since the founding of Montenegro, and also the first of its kind in the country. Following its completion, the expressway will become part of the international road traffic network, lead to many countries in Central Europe, and drive the economic and social development of Montenegro and the entire Central and Eastern Europe. Therefore, the project has attracted wide attention from the entire Europe.

4.1.2 Project Overview

The South-North Expressway of Montenegro stretches from its southern city Bar Harbor to Boljare in the north, with a full length of around 180 km. According to the plan prepared by the government of Montenegro, construction is divided into five phases, giving priority to the 41 km section from Smokovac to Matesevo. Started in May 2015, construction was undertaken by the China Road and Bridge Corporation (CRBC) of China Communications Construction Company Limited (CCCC), with the contracted amount reaching EUR 809 million (Fig. 4.1).

This section is also the most difficult one in terms of technology and engineering. It mainly includes 20 main bridges, 16 tunnels, four interchanges, one service zone,

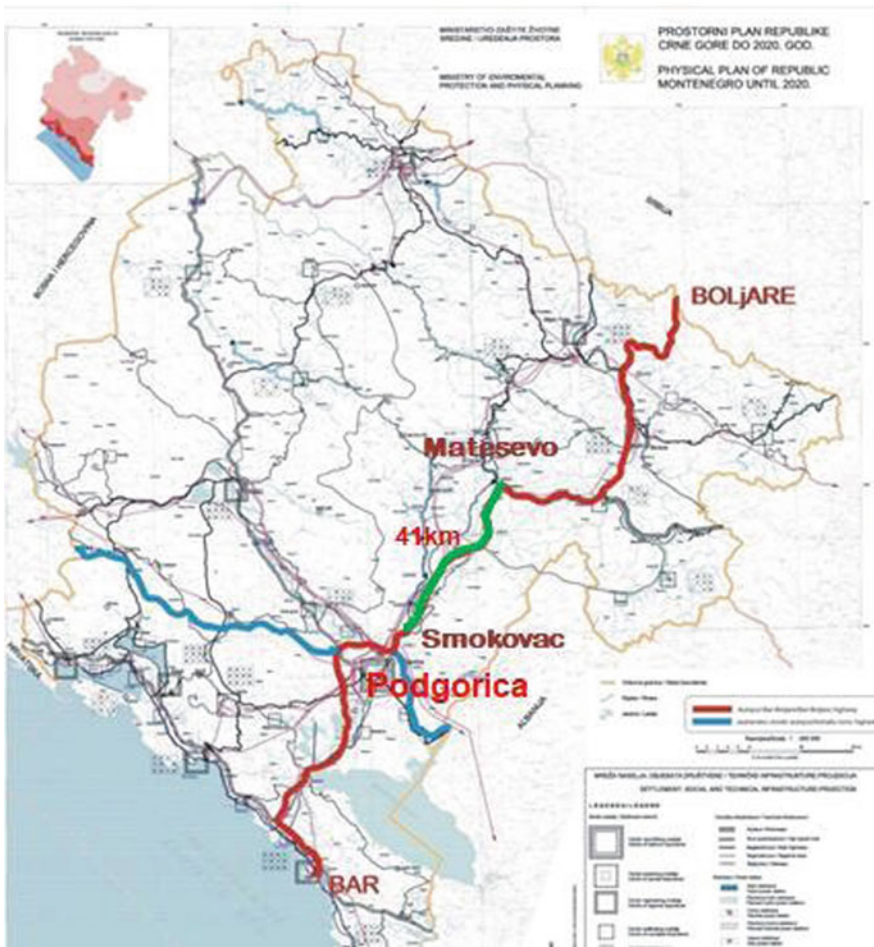


Fig. 4.1 Location of the project (green part)



Fig. 4.2 Construction site of the Podgorica bridge (2018)

one maintenance area and four toll stations. The total length of tunnels and bridges are 18.3 km and 6.25 km respectively, accounting for 60% of the entire section. In October 2019, the two sections from Smokovac to Matesevo were formally joined, marking the final stage of the construction of its main structure (Fig. 4.2).

4.1.3 Green Design Strategies and Technical Solutions

(1) Green Design Strategies

The South-North Expressway of Montenegro Project stretches over the Tara River, which is called “Tear of Europe”, and River Moraca, a main river in Montenegro. To preserve water resources and the environment, the project team envisioned environmentally-friendly drainage for the closed drainage system.

The design concept and core idea are as follows. Under the impact of various vehicles, water on the road surface is normally polluted by hazardous substances such as tire bits, oil stains and pitch particles, so it cannot be directly discharged to the natural environment. Instead, the water can only be discharged after it is collected, precipitated and purified via a special drainage system. Admittedly, not all surface catchment is polluted. According to this idea, continuous rainfall will wash away dirty substances from the road surface. Only the first 20% of surface catchment is the most contaminating, and the rest of the 80% that follows can be directly discharged into the surface drainage or natural environment. Therefore, the core of the closed drainage system is to collect and dispose of the first 20% of surface catchment, precipitate and filter

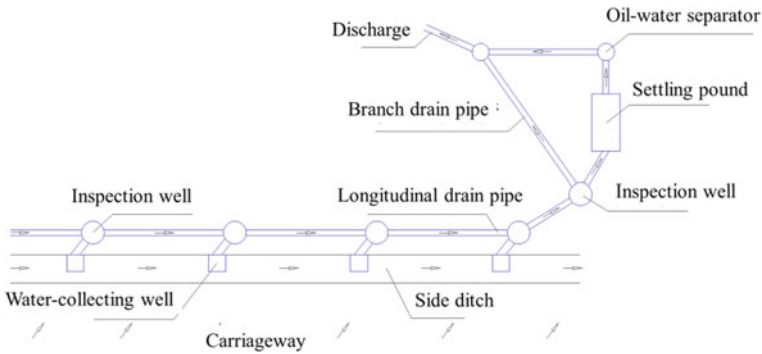


Fig. 4.3 Plan of the closed drainage system

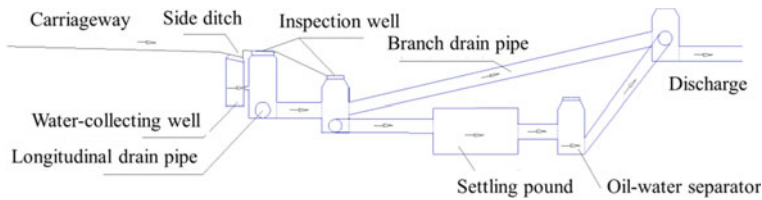


Fig. 4.4 Profile of the closed drainage system

it, and discharge it into the natural environment after it meets certain ecological and environmental indexes.

(2) **Technical Solutions**

The design of closed drainage is mainly targeted at rainwater on the carriageway and other road surface water, and mainly comprises side ditches, water-collecting well, inspection wells, drainpipes, settling ponds and oil–water separators (Figs. 4.3 and 4.4).

The working mechanism of closed drainage design is as follows. In a drainage system unit, road surface water flows into the side ditch from longitudinal and cross slopes, flows into the reasonably placed water trap, then into the inspection well, and eventually follows installed tubes to the processing terminal. Through setting up pipes with different elevations at the diversion inspection well, the system directs the first 20% sewage into the settling pond for purification in the oil–water separator and then release it. The remaining 80% of rainwater is directly discharged through the branches. Every component of the system has been scientifically analyzed and proved with distinct characteristics.

The closed drainage system can be closely combined with the design and construction of expressways. As the entire system is embedded in the roadbed, the system is both practical and decorative. While greening and protecting the environment, it does not affect the geometric shape and appearance of the expressway. Hence, it is a brand-new design concept and technique (Figs. 4.5, 4.6, 4.7 and 4.8).



Fig. 4.5 Water trapper and inspection wells along the roadbed



Fig. 4.6 Connection between the inspection well and drainage pipes

4.1.4 Environmental Benefits and Related Experience

The closed drainage system of the South-North Expressway of Montenegro Project complies with local hydrologic and meteorological conditions, as well as EU requirements for sewage discharge. With the system in place, under 10-min heavy rainfall (10-year recurrence interval), water on the surface of the expressway can be fully filtered and meet the requirements of the EU standard (EN858), i.e. pollutants content less than 5 ml/L, meaning that it can be directly discharged.



Fig. 4.7 Installation of oil–water separators



Fig. 4.8 Close combination between the closed drainage system and the expressway

There are many rivers and national forest parks along the South-North Expressway of Montenegro, and the road also stretches across some private lands. With extremely strict environmental requirements, the design of a closed drainage system fully filters wastewater on the road surface and satisfies EU standards on discharge without affecting road performance. In addition, through adjusting the property of its internal parts, the system is able to meet environmental protection requirements and discharge

standards in different areas and environments. Along the expressway, especially in districts with high protection standards of water resources and high environmental sensitivity, e.g. natural reserves, ecological preservation areas and drinking water source areas, the system is able to avoid or significantly reduce the road sewage-induced damage to nearby water resources and the natural environment, thus effectively improving the ecological environment.

The closed drainage system in the South-North Expressway of Montenegro is a brand-new design and part of the construction work, leading to higher costs. However, from the perspective of protection of environment and ecological civilization during project construction, such huge one-off investment brings about enormous value. The application of such a green design concept avoids potential environmental damage or pollution from the origin, and thus saves spending in repairing such damage, which is immeasurable.

4.2 Peljesac Cross-Sea Bridge of Croatia

The Peljesac Cross-sea Bridge of Croatia project has employed a mix of measures—optimization of design and the construction plan, reasonable allocation of resources, noise reduction by the application of a Bubble Screen, long-distance marine transportation of drilling slag and in-depth cooperation with local specialized firms—to protect the marine environment and promote green construction, which contributes to energy efficiency, material saving and the protection of the marine environment.

4.2.1 Background

Dubrovnik in southern Croatia is a famous tourist spot. However, a ride from the capital Zagreb to the city has to pass the roughly 20 km “Neum Corridor” in Bosnia and Herzegovina. During peak seasons, the Corridor is often overwhelmed by vehicles awaiting clearance. Building a cross-sea bridge over the Bay of Mali Ston in the Adriatic Sea will connect southern and northern Croatia, and residents commuting between the south and the north will no longer have to enter or depart the border. A few minutes’ drive will replace the original two to three-hour travel (Fig. 4.9).

In April 2019, Chinese Premier Li Keqiang investigated the Peljesac Bridge Project with the company of Croatian Prime Minister Andrej Plenković. Premier Li said that the Peljesac Bridge is a bridge of friendship, which not only connects both sides of the bay, but also carries the friendship between the two peoples, contributing to peace, stability, prosperity and development of the region. It is also a bridge of people’s livelihood, as it facilitates the flow of people and goods, offers convenience to local residents’ life, strongly promotes economic and social development, and improves people’s livelihood in Croatia.



Fig. 4.9 Blueprint of the bridge

Prime Minister Plenković stated that the Peljesac Bridge is a major infrastructure project carried out by Croatia and China and symbolizes the friendship and cooperation between the two countries. The bridge, long expected by the Croatian people, finally took shape with help from Chinese friends. Its completion will greatly help people with their travel, effectively promote local development, offer new market opportunities for Chinese enterprises, and play a demonstrative role in the pragmatic cooperation between Europe and China.

