

China: The Environmental Challenge of Railway Development

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The phenomenal development of railways in China has brought real economic benefits to its people and businesses but, with the benefits, an environment, already buckling from the dizzying economic growth of the country, has been impacted. International experience demonstrates that environmental impacts can be effectively mitigated and the worst avoided if appropriate measures are taken. How has China responded to the profound environmental challenges of its rail program? This paper draws on almost 30 years of World Bank's support to railway development in China in order to attempt to answer this question. Environmental practices such as avoidance of sensitive sites through alternative analysis, design of tunnel-bridge-tunnel schemes, application of innovative slope stabilization measures, attention to community connectivity, and incorporation of landscape design are noteworthy examples of effective measures routinely employed by the Ministry of Railways. At the same time, challenges remain in addressing cumulative impacts, improving the quality of public consultation and the integration of social mitigation measures with those meant to protect the environment.

THE RAILWAY ENVIRONMENTAL CHALLENGE

China's railways entered a new phase of development with the Mid and Long-Term Railway Development Plan, adopted in 2004 and revised upwards in 2008 and currently being implemented. The plan seeks to increase the total rail network from 75,000 route-km in 2005 to 120,000 km by 2020. The integrated network, administered by the Ministry of Railways (MOR), will include dedicated high-speed passenger routes on the main corridors, new regional inter-city networks, new dedicated freight lines and substantial double tracking and electrification. It is the world's largest national railway development program for more than a century.

Impacts of this ambitious program are being felt throughout the country: in the densely-populated and developed southeast and northeast; in the ecologically fragile and less developed northwest; and in the dramatic landscapes of the southwest. The development of such a system poses significant environmental and social challenges. For example, some of the new lines cross sensitive ecosystems, are built in fragile mountain ecosystems, pass through densely populated areas, or threaten rural connectivity.

The World Bank has been involved in China's railway sector since the 1980's including the financing of 17 projects with a total length of over 10,000 km. All

railway projects include environmental impact assessment (EIA) reports prepared by MOR and other related safeguard instruments. Over the years the World Bank has seen a convergence of national environmental practice with international practice, particularly in the application of a mitigation hierarchy (avoidance, mitigation and offset) to reduce impacts, and in a number of environmental management practices such as the use of public consultation, alternatives analysis, and establishment of environmental management plans.

EVOLUTION IN SAFEGUARDING THE ENVIRONMENT

The strengthening regulatory and institutional framework in China has provided a foundation for better environmental practices. Statutory environmental protection formally began with the introduction of the Environmental Protection Law of China (1979) leading to the adoption of specific environmental protection measures in railway construction projects. In 1986, the State Environmental Protection Agency¹ (SEPA) issued the Environmental Management Measures for Construction Projects, which specified the requirements for environmental impact assessment (EIA) reports. It also required the integration of pollution prevention and control facilities in project design, construction and operation as part of the

¹ Now Ministry of Environmental Protection (MEP)

“Three Simultaneous” policy for construction projects. MOR responded by incorporating environmental mitigation works in its project design, construction and operation.

Since 1995, MOR has developed a broader set of environmental protection regulations, guidelines and standards and improved its enforcement. Railway projects are planned and implemented to comply with national requirements on EIA and the “Three Simultaneous” policy. MOR has financed overseas study tours to countries such as Germany, US, and France for its environmental management personnel and EIA practitioners to share environmental management experiences.

Network planning began to include macro-level environmental measures with the promulgation of China’s EIA Law (2003). This law requires that an EIA be conducted for sector plans (such as energy, agriculture, and transport) before the draft of such plans are submitted for examination and approval. The railway sector was identified by the Ministry of Environmental Protection as one of the pilot sectors for such a sector plan EIA. It was applied to the railway network development program in the nation’s Eleventh-Five Year Plan (2006-2010). Today, national and project level railway EIAs are routinely developed and implemented.

APPROACH TO ENVIRONMENTAL PROTECTION IN RAILWAY PROJECT

Environmental protection is integrated throughout the project cycle, during network planning, prefeasibility analysis, feasibility analysis, preliminary design, construction, and operation. At the core is a hierarchy of measures:

Avoidance of sensitive sites. The preferred option is where possible to avoid impacts on ecosystems, biodiversity, and communities. Third party EIA consultants are employed to undertake a analysis of alternative corridor alignments and to examine in details areas of particular potential environmental sensitivity. Appropriately conducted alternative analyses are regarded as one of the most important measures to avoid and greatly reduce potentially adverse environmental and social impacts.

