

International Cooperation for Building Low-Carbon and Water-Saving Society

— Case Study of Japan and China —

Osamu HIGASHI

Associate Professor

Graduate School for International Development and Cooperation, Hiroshima University

1-5-1 Kagamiyama, Higashi-Hiroshima, Hiroshima 739-8529, Japan

E-mail: hi036@hiroshima-u.ac.jp

Hiroaki SHIRAKAWA

Associate Professor

Graduate School of Environmental Studies, Nagoya University

Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan

E-mail: sirakawa@urban.env.nagoya-u.ac.jp

Abstract

The Yellow River basin, located in arid and semi-arid area in China, is confronted serious water shortage problems. In this context, central government is promoting development and utilization of vast natural resources in the Yellow River basin, such as coal and natural gases, for national and regional economic growth. The water rights transfer, implemented in Inner Mongolia, is one of the effective policy tools for regional industrial development under severe water deficit conditions. However, as a result of the policy, CO₂ emissions have increased in this region due to expanding of coal-fired electric power capacity.

Realizing “saving water” and “low-carbon” society in the same time is absolutely necessary in the Yellow River basin. Therefore, it is important to develop an effective cooperation system for technology transfer between Japan and China. In this study, a new cooperation framework, for promoting water rights transfer and utilization of renewable energy in the basin is designed based on existing policies such as CDM, ODA, micro finance, and so on. It is considered that the framework will contribute to sustainable growth of both countries. In addition, some policies for improvement of water environment and ensuring food security in the basin are also discussed.

1. Introduction

China today is placing a high priority on national policies promoting further economic development through megaprojects like the country's south-to-north water diversion project, the west-to-east electricity transmission project, and the west-to-east natural gas transportation project. In this context, the Yellow River basin boasts a wealth of resources, including the natural gas of the Ordos basin, and the coal in Inner Mongolia, Shanxi Province, and Shaanxi Province, and widely expected to develop as an energy supply base. Meanwhile, it is undeniable that water shortages in the Yellow River basin have the potential to impede economic growth in the future.

A framework to stimulate energy production by using water rights transfers was launched on a trial basis in the Inner Mongolia Autonomous Region. The power generation sector invests in infrastructure for water-efficient irrigation and then obtains from the agricultural sector the surplus water thereby made available. If this water rights transfers system functions properly, it will facilitate development in the Yellow River basin even in the face of water supply constraints.

In that context, this paper outlines developments in the Yellow River basin in the context of water rights transfers and related issues, and then discusses possible ways for Japan to contribute to stable societal conditions in the river basin region. More specifically, this paper describes the role of the Yellow River basin in China's national development strategy and discusses the significance of water rights transfers in the basin. Next it takes a close look at the basin's stages of development in terms of Japanese and other overseas capital flows into China. Finally, this paper describes the correlation between increased energy production in the Yellow River basin facilitated by water rights transfers and China's overall development on one hand, and the expansion of environmental impacts, such as increase of GHG emissions, and regional disparities on the other, discusses risk management approaches to address future droughts, and considers possible ways for Japan to contribute to the Yellow River basin.

2. Water rights transfers and the role of the Yellow River basin in China's national development strategy

(1) Three Chinese megaprojects (south-to-north water diversion, west-to-east electricity transmission, west-to-east natural gas transportation) and their relationship with the Yellow River basin

Figure 1 shows the role of the Yellow River basin in China's national development strategy.

The west-to-east natural gas transportation project involves construction of a pipeline to link gas fields in the Tarim Basin and Qaidam Basin in the west and north with gas fields in the Ordos Basin (in the Yellow River basin), and then branch out from the Ordos Basin toward Beijing and Shanghai. The natural gas reserves in the Ordos basin hold 408.8 billion cubic meters (confirmed crude reserves, 2000), making this area an important supply base of natural gas for major cities.

The west-to-east electricity transmission project involves a northern route, a central route and a southern route, and the Yellow River basin is associated with the northern one. This project involves plans for the transmission of coal-generated electricity to Beijing, Tianjin, and Hebei Province using the abundant coal resources in the western part of Inner Mongolia and in Shanxi Province, and transmission of hydropower-generated electricity to northern China and Shandong Province from the Yellow River and coal-generated power electricity from the Ningxia Autonomous Region and northern Shaanxi Province. Thus, the upper and middle reaches of the Yellow River basin have an important role to play in expanding the supply of electricity for regional development in Beijing, Tianjin, and the lower reaches of the Yellow River basin.

As for the south-to-north water diversion project, the eastern and central routes are already under construction,

and some relief for the water shortages facing Beijing and Tianjin is imminent as a result of water that will be diverted to these cities from the Yangtze River. The figure shows that many major coal-fired power plants are located along the eastern and central routes, making it possible to expand the electricity supplied further east. Meanwhile, the western route is the only one that can supply water directly to the Yellow River basin; it is now at the planning stage, but indications are that actual construction will be extremely difficult due to terrain and other challenges. In conclusion, any development of the Yellow River basin as an energy supply base under current circumstances must be achieved in the context of constraints on the supply of water.