4.2.2 Project Overview

The Peljesac Bridge and its access roads is the costliest construction project to date in Croatia, with an estimated total construction cost of roughly EUR420 million. According to the plan, the project includes both the cross-sea bridge and its access roads. In particular, the bridge is 2.4 km long and 22.5 m wide, with a navigation clearance of 55 m; the access roads are 1.5 km long and 12 m wide. In June 2017, the EU officially approved the project and decided to undertake 85% of its construction cost (EUR 357 million).¹ In January 2018, a consortium led by China Road and Bridge Corporation (CRBC) won the bid for Phase I of the Peljesac Bridge and its access roads. The contract value is roughly EUR 280 million, and the construction period is 36 months. On July 31, 2018, the project was commenced (Fig. 4.10).

The Bay of Mali Ston in the Adriatic Sea, where the Peljesac Bridge is situated, belongs to the EU marine natural reserve, and is a key water for the EU to protect endangered species and their habitat. Besides, well-developed local fish breeding and

¹ <http://hr.mofcom.gov.cn/article/jmxw/201801/20180102698900.shtml>



Fig. 4.10 Construction site of the bridge

tourism industries are highly environmentally demanding. Therefore, reducing the impact of construction on the surroundings and carrying out environmental protection in strict compliance with local laws and regulations has become the key of the project.

4.2.3 Plan of Green Construction

(1) Narrowing the Scope and Time of Construction Impact Through Well-thought-out Planning

First, the plan for pile foundation construction has been optimized. There are a total of 150 steel pipe piles in the bridge (including test piles), with a total length of 15,483 linear meters and total weight of 31,100 tons. Compared with the conventional technique of bored perfusion, complete steel pipes are driven into the ground in the project with China's "Xiongcheng No.1" pile driving barge. Meanwhile, the steel pipes are molded in one take, and their welding quality fully satisfies the requirements of "EXC4 B + ". Therefore, there is no need to start construction after welding them on site, thus greatly reducing the risks of offshore construction. After optimization, the construction period has been reduced by three months, and the number of drilling machines, working vessels and staff has also been curtailed. Second, the plan for building the submerged elevated pile cap has also been optimized. Precast concrete cofferdam, used in the original design, occupies much space and is time-consuming. Following the optimization, precast concrete cofferdam floor and steel bolster plates are spliced to form a cofferdam structure, which enables not only simultaneous construction in the water, but also the recycling of these plates, thus significantly saving space and controlling environmental impact (Fig. 4.11).



Fig. 4.11 Construction of steel pipes (Left: steel pipe transportation; Right: steel pipe welding)

(2) **Use of Bubble Screen to Reduce Noise and Protect the Marine Environment**

The relatively huge noise from the welding process of steel pipes influences marine life. The project reduced noise with bubble screens: Air comes into pipes placed on the surface of seabed, and rising bubbles at the opening of pipes form a closed Bubble Screen. Due to difference between the density of air and water, the Bubble Screen causes high damping loss and scattering to noise transmission, brings noise out of the water and discharges it into the air. In addition, when the bubbles come out, water is disturbed and sound produced, which alarms marine creatures and allows them to escape from the construction area, so as not to be harmed (Figs. 4.12 and 4.13).

Thanks to the installation and successful application of bubble screen-enabled noise reduction devices, the steel pipe welding process could comply with

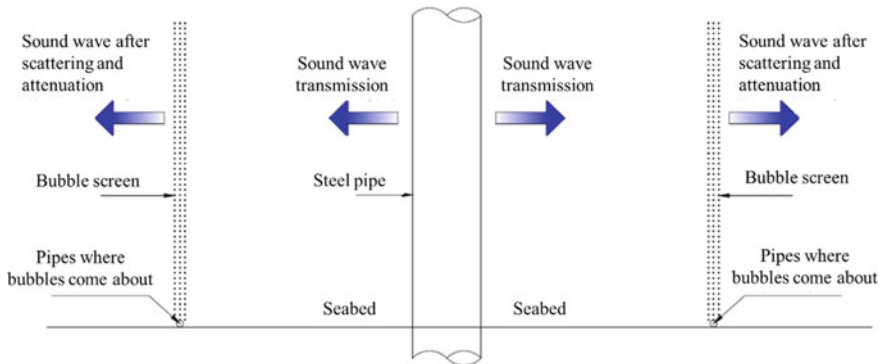


Fig. 4.12 Principle diagram of bubble screens

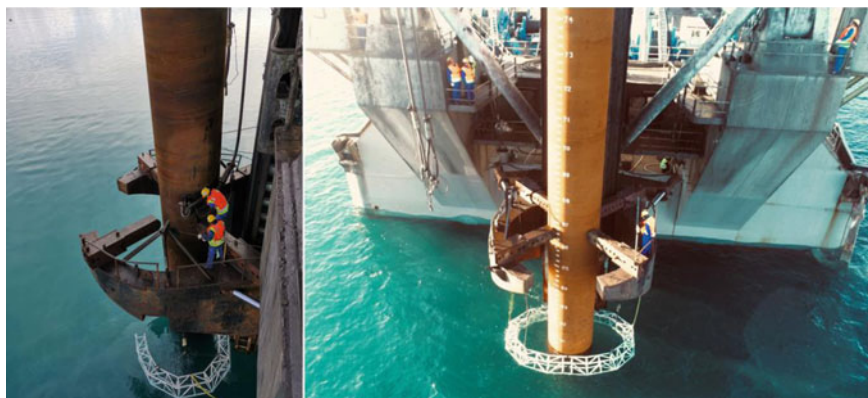


Fig. 4.13 Bubble screen-enabled noise reduction device (white annular duct)

local environmental protection and noise protection laws. No marine creatures have died from sound waves or high-energy vibration, and no complaint from nearby residents has been received.

(3) **Strict Control of Marine Pollution.**

The project team has allocated special funds for energy conservation and environmental protection. In 2019, more than RMB 4 million was invested in environmental protection facilities, mainly including purchasing oil barrage at sea to prevent possible oil spills, and using two barges to send drilling slag 20 nautical miles away for centralized discharge. The team also transformed three-level wastewater settling tanks into level-four tanks and connected all the wastewater-producing pipelines to ensure 100% recycling of wastewater. A treatment system of domestic sewage has been set up, and qualified local sewage treatment companies hired for regular disposal, so as not to cause any environmental pollution. As a result, marine pollution accident has taken place during construction (Fig. 4.14).

According to a report released by the sea bathing water quality in Croatia, in line with the standards set forth by the *Regulation on Sea Bathing Water Quality* (OG 73/08) and *Directive 2006/7/EC concerning the management of bathing water quality*, sea water quality in the construction area of the bridge was rated as EXCELLENT in both 2018 and 2019. The seven monitoring points set up by the agency within 50 km of the construction area were also rated as EXCELLENT.

4.2.4 Sound Social Benefit

The Peljesac Bridge is a project awarded to the consortium formed by the CRBC through open tendering and fair competition, which complies with market principles



Fig. 4.14 Third-party inspection of the construction equipment and domestic sewage treatment system in the living quarter



Fig. 4.15 Main construction materials and equipment meet CE certification

and EU rules. It is not only the first EU-funded infrastructure project undertaken by Chinese enterprises within the EU, but also the largest bridge project won by Chinese enterprises in the EU by now.

The project follows EU construction standards for bridges. Notably, the making of its steel structure has met the highest EXC4 standard in Europe. To better integrate into EU's construction system, the company undertaking the project has successively cooperated with eight design consulting firms within the EU for upfront issues, such as engineering design, safety and environmental protection consulting, legal and tax registration. It has worked together with 17 construction enterprises within the EU on measurement, geological surveys, experiments and testing, safety training and engineering consulting. It has also collaborated with 65 equipment and material suppliers from countries like Croatia, Romania and Poland (Fig. 4.15).

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Chapter 5

Solid Waste Treatment



5.1 Can The Waste-To-Energy Plant in Vietnam

Domestic waste is a major environmental issue in cities and communities. The Can Tho Waste-to-Energy Plant in Vietnam not only solves the problems resulting from domestic waste stacking in the open air in the city, but significantly contributes to reducing local waste pollution and improving people's living environments, thus promoting the technological development of Vietnam in generating electricity from waste incineration.

5.1.1 Background

Located in southern Vietnam, Can Tho is one of the five municipalities directly under the Central Government in the country. It is also the largest city in the Mekong Delta with a population of 1.95 million and is approximately 160 km away from Ho Chi Minh City. With the rapid economic development and continuous urban expansion in recent years, there has been a constant increase of domestic waste, bringing threats to the local residents' well-being and environmental protection. The amount of waste clearance in Can Tho reaches about 650 tons per day. In the past, there were two waste incineration plants (incapable of generating electricity) in the city, and their disposal capacity could reach 150 to 200 tons per day in total, but they have been shut down this year. The Can Tho waste-to-energy project in Vietnam has effectively tackled the shortage in local waste treatment capacity (Fig. 5.1).



Fig. 5.1 Panorama of Can Tho waste-to-energy plant in Vietnam

5.1.2 Project Overview

In July 2016, the Can Tho waste-to-energy project, which was invested, constructed, and operated by China Everbright International Ltd. (hereinafter referred to as Everbright International), was officially launched. The waste-to-energy plant was officially put into operation in November 2018. As the first modern waste-to-energy project in Vietnam, the plant can facilitate local economic development and environmental protection, thus serving as an important demonstration. In 2018, the project was awarded the “2018 Award of Orders of Merit to Enterprises in Can Tho” by the Can Tho Investment Promotion Conference (Fig. 5.2).



Fig. 5.2 Can Tho project was awarded the “2018 award of orders of merit to enterprises in Can Tho” by the Can Tho investment promotion conference

The project received a total investment of around USD 47 million and is constructed using the EPC¹ model, with an operation period of 22 years (including two years of the construction period). It is equipped with an incinerator disposing of 400 tons of domestic waste per day and a 7.5-MW steam turbine generator set. Currently, the waste disposal capacity of the plant takes up about 70% of the total daily waste treatment of the city. By the end of August 2020, the amount of domestic waste disposed of added up to 317,000 tons and 103 million kWh of electricity were generated. A part of the electricity generated is for the plant's own use, while the other part is transmitted to local electrical grids.

Other than disposing of new domestic waste every day, further efforts have been made to assist the government to gradually dispose of the stale waste in the original landfill sites, solving the problems resulting from domestic waste stacking in the open air in the city.

5.1.3 Environmental Protection Technologies

From construction to operation, the Can Tho project is implemented strictly in line with the *Domestic Waste Disposal Service Agreement* signed with government departments, and all its indicators strictly meet the standards in the project's EIA. During its construction, a total of five environment-related projects have been launched, including the wastewater collection and disposal project, dust and flue gas treatment project, domestic solid waste storage and disposal project, hazardous waste storage project, and environmental protection project. At present, the Can Tho project has obtained the certificate of completion of environmental protection facilities issued by the Ministry of Natural Resources and Environment of Vietnam, marking that all its five environmental protection projects have been completed.