Avoiding Sensitive Sites by Alternatives

Guiyang-Guangzhou Railway Project, a new 857 km double track electrified railway with design speed of 250 km/h, will, when completed, traverse vast remote and mountainous area in southeast of Guizhou and Guangxi with rich ecosystems and scenic areas. Forty-seven environmental sensitive sites were identified along the planned project corridor, including nature reserves, forest parks, scenic areas, water resources protection areas and cultural relics sites. Various alternative analysis were undertaken during the feasibility study and the alignment finally selected avoided 40 of these areas.

Sound Engineering Schemes. The analysis of alternatives is complemented in mountainous areas by an intensive use of tunnel-bridge-tunnel schemes. These minimize the potentially damaging environmental impact on mountain ecosystems caused by landslides and erosion. On the Guiyang-Guangzhou railway line tunnel-bridge-tunnel schemes are extensively adopted for about 81 percent of the alignment in order to in part avoid the most sensitive land-take issues and minimize the ecological footprint. The extensive use of tunnel-bridge-tunnel schemes in this and other selected projects is shown in Table 1.

Table 1 Physical Characteristics under Selected World Bank supported Projects

Bank-supported project	Total Length (km)	Tunnel-Bridge-Tunnel (% of km)	Spoils (million m ³)
Guiyang-Guangzhou	857	81	41
Nanning-Guangzhou	400	33	7
Jilin-Hunchun	360	66	14
Zhangjiakou-Hohhot	286	68	5

These schemes have a significant cost, since the cost of bridges and tunnels is about 50% - 100% more than that of embankments. But this is not just true of mountainous alignments. A viaduct scheme is also adopted for more than 60% of the alignment across the flat plains of the Shijiazhuang-Zhengzhou railway line. The typical 18 m wide viaduct allows for minimum land take for its columns and for under-the-bridge crossing and farming while the typical railway

embankment permanently occupies a swath of land 30-50 m wide.

Railway projects in China routinely adopt advanced soil stabilization techniques including structural and non-structural measures, complemented with extensive landscaping. The aim is to blend the rail line with the scenic qualities of the geographical area being crossed.



Slope Erosion and Protection Control

Comprehensive Mitigation Plan. Some social and environmental impacts are unavoidable. In these cases comprehensive mitigation measures are incorporated into the project design and environmental management plan.

Disposal and restoration. An inevitable outcome of the tunnel-bridge-tunnel schemes is the production of large volumes of excavated material (spoils). These spoils receive special attention during construction by balancing excavation with embankment.



Disposal Site Reclamation for Local Agriculture

Excess spoils are often converted to arable land and used for retention walls, landscaping, local farmers and communities. Sediments are removed from tunnel construction waste water before discharging the water into rivers. Sites and buildings used for temporary construction works are often converted to farmland. Temporary construction roads are converted into permanent rural roads where needed.



Ongoing Reclamation in Former Beam Factory



Borrow Pit Returned to Local Community as Fish Pond

Construction Site Management. Temporary construction impacts such as noise, vibration, and erosion are mitigated through the implementation of environmentally sound construction management measures. An environmental management leadership group is routinely established within the railway project management units and led by a Chief Commander, supported by division chiefs and environmental management staff. Environmental mitigation measures are incorporated in the bidding documents. Project-specific environmental management rules and procedures are developed. Inspection and incentive and penalty systems are enforced by the project management units.



Camp for Construction Workers

In 2007, MOR issued the “Six in One” policy which classifies overall railway project objectives into six control targets, namely: quality, safety, environmental protection, construction duration, investment, and technical innovation. These objectives are specified, quantified and enforced by the parties responsible for the rail project construction. In 2008, MOR issued its “Decision on Promotion of Standardized Management of Construction Projects” (or the “Four Standardizations”), which imposed standardized management procedures, staff assignments, construction site management and process control. Comprehensive implementation regulations and procedures have been developed by the 18 railway administrations within MOR, and enforced by the railway construction entities. Contractors have subsequently developed a set of standardized implementation measures. The predominance of clean and orderly construction sites are evidence of the implementation of these standards.

