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INTERNATIONAL VIEWPOINT AND NEWS

Building a new and sustainable "Silk Road economic belt"

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Abstract The building of the Silk Road economic belt is an exciting prospect that may bring immense economic benefits to Eurasian countries. However, intensive human activities to be induced by it may double the water crisis in central Asia, deteriorate the vulnerable environment, and accelerate energy consumption in this area. To build a new and sustainable Silk Road economic belt, advancing scientific research, reinforcing international collaboration and enhancing education are necessary steps. With careful planning, sound research, good data and the support from governments and the people, the Silk Road economic belt can be developed in an environmentally sustainable manner that is a credit to all involved.

Keywords Silk Road · Water resources · Environmental protection · Energy saving · Human activity

Introduction

The original "Silk Road" was established over 2100 years ago during the Han Dynasty (206 BC–AD 24) to promote trade between China and Europe (Xu et al. 2010). Stretching for over 7000 km through Asia, Europe and Africa, the Silk Road proved to be a catalyst for development, facilitating for many centuries, the exchange of goods, culture, art, history and religion between China and the West. On September 7, 2013, Chinese President, Xi Jinping, delivered a landmark address at Nazarbayev University in Astana, Kazakhstan (online news at http://news.xinhuanet.com/english/china/2013-09/07/c_132700695.htm), calling for China and Central Asia to join in the creation of a new "Silk Road economic belt" that would bring immense commercial benefits to the region (Fig. 1). The proposal aims at helping Eurasian countries, especially central Asian countries, develop rapidly in economy while achieving fast development in China. It is a win–win option for central Asia and China.

The Old Silk Road provided a stimulus for cultural growth and economic prosperity along its entire route. In the Han Dynasty, it provided the opportunity for Zhang Qian to explore Xiyu and bring back valuable information about remote parts of Central Asia. In the Tang Dynasty, Buddhist monk Xuan Zang traveled to Tianzhu (currently India) to obtain the original sacred scriptures. His pilgrimage was immortalized during the 16th Century in *Journey to the West*, one of the "four great classical novels" of Chinese literature. Europeans also travelled the road, with the Venetian explorer and trader Marco Polo becoming one of the first Westerners to reach China over 700 years ago. His legendary book *The Travels of Marco Polo* has been translated into many languages and opened Western eyes to the cultural wealth of Central Asia and China. In June 2014, UNESCO commemorated the historical importance of the transcontinental trade route by designating the Chang'an-Tianshan corridor of the Old Silk Road from Central China to the Zhetsyu Region of Central Asia as a World Heritage Site.

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Fig. 1 The new Silk Road. *Red* is the land-based route, which is referred as Silk Road economic belt. *Blue* indicates the marine-based route that is referred as Maritime Silk Road of the 21st Century (modified from Wikipedia https://en.wikipedia.org/wiki/Silk_Road)

The President's "Silk Road economic belt" is referred to by many Chinese citizens as the "New Silk Road". Its rebirth will inevitably bring immense benefits to underdeveloped regions of northwest China and Central Asia, creating much needed wealth and prosperity. The goal is clearly achievable. However, that real challenge will be to ensure that the New Silk Road is built in a sustainable way that gives adequate attention to the environment and the collateral damage that could be caused. For example, much of the route is situated in semi-arid and arid regions where the natural environment is highly vulnerable and water resources are already under stress (Libert et al. 2008). The problem is further compounded by the prospect of climate change and human activity, which together, will place a further strain on the limited natural resources and vulnerable environment (Immerzeel et al. 2010; Li et al. 2014). The inherent complexity of the natural system and a scarcity of scientific research on the natural environment and resources of these regions make it difficult to find effective solutions.

Meeting the sustainable challenge will require enhanced cooperation among regions and nations along the route. The project needs to be supported by sound science and good data if we are to ensure that resources are efficiently used and the environment is protected. Local governments will need to invest in scientific research in the relevant fields. Moreover, public education is essential if people are to become effective stakeholders in the project. The public needs to understand the need for environmental protection and the potentially devastating implications of excessive exploitation of natural resources. With careful planning, adequate scientific research and close cooperation among the regions and nations involved, the New Silk Road can be built beneficially and sustainably.

Specific concerns

A primary concern is the region's largely arid climate and the limited availability of water resources. Global climate change will make matters worse. It is reported that the eastern basin of the Aral Sea dried up completely in August, 2014 for the first time in 600 years (Eliasson 2015). It is now a desert. Also, glaciers in the Himalayan and Tianshan Mountains are shrinking at an alarming rate due to climate change (Chen 2014). Glacial melting creates additional stream flow in the short term, but will have disastrous, irreversible consequences in the future when the glaciers disappear. Currently, around 3 billion people are living along the route of the new road—a number that will significantly increase as the project proceeds. At present, water resources in the region are used very inefficiently

with most water used for agricultural irrigation that generates weak economic returns in terms of GDP (Varis 2014). The problem is exacerbated by declining water quality due to human activity (Törnqvist et al. 2011). Radical changes in the approach to water management are required if the problem is to be resolved.