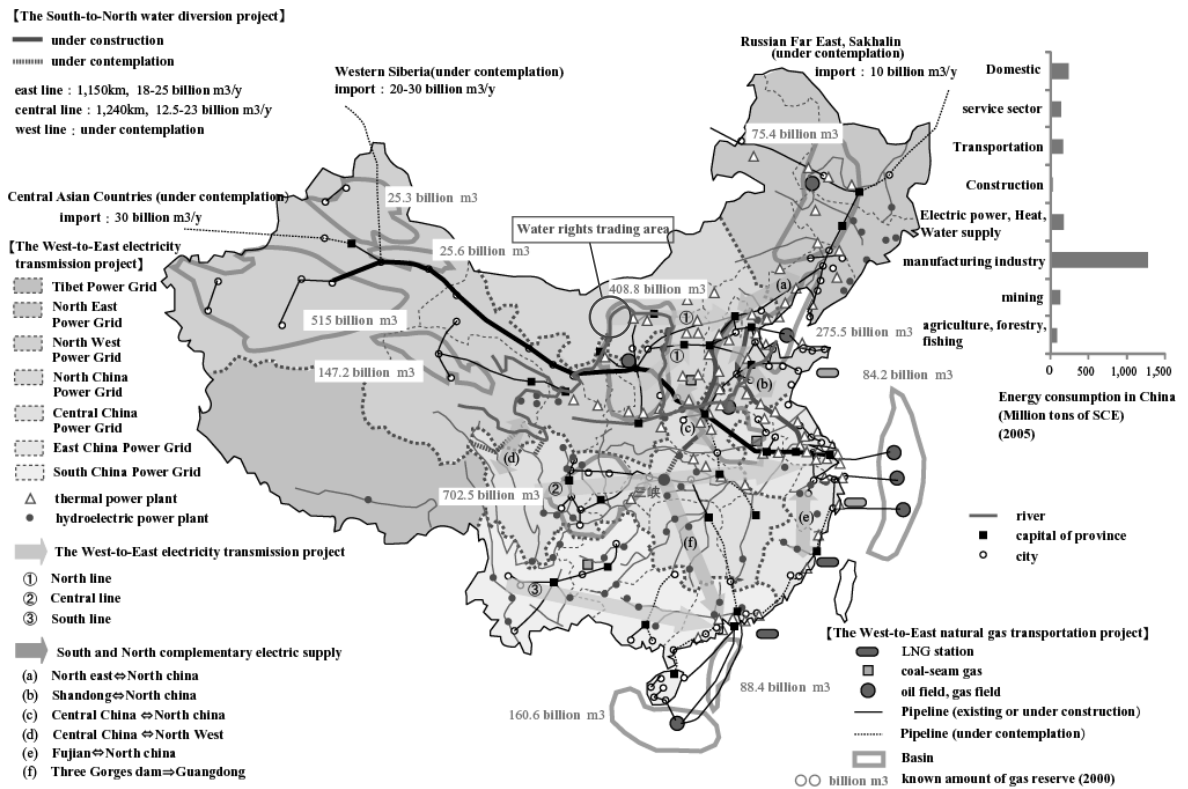


Figure 1. The Yellow River basin and China’s national development strategy.

Source: Prepared by author from “JOGMEC, Oil and Natural Gas Review, Vol.34, No.4, 2008”, “JETRO Beijing Center, Foreign Countries’ Electric Power Survey, 2004”, “TEPCO Report, 2002”, China Electric Power Yearbook, 2000” and “China Statistic Yearbook, 2006”.

(2) The significance of water rights transfers in the Yellow River basin

In response to serious river flow of stoppages on the Yellow River in 1997, the Yellow River Conservancy Commission (YRCC) bolstered its management of the river water resources, and introduced controls on water withdrawals permitted in provinces and autonomous regions in the river basin. Inner Mongolia allocates 5.68 tons of water from the Yellow River for use per year (actual allocations in past drought years were 4.8 billion tons per year), and the actual amount of water currently being used in this autonomous region is already reaching that limit. It will be difficult to obtain new water resources from the Yellow River in the future for the purpose of increasing

energy production. Meanwhile, the agricultural sector accounts for 94% of overall water use in Inner Mongolia, although the irrigation efficiency is low at about 40%.

Under these conditions, Inner Mongolia has obtained permission from the YRCC to implement a water-rights transfers system in which the power generation and industrial sectors invest into water-conserving irrigation infrastructure improvements in the agricultural sector, and the surplus water arising from increased water efficiency in the agricultural sector is made available to the power generation and industrial sectors. This system has revealed the potential for development in the Yellow River basin despite constraints on the water supply.

Figure 2 shows the current status of projects involving water rights transfers in Inner Mongolia. It indicates the need for a total investment of 640 million yuan, or about 5 yuan per ton of water saved, but this investment can probably be adequately recovered thanks to expanded electricity demand in Beijing and Tianjin.

