ENVIRONMENTAL SCIENCE & POLICY 12 (2009) 970–980

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/envsci

The social and environmental costs associated with water management practices in state environmental protection projects in Xinjiang, China

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ARTICLE INFO

Published on line 25 April 2009

Keywords:
China
Environmental protection
Irrigation agriculture
Water management
Xinjiang

ABSTRACT

Since the late 1970s the central government of China has initiated several ecological environmental protection projects. The most significant of these has been the *tui geng huan lin* (returning cultivated land to forest and pasture) project in operation since the late 1990s. China's northwest region is characterized by lack of water resources, yet such resources are of vital importance. There is scant discussion in the literature (including in China) on the linkages between the environmental protection projects and water management practices. This paper analyses how central government environmental protection projects are interpreted in the local setting, and how local water management policies and practices correspond to the projects. The conclusion is that local water management policies and practices are interlinked with both central government and local government policies on the environmental protection projects, and a new process for the redistribution of water has been established. When equity and social costs are not factored into the planning of new environmental protection projects, the social costs may be as high as the environmental costs.

1. Introduction

Since the late 1970s, the central government of China has initiated several ecological environmental protection projects (MacBean, 2007; Zhang and Wen, 2008). The state Three North (*sanbei*) ecological forest protection project began in 1978 and is scheduled to be completed in eight phases by 2050, covering a total of 13 provinces and autonomous regions (590 counties) in northern China.[1] The main tasks of the project are to increase tree coverage, protect farmland from wind and sand invasion, and preserve soils.

From the late 1990s, the central government of China has forcefully pursued a project called *tui geng huan lin*, which translates as returning cultivated land to forest and pasture (Notice of the State Council on Perfecting the Policy of Returning Cultivated Land to Forest and Pasture, 2007; The Regulations on Returning Cultivated Land to Forest and Pasture, 2002). The *tui geng huan lin* project is one package of the state Three North (*sanbei*) ecological forest protection project. The reasons for initiating this project are complex. According to Xu and Cao (2002), the trigger was the disaster of water running dry in the lower reaches of the Yellow River

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[1] The Three North (*sanbei*) Ecological Forest Construction Bureau of the State Forest Bureau is responsible for the work (for more details see the Three North (*sanbei*) Ecological Forest Construction Bureau of the State Forest Bureau's website: http://www.3northforest.com/gcjj.htm).

1462-9011/$ – see front matter
doi:10.1016/j.envsci.2009.03.006

Basin in 1997, and the flooding of the Yangtze River in 1998. Huge damage was recognized and blamed by the central government to be the land and water erosion and ecological destruction in the upper reaches of the two river basins. However, Tao et al. (2004) argue that the main reason for initiating the project was the grain surplus in China in the late 1990s, i.e. the need to reduce stored grain and the huge financial deficits of the government grain sectors, as well as the regime reforms relating to grain purchase and sale.

A number of recent studies have focused on the environmental protection projects in China (Jiang, 2004, 2006; Wang and Pei, 2004; Yu et al., 2006). According to Wang and Pei (2004) the *tui geng huan lin* project has evidently improved ecological conditions in some areas, but it has also been hampered by the inappropriate selection of areas to be reforested, partly due to local government officers being driven to report progress.

Since the late 1990s, in Xinjiang Uyghur Autonomous Region (XUAR), as a consequence of central government's Great Western Development Strategy, the focal point has become the protection of the ecological environment of the lower reaches of the Tarim River Basin (Hou et al., 2005, 2006; Jiang et al., 2005; Xu et al., 2008; Yang et al., 2006; Zhu and Lei, 2003).[2] Zhu and Lei (2003) claim that the *tui geng huan lin* project will definitely improve the ecological systems of oases in Xinjiang, although to date the benefits have not been readily apparent. Further, Xu et al. (2008) claim that the ecological degradation in lower reaches of the Tarim Basin has clearly been reversed, and positive effects on local agricultural development have been observed.

There are many rhyming couplets in China about tree planting, such as 'plant trees, construct nothing' and 'year after year planted trees die, year after year planting trees at the same place'.[3] The failure of tree planting is normally imputed as due to bad tree management and weak public participation. For example, Yu et al. (2006) argue that 'due to insufficient public participation, long-term management may become a serious challenge'. Xinjiang is an arid region, and is characterized by lack of water resources. Although water resources are of vital importance, and the fact that plants cannot grow without irrigation, there has been scant discussion on the linkage between the environmental protection projects and water management practices.

The primary goal of this study is to understand water and land management practices in one river basin in Xinjiang, from river basin level to individual farmer household level. The central government advocated the environmental protection projects, which have been carried out on a large and spectacular scale in the study area. Water and land management practices are closely related to the projects. Accordingly, this paper analyses how the central government's environmental protection projects are interpreted in the local setting, and how water management practices are linked to the environmental protection projects. The cases in the study area show that equity and social costs are not factored into the planning of new environmental protection projects, while the economic cost of green highways, such as the desert highway, is high,[4] and in terms of the lives of farmers needing water to survive, the cost is even higher.

In the following sections, firstly, I introduce the study area and study method. Secondly, I briefly describe how water is managed in the study area. Thirdly, I introduce how the central government policies are interpreted in the local government documents. Fourthly, I describe how water management policies and practices are linked to the environment protection projects. In the final section, I present my conclusions.