Since the calorific value and composition of the domestic waste in Vietnam are close to that in cities in southern China, the technologies adopted by Everbright International include the mechanical grate technology of "multistage reciprocating forward-pushing + churning", the flue gas treatment technology of "SNCR + semi-wet process + dry process + activated carbon injection + bag filter," and the leachate disposal technology of "pretreatment + high-efficiency anaerobic IOC + aerobic A/O + ultrafiltration + chemical softening + microfiltration + reverse osmosis". The aforesaid flue gas treatment technology and the leachate disposal technology have been widely used in cities of southern China and have become stable and mature. Constructed exactly according to China's standards, the Can Tho project is under strict control of Everbright International in accordance with the "one-in-four-out" principle (the waste goes in while cinder, flying ash, leachate, and flue gas come out) in the safety and environment management systems in China. According to a

¹ EPC (Engineering Procurement Construction) means a company (the contractor) is commissioned by the owner to undertake the whole or part of the construction work including design, procurement, construction, and trial operation of engineering construction projects in accordance with the contract.



Fig. 5.3 The Can Tho waste-to-energy plant in Vietnam

qualified third-party inspection in Vietnam, all data of the project meet the current national standards of Vietnam and the daily average value of online monitoring indicators for flue gas complies with the EU 2010 standards (Fig. 5.3).

5.1.4 Boosting Development of the Local Industries and Creating More Jobs

Since the waste-to-energy technology in Vietnam is still in its infancy, the relevant regulations and standards are not yet fully in place, but the Can Tho project's construction, technology, and operation standards have provided the Vietnamese government with references for improving the waste-to-energy industry standards. Adhering to the concepts of sustainable development and using local labor force, the Can Tho project has employed nearly 200 local residents from local universities, vocational training schools as well as the surrounding communities (Fig. 5.4).

In the past, the Vietnamese people were not familiar with the waste-to-energy technology, and neither did they support it. Everbright International actively organized Open Plant tours to increase the engagement from the public. The plant has a garden-style, odorless and noise-free environment, where the waste is disposed of with strict inspection and qualified emission. Also, the plant facilitates stale waste disposal and contributes to improving local urban ecological environment. Therefore, Everbright International has been recognized by the government, the public, and the media. In June 2020, the Can Tho project was approved by the Can Tho government as the first industrial tourism base in Vietnam's waste-to-energy industry (Figs. 5.5 and 5.6).



Fig. 5.4 Training local employees to increase local employment

5.1.5 Actively Communicating with the Local Governments and Communities

The Can Tho project is completely open to the public and subject to the supervision of the government and the society. The flue gas data are made public on the LED screens outside the plant’s gate, and released to local environmental regulation departments via the internet in real time. By giving the access to visiting the plant and knowing the operation of environmental protection facilities and pollution control information in real time, the pollution control facilities are supervised by the public. The project not only maintains a high level of environmental management, but ensures the safe, uninterrupted, stable, and qualified operation. Since April 2019, the project has made the first Friday of each month as the Open Plant Day. As of today, it has received over 2,000 people times in more than 100 tours, including government agencies,



Fig. 5.5 The project was approved by the Can Tho tourism association as the “Can Tho industrial tourism base”

Bà Hisaka Kimura, Trưởng Phòng Tài chính cơ sở hạ tầng Đông Á, Ngân hàng phát triển châu Á (ADB) cho biết, ADB chọn Everbright là đối tác hợp tác chiến lược lâu dài trong lĩnh vực môi trường, ứng phó với biến đổi khí hậu.

Theo bà Hisaka Kimura, nhiều thành phố ở châu Á đang đối mặt với khó khăn trong vấn đề xử lý chất thải rắn. Dự án Nhà máy đốt rác phát điện Cần Thơ đem lại một phương án bảo vệ môi trường có hiệu quả, đồng thời giúp các quốc gia giảm sự phụ thuộc vào nguồn nhiên liệu hóa thạch.



Khuôn viên nhà máy. Ảnh: Thanh Liêm/TTXVN

Từ tháng 4/2019, nhà máy mở cửa cho người dân đến tham quan vào thứ 6 tuần đầu tiên của mỗi tháng. Đại diện nhà máy cho biết, đến nay đã có hơn 1.000 lượt khách đến tham quan, tìm hiểu quy trình hoạt động của nhà máy.

Gia đình chị Lê Thị Kiều Trang, xã Trường Xuân, huyện Thới Lai đã vào tham quan nhà máy. Khi chứng kiến quy trình tiếp nhận, xử lý rác tại đây, chị không còn lo ngại như lúc mới nghe tin nhà máy xử lý rác sẽ được xây dựng đối diện nhà mình.

Fig. 5.6 An article by the Vietnam news agency complimenting the Can Tho project (November 2019)



Fig. 5.7 The Open Plant Day is organized on the first friday of each month

local residents, journalists, industry experts, employees’ families, and students from elementary and middle schools (Fig. 5.7).

People in local communities have been engaged in the Can Tho project since its launch. In the early stage of the project, in order to avoid the “Not-in-My-Back-Yard’ syndrome²” in the domestic waste incineration project, people in local communities

² The “‘Not in My Backyard’ (NIMBY) syndrome” is a characterization of dislike and intense, resolute, and sometimes highly emotional collective oppositions and even protests by residents or local organizations due to the fear that the construction projects (such as garbage dump, nuclear power plants, and other NIMBY facilities) may negatively affect the physical health, environmental quality, and property value.

Fig. 5.8 A local resident was interviewed by Xinwen Lianbo of china central television (April 2019)



were invited to see the waste-to-energy projects in operation by Everbright International in China. Besides, community surveys were also sent out during the project's environmental assessment, so as to ensure that the project was constructed in accordance with laws and regulations. After the completion of the project, local residents were invited to visit the plant for several times, which shows it is supervised by the public. The local residents commented, "In the past, the domestic waste stacking outside the houses would simply be incinerated or buried. But now, there are garbage trucks coming to our houses now and then to collect the waste, which makes our living environment much cleaner (Fig. 5.8)."

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Chapter 6

Sustainable Consumption and Production



6.1 FINEX™ Fiber Project

In order to promote the recycling of waste textiles and reduce the environmental pollution and waste of resources caused by waste textiles, Sateri, through independent research and development, uses post-consumer textile waste (such as jeans, T-shirts and other old clothes) to produce FINEX™ recycled fiber, opening up a recycling industry path of “resources—products—consumption—recycled resources” and providing a new solution for the sustainable development of the fashion industry.

6.1.1 Background

China is the world’s largest textile and garment producer and exporter, and also one of the world’s largest consumer markets for textiles and garments.¹ Under the influence of “fast fashion”, more and more textiles are updated faster and faster; more than 50% of the fast-fashion garments will be discarded within a year. In this case, the recycling of waste textiles has become an urgent requirement. It is estimated that in 2020, the total clothing waste in China weighs as much as 30 million tons, and most of these waste textiles are incinerated or landfilled, with a recycling rate of less than 1%, resulting in severe environmental pollution and waste of resources. At the same time, the textile industry is plagued with tensions in the supply of raw materials, more than 65% of which are imported.

With the further prominence of resource and environmental constraints, China continues to accelerate the systemic transformation of circular economy development in the textile and garment industry. In 2013, China issued the *Circular Economy Development Strategy and Near-Term Action Plan*, clearly stating that the textile

¹ Make Fashion Circular: Outlook for A New Textile Economy.

industry should accelerate the development of biomass textile fiber materials as an alternative to petroleum and promote the standardized development of waste textile recycling.² In 2017, China's *Circular Development and Leading Action* proposed a development direction to promote the recycling of waste textiles and encourage textile enterprises to use recycled materials in the production.³

In the international community, the concept of sustainable consumption is increasingly recognized and practiced by consumers, and a large number of brands and companies are aware of this trend and have taken positive actions: H&M Group is committed to making 100% of its raw materials sustainable fibers, including recycled fibers, by 2030⁴; Inditex (Zara) Group plans to achieve 100% sustainability in raw materials by 2025.⁵ In order to promote the recycling of waste textiles, collaboration should be strengthened within the entire industry chain, from waste textile recycling and sorting, fiber extracting and producing and yarn weaving to terminal brands, advancing the innovation and R&D of the production process and technology of recycled fibers in the upstream and boosting awareness and demand for sustainable consumption in the downstream, to achieve an industry-wide upgrading and value adding.

6.1.2 Project Overview

Viscose is a kind of cellulose originating from natural materials (such as trees and bamboos), which is degradable. Therefore, as a good alternative to man-made fibers made from chemical raw materials and cotton fibers consuming a lot of water during production. Viscose has become one of the most commonly and widely used fibers in the world.

Sateri Group, a subsidiary of the Singapore-based Royal Golden Eagle (RGE) Group, is currently the world's largest producer of viscose. Since June 2019, Sateri has developed an in-depth cooperation with a Swedish pulp supplier to produce recycled dissolving pulp from fibers extracted from discarded textiles (such as jeans, T-shirts, hotel linens and other post-consumer textiles). Through independent R&D, Sateri has realized the industrial production of recycled viscose. Sateri (Jiangsu) Fiber Co., Ltd. has started to produce and sell recycled viscose fiber—FINEX™ fiber, which has been certified to the Recycled Claim Standard (RCS) (Fig. 6.1).⁶

² http://www.gov.cn/zwgk/2013-02/05/content_2327562.htm.

³ https://www.ndrc.gov.cn/fggz/hjzy/fzxhjj/201705/t20170504_1203307.html.

⁴ H&M Group Sustainability Performance Report 2019.

⁵ INDITEX <https://www.inditex.cn/en/our-commitment-to-the-environment>.

⁶ Recycled Claim Standard (RCS) is a recycling (recycled) standard launched by Textile Exchange (TE) in 2013, providing a basis for the certification of products with recycled raw materials.



Fig. 6.1 Recycled claim

6.1.3 Main Techniques and Applications

(1) **Material Selection**

After tests and comparisons, recycled pulp originating from waste home textiles and denim fabrics is chosen as the raw material for recycled viscose.

(2) **R&D on Production Techniques**

On the basis of traditional production techniques, Sateri’s R&D team, through constant adjustment and innovation, has explored a new technique suitable for the industrial production of recycled viscose fiber from recycled pulp and increased the proportion of recycled pulp from 1 to 20%.

(3) **Product Features**

Fabrics made from FINEX™ fiber share similar features with common viscose products. They are skin-friendly, moisture-absorbing and breathable, suitable for blending or interweaving with other fiber products to give the fabrics a bright and soft color and a distinctive style.

(4) **Product Application**

Since April 2020, Sateri has developed an in-depth cooperation with RICOLEE, an emerging designer brand, and LAFUMA, a French outdoor brand, to bring FINEX™ fiber-based garment products to market in succession. In the future, Sateri will continue to promote cooperation with more international brands to launch more garments made from recycled viscose fiber (Fig. 6.2).



Fig. 6.2 Garment products made from FINEX™ fiber

6.1.4 Environmental Benefits

A study carried out by Bureau of International Recycling (BIR) in University of Copenhagen, Sweden in 2008 found that recycling 1 kg of waste textiles means lowering 3.6 kg of carbon dioxide emission, saving 6,000 L of water and reducing the use of fertilizer and pesticide by 0.3 kg and 0.2 kg respectively.⁷ Wood pulp made from waste textiles is used in the production of the recycled viscose FINEX™ fiber, emitting less carbon dioxide than the processing of non-recycled materials.

As is estimated, if the annual output of waste textiles is 26 million tons and the comprehensive utilization rate is 60%, 9.4 million tons of chemical fibers and 4.7 million tons of natural fibers will be saved every year, leading to an annual saving of 18.8 million tons of crude oil, equivalent to half of the output of Daqing Oilfield, and about 10,893.33 million m² of arable land, which accounts for 46% of the total cotton area.⁸

6.2 Yanbu Refinery in Saudi Arabia

The Kingdom of Saudi Arabia (hereinafter referred to as Saudi Arabia) has a fragile environment composed of extensive desert and Gobi areas. As a world-class oil refinery, the Yanbu Refinery project is an effort to execute the national development strategy of optimizing and upgrading the Saudi economy and energy industry.