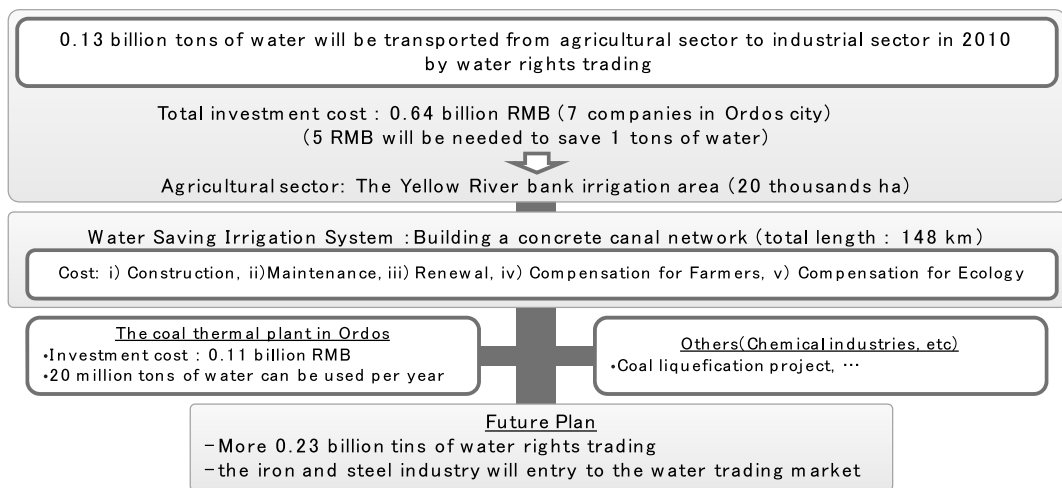


Figure 2. Status of water rights transfer projects in Inner Mongolia.

3. Development and environmental impacts in the Yellow River basin and China overall

(1) Investment in fixed capital investment and overseas capital flows into the Yellow River basin and China overall

Figure 3 shows the status of fixed capital investment and overseas capital flows into the Yellow River basin and China overall. Over 60% of fixed capital investment in China in 2005 was focused in the eastern coastal region. An analysis of the state of implementation of the three megaprojects reinforces the observation that the focus of development in the coming years will continue to be in China's eastern coastal region. Looking at the Yellow River basin, we see that investment into the Bohai Sea area in the lower reaches of the Yellow River is much greater than in other regions, and can predict that mitigation of regional disparities will be difficult in the immediate future.

Hong Kong, Taiwan, Korea and Japan account for over 50% of total overseas direct investment into China in 2004, and most of the companies involved were concentrated in the eastern coastal region of the country. Thus, the scale East Asian economic region is very large—defined here as China's eastern coastal area plus Hong Kong, Taiwan, Korea and Japan. Overseas capital flows further inland in China are essentially focused on the creation of manufacturing centers, but the size of funds flowing here are considerably less than to the eastern coastal region. Thus, development of the central and upper reaches of the Yellow River basin as an energy supply base for the eastern coastal region will have an enormous impact on the further development of the East Asian economic zone,

and also on China's securing of overseas capital in the coming years. Stated differently, overseas companies expanding into China stand to benefit further by the stabilization of the energy supply in the eastern coastal area as a result of China's national development strategy and water rights transfers in the Yellow River basin.

(2) Economic development in the Yellow River basin and increases in China's overall environmental impacts

Figure 4 shows conceptually the cause and effect relationships of economic development and the increase in environmental impacts in the Yellow River basin and China.

The figure shows that the promotion of water rights transfers is also likely to stimulate the industrial activity of companies from overseas, if the Yellow River basin development as an energy supply base under water supply constraints becomes fully operational through linkages with the three megaprojects, thereby further promoting economic development in China's eastern coastal area. Coal-fired electrical power generation continues to account for a major percentage of the energy supply, however, and industrial development is likely to lead to the further spread of automobiles and household electrical products, thereby increasing greenhouse gas emissions and air and water pollution in China, as well as air and water pollution in the East Asian region through the transboundary movement of pollutants.