2. The study area and study method

Xinjiang is located in the northwest of China. The Tianshan mountain ranges extend from east to west in the centre of Xinjiang and divide the region into two: the Junggar Basin in the north, and the Tarim Basin to the south (Fig. 1). The Tarim Basin, covering an area of 0.5 million km^2, is the largest inland basin in the world. Within the Tarim Basin, the Taklamagan Desert constitutes the second largest desert in the world. The climate of the Tarim Basin is extremely dry: the annual precipitation in the lowland is only 50–70 mm, whereas the potential evaporation of free water in the same area is in the range of 2000–3000 mm/year (Li, 1991). Approximately 100 years ago, the famous Swedish geographer, Hedin (1904, 1905) travelled along the Tarim River, which flows over a distance of more than 1000 km from west to east in the Tarim Basin. He measured the main courses of the Tarim River, and the life and death of the branches of the Tarim River. Every year, when the flood season came, mud and sand were swept, poplars and bushes either grew or declined according to the changing water courses. In the parts of the desert reached by river water, life existed. However, after the river changed its course, vegetation dried and died, and people had to move to other places.

My study area is located within the area administered by Bayinguoleng Mongolian Autonomous Prefecture (Bazhou). The Kaidu-Kongque River constitutes the main surface water resource in Bazhou. The Kaidu River originates in the Tianshan Mountains, where annual precipitation is *c.* 400 mm. From there it flows a distance of 560 km, before entering Bosteng Lake. The Kongque River starts from Bosteng Lake, and forms the lower reaches of the Kaidu River. In 2000, approximately 172,000 ha of land were irrigated by diverting water from the Kaidu-Kongque River (interview data).

[2] Since the late 1990s, it has become popular to improve the ecological environment of the lower reaches of the Tarim River. The central government invested *c.* 10.7 billion yuan (1 USD = 8.3 yuan in 2001) between 2001 and 2005 to improve the management of the Tarim River. One of the main efforts was to divert water from Bosteng Lake to the Daxihaizi Reservoir (Xinhua News, 2001).

[3] Respectively, '*zhishu zao ling*' (in Chinese, wood and zero (nothing) are almost homophonic) and '*niannian zhishu niannian huang, niannian zhishu laodifang*'.

[4] Investment in green desert highway construction was 0.22 billion yuan (Xinhua News, 2005). The important role of this green highway is stated thus: to protect the highway, improve the eco-environment, and promote economic development in southern Xinjiang. No questions have been raised concerning how many years the green coverage could last.

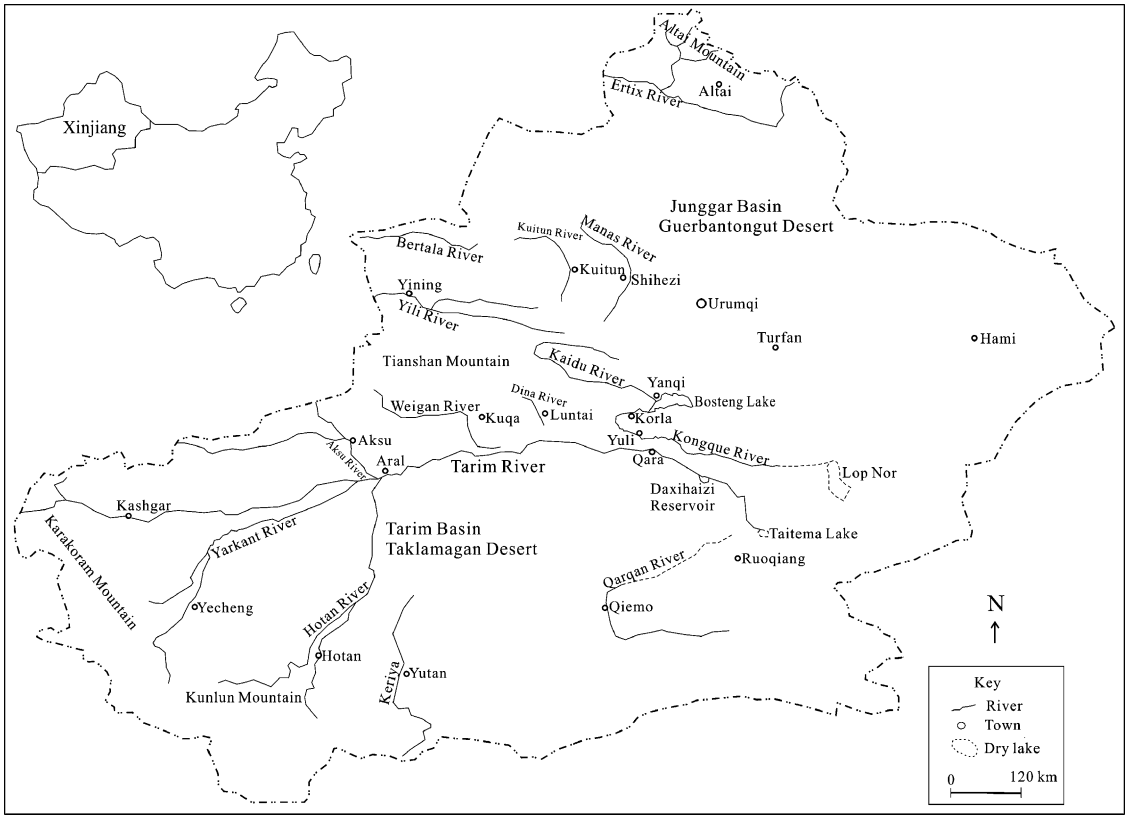

Fig. 1 – Map of Xinjiang (modified from Yang, 1987).

