ENVIRONMENT

Building a "Green" Railway in China

Construction of the Qinghai-Tibet Railway, the world's highest railway, has been achieved with ecological protection at the top of the project's agenda.

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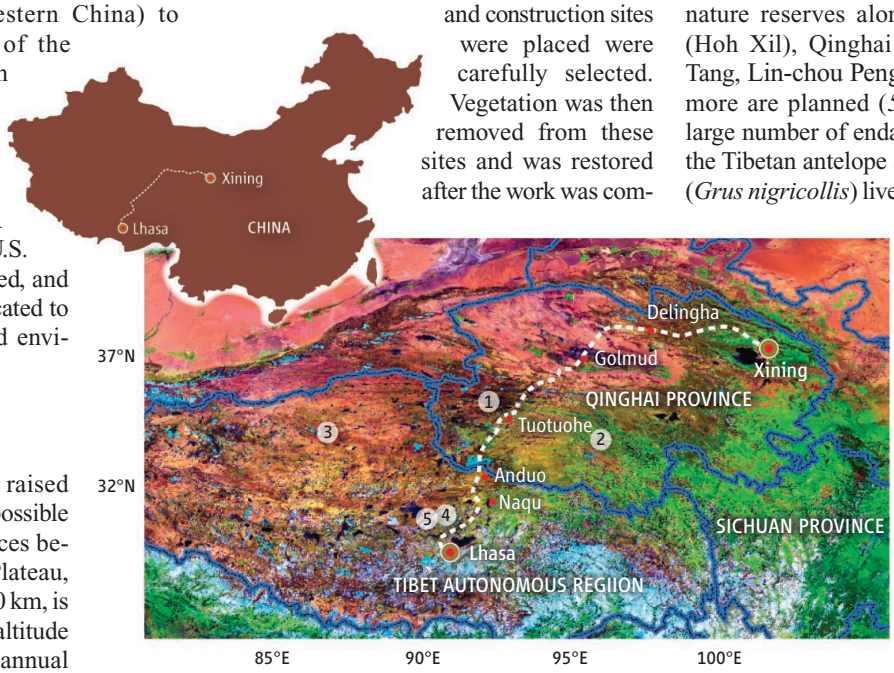
The Qinghai-Tibet Railway (QTR) was built during China's Tenth 5-Year Plan (2001–05) and, in China, is considered a landmark project (*1*). The QTR, completed in October 2005 and in trial operation since 1 July 2006, is the world's highest-elevation railway and the longest highland railway, extending over 1956 km from Xining (Qinghai's capital in northwestern China) to Lhasa, the capital city of the Tibet Autonomous Region (see figure, right). The Chinese government has invested an unprecedented amount of money to protect the area's ecology. A total of 26.2 billion yuan (U.S. $3.39 billion) was budgeted, and 1.54 billion yuan was allocated to ecosystem restoration and environmental protection.



The highest railroad in the world. The Qinghai-Tibet railway from Xining to Lhasa (1956 km). Distribution of vegetation based on the MODIS product (MOD09AI V4), 21 July 2005. Locations of the centers of five established natural reserves: (1) Kekexili (Hoh Xil) (92.3°E, 34.8°N); (2) Qinghai Sanjiangyuan (96°E, 34°N); (3) Chang Tang (87.2°E, 34.2°N); (4) Lin-chou Black-Necked Crane (91.3°E, 29.9°N); and (5) La-lu wetland (90.8°E, 29.8°N).

An Environment-Friendly Railway

The railway project has raised serious concerns about its possible environmental consequences because the Qinghai-Tibet Plateau, covering more than 360,000 km, is a unique and fragile high-altitude ecosystem (*2*). The mean annual temperature of the plateau ranges between – 4° and 6°C, and the average altitude is 4000 m. As a result, the Chinese government and local officials took great pains to address environmental concerns during their preparation for the construction of the QTR. The railway planners developed a "green policy" that emphasized protection of soils, vegetation, animals, and water resources (*3*–*5*).

In total, 550 km of the tracks were laid on permafrost. To avoid disrupting the seasonal migration routes of animals, including the famous Tibetan antelope (*Pantholops hodgsonii*), planners added a network of tunnels to their blueprints. To minimize the negative impacts of the construction, the Chinese government implemented several key measures: (i) Locations where earth was removed and construction sites were placed were carefully selected. Vegetation was then removed from these sites and was restored after the work was complete (see figure, page 547). (ii) Where possible, the railway path was directed around sensitive natural zones, and construction work was confined to the smallest possible area surrounding the railway. (iii) Planners detoured around wetlands and lakes wherever possible, and when this was not possible, they built bridges rather than surface routes to minimize the impact. (iv) Insulation and temperature-reducing facilities for frozen layers were used below the tracks to stabilize permafrost along the railway line. (v) The number of stations established along the line was minimized to reduce the impact of human wastes, and water treatment facilities were installed at every station. Recycled water is prevented from directly entering natural bodies of water. (vi) Railway construction was monitored by a third-party environmental inspector (the Qinghai Environmental Protection Bureau). (vii) The trains that will use the railway are fully enclosed to provide additional environmental protection.