⁷ <http://www.sh-recycle.org/article/detail.asp?id=1805>.

⁸ <http://www.sh-recycle.org/article/detail.asp?id=1805>.

It has become a demonstration project for energy cooperation between China and Saudi Arabia that adheres to the concept of green development and creates social and economic benefits while minimizing the impact of the project's production and operation on the local environment.

6.2.1 Background

Located in the Arabian Peninsula in Southwest Asia, Saudi Arabia is famous for its rich oil reserves and is the “lead country” of the Organization of Petroleum Exporting Countries (OPEC). In April 2016, Saudi Arabia formally announced its strategic planning “Saudi Vision 2030,” which defined three main visions: “Heart of the Arab and Islamic Worlds,” “the Investment Powerhouse,” and “the Hub Connecting Afro-Eurasia.” It is built around three main themes, namely, society, economy, and national development, and sets out magnificent objectives of “a vibrant society, a thriving economy, and an ambitious nation,” and clarifies the direction of economic, political, military, and social development for the next 15 years.

Saudi Arabia is an important partner of the BRI. In 2019, China and Saudi Arabia signed a memorandum of understanding on the alignment of the Saudi Vision 2030 with the BRI. Upon the signatures of a series of cooperation agreements, the China-Saudi Arabia comprehensive strategic partnership has achieved a new pattern that is multi-dimensional, multi-level, and wide-ranging. “Saudi Vision 2030” has made clear the development goal of diversifying the Saudi economy, and the cooperation of the entire oil and gas industry chain has ushered in tremendous opportunities.⁹

6.2.2 Project Overview

Yanbu Refinery is the first overseas refinery and chemical investment project of China Petrochemical Corporation (Sinopec). In January 2012, Sinopec signed an agreement with Saudi Aramco to establish Yanbu Aramco Sinopec Refining Company Ltd (YASREF), with a joint investment of USD 8.6 billion for the construction and operation of the fuel-based refinery with a crude oil processing capacity of 400,000 barrels per day (20 million tons per day). In January 2016, President Xi Jinping of China and Saudi King Salman attended the project's commissioning ceremony.

The Yanbu Refinery uses Saudi fuel oil as its raw material and has a world-leading scale of its single-series central processing units. With advanced technologies, reasonable processes, and a high degree of automation, the project has achieved full conversion of raw materials, producing 4 million tons/year and 12 million tons/year of gasoline and diesel with ultra-low sulphur content of less than 10 ppm respectively, and also producing 120,000 tons/year of chemical raw material benzene

⁹ <http://world.people.com.cn/n1/2017/1212/c1002-29702218.html>.



Fig. 6.3 A panoramic view of the YASREF

with purity of greater than 99.9%. The quality of the main products has reached the world's top level, and these products are shipped and sold directly to North-West Europe, Asia, the Mediterranean, North America, and other regions.

The Yanbu Refinery has created an excellent track record in the Middle East in terms of its advanced technology, cost-effective investment, short construction period, high quality, and great safety performance, and it has won the “Construction Project of the Year” at the 2015 Platts Global Energy Awards, the highest award in the international energy community (Fig. 6.3).¹⁰

6.2.3 *Strict Environmental Management System*

Before the construction of the project, a rigorous assessment on the local environmental impact was conducted as required. Saudi Aramco commissioned the independent consulting firm CH2M HILL to prepare a EIA report on the project, which evaluated the emissions of air pollutants and other pollutants, and the main conclusions are as follows: the emissions of NO_x and SO₂ both meet the threshold of the Saudi Environmental Performance Index; the harmless solid waste (150m³/year) and hazardous solid waste (600m³/year) generated by the project are all sent to a local solid waste treatment landfill plant for disposal; the wastewater is sent out of the plant after pre-treatment and received centralized treatment in an industrial sewage treatment plant. In November 2009, the EIA report for the project was approved by the Royal Commission for Yanbu on behalf of the Saudi government.

The implementation of the project carried through the concept of green development, strictly abode by the local environmental laws and regulations of Saudi

¹⁰ <http://ihl.cankaoxiaoxi.com/2018/0710/2290438.shtml>.

Arabia, and strictly implemented the environmental protection requirements of the facility owner. The project established and improved the environmental protection management system, strictly implemented the environmental licensing requirements, established a list of environmental factors, and performed environmental protection responsibilities.

At the same time, the project organized training for employees to learn environmental protection knowledge and environmental knowledge trivia competition, gave public lectures about environmental protection using the camp radio, set up environmental protection signs and slogans in areas that are clearly visible on the project site, posted promotional materials, and showed short videos about environmental protection to the staff in their spare time. Brochures about environmental protection were prepared in English and Arabic. All these measures intend to the staff can be properly educated about environmental responsibility through different channels.

6.2.4 Green Production

By improving the production process and work flows and adopting energy-saving and emission-reduction technologies, the project effectively controlled pollutant emissions and conducted harmless treatment for the “three wastes (waste gas, waste water, and industrial residue)” that should not be recycled, thus minimizing the negative impact on the environment.

In order to avoid soil pollution, Sinopec has taken the following measures: spreading impermeable fabric for special purposes in the mud pits, installing wastewater treatment equipment at drilling sites, discharging the wastewater after it is pre-treated and up-to-standard to the mud pits through sealed pipelines without a single drop of oil polluting the soil, and cleaning the mud tanks and pipelines regularly to avoid any mud leakage. Solid waste disposal has also been enhanced—all the garbage and solid waste are disposed by qualified companies. At the same time, Sinopec has conducted strict management on the temporary facilities on the construction sites. All the temporary facilities should be approved by the owner before construction and dismantled after use to avoid new pollution (Fig. 6.4).

In order to protect the surrounding environment, Sinopec strictly classified industrial and domestic waste, and the bins for hazardous waste alone are in six different colors. Sinopec regularly asked professional companies to collect the waste and spent an average of more than RMB 3 million per year to treat all kinds of waste. Sinopec requires that all the domestic sewage should be discharged into centralized sewage treatment tanks. In S62 project, a professional sewage treatment unit was installed to treat the sewage in the camp. The treated sewage can be discharged directly and can also be used to water the plants in the camp, thus realizing the recycling of water resources.

Furthermore, 56.1% of the energy consumption of the Refinery is fuel, 34.5% is electricity, and 9.5% is steam. In terms of water consumption, because of the local conditions in Saudi Arabia, the Yanbu Refinery was designed as a water-saving



Fig. 6.4 A panoramic view of the Yanbu Refinery

refinery with a closed recirculating water system and a recirculating seawater cooling system.

6.2.5 Promotion of Local Employment

In accordance with the principle of “employing local talent that has a global mindset,” Sinopec followed the Saudi government’s “Nitaqat Programme” employment policy and “In-Kingdom Total Value Add Program” (IKTVA) system, increased the number of employees recruited from the community and continuously raised the proportion of local employees. During the peak time of some projects, the proportion of local employees was up to over 65%.

The Yanbu Refinery is the second joint venture refinery project in the western region of Saudi Arabia. During the construction and operation of the Yanbu refinery, 6,000 direct and indirect jobs were created in Saudi Arabia. At the same time, nearly 800 technical apprentices were recruited and trained through the Saudi Aramco Training Institute, 600 of whom were employed by the joint venture after passing the examination. In addition, the Yanbu Refinery has provided internship opportunities for nearly 100 students from local Saudi universities. Currently, the proportion of Saudi employees in the joint venture is 75%, making the refinery one of joint ventures with the highest percentage of Saudi employees. The Yanbu Refinery received awards from the Saudi government consecutively in 2014 and 2015 for its outstanding contribution to improving the skills and employment rate of local Saudi employees (Fig. 6.5).

In order to attract more high-quality talent and help improve the employment rate of local Saudi talent, Sinopec has established partnerships with local universities



Fig. 6.5 Chinese and Saudi employees working together

and secondary vocational schools, actively cooperated with Saudi Petroleum Service College, Saudi Arabian Drilling Academy, Saudi Petroleum Services Polytechnic, and Saudi Human Resources Development Fund, provided interview opportunities for Saudi university graduates, and offered internships and jobs to students from several universities and colleges.

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Chapter 7

Green Architecture



7.1 Lusail Stadium in Qatar

Promoting innovation and technological progress is an important way to address economic and environmental challenges. In accordance with the requirements of Qatar Global Sustainability Assessment System (GSAS), the Lusail Stadium project in Qatar was built with various green designs, green technologies, and energy-saving materials to highlight innovation while preventing environmental pollution and risks; the design improves the efficiency of utilizing resource and energy. At present, the design phase of the project has satisfied the standards of the GSAS five-star rating, and the construction management phase is also being implemented in an orderly manner with the standards of the GSAS five-star rating as the goals.

7.1.1 Background

The 22nd FIFA World Cup will be held in Qatar in 2022. This will be the first World Cup to be held in a Middle Eastern country and the second World Cup held in Asia. The 2022 World Cup will also be the first time that the winter World Cup in the northern hemisphere, and Qatar will be the first World Cup hosted country that has never competed at the World Cup finals. This event is thus of great significance for and has profound influence on Qatar and the Middle East. Qatar has invested heavily to build a new city, “Lusail,” a “green city” about 15 km to the north of the capital city Doha. Bordering the Persian Gulf in the east, Lusail City covers an area of 38km² and contains a series of sports stadiums and supporting facilities.

In order to host the World Cup of a high quality and achieve the national goal of becoming an example for quality life and sustainable lifestyle by 2030, Qatar required that all stadium construction projects in Lusail should meet the four-star rating standards of GSAS, Qatar’s green construction rating system, in both the design

and construction phases. The GSAS system adopts a lifecycle approach to evaluate the sustainability performance of buildings and their environment, aiming to meet the project needs while minimizing the ecological impact and resource consumption of construction projects. In 2016, International Federation of Association Football (FIFA) officially adopted the GSAS system as the green building evaluation system for the 2022 World Cup stadiums in Qatar.

Located in the heart of Lusail, Lusail Stadium will be the main stadium for the 2022 World Cup in Qatar. It will host the final, the closing ceremony, and other major events and ceremonies and will be preserved as a landmark sports building and a World Cup heritage in Qatar. Therefore, the design, construction, operation, and overall management of the Lusail Stadium not only had to overcome various technical challenges to complete the design and construction of the stadium of high quality, but also had to meet the strict requirements of the GSAS standards.

7.1.2 Project Overview

In November 2016, China Railway Construction Corporation (CRCC) and Qatar contractor HBK Contracting (HBK) won the bid as a joint venture and were awarded the main contract to build the Lusail Stadium project in Qatar. The total contract value of the project is QAR 2.8 billion (approximately USD 767 million).

With a gross floor area of 180,000 m², the Lusail Stadium is bowl-shaped, with a diameter of 312 m, a height of 74 m on the east and west sides and 58 m on the north and south sides, and a capacity of 92,000 seats, making it the second largest professional football stadium in the world that meets the standards of FIFA. The Lusail Stadium is also the largest membrane-structure building in the world, with the roof incorporating 56,000 m² membrane, and it is one of the World Cup stadiums that has a roof with the fish-belly-shaped cable net being one of the world's largest by span and overhanging distance (Fig. 7.1).