Xinjiang is ethnically diverse, with the Muslim, Turkic-speaking Uyghur making up almost half of the population. In addition, there are Kazak, Hui, Kirgiz, Mongolian, Xibe, and other minority ethnic groups. Since 1949 there has been substantial in-migration to Xinjiang from other parts of China: Xinjiang's population increased very rapidly from 4.3 million in 1949 to 20.5 million in 2006 (Table 1). The migration of Han Chinese to Xinjiang since 1949 has drastically altered the traditional population balance of the region. In 1949, the Han Chinese accounted for *c.* 7%, and the Uyghur ethnic group accounted for *c.* 76%. In 2006, Han Chinese accounted for *c.* 40% and the Uyghur ethnic group accounted for *c.* 46%.

There are two administrative systems in Xinjiang, one is the local government system, the other is the Bingtuan system, which currently has 14 divisions (numbered from 1 to 14), in addition to several departments. The Bingtuan system has provincial government authority, and its economy and social development are carried out both separately and exclusively under the state plan (Cliff, 2005; Seymour, 2000). Agriculture Division No. 2 in the Bingtuan system has developed large-scale irrigation agriculture in the Kaidu-Kongque River Basin.

After 1949, the target of irrigation-agriculture development in Xinjiang is to convert desert into farmland (Fig. 2). Opening up wasteland is strongly encouraged by both central and local governments, and increasing the amount of cultivated land is a key goal of agricultural development at all levels of the government. Large areas of wasteland (*huangdi*, meaning unused land, including wetland, forest, grassland, and desert) have been opened up and become cultivated land. Statistics on the areas that have been 'opened up' have become one of the most important measure of agricultural development at all levels of government. Less attention has been given to the consequences of the loss of grassland and forests. In general, crop farming is stressed and animal husbandry is perceived as being inferior to some extent. In 1949 the cultivated area was *c.* 1.2 million ha. By 2006 the cultivated area had increased to 3.6 million ha (XUAR Statistics Bureau, 2007). However, many areas of opened land had to be abandoned due to problems relating to lack of water and soil salinization (Shen and Lein, 2005). Today, the local government still actively encourages farmers to save money to open up the 'five wastelands': wasteland (desert), waste beaches, waste sloping land, waste wetland, and waste hillside land. The policy is that 'whoever invests in opening up wasteland receives the benefit from it', and anyone can open up as much wasteland as they can afford (Shen, 2007).

Castree (2001: 3) argues that 'nature is defined, delimited, and even physically reconstituted by different societies, often

Table 1 – Comparison of the population in Xinjiang in 1949 and 2006 (unit: million).

Year	Total population	Uyghur	Han	Other ethnic groups
1949	4.33	3.29	0.29	0.75
2006	20.50	9.41	8.12	2.97

Source: XUAR CCP Committee and XUAR People's Government (2000), XUAR Statistics Bureau (2007).

Fig. 2 – Members of the Bingtuan clearing land in the Tarim Basin (CIA, 1971).
The original text accompanying the photo is as follows: 'Members of the Sinkiang Production and Construction Corps clear land in the Tarim Basin preparatory to planting. The dead trees and undergrowth being removed are the remains of a dense poplar-willow-tamarisk jungle that once flourished along the banks of a now dry stream channel. Live trees and bushes in the background indicate an active watercourse'.

in order to serve specific, and usually dominant, social interests'. Castree suggests that the question of what types of artificial nature exist today, and for whose benefit and with what social and ecological consequences, should be asked when discussing environmental problems. These are addressed below in relation to Xinjiang.

During the last half century in Xinjiang, by terming natural forest land, grassland, wetland, and desert as 'wasteland', the utilization of the natural resources by indigenous people (farmers and herdsmen) has been rendered non-existent. The expansion of cultivated land and redistribution of natural resources (including water and land resources) has become a question of rationality and politically positive; in other words, the entire of society can obtain benefits by exploiting unused land. Thereby, the problems of water resource shortages in the dry region have effectively become redundant. Hunt and Hunt (1976) have shown that water shortage is not an absolute concept. Where there is irrigation agriculture, there is social stratification, and the decision-making power over the tasks of the irrigation system is linked to the stratification. Today, with central government advocating the return of cultivated land to forest, the relationship between the abstract slogan 'to make desert green' and the concrete policies and practices of local government is much more complex than might be expected.

This paper is based on a review of various government documents and information collected through interviews with water managers at various levels in the government water management organizations, and also interviews with local leaders and farmers in villages in 2000, 2001, 2002, and 2004. In order to gain information on the formal government regulations, government documents relating to irrigation agricultural development and environmental protection as well as land and water management were collected and studied. The main sources of these documents were officials in Bazhou Water Management Bureau, Bazhou Land Management Bureau, Bazhou Agriculture Bureau, Bazhou Forest Bureau, Bazhou Price Management Bureau, and three counties water management bureaus, land management bureaus, forest bureaus, and archive bureaus. As many important issues in water management practices, such as water distribution processes and water loss calculations, are not stated in the government documents, the main strategy of acquiring information on these issues was to interview people holding positions in the system, mainly including leaders and water managers at four river basin level water management stations and five county level water management stations. In total, three counties, four *xiang* (town), and c. 20 villages (production teams) were visited. In the villages, both the village head (in many cases, the production team head) and the party secretary were interviewed. The interviews with farmers usually took place following encounters with people in the field. Often the discussions were on a group basis, whereby some people joined and some left during the process.