Physical Cultural Resources. The EIA process includes a physical cultural resources survey conducted through field investigation and consultation with local authorities and communities. The alternative analysis includes avoidance to the greatest extent possible of cultural resource sites. Where relics are suspected and impacts probable, detailed site investigation and excavation by a professionally licensed institute is conducted prior to construction. Relics retrieved from the sites are turned over to museums. Chance-find procedures in line with national laws and regulations are included in the environmental management plans.



Cultural Relics Survey and Excavation Prior to Construction (Zhongshan Tomb Protection Area, GuiGuang Railway Project)

Community Severance. As linear infrastructure, railway lines often physically sever communities, traffic, and irrigation systems. As such, the project design seeks to identify and mitigate these impacts by designing, in consultation with local communities, safe crossings when allowed or under or over crossings when the rail and road are grade separated. The same is true of irrigation canals.

Table 2 Examples of Connectivity Measures

Rail Project (World Bank financed)	Community Connectivity Measures
Guiyang-Guangzhou	Approximately 300 interchanges, 20 pedestrian overpasses and 15 underpasses, and more than 900 culverts
Nanning-Guangzhou	Approximately 290 road overpasses and underpasses, and almost 1,200 culverts
Jilin-Hunchun	Approximately 30 road viaducts and 280 culverts
Harbin-Jiamusi	Approximately 300 culverts
Zhangjiakou-Hohhot	Approximately 5 road viaducts and over 200 small community crossing culverts

Environmental Supervision. Following a Notice issued in 2002, MOR requires environmental supervision to

² The Notice on Promoting Environmental Supervision in Major Construction Projects was jointly issued by SEPA, MOR, the Ministry of Transport, the Ministry of Water

be an integral part of the supervision engineer's responsibility. Independent environmental supervision companies have been employed on some key national railway projects such as the Qinghai-Tibet line and the Chongqing-Huaihua line to further enhance the environmental safeguards enforcement.

Regular supervision enforces the implementation of required mitigation measures. The use of an independent environmental monitor on Bank-funded projects has been extended to some MOR projects including the Beijing-Shanghai and Wuhan –Yichang lines. Several independent environment monitoring consultants with railway project experience are now practicing in China.

Looking Ahead

In many ways, the railway sector in China has been a pioneer in integrating environmental impact analysis and management into infrastructure projects. These efforts continue in several key areas.

Standardized Environmental Code of Practice. MOR's "Four Standardizations" details environmental regulations and procedures, but these remain specific to each railway administration. A sector-wide railway environmental code of practice for railway construction environmental management would further standardize good practice and ensure uniform application.

EIA Documentation. The EIA documents prepared by railway design institutes follow the Ministry of Environmental Protection requirements in terms of document structure and contents. The documents are technically strong, but would benefit from further analysis of social and cultural impact and induced or cumulative impacts.

Public Consultation and Information Disclosure. Though they share the same aims, there are practical differences between Chinese EIA regulations and international practices regarding public consultation and information disclosure. In the former, the breadth and depth of public consultation are often limited compared to international practices, and information disclosure is often rudimentary.

Sources, and China National Petroleum Corporation in 2002. It calls for piloting the enforcement of environmental supervision as an integral part of engineering supervision in several key sectors.

Environmental Management Plans. An Environmental Management Plan is prepared for each Bank-financed project but is not formally required in China. A stand-alone Environmental Management Plan, which extracts the EIA conclusions and recommendations, is a clear and succinct tool for managing environmental impacts and incorporating measures into project design, bidding documents and implementation practice.

Integrate social impacts. The Chinese EIA law requirements mainly emphasize the potential impacts on biophysical environment, but there has been an increasing awareness that the broader social impacts including land acquisition and involuntary resettlement need to be addressed in an integrated way.

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This note is part of the China Transport Note Series to share experience about the transformation of the Chinese transport sector. For comments, please contact Ning Yang (nyang@worldbank.org), John Scales (jscales@worldbank.org) or Gerald Ollivier (gollivier@worldbank.org).

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