The construction of the project commenced in November 2016. As of October 2020, the main steel structure has been completed and the whole project has been running smoothly. According to the assessment by the relevant authorities in Qatar, the design phase of the project has reached the GSAS five-star rating standards, and the construction management phase is also progressing towards the standards (Fig. 7.2).

7.1.3 Establishment of a Strict Environmental Management System to Implement the Project

Qatar has high standards in environmental protection. In the construction and management of the project, it refers to and implements the relevant environmental



Fig. 7.1 The Lusail stadium



Fig. 7.2 The construction of the cable net roof

management systems and standards of the western developed countries in consideration of the local circumstances, creating an environmental management style that incorporates characteristics of the Middle East and other sources. In the Lusail Stadium project, the main contractor is required to establish and implement the Environmental Management System (Q22M-APW-CMN-PMC-HSE-0362) specified by the owner of the World Cup project, and to strictly comply with the *Qatar Environment Protection Law*, *Qatar Air Quality Standards*, *Qatar Irrigation Water Standards and Sea Drainage Standards*, and *Qatar Construction Specifications 2014*. Furthermore, the design and construction are carried out in accordance with the GSAS

four-star rating standards, Dutch soil and groundwater quality standards, and relevant British standards.

(1) **Commissioning a Third-Party Environmental Consulting Organization to Establish an Environmental Management System and Strictly Implementing It**

The joint venture commissioned KEO, a local third-party environmental consulting firm, to provide comprehensive technical support and services for the environmental management of the project. With KEO's support, a Construction Environmental Management Plan (CEMP) (SC-C01-CAG-HBC-PLN-EN-00014) was developed as the basic environmental policy for the project, covering environmental control policies, environmental control index, environmental management plans, environmental inspections and audits, etc. The CEMP was used as the basis for the establishment of the project's specific environmental management system, which was then strictly applied to the control and management of project site. The CEMP was firstly approved by the project engineers and the owner before being submitted to the Ministry of Municipality and Environment (MME) for approval.

(2) **Environmental Pollution Prevention Measures and Environmental Monitoring Management**

In accordance with the CEMP, the Lusail Stadium project focused on strict monitoring of environmental indicators such as noise, air quality (especially dust), soil, groundwater quality, and waste disposal. During the construction, the main pollution risks on site included potential soil and groundwater contamination, and the main focus of risk control was fuel or chemical spills.

To this end, the project has set up a special oil storage warehouse, which was managed in strict accordance with the warehouse management regulations and chemical management guide and was inspected regularly; oil trays were set up for the generator and other areas of the construction site to prevent soil contamination caused by oil; when the construction involves painting, a special shed would be set up for proper protection and the ground would be covered with protective films to prevent soil pollution caused by chemicals; routine environmental inspections were conducted to deal with any violations in a timely manner and provide training and environmental protection education to the relevant construction teams. At the same time, the project established contact with local environmental protection laboratories through a professional third-party environmental protection agency; the laboratory provided technical support and services, such as testing and analysis of soil samples and water samples.

In addition to the risk management measures above, the project office also adopted the following environmental monitoring measures.

- Carrying out standardized environmental protection control: Since the start of the project, a total of 38 monthly environmental protection reports have been developed to keep detailed records of environmental protection control during the project construction.

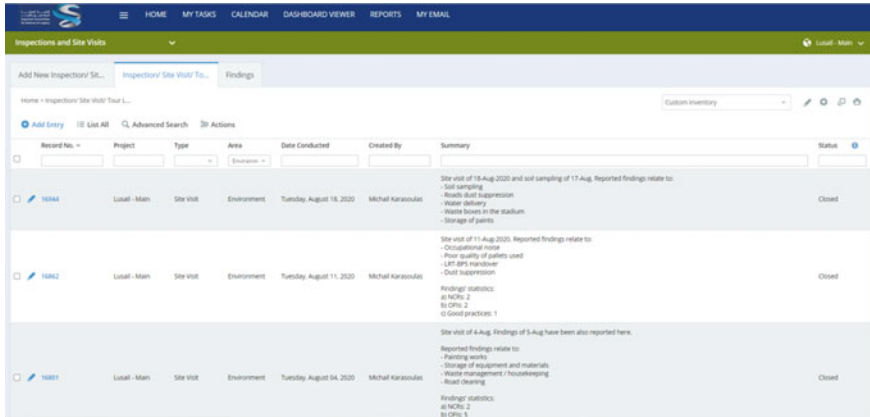


Fig. 7.3 Using information technology in environmental inspection and disposal

- Building a professional environmental management team: Relying on the technical support provided by a professional third-party organization, the project office has set up a special environmental protection department responsible for the daily work of the project, and has equipped with mechanical equipment such as sprinklers, sweepers, crates, and forklifts that can be used at any time.
- Developing the environmental protection control system: A daily inspection system has been established to provide timely guidance and solution for problems; the weekly on-site inspections and regular meetings with owners have been organized to engage all parties to settle any environmental issue; the environmental audit plans have been strictly implemented.
- Strengthening the environmental protection education: Emphasis has been placed on environmental protection training and education, and special educational activities have been conducted to address typical on-site problems.
- Using information technologies in environmental inspections: Relying on the project’s Intelix’s EHS Management Software, information technologies are utilized in the whole process of environmental protection inspection, disposal, approval, and settlement.
- Ensuring the standardization of environmental information: The environmental protection department of the project has drawn and analyzed the environmental control information on a monthly basis to form a detailed monthly report, so the environmental control efforts could be traced (Figs. 7.3, 7.4, 7.5 and 7.6).

7.1.4 Implementation of the Green Building

GSAS is a green building rating system originated from Qatar and designated by FIFA as the rating system for the 2022 World Cup stadiums. It is also widely used in Qatar and the Middle East. The GSAS system assesses the sustainability of a construction

Daily Environmental Site Inspection Checklist

Shift time 6 AM to 5 PM 5 PM to 4 AM

Date

S. No	Item (please mark yes or no in respective area column)	Stadium	Laydown	Worker Accom.	Crusher, Screener & Stockpiles	Site Env. Inspector Remarks	Inspector Response
1	Is there any visible dust cloud?					If yes, what are the actions taken?	
1.1	Is there any black smoke from the operating machinery/ vehicles?					If yes, what are the actions taken?	
2.1	Are the waste signages placed at each skip?					If no, what are the actions taken?	
2.1	Is there effective waste segregation inside the skips?					If no, what are the actions taken?	
2.2	Are skips covered?					If no, what are the actions taken?	
2.3	Is there any overflowing skip?					If yes, what are the actions taken?	
3	Is there any oil spill in this area? (trace/drop)					If yes, what are the actions taken?	
3.1	Are the spill kits readily available nearer to working zone ?					If no, what are the actions taken?	
3.2	Are the spill kits clean i.e. no traces or accumulation of waste?					If no, what are the actions taken?	
4	Is there any leakages from the tanks (holding, fuel, water etc.) ?					If yes, what are the actions taken?	
5	Is there any abnormal/ excessive noise/ vibration noticed from any operating machinery/ vehicles?					If yes, what are the actions taken?	
6	Are the A ₁ /C ₁ Exhausts in chemical store are working?					If no, what are the actions taken?	
7	Are there unattended chemicals without drip trays?					If yes, what are the actions taken?	
8	Is the site fence secured					If no, what are the actions taken	

Site Environmental Inspector Notes	
Best practices noticed	
Discussed with (in the event of any non-conformances)	
Environmental Inspector	Environmental Engineer

Fig. 7.4 Daily on-site inspections



Fig. 7.5 Noise testing around the stadium



Fig. 7.6 Dust testing around the stadium

project during the three phases of its lifecycle: design, construction management, and operation. The GSAS assessment framework sets eight evaluation indicators including urban connectivity, site, energy, water, materials, indoor/outdoor environment, cultural and economic values, and management and operations, focusing on challenges such as air pollution, land abuse and pollution, loss of fossil fuel, water consumption and pollution, material loss, human health and comfort, and climate change in the building environment. The GSAS certification has different levels for different phases of the project. There are 6 stars for the design phase (GSAS-DB), 5 stars for the construction phase (GSAS-CM) and 5 stars for the operation phase (GSAS-OP).

Qatar requires the Lusail Stadium project to meet four-star rating standards in terms of design, construction, and delivery. On the basis of close cooperation between all parties, the project fully tapped on the main advantages of technologies, equipment, and businesses from China. The design and construction of the project were audited, directed, and approved using the BIM model. In the construction process, SPTM was used for steel structure transport, hollow plunger jacks for steel structure V-column and junk ring hoisting, and 3D laser scanning for precision control. The radial cables of the roof are made of high-vanadium spiral cables, the circumferential cables are made of high-vanadium enclosed cables, and the clamps of the circumferential cables are made of G10MnMoV6-3 cast steel. The exterior curtain wall is made of hyperboloid hollowed-out aluminum slab curtain wall. The green design of the project highlighted the combination of building functionality and energy-saving and took into account the cultural characteristics of Qatar. The efficient and precise construction enhanced the efficiency of energy and materials usage. The materials used in the building were in compliance with green standards, which can effectively save energy and reduce emissions. The environmental protection measures and risk prevention measures during the construction greatly reduced the environmental impacts and risks of the project.

At present, the total score of the design phase of the Lusail Stadium project is 2.133 (out of 3), which has reached the GSAS-DB five-star rating standards. The project is being executed in strict accordance with the highest standards during the construction phase and strives to maintain the four-star rating and increase to a five-star rating, which will make the Lusail Stadium project an example of GSAS five-star architecture.

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Chapter 8

Sustainable Food Production



8.1 Zambian Solar-Powered Mill Program¹

8.1.1 Background

Adequate and safe supply of food, especially the access to adequate, safe and affordable by low-income families is a top priority for many African countries.

Cornmeal processed from corn is the main food in Zambia, but the cornmeal market is dominated by several large commercial mills with the amount produced failing to meet the market demand, resulting in a high price. Since 2014, reduction in rainfall caused shortage in electricity supply in Zambia with hydropower as the main energy resource, and the shortage of power made it impossible for the mills to produce at full capacity, leading to the soaring price of cornmeal. In response, the Zambian government has invested a large amount of financial subsidies to lower cornmeal prices, but failed to achieve the expected effect. For example, the price for a bag of cornmeal of 25 kg in 2015 was ZMK 65 (equivalent to USD 6.50); with a government subsidy of ZMK 5 per bag, the ex-factory price dropped to ZMK 60. However, due to the serious shortage of supply, price rose up to ZMK 140 (equivalent to USD 14) in the market, which brought huge burden to the Zambian people, especially the rural population.

In addition, World Bank highlighted in the *Zambia Economic Brief* issued in September 2018 that Zambia's external debt and government-guaranteed debt stocks climbed from USD 7.9 billion in 2016 to USD 8.4 billion in 2017, USD 10.2 billion in 2018, and USD 11.4 billion in 2019. By 2019, the present value of external debt-to-GDP ratio in Zambia was expected to reach 40%. At the same time, higher bank interest rates and increasing risks in many sectors made it difficult for public welfare projects to make profits.

¹ Case source: Inclusive Development Research Center, 2019.