3. Water management in Bazhou

Water management in China is a top-down government management regime. In Bazhou, there are two levels of formal government water management organizations in the local government system: one at prefecture level, the other at county level (Fig. 3). At the prefecture level, Bazhou Water Conservancy Bureau (BWCB) (*Bazhou shuiliju*) is an administrative unit and enforces government political power over water management at river basin level. The routine duty of water management is undertaken by Bazhou Water Management Department (BWMD) (*Bazhou shuili guanlichu*). BWMD is a subordinate unit of BWCB and formally a so-called institute unit, but operates as an enterprise, and is totally funded by

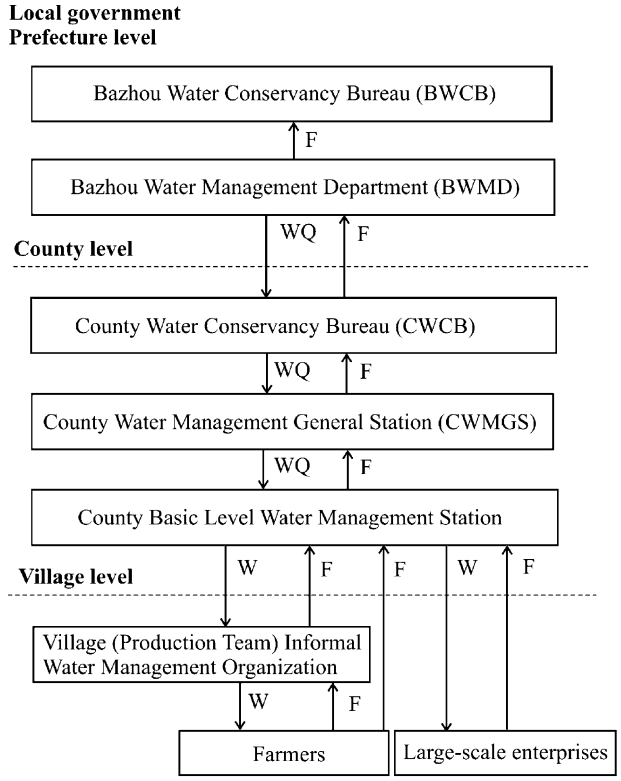

Fig. 3 – Water management organizations in Bazhou.

income from water fees.[5] The main tasks of BWMD are water distribution at river basin level, guidance and control of water infrastructure development, and various other economic activities (*zonghe jingying*), including agricultural farming, livestock farming and aquaculture. The department also runs a hotel. BWMD is responsible for preparing the plans for the water quota to be supplied to the primary canals.

A fundamental policy of water management in Bazhou is a 16 Chinese characters policy: 'quota of supply water to each county [each main canal has a quota]; each county decides on water distribution and schedule itself; water price will be doubled if more than the quota is used; thrifty use of water to expand irrigated areas' (BWMD, 1997). Today, each county has a water supply quota allotted to it by BWMD, mainly based on the irrigated area reported by each county. However, the water supply quota is not fixed, and BWMD has the right to adjust the water supply quota according to water and land situation changes in Bazhou. Water users below the county level do not have such quota. This means that villages and individual farmers have rights to water, but do not have rights regarding issues such as when, how much, and with what frequency water will be supplied.

At the county level, the county water conservancy bureau (CWCB) is the administrative unit responsible for enforcing the regulations governing water administration. The county water management general station (CWMGS) is a subordinate unit of the CWCB, and is responsible for routine water distribution at county level. Like BWMD, the CWMGS is an institute unit but is totally funded by water fees. All inlets of primary canals are managed by BWMD, but water distribution and maintenance of the primary canals are the duty of the CWCB. There are several basic level water management stations responsible for water distribution in each county. However, no common regulations exist on how water should be distributed, and each basic level water management station has its own water distribution practices. The basic level water management stations – which are at the lowest level of the government water management structure – distribute water to villages via the primary or secondary canals.

BWMD advocates that water management at the basic level water management stations should be carried out according to the slogan 'four to a household' (*sidaohu*, meaning that each household should be regarded as a unit in terms of water distribution and measurement, settling accounts and collecting water fees).[6] The practical meaning of the policy is that BWMD sells water wholesale to each CWCB, and each CWCB is expected to retail water to individual households. Water fee collection has become the focal point of water management in government water management units. Under the existing system, farmers' actual water fees are calculated on the basis of water volume multiplied by the water price fixed by the government water management units. In 2001, the water price was set by BWCB at 3.1 fen/m^3 (in 2001, 1 USD = 8.3 yuan, 1 yuan = 100 fen) for water diverted from the Kaidu River and 4.97 fen/m^3 for water diverted from the Kongque River.