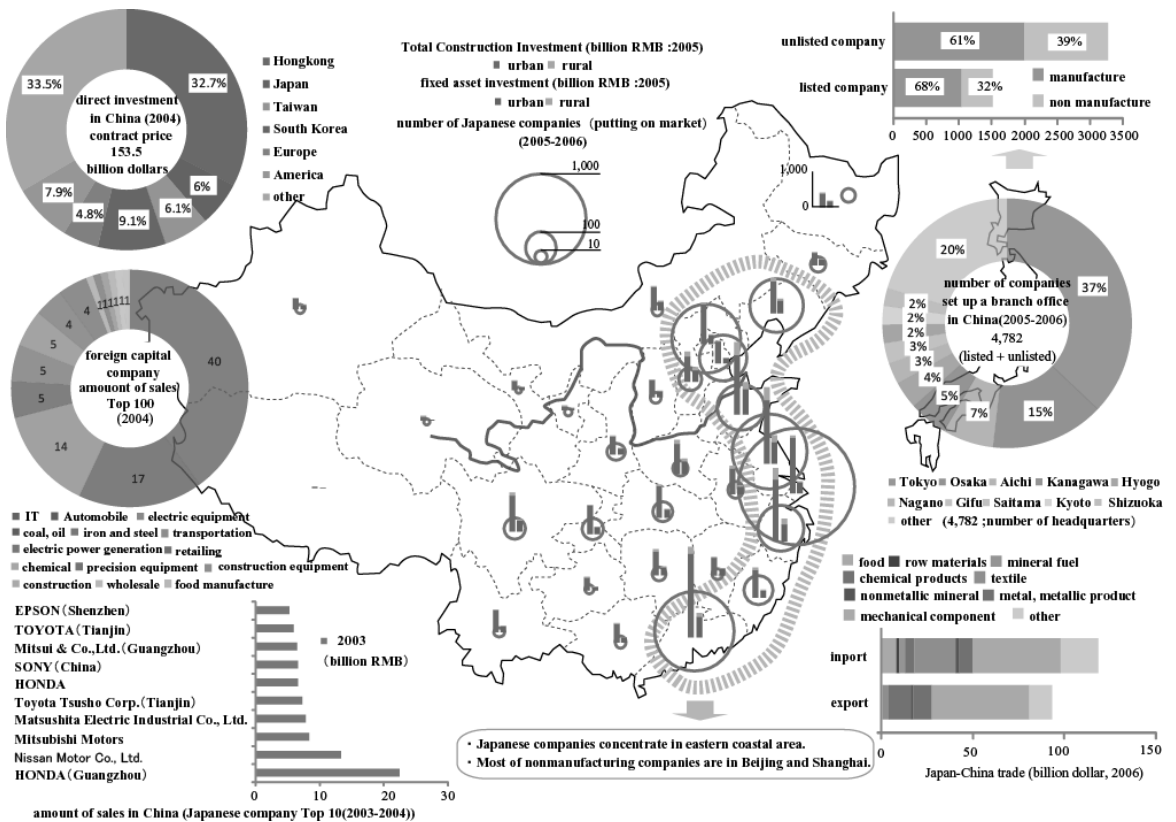


Figure 3. Investment in fixed assets and overseas capital flows into the Yellow River basin and China overall
 Source: Prepared by author from list of foreign companies in China, 21st Century China Study (2005-2006), and China Statistical Yearbook (2006).

China's greenhouse gas emissions are already among the highest in the world, and the transboundary movement of air pollution from China to the East Asian region is already significant. Meanwhile, major Japanese automakers and household electrical products makers are moving aggressively into China, creating production centers and aiming to promote their products particularly in the eastern coastal region. It is also worth noting that China accounts for the largest share of Japanese trade figures, so Japan clearly plays a significant role in environmental pollution and regional disparities arising from China's economic development.