8.1.2 Project Overview

The Zambian solar-powered mill program aims to construct 1,583 solar-powered mills and 8 production service stations in 10 provinces within Zambia to process and produce cornmeal (or rice in some areas based on local conditions) to ease food shortage in Zambia. The 1,583 solar-powered mills that were finally constructed in 79 regions in 10 provinces in Zambia with limited access to electricity to provide high-quality cornmeal for rural residents and address the problems of the rising price of cornmeal and the lack of machines for processing. It brought an end to the current state of producing cornmeal by manual labor and guaranteed local food supply. Its success also led to a drop of 1/3 in the price of food, which was recognized as the No. 1 project from the Zambian government due to its contribution to improving people’s livelihood (Fig. 8.1).

The total amount of the contract is USD 200 million, among which USD 30 million was raised by the Ministry of Finance of Zambia, while USD 170 million was funded by a loan provided by China Development Bank (CDB) to the Ministry of Finance of Zambia.

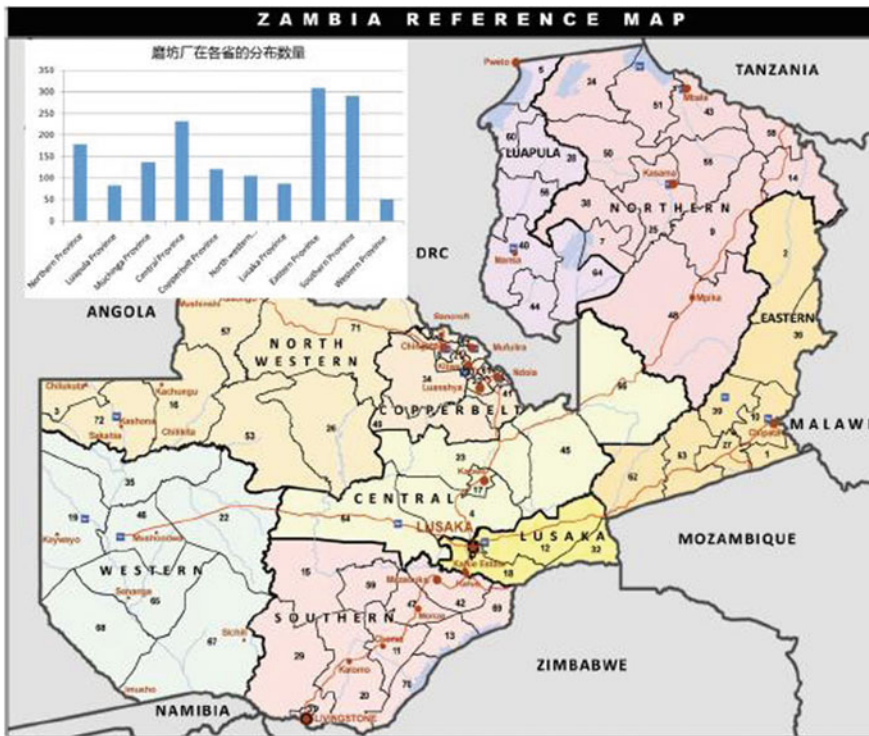


Fig. 8.1 The location of solar-powered mills in different provinces across Zambia

Zambian Ministry of Finance arranged sovereign loans for this project. The Ministry of Commerce, Trade and Industry of Zambia and Zambia Cooperative Federation (ZCF) organized implementation respectively as the owner and the executive owner. Considering that this is a major livelihood project, CDB has charged no other fees in accordance with international practices. With medium and long-term credit insurance support from China Export and Credit Insurance Corporation (SINOSURE), China Shandong Dejian Group designed and constructed 1,583 solar mills as the EPC general contractor.

8.1.3 Actions

As one of China’s first financial institutions to join the UN Global Compact and one of the active advocates for “green credit”, CDB has long been committed to supporting poverty alleviation, environmental protection as well as energy conservation and emission reduction with financial products for development.

Through the combination of Zambian cooperative system and mill operation, the project formed a sustainable business model through the new practice of green and sustainable credit (Fig. 8.2).

The executive owner and operator of this project is Zambia Cooperative Federation (ZCF) which was registered in April 1973 under the joint efforts by cooperative organization, Ministry of Market Cooperation and donation organizations. Designed to enhance the lives of its members and all Zambian people by providing technical, professional, commercial and other support to empower members, ZCF is a four-level structured agency consisting of 13,000 grassroots cooperatives (providing single or

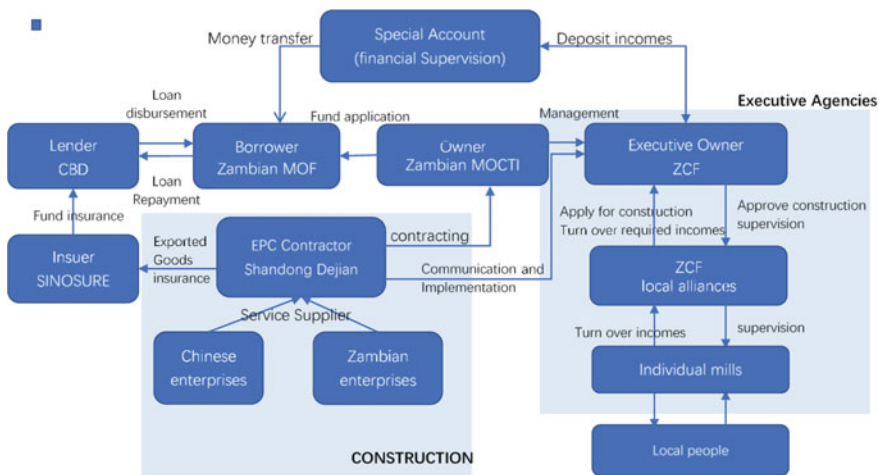


Fig. 8.2 The business model of Zambia solar-powered mill project

multiple functions), 72 regional alliances, 9 provincial alliances, and ZCF. ZCF is the top organization of the entire structure, with a total membership of over 2 million.

Based on the economic reality of rural Zambia, there are 2 kinds of business operation models for solar-powered mills: 1) ZCF members raise funds to purchase corns from famers nearby, the market or Zambian Food Reserve (FRA) and sell cornmeal to the market at the suggested price from the government, making their profits from the gap in pricing; 2) considering its impact on people's livelihood, the Zambian government requires that in addition to business operation, cooperatives with mills should also process cornmeal for villagers nearby. The villagers brought the corns used as their own food to the mills and would be charged by certain processing fees (ZMK 15–25 per bag) or corns by the cooperatives.

ZCF created a special account into which all member agricultural cooperatives needed to deposit ZMK 1,700 (about USD 170) every month continuously for 15 years. ZCF collected the funds to the Ministry of Finance for the repayment of loans. After 15 years, the solar mills will become the property of various agricultural cooperatives. Based on the performance of existing mills, the project has been quite successful.

8.1.4 Outcomes

A total of 1,583 solar mills have been built so far (for provinces producing cornmeal, all the 1,583 plants have completed construction with 1,583 sets of equipment successfully installed and tested. All the 1,583 solar mills contracted have been delivered). The implementation of this project makes a huge difference in Zambia and is seen as a milestone success for the government led by President Edgar Lungu. He commented that the project accounted for an ambitious and unprecedented initiative in ensuring food security in Zambia, especially in rural areas (Fig. 8.3).

The specific contributions from this project to food security, economic growth and environmental sustainability are displayed in Table 8.1.

8.1.5 Experience and Insights

This project is a “small but exquisite” project on processing agricultural products financed by Chinese bank for Zambia with the latter in urgent need for capitals for economic construction. It is an investment related to people's livelihood and realized by designing reasonable financing structures along with the government and private sectors. Operating in line with market principles, this project constitutes a classical case that assisted project development agencies to realize debt sustainability.



Fig. 8.3 Zambian minister of finance inspected the project

- **Coordination among diversified stakeholders to realize sustainable financing and investment**
National debt issues triggered by the economic growth pattern of trading off resources for growth has been a shared concern of the international community. This project introduced the involvement of multiple stakeholders, including government, banks and insurance agencies and private sectors, to innovate the business and investment model and guarantee the sustainability of project investment and financing activities.
The project was implemented by the Ministry of Commerce, Trade and Industry of Zambia and ZCF respectively as the owner and the executive owner. CDB provided loans and SINOSURE provided medium and long-term credit insurance support to minimize the potential commercial and political risks. Chinese business executed specific construction work as the technology supplier. As the operator at the later stage, ZCF provided sustainable economic returns for the project to pay loans and helped to avoid debt crisis for Zambia.
- **Green finance levered local sustainable development**
Starting with fulfilling the basic livelihood needs of citizens in the host country, the project used the low-cost renewable energy technologies and agricultural product processing techniques in China to help Zambia to construct a large number of new township enterprises through green finance, which improved agricultural economy while protecting people’s livelihoods and promoted south-south cooperation and the sustainable development of rural areas in Africa.

Table 8.1 The specific achievements and contributions of the Zambian program on solar-powered mills

Alleviating poverty and improving welfare	After the completion of construction, the solar mills in this project effectively reduced the cornmeal price in the rural areas of Zambia by 1/3, benefiting tens of thousands of families in poverty, and finding a good market for surplus corns in rural areas. The income of rural residents was increased, which set a good example in poverty alleviation
Reducing government subsidy and financial expense on cornmeal	By the construction of a large number of solar mills that are stable and profitable, the supply of cornmeal in the market has been greatly increased, which effectively reduced the annual financial subsidies on cornmeal provided by the Zambian government and increased the disposable budget for the central government
Improving employment and the skills of workers	The implementation of the project has effectively improved employment in Zambia. 1,583 solar mills nationwide will provide at least 4,749 long-term stable jobs, which is a huge breakthrough in rural Zambia. The project contractor and the executive owner have carried out comprehensive trainings for professional engineers, lecturers, operators, and cooperative leaders among other staff and personnel from the mills, which improved local labor quality and technical skills as well as stimulated business development
Facilitating industry development and stimulating economic growth	Through the construction of the solar mills, the project brought vitality to a large amount of township businesses and improved rural economic development. At the same time, these solar mills catalyzed local economic growth through carrying out regional transactions, and their plants have gradually become local centers for small market trade
Reducing GHG	PV technologies of the project provide affordable clean energy, resulting in an annual average emission reduction of 27,633 tons of carbon dioxide, which contributed to mitigating climate change. At the same time, the successful operation of the project has enabled the local government and people to have a deeper understanding of clean energy projects, which will facilitate the development of more local renewable energy projects

(continued)

Table 8.1 (continued)

Alleviating poverty and improving welfare	After the completion of construction, the solar mills in this project effectively reduced the cornmeal price in the rural areas of Zambia by 1/3, benefiting tens of thousands of families in poverty, and finding a good market for surplus corns in rural areas. The income of rural residents was increased, which set a good example in poverty alleviation
Enhancing cooperation and exchange on trade and commerce between China and Zambia	The implementation of the project promoted the exportation of advanced equipment manufactured in China and galvanized the development of support industries such as steel structure plants in Zambia

8.2 Wanbao Mozambique Rice Farm²

8.2.1 Background

Located in the southeast of Africa, Mozambique witnessed steady economic growth since the end of the civil war. Rice gradually became one of the main crops of this country. In recent years, the rice consumption in Mozambique has grown at an average annual rate of 8.6%, much higher than the consumption growth of traditional food crops such as corn (5.5%), wheat (7.4%) and sorghum (4.7%). The annual demand for rice in Mozambique is about 750,000 tons, yet only 28% of the demand could be met with domestic production, leaving a huge gap between supply and demand, causing high dependency on imports. About 900,000 hectares of land in Mozambique is suitable for growing rice, among which the developed land covers an area of about 310,000 hectares with 97% cultivated by individual farmers. There is still a lot of room for improvement in production efficiency. Developing and promoting the rice industry are critical to ensuring food security in Mozambique. In addition, there are favorable natural conditions for the development of agriculture in Mozambique. Promoting rice cultivation in Mozambique is of great significance in helping African countries solve food security problems.