Qigexing Water Management Station (QWMS) in Yanqi County is used here as an example of how water is managed by the basic level water management station. Qigexing Water Management Station (QWMS) is responsible for water man-

[5] A unit with the character of both an institute and an enterprise is known as an institute unit managed as an enterprise (*shiye danwei, qiye guanli*). At present, there are three kinds of unit (*danwei*) in China. An administrative unit (*xingzheng danwei*) is a governmental political unit, where the employees are civil servants. The unit is funded by the state and the number of employees is strictly limited. An institute unit (*shiye danwei*) deals with public issues but has no governmental political power. It is partly funded by the government, and partly by income from customers of the services provided. The limit on the number of employees is flexible. An enterprise unit (*qiye danwei*) runs on a commercial basis, derives its income from business, and there is no limit on the number of people it can employ. The document of XUAR People's Government (1983) states that the water conservancy management units belong to productive service units of institutional character, are managed according to the demand from enterprises, control their financial affairs themselves, and are responsible for their own profits and losses (Clause 3).

[6] It is not practical to measure the volume of water supplied to individual farmer's land. One plot of land may be managed by several households and planted with different crops, each with differing water requirements. The basic level water management stations measured water volume at inlets in production teams' canals, and calculated water fees to production teams as basic units. The production teams then apportioned the water fees to individual households. Farmers usually paid water fees to production teams, and the production teams then handed the water fees to the basic level water management stations. In some cases, farmers paid water fees directly to the basic level water management stations.

agement, especially water distribution in Qigexing town, which is located on the alluvial plain of Yanqi County. The western part of Qigexing town is desert and has very little vegetation; by contrast, the eastern part is a developed irrigation agricultural region. In 2001, Qigexing town had seven villages, with a combined population of *c.* 13,000, and with Han Chinese, Uyghur, Hui, and Mongolian peoples accounting for 51%, 34%, 9%, and 6% of the total population respectively (interview data). In the first round of land contracts in 1984, the total area of contract land was 43,000 mu ('mu' is unit of land area; 1 ha = 15 mu) in Qigexing town. Since then, large areas of wasteland have been opened up. In the second round of land contracts in 1998, the total contract land area was still 43,000 mu, as newly opened-up wasteland had not been registered in the contract land books. Land is managed by the land management bureau, but the bureau has no responsibility for measuring land again after the contract land books have been issued. In principle, the owners of the new land have to pay water fees, but the production teams' data relating to the new land are not clear in this respect. When water fees are apportioned to contract land, someone will inevitably gain at another's expense, and this makes water fee collection difficult. In 2001, QWMS measured the total land area as *c.* 66,000 mu (interview data). The Dabalong Canal is the only water supply canal in Qigexing town, and it has 13 branch canals diverting water to the villages. The Dabalong Canal contains water from early April to the end of October. When the canal has water, all branch canals have some amount of flow. Thus, in practice, rotation in branch canals simply means either greater or lesser flow. As all branch canals receive some flow of water, the main task of QWMS is to adjust the size of the flow in the branch canals. The vice-head of the water management station is responsible for flow adjustment at the inlet of each branch canal, and while one water manager carries out the actual task, another will measure the water volume. As a consequence of the increase in irrigated area, the time taken for one round of irrigation has been gradually prolonged, and it is very difficult to adjust water flow in branch canals according to farmers' requirements.

BWMD collects water fees from QWMS based on water volume, which is measured at the QWMS water receiving point in the Dabalong Canal, and then the total water volume is multiplied by the water price, which is decided by BWCB. QWMS then charges the water fees to production teams. There is no formal water management organization in villages. The head of the production team is responsible for water issues in each production team, and a water manager is elected by villagers or appointed by the head of a production team. The water managers in QWMS usually measure water volume once, in the morning, at the inlets of production teams' branch canals, and water managers in production teams are asked to be present, but water managers in production teams are not usually present. In general, this is because water managers in production teams cannot understand how water volume is calculated. In addition, the water flow is not stable in branch canals but fluctuates throughout the day, which may lead to big errors when calculating water volume data. In 2001, the Dabalong Canal was an unlined canal; the length from the water receiving point to the end of the Dabalong Canal is *c.* 10 km. Water conveyance efficiency in the Dabalong Canal is *c.* 70–85% according to weather conditions (interview data). Water losses in the Dabalong Canal are large and constantly changing. When water fees are calculated, water losses in the Dabalong Canal are added to the calculations. The water volume to be paid for is much greater than the actual water volume delivered and signed for. This means that farmers have to pay for water losses in the canals that they have no right to manage. Farmers pay water fees, despite the fact that it is difficult for them to monitor the water measurement and calculation processes.

Water supply and water fee collection by villages are interlinked. The rule is that production teams that hand over water fees on time will receive water on time. In cases when production teams do not hand over water fees on time, QWMS has the right to stop their water supplies. In 2003, the yearly average water fee was 38–98 yuan/mu. Some farmers are unwilling to pay water fees because of the poor quality of the water supplied, while others are poor and cannot afford the water fees. Even if a farmer's land only receives one round of irrigation and nothing is harvested, he/she still has to pay for the round of irrigation. If the task of collecting water fees is unfinished, the whole production team is unable to receive water on time, because a production team is treated as the basic unit for water volume measurement. For example, in 2003 due to some poor farmers not paying their fees, Production Team No. 6 in Harmaodong village was unable to pay in full and consequently QWMS did not supply water to the team until all of the water fees had been paid in full. The first round irrigation of wheat was delayed until the 10th of May, when it should have taken place between the 15th and 20th of April. Such delays are very harmful for the overall wheat yield, and hence even rich farmers may be reduced to poverty due to a few poor farmers failing to pay their fees.