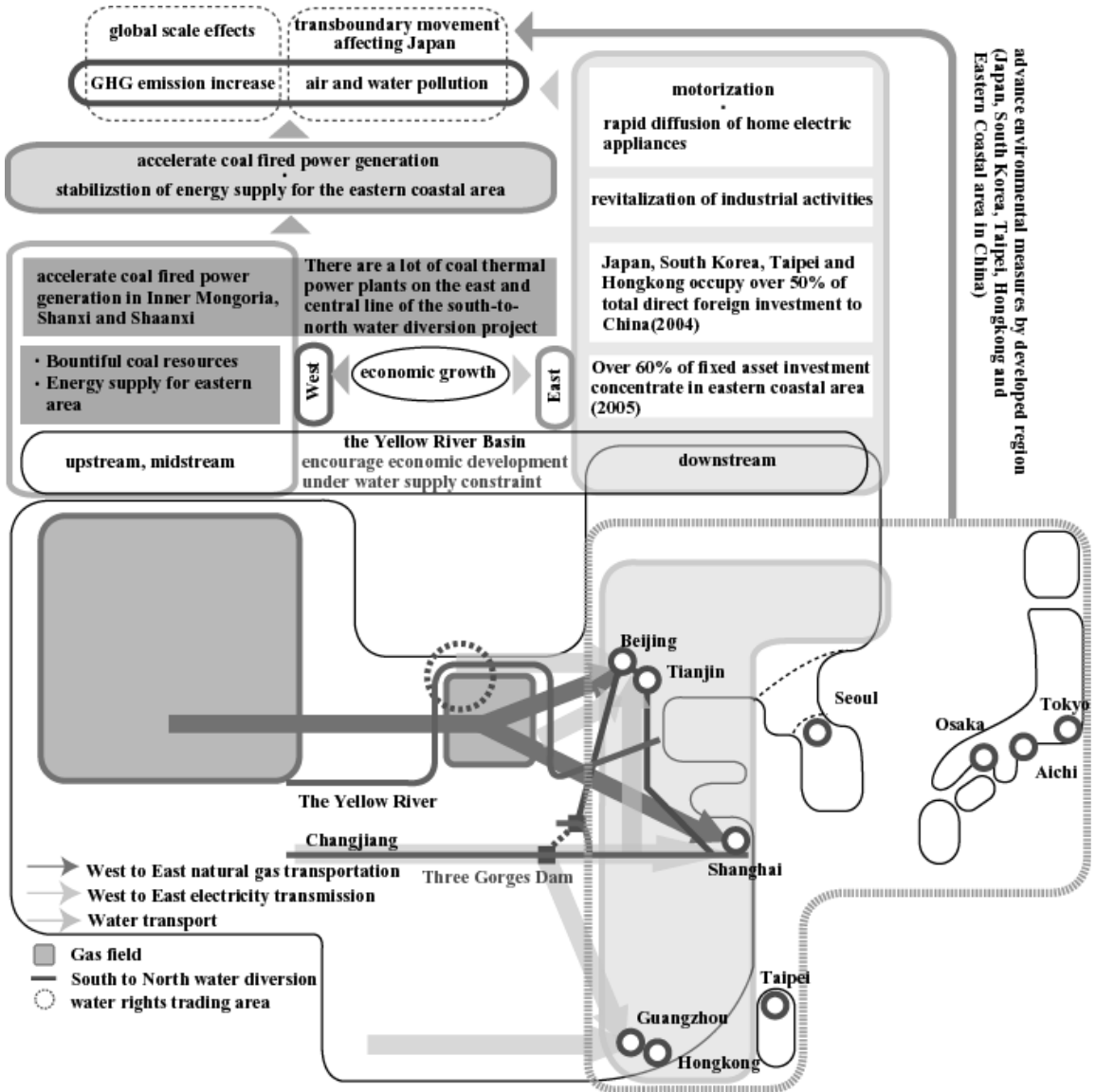


Figure 4. Cause and effect relationships between economic development and increased environmental impacts due to three megaprojects.

Another point is that, as stated above, the energy supply to the eastern coastal region will be stabilized as a result water rights transfers in the Yellow River basin, but some attention must be given to address risks during periods of drought. A number of issues will arise if a serious drought occurs in the Yellow River basin. For example, will industrial activity be given the priority at the expense of agricultural production, and if agricultural production is restricted, how will China's food security be ensured?

The discussion above shows that Japan is intimately connected with China's economic development and an increase in environmental impacts, that a need exists to develop comprehensive approaches that will help to reduce environmental impacts and regional disparities, and that some consideration must be given to address risk in the event of periods of drought in the Yellow River basin. The next section outlines some thoughts on possible approaches by Japan that could help address these issues.

4. Japanese Approaches to Develop a Low-Carbon and Saving Water Society in the YRB, China

Below, we consider some approaches Japan might take to help address key issues raised above, including responses to the risk of drought in the Yellow River basin (i.e., stabilization of industrial activity, assurance of food security) and related to this, compensation for farmers (income assurance, poverty prevention, etc.), as well as strategies to reduce air pollution, water pollution, and greenhouse gas emissions.

These proposals will contribute to not only economic growth and minimize regional income gap in China, but also Japanese economic growth.

(1) Development of Low-Carbon and Saving-Water Policy System in China

—Promoting Renewable Energy System—

Figure 5 shows a policy package for promoting Japanese low-carbon technology in China. It is considered that implementation of the policy package is theoretically possible.

Current ODA scheme has many problems. For example, ODA covered initial cost only, for constructing some infrastructures, so it was difficult to develop a maintenance management system for keeping those infrastructures in developing countries. Hence, the central government in Japan tries to improve current ODA scheme for developing more effective system. By introduction of the microcredit mechanism¹⁾²⁾, that was developed by Grameen bank, to current ODA scheme in Japan, it is expected the following

(for developing countries)

- Contribute to solve poverty problems
Give new business opportunities/ Enhance of willingness to work/ Rising income levels/ development of human resources/...
- Contribute to improve environmental problems
CO₂ emission reduction by installation of Japanese low-carbon technologies/ improve of air pollution/...
- Contribute to low-carbon regional development

(for Japan)

- Contribute to cost reduction of Japanese low-carbon products, such as solar battery.
This policy package will be one of the driving forces to generate following cycle base on increasing returns to scale. a) promoting of installation of Japanese low-carbon products in developing countries→b) contribute to technology development in Japan, such as cost reduction, products' performance upgrade, and so on→c) promoting low-carbon products in Japan→d) economic growth in Japan→a)...→development of low-carbon society.