In addition, planners established five nature reserves along the route [Kekexili (Hoh Xil), Qinghai Sanjiangyuan, Chang Tang, Lin-chou Pengbo, and La-lu], and six more are planned (*5*). In these reserves, a large number of endangered species such as the Tibetan antelope and black-necked crane (*Grus nigricollis*) live. To protect animals and plants, additional bridges and passages for animals will be built in sections of the railway that go through the reserves.

During construction, efforts were made to reduce noise during the fieldwork and to avoid alarming animals. Moreover, planners identified areas where animals traveled, and built more than 33 passageways in the Hoh Xil nature reserve in Qinghai and the Chang Tang nature reserve in Tibet to permit undisturbed migration. The results of these measures were that the construction did not significantly affect species such as the Tibetan antelope. In 2006, the number of pregnant female antelopes was more than 30,000, the largest number ever recorded in this area (*6*).

Protection of bodies of water was also prioritized during the fieldwork. Construction of the huge railway bridge across three big rivers of the Clear-Water and Qumar was performed by the 12th bureau of China Railway Construction. Builders used 48 drilling machines to establish supports for the bridges in areas with permafrost. This approach prevented sedimentation of river water when drilling to

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establish underwater piers and when hauling sand along watercourses. In the tunneling work through Fenghuo Mountain, workers resorted to methods such as wet-spraying of cement and wet-drilling to reduce dust emissions.

In April 2001, the railway construction unit signed a letter of responsibility with the Qinghai Environmental Protection Bureau (*7*). This is the first letter of responsibility for environmental protection in the history of railway construction in China. It covered not only the underlying principles and main tasks (including protection of vegetation, wild animals, natural reserves, wetlands, permafrost, and the water quality of the main sources of China's five major river systems); but also detailed construction standards and regulations; the responsibilities of leaders, staff, and workers; and reporting, managing, and monitoring systems.

In addition, builders promoted the use of nonphosphate detergents at base camps and prevented discharge of untreated sewage. Workers used oil-burning boilers to stay warm and solar energy to power electrical equipment, rather than burning local woody vegetation such as trees. All daily waste generated by construction workers was collected and treated, and monitoring teams thus found no evidence of littering. A recent investigation conducted by the State Administration of Environmental Protection on the environmental protection work at the QTR construction sites reported no obvious changes in the water environment on the Qinghai-Tibet Plateau since the project started and stated that the area's vegetation and animals had been effectively protected (*7*). More measures will be taken to keep the environment clean, including the use of clean energy sources (e.g., solar power, wind power, and other non–fossil fuel sources of electric power) for railway stations built along the QTR, and passenger trains will have proper rubbish disposal facilities on board. However, long-term monitoring of the local environment and of wildlife must be carried out to provide advance warning of any developing problems and to permit timely improvements.

Grass restored. Grassland vegetation and its root soil layer were removed during construction then were replanted once the work was complete (*12*).

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Local Transportation and Ecotourism

The new railway will greatly reduce transportation costs for materials entering and exiting Tibet, and this will help domestic and foreign enterprises that want to establish a presence in the Tibetan market. In addition, the QTR will boost cross-border trade with Nepal and India and will turn Tibet into a new economic frontier for southern Asia.

The QTR will also promote local tourism and related economic development. The tourism resources along the railway are very rich, with a wide range of landscapes, biology, and ethnic cultures. Regional authorities estimate that by 2010 the number of tourists will double from the 2006 total of 2.5 million, and tourist revenues in the region will rise to 5.8 billion yuan (U.S.$750 million) per year (*8*). Although tourism creates excellent opportunities, it also carries the risk of increasing pollution, habitat destruction, and the introduction of exotic species (*9*). It will need to be carefully managed to promote and ensure long-term ecosystem health and sustainability in the region.

Concerns for the Future

Recent studies indicate that plateau temperatures have risen remarkably since the 1980s and that winter temperatures could increase by another 1° to 2°C by 2050 (*10*). Such warming could cause permafrost to melt and might seriously threaten the stability of the railway's foundation. It will be necessary to find ways to stabilize the gradually thawing earth.

The most serious environmental problems created by the QTR, including garbage disposal, water treatment, and ecotourism, will only become apparent in the long run. These problems will not be identified in time unless the authorities assign clear responsibility for this task. The key to protecting the region's fragile environment from direct and indirect human damage will lie in tightly controlling the number of ecotourists and the speed of economic development.

In addition, mining and animal smuggling present a serious problem. There will need to be monitoring to ensure that Chinese local governments enforce environmental protection laws. Nongovernmental organizations (e.g., Green River) can also help to prevent local exploitation of animals and to protect biodiversity in the nature reserve areas.

Another concern is that construction of the QTR, by increasing movement of people into the region, could have a serious impact on the prevalence of diseases such as AIDS (*11*). Active disease surveillance and the ability to impose quarantine rapidly when warranted will be the most effective way to reduce the risk of disease spread.

If carefully managed, the Qinghai-Tibet railway will ultimately promote the sustainable ecological, social, and economic development of western China. We hope that it will be remembered as more than just an engineering accomplishment—that it will also be remembered as an ecological miracle and a successful example of a green railway that can be followed by other regions and developing countries.

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