4. Policies relating to environmental protection in Xinjiang

At the beginning of 2004, XUAR People's Government issued an environmental protection document (XUAR People's Government, 2004). In Clause 1 – To encourage people to convert waste mountain land and wasteland to vegetation – it is stated that when waste mountain land and wasteland are converted to forest or grass, people are exempt from paying the land use fee, and land use rights can be kept for 50 years without change.

Clause 10 deals with the conversion of the barren desert grassland contracted by herdsmen. When the environmental protection project involves grassland, the herdsmen will be compensated according to the minimum standards of compensation and the lowest grade of grassland, on the principle that it will not reduce the herdsmen's original income levels and living conditions. However, if there are other places available that are suitable for grazing, no compensation will be paid.

In 2002, the Bazhou People's Government issued a document titled the 'trees and paper integration project' as one package of Three North (*sanbei*) ecological environmental protection project (Bazhou People's Government, 2002). The

project was to plant fast-growing trees and make paper from them. The basic idea was that trees could protect the environment, and in the future income could be earned through making paper. The Bazhou People's Government drew up a detailed plan to put the project into practice. Clause 2 stipulates the development of areas of fast-growing trees as follows: 320,000 mu in the Kaidu River irrigation area, and 280,000 mu in the Kongque and Dina River irrigation area.

Clause 3 of the document provides incentives for units and people who plant fast-growing trees in the wastelands as follows: (1) Approval to receive and issue of land use rights licenses for 50–70 years; (2) For land where surface water is used to irrigate the fast-growing trees, water volumes are to be included in the agricultural water use plan, and these lands shall have priority when it comes to receiving water. In the Kaidu River irrigation area, land which is used for fast-growing trees is exempt from water fees. In the Kongque River irrigation area, land with fast-growing trees is charged only 10% of the agricultural water fee. Payment can be postponed until the fourth year. From the fourth to the tenth year, water fees are paid on the basis of half of the agricultural water price. To encourage people to dig wells to irrigate the trees, wells are exempt from inclusion in water resource fees for the first 5 years, and with regard to electricity supplies, pump wells are given priority.

Under Clause 7, new companies and enterprises which plant fast-growing trees can be exempt from enterprise income tax for 3 years, and up to year 2010 will pay 15% enterprise income tax, compared to the normal enterprise income tax rate of 33%.

Under Clause 10, the Bazhou People's Government will allocate 2 million yuan from interest-deducted funds (which are for the development of special economies) and use this for the tree and paper integration project.

In 2005, a new water fee document was issued by the Bazhou People's Government (Bazhou People's Government, 2005). The document stated that in principle it will not supply water to newly opened-up wasteland, although water may be supplied at double the normal water price at times when the supply of water is abundant (Clause 1, Section 3). The document also stated that those who take responsibility for development projects relating to ecological forests will be exempt from paying water fees (Clause 3, Section 3). In practice, in Bazhou the policy has been interpreted as meaning that planting trees should be given priority in terms of water supply, regardless of where they are planted and by what means water is conveyed to the site. Water distribution has therefore been undergoing a new adjustment process.

The main goal of the *tui geng huan lin* project is to protect the environment, but the natural environment is desert, not forest. Xinjiang is a land-rich but water-scarce dry region. No appraisements of the water use situation are carried out when such central and local government environmental protection projects are implemented. Water resources are basic social and economic resources, especially in the dry region, and furthermore, water resources are the basic agriculture production element for farmers, yet when favourable policies are provided for environmental protection projects, the provisions for irrigation agriculture are not advantageous. There is no discussion on the issue of equity and social justice regarding water resources distribution in government environmental protection policies.

In the Yanqi Basin, the main agricultural problem is the high level of the groundwater table and high salinity level of the soils. In the desert, soils are coarse-textured and have high levels of salinity. Because there are no canals in good physical condition, both the water volume for the irrigation of fast-growing trees and seepages from soils are huge. This is accompanied by large amounts of salts being washed into the groundwater, worsening soil conditions in the lower reaches of existing farmland. Drainage water that contains high levels of salinity is drained into Bosteng Lake.

In the trees and paper integration project, the most serious problem is that the waste water from the paper mills is not mentioned at all. Several paper mills, such as the Bazhou paper mill and Bingtuan Agriculture Division No. 2's paper mill, are located near Bosteng Lake. There, reeds are cut as raw materials and the waste water is drained into the lake or at the place near the Kongque River bed, seriously polluting the water. Officials have mentioned that water quality in the whole Kongque River is below the state standard for drinking water. However, people in Korla city are able to drink water conveyed from the upper reaches of the Kaidu River.[7] Drinking water supplied to people living in the rural area of Korla city and the lower reaches of the Kongque River is of bad quality and not suitable for drinking.

In the following section, I will describe the practices of the environmental protection projects in Bazhou using evidence from two counties, Yanqi County in the upper reaches the Kaidu-Kongque River Basin and Yuli County in the lower reaches.