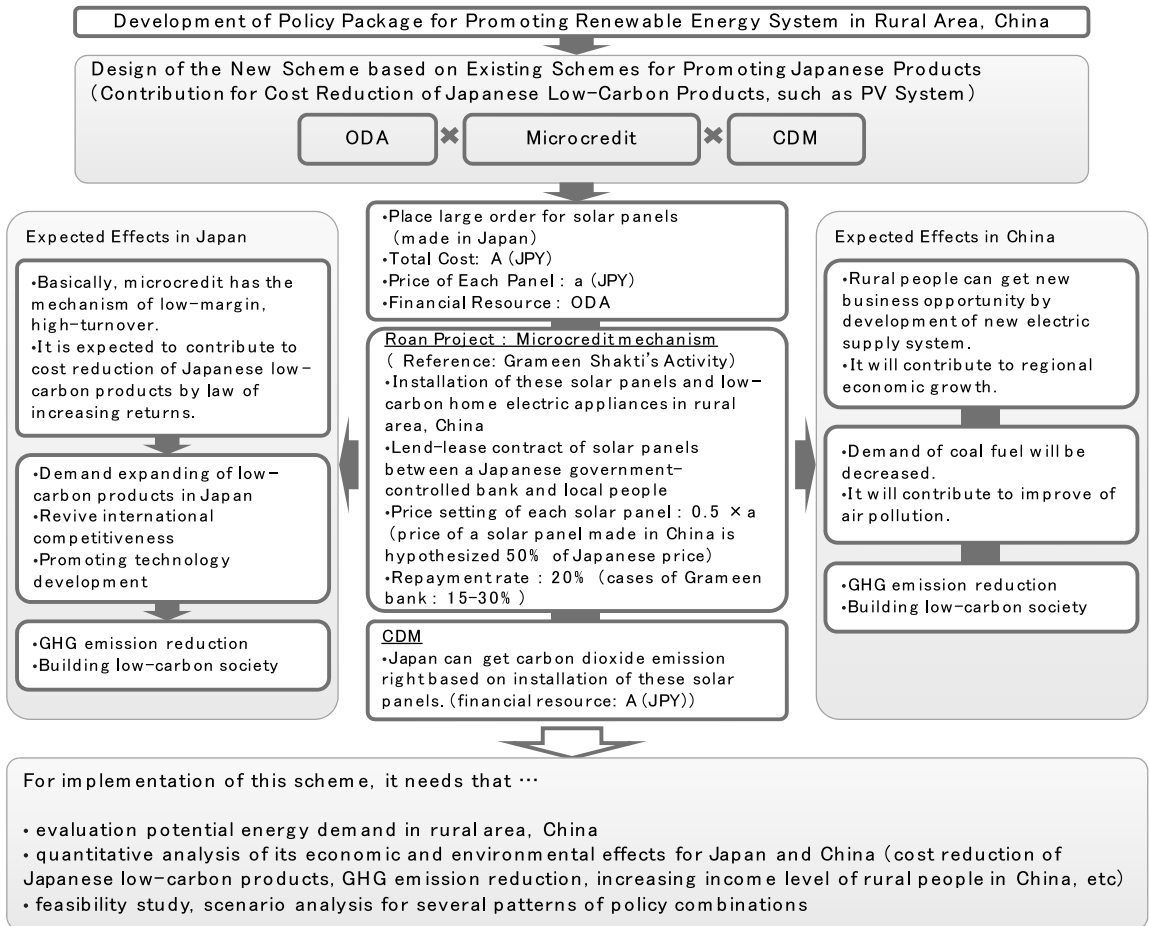


Figure 5. A Policy Package for Promoting Japanese Low-Carbon Technology in China.

For implementation of such a policy package, we need to do some quantitative analyses for evaluating of its economic and environmental effect for Japan and developing countries. Then, if the effectiveness of this policy package will be established, we need to require an understanding of this scheme to developing countries.

F. Shi, et al. (2007)³⁾, and F. Shi, et al. (2009)⁴⁾, evaluated effects of water rights trading in the YRB for economic growth and CO₂ emissions in China, with some quantitative analyses. In these papers, it is clarified that promoting water rights trading will contribute to economic growth in China, especially eastern coastal area and increase CO₂ emissions. Renewable energy, does not contribute to increase CO₂ emissions, will make important roles to improve current situation. Figure 6 shows an example of regional development system which contributes to implementation of CO₂ emissions' reduction, saving water and regional economic growth in the YRB. Based on the current political background between Japan and China, it is also considered that implementation of this system is theoretically possible.

(2) Addressing risk of drought: Part 1 (linkages with food security)

In interviews conducted for this study, Inner Mongolia's Ministry of Water Resources answered that as a