Fossil energy sources are also being expended at an increasing rate. China is the world's largest user of fossil fuels, burning enormous amounts of coal, natural gas and petroleum each year, especially in the east. A recent forecast warned that China's coal reserves could be exhausted in just 19 years if consumption continues to grow (Heinberg and Fridley 2010). Climate change and environmental pollution (Liu and Diamond 2005) are inevitable consequences of this trend and threaten the economic viability of the New Silk Road venture. Air and water quality are obvious concerns, but land degradation is also a serious issue (http://www.nature.com/news/2005/050613/full/news050613-7.html) since soil pollution, soil salinization and land desertification can devastate agricultural productivity.

Scientific research may help to resolve or at least alleviate some of the potential problems. However, support from the governments for much needed scientific research is currently limited. Urgent research priorities include:

- Detailed estimates of the project's water and energy needed, including an evaluation of transboundary waters and how these should be managed.
- A full assessment of the project's potential environmental and ecological impacts, together with options for remediation.
- A complete appraisal of the geologic hazards that may arise as a result of the project activities.

It is also important that an environmental monitoring network be established along the proposed route in time for pre-project, baseline measurements to be made.

Presently, collaboration between scientists from the countries involved is weak and this will undermine the effectiveness of the research undertaken. The Chinese government tends to favor the involvement of scientists from developed countries in North America and Europe. However, considerable benefits are likely to be gained by engaging scientists from local countries such as Iran and India who have gained valuable first-hand experience of the types of environmental problem that may be encountered.

Ultimately, the research will be in vain unless the local people can fully appreciate the environmental risks and are willing to co-operate as partners in the effort to combat environmental degradation and promote sustainable development. This will be a slow process and will require education and government incentives. Any effort to build the New Silk Road in an environmentally sustainable will fail without the full support of the local people.

Proactive measures

Some nations have already taken proactive measures to help protect the environment. Research programs initiated with the support of the Chinese government include the National Key Basic Research Program of China (973 Program), which is examining the impacts of climate change on water resources in arid areas, as well as disaster risk and prevention in the Loess Plateau. Further studies related to potential hydrogeological, geo-environmental and engineering geological concerns are also being considered. A new Environmental Protection Law of China took effect in January 2015, and several national guidelines concerning environmental impacts, groundwater assessment and agricultural water management have recently emerged. These legal instruments are an important first step towards the building of a sustainable New Silk Road.

Also, other countries in Eurasia appear to be responding to the potential environmental problems. For example, the European Water Resources Association's (EWRA's) decision to hold a Congress in Istanbul, Turkey during 2015 is seen as an indication of EWRA's willingness to expand towards Asia. Adoption by Asian countries of the European Water Framework Directive and its advanced strategies for water resources management would go a long way to alleviating Asia's water resources problems.

The road ahead

Despite several promising initial signs, the rebuilding project remains an enormous long-term task for both China and Eurasia, with numerous, very serious environmental issues that must be resolved. Meticulous planning is required if the goal of environmental sustainability is to be achieved. This will require a co-operative, concerted effort by planners, hydrologists, environmentalists, hydrogeologists, geologists, engineering geologists, ecologists, meteorologists and specialists in pollution control and ecological recovery, amongst all the countries involved. It will also require international co-operation to develop a trans-national legal system that will create rules and regulations that are consistent and enforceable along the entire route.

Education will be critical to the project's success. On one hand, it is essential for the specialist training of scientists, engineers and planners engaged in the work, but on the other, it is needed to ensure that members of the public are fully sensitized to the environmental risks associated

with the project and the contribution they must make to ensure water resources and the natural environment are protected. Given that most of the countries along the route host large populations with minimal formal schooling, significant investment will be required from central governments to raise education standards to the appropriate level.

Recognizing the threats to water and the environment, it will be essential to advance research in such fields as transboundary water resources management, renewable energy sources, and sustainable development technologies. Although some of this work is currently being supported by central governments, there is an urgent need to accelerate such research by promoting and funding collaborative research and exchange of data and technical skills between institutes and universities in countries along the project route. In effect, the New Silk Road could become a great "river of knowledge" connecting China and Central Asian countries such as India and Pakistan, with the Middle East and Europe. As the seed to this initiative, a research institute needs to be established under the auspices of the Chinese central government that would be responsible for conducting, managing and supervising pioneering research in support of the New Silk Road project. This institute could be based in Xi'an, where the road starts, with sub-branches of the parent institute created in other countries as the road grows and the "river of knowledge" develops. Such an institute would allow early development of the regional and international environmental monitoring networks that would provide the climate data, hydrological data, hydrogeological data, water quality data and land cover/land change data needed to underpin the scientific research programs. The data collected would be made readily available to countries along the Silk Road route and to the public at large. In this way, partner countries and the general public will be encouraged to "buy in" to the New Silk Road project and the environmental goals that must be met.

The building of a New Silk Road is an exciting prospect that can bring immense benefits to all countries along its route. With careful planning, sound research, good data and the support of governments and the people at large, the New Silk Road can be developed in an environmentally sustainable manner that is a credit to all involved.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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