5. The practice of the environmental protection projects

On one occasion, I interviewed the leaders in Yanqi CWCB about environmental protection:

> Interviewer: *What is environmental protection?*
> Response: *Environmental protection is planting trees, to make wasteland become green.*
> Interviewer: *Is the grapevine a tree or not?*
> Response: *Yes, the grapevine is taller than other crops, and can prevent wind and sandstorms from invading farmland.*
> Interviewer: *Does planting trees in the desert belong to the state project of tui geng huan lin?*
> Response: *Yes, the desert belongs to the periphery of cultivated land, and planting trees there has an environmental protection function.*

In Yanqi County, most *tui geng huan lin* land is located in the desert, on the periphery of the agricultural area of Qigexing town. From 2001 to 2004, *c.* 18,000 mu of trees were planted,

[7] The Korla city domestic use water conveyance project (the water source construction project) was finished in 2003; it was very costly and financed by The World Bank's Tarim Basin II Project (The World Bank, 1998). The water source is groundwater from nearby Qigexing town.

mainly by private developers. The planted areas were not only favoured under central government policies, but also under Bazhou People's Government's 'trees and paper integration project'. After 2001, a private developer planted tree belts amounting to more than 2100 mu in the desert in Qigexing, and a new canal was dug for the tree belts, with an inlet in the Dabalong Canal (Supp. 4 and 5).[8]

One project for carrying out the environmental protection projects has been the grape base construction project in Qigexing town. This was started in 1999 with the aim of planting 70,000 mu of grapevines in the western desert on the periphery of the agricultural area of Qigexing town in the period 2002–2007. The location is considered by experts to be suitable for growing grapes, and the government believes grapevines to be good for environmental protection because they can prevent wind and dust storms. As part of the government's favourable policies, neither land use rights nor water fees are applied. By the end of 2002, 11,000 mu of young grapevines had been planted by village farmers and private enterprises in the desert in Qigexing. Of these private enterprises, Winery Z is an interesting case, as will be described in the following.

In the spring of 2000, I visited Winery Z for the first time. In the desert, land had been ploughed by tractors, and thousands of cement posts had been erected in the sandy and stony soils. A big plantation called Winery Z was in the process of being developed (Supp. 6). In 2002, when I visited the place for the second time, a winery factory was under construction; Winery Z had even hired several French experts to guide the construction. Bazhou People's Government intended to give aid to the winery in the hope that it would be developed as an international enterprise. Since the wine was to be sold on the international market, the winery would encourage farmers to plant grapevines, and farmers would then sell their grapes to the winery, and thereby poverty would be eliminated in the area. Winery Z itself had plans to develop 40,000 mu for grapevines. It all looked very impressive. In 2004, I visited the site again and gained further insights.

At the end of 2000, Winery Z had opened up wasteland and planted grapevines on 5000 mu of land; it claimed, however, to have opened up 29,000 mu. In Qigexing town, 6000 mu of grapevines were planted by village farmers and other private enterprises in the desert. In the winter of 2001, temperatures were very low, and over large areas the young grapevines had frozen and died. In the spring of 2002, only c. 500 mu of grapevines remained on farmers' land. In 2003, 3 years after the grapevines had been planted, farmers began to harvest grapes and sell them to the winery. Rather than paying in cash, the winery paid them in the form of promissory notes that had little binding force.[9] The farmers complained about this to the town government, and the town government intervened. Ultimately, the winery paid the promissory notes in wine rather than cash, and the farmers each received several boxes of wine. After losing 3 years' worth of harvests, angry farmers uprooted all of the grapevines from their land. In 2004, the county government again asked farmers to finish the task of planting 3000 mu of grapevines. Both the town government and the forestry station kept books that contained written records of responsibility, and the forestry station was to be penalized if it did not finish the allocated task. The town government again tried to mobilize farmers to plant grapevines, but none were willing to do so. The town forestry station wanted to measure the area of grapevines in Winery Z, but the winery would not allow them to do so. The main purpose of exaggerating the area under grapevines was that the bigger the enterprise, the more favourable the policies would be regarding the winery. Further, the leaders wanted high figures as this would reflect their achievements favourably in terms of their official careers.[10] However, no one actually knows or is concerned about how large the plantation is.

Originally, it was supposed that Winery Z would pump groundwater and use modern technology to save water, namely by using the drip irrigation method. Drip irrigation pipes lie on the surface of the ground, but since the plantation is located in desert and the soils contain large amount of salts, the salts need to be washed out by flood irrigation. The site was selected for a water source construction project under The World Bank's Tarim Basin II Project, which was to develop water resources by pumping groundwater, mainly for supplying drinking water to Korla city. Since more and more deep wells are pumping water from groundwater in the region, the level of the groundwater table has fallen, and the costs of pumping water have become very high. Consequently, the plantation uses large volumes of surface water.

Winery Z has planted tree belts covering an area of c. 300 mu around the vineyard. The tree belts could be irrigated by surface water according to government policy. In 1999, the winery applied and received a 0.8 million m^3 surface water quota from BWMD for the tree belts and the vineyard. The tree belts need to be irrigated two times each month, with at least eight rounds of irrigation per year—one round of irrigation usually lasts between four and eight days in the local coarse-textured soil conditions. An outlet to the vineyard was opened by QWMS from the one branch canal of the Dabalong Canal. Because owners of tree belts are exempt from paying water fees according to BWCB, there was no measurement of or limitation on water volume, and some parts of the vineyard also received water when tree belts had water.

In 2004, QWMS estimated that Winery Z actually uses more than 3 million m^3 water for the tree belts and the vineyard combined each year, which was much more than its water quota (0.8 million m^3). BWCB transmitted a document to QWMS to permit the winery to be exempt from water fees for 5 years (1999–2003). The total water fees for the winery for this period were estimated at 370,000 yuan by BWMD and were made exempt by BWMD. BWMD had calculated these water fees based on the price of 31 yuan/mu (the water volume was

[8] The state's favourable policy comprises a 100 kg/mu grain subsidy every year for 8 years, a 20 yuan/mu education subsidy for 8 years, and a one-off 50 yuan/mu young trees subsidy. In addition, the mentioned developer enjoyed a 170,000 yuan subsidy for the trees planted near State Highway 218 (i.e. a subsidy for greening the state highway).