² Case sources:

[1] China-Africa cases/ programs, China-Africa Economic and Trade Expo, China-Africa Development Fund. https://www.caetexpo.org.cn/html/2019/nyl_0614/169.html.

[2] China Railway 20 Bureau Group Corporation.

8.2.2 Project Overview

Being put into construction in July 2011, Wanbao Mozambique rice farm is currently China's largest program on growing rice in Africa, as well as one of the 13 priority projects in production capacity cooperation between China and Mozambique.

Located in the city of Xai-Xai in Gaza Province, Mozambique, Wanbao Mozambique rice farm covers an area of 20,000 hectares with a plan to cultivate crops on 13,000 hectares of farmland. It is a comprehensive agricultural-industrial facility that integrates farmland development, grain production, warehousing, processing and sales with a focus on rice cultivation supplemented by the cultivation of various grain crops and cash crops. Wanbao Mozambique rice farm has advanced rice cultivation technologies introduced from China to Mozambique without increasing Mozambique's debt, thus making tremendous contributions to the improvement of local people's livelihoods and economic development.

8.2.3 Actions

In 2011, Wanbao Grains and Oils Company, a private business from China, cooperated with the Mozambique government to initiate the planting of rice, develop farmland water conservancy facilities and built an industrial base for crop production and processing. In 2012, China-Africa Development Fund became a shareholder as a commercial equity investment fund to provide financial support for Wanbao Mozambique rice farm. China-Africa Development Fund is initiated by the Chinese government at the Beijing Summit of the Forum on China-Africa Cooperation in 2006. It is China's first equity investment fund that focused on investment in Africa. The fund prioritizes investment in infrastructure, basic industries, agriculture, manufacturing, and other areas with an important impact on the economic and social development of African countries and those that could help African countries to realize independent economic development. In 2017, China Railway 20 Bureau Group Corporation signed a cooperation agreement with China-Africa Development Fund and began to manage the Wanbao Mozambique rice farm.

The project is operated and managed by an "enterprise + small farm" partnership under which cooperative agreements were signed with local farmers. According to the agreement, part of the cultivated land would be transferred to local farmers with capital, instruments, agricultural machinery and technologies being provided. The rice produced would be purchased for further processing. Harvested rice will be processed in the Wanbao farm. Inside the factories, a full-set of equipment on rice processing imported from China was operating. After cleaning, shelling, milling, screening, and color-selecting, the rice was processed into commodities for thousands of households, the "Born Guston"—this kind of grainy and sweet-smelling rice was named by Armando Gueza, Mozambique's president at the time and has become a famous brand in Mozambique.

8.2.4 Outcomes

Through years of construction, by now, the site of Wanbao rice farm has been transformed from grassland and shrubs to a 10,000-acre farmland. In the planting season for 2018–2019, Wanbao rice farm grew 2,400 hectares of rice in cooperation with 500 farmers. The rice output was increased from 1.5 to 7 tons/ha, hitting historical records in planting area, average yield per unit, and number of farmers benefited.

Wanbao rice farm also helped Mozambique to realize localized production of important agricultural products. By now, operators of Wanbao rice farm has basically completed the construction of supportive facilities related with agricultural production, including ditch, culvert, pumping station and warehouse. Seed resources under this project were updated and planting technologies on machine-transplanted seedling, ratoon rice and seed soaking were perfected, which improved agricultural productivity. In addition, based on local plans for development, Wanbao rice farm helped farmers to learn about agricultural production technologies. Since 2012, it has provided training for 1,500 households in planting rice. Farmers who used to depend solely on nature for harvest, are now cooperative farmers with expertise in agricultural machinery and techniques as well as promising income.

The partnership model of “enterprise + small farm” was adopted by Wanbao rice farm, which hired over 900 local employees at its busiest season, bringing benefits to 500 households, effectively improving local income, improving people’s life and gaining trust from local residents (Fig. 8.4).

The achievements of Wanbao rice farm were highly received by the leadership from Department of Agriculture and Food Security in Gaza Province. It is conceived



Fig. 8.4 Thumb-upping the first training on agricultural technologies by China Railway 20 Bureau Group Corporation (Source: ThePaper.cn)

that the project outcomes of Wanbao rice farm helped to address the shortage in food supply in Mozambique and improve the efficiency of agricultural production. The Mozambique government appreciated China and Chinese businesses for their help. This project also signified fruits of mutual benefits and friendly development harvested in the cooperation between China and African countries.

Wanbao rice farm stood up to its CSRs. In the past years, it sponsored the construction of 2 schools and 1 police station, providing vehicle service for local governments, organizations and communities, helping to improve local security and education, and donating rice in support of activities carried out by local organizations and associations for youth, the disabled and women.

In March 2019, Cyclone Idai landed in north-central Mozambique, causing casualties and huge damage to property. China-Africa Development Fund, Fundo de Cooperação e Desenvolvimento China-Países de Língua Portuguesa and Wanbao Mozambique rice farm donated 100 tons of rice at the first time to disaster-stricken area in Mozambique, and worked with the United Nations Food Agency and Chinese merchants' association in Mozambique to offer full support to disaster relief efforts.

8.2.5 *Experience and Insights*

- Green finance aids technological transfer related with people's livelihood. Green finance aids technological transfer related with people's livelihood. Green finance aids technological transfer related with people's livelihood.

While introducing the advanced technologies of China, Wanbao Mozambique rice farm actively promoted the localization of technologies. As a financial investor, China-Africa Development Fund provides funding support for Wanbao rice farm by means of equity investment. As an industrial investor, China Railway 20 Bureau Group Corporation operated and developed the rice farm with capital and facilitated to address its funding issues. Without increasing the debt of local governments, Wanbao rice farm introduced China's advanced technologies into Mozambique, motivated the involvement of local farmers, and taught planting technologies to help them get rid of poverty, creating both economic profits and social benefits. The project model is "replicable, easy to manage, and effective", which can be quickly promoted in Africa with favorable rice-planting conditions.

- Catalyzing multilateral cooperation in a larger scale
On June 27, 2019, China International Center for Economic and Technical Exchanges, China National Hybrid Rice R&D Center, African Union, United Nations Office for South-South Cooperation, United Nations World Food Programme, Bill & Melinda Gates Foundation, and Alliance for a Green Revolution in Africa (AGRA) signed the Initiative on Strengthening South-South and Tripartite Cooperation on Rice between China and Africa in Changsha, Hunan

Province of China. All parties advocated to adhere to the UN principles of south-south cooperation and tripartite cooperation, actively explore the comparative advantages of each partner and strengthen cooperation on rice between China and Africa.

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Chapter 9

Corporate Social Responsibility



9.1 Uganda Isimba Hydropower Plant

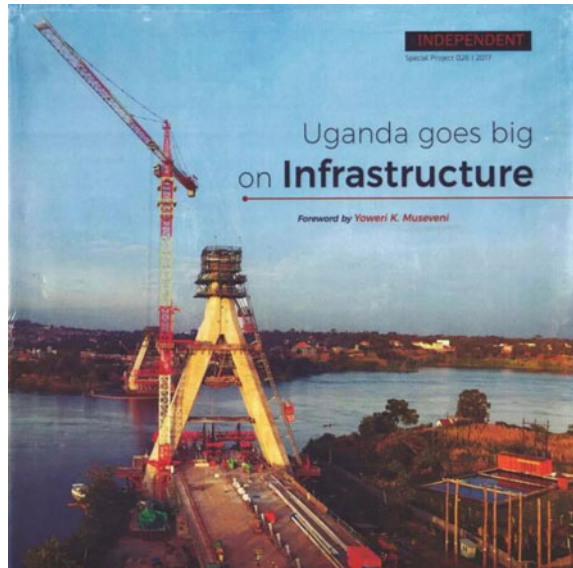
The Isimba Hydropower Plant constructed by China International Water & Electric Corp. (CWE), a subsidiary of China Three Gorges Corporation (CTG), is an important livelihood project in Uganda. During the construction of the project, CWE actively fulfilled its corporate social responsibilities. CWE not only brought more job opportunities to the local area and helped to improve working skills of the local workers, but also repaired local access roads to provide transportation convenience for the local residents, rebuilt local primary schools and donated desks, chairs and stationery, and invited the Chinese medical team in Uganda to provide the local residents with community medical services.

9.1.1 Background

The Isimba hydropower project is located on the White Nile River in southern Uganda, between Lake Victoria and Lake Kyoga, just 4 km away from Simba Falls, hence its name. The operation of the Isimba Hydropower Plant increases Uganda's installed generating capacity by approximately 20%, which will significantly alleviate the country's power shortage. According to the book *Uganda Goes Big on Infrastructure*, the Isimba hydropower project is one of the most important hydropower projects in Uganda, playing a critical role in easing the country's energy shortage crisis and accelerating economic development (Fig. 9.1).¹

¹ https://www.sohu.com/a/327040898_696766.

Fig. 9.1 Cover of *Uganda goes big on infrastructure*



9.1.2 Project Overview

The Isimba Hydropower Plant and its supporting transmission line project is constructed by CWE, a subsidiary of CTG, under the EPC contracts, with the Ministry of Energy and Mineral Development, Uganda as the owner. The contract value of the project is USD 568 million, among which 85% is provided by the Export–Import Bank of China in the form of preferential loans as supporting funds and 15% is raised by the Ugandan government. The project was signed in September 2013 and commenced on April 30, 2015.

The Isimba Hydropower Plant is designed with a total installed capacity of 183.2 MW and is equipped with four Kaplan turbine units to yield an average annual generation capacity of 1.039 billion kWh. The first phase of the project, which includes the power station hub project as well as the 132 kV switching station and supporting 132 kV transmission line project, was completed and handed over on April 12, 2019 (Fig. 9.2).

The second phase of the project consists of a downstream permanent public bridge and an access road, to be specific, a downstream public bridge and its attached roads and a 3.5-km access road. The downstream permanent public bridge and its attached roads, with a total length of 2.126 km, are located about 500 m downstream of the Isimba Dam, starting from Nampanyi Village, crossing the Nile River in southeast direction and ending at Bugumira Village. The permanent public bridge, with a total length of 890.5 m, is divided into two sections that stand on the two sides of the channel respectively. The downstream public bridge is expected to be completed and open to traffic at the end of 2020 and will be a permanent passageway bridging the two sides of the Nile River (Fig. 9.3).