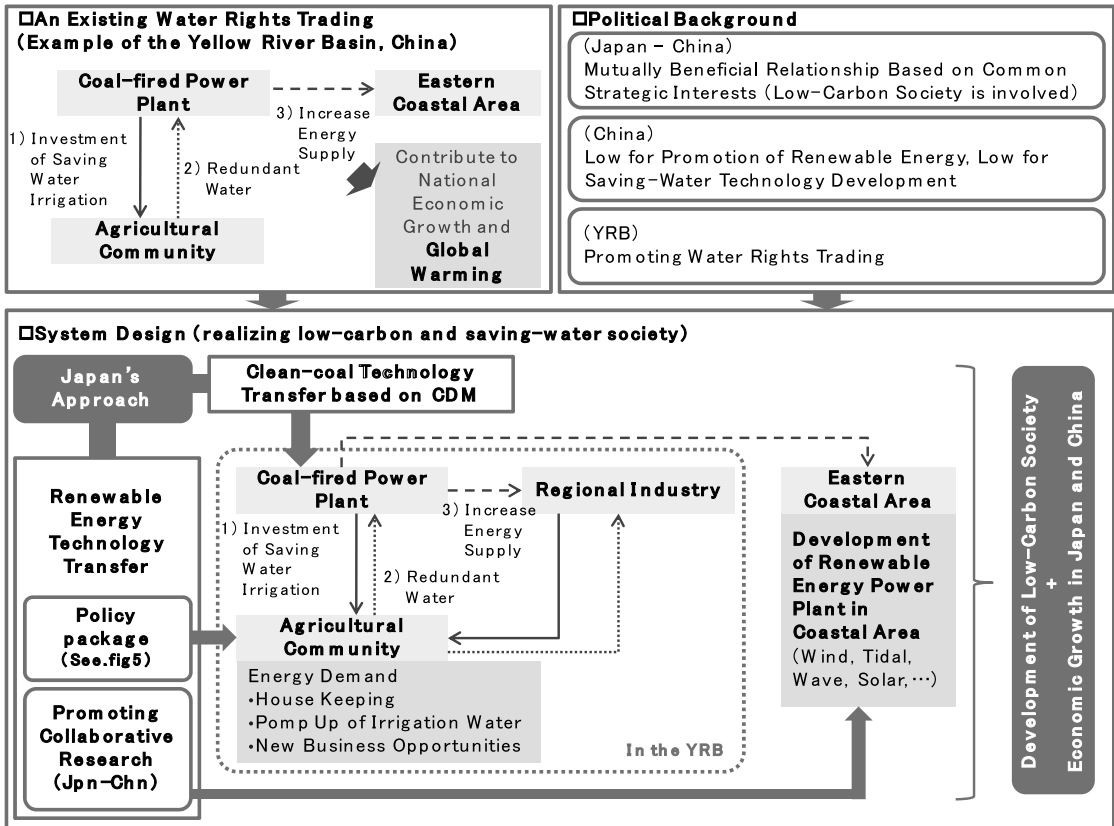


Figure 6. International Cooperation between Japan and China for Realizing Economic Growth and Low-Carbon and Saving-Water Society in the YRB.

response to the risk of drought, it would reduce agricultural water allocations (in other words, reduce food production), and give priority to energy production. In such a scenario, this would involve some kind of compensation for farmers. For discussion purposes, research by Higashi et al⁵⁾ and Baba et al⁶⁾ predicts that a drought on a scale likely to occur once every fifty years would mean a 10% to 20% reduction in food production. Figure 7 shows the possible flow of responses relating to assurance of food security in such cases.

In this context, a possible strategy for Japan might be to boost its own food self-sufficiency ratio in order to help stabilize international food prices. This approach would also contribute to the stability of food policies in China in a time of drought in the Yellow River basin.

(3) Addressing risk of drought: Part 2 (linkages with water pollution countermeasures)

The water rights transfer system currently being tested in the Yellow River basin is only being conducted between the industrial and agricultural sectors. If water rights transfers were to be implemented between two industrial sectors, or between an industrial sector and the domestic (household) sector, for example, by investing in wastewater treatment facilities, in effect it would amount to water rights transfers by one sector obtaining treated water. This approach could facilitate not only water conservation but also water pollution countermeasures. Figure 8 shows an example of water rights transfers between the industrial and domestic sectors.

The Japanese government already has a track record in the construction of water treatment facilities through official development assistance (ODA) to China, and French and other corporations have brought foreign capital into water treatment projects in places like Lanzhou City (Gansu Province).⁸⁾ Thus, the creation of schemes through private finance initiatives (PFI) as shown in the figure are also worth considering. Incidentally, the cost per ton of treated water has been estimated at about 5 yuan per ton, according to existing literature—based on initial investment, as well as maintenance and operating costs for wastewater treatments facilities in various provinces of China in 2004.⁹⁾ By way of comparison, municipal water in Beijing in 2004 was priced at 3.7 yuan per ton, and industrial water was 5.6 yuan per ton, and these prices are expected to continue rising.¹⁰⁾ Based on the above, if it were possible to provide recycled water at prices below the regular price of industrial water, water rights transfers could occur between industrial and urban sectors. Thus, by providing not only technology but also effective water resource management systems, Japan could contribute to water conservation and the prevention of water pollution in the Yellow River basin.

5. Conclusion

This study proposed some strategies for Japan to contribute to China’s efforts to address key issues. The discussion first addressed topics relating to the economic development of China overall, including an analysis of capital from overseas and the orientation of development in the Yellow River basin by promoting water rights transfers, as well as the cause-effect relationship between economic development and increased environmental impacts and regional disparities. We learned that the development of the Yellow River basin through water rights transfers has, in effect, major benefits for developed countries whose corporations are active in China. At the same time, development in the Yellow River basin also raises concerns about the transboundary movement of water pollution and air pollution, and about increases in greenhouse gas emissions.