[9] Some years ago payment by promissory notes (*baitiaozi*) was prohibited by the central government.

[10] See Shambaugh (2008) for a detailed discussion on this issue.

determined at a rate of 1000 m^3/mu gross irrigation norm, the water price was 0.031 yuan/m^3). The actual water use is, however, more than 2000 m^3/mu, and the water fees should be more than 62 yuan/mu according to QMWS. This extra water was apportioned to canal conveyance losses, and ultimately it was apportioned to and paid for by the local farmers.

The Chairwoman of Winery Z has won several medals at the state and Xinjiang levels (Tianshan Web, 2006). The winery is stated as a miracle of hard work and wealth production. According to Bazhou People's Government (Bazhou Statistic Information Web, 2003), the winery has won several international medals, and the government will support it as a 'dragon head enterprise' in Bazhou and will provide the winery with favourable policies on water use, land use, finance, and taxation.

Along with the priority of water supply to the land newly planted with trees and grapevines, the normal order of water supply to villages has been thrown into confusion. In mid-April 2004, the weather was already warm and a dozen farmers had gathered in QWMS in order to demand water. It was the time to release the first round of water to the wheat crops, and make land wet before sowing (*yingou*) for red peppers and tomatoes as the saying goes: 'a whole year's harvest depends on the spring' (*yi nian zhi ji zai yu chun*). The water management station was supplying water to the newly planted trees and grapevines, and intentionally delayed water supplies to villages, simply because water fees had not been collected in full by most production teams, and it wanted to force farmers to hand in their water fees more quickly.

Yuli County is located in the lower reaches of the Kongque River. Since 1990, Yuli County has been carrying out irrigation agricultural development and the irrigated area has increased, water supply situation in the local villages has worsened, and large areas of cultivated land in the local villages cannot receive water on time. In 2002, Yuli County started to implement the state *tui geng huan lin* project, and planned to return 10,000 mu of cultivated land to forest.

According to a report by Yuli County Forest Bureau (2003), in 2002 in Xingping *xiang*, 12 households with 3761 mu of cultivated land were counted as having been 'returned to trees'. One Uyghur household had 913 mu of land 'returned to trees' in Kongqi village, and one Han Chinese household had 2400 mu of land 'returned to trees' in Tongqike village. Together, these two households accounted for 88% of the total returned land. The Han Chinese household has opened up more than 3000 mu of wasteland to plant cotton in recent years and pumped water from the Kongque River to irrigate the land. The distance from the land to the Kongque River is considerable and hence irrigation is inconvenient, and the cotton yield very low. However, the farmer had responded to the state policy to plant trees on the land and enjoyed the favourable policies. Accordingly, starting in 2002, every year for eight years he can receive subsidies of 288,000 yuan from the government for the newly opened up land.[11] He has 30 years' worth of land use rights and 50 years' worth of tree responsibility contracts, which is good business and has made him a wealthy man.

[11] Author's calculation: 2400 mu × 120 yuan/mu = 288,000 yuan.

Yuli County initiated one package of Three North (*sanbei*) ecological environmental protection in the northern parts of Yuli town in 2004. The goal was to plant trees on a 40 m × 28 km stretch of wasteland along State Highway 218, and the task was scheduled to finish in 2010. In spring 2004, tractors and various heavy machines were working on the wasteland, cutting down bushes and grass, and levelling the wasteland. Two new canals were under construction. BWMD approved a 3 million m^3 water supply quota for the tree belts. While many farmers in the local villages cannot obtain sufficient water for their crops, precious water resources are diverted to the trees to protect the desert environment. With more and more water being diverted from the Kongque River to the planted trees, water flow in the lower reaches of the Kongque River decreases, and consequently the natural poplars along the river banks of the lower reaches of the Kongque River are drying up and dying.

6. Conclusion

The local water management policies and practices are interlinked with central government and local government policies on the environmental protection projects. When equity and social costs are not factored into the planning of new environmental protection projects, the social costs may be as high as the environmental costs. This is demonstrated by the fact, as discussed in Sections 4 and 5, that when favourable policies are provided for environmental protection projects, water supply for irrigation agriculture is at disadvantageous situation. The benefits of the environmental protection projects are enjoyed by a small number of individuals. Foremost among these we can note rich developers who have taken advantage of government policies and have the financial capability to open up wasteland. Because the owners of newly planted trees are exempt from paying water fees, farmers have to pay water fees for their own water use and extra water fees to cover for the developers. It is evident that the redistribution of water resources, in essence is a redistribution of social and economic resources, but so far there is scant discussion on this issue in China. This research paper has shown that the environmental protection projects not only fail to engage the fundamentally political character and diverse circumstances of China's geographical settings, but also ignore the basic problem of social justice in the distribution of water resources.

Acknowledgements

I am grateful to Haakon Lein, Geir Vatne, Jorgen Delman, Roger Greatrex, and two anonymous reviewers for helpful comments. I appreciate Catriona Turner for her help in correcting the language.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.envsci.2009.03.006.

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