Fig. 9.2 Aerial view of the Isimba hydropower plant



Fig. 9.3 The downstream public bridge

9.1.3 Environment and Social Management

The project team strictly implemented the Environment and Social Management Plan (ESMP), and stuck to environmental protection management through dust control, noise reduction, sewage treatment, solid waste disposal, soil and water conservation and biodiversity and water environment protection during the construction. The



Fig. 9.4 Domestic sewage treatment system

Ministry of Environmental Protection, Department of Water Resources, Ministry of Labor, Wildlife Conservation Organization and Fishery Protection Organization of Uganda conducted supervision on the whole process of project implementation. Thanks to the strict environmental management measures, the project team has been highly recognized by the owner and the supervisory authorities in the aspect of environmental protection. No environmental accident has occurred during the construction, and no administrative penalty has been received from any ministries, commissions or organizations of Uganda (Fig. 9.4).

Although the land acquisition and resettlement for the Isimba hydropower project was carried out by the Ugandan government, the project team still took the initiative to assign professional community coordinators to help the owner and government departments introduce the project construction and assist with community work related to construction disturbance, which has achieved good results.

9.1.4 Employment and Training

In order to promote local employment, the project team required that the priority should be given to Ugandan workers in hiring for certain positions and types of work in the stage of allocating and preparing construction resources, to ensure a proportion of Ugandan workers not less than 70%, and actively organized skill trainings for local employees to improve their working skills. At the peak of the project, about 3,200 employees were taking part in the construction, of which about 2,700 were Ugandan and about 500 were Chinese, with Ugandan employees accounting for 84.4% of the total number. The Ugandan employees served as safety engineers, environmental engineers, community coordinators, administrative assistants, medical



Fig. 9.5 Training in machine maintenance

personnel, drivers, heavy equipment operators, welders, wood patternmakers, electricians, drillers, steel fixers, bricklayers, repairmen and other types of technicians as well as general physical laborers.

Considering that the Uganda employees are less skilled, the project team invited local government departments and skilled Chinese workers to give them a series of skill trainings, including those for mechanics, wood patternmakers, drivers, operators, welders, lathe mechanics, first aiders and firefighters. Through theoretical coaching, massed learning, pre-job education, hands-on mentoring, operation demonstration and self-learning, the Ugandan employees have constantly improved their skills by combining theory with practice in their work (Figs. 9.5, 9.6 and 9.7).

9.1.5 Active Fulfillment of Corporate Social Responsibilities

(1) Improve Local Traffic Conditions

In the early stage of the project, the roads in the surrounding communities were potholed and dilapidated, and flooded heavily during the rainy season, seriously affecting the daily travel of the community residents. Moreover, some communities had no tap water so that residents often walked through bushes to get water from the river. The project team, after a field survey, assembled road rollers, bulldozers, dump trucks, loaders and other construction equipment to build gutterways and lay pipelines and pave roads for getting water, thus improved the traffic conditions of surrounding communities in a planned and gradual way. Altogether, considerable results have been achieved.



Fig. 9.6 Training in job skills



Fig. 9.7 Training in first-aid knowledge

In June 2015, the project team widened and rebuilt the road from Kiterede Village to the Nile River, which facilitated the daily travel and domestic use of water for more than 1,000 people living in the surrounding communities (Fig. 9.8).

In February 2016, the project team rehabilitated rural roads in Nampanyi Village on the left bank of the dam area, facilitating the daily travel of more than 1,500 people living in the surrounding communities (Fig. 9.9).



Fig. 9.8 Road from Kiterede village to the Nile river



(a) Before the Repair



(b) After the Repair

Fig. 9.9 Rural road in Nampanyi village

In May 2016, the project team widened and repaired the rural road from Busaana Town to the entrance of the project site, facilitating the daily travel of more than 20,000 people living in the surrounding communities (Fig. 9.10).

In June 2017, the project team assembled construction equipment including graders, loaders, dump trucks, sprinkling cars, bulldozers, loader-diggers and road rollers to maintain the main roads connecting Kayunga, Busaana and Kasaana to improve traffic conditions for the surrounding residents (Fig. 9.11).

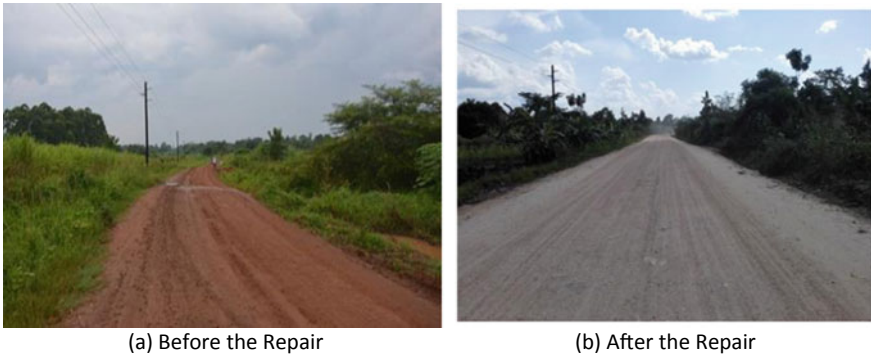


Fig. 9.10 Rural road in Busaana town



Fig. 9.11 Main roads connecting Kayunga, Busaana and Kasaana

(2) **Provide Free Medical Services**

On the project site, a hospital, equipped with ambulances, medical equipment, full range of medicines and medical staff including two Chinese physicians, two local physicians and two local nurses, was established to provide free medical services for all employees and their families. In addition, the project team regularly organized or invited Chinese medical teams in Uganda to hold community health service activities, conducting health training for the surrounding communities, disseminating knowledge on AIDS and malaria prevention, providing free diagnosis and treatment on common diseases and distributing medicines, to help improve the health conditions of the community residents.

In March 2015, the project team, in collaboration with Chinese medical teams in Uganda, organized a free clinic in Kayunga District on the left bank of the dam area to conduct health check-ups for the community residents, disseminate knowledge on disease prevention and distribute free medicines for common diseases, benefiting more than 600 people (Fig. 9.12).



Fig. 9.12 Free clinic in Kayunga district



Fig. 9.13 Free clinic in Kamuli district

In November 2015, the project team, in collaboration with Chinese medical teams in Uganda, organized a free clinic in Kamuli District on the right bank of the dam area to conduct health check-ups for the community residents, disseminate knowledge on disease prevention and distribute free medicines for common diseases, benefiting more than 700 people (Fig. 9.13).

In December 2016, the project team funded the Busaana Health Centre III (Busaana HC III) to hold a 3-day community health service activity in Busaana Town, Nampanyi Village and Kasaana Village to disseminate knowledge on AIDS and malaria prevention, give training in family health programs, conduct health check-ups for children in the communities and distribute free medicines, benefiting more than 1,000 people (Fig. 9.14).

From October to December 2017, the project team organized local physicians, nurses and community coordinators to hold community health service activities in villages of Kotwe, Bukamba, Bulangira and Bwase-Buseta in Kamuli District on the right bank of the dam area to launch training for local residents in AIDS prevention, malaria prevention and family health, conduct health check-ups for children in the communities and distribute free medicines, benefiting more than 1,500 residents (Fig. 9.15).



Fig. 9.14 Community health service in Busaana town



Fig. 9.15 Community health service activities in Kotwe village and Bukamba village in Kamuli district

(3) **Improve Local Educational Conditions**

The schools near the project site were challenged by underdeveloped hardware facilities and a serious lack of educational resources. The classroom doors, windows, walls, floors, desks and chairs were seriously worn, the drainage facilities and sanitation facilities on campus were inadequate, and the students often sat directly on the floor in class. Taking the actual situation into account, the project team, after a sufficient communication with the district government, improved the local educational conditions by donating school supplies and renovating the school buildings.

In November 2014, the project team donated stationery including notebooks, school bags and pencil boxes to about 100 students at the Nurary Primary School (Fig. 9.16).

From March to May 2017, after repeated communications with the Kayunga District Government and the Kayunga District Education Bureau on the left bank of the dam area, in order to improve the conditions of the local school and the quality of local education, the project team organized a maintenance and renovation of Nakakandwa RC Primary School, including refurbishment



Fig. 9.16 Donation of school supplies at the Nurary primary school

of internal and external walls and floors, roof rebuilding, building reinforcement, repair or replacement of doors and windows, replenishment of desks and chairs, improvement of drainage facilities and construction of flag platform, and donated teachers’ desks and chairs, students’ desks and chairs, school bags, stationery and other office and school supplies, which greatly improved the conditions of the school (Figs. 9.17, 9.18 and 9.19).

(4) **Donate Supplies to Local Residents**

In July 2013, the project team donated mosquito nets, footballs and other household and sporting goods to local residents on both banks of the dam area (Fig. 9.20).

In June 2014, the project team sponsored the Prolane Football Club of Kayunga to participate in the 13/14 season matches in the Buganda Region (Fig. 9.21).

In February 2015, the project team accompanied the Chinese ambassador to Uganda, Zhao Yali, to donate sewing machines, tractors, mattresses, televisions, footballs and other agricultural machinery and household goods to Kamuli District on the right bank of the dam area (Fig. 9.22).



Fig. 9.17 Nakakandwa RC primary school before the repair



Fig. 9.18 Nakakandwa RC primary school after the repair



Fig. 9.19 Donation ceremony at the Nakakandwa RC primary school

In December 2015, the project team accompanied the Chinese ambassador to Uganda, Zhao Yali, to donate sewing machines, tractors, mattresses, televisions, footballs and other agricultural machinery and household goods to Kayunga District on the left bank of the dam area (Fig. 9.23).



Fig. 9.20 Donation of household and sporting goods to local residents



Fig. 9.21 Sponsorship for the prolane football club of Kayunga

In December 2016, the project team donated cement to the Busaana Town Government to improve the housing conditions of local residents, and the chairman of the town government presented the project team with a letter of appreciation (Fig. 9.24).

The project has been highly recognized by the Ugandan government, and in May 2019, the Uganda Post Office officially issued a series of stamps featuring images of the Isimba Hydropower Plant (Fig. 9.25).



Fig. 9.22 Donation activity in Kamuli district on the right bank of the dam area



Fig. 9.23 Donation activity in Kayunga district on the left bank of the dam area



Fig. 9.24 Donation of cement to the Busaana town government



Fig. 9.25 Stamp commemorating the Isimba hydropower plant of Uganda

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Chapter 10

Conclusion



Along the route of BRI are mostly developing countries and emerging economies that are highly dependent on resources in their economic development and generally face the contradictions between development and protection because of industrialization and urbanization. During the building of BRI, Chinese businesses have brought China's ideas of ecological civilization, best practices, as well as advanced technologies and equipment to the BRI partner countries, which will set an example for the latecomers, so they can avoid depending on the traditional development paths and lock-in effect and thus achieve green, low-carbon, and sustainable development in coordinating economic development and environmental protection.

Building a green Belt and Road through joint efforts is both a significant part of high-quality BRI development and a common aspiration of people from all countries. To achieve this goal, we should enhance the alignment of ideas of ecological civilization and green development strategies among partner countries, improve the green development in infrastructure building, international capacity cooperation, and trade activities, innovate in green financial mechanisms, carry out projects of ecological environmental protection that affects people's well-being, and thus create a Silk Road featuring low carbon, environmental-friendliness, and vitality.

Green development is embodied in the policy alignment and concept recognition with countries along the route, in highly efficient trade activities, connectivity, and international capacity cooperation, in strengthening cooperation in ecological conservation and environmental protection, and in enhancing people's sense of fulfillment in terms of environment in countries along the route. Through foreign aid, technology transfer, industrial cooperation, and other means, efforts will be made to effectively enhance the environmental protection capabilities of countries along the route, reduce and control pollutant emission, and bring about actual improvements in our environment.

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