In this study, we try to design some new policy packages contribute to economic growth and environmental

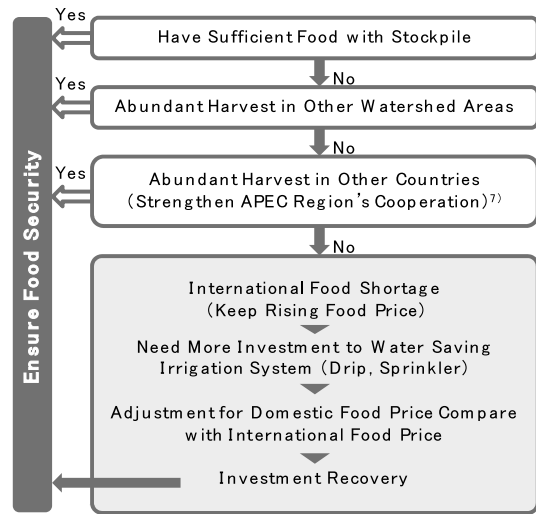


Figure 7. Drought risk responses to address food security.

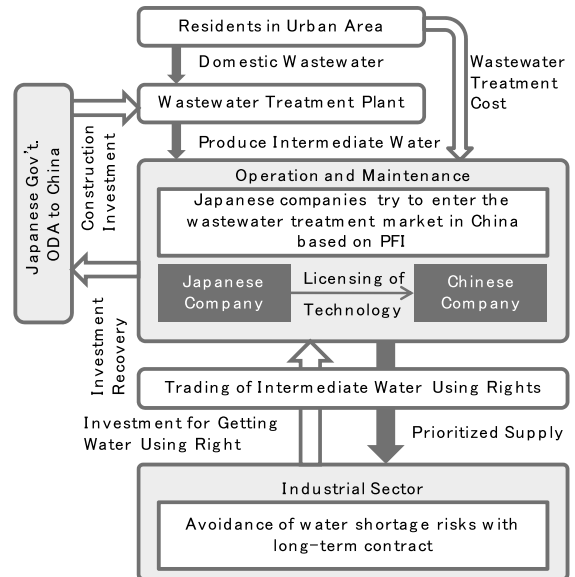


Figure 8. Example of water rights transfers between industrial and urban domestic sectors.

protection in Japan and China. It is considered that implementations of all schemes are theoretically possible. We need to evaluate economic and environmental effects by these policies with quantitative analyses and scenario analyses. Then, we should clarify the suitable policy scenario for the YRB. Moreover, it is important to develop human resources have not only deep understanding of low-carbon technology and political and economic system, but also high international negotiation skills, for implementation of such policy packages.

In Japan, a lot of advanced low-carbon technologies have already developed. However, policies for promoting them are inadequate. To overcome the current situation, it is urgent need to develop some new policy packages to support expanding international and domestic demand of these technologies and realizing low-carbon society.

Acknowledgement

This study is supported by MEXT Special Coordination Funds for Promotion of Science and Technology, FY 2008, “Hiroshima University’s Global Environmental Leaders Education Program for Designing a Low-Carbon Society”.

References

1. Grameen bank (website: <http://www.grameen-info.org/>)
2. Grameen Shakti (website: <http://www.gshakti.org/>)
3. Feng SHI, Hidefumi IMURA, Osamu HIGASHI, Cao XIN, Akio OHNISHI: Water Rights Trading and Regional Development in China, *Environmental System Research*, vol.35, pp.199-206, 2007. (in Japanese)
4. Feng SHI, Akio OHNISHI, Osamu HIGASHI, Hiroaki SHIRAKAWA, Hidefumi IMURA : The Reallocation of Water Right Policy and Carbon Dioxide Emissions in North China, *Journal of Environmental Information Science*, Vol. 37, No. 5, pp. 91-96, 2009.
5. Osamu Higashi, Tetsuya Kusuda, Xiaochang Wang, Dawen Yang, Shimpei Ozaki, Keisuke Baba, Katsushi Shibata: Development of an water quantity and water quality integrated model and future projections of available water in the Wei River basin, *Environmental Engineering Research Papers*, vol. 42, pp. 111-118, 2005 (in Japanese).
6. Keisuke Baba, Tetsuya Kusuda, Xiaochang Wang, Dawen Yang, Osamu Higashi, Shimpei Ozaki, Katsushi Shibata: Crop production assessment and consideration of food security in the Wei River basin using EPIC, *Environmental Engineering Research Papers*, vol. 41, pp. 659-664, 2004 (in Japanese).
7. Niigata Declaration on APEC food Security, First APEC Ministerial Meeting on Food Security, Niigata, Japan, 2010
(http://www.apec.org/apec/ministerial_statements/sectoral_ministerial/food_security/2010_fs.html)
8. 21st Century Economy News (31 July 2007) (in Chinese).
9. China Environmental Yearbook (2000-2005) (in Chinese).
10. Xinhua Communication (31 July 2005) (in